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**Essays on the Microeconomics of Financial Market Structure and
Performance**

by

Prasad Krishnamurthy

A dissertation submitted in partial satisfaction of the
requirements for the degree of
Doctor of Philosophy

in

Economics

in the

GRADUATE DIVISION

of the

UNIVERSITY OF CALIFORNIA, BERKELEY

Committee in charge:

Professor David Card , Chair

Professor Ulrike Malmendier

Professor Eric Talley

Fall 2011

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Prasad Krishnamurthy

Abstract

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University of California, Berkeley

Professor David Card , Chair

How does financial market structure affect business growth and consumer welfare? Microeconomic theory presumes that market outcomes are a result of the equilibrium interaction of agents with differing objectives. This dissertation develops and tests microeconomic models of the credit and deposit markets . Parts 1 and 2 emphasize the importance of asymmetric information and strategic interaction, respectively, in determining financial market structure and performance.

Part 1 provides new evidence on the relationship between financial market structure and firm growth. I develop an equilibrium model of firms who can access debt capital and capital from banks that monitor their borrowers. In this model, (1) shifts in the supply of bank credit have the largest effect on firms who have just enough capital to acquire finance, and (2) financial integration dampens the quantity effects of shocks to credit supply, but exacerbates the quantity effects of shocks to credit demand.

I test these hypotheses by exploiting the history of bank-branching deregulation in the United States. I use the differential timing of state deregulation to trace the causal channel that runs from financial integration to firm growth. I find that for mid-sized establishments, financial integration lowered the association between local credit supply and business growth. My findings suggest that the excess volatility in business growth in unintegrated markets may entail significant allocative inefficiencies.

Part 2 investigates the contribution of deposit market competition and consumer preferences to banking market structure and pricing. I develop a general model of spatial competition where consumers' higher willingness to pay for firms with more locations generates an externality in firms' location decisions. I characterize the equilibrium of this model and provide novel analytical results for prices, markups and limiting market shares.

I then consider the application of this model to the market for bank deposits. The model generates predictions on (1) the density of branches, (2) the pattern of within-market and across-market concentration, (3) the relationship between concentration and

market size, (4) the relationship between branching networks and deposit prices, and (5) the dispersion of deposit prices. I utilize the history of bank branch deregulation to test the predictions of this model by comparing free branching to unit branching—one bank/one branch—states. The empirical tests are broadly consistent with the hypothesis that strategic competition in branch networks plays a role in determining market structure.

To my parents, for their love, encouragement, and patience.

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Part I

Financial Market Integration & Firm Growth: Evidence From U.S. Bank Deregulation

Chapter 1

Introduction

Does financial integration promote business growth? Understanding whether a causal channel runs from integration to growth is central to several areas of economics. In industrial organization, this channel informs our account of the effects of financial market structure on the size and sectoral distribution of firms and the dynamics of entry and exit. These effects, in turn, matter for regulatory policies toward financial institutions and industrial policy toward key technological sectors. Developing or transition economies continue to place significant restrictions on the mobility and scope of financial institutions. Predicting and managing the process of financial deregulation in these economies requires an understanding of the size and sectoral reallocations that accompany financial integration. And in macroeconomics, empirical estimates of the effect of integration on firms can inform models of business cycle volatility and help to forecast the consequences of increased financial openness or monetary union. The transmission of credit shocks across previously unintegrated markets through the banking channel is a topic of special contemporary relevance.

Economists have long sought to understand the relationship between financial institutions and business growth. In his “Theory of Economic Development,” Joseph Schumpeter emphasized the role of financial institutions in identifying and promoting innovative technologies, ideas, and business methods [Schumpeter 1969]. Joan Robinson, in contrast, argued that financial institutions played little role in inducing growth, and that the development of such institutions was a natural consequence, as opposed to a cause, of a growing economy [Robinson 1952]. The systematic empirical investigation of this question extends back to Goldsmith [1969], who pointed out a persistent correlation between economies with high growth levels and developed financial institutions.

The empirical difficulty in this area has been to identify plausibly exogenous changes in the characteristics of financial institutions in order to consistently estimate their impact on firms. As a result, the mechanism through which financial structure impacts business formation, investment, and growth, as well as the magnitude of these effects, remain a subject of considerable debate.

This paper provides new evidence on the relationship between financial market structure and firm growth by estimating the differential effect of local credit supply on business growth in more- and less-integrated commercial-banking markets. In markets that

are not financially well-integrated, the supply of bank credit to firms is partially limited by locally available funds. In such markets, firm investment should exhibit greater sensitivity to variations in local credit supply, and this sensitivity should be greater for smaller firms and firms in sectors with greater need for external finance. In financially integrated markets, by contrast, local firm growth should exhibit greater sensitivity to movements in credit supply and demand in outside markets where local banks have the opportunity to lend. Financial integration does not unambiguously benefit individual markets. On the one hand, forces that raise the price of credit in outside markets should lower local firm growth since banks will lend where the returns are highest. On the other hand, forces that lower the price of credit in outside markets should make local investment more attractive and increase local firm growth.

To test these hypotheses, I exploit the history of bank-branching deregulation in the United States. I examine whether states that lifted restrictions on within and across-state bank branching (1) lowered the dependence of business growth on local credit supply growth and (2) increased the dependence of business growth on credit supply and demand in other markets. By exploiting the differential timing of state deregulation, I am able to trace the causal channel that runs from legal restrictions on bank expansion to financial integration and firm growth. I also investigate the history of litigation between state and federal regulators of banks and identify a subset of states who changed their laws for reasons that were independent of the political and economic forces within those states. I am able to test my hypotheses using these states as treatment group, which helps to address the endogeneity concerns that arise in all studies of this nature.

I first develop a simple equilibrium model of firms who can access unmonitored debt capital and capital from banks that monitor their borrowers. The informational asymmetry between firms and lenders who do not monitor leads to credit rationing, which affects small firms and/or firms that are reliant on external finance. Capital constrained firms can acquire more expensive capital from a bank, which alleviates their incentive constraint and allows them to raise a larger total of external funds. I analyze the equilibrium for a single market and compare this to two markets where bank capital moves freely to equate the cost of bank finance across markets. The main results are that (1) shifts in the supply of bank credit have the largest effect on marginal firms who have just enough capital/cash to acquire finance, (2) financial integration dampens the quantity effects of shocks to credit supply, but exacerbates the quantity effects of shocks to credit demand, and (3) financial integration increases the effect of outside-market credit supply/demand movements on local firm growth.

I construct a unique panel dataset to provide empirical support for these predictions. The panel consists of MSA and non-MSA (county) markets from the 50 states, excluding Delaware, from 1977-1997. I merge the Summary of Deposits dataset from the Federal Reserve, which contains branch level information on deposits, with the Call Reports Data and the County Business Patterns Database to create market level measures of deposit growth, firm growth, and banking market characteristics such as deposit concentration. I add to this market level and state level economic measures such as per capita income, population, and unemployment.

Using this data, I demonstrate that within and across-state deregulation led to

an increase in financial integration, defined as the effective deposits available to a market, relative to the size of that market. I show that within-state deregulation led to an increase in within-state financial integration and that across-state deregulation led to an increase in across-state financial integration. I also identify the different institutional mechanisms by which this process occurred. Within-state integration took place at the level of the banking corporation. The effective funds that a market could draw on increased when measured by the internal capital market structure of multi-market banks. Across-state integration, by contrast, took place at the bank holding company (BHC) level. These “first-stage” results confirm that deregulation led to sharp increases in financial integration, which is consistent with the mechanism that I propose.

After providing evidence for a link between branch deregulation and financial integration, I use a generalized difference-in-differences approach to estimate the relative change in the relationship between local credit supply growth and different measures of firm growth after deregulation.¹ I first estimate this effect across establishment size categories in order to test whether the effect is stronger for smaller firms and for firms that are more reliant on external finance. I use the growth rate of market deposits as a proxy for the local supply of credit. My estimates suggest that for establishments with 20 to 99 employees, within-state deregulation lowered the association between local credit supply and business growth in MSA markets and that across-state deregulation did so in non-MSA markets. It is likely that this effect occurs on the intensive margin of growth, as firms increase or decrease in size in response to credit supply movements. It is possible, however, that there is an effect on the extensive, or new establishment margin.

These results are qualitatively consistent with my predictions. The marginal firm affected by credit constraints in an unintegrated market is neither so small that it cannot obtain external finance nor so large that it can turn to the debt market. These results also suggest that within and across-state capital flows differentially affect the credit-growth nexus in urban and rural markets. Within-state integration matters for urban (MSA) markets, while across-state integration matters for rural (non-MSA) markets. I also find evidence consistent with these predictions when I estimate the same relationships using employment growth and payroll growth as measures of firm growth.

The changes in the effect of local credit supply on firm growth that I identify are of economic significance at the margin of growth. For within-state deregulation, the magnitude of the effect of local deposit growth on establishment growth is 80% smaller than it is in the regulated period. For the average MSA market in 1997, I compute the pre and post-regulation effect on the growth rate of establishments of a fall of .05 (about one standard deviation) in the growth rate of deposits. After deregulation, this fall is associated with a loss of about 9 fewer establishments than it is before deregulation. This represents 14% of new business formation in the average MSA. If firm growth is measured by employment, a fall of .05 in the growth rate of deposits is associated with a loss of 780 fewer jobs than it is before deregulation. This represents 11% of employment growth in the average MSA market.

¹In Appendix C, I show that these reduced-form estimates can be rationalized by parameter restrictions on a structural econometric model that follows directly from the equilibrium conditions of the microeconomic model.

When I perform the same calculations for the effect of across-state deregulation, the magnitude of the effect of deposit growth on establishment growth is also 80% smaller after deregulation. For the average non-MSA market in 1997, a fall of .05 in the growth rate of market deposits is associated with a marginal reduction in the loss of establishments that is 14.7% of new business formation. I conclude that, for this size class of firms, both types of deregulation led to a significant decrease in the importance on local credit supply at the margin of establishment growth. I find no evidence, however, that this effect varies systematically by firm sector (manufacturing, services, retail, wholesale, and construction.)

I also find evidence for the effects on firm growth of outside-market credit supply and demand that are predicted by the model. I show that within-state deregulation increases the marginal effect of outside market credit supply on firm growth in the home market. I use the average growth rate of deposits in other MSA markets in the state to proxy for the growth of credit supply in outside markets. For the average MSA market in 1997 before deregulation, an increase of .05 in the average growth rate of deposits in other MSA markets in the state lowers the number of mid-sized firms in the home market by about 11. After deregulation, the effect of average deposit growth in other MSA markets on the home market is no longer statistically different from zero and is 85% smaller in magnitude than it was before deregulation. The marginal effect of outside credit supply on firm growth thus increases as a result of deregulation. The fact that this marginal effect goes from being negative to effectively zero suggests that, before deregulation, there is some relocation of firms to markets where the supply of credit is relatively more abundant.

I then show that within-state deregulation decreases the marginal effect of outside-market credit demand on firm growth in the home market. I use the average growth rate of mid-sized establishments in other MSA markets in the state to proxy for the growth of credit demand in outside markets. For the average MSA market in 1997, an increase of one standard deviation (.02) in the average growth rate of mid-sized establishments in other MSA markets is associated with the growth of 3 firms before deregulation and the loss of 4 firms after deregulation—a difference of -7. Consequently, the marginal effect of outside market credit demand on local firm growth falls after deregulation.

Finally, I use IV regression to measure the effect of financial integration on firm growth.² I estimate the effect on establishment growth of the interaction between the growth rate of deposits and financial integration, while using deregulation as an instrument for financial integration. The IV coefficients in these regressions are a rescaling of the difference-in-differences coefficients and therefore represent a different interpretation of the same result. They do, however, allow me to interpret the effect of a continuous change in financial integration on the relationship between firm growth and credit supply. To measure within-state integration, I use data on multi-market banks and BHCs to compute total market deposits as a fraction of available state deposits. For across-state integration, I compute the available state deposits as a fraction of available national deposits. I use within-state and across-state deregulation to instrument for these measures of within and across-state financial integration. The IV results suggest that within and across-state financial integration reduce the dependence of firms on local credit in both MSA and non-MSA markets. The IV approach, however, does not allow separate identification of the

²The IV results are reported in Appendix D.

effects of within and across-state deregulation. Because the two are likely to be correlated, the IV estimates are likely to confound their effects.

Taken as a whole, my findings suggest that the excess volatility in firm growth in unintegrated markets may entail significant allocative inefficiencies. It is likely that these effects occur on the intensive margin of growth. Negative shocks to local credit supply trigger inefficiently large reductions in firm size, while positive shocks trigger inefficiently large expansions. These growth effects on the labor margin are consistent with evidence on labor flows that occur in response to state-specific shocks [Blanchard and Katz 1992]. It is also possible that the effects occur on the extensive margin, in which case negative shocks result in the exit of firms that could survive with additional finance, and positive shocks result in the entry of firms that should not be financed. My findings also suggest that financial integration through large banking networks exposes local credit markets to price volatility in other markets. Where these price movements are a result of the allocation of credit to its highest marginal return, the free movement of bank credit across markets maximizes aggregate surplus. Where such price movements are, however, a result of regulatory failures, financial integration exposes local markets to the consequences of such failures.

There are two major objections to my empirical approach. First, it is possible to argue that state legislation abolishing within or across-state branching restrictions is a consequence of unobserved factors that make local investment opportunities more attractive to outside capital. These unobserved factors are responsible for the measured fall in correlation between local credit supply and business growth after deregulation. I attempt to deal with this problem by estimating the long-run effect of the legislation, which minimizes the impact of business-cycle-specific causes for deregulation. I also estimate the econometric model using state-year indicator variables, which partial out any unobserved effects that are common to all markets in a state in a given year. This still leaves the estimates vulnerable to biases from market-specific, unobserved factors that cause outside interest in local investment. However, it is difficult to give a plausible explanation for why such factors would be correlated with deregulation, but sufficiently heterogeneous in their impact on the state's markets to cause large biases.

As a further robustness test, I am able to replicate my results when I test these hypotheses on the subset of states who changed their within-state branching laws as a result of litigation between the OCC and the state regulators. These changes in the law were largely exogenous to the economic environment in the states at the time, and so alleviate the usual concerns over omitted variables and simultaneity.

Second, one can argue that because the observed rates of increase in deposits and firm growth are equilibrium phenomena, deposit growth cannot be interpreted as a shift in the supply of credit. Market level shocks to supply and demand for capital are likely to be positively correlated, so a reduced form estimate of the effect of deposit growth on establishment growth will be upwardly biased.. To this objection I provide three responses. First, my difference-in- differences approach mitigates this concern. If the source of bias from the co-movement of supply and demand is conditionally identical across markets, then it is partialled out in the estimation. Second, the use of market covariates to control for demand conditions allows me to estimate changes in the effect of credit supply (deposits) on firm growth that are relatively more influenced by the supply side than the demand side.

Third, as I later show in more detail, my model predicts that credit demand growth that is positively correlated with supply growth biases my coefficients in the opposite direction of my predicted effects. In integrated markets the effect of shocks to the demand for capital on business growth is exacerbated rather than dampened. When the supply curve of credit is flatter, a shift in demand has a larger quantity effect.

This paper complements and extends the existing studies of the effects of financial market integration on firms. First, I provide a unifying, causal mechanism for previous studies that have shown simple correlations between the geographic deregulation of banking and (1) a decrease in the amplitude of state business cycles [Morgan, Rimes, and Strahan 2004] and (2) a shift the size and sectoral distribution of firms at the state level toward medium-sized and credit-reliant firms [Cetorelli and Strahan 2006]. Unlike previous studies, there is a direct relationship between the econometric specifications I employ and the underlying model.

Second, I am better able to account for the possible endogeneity of the timing of deregulation. My conclusions are unaltered when I test my hypotheses on a subset of states that changed their branching laws for exogenous reasons. These states changed their laws in response to litigation between the Office of Comptroller of the Currency (OCC) and individual states over the right of nationally-chartered banks to freely branch in states where savings-and-loan banks could do so. I discuss the history of this legal issue in detail and argue that these litigation outcomes were unrelated to state-level macroeconomic conditions or to shocks to the local banking system. This robustness test helps to alleviate the concern that unobserved factors that accompany changes in the law explain my findings.

Third, in contrast to previous studies that estimate the effects of deregulation at the state level [Jayaratne and Strahan 1996, Black and Strahan 2002], this is the first study to test hypotheses at the MSA (Metropolitan Statistical Area) and non-MSA market-or urban and rural market-level. Market-level estimation presents a number of advantages. It is consistent with evidence that the relevant geographic market for credit for small to medium-sized firms is local [Peterson and Rajan 2002]. It allows me to separately identify the effects of integration across urban and rural markets. These effects are of particular interest given the possibility that increased financial integration induces capital flight from markets where investment opportunities were previously limited. Market level estimation enables me to use within and across-state branching deregulation, respectively, to infer the relative importance of within-state and across-state integration. It also enables me to test for cross-market effects within a state, which the previous literature has ignored.

From an econometric perspective, market-level estimation allows me to condition on common shocks to firm growth—the dependent variable of interest—in a given state in a given year. This helps to alleviate the concern that the endogeneity of the timing of deregulation could bias the estimates. I am able to control for market-specific economic conditions and financial structure, as well as utilize a far greater number of observations over the period of interest. I am also able to cluster observations at the state-level to account for inter-market dependence.

My results suggest an important economic channel running from the integration of financial markets to the volatility of firm growth, the composition of new and exiting firms in a market, and the size distribution of firms in the market. They also provide

a framework for future research that (1) attempts to measure the “contagion effect”, i.e. whether financial market shocks have a larger effect on firms in integrated banking markets, (2) examines the effects of financial integration by using data that matches firm and loan characteristics to those of banks and (3) better decomposes the effects of financial integration across types of firms by using the Census longitudinal business database on firms.

Chapter 2

Background

A considerable body of econometric work, relying on identification arguments in the tradition of Granger, has sought to demonstrate that high measures of financial development at a given point in time are correlated with future growth in per capita income [King and Levine 1993]. A parallel line of research in finance and in industrial organization has tried to exploit determinants of external financial dependence in order to measure the differential impact of financial development on more and less financially-constrained sectors [Rajan and Zingales 1998,2001]. While these studies provide suggestive evidence of a causal arrow running from finance to growth, the omitted variables and simultaneity problems associated with cross-country regressions, as well as the instability of the estimates across regression specifications limit the conclusions that can be drawn from them [Malmendier 2008]. As a result, empirical researchers have looked for plausibly exogenous variation in the characteristics of a financial regime in order to estimate the effect of a change in these characteristics on economic performance, variously defined.

Jayaratne and Strahan [1996] represent a qualitative step forward in the empirical identification of a “finance-growth nexus.” The authors are the first to exploit the natural experiment created by the removal of within and across-state bank branching restrictions by U.S. states from the 1970s to the 1990s. Using a difference-in-differences approach, they find that the per capita growth rates of income and output increased in states after within-state branching deregulation. While these findings are consistent with a causal effect running from bank deregulation to growth, the authors do not identify the economic mechanism through which this effect might occur. Subsequent research, much of it by Strahan, has attempted to more carefully decompose these effects and place their causes on solid micro-foundations.

Black and Strahan [2002] estimate the effect of within and across-state branch deregulation on new incorporations. They hypothesize that deregulation encourages business formation by reducing entry barriers, facilitating the take-over of struggling banks, and consolidating banking enterprises, all of which reduce the power of incumbent firms and lower the cost of credit. Using state level panel regressions, the authors find that across-state deregulation led to an increase of about 6 percent in the number of new incorporations per capita. The authors find that within-state branch deregulation has no effect on new incorporations.

Cetorelli and Strahan [2006] estimate the effects of within and across-state branching deregulation on the total number of establishments per capita and the average number of employees per capita. The authors argue that deregulation leads to an increase in bank competition that affects the difference between the average number (and size) of establishments in financially constrained and unconstrained industries. They find that, after across-state deregulation, the average number of establishments in financially dependant sectors increases relative to that of less dependant sectors. Under the same test, they find that average establishment size decreases. The authors also show a differential shift in the establishment size distribution after across-state deregulation. Relative to less finance-dependent sectors, the fractions of establishments with fewer than 5 employees and from 100-999 employees falls, while the fractions from 5-19 employees and 20-99 employees rise.

Morgan, Rime, and Strahan [2004] provide evidence that economic volatility decreased in states after across-state banking deregulation due to increased financial integration. For their measures of integration, the authors construct (1) an across-state asset ratio—the fraction of banks assets in a state owned by out of state holding companies—and (2) an other-state asset ratio—the total amount of assets held out of state by banks in that state divided by the state’s assets. Instrumenting for these measures using indicators for within and across-state deregulation. They find that increases in both measures of integration are associated with a decline in volatility, measured as the absolute deviation of unemployment, personal income or gross product growth rates relative to their trend.

To summarize, in what has been the most convincing empirical setting in which to identify the effects of a large and plausibly exogenous change in financial market institutions, there is state-level evidence that (1) new incorporations increased and that, relative to less financially dependent sectors, (2) the average size of firms decreased and (3) the average number of firms increased. There is also state-level evidence that GDP growth increased and aggregate volatility decreased after deregulation. The literature has yet to identify the economic mechanism through which these reduced-form effects that appear to accompany deregulation occurred. In the context of U.S. bank deregulation, this paper is the first to propose a mechanism through which financial market integration directly effects the credit constraints faced by firms at the market level, predict the differential outcomes across size and external finance dependence that follow from these constraints, and test these predictions at the market level.

Chapter 3

An Illustrative Model of Financial Integration

I develop a simple equilibrium model of firms who can access unmonitored debt capital and capital from banks that monitor their borrowers. The informational asymmetry between firms and lenders who do not monitor leads to credit rationing, which affects small firms and/or firms that are reliant on external finance. Capital constrained firms can acquire more expensive capital from a bank, which alleviates their incentive constraint and allows them to raise a larger total of external funds. I analyze the equilibrium for a single market and compare this to two markets where bank capital moves freely to equate the cost of bank finance across markets. The main results are that (1) shifts in the supply of bank credit have the largest effect on marginal firms who have just enough capital/cash to acquire finance, (2) financial integration dampens the quantity effects of shocks to credit supply, but exacerbates the quantity effects of shocks to credit demand, and (3) financial integration increases the effect of outside-market credit supply/demand movements on local firm growth. The model is an adaptation of Holmstrom and Tirole [1997] to the context of financial integration along the lines of Morgan, Rimes, and Strahan [2006].

Debt Market Lending with No Monitoring

The economic environment consists of firms, banks, and outside investors who cannot monitor the firm's effort level. Throughout, I assume all agents are risk neutral. Each firm has a project that requires I units of capital and has outcome $\{R, 0\}$. Firms have a positive level of assets A , where A is continuously distributed according to $F(A)$. If a firm takes effort e then return is high with probability p_h . If the firm takes effort 0, then the return is high with probability p_l . An optimal contract takes the form of a debt payment R_d if return is high and 0 otherwise, so the firm keeps $R_f = R - R_d$. I assume high effort is socially optimal. The incentive compatibility constraint for the firm is:

$$p_h R_f - e \geq p_l R_f \Rightarrow R_f \geq \frac{e}{p_h - p_l}$$

This implies that the maximum return for investors in expectation is $p_h \cdot (R - \frac{e}{p_h - p_l})$.

Investors have access to an outside investment option with return r_d . This implies that a given firm can only meet its external finance needs if

$$p_h \cdot (R - \frac{e}{p_h - p_l}) \geq r_d(I - A) \Rightarrow A(r_d) \geq I - \frac{p_h}{r_d}(R - \frac{e}{p_h - p_l})$$

The information asymmetry between firms and outside investors leads to credit rationing so that only firms with assets or collateral greater than $A(r_d)$ can obtain external finance. I interpret the condition on $A(r_d)$ to hold that small firms or firms that are heavily reliant on external finance can be capital-constrained due to information asymmetries. It also follows that in the event of an increase in r_d , such financially constrained firm will be the first to be rationed.

Bank Lending with Perfect Monitoring

I next assume that a firm can also borrow from a bank with a monitoring technology. The bank can pay a cost c and perfectly observe the borrower's effort. Letting the payment from firm to the bank be R_b , the borrower's participation constraint and the bank's incentive compatibility constraint are:

$$p_h R_f - e \geq 0 \Rightarrow R_f \geq \frac{e}{p_h} \quad (IR \text{ firm})$$

$$p_h R_b - c \geq p_l R_b \Rightarrow R_b \geq \frac{c}{p_h - p_l} \quad (IC \text{ bank})$$

I can then define a rate of return for bank, or monitoring capital $r_b = \frac{p_h R_b}{I_b}$ where I_b is the amount of capital lent. Substituting for R_b in the IC constraint for the bank, it follows that:

$$I_b(r_b) \geq p_h \cdot \frac{c}{p_h - p_l} \cdot \frac{1}{r_b}$$

This condition will hold with equality because the firm will not want to borrow any more capital than necessary from banks ($r_b > r_d$ as shown below). Conditional on borrowing from a bank, a given firm can acquire unmonitored, external funds if:

$$\begin{aligned} p_h \cdot (R - \frac{c}{p_h - p_l} - \frac{e}{p_h}) &\geq r_d \cdot (I - A - I_b(r_b)) \Rightarrow \\ A(r_d, r_b) &\geq I - I_b(r_b) - \frac{p_h}{r_d} \cdot (R - \frac{c}{p_h - p_l} - \frac{e}{p_h}) \end{aligned}$$

This expression implies that $A(r_d, r_b)$ is increasing in both interest rates. Monitoring will allow more firms to access capital if $A(r_d, r_b) < A(r_d)$. This cannot hold if r_b is too high, but r_b must be high enough to satisfy a participation constraint for the bank. Intuitively,

by contracting with a bank who can monitor its effort, the firm relaxes its own incentive compatibility constraint, and can thus pledge more money to outside investors.

In this model the bank is a pure financial intermediary and owns no capital. As a consequence, there exists an agency relationship between banks who possess a monitoring technology, and depositors who own capital but cannot observe payments from firms to the bank. The informational asymmetry in this agency relationship will create a cost of delegation, but the bank will be able to “diversify” this cost away by adding independent risks to its portfolio of firms. The optimal contract between the bank and depositors will also provide the bank with incentives to monitor its borrowers. As shown by Diamond [1984], an optimal contract between the bank and depositors with imperfect information approximates an optimal contract with no agency costs if the bank makes a large enough number of loans to firms with independent, or conditionally independent, returns. Relying on this result, I limit attention here to the perfect information case. If depositors could perfectly observe the bank’s cash flows, then the participation constraint for the bank would be:

$$p_h \cdot \frac{c}{p_h - p_l} - c \geq r_d \cdot I_b(r_b) \Rightarrow r_b \geq r_d \cdot \frac{p_h}{p_l}$$

Recall that monitoring will allow firms more access to capital if $A(r_d, r_b) < A(r_d)$. Under perfect information, a sufficient condition that will guarantee $A(r_d, r_b) < A(r_d)$ at the minimal level of r_b is that $\frac{p_l}{p_h - p_l} \cdot c - c > 0$. Intuitively, bank finance can increase a firm’s access to capital if the costs of monitoring are not too high.

Single Market Equilibrium with Bank and Debt Finance

I let the inelastic local supply of deposits to banks be K_b and exogenously fix the price of unmonitored credit at r_d so that there is an infinitely elastic supply of unmonitored capital. Demand for bank capital is given by:

$$D_b(r_d, r_b) = [F(A(r_d)) - F(A(r_d, r_b))] \cdot I_b(r_b)$$

For fixed r_d it is immediate that $D_b(r_d, r_b)$ is strictly decreasing in r_b so demand for bank finance is downward sloping. I further assume that $D_b(r_d, r_d \cdot \frac{p_h}{p_l}) \geq K_b$ which guarantees that supply does not exceed demand at the minimum price $r_b = r_d \cdot \frac{p_h}{p_l}$. It follows that the equilibrium value of r_b is given by $D_b(r_d, r_b) = K_b$. This equation also determines the market demand for unmonitored debt capital:

$$D_d(r_d, r_b) = \int_{A(r_d, r_b)}^{A(r_d)} [I - A - I_b(r_b)] f(A) dA + \int_{A(r_d)}^I [I - A] f(A) dA.$$

I am then in a position to carry out the comparative statics of the single market model. Proofs and further discussion are contained in Appendix A.

Equilibrium in Two Integrated Markets

I next use the above model to consider the effects of financially integrating two previously distinct markets. For simplicity, I assume there are two symmetric markets. None of the qualitative results depend on this symmetry assumption. I also assume that the markets for bank capital are perfectly integrated so that bank capital moves freely across both markets to equalize the rate of return. Let the local stock of capital in markets one and two be K_{b1} and K_{b2} . The equilibrium across both markets is now defined by:

$$\begin{aligned} D_{b1}(r_d, r_{b1}) &= \theta \cdot (K_{b1} + K_{b2}) \\ D_{b2}(r_d, r_{b2}) &= (1 - \theta) \cdot (K_{b1} + K_{b2}) \\ r_{b1} &= r_{b2} = r_b \end{aligned}$$

where θ defines the fraction of total monitored capital employed in a given market.

In Appendix A, I show that supply side and demand side credit shocks have different consequences for volatility after integration. The quantity effects of shocks to local credit supply are muted in integrated markets, while the quantity effects of credit demand shocks are exacerbated.¹ These comparative statics are easily shown in a diagram. Figure 2 shows two integrated markets in an initial equilibrium. The parameter θ captures the free movement of bank capital that equates the price of bank finance across both markets. In Figure 3, a negative shock to the supply of bank capital in market one raises the price of bank finance. Bank capital from market two then enters market one until the price of bank finance is equated across both markets (Figure 4). A negative shock to bank capital therefore raises the equilibrium price and lowers the equilibrium quantity of bank capital, but both effects are smaller in magnitude in an integrated market than in a single market. Put differently, integration flattens the credit supply curve for an individual market. As a result, shifts of the supply curve have a smaller effect on equilibrium quantities.

A demand shock in an integrated market also lowers the equilibrium quantity of bank capital, but the effect is larger in magnitude than in a single market. Figure 5 depicts a negative shock to the demand for bank capital in market one, which lowers the price of credit. In Figure 6, capital is reallocated from market one to market two, equating the cost of bank finance. Recall the single market case exhibits no quantity effect from a negative shock to demand because of inelastic supply. In an integrated market, this effect is negative. The quantity effects of shocks to demand are thus larger in integrated markets. Again, put differently, integration flattens the credit supply curve for an individual market, so demand shifts have a larger effect on equilibrium quantities.

The comparative statics of the model can be applied to the context of within and across-state deregulation. First, the model suggests that the effect of local credit supply on firm growth should be smaller in deregulated (integrated) markets. Second, this decrease in the effect of credit supply on firm growth should be most pronounced for marginal firms that either lack the requisite assets to pledge against their loans or exhibit high demand for external finance. Third, to the extent that empirical measures of local credit supply are

¹The price effects of both supply and demand shocks are, of course, muted in integrated markets.

correlated with local credit demand, this should bias the empirical findings in the opposite direction from the predicted results. This follows because the effect of credit demand shifts on firm growth should be larger in deregulated (integrated) markets. Fourth, the model implies that, after deregulation, credit supply and demand movements in outside markets affect firm growth in the home market. An increase in the supply of credit in outside markets should raise firm growth in the home market, and an increase in the demand for credit in outside markets should lower firm growth in the home market.

Chapter 4

Historical Background

In order to test this model, I exploit the history of bank regulation in the United States. I briefly outline the history of within and across-state branching restrictions in the United States in order to highlight the causal factors behind deregulation that my empirical analysis must take into account. I then explain the competitive equality doctrine and the history of litigation between the OCC and the states that led a subset of states to change their within-state branching laws for relatively exogenous reasons.

Within and Across State Bank-Branching Deregulation

For most of the twentieth century, the United States consisted of at least 50 different banking markets. This fragmented system was maintained, in part, through the dual banking system and through legal restrictions on across-state bank expansion. The dual banking system has its origins in the National Bank Acts of 1863 and 1864, which created a system of nationally-chartered banks that could compete with state-chartered banks. The Office of the Comptroller of the Currency (OCC) regulated nationally-chartered banks, while the state banking authorities regulated state-chartered banks. State-chartered banks could not establish branches in other states. National banks were also restricted by their charters and by OCC policy to individual states and had limited branching rights within those states [Calomiris 2000]. As a result, across-state banking was virtually nonexistent in the United States until after the Glass-Steagall Act of 1933. Subsequently, bank holding companies (BHCs) began to operate across state lines by purchasing banks with different state charters. The Douglas Amendment to the Bank Holding Company Act of 1956 prevented this practice by precluding out-of-state banks or BHCs from making acquisitions without the target state's approval. Because no state permitted out-of-state acquisitions at the time, the Douglas Amendment effectively outlawed across-state banking organizations. Across-state banking became a reality largely through the actions of individual states. Beginning with Maine in 1978, states passed laws allowing BHCs to make in-state acquisitions, and by 1994 all states except Hawaii had adopted such agreements. The federal government also facilitated this process of integration. In 1982, in response to instabilities in the banking sector brought on by mismatches between long-term, low-interest-rate assets and short-term, inflated liabilities, Congress passed the Garn St. Germain Act, allowing failed

banks and thrifts to be acquired by any BHC, whether in-state or out-of-state. Congress finally allowed nation-wide branching with its passage of the Riegle Neal Act in 1994.

While across-state branching restrictions limited across-state financial integration, within-state branching restrictions limited within-state financial integration. The debate over within-state bank branching holds a venerable place in U.S. financial history. State-chartered banks in the eighteenth and early nineteenth centuries were usually prohibited from establishing branches by their charters. Southern states were the exception to this rule. Banks were often granted branching rights within their charters, and the greater resilience of the southern banking system was attributed to its extensive branch networks [Calomiris 2000]. Branch banking declined in the South after the Civil War, but resurfaced in the North with the movement for banking consolidation following the widespread bank failures of the 1890s. California's decision to liberalize its branching laws in 1909 also served as an example to other states [Chapman & Westerfield 1942]. From the 1920s to the mid 1930s a considerable number of states eased their restrictions on branching [Dehejia and Lleras-Muney 2007]. Calomiris [2000] argues that states did so in response to bank failures. Dehejia and Lleras-Muney [2007] show that states who adopted bank reforms in this period chose either to ease branching restrictions or to adopt deposit insurance. They find some statistical evidence that states chose branching or deposit insurance in response to economic downturns and that states with large manufacturing establishments were more likely to adopt branching reform.

These changes in state branching laws prompted federal legislation. In 1927, Congress passed the McFadden Act, which allowed national banks to branch within a city to the extent that state banks were allowed to do so. The Act also restricted the branching of state banks that were members of the Federal Reserve to the extent that national banks were allowed to branch. The McFadden Act was then amended by the Glass-Steagall (Banking Act) of 1933, which permitted national banks to branch to the extent that state banks were allowed to do so. After 1933, state branching laws governed both state-chartered and nationally-chartered banks.

There was little change in state branching laws from the 1940s to the 1970s. By 1975, only fourteen states allowed banks to freely branch within the state, and a total of 18 "unit" branching states went so far as to restrict bank branching altogether. From 1975 to 1994, almost all states lifted their restrictions on within-state branching. The legislative process through which deregulation occurred varied across states. Some states first allowed BHCs to operate multiple bank subsidiaries. These subsidiaries were treated as distinct institutions that had to separately comply with state regulations such as capital and risk requirements. These states then allowed BHCs to convert their subsidiaries into branches of a single bank and to acquire new branches by merger and acquisition. Kroszner and Strahan [1999] provide evidence that deregulation occurred earlier in states with smaller and weaker small-banking sectors, and in states with a larger fraction of small, bank dependent firms. They find no evidence that states deregulated in response to bank failures or distress. The authors suggest that, over time, ATM machines, checkable money market funds, and lower transportation costs reduced the value of the geographic monopoly over depositors held by local banks. They also argue that the introduction of credit scoring and other quantitative financial techniques reduced the informational advantages of local banks in

lending to local borrowers. As a result, the benefits of branch restrictions to smaller banks were no longer worth the political costs of maintaining the status quo.

The Competitive Equality Doctrine and the Branching Rights of National Banks

States thus changed their within-state and across-state branching laws in response to a variety of political and economic forces. In order to rule out the possibility that these forces account for the relationships that I find in the data, I also consider a subset of states who changed their within-state branching laws in response to litigation. Here, I argue that these changes in the law were largely unrelated to political and economic forces in these states.

The McFadden Act of 1928 and the Glass Steagall (Banking Act) of 1933 permitted national banks to branch to the extent that state banks were allowed to do so. These statutes formed the basis of the Supreme Court’s “competitive equality” doctrine, announced in *First National Bank v. Walker Bank & Trust Company*, 385 U.S. 252 (1966). The Court overturned a decision by the Comptroller of the Currency to permit national banks to establish branches in smaller cities in Utah, where Utah law did not allow states banks to do so. The Court interpreted the McFadden Act and Glass Steagall Act to ensure a competitive equality between national and state banks. In *First National Bank v. Dickinson*, 396 U.S. 122 (1969), the Court held that, when deciding whether an activity constituted branching, they would consider any activity that might give one bank a competitive advantage over another. The competitive equality doctrine thus set the terms of competition between state and national banks.

Because courts adopted an expansive interpretation of branching under the McFadden Act, the Comptroller sought to expand the ability of national banks to branch by arguing that state-chartered savings and loan institutions should be considered branches under the Act. The Comptroller brought this issue before a court in the late 1970s by allowing a national bank to open a branch in contravention of Washington law. The Ninth Circuit Court of Appeals rejected this argument in *Mutschler v. People’s National Bank*, 607 F.2d 274 (9th Cir. 1979), holding that savings and loan institutions were distinct from commercial banks.

Independent developments in the law made the Comptroller’s argument stronger over time. The Garn St. Germain Act of 1982 expanded the ability of banks to provide interest bearing deposit accounts, loans for commercial real estate, and business loans. Then, in *Clarke v. Securities Industry Association*, 479 U.S. 388 (1987), the Court held that “core banking functions” included, but were not limited to receiving deposits, paying checks, and lending money. The Comptroller subsequently allowed a national bank to open a branch in contravention of Mississippi branching law. At the time, Mississippi allowed thrifts to branch freely. The Comptroller persuaded the Fifth Circuit Court of Appeals to adopt its position in *Department of Banking and Consumer Finance (Deposit Guaranty) v. Clarke*, 809 F.2d 266 (5th Cir. 1987). The court held that savings and loan associations in Mississippi engaged in core banking functions under the Supreme Court’s reasoning in *Clarke*. As a result of the court’s ruling, national banks were allowed to branch freely in Mississippi. Since national banks were allowed to branch freely, Mississippi allowed state banks to branch freely in 1988.

The decision by the Fifth Circuit led to series of responses by other states. Tennessee had a “wild card” statute that automatically granted to state banks any powers granted to national banks. Predicting that the court’s decision in *Deposit Guaranty* would result in state-wide branching rights for national banks, the Banking Commissioner of Tennessee approved state-wide branching. The Comptroller proceeded with its strategy in other states. Texas approved state-wide branching after national banks were accorded this right in *Texas v. Clarke*, 690 F.Supp. 573 (W.D. Tex. 1988). All told, Alabama, Florida, Indiana, Louisiana, Mississippi, Missouri, New Mexico, Oklahoma, Tennessee, and Texas lifted restrictions on branching by state banks in response to court rulings that allowed national banks to freely branch within those states [Jayaratne and Strahan 1996]. As a result of this history, I argue that within-state deregulation in these states was unlikely to be correlated with unobserved state characteristics that alter the relationship between local credit supply and firm growth.

Chapter 5

Data and Empirical Analysis

5.1 Data

I construct a unique panel dataset to test my predictions. The panel consists of MSA and non-MSA (county) markets from the 50 states, excluding Delaware, from 1977-1997. I merge the Summary of Deposits dataset from the Federal Reserve, which contains branch level information on deposits, with the Call Reports Data from the Federal Reserve and the County Business Patterns Database from the U.S. Census to create market-level measures of deposit growth, firm growth, and banking market characteristics such as the k-firm deposit ratio, the number of banks per market, and the Herfindahl index. I add to this market level and state level economic measures such as per capita income, population, and unemployment from the Bureau of Economic Analysis.

In my data, a state undergoes within-state deregulation when it allows banks to expand by merger and acquisition and to manage all its branches as a single commercial entity. A state undergoes across-state deregulation when it allows banks or BHCs outside the state to acquire in-state branches. Table 1 presents the year of within and across-state deregulation for each state.

5.2 Deregulation and Banking Market Integration

My empirical analysis proceeds in two steps. I first construct measures of banking market integration and show that within-state and across-state deregulation led to an increase in within-state and across-state integration. I then use these changes in state law to proxy for an increase in deregulation and test the home-market and cross-market predictions of the model.

I first show that market levels of banking concentration did not substantially change over the sample period. Table 2 summarizes the population and banking statistics for the average MSA and non-MSA market over this period. The 3-firm concentration ratio measures the fraction of bank deposits in the market held by the largest three banks

or BHCs, while the Herfindahl index measures the sum of squared deposit market shares for all banks or BHCs. Despite the wave of within and across-state deregulation that occurred during this period, market concentration by either measure remained fairly constant. Table 2 illustrates that the substantial industry consolidation that took place in this period was primarily across markets rather than within markets.

Financial integration across markets, however, increased dramatically. Table 2 illustrates the increase in the level of banking market integration across both MSA and non-MSA markets using three market-level measures. To construct the “Market/State” measure, I divide the total deposits in a market by the total deposits held in-state by banks or BHCs in that market. I then subtract this fraction from one. Market/State acts as a proxy for the level of financial integration across banking markets within a particular state. A higher value indicates greater within-state integration. To construct the “State/U.S.” measure for a market, I divide the total deposits held in-state by banks or BHCs in that market by their total U.S. deposits. I then subtract this fraction from one. State/U.S. acts as a proxy for the level of financial integration of banking markets across state boundaries. Again, a higher value indicates greater across-state integration. “Multi” measures the fraction of deposits in a market held by multi-market banks or BHCs.

The integration measures in the “Bank” column assume that the branches of an individual bank (corporation) act as a single lending entity. The integration measures in the “BHC” column assume the branches of an individual BHC act a single lending entity. Whether BHCs should be treated as an integrated financial unit is an empirical question. Individual entities within a BHC must separately comply with state and national bank regulations. Depositors with funds in one bank in a BHC cannot access their funds through a different bank in the same BHC. The existing evidence [Houston, James, and Marcus 1997] suggests that BHCs may constitute an internal capital market. At both the bank and BHC level, all of these measures show a marked increase in the level of financial integration over time.

I next present evidence that within and across-state deregulation led to an increase in financial integration. I find that within-state bank branch deregulation led to an increase in within-state financial integration, measured at the bank level, and that across-state deregulation led to an increase in across-state financial integration, measured at the BHC level. This conclusion can be readily shown through the time series evidence. I first present the evidence for within-state branch deregulation. Figure 7 depicts the bank Market/State measure for MSA Markets in Colorado as a function of time, with the vertical line at 1991 denoting the year of within-state bank branch deregulation. There is a sharp increase in within-state integration for all MSA markets after deregulation. When the Market/State measure is computed for Colorado at the BHC level, as in Figure 8, there is little evidence of either a change in this measure over time or an effect arising from deregulation. Within-state deregulation thus captures the marginal change from integrating credit markets at the BHC level to integrating at the bank level.¹ I find these plots to be persuasive evidence that within-state branch deregulation led to an increase in within-state financial integration when measured at the bank level.

¹Colorado can be contrasted with California where, as depicted in Figures 9 and 10, neither the bank nor the BHC Market/State ratio changed appreciably over time.

Across-state deregulation, by contrast, led to an increase in across-state financial integration when measured at the BHC level. As shown in Figure 11, across-state deregulation in Colorado in 1988 is associated with an increase in across-state integration when measured at the BHC level, with some evidence for an increase preceding deregulation. When measured at the bank level as in Figure 12, however, there is little change in across-state integration until 1995. It is likely that the increase in integration observed after 1995 is due to the Riegle Neal Act of 1994, which permitted nation-wide branching.² These plots are consistent with my claim that across-state bank branch deregulation led to an increase in across-state financial integration when measured at the BHC level.

I also provide statistical evidence for the increase in integration following within and across-state deregulation. I estimate equations of the form:

$$y_{mst} = \alpha_m + \alpha_t + \alpha_s t + \beta_1 p_{mst} + \beta_2 p_{mst} \cdot t + \beta_3 \mathbf{z}_{mst} + \epsilon_{mst} \quad (5.1)$$

Each observation corresponds to a given market/state/year, where a market is defined to be a Metropolitan Statistical Area (MSA) or county for non-MSA areas. I regress integration measured at the market level (y_{mst}) on market indicator variables, (α_m), time indicators (α_t), state-specific time trends ($\alpha_s t$), an indicator for post-deregulation years (p_{mst}), a time trend for post deregulation years ($p_{mst} \cdot t$), and a vector of market and state level covariates ($\mathbf{z}_{mst}$). I estimate these models separately for MSA and non-MSA markets and for both measures of integration (Market/State and State/U.S.), using within-state and across-state deregulation as the treatment indicators.

Table A1 presents the evidence for within-state regulation. The coefficients on the indicator variable for post-deregulation years are large and statistically significant for both MSA and non-MSA markets when within-state integration is measured at the bank level. In MSA markets, this increase in integration is about .18 and in non-MSA markets it is about .10. For both sets of markets, the coefficients are quite stable across specifications that include of a rich set of market and state covariates, whether these covariates are included as growth rates or logs. The trend coefficients are only significant for non-MSA markets. Table A2 presents the evidence for across-state deregulation. The coefficients on the indicator variable and trend variables for post deregulation years are large and statistically significant for both MSA and non-MSA markets when across-state integration is measured at the BHC level. In MSA markets, the increase in integration is about .12 and in non-MSA markets it is about .06. The coefficients for both the post-deregulation indicator and the trend variables are again stable across specifications that include market and state covariates. Both the regression results and time series plots presented in this section suggest that (1) within-state bank branch deregulation led to an increase in within-state financial integration measured at the bank level and (2) across-state deregulation led to an increase in across-state financial integration measured at the BHC level.

²California, which deregulated interstate branching in 1987, shows no increase in its rate of integration when measured at the BHC level (Figure 13). The pattern for California's Bank State/U.S. ratio, shown in Figure 14, is similar to that for Colorado, again suggesting the importance of the Riegle Neal Act for this measure of across-state integration.

5.3 Deregulation, Local Credit Supply, and Firm Growth

Having established that bank branch deregulation led to an increase in financial integration, I am now in position to estimate the effects of deregulation on the relationship between firm growth and local credit supply. My model readily generates reduced-form predictions for the effects of bank branch deregulation: (1) the correlation between local credit supply and business growth is greater in regulated states than in unregulated states, and (2) this correlation decreases post deregulation.³ These effects should be greater for firms that are dependent on external bank finance. In order to measure these effects, I estimate equations of the form:

$$y_{mst} = \alpha_m + \alpha_t + \alpha_s t + \beta_0 p_{mst} + \beta_1 x_{mst} + \beta_2 x_{mst} \cdot d_{ms} + \beta_3 x_{mst} \cdot p_{mst} + \beta_4 \mathbf{z}_{mst} + \epsilon_{mst} \quad (5.2)$$

I regress measures of firm growth (y_{mst}) on market indicator variables, (α_m), time indicators (α_t), state-specific time trends ($\alpha_s t$), an indicator for post-deregulation years (p_{mst}), the growth rate of deposits (x_{mst}), interactions of the deposit growth rate with a deregulating-market indicator ($x_{mst} \cdot d_{ms}$) and the post-deregulation period ($x_{mst} \cdot p_{mst}$), and a vector of market and state level covariates ($\mathbf{z}_{mst}$).⁴ This regression captures the effects of within or across-state bank branch deregulation on the relationship between the growth rate of deposits and the growth rate of firms. I estimate these equations separately as well as jointly for within-state and across-state deregulation. For across-state deregulation, β_2 is not identified since each market deregulated during the sample period.

I also estimate these equations using state-year indicator variables to account for state-year-specific, omitted variables that affect firm growth. By including state-year indicators, I control for state-specific policies or macroeconomic conditions that directly effect firm growth and are correlated with deregulation. In these regressions, the effect of deregulation on the credit-growth nexus is identified from variation in market deposit growth relative to the state average for that year.

My hypotheses can be stated in terms of the econometric model as follows:

$$\begin{aligned} \text{Within} - \text{State Deregulation} & : \beta_2 > 0, \beta_3 < 0 \\ \text{Across} - \text{State Deregulation} & : \beta_3 < 0 \end{aligned}$$

The correlation between credit growth and firm growth is higher in regulated states ($\beta_2 > 0$) and this correlation falls after deregulation ($\beta_3 < 0$). I first use the growth rate of establishments in a market as a measure of firm growth and the growth rate of deposits in the market as a proxy for the local supply of credit. I estimate the model using firms

³In Appendix C, I show that these reduced form predictions can be rationalized by parameter restrictions on a simple, structural model of credit-market equilibrium that follows directly from the microeconomic model.

⁴The market-level covariates include the growth rates of per capita income and population, the 3-firm concentration ratio of deposits, the Herfindahl index, and the number of banks per market. The state-level covariates include the growth rates of population and GDP, as well as the unemployment rate.

of different sizes, as measured by the number of employees, in order to proxy for the level of external financial dependence. This proxy for firm growth does not distinguish new establishments started by firms already in the market from establishments by entrants. It also does not distinguish the intensive and extensive margin of firm growth.

I report empirical estimates of Equation 2 for MSA markets in Table 3. Columns 1-3 present estimates using state specific linear time trends and columns 4-6 present estimates with state/time indicator variables. All equations include both the within-state and across-state deregulation indicators. Standard errors are clustered at the state level. The coefficients are similar in magnitude and value when the effects of the deregulations are measured separately.

These estimates are consistent with the presence of financial constraints in the 20-99 employee size class in MSA markets due to low levels of within-state integration. They are consistent with the model's predictions whether the regressions contain state time trends or state-year indicators. For the estimates using state time trends, the positive coefficient of .081 on $GrBdeps \cdot Intra$ (β_2) indicates that there was a stronger association between local bank deposits—the proxy for local credit supply—and establishment growth in states with within-state branching restrictions compared to states without such restrictions. The negative coefficient of .097 on $GrBdeps \cdot Intra \cdot Post$ (β_3) indicates that the relationship between deposit growth and establishment growth decreased as a result of deregulation.

The coefficient of .097 can be interpreted in two ways. First, the magnitude of the effect of deposit growth on establishment growth is 80% smaller than it was in the regulated period. Second, for the average-sized MSA market in 1997 after deregulation, a fall in the growth rate of deposits of .05 is associated with a loss of about 9 fewer establishments than it is before deregulation. Since over the sample period the number of new establishments in this size class in the average MSA is about 61, this represents 14% of new business formation. I conclude that for medium-sized firms, within-state deregulation led to an economically significant decrease in the importance of local credit supply at the margin of establishment growth. I emphasize, however, that these regressions cannot distinguish the extensive margin of growth attributable to new establishments from the intensive margin of growth due to the expansion of smaller firms.

The estimates presented in Table 4 are also consistent with the presence of financial constraints in the 20-99 employee class due to low levels of across-state integration in non-MSA markets. The negative coefficient of .109 on $GrBdeps \cdot Inter \cdot Post$ (β_3) suggests that across-state branch deregulation reduced the effect of deposit growth on establishment growth. This coefficient implies an 80% reduction in the effect of deposit growth on establishment growth compared to the regulated period. For the average non-MSA market in 1997, a fall of .05 in the growth rate of market deposits is associated with a marginal reduction in the loss of establishments that is 14.7% of new business formation.

My model predicts that the marginal firms who gain or lose access to finance are neither so small that they are unable to obtain external finance nor so large that they can rely on debt markets. Consistent with the model, I do not find an effect for the largest and smallest size category of firms. It is possible that there is an effect on the relationship between credit supply and establishment growth at the intensive margin as establishments with 1-19 employees moving into the 20-99 employee class.

These estimates also indicate a differential effect of within and across-state financial integration on MSA and non-MSA markets. For MSA markets, within-state deregulation reduces the dependence of mid-sized firm growth on local credit supply. This suggests that within-state financial integration led to an increase in credit flows in response to market-specific shocks. across-state deregulation, however, had no measurable effect in MSA markets. This suggests that, conditional on within-state integration, the financial flows enabled by across-state integration are of less importance for firm growth. For non-MSA markets, by contrast, across-state deregulation lowered the dependence of mid-sized firms on local credit supply, while within-state deregulation had no measurable effect. This suggests that credit flows enabled by across-state financial integration lowered the effect of local shocks to credit supply. It also suggests that regional and national banks are more willing or able to smooth the flow of credit to rural areas in response to such shocks than are state-wide banks.

It is difficult to attribute these findings to biases that result from omitted variables in the regressions. The historical literature suggests that states enacted banking regulation in response to economic downturns or to financial instability in the banking sector. Though Kroszner and Strahan [1999] dispute this finding for the case of within-state deregulation, I accept it in order to consider the effect on my estimates. First, such downturns would not explain the greater sensitivity of business growth to deposit growth *before* deregulation. Second, it is possible that states deregulate in response to shocks to their banking sector. Outside capital then enters to meet the excess demand for credit and lowers the correlation between local deposit growth and business growth. This movement of outside capital, however, is exactly what was previously limited by branching restrictions. Third, my estimates of this effect are nearly identical when I include state-year dummies in the regression. It is difficult to see how such a shock could affect enough banking markets to cause deregulation, and still be sufficiently heterogeneous in its impact on these markets to cause large biases after partialling out this common effect.

It could also be argued that my estimates do not contain large biases, but that the causality is reversed. States deregulate in anticipation of future growth. Outside investors then respond to this growth potential, resulting in a lower association between local credit supply and growth. Under this interpretation, I should also find a direct effect of deregulation on growth. I find none. This interpretation is also largely consistent with my underlying argument that banking restrictions limit the ability of credit to move freely to equalize returns across markets.

The fact that states that deregulated later had significant, small-banking sectors does not pose a serious problem for my estimates. By including market indicators, I partial out much of this effect. The robustness of my findings to the inclusion of state-year indicators also alleviates this concern. Conceptually, this difference between regulated and deregulated states is entirely consistent with the predicted effect of integration on the sensitivity of firm growth to local credit supply.

It is also unlikely my findings are a result of using deposits as a proxy for local credit supply. It is true that, over the sample period, deposits should be a less accurate measure of the total supply of bank credit to a market. My results, however, show that deposits are a better proxy for credit supply in markets with branching restrictions, and a

worse proxy after these restrictions are lifted. I concede that this effect is not, as represented in my model, driven solely by the availability of deposits from other branches. Deregulation increases the fraction of large banks in a market. These banks have the ability to secure funds through a variety of methods, such as issuing short-term and long-term debt, selling shares, and borrowing on the across-bank market. What is central to my argument is that such non-deposit funds be raised outside the local market. A change in composition of the source of funds (from local to nonlocal) that arises from the changing size distribution of banks in the market is entirely consistent with the mechanism detailed in my model.

I also estimate the effect of deregulation using employment growth and payroll growth to proxy for firm growth. Table 5 reports the results for these regressions in MSA markets. I again find persuasive evidence that in MSA markets within-state deregulation lowered the effect of local credit supply growth on firm growth. The positive coefficient of .056 on $GrBdeps \cdot Intra$ (β_2) indicates that there was a stronger association between local bank deposits and employment growth in states with within-state branching restrictions. The negative coefficient of .064 on $GrBdeps \cdot Intra \cdot Post$ (β_3) indicates that the correlation between deposit growth and employment growth decreased as a result of deregulation. This represents a decrease in magnitude of about 63% of the effect of deposit growth on employment growth. For the average sized MSA market in 1997, a drop in the growth rate of deposits of .05 after deregulation is associated with a loss of about 780 fewer jobs than it is before deregulation. Since the average number of new jobs in the average MSA market is 7100, this represents 11% of employment growth. These magnitude of these effects are consistent with the estimate of a loss of 20 fewer establishments in the 20-99 employee size class. The results for the effect of within-state deregulation on the relationship between deposit growth and employment growth are similar in magnitude when state-year dummies are included in the regression.

There is also weak evidence that across-state deregulation led to a fall in the effect of deposits on employment growth. The coefficient of .034 on $GrBdeps \cdot Inter \cdot Post$ (β_3) is statistically significant when estimated with state time trends, but is no longer significant when state-time indicators are included. Table 5 also reports the analogous estimates for non-MSA markets. There is little evidence that within or across-state deregulation affected the relationship between deposit growth and employment growth in non-MSA markets.

The results for payroll growth in MSA markets are similar to those for employment. The positive coefficient of .099 on $GrBdeps \cdot Intra$ (β_2) indicates that there was a stronger association between local bank deposits and payroll growth in states with within-state branching restrictions. The negative coefficient of .052 on $GrBdeps \cdot Intra \cdot Post$ (β_3) provides weak evidence that the correlation between deposit growth and employment growth decreased as a result of deregulation. This represents a decrease in magnitude of about 49% in the effect of deposit growth on payroll growth. For the average sized MSA market in 1997, a fall in the growth rate of deposits of .05 after deregulation is associated with a loss in payroll of around \$16,241,000 less than it is before deregulation. Since the median amount of payroll growth in the average MSA market is \$351,650,000, this represents about 4.5% of payroll growth. The magnitude of these effects are consistent with those observe for establishment growth and employment growth. When the regression includes state-year indicators, the coefficient on $GrBdeps \cdot Intra \cdot Post$ (β_3) is of similar magnitude,

but is no longer statistically significant. As in the case of employment growth, there is little evidence that within or across-state deregulation affected the relationship between deposit growth and payroll growth in non-MSA markets.⁵

5.4 Deregulation and Outside Market Effects

My model predicts that an increase in outside-market credit supply raises growth in the home market and that an increase in outside-market credit demand lowers growth in the home market. These hypotheses readily extend to predictions concerning the reduced form correlations between firm growth and proxies for credit supply and demand in outside markets.⁶ In order to test this prediction for within-state deregulation, I estimate equations of the form:

$$\begin{aligned}
 y_{mst} = & \alpha_m + \alpha_t + \alpha_s t + \beta_0 p_{mst} + \\
 & \beta_1 x_{mst} + \beta_2 x_{mst} \cdot d_{ms} + \beta_3 x_{mst} \cdot p_{mst} + \\
 & \beta_4 \bar{x}_{mst} + \beta_5 \bar{x}_{mst} \cdot d_{ms} + \beta_6 \bar{x}_{mst} \cdot p_{mst} + \\
 & \beta_7 \bar{y}_{mst} + \beta_8 \bar{y}_{mst} \cdot d_{ms} + \beta_9 \bar{y}_{mst} \cdot p_{mst} + \\
 & \beta_4 \mathbf{z}_{mst} + \epsilon_{mst}
 \end{aligned} \tag{5.3}$$

I regress measures of firm growth (y_{mst}) on market indicator variables, (α_m), time indicators (α_t), state-specific time trends ($\alpha_s t$), an indicator for post-deregulation years (p_{mst}), the growth rate of deposits (x_{mst}), interactions of the deposit growth rate with a deregulating-market indicator ($x_{mst} \cdot d_{ms}$) and the post-deregulation period ($x_{mst} \cdot p_{mst}$), the average growth rate of deposits in other MSA markets in the state ($\bar{x}_{mst}$), average firm growth in other MSA markets in the state ($\bar{y}_{mst}$), and a vector of market and state level covariates ($\mathbf{z}_{mst}$).

My hypotheses can be stated in terms of the econometric model as follows:

$$Within - State Deregulation : \beta_6 > 0, \beta_9 < 0$$

Deregulation raises the correlation between outside-market deposit supply and local firm growth ($\beta_6 > 0$), and lowers the correlation between outside-market credit demand—proxied by outside firm growth—and local firm growth ($\beta_9 < 0$). Table 6 reports the results when firm growth is measured by establishment growth.⁷ I use the average growth rate of deposits in other MSA markets in the state (*GrBdepsOther*) to proxy for the growth of credit supply in outside markets.

⁵The difference-in-differences estimates using states that were always deregulated and states that changed their branching laws in response to litigation by the OCC are presented in Tables A6 and A7. These estimates are consistent with the results found for the full sample.

⁶In the Appendix, I show that these reduced form predictions can be rationalized by parameter restrictions on a simple, structural model of pre and post-deregulation credit-market equilibrium that follows directly from the microeconomic model.

⁷Table 18 reports these results when firm growth is measured by employment growth and payroll growth.

The prediction that the coefficient on $GrBdepsOther \cdot Intra \cdot Post$ (β_6) > 0 implies that within-state integration increases the marginal effect of outside-market credit supply on firm growth in the home market. I find evidence that this is true for establishments with 1-19 employees and establishments with 20-99 employees in MSA markets, and for establishments with over 100 employees in non-MSA markets. For the average MSA market in 1997 before within-state deregulation, an increase of .05 in the average growth rate of deposits in other MSA markets in the state lowers the number of mid-sized firms (20-99 employees) in the home market by about 11. After deregulation, the effect of average deposit growth in other MSA markets on the home market is no longer statistically significant and is 85% smaller in magnitude than it was before deregulation. The marginal effect of outside credit supply on firm growth thus increases as a result of deregulation.

That the coefficient on $GrBdepsOther \cdot Intra$ (β_5) < 0 suggests that, before deregulation, there is some relocation of firms to markets where the supply of credit is relatively more abundant. For both small and medium-sized firm, the total effect of outside-market deposit growth ($\beta_5 + \beta_6$) is statistically insignificant from zero after deregulation. This suggests that, after deregulation, the presence of large banking organizations removes the effect of state-level deposit supply on firm growth.

The prediction that $GrEstabOther \cdot Intra \cdot Post$ (β_9) < 0 implies that within-state integration lowers the marginal effect of outside-market credit demand on firm growth in the home market. I find evidence that this is true for small and mid-sized establishments in MSA markets and for mid-sized and large establishments in non-MSA markets. I use the average growth rate of mid-sized establishments in other MSA markets ($GrEstabOther$) to proxy for the growth of credit demand in outside markets. For the average MSA market in 1997, an increase of one standard deviation (.02) in the average growth rate of mid-sized establishments in other MSA markets is associated with the growth of 3 firms before deregulation and the loss of 4 firms after deregulation—a difference of -7. This effect is the opposite of what one would predict if deregulation led to the real integration of the state economy through trade or common specialization. If real integration occurred, the correlation between growth in different markets should increase after deregulation. The fact that it decreases suggests that the integration that took place was mainly financial. The fact that firm growth in outside markets can lower firm growth in the home market illustrates the potentially negative consequences of financial integration. The integration of credit markets can have adverse consequences when the variation in credit conditions across markets is driven by market failures rather than by supply and demand.

Chapter 6

Conclusion

This paper uses the timing of within and across-state bank branch deregulation to estimate the effect of financial integration on the sensitivity of firm growth to local credit supply. Using a difference-in-differences framework, I find that within-state deregulation lowers the sensitivity of firm growth to local credit supply in MSA markets for mid-sized establishments (20-99 employees). Across-state deregulation has similar effects for mid-sized establishments in non-MSA markets. When employment growth and payroll growth are used as measures of firm growth, the effects of within-state deregulation in MSA markets are consistent with those found for establishment growth. I also find that within-state deregulation increases the sensitivity of firm growth to credit supply and demand movements in other MSA markets in the state. Increases in the supply of credit in other MSA markets within the state raise local firm growth, while increases in the demand for credit in other MSA markets within the state lower local firm growth.

My empirical findings have several implications for the scholarly literature on the effects of financial market structure on firm growth. First, my results suggest that within-state financial flows are crucial for reducing the sensitivity of firm growth to local credit shocks in larger, urban markets. Conditional on the availability of such flows, across-state financial integration has little impact. Across-state financial flows play a substantial role, however, in reducing the sensitivity of firm growth to local credit shocks in smaller, rural markets. Multi-state banks appear to be more willing or able to channel funds to rural markets in response such shocks. Given that within-state flows are associated with multi-market banks and across-state flows with multi-state BHCs, these findings suggest future work on the relationship between the internal capital markets of financial firms and their legal/institutional structure.

Second, the effects of financial integration on mid-sized firms that I find are consistent with those of Cetorelli and Strahan [2006], who show that after deregulation, sectors that are more dependent on external finance experience an increase in the fraction of mid-sized firms relative to sectors that are less dependent. This similarity suggests the need of further empirical work using bank-branch deregulation to investigate the sector-specific effects of firm credit constraints at the market level. I hope to do this in a future paper that utilizes data from the U.S. Census Bureau's longitudinal survey of firms.

Third, my findings on the relative effects of within and across-state integration call

into question Morgan, Rime, and Strahan's [2004] evidence on the role of across-state branch deregulation in lowering state business cycle volatility. Their finding rely on IV regressions that use across-state deregulation to instrument for measures of across-state integration. As my results show, such regressions do a poor job in distinguishing the effects of within and across-state integration. It is likely that their analysis overstates the role of across-state integration at the expense of within-state integration. This distinction is crucial for research on the implications of financial market structure in small, transition or developing countries, who must weigh the opportunity costs of efforts to increase international or domestic integration.

Fourth, my findings that firms respond on the labor margin to local credit shocks are consistent with studies that document large, across-state labor flows in response to state-specific macroeconomic shocks [Blanchard and Katz 1992]. This consistency suggests the need for further empirical work on the role of across-market and across-sector labor flows in response to market-specific credit shocks.

Chapter 7

References

- Amel, Dean, "State Laws Affecting the Geographic Expansion of Commercial Banks," unpublished manuscript, Board of Governors of the Federal Reserve System, 1993.
- Barth, James R., Gerard Caprio, and Ross Levine, *Rethinking Bank Regulation: Till Angels Govern*, Cambridge University Press (2006).
- Berger, A.N., R.S. Demsetz, and P.E. Strahan, "The Consolidation of the Financial Services Industry: Causes, Consequences, and Implications for the Future," *Journal of Banking and Finance* 23 (1999), 135–194.
- Berger, A.N., A.K. Kashyap, and J.M. Scalise, "The Transformation of the U.S. Banking Industry: What a Long, Strange Trip It's Been," *Brookings Papers on Economic Activity* 2 (1995), 55–218.
- Bertrand, Marianne, Esther Duflo and Sendhil Mullainathan, "How Much Should We Trust Difference-in-Differences Estimators?" *Quarterly Journal of Economics*, CXIX (2004), 249–276.
- Black, S.E., and P.E. Strahan, "Entrepreneurship and Bank Credit Availability," *Journal of Finance* 57 (2002), 2807–2833.
- Blanchard, Olivier, and Lawrence F. Katz, "Regional Evolutions," *Brookings Papers on Economic Activity*, No. 1 (1992), 1–74.
- Butler, Henry N., and Jonathan R. Macey, "The Myth of Competition in the Dual Banking System," 73 *Cornell L. Rev.* 677, 693–701 (1988).
- Calomiris, Charles, *U.S. Banking Deregulation in Historical Perspective*, Cambridge University Press (2000).
- Calomiris, Charles, and Carlos Ramirez, "The Political Economy of Bank Entry Restrictions: Theory and Evidence from the U.S. in the 1920s," *Columbia University Working Paper* (2004).
- Cetorelli, N., and P.E. Strahan, "Finance as a Barrier to Entry: Bank Competition and Industry Structure in Local U.S. Markets," *Journal of Finance* 61 (2006), 437–461.
- Chapman, John M., and Ray B. Westerfield, *Branch Banking: Its Historical and Theoretical Position in American and Abroad*, Harper & Brothers (1942).
- Claessens Stijn, "Competitive Implications of Cross-Border Banking," in *Cross-Border Banking: Regulatory Challenges*, Gerard Caprio, Douglas D. Evanoff, and George G. Kaufman, eds., 151–82, World Scientific Publishing (2006).

Dehejia, Rajeev and Adriana Lleras-Muney, "Financial Development and Pathways of Growth: State Branching and Deposit Insurance Laws in the United States from 1900 to 1940," *Journal of Law and Economics*, Vol. 50 (2007), No. 2, 239-272.

Diamond, Douglas W., "Financial Intermediation and Delegated Monitoring," *The Review of Economic Studies*, Vol. 51, No. 3. (1984), 393-414.

Djankov, Simeon, Rafael La Porta, Florencio López de Silanes and Andrei Shleifer, "The Regulation of Entry" *Quarterly Journal of Economics*, 117 (2002), 1-37.

Djankov, Simeon, Rafael La Porta, Florencio López de Silanes and Andrei Shleifer, "Courts," *Quarterly Journal of Economics*, 118 (2003), 453-517.

Djankov, Simeon, Caralee McLiesh and Andrei Shleifer, "Private Credit in 129 Countries," *Journal of Financial Economics*, 84(2) (2007), 299-329.

Djankov, Simeon, Oliver Hart, Caralee McLiesh and Andrei Shleifer, "Debt Enforcement around the World," *Journal of Political Economy*, 116(6) (2008), 1105-1149.

Gadinis, Stavros, "The Politics of Competition in International Financial Regulation", 49 *Harv. Int'l L. J.* 447 (2008)

Goldsmith, Raymond, *Financial Structure and Development*, Yale University Press (1969)

Haselmann, Rainer F. H., Katharina Pistor, and Vikrant Vig, "How Law Affects Lending," *Columbia Law and Economics Working Paper*, No. 285 (August 2008).

Holmstrom, Bengt, and Jean Tirole, "Financial Intermediation, Loanable Funds, and the Real Sector," *Quarterly Journal of Economics*, CXII (1997), 663-691.

Houston, J.F., C.M. James, and D. Marcus, "Capital Market Frictions and the Role of Internal Capital Markets in Banking," *Journal of Financial Economics* 46 (1997), 135-164.

Hubbard, R. Glenn, Darius Palia, and Nicolas Economides, "The Political Economy of Branching Restrictions and Deposit Insurance," *Journal of Law and Economics*, XXIX (1996), 667-704.

Jackson, Howell E. "Centralization, Competition, and Privatization in Financial Regulation," *Theoretical Inquiries in Law*, Vol. 2(4) (2001).

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

Jayaratne, Jith and Philip E. Strahan, "Entry Restrictions, Industry Evolution and Dynamic Efficiency: Evidence from Commercial Banking," *Journal of Law and Economics*, 41:1 (1998), 239-74.

King, Robert G., and Ross Levine, "Finance and Growth: Schumpeter Might Be Right," *Quarterly Journal of Economics* 108 (1993), 717-737.

Kroszner, Randall S., and Philip E. Strahan, "What Drives Deregulation: Economics and Politics of the Relaxation of Bank Branching Restrictions," *Quarterly Journal of Economics*, CXIV (1999), 1437-1467.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer and Robert W. Vishny, "Investor Protection and Corporate Governance," *Journal of Financial Economics*, 58 (2000), 3-27.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer and Robert W. Vishny, "Law and Finance," *Journal of Political Economy*, 106(6) (1998), 1113-55.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer and Robert W. Vishny, "The Legal Determinants of External Finance" *Journal of Finance*, 53(3), 1997, 1131-50.

Macey, Jonathan and Miller, Geoffrey, *Banking Law and Regulation*, Little, Brown and Company (1992).

Macey, Jonathan, Commercial Banking and Democracy: The Illusive Quest for Deregulation, *Yale Journal On Regulation*, Vol. 23, No. 1 (2006).

Malmendier, Ulrike, "Law and Finance at the Origin," *Journal of Economic Literature* (forthcoming 2009).

Morgan, Donald P., Bertrand Rime and Philip E. Strahan, 2004, "Bank Integration and State Business Cycles," *Quarterly Journal of Economics* 119(4), 1555-85.

Petersen, M., and R.G. Rajan, "Does Distance Still Matter? The Revolution in Small Business Lending" *Journal of Finance* 57 (2002), 2533-2570.

Rajan, Raghuram and Luigi Zingales, "Financial Dependence and Growth," *American Economic Review* 88 (1998), 559-586.

Rajan, Raghuram and Luigi Zingales, "Financial Systems, Industrial Structure, and Growth" *Oxford Review of Economic Policy*, 17(4) (2002), 467-81.

Robinson, Joan, *The Rate of Interest and Other Essays*, Macmillan (1952).

Schumpeter, Joseph, *The Theory of Economic Development*, Oxford University Press (1969).

Stein, Jeremy, "Information Production and Capital Allocation: Decentralized Versus Hierarchical Firms," *Journal of Finance* 57 (2002), 1891-1921.

Chapter 8

Appendix

8.1 Proofs of Propositions in Model

I first present the analysis of the comparative statics for the single market model.

Proposition 1 *An increase/decrease in the local supply of capital lowers/raises the equilibrium price of bank finance and increases/decreases the equilibrium quantity of bank capital.*

Proof. The equilibrium condition in the market for bank credit ($D_b(r_d, r_b) = K_b$) implicitly determines the equilibrium pricing function $r_b(K_b, r_d)$. Applying the implicit function theorem and differentiating I obtain:

$$\begin{aligned} \frac{\partial r_b(K_b, r_d)}{\partial K_b} &= \left\{ \frac{\partial D_b(r_d, r_b(K_b, r_d))}{\partial r_b} \right\}^{-1} = \\ &= \{ [F(A(r_d)) - F(A(r_d, r_b(K_b, r_d)))] \cdot \frac{dI_b(r_b(K_b, r_d))}{dr_b} - \\ &= I_b(r_b(K_b, r_d)) \cdot F(A(r_d, r_b(K_b, r_d))) \cdot \frac{\partial A(r_d, r_b(K_b, r_d))}{\partial r_b} \}^{-1} = \\ &= \{ (+)(-) - (+)(+)(+) \}^{-1} = (-) \end{aligned}$$

The result for quantities follows from the fact that $\frac{\partial D_b(r_d, r_b(K_b, r_d))}{\partial r_b} < 0$. ■

Proposition 2 *An increase/decrease in the demand for bank capital raises/lowers the equilibrium price of bank finance but leaves the equilibrium quantity of capital supplied/demanded unchanged.*

Proof. The result for quantities follows from the assumption of inelastic supply. To see the result for prices, I parametrize the distribution of assets across firms ($\sigma \cdot F(A)$) so that demand for monitoring capital is given by:

$$D_b(r_d, r_b, \sigma) = \sigma \cdot [F(A(r_d)) - F(A(r_d, r_b))] \cdot I_b(r_b)$$

Equilibrium is then given by

$$D_b(r_d, r_b(r_d, \sigma, K_b), \sigma) = K_b \Rightarrow$$

$$\frac{\partial r_b(r_d, \sigma, K_b)}{\partial \sigma} = - \frac{\left(\frac{\partial D_b(r_d, r_b(r_d, \sigma, K_b), \sigma)}{\partial \sigma} \right)}{\left(\frac{\partial D_b(r_d, r_b(r_d, \sigma, K_b), \sigma)}{\partial r_b} \right)} = \frac{(-) \cdot (+)}{(-)} = (+) \quad \blacksquare$$

Figure 1a presents a graphical interpretation of the single market model. A negative shock to the supply of local capital (Figure 1b) raises the equilibrium price of bank credit and lowers the demand for bank capital. The effect of this shock on the demand for unmonitored debt capital is ambiguous (Figure 1c). The number of firms who can access external finance falls, but the amount of unmonitored debt capital per firm increases. The total demand for finance (bank plus debt) decreases, and the marginal firms that lose access to finance are those with the smallest level of assets or, alternatively, those with the greatest need for external finance. The effect of a demand shift is also clear from the graph. A negative shock to the demand for bank capital lowers the equilibrium price of bank credit, but leaves the equilibrium quantity unchanged.

In the single market case, the demand for bank capital and unmonitored debt capital are given by:

$$D_b(r_d, r_b) = [F(A(r_d)) - F(A(r_d, r_b))] \cdot I_b(r_b)$$

$$D_d(r_d, r_b) = \int_{A(r_d, r_b)}^{A(r_d)} [I - A - I_b(r_b)] f(A) dA + \int_{A(r_d)}^I [I - A] f(A) dA.$$

It is straightforward to show that for a fixed r_d , the demand for bank finance is strictly decreasing in r_b . An increase in r_d , on the other hand, has an ambiguous effect on the demand for bank finance. The sign of this effect depends on the relative mass of the number of the marginal firm who can just obtain outside finance ($f(A(r_d))$) and the marginal firm who can just obtain bank finance ($f(A(r_d, r_b))$), as well as the shift in the asset size of the marginal firms ($A'(r_d)$ and $\frac{\partial A(r_d, r_b)}{\partial r_d}$).

It is easy to see by inspection that the demand for unmonitored debt finance is strictly decreasing in r_d . The effect of an increase in the price of bank finance (r_b) on the demand for unmonitored debt capital is ambiguous because, while the set of firms who can access capital grows smaller ($\frac{\partial A(r_d, r_b(K_b, r_d))}{\partial r_b} > 0$), the amount of unmonitored debt capital for firms who do receive finance increases ($I'(r_b) < 0$). This implies that the effect of an increase in the local supply of bank capital (K_b) on the demand for unmonitored capital is ambiguous. Despite this ambiguity for the effect on unmonitored, or external, capital, the total market demand for capital is decreasing in the price of bank finance (r_b). The subsequent Propositions deal with case of integrated markets.

Proposition 3 *In an integrated market an increase/decrease in the local supply of capital lowers/raises the equilibrium price of bank finance and increases/decreases the demand for bank capital, but the price and quantity effects are smaller than in an unintegrated market.*

Proof. The above system implicitly determines the equilibrium pricing and allocation functions $r_b(r_d, K_1 + K_2)$ and $\theta(r_d, K_1 + K_2)$. Consider the market clearing condition in market one, parametrized by a market specific shock to capital ϵ that is initially set to zero:

$$D_{b1}(r_d, r_b(r_d, K_1 + K_2, \epsilon)) = \theta(r_d, K_1 + K_2, \epsilon) \cdot (K_1 + K_2) + \epsilon \Rightarrow \quad (1)$$

$$\frac{\partial D_{b1}(r_d, r_b(r_d, K_1 + K_2, \epsilon))}{\partial r_b} \cdot \frac{\partial r_b(r_d, K_1 + K_2, \epsilon)}{\partial \epsilon} =$$

$$1 + \frac{\partial \theta(r_d, K_1 + K_2, \epsilon)}{\partial \epsilon} \cdot (K_1 + K_2) \Rightarrow \quad (2)$$

$$\frac{\partial r_b(r_d, K_1 + K_2, \epsilon)}{\partial \epsilon} = [1 + \frac{\partial \theta(r_d, K_1 + K_2, \epsilon)}{\partial \epsilon} \cdot (K_1 + K_2)] \cdot \left\{ \frac{\partial D_{b1}(r_d, r_b(r_d, K_1 + K_2, \epsilon))}{\partial r_b} \right\}^{-1} \quad (3)$$

This expression is identical to that in Proposition 1 except for the first term in the square brackets. Totally differentiating the equilibrium condition for the second market, I get:

$$\frac{\partial D_{b2}(r_d, r_b(r_d, K_1 + K_2, \epsilon))}{\partial r_b} \cdot \frac{\partial r_b(r_d, K_1 + K_2, \epsilon)}{\partial \epsilon} =$$

$$- \frac{\partial \theta(r_d, K_1 + K_2, \epsilon)}{\partial \epsilon} \cdot (K_1 + K_2) \quad (4)$$

Imposing the symmetry condition, equations (2) and (3) imply

$$\frac{\partial \theta(r_d, K_1 + K_2, \epsilon)}{\partial \epsilon} = -\frac{1}{2} \cdot ((K_1 + K_2)^{-1} \Rightarrow \quad (\text{using (3)})$$

$$\frac{\partial r_b(r_d, K_1 + K_2, \epsilon)}{\partial \epsilon} = \frac{1}{2} \cdot \left\{ \frac{\partial D_b(r_d, r_b(r_d, K_1 + K_2, \epsilon))}{\partial r_b} \right\}^{-1} = (-)$$

Therefore the price response to a shock to capital is negative but half that of an unintegrated market. ■

Proposition 4 *In an integrated market, an increase/decrease in the demand for bank capital raises/lowers the equilibrium price of bank finance, but the price effects are smaller than for an unintegrated market.*

Proof. Parametrize the distribution of assets across firms $(\sigma \cdot F(A))$ so that the equilibrium condition for monitoring capital in market one is given by:

$$D_{b1}(r_d, r_b(r_d, K_1 + K_2, \sigma), \sigma) = \theta(r_d, K_1 + K_2, \sigma) \cdot (K_1 + K_2) \Rightarrow \quad (1)$$

$$\frac{\partial D_{b1}(r_d, r_b(r_d, K_1 + K_2, \sigma), \sigma)}{\partial r_b} \cdot \frac{\partial r_b(r_d, K_1 + K_2, \sigma)}{\partial \sigma} + \frac{\partial D_{b1}(r_d, r_b(r_d, K_1 + K_2, \sigma), \sigma)}{\partial \sigma} =$$

$$\frac{\partial \theta(r_d, K_1 + K_2, \sigma)}{\partial \sigma} \cdot (K_1 + K_2) \quad (2)$$

Differentiating the equilibrium expression for the second market I get

$$\frac{\partial D_{b2}(r_d, r_b(r_d, K_1 + K_2, \sigma), \sigma)}{\partial r_b} \frac{\partial r_b(r_d, K_1 + K_2, \sigma)}{\partial \sigma} = - \frac{\partial \theta(r_d, K_1 + K_2, \sigma)}{\partial \sigma} \cdot (K_1 + K_2) \quad (3)$$

Combining (2) and (3) and imposing the symmetry conditions implies

$$\frac{\partial r_b(r_d, K_1 + K_2, \sigma)}{\partial \sigma} = -\frac{1}{2} \cdot \frac{\left(\frac{\partial D_b(r_d, r_b(r_d, \sigma, K_b), \sigma)}{\partial \sigma} \right)}{\left(\frac{\partial D_b(r_d, r_b(r_d, \sigma, K_b), \sigma)}{\partial r_b} \right)} = (+) \quad \blacksquare$$

Proposition 5 *In an integrated market, an increase/decrease in the demand for bank capital increases/decreases the equilibrium quantity of bank capital, but the quantity effects are larger than for an unintegrated market.*

Proof. From (2) and (3) above it follows that

$$\frac{\partial \theta(r_d, K_1 + K_2, \sigma)}{\partial \sigma} = \frac{1}{2} \left(\frac{\partial D_b(r_d, r_b(r_d, \sigma, K_b), \sigma)}{\partial \sigma} \right) \cdot (K_1 + K_2)^{-1} = (+)$$

This effect is larger than for an unintegrated market, where a shift in demand has no effect on the equilibrium quantity. $\blacksquare$

8.2 Econometric Model of Credit Market Equilibrium

Home Market Effects

I develop an econometric model that rationalizes the reduced-form equations estimated in the paper. Consider a simple, statistical analogue of credit market equilibrium presented in the model:

$$\begin{aligned} Q_i^d &= \gamma_0 + \varepsilon^d p_i^* + \gamma_1 x_i + \gamma_2 z_i + \epsilon_i^d \\ Q_i^s &= \alpha_0 + \varepsilon^s p_i^* + \alpha_1 x_i + \alpha_2 z_i + \epsilon_i^s \\ Q_i^s(p_i^*) &= Q_i^d(p_i^*) = Q_i^* \end{aligned}$$

where Q_i^d and Q_i^s are the log of quantities of credit demand and supply, p_i is the log of price so that ε^d and ε^s are elasticities of demand and supply, x_i is the quantity of deposits in the market, and z_i is a demand/supply shifter such as income. The parameter α_1 can be interpreted as the marginal propensity to lend to local firms from deposits. I assume that:

$$\begin{aligned} E[\epsilon_i^d \mid p_i, x_i, z_i] &= 0 \\ E[\epsilon_i^s \mid p_i, x_i, z_i] &= 0 \end{aligned}$$

The reduced form of this model is given by:

$$Q_i^* = \beta_0 + \beta_1 x_i + \beta_2 z_i + \nu_i$$

where β_0, β_1 , and β_2 are functions of the underlying parameters of interest and are identified under the above assumptions. The coefficient β_1 , which captures the relationship between deposits and output can be expressed as:

$$\beta_1 = \frac{dQ_i^*}{dx_i} = \frac{\partial Q_i^*}{\partial x_i} + \frac{\partial Q_i^*}{\partial p_i^*} \frac{\partial p_i^*}{\partial x_i} = \alpha_1 + \varepsilon^s \left(\frac{\alpha_1 - \gamma_1}{\varepsilon^d - \varepsilon^s} \right)$$

In other words, the effect of a change in deposits on the equilibrium quantity of credit is determined by the magnitude of the shift in supply curve (α_1 or the marginal propensity to lend) and the magnitude of the movement along the supply curve ($\frac{\alpha_1 - \gamma_1}{\varepsilon^d - \varepsilon^s} < 0$). I assume that $\alpha_1 - \gamma_1 > 0$, that is, conditional on market covariates, deposits are a larger shifter of credit supply than of credit demand. I then consider the effect of financial integration on the equilibrium relationship between deposits and output.

In the theoretical model presented above, the effect of financial integration is to flatten the supply curve of credit ($\Delta \varepsilon^s > 0$). It can be shown that $\frac{d\beta_1}{d\varepsilon^s} < 0$, so that financial integration lowers the equilibrium association between deposits and output. The effect of financial integration on the relationship between integration and output is thus exactly identified under the assumption that the other structural parameters do not change. This may not be a reasonable assumption¹. It is likely that the marginal propensity to lend also falls after integration ($\Delta \alpha_1 > 0$), which implies that, post deregulation, $\frac{-d\beta_1}{d\alpha_1} < 0$. As a result, an increase in supply elasticity and a decrease in the marginal propensity to lend cannot be distinguished by an observed fall in the reduced form coefficient (β_1). Both changes, however, are consistent with the argument that local credit supply matters less after integration. I estimate the reduced-form coefficient using growth rates in order to better deal with trends. The comparative statics of the reduced form coefficients can thus be rationalized by a structural model of credit market equilibrium.

Cross Market Effects

I next consider a model that captures the cross-market effects of financial integration. Rather than modelling deregulation through comparative statics with respect to the underlying parameters, I model deregulation as a change in the underlying equilibrium. The pre-deregulation equilibrium is defined as above. After deregulation, a statistical analogue of the credit market equilibrium between two integrated markets is defined as:

¹I will assume that the effect of integration on demand-side parameters is small, or small relative to changes in the supply-side parameters ($\Delta \varepsilon^d \approx 0, \Delta \gamma_1 \approx 0$).

$$\begin{aligned}
Q^d &= Q^{d1} + Q^{d2} \\
Q^s &= Q^{s1} + Q^{s2} \\
Q^d(p^*) &= Q^s(p^*) = Q^*(p^*)
\end{aligned}$$

The reduced form of this model for market 1 is given by:

$$Q_i^{*d1} = \beta_0^{post} + \beta_1^{post} x_i^1 + \beta_2^{post} z_i^1 + \beta_3^{post} x_i^2 + \beta_4^{post} z_i^2 + v_i$$

where x_i^1 is the quantity of deposits in market 1, z_i^1 is a demand/supply shifter in market 1 such as income, and the variables are defined analogously for market 2. The coefficients in this equation, which are functions of the underlying structural parameters, are identified under the same assumptions as the single market case. The coefficient β_1^{post} , which captures the relationship between deposits and output can be expressed as:

$$\beta_1^{post} = \frac{dQ_i^{*d1}}{dx_i^1} = \frac{\partial Q_i^{*d1}}{\partial x_i^1} + \frac{\partial Q_i^{*d1}}{\partial p_i^*} \frac{\partial p_i^*}{\partial x_i^1} = \gamma_1^1 + \varepsilon^{d1} \left(\frac{\alpha_1^1 - \gamma_1^1}{(\varepsilon^{d1} + \varepsilon^{d2}) - (\varepsilon^{s1} + \varepsilon^{s2})} \right)$$

The analogous expression for the pre-deregulation equilibrium is given by:

$$\beta_1^{pre} = \frac{dQ_i^{*d1}}{dx_i^1} = \frac{\partial Q_i^{*d1}}{\partial x_i^1} + \frac{\partial Q_i^{*d1}}{\partial p_i^*} \frac{\partial p_i^*}{\partial x_i^1} = \gamma_1^1 + \varepsilon^{d1} \left(\frac{\alpha_1^1 - \gamma_1^1}{(\varepsilon^{d1} - \varepsilon^{s1})} \right)$$

By inspection, it follows that $\beta_1^{post} < \beta_1^{pre}$, that is, the reduced form correlation between deposits and output is lower after deregulation. The cross-market effects are given by β_3^{post} and β_4^{post} .

$$\begin{aligned}
\beta_3^{post} &= \frac{dQ_i^{*d1}}{dx_i^2} = \varepsilon^{d1} \left(\frac{\alpha_1^2 - \gamma_1^2}{(\varepsilon^{d1} + \varepsilon^{d2}) - (\varepsilon^{s1} + \varepsilon^{s2})} \right) = (+) \\
\beta_4^{post} &= \frac{dQ_i^{*d1}}{dz_i^2} = \varepsilon^{d1} \left(\frac{\alpha_2^2 - \gamma_2^2}{(\varepsilon^{d1} + \varepsilon^{d2}) - (\varepsilon^{s1} + \varepsilon^{s2})} \right) = (-)
\end{aligned}$$

I assume that deposits are, conditional on other covariates, more important to credit supply than credit demand ($\alpha_1^2 - \gamma_1^2 > 0$) and that income is, conditional on other covariates, more important to credit demand than credit supply ($\alpha_2^2 - \gamma_2^2 < 0$). I assume that $\beta_3^{pre} \approx \beta_4^{pre} \approx 0$ so the sign of the *post* coefficients determine the sign of the marginal effects. In other words, a shift in outside market credit supply raises output in the home market ($\beta_3^{post} > 0$) and a shift in outside market credit demand in the home market lowers output in the home market ($\beta_4^{post} < 0$). I again estimate the reduced form of this equation using growth rates in order to better account for trends. The change in the reduced form coefficients as a result of deregulation can thus be rationalized by a structural model of pre and post-deregulation credit market equilibrium.

8.3 Instrumental Variables Estimation

As another interpretive strategy, I estimate the effect of financial integration on the relationship between credit supply and firm growth using within and across-state deregulation to instrument for within and across-state integration. I first use OLS to estimate equations of the form:

$$y_{mst} = \alpha_m + \alpha_t + \alpha_s t + \beta_1 x_{mst} + \beta_2 i_{mst} + \beta_3 x_{mst} \cdot i_{mst} + \beta_4 \mathbf{z}_{mst} + \epsilon_{mst} \quad (8.1)$$

I regress measures of firm growth (y_{mst}) on the growth rate of bank deposits (x_{mst}), a measure of financial integration (i_{mst}), the interaction between deposit growth and financial integration ($x_{mst} \cdot i_{mst}$), and a vector of market and state level covariates ($\mathbf{z}_{mst}$). I then re-estimate the effect of integration on growth using IV. I use an indicator variable and a linear time trend for post-deregulation years to instrument for financial integration and the interaction between deposit growth and financial integration. My model predicts that $\beta_3 < 0$. As the level of financial integration increases, the growth rate of local credit supply should have a smaller effect on firm growth. To the extent that the OLS regressions contain omitted variables that are positively correlated with deposit growth and financial integration and have a positive impact on firm growth, the OLS estimates of β_3 should be biased upward. Since the within and across-state branching deregulations are correlated with one another in time, I expect the IV regressions to do a poorer job in distinguishing the effect of one from the other compared to the difference-in-differences regressions, where the effects are jointly estimated. The IV estimates rescale the estimates from the difference-in-differences regressions when the effect of only one set of deregulations is estimated.

When the dependent variable is the growth rate of establishments, the IV results are largely consistent with the prediction that an increase in financial integration lowers the dependence of smaller, potentially credit-constrained firms on local credit supply. Table A3 reports the OLS and IV results for MSA and non-MSA markets using the Market/State measure of within-state financial integration. The first stages for the IV regressions are reported in Column 2 of Table A1 and Column 5 of Table A2. The IV regressions provide evidence that, for establishments with 20-99 employees in MSA markets, the increase in financial integration due to within-state deregulation lowers the dependence of growth on local credit supply. To interpret this coefficient, I consider the effect of an increase in within-state integration of .5, which constitutes the difference between an MSA market in 1992 at the 25th percentile of the integration distribution and one at the 75th percentile. This change in integration is associated with a decrease in the marginal effect of deposit growth on firm growth of about .13. This estimate is consistent with the effect of .097 found in the differences-in-differences framework. As predicted, the OLS estimates for the interaction between deposit growth and integration are smaller in absolute value than the IV estimates. The IV regressions also show that within-state financial integration lowers the dependence of firm growth on credit supply in non-MSA markets for firms with 20-99 employees. It is possible that these regressions are picking up the effect of across-state deregulation identified in the difference-in-differences framework.

The results for the effects of across-state integration on firm growth also suggest that integration lowers the reliance of small firms on local credit supply. Table A4 reports the OLS and IV results for MSA and non-MSA markets using the State/U.S. measure of across-state financial integration. For the IV regressions, the interaction between deposit growth and integration is statistically significant with the predicted sign for establishments with 1 to 19 employees and 20 to 99 employees in MSA markets, and for establishments with 20 to 99 employees in non-MSA markets. For establishments of 20 to 99 employees in non-MSA markets, I again consider the effect of an increase in across-state integration of .5, which is approximately the difference between a non-MSA market at the 25th percentile of the integration distribution and one at the 75th percentile in 1992. This change in integration is associated with a decrease in the marginal effect of deposit growth on firm growth of about .15. This estimate is consistent with the effect of .11 found for this establishment size in non-MSA markets in the difference-in-differences framework.

The IV results for across-state integration in MSA markets are not consistent with the difference-in-difference results, where no effects were found for across-state deregulation. It is possible that the effect found for establishments with 20 to 99 employees in MSA markets for the IV regressions is due to the correlation in time between across-state and within-state deregulations. The IV results imply that across-state financial integration reduces the reliance on local credit supply for firms with 1 to 19 employees and 20 to 99 employees in MSA markets.

The OLS and IV estimates using the growth rate of employment and payroll as dependent variables are also consistent with the model's predictions for the effects of financial integration on the sensitivity of firm growth to local credit supply. Table A5 reports the OLS and IV results for the effects of within-state integration. The IV estimates for the interaction between the Market/State integration measure and the growth rate of deposits are negative and statistically significant for both MSA and non-MSA markets. Table A5 also reports the OLS and IV results for the effects of across-state integration. The IV estimates for the interaction between the State/U.S. integration measure and the growth rate of deposits are also negative and statistically significant for both MSA and non-MSA markets. For both within and across-state integration, the IV estimates are, as predicted, larger in absolute value than the OLS estimates. For both within and across-state integration, however, the results for non-MSA markets are not consistent with the difference-in-difference estimates, which show no effect for within or across-state deregulation. As stated above, it is likely that the IV regressions are unable to distinguish the effect of within and across-state deregulation.

8.4 Tables and Figures

Table 1
Deregulation of Bank Branching by State

State	Year of Deregulation		State	Year of Deregulation	
	Inter State	Intra State		Inter State	Intra State
Maine	1978	1975	Pennsylvania	1986	1982
Alaska	1982	<1970	South Carolina	1986	<1970
New York	1982	1976	Alabama	1987	1981
Connecticut	1983	1980*	California	1987	<1970
Massachusetts	1983	1984	Louisiana	1987	1988
Kentucky	1984	1990	New Hampshire	1987	1987
Rhode Island	1984	<1970	Oklahoma	1987	1988*
Utah	1984	1981	Texas	1987	1988*
Washington, DC	1985	<1970	Washington	1987	1985
Florida	1985	1988*	Wisconsin	1987	1990*
Georgia	1985	1983	Wyoming	1987	1988*
Idaho	1985	<1970	Colorado	1988	1991*
Maryland	1985	<1970	Delaware	1988	<1970
Nevada	1985	<1970	Mississippi	1988	1986
North Carolina	1985	<1970	South Dakota	1988	<1970
Ohio	1985	1979	Vermont	1988	1970
Tennessee	1985	1985	West Virginia	1988	1987*
Virginia	1985	1978	Arkansas	1989	1994*
Arizona	1986	<1970	New Mexico	1989	1991*
Illinois	1986	1988*	Nebraska	1990	1985*
Indiana	1986	1989	Iowa	1991	2001
Michigan	1986	1987	North Dakota	1991	1987*
Minnesota	1986	1993*	Kansas	1992	1987*
Missouri	1986	1990*	Montana	1993	1990*
New Jersey	1986	1977	Hawaii	1994	1986*
Oregon	1986	1985			

* Indicates unit branching state

Table 2
Banking Market Characteristics

	Average Market Characteristics					Bank Integration			BHC Integration		
	Pop	3-Firm	Herf	Banks	Markets	Mkt/St	Multi	St/US	Mkt/St	Multi	St/US
MSA											
1977	466,967	0.69 (0.17)	0.22 (0.11)	18.9 (28.2)	362	0.32 (0.40)	0.33 (0.39)	0.00 (0.02)	0.61 (0.38)	0.54 (0.35)	0.10 (0.25)
1982	493,581	0.67 (0.16)	0.21 (0.10)	18.9 (27.6)	362	0.41 (0.41)	0.38 (0.40)	0.00 (0.01)	0.66 (0.37)	0.61 (0.35)	0.12 (0.26)
1987	493,581	0.69 (0.15)	0.22 (0.10)	18.9 (25.5)	362	0.50 (0.41)	0.48 (0.38)	0.00 (0.01)	0.78 (0.26)	0.74 (0.25)	0.34 (0.31)
1992	556,030	0.70 (0.15)	0.22 (0.10)	18.0 (21.8)	362	0.66 (0.34)	0.62 (0.31)	0.00 (0.04)	0.81 (0.22)	0.78 (0.21)	0.55 (0.30)
1997	592,037	0.69 (0.13)	0.21 (0.10)	17.0 (18.0)	363	0.79 (0.24)	0.77 (0.22)	0.41 (0.34)	0.83 (0.21)	0.83 (0.18)	0.56 (0.28)
Non-MSA											
1977	20,720	0.90 (0.14)	0.45 (0.25)	4.0 (2.9)	2,256	0.23 (0.38)	0.21 (0.36)	0.00 (0.00)	0.36 (0.44)	0.28 (0.38)	0.06 (0.21)
1982	21,529	0.90 (0.14)	0.44 (0.24)	4.1 (2.8)	2,265	0.26 (0.40)	0.24 (0.38)	0.00 (0.00)	0.43 (0.45)	0.34 (0.39)	0.07 (0.22)
1987	24,189	0.90 (0.14)	0.44 (0.24)	4.0 (2.8)	2,272	0.34 (0.42)	0.31 (0.39)	0.00 (0.01)	0.57 (0.42)	0.48 (0.39)	0.14 (0.27)
1992	22,311	0.90 (0.13)	0.43 (0.23)	4.1 (2.7)	2,262	0.51 (0.40)	0.44 (0.38)	0.00 (0.01)	0.67 (0.37)	0.59 (0.36)	0.26 (0.35)
1997	23,565	0.89 (0.13)	0.42 (0.23)	4.3 (2.67)	2,262	0.68 (0.35)	0.60 (0.36)	0.19 (0.33)	0.77 (0.30)	0.70 (0.32)	0.35 (0.36)

Notes: Each column represents the market average for a given year with standard deviations in parentheses. "3 firm" is the fraction of deposits in a market held by the largest three banks or bank holding companies. "Herf" is the market Herfindahl index for deposits computed at the bank holding company level. "Banks" is the number of banks and bank holding companies. "Mkt/St" is one minus the total deposits in the market divided by the total deposits held by market banks or bank holding companies in the state. "Multi" is the fraction of deposits in the market held by multi-market banks or bank holding companies. "St/US" is one minus the total deposits held by market banks or bank holding companies in the state divided by their total deposits in the United States.

Table 3
Growth Rate of Establishments Post Inter & Intra State Branching Deregulation

	Dependent Variable - Growth Rate of Establishments Across Employee Size					
	Treatment - Inter and Intra State Deregulation					
	State Time Trends			State/Year Indicators		
	1-19 Emp (1)	20-99 Emp (2)	100+ Emp (3)	1-19 Emp (4)	20-99 Emp (5)	100+ Emp (6)
MSA						
Gr Bdeps	0.0327*** (0.0117)	0.0393* (0.0208)	0.0575 (0.0480)	0.0193** (0.0090)	0.0080 (0.0286)	0.0232 (0.0490)
Gr Bdeps*Intra	-0.0005 (0.0179)	0.0810*** (0.0302)	-0.0192 (0.0766)	0.0065 (0.0174)	0.1329*** (0.0449)	-0.0218 (0.0682)
Gr Bdeps*Intra*Post	-0.0076 (0.0183)	-0.0967*** (0.0307)	-0.0113 (0.0706)	-0.0048 (0.0182)	-0.1161** (0.0517)	0.0267 (0.0812)
Intra*Post	0.0031 (0.0020)	0.0085 (0.0054)	0.0068 (0.0057)			
Gr Bdeps*Inter*Post	-0.0059 (0.0108)	-0.0168 (0.0272)	-0.0472 (0.0369)	-0.0051 (0.0110)	-0.0149 (0.0391)	-0.0450 (0.0612)
Inter*Post	0.0023 (0.0018)	-0.0025 (0.0038)	0.0029 (0.0064)			
N	6,995	7,025	7,027	6,995	6,995	7,027
R-sq	0.81	0.34	0.21	0.87	0.49	0.34

Notes: The table presents an OLS regression of the growth rate of establishments by employment size in MSA markets on the growth rate of market deposits interacted with indicator variables for deregulating states and post-deregulation years. Coefficients for market level covariates --growth rates of personal income and population, bank market Herfindahl, 3-firm bank concentration ratio--and state level covariates--unemployment rate, population growth rate, GDP growth rate--are not included. Deposit level data are from the Federal Reserve's Summary of Deposits, county business data are from the County Business Patterns, and market and state level covariates are from the Bureau of Economic Analysis. All regressions contain market level fixed effects and are clustered at the state level.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4
Growth Rate of Establishments Post Inter & Intra State Branching Deregulation

	Dependent Variable - Growth Rate of Establishments Across Employee Size					
	Treatment - Inter and Intra State Deregulation					
	State Time Trends			State/Year Indicators		
	1-19 Emp (1)	20-99 Emp (2)	100+ Emp (3)	1-19 Emp (4)	20-99 Emp (5)	100+ Emp (6)
NonMSA						
Gr Bdeps	0.0349*** (0.0098)	0.1381*** (0.0493)	0.0436 (0.0484)	0.0328*** (0.0113)	0.1034** (0.0403)	0.0107 (0.0580)
Gr Bdeps*Intra	0.0168 (0.0138)	-0.0003 (0.0571)	0.0461 (0.0548)	0.0138 (0.0149)	0.0199 (0.0471)	0.0852 (0.0723)
Gr Bdeps*Intra*Post	-0.0120 (0.0139)	0.0043 (0.0471)	-0.0516 (0.0608)	-0.0096 (0.0149)	-0.0176 (0.0471)	-0.0666 (0.0807)
Intra*Post	0.0018 (0.0018)	0.0054 (0.0059)	0.0059 (0.0059)			
Gr Bdeps*Inter*Post	-0.0095 (0.0122)	-0.1090*** (0.0384)	-0.0533 (0.0589)	-0.0088 (0.0113)	-0.0814** (0.0373)	-0.0290 (0.0636)
Inter*Post	0.0024 (0.0016)	0.0105 (0.0064)	0.0005 (0.0057)			
N	41,091	41,045	40,902	41,091	41,045	40,902
R-sq	0.41	0.06	0.05	0.44	0.09	0.07

Notes: The table presents an OLS regression of the growth rate of establishments by employment size in nonMSA markets on the growth rate of market deposits interacted with indicator variables for deregulating states and post-deregulation years. Coefficients for market level covariates --growth rates of personal income and population, bank market Herfindahl, 3-firm bank concentration ratio--and state level covariates--unemployment rate, population growth rate, GDP growth rate--are not included. Deposit level data are from the Federal Reserve's Summary of Deposits, county business data are from the County Business Patterns, and market and state level covariates are from the Bureau of Economic Analysis. All regressions contain market level fixed effects and are clustered at the state level.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5
Growth Rate of Employment & Payroll Post Inter & Intra State Branching Deregulation

	Dependent Variable - Growth Rate of Employment and Payroll							
	Treatment - Inter and Intra State Deregulation							
	State Time Trends		State/Year Indicators		State Time Trends		State/Year Indicators	
	Empl (1)	Payroll (2)	Empl (3)	Payroll (4)	Empl (1)	Payroll (2)	Empl (3)	Payroll (4)
MSA/NonMSA								
Gr Bdeps	0.0447*** (0.0132)	0.0071 (0.0196)	0.0326** (0.0132)	-0.0030 (0.0201)	0.0417** (0.0201)	0.0839*** (0.0234)	0.0314 (0.0204)	0.0732*** (0.0189)
Gr Bdeps*Intra	0.0561** (0.0235)	0.0989*** (0.0282)	0.0512** (0.0202)	0.0937*** (0.0315)	0.0260 (0.0248)	0.0369 (0.0299)	0.0131 (0.0247)	0.0148 (0.0267)
Gr Bdeps*Intra*Post	-0.0639** (0.0262)	-0.0515* (0.0283)	-0.0552** (0.0263)	-0.0444 (0.0366)	-0.0177 (0.0222)	-0.0367 (0.0275)	-0.0116 (0.0203)	-0.0355 (0.0288)
Intra*Post	0.0061 (0.0040)	0.0013 (0.0044)			0.0038 (0.0032)	0.0015 (0.0031)		
Gr Bdeps*Inter*Post	-0.0343** (0.0144)	-0.0388* (0.0201)	-0.0278 (0.0190)	-0.0276 (0.0245)	-0.0119 (0.0173)	-0.0377* (0.0194)	0.0014 (0.0164)	-0.0195 (0.0197)
Inter*Post	-0.0005 (0.0030)	0.0000 (0.0031)			0.0007 (0.0032)	0.0063 (0.0038)		
N	7,021	7,017	7,021	7,017	41,073	41,070	41,073	41,070
R-sq	0.56	0.59	0.65	0.68	0.19	0.22	0.23	0.26

Notes: The table presents an OLS regression of the growth rate of establishments by employment size in MSA and non-MSA markets on the growth rate of market level deposits interacted with dummy variables for post-regulation years. Coefficients for market level covariates--growth rates of personal income and population, bank market Herfindahl, 3-firm bank concentration ratio--and state level covariates--unemployment rate, population growth rate, GDP growth rate--are not included. Deposit level data are from the Federal Reserve's Summary of Deposits, county business data are from the County Business Patterns, and market and state level covariates are from the Bureau of Economic Analysis.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6
Growth Rate of Establishments Post Inter & Intra State Branching Deregulation

	Dependent Variable - Growth Rate of Establishments Across Employee Size					
	Treatment - Inter and Intra State Deregulation					
	MSA			NonMSA		
	1-19 Emp (1)	20-99 Emp (2)	100+ Emp (3)	1-19 Emp (4)	20-99 Emp (5)	100+ Emp (6)
Gr BdepsOther	-0.0052 (0.0097)	0.0059 (0.0156)	-0.0104 (0.0453)	-0.0122** (0.0051)	-0.0318 (0.0290)	0.0476*** (0.0164)
Gr BdepsOther*Intra	-0.0789*** (0.0274)	-0.1279*** (0.0458)	-0.0514 (0.0834)	-0.0731** (0.0282)	-0.0529 (0.0606)	-0.2667*** (0.0688)
Gr BdepsOther*Intra*Post	0.1014*** (0.0280)	0.1027* (0.0545)	-0.041 (0.0791)	0.0535* (0.0285)	0.1071 (0.0700)	0.2020** (0.0960)
GrEstabOther	0.1058*** (0.0392)	0.1401** (0.0614)	0.1195* (0.0674)	0.0401 (0.0466)	-0.0219 (0.1207)	0.0743 (0.0592)
GrEstabOther*Intra	-0.0233 (0.0350)	-0.0584 (0.0613)	-0.0874 (0.0727)	0.0345 (0.0436)	0.0716 (0.1175)	0.0547 (0.0621)
GrEstabOther*Intra*Post	-0.1027** (0.0425)	-0.1839*** (0.0632)	0.0162 (0.0742)	-0.0426 (0.0371)	-0.3637*** (0.1190)	-0.1825** (0.0786)
N	6,919	6,949	6,951	41,091	41,045	40,902
R-sq	0.81	0.35	0.21	0.41	0.07	0.05

Notes: The table presents an OLS regression of the growth rate of establishments by employment size in MSA markets on the growth rate of market deposits, the average growth rate of market deposits in other MSA markets in the state, and the average growth rate of establishments in other MSA markets in the state, each interacted with indicator variables for deregulating states and post-deregulation years. Coefficients for market level covariates --growth rates of personal income and population, bank market Herfindahl, 3-firm bank concentration ratio--and state level covariates--unemployment rate, population growth rate, GDP growth rate--are not included. Deposit level data are from the Federal Reserve's Summary of Deposits, county business data are from the County Business Patterns, and market and state level covariates are from the Bureau of Economic Analysis. All regressions contain market level fixed effects and are clustered at the state level.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7
Growth Rate of Employment & Payroll Post Inter & Intra State Branching Deregulation

	Dependent Variable - Growth Rate of Employment and Payroll			
	Treatment - Inter and Intra State Deregulation			
	MSA		NonMSA	
	Empl (1)	Payroll (2)	Empl (3)	Payroll (4)
Gr BdepsOther	-0.0025 (0.0074)	0.0087 (0.0153)	0.0033 (0.0078)	0.0243*** (0.0085)
Gr BdepsOther*Intra	-0.0336 (0.0230)	-0.0461 (0.0414)	-0.0484* (0.0284)	-0.0960*** (0.0340)
Gr BdepsOther*Intra*Post	0.0431* (0.0256)	0.0166 (0.0370)	0.0315 (0.0358)	0.0917* (0.0465)
Gr (Empl/Pay)Other	0.1137** (0.0491)	0.0223 (0.0707)	0.0391 (0.0541)	0.0406 (0.0681)
Gr (Empl/Pay)Other*Intra	-0.0908* (0.0469)	-0.006 (0.0640)	-0.0107 (0.0523)	-0.0107 (0.0670)
Gr (Empl/Pay)Other*Intra*Post	-0.1050** (0.0518)	-0.0225 (0.0672)	-0.1182* (0.0588)	-0.0837 (0.0651)
N	6,945	6,941	41,073	41,070
R-sq	0.56	0.59	0.19	0.22

Notes: The table presents an OLS regression of the growth rate of employment and payroll in MSA markets on the growth rate of market level deposits, the average growth rate of deposits in other MSA markets in the state, and the average growth rate of employment and payroll in other MSA markets in the state, each interacted with indicator variables for deregulating states and post-deregulation years. Coefficients for market level covariates--growth rates of personal income and population, bank market Herfindahl, 3-firm bank concentration ratio--and state level covariates--unemployment rate, population growth rate, GDP growth rate--are not included. Deposit level data are from the Federal Reserve's Summary of Deposits, county business data are from the County Business Patterns, and market and state level covariates are from the Bureau of Economic Analysis.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table A1
Change in Market/State Deposit Ratio Post Intra-State Branching Deregulation

	Dependent Variable - Market/State Ratio					
	Treatment - Intra State Deregulation					
	Banks			BHCs		
	(1)	(2)	(3)	(4)	(5)	(6)
MSA						
Intra*Post	0.1892*** (0.0588)	0.1658*** (0.0562)	0.1823*** (0.0552)	0.0083 (0.0152)	0.0014 (0.0163)	0.0053 (0.0162)
Intra*Post*Time	0.0336* (0.0184)	0.0291 (0.0248)	0.026 (0.0235)	-0.0134** (0.0058)	-0.0172** (0.0078)	-0.0138* (0.0071)
R-sq	0.87	0.87	0.88	0.90	0.90	0.90
N	7,581	7,200	7,560	7,581	7,200	7,560
NonMSA						
Intra*Post	0.1227*** (0.0212)	0.0982*** (0.0170)	0.1050*** (0.0203)	0.0435** (0.0197)	0.0374* (0.0193)	0.0402** (0.0192)
Intra*Post*Time	0.0175*** (0.0051)	0.0427*** (0.0081)	0.0373*** (0.0076)	0.0172*** (0.0063)	0.0145* (0.0073)	0.0138* (0.0072)
R-sq	0.80	0.83	0.84	0.80	0.80	0.81
N	47,488	44,544	46,800	47,488	44,544	46,800
Covar	None	Growth	Level	None	Growth	Level

Notes: The table presents an OLS regression of the market/state deposit ratio on market indicators, year indicators, state time trends, indicators and linear trends for post-deregulation years, and state and market level covariates. The market/state deposit ratio represents one minus the total amount of deposits in a market divided by the total deposits held by banks or bank holding companies in that market anywhere in the state. The second and third column contain market and state level covariates in growth rates and levels, respectively. All regressions are clustered at the state level. Deposit level data are from the Federal Reserve's Summary of Deposits.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table A2
Change in State/U.S. Deposit Ratio Post Inter-State Branching Deregulation

	Dependent Variable - State/U.S. Ratio					
	Treatment - Inter State Deregulation					
	Banks			BHCs		
	(1)	(2)	(3)	(4)	(5)	(6)
MSA						
Inter*Post	-0.0151 (0.0093)	-0.0064 (0.0092)	-0.0034 (0.0095)	0.1428*** (0.0361)	0.1289*** (0.0363)	0.1192*** (0.0358)
Inter*Post*Time	-0.0128 (0.0091)	-0.0140 (0.0105)	-0.0096 (0.0085)	0.0794*** (0.0201)	0.0795*** (0.0213)	0.0771*** (0.0189)
R-sq	0.62	0.63	0.62	0.74	0.85	0.85
N	7,581	7,200	7,560	7,581	7,200	7,560
NonMSA						
Inter*Post	-0.0191*** (0.0063)	-0.0147** (0.0061)	-0.0151** (0.0066)	0.0666*** (0.0167)	0.0646*** (0.0156)	0.0585*** (0.0150)
Inter*Post*Time	-0.0136*** (0.0048)	-0.0153** (0.0059)	-0.0130** (0.0054)	0.0500*** (0.0105)	0.0508*** (0.0105)	0.0441*** (0.0089)
R-sq	0.35	0.35	0.35	0.37	0.70	0.71
N	47,488	44,544	46,800	47,488	44,544	46,800
Covar	None	Growth	Level	None	Growth	Level

Notes: The table presents an OLS regression of the State/U.S. deposit ratio on market indicators, year indicators, state time trends, indicators and linear time trends for post-deregulation years, and state and market level covariates. The State/U.S. deposit ratio represents one minus the total amount of deposits in the state held by banks or bank holding companies in that market, divided by the total deposits held in the United States by these entities. The second and third column contain market and state level covariates in growth rates and levels, respectively. All regressions are clustered at the state level. Deposit level data are from the Federal Reserve's Summary of Deposits.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table A3
Change in Growth Rate of Establishments and Within-State Financial Integration

	Dependent Variable - Growth Rate of Establishments Across Employee Size					
	Market/State Integration Measure					
	OLS Regression			IV Regression		
	1-19 Emp (1)	20-99 Emp (2)	100+ Emp (3)	1-19 Emp (4)	20-99 Emp (5)	100+ Emp (6)
MSA						
Gr Bdeps	0.0341*** (0.0116)	0.0621* (0.0314)	0.0818** (0.0367)	0.0485 (0.0343)	0.2071*** (0.0797)	0.1135 (0.1471)
Integration	0.0054** (0.0025)	0.0014 (0.0069)	0.0000 (0.0073)	0.0123 (0.0096)	-0.0146 (0.0292)	0.0120 (0.0266)
Gr Bdeps*Integration	-0.0154 (0.0166)	-0.0423 (0.0381)	-0.1225** (0.0602)	-0.0384 (0.0527)	-0.2711** (0.1121)	-0.1728 (0.2161)
N	6,995	7,025	7,027	6,995	7,025	7,027
R-sq	0.81	0.34	0.21			
NonMSA						
Gr Bdeps	0.0524*** (0.0051)	0.0974*** (0.0221)	0.0320 (0.0326)	0.0628*** (0.0217)	0.2411*** (0.0909)	0.1317 (0.0966)
Integration	0.0022* (0.0012)	-0.0028 (0.0047)	0.0008 (0.0067)	-0.0043 (0.0139)	0.0355 (0.0303)	-0.0031 (0.0371)
GrBdeps*Integration	-0.0321*** (0.0086)	-0.0426 (0.0357)	-0.0136 (0.0584)	-0.0542 (0.0448)	-0.3573** (0.1654)	-0.2297 (0.1942)
N	41,091	41,045	40,902	41,089	41,044	40,899
R-sq	0.41	0.06	0.05			

Notes: The table presents OLS and IV regressions of the growth rate of establishments by employment size in MSA and nonMSA markets on the growth rate of market level deposits, the Market/State measure of within-state financial integration, the interaction of deposit growth and integration, and market and state level covariates. The IV regressions use an indicator variable and linear time trend for years after intra-state deregulation to instrument for the measure of within-state financial integration. Coefficients for market level covariates --growth rates of personal income and population, bank market Herfindahl, 3-firm bank concentration ratio--and state level covariates--unemployment rate, population growth rate, GDP growth rate--are not included. Deposit level data are from the Federal Reserve's Summary of Deposits, county business data are from the County Business Patterns, and market and state level covariates are from the Bureau of Economic Analysis.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table A4
Change in Growth Rate of Establishments and Across-State Financial Integration

	Dependent Variable - Growth Rate of Establishments Across Employee Size					
	State/U.S. Integration Measure					
	OLS Regression			IV Regression		
	1-19 Emp (1)	20-99 Emp (2)	100+ Emp (3)	1-19 Emp (4)	20-99 Emp (5)	100+ Emp (6)
MSA						
Gr Bdeps	0.0345*** (0.0073)	0.0836*** (0.0256)	0.0362 (0.0363)	0.0486*** (0.0128)	0.1203*** (0.0332)	0.1012* (0.0613)
Integration	0.0021 (0.0024)	0.0031 (0.0058)	-0.0073 (0.0086)	0.0123 (0.0104)	-0.0321 (0.0308)	-0.0334 (0.0315)
Gr Bdeps*Integration	-0.0240 (0.0148)	-0.1136*** (0.0402)	-0.0740 (0.0587)	-0.0584** (0.0282)	-0.1952*** (0.0607)	-0.2231* (0.1183)
N	6,995	7,025	7,027	6,995	7,025	7,027
R-sq	0.81	0.34	0.21			
NonMSA						
Gr Bdeps	0.0480*** (0.0055)	0.0920*** (0.0193)	0.0203 (0.0271)	0.0501*** (0.0084)	0.1487*** (0.0300)	0.0862** (0.0398)
Integration	0.0022* (0.0011)	-0.0050 (0.0044)	-0.0085 (0.0070)	-0.0395* (0.0228)	-0.0811* (0.0489)	-0.0757 (0.0502)
GrBdeps*Integration	-0.0487*** (0.0109)	-0.0649 (0.0470)	0.0282 (0.0703)	-0.0476 (0.0357)	-0.3090*** (0.1183)	-0.2626* (0.1356)
N	41,091	41,045	40,902	41,089	41,044	40,899
R-sq	0.41	0.06	0.05			

Notes: The table presents OLS and IV regressions of the growth rate of establishments by employment size in MSA and nonMSA markets on the growth rate of market level deposits, the State/U.S. measure of across-state financial integration, the interaction of deposit growth and integration, and market and state level covariates. The IV regressions use an indicator variable and linear time trend for years after inter-state deregulation to instrument for the measure of across-state financial integration. Coefficients for market level covariates --growth rates of personal income and population, bank market Herfindahl, 3-firm bank concentration ratio--and state level covariates--unemployment rate, population growth rate, GDP growth rate--are not included. Deposit level data are from the Federal Reserve's Summary of Deposits, county business data are from the County Business Patterns, and market and state level covariates are from the Bureau of Economic Analysis.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table A5
Change in Growth Rate of Employment/Payroll and Within-State Financial Integration

	Dependent Variables - Growth Rate of Employment and Payroll							
	Market/State Integration Measure				State/U.S. Integration Measure			
	OLS Regression		IV Regression		OLS Regression		IV Regression	
	Empl (1)	Payroll (2)	Empl (3)	Payroll (4)	Empl (1)	Payroll (2)	Empl (3)	Payroll (4)
MSA								
Gr Bdeps	0.0959*** (0.0173)	0.1013*** (0.0206)	0.1618*** (0.0452)	0.1256*** (0.0403)	0.0639*** (0.0159)	0.0725*** (0.0178)	0.1095*** (0.0243)	0.1037*** (0.0234)
Integration	0.0055 (0.0057)	0.0080 (0.0064)	0.0002 (0.0179)	0.0026 (0.0213)	0.0004 (0.0045)	0.0034 (0.0050)	-0.0307 (0.0190)	-0.0138 (0.0159)
Gr Bdeps*Integration	-0.1076*** (0.0245)	-0.1196*** (0.0276)	-0.2115*** (0.0642)	-0.1579*** (0.0601)	-0.0850*** (0.0300)	-0.1104*** (0.0291)	-0.1878*** (0.0502)	-0.1814*** (0.0510)
N	7,021	7,017	7,021	7,017	7,021	7,017	7,021	7,017
R-sq	0.56	0.59			0.56	0.59		
NonMSA								
Gr Bdeps	0.0687*** (0.0105)	0.0951*** (0.0154)	0.0985*** (0.0244)	0.1651*** (0.0339)	0.0592*** (0.0088)	0.0909*** (0.0108)	0.0776*** (0.0108)	0.1237*** (0.0158)
Integration	0.0024 (0.0021)	0.0041 (0.0029)	0.0040 (0.0257)	0.0259 (0.0311)	-0.0022 (0.0018)	-0.0001 (0.0030)	-0.0555* (0.0288)	-0.0437 (0.0377)
GrBdeps*Integration	-0.0457*** (0.0151)	-0.0426** (0.0211)	-0.1108** (0.0473)	-0.1966*** (0.0578)	-0.0528** (0.0207)	-0.0716*** (0.0189)	-0.1251*** (0.0405)	-0.2131*** (0.0481)
N	41,073	41,070	41,071	41,067	41,073	41,070	41,071	41,067
R-sq	0.19	0.22			0.19	0.22		

Notes: The table presents OLS and IV regressions of the growth rate of employment and payroll in MSA and nonMSA markets, respectively, on the growth rate of market level deposits, the Market/State and State/US measures of within-state financial integration, the interaction of deposit growth and integration, and market and state level covariates. The IV regressions use an indicator variable and linear time trend for years after intra-state deregulation to instrument for the measure of within-state financial integration. Coefficients for market level covariates --growth rates of personal income and population, bank market Herfindahl, 3-firm bank concentration ratio--and state level covariates--unemployment rate, population growth rate, GDP growth rate--are not included. Deposit level data are from the Federal Reserve's Summary of Deposits, county business data are from the County Business Patterns, and market and state level covariates are from the Bureau of Economic Analysis.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table A6
Growth Rate of Establishments Post Inter & Intra State Branching Deregulation

	Dependent Variable - Growth Rate of Establishments Across Employee Size					
	Treatment - Inter and Intra State Deregulation					
	MSA			NonMSA		
	1-19 Emp (1)	20-99 Emp (2)	100+ Emp (3)	1-19 Emp (4)	20-99 Emp (5)	100+ Emp (6)
Litigation States						
Gr Bdeps	0.0292* (0.0144)	0.0423 (0.0302)	0.049 (0.0563)	0.0335** (0.0130)	0.1525** (0.0602)	0.0349 (0.0612)
Gr Bdeps*Intra	0.0142 (0.0164)	0.0917*** (0.0276)	-0.002 (0.0972)	0.0409** (0.0170)	-0.0004 (0.0706)	0.1281* (0.0708)
Gr Bdeps*Intra*Post	-0.0074 (0.0189)	-0.1073*** (0.0330)	-0.0061 (0.1061)	-0.0342 (0.0215)	0.041 (0.0664)	-0.1456 (0.0970)
Intra*Post	0.0054* (0.0030)	0.0114 (0.0072)	-0.0083 (0.0095)	0.0015 (0.0032)	0.0085 (0.0085)	0.0049 (0.0069)
Gr Bdeps*Inter*Post	-0.0126 (0.0143)	-0.0259 (0.0443)	-0.027 (0.0587)	-0.0119 (0.0198)	-0.1458** (0.0608)	-0.0386 (0.0870)
Inter*Post	0.0039 (0.0031)	-0.0019 (0.0066)	-0.0061 (0.0111)	0.0036 (0.0024)	0.0138 (0.0141)	-0.0004 (0.0092)
N	3,449	3,472	3,473	19,335	19,393	19,231
R-sq	0.82	0.4	0.22	0.43	0.07	0.05

Notes: The table presents an OLS regression of the growth rate of establishments by employment size in MSA markets on the growth rate of market deposits interacted with indicator variables for deregulating states and post-deregulation years. Coefficients for market level covariates --growth rates of personal income and population, bank market Herfindahl, 3-firm bank concentration ratio--and state level covariates--unemployment rate, population growth rate, GDP growth rate--are not included. Deposit level data are from the Federal Reserve's Summary of Deposits, county business data are from the County Business Patterns, and market and state level covariates are from the Bureau of Economic Analysis. All regressions contain market level fixed effects and are clustered at the state level.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table A7
Growth Rate of Employment & Payroll Post Inter & Intra State Branching Deregulation

	Dependent Variable - Growth Rate of Employment and Payroll			
	Treatment - Inter and Intra State Deregulation			
	MSA		NonMSA	
	Empl (1)	Payroll (2)	Empl (3)	Payroll (4)
Litigation States				
Gr Bdeps	0.0368** (0.0161)	0.0015 (0.0237)	0.0446* (0.0223)	0.0649** (0.0242)
Gr Bdeps*Intra	0.0525* (0.0268)	0.1113*** (0.0345)	0.0617* (0.0307)	0.0751** (0.0274)
Gr Bdeps*Intra*Post	-0.0551 (0.0377)	-0.0670 (0.0424)	-0.0420 (0.0376)	-0.0932*** (0.0309)
Intra*Post	0.0040 (0.0065)	-0.0004 (0.0073)	0.0102* (0.0049)	0.0079 (0.0058)
Gr Bdeps*Inter*Post	-0.0229 (0.0205)	-0.0238 (0.0256)	-0.0229 (0.0271)	-0.0103 (0.0292)
Inter*Post	-0.0055 (0.0033)	-0.0054 (0.0036)	-0.0029 (0.0063)	-0.0014 (0.0077)
N	3,471	3,469	19,377	19,350
R-sq	0.59	0.64	0.20	0.22

Notes: The table presents an OLS regression of the growth rate of employment and payroll in MSA markets on the growth rate of market level deposits interacted with dummy variables for post-regulation years. Coefficients for market level covariates--growth rates of personal income and population, bank market Herfindahl, 3-firm bank concentration ratio--and state level covariates--unemployment rate, population growth rate, GDP growth rate--are not included. Deposit level data are from the Federal Reserve's Summary of Deposits, county business data are from the County Business Patterns, and market and state level covariates are from the Bureau of Economic Analysis.

* significant at 10%; ** significant at 5%; *** significant at 1%

Figure 1a - Single Market Equilibrium

Supply and Demand of Bank and Debt Capital

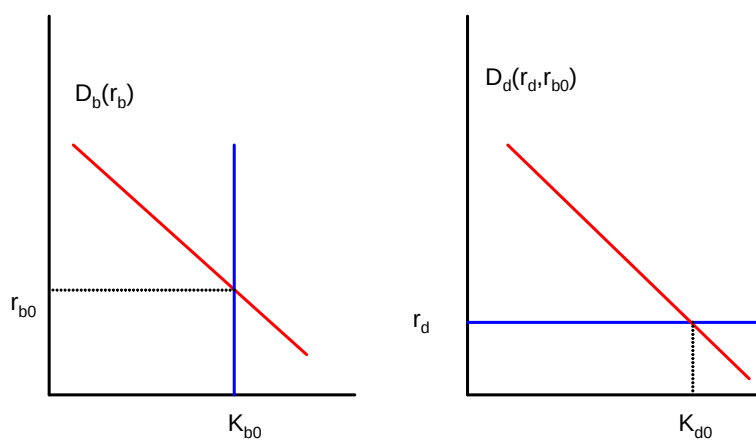


Figure 1b - Single Market Equilibrium

Supply and Demand of Bank and Debt Capital

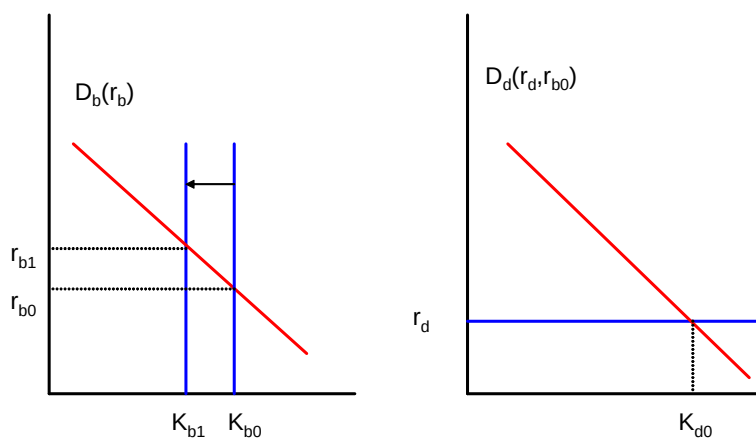


Figure 1c - Single Market Equilibrium

Supply and Demand of Bank and Debt Capital

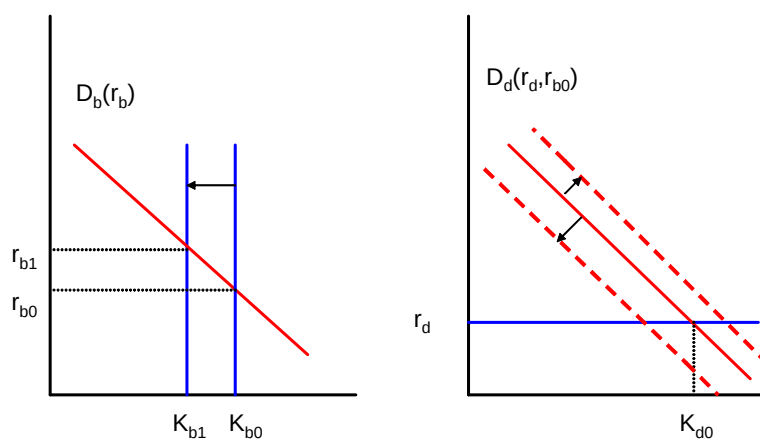


Figure 2 - Integrated Equilibrium

Initial Equilibrium in Markets for Bank Capital

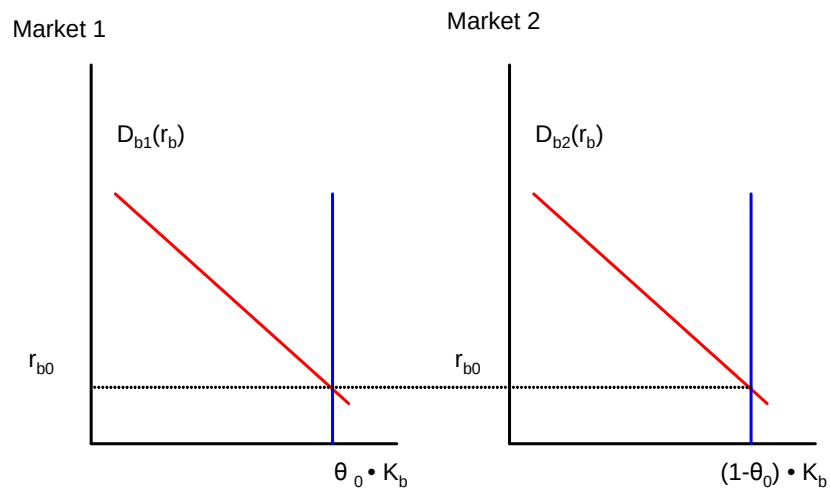


Figure 3 - Integrated Equilibrium

Effect of Supply Shift for Bank Capital

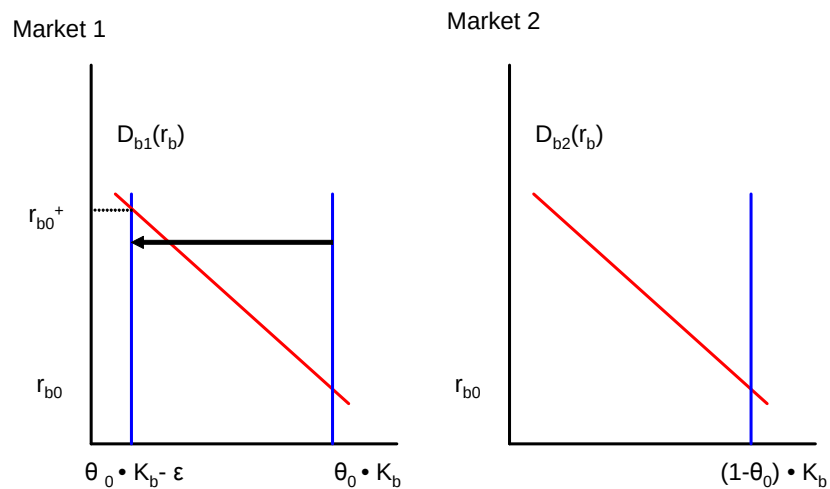


Figure 4 - Integrated Equilibrium

Effect of Supply Shift for Bank Capital

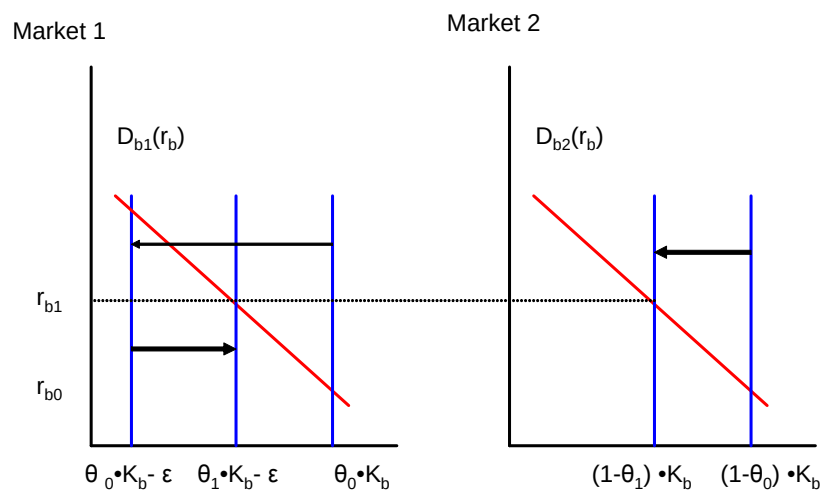


Figure 5 - Integrated Equilibrium

Effect of Demand Shift for Bank Capital

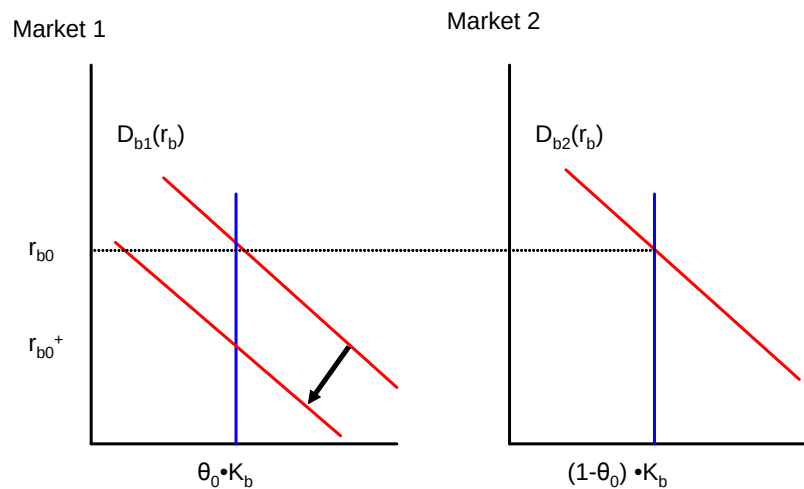


Figure 6 - Integrated Equilibrium

Effect of Demand Shift for Bank Capital

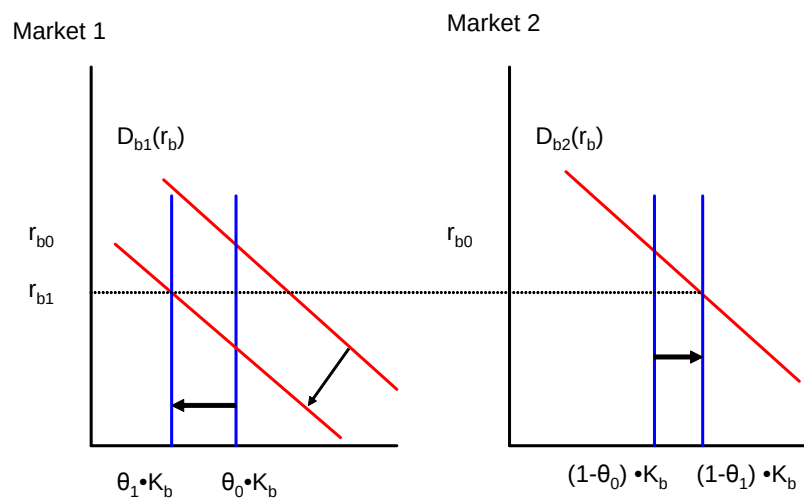


Figure 7

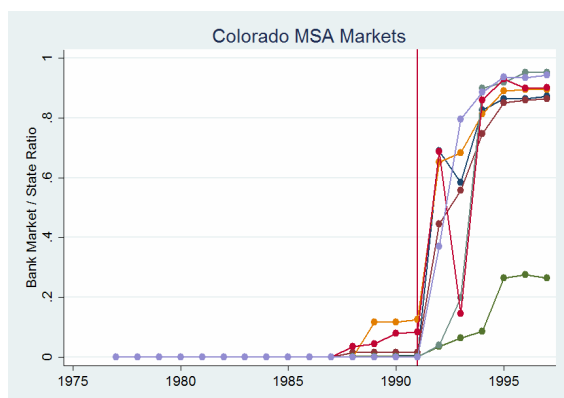


Figure 8

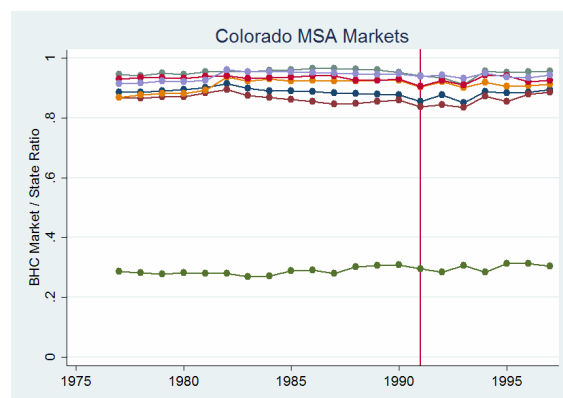


Figure 9

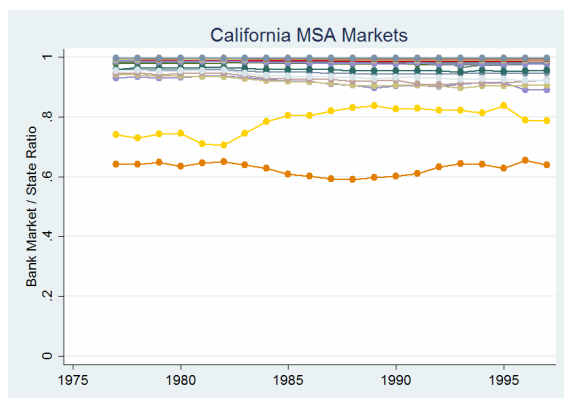


Figure 10

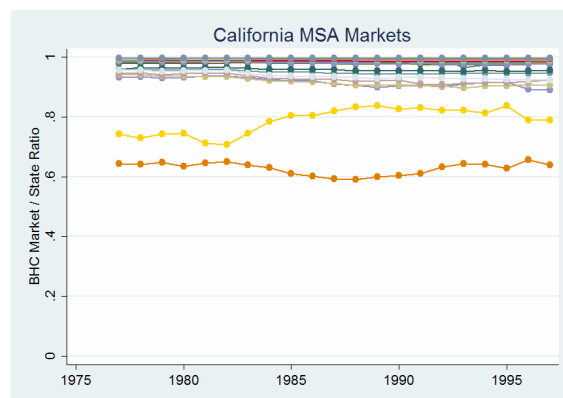


Figure 11

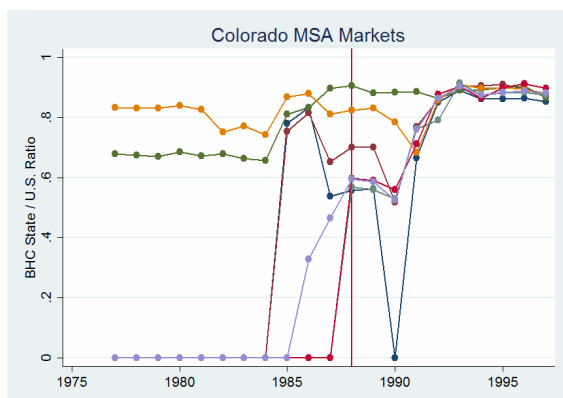


Figure 12

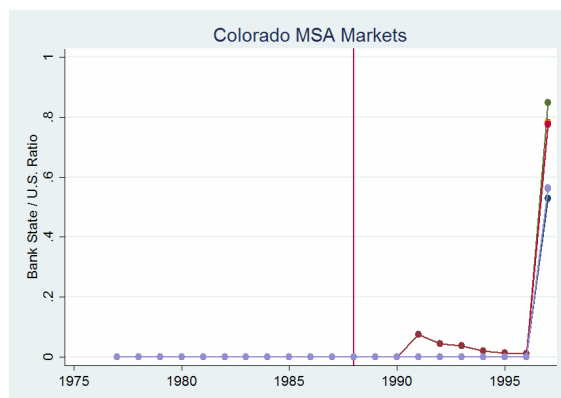


Figure 13

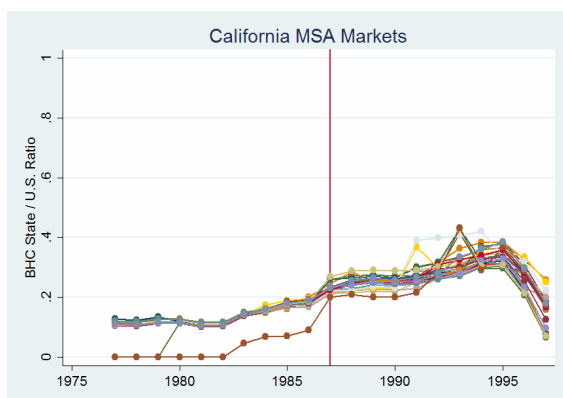
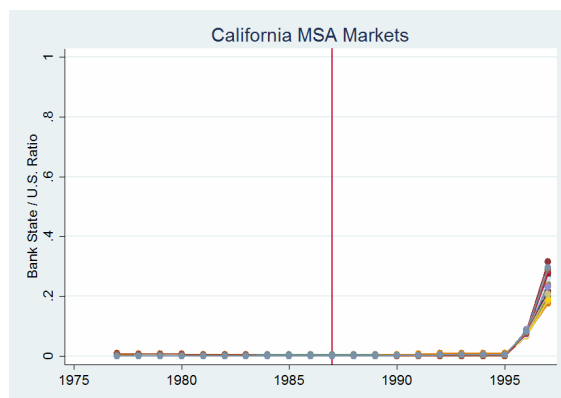


Figure 14



Part II

Spatial Competition, Network Externalities, and Market Structure: An Application to Commercial Banking

Chapter 9

Introduction

Since Hotelling [1929], spatial models have informed economists' understanding of the interaction between product differentiation, firms' pricing decisions, and consumer welfare. Within competition policy, these models provide an analytic framework for defining product and geographic markets, as well as for inferring market performance from market structure and firm conduct. Models of firm location in geographic space, including Hotelling's classic model, typically involve horizontal product differentiation. Firms compete by locating close to consumers. Consumers prefer firms in their geographic locality. Typically, as the market demand curve shifts out, a larger number of firms can enter and the equilibrium outcome becomes arbitrarily close to that of a competitive market [Shaked & Sutton (1987)]. Models of vertical product differentiation, by contrast, involve firms choosing different levels of quality, where every consumer prefers a higher quality to lower quality, but consumers differ in their willingness to pay [Tirole (1989)]. In such models of quality competition, depending on the distribution of consumer preferences, a few high quality firms can maintain large market shares even if the market demand grows arbitrarily large [Shaked & Sutton (1982)].

I consider a model where individual firms choose to locate multiples branches in geographic space. Consumers value both whether the firm's branch is close to them as well as the total number of other branches—or geographic locations—the firm has. All else equal, consumers prefer firms with more branches. The model thus contains both features of horizontal and vertical product differentiation. Firms find it advantageous to locate close to consumers, a la Hotelling. But the decision to build the marginal branch involves an externality because it raises consumers' willingness to pay for infra-marginal branches. This branching or location externality characterizes products as diverse as health clubs and wireless internet access, and could provide an explanation for common features of such markets.

In this paper I focus on a particular application of a such a model—deposit competition among commercial banks. I ask to what extent bank competition for deposits explains persistent features of the market structure and size distribution of commercial banks? Since at least Diamond [1984], there is a large literature that explains the structure of banking markets by treating banks as delegated monitors of funds channelled from savers to borrowers [Krasa and Villamil (1992), Milbourn, Boot, and Thakor (1999), Diamond and Rajan

(2000), Stein (2002),]. This literature emphasizes the special role of banks in making loans. More recent developments in the literature have begun to ask whether the deposit function could also play a role in explaining bank market structure [Kashyap, Rajan, and Stein (2002), Cohen and Mazzeo (2007), Dick (2007), Miller (2010)]. Banks compete for deposits by building large networks of branches and ATMs, offering a suite of services, and setting deposit interest rates and fees. The strategic interaction between competing banks and the distribution of consumer preferences over these services could also shape important features of the banking market.

Understanding the determinants of bank market structure is, in turn, a prerequisite for deciding how to optimally regulate financial institutions. By a variety of measures, the concentration of the commercial banking industry has increased over the last several decades [Berger, Demsetz, and Strahan (1999)]. To the extent that this increase has been driven by the demand for credit on the part of borrowing firms and households, by the demand for state-wide or nation-wide banking services by consumers, or by technological change in the banking industry, it has likely been welfare-improving [Berger, Kashyap, and Scalise (1995)]. To the extent that it has been driven by a desire to become too big to fail, to acquire government-insured sources of funds, or to exert market power, policy makers should be concerned [Milbourn, Boot, & Thakor (1999), Johnson and Kwak (2010)] .

The empirical difficulty in identifying the effect of deposit competition is that bank market structure is simultaneously determined by firm and consumer demand for credit, bank lending technology, bank demand for external funds, and consumer supply of deposits and demand for services. This poses a formidable identification challenge. The conceptual experiment requires holding fixed the loan side of the market while varying the ability of banks to compete for deposits. To this end, I utilize the history of state bank-branching restrictions in the United States as a natural experiment to identify the effect of changes in deposit market competition. For reasons that I detail below, these branching restrictions constrained the ability of banks to compete for deposits, but had less of an effect on their lending activity. By lifting these restrictions, states enabled banks to compete for deposits through branch networks.

I use state bank-branching restrictions to test whether the proposed model can explain salient features of deposit market structure. In the model, banks compete by locating close to consumers and offering a deposit rate. The locations that banks can choose constitute a set of neighborhoods that, taken together, constitute a market.¹ Each consumer chooses a bank in its neighborhood. At a given deposit rate, all consumers prefer a bank with locations in many neighborhoods to one with fewer locations.

The model generates the following predictions when branching restrictions are lifted and banks are able to compete by building large branch networks. First, the density of branches should increase within a market and neighborhood. Second, market concentration should increase, while neighborhood concentration may decrease. The intuition for the latter result is as follows. Within a small enough locality or neighborhood, product differentiation through network size allows banks of different scope to co-exist without competing aggressively on price. Without such differentiation, fewer banks can coexist. Further concentration with a market and concentration across markets should be quite similar.

¹Alternatively, the locations constitute a set of markets that, taken together, constitute a state or region.

Third, the negative relationship between market concentration and market size should decrease in magnitude. Put differently, market concentration should increase more in larger markets than in smaller ones. Fourth, with branching there should be a negative association between the size of a bank's branch network and its deposit rate. Consumers should be willing to accept a lower deposit rate from a bank with a large network. This negative association should increase in magnitude with the ability of banks to engage in branch network competition. Fifth, the variance in deposit interest rates should increase with branching. Greater product variety should lead to greater price dispersion.

The empirical evidence is broadly consistent with these predictions. First, in states that have always had free branching, branches per capita have remained largely constant over time. In states with unit branching (one bank/one branch) laws, in contrast, branches per capita increased dramatically. In unit branching states where these laws were strictly binding in 1977, branches per capita increased by 98% in MSA markets (from .100 branches per thousand persons to .198) and by 30% in NonMSA markets (from .387 to .505). This increase was also larger for states that had limitations on bank holding company formation. Regression results indicate that this increase in branches per capita pre-dates branch deregulation in these states.

The evidence on concentration provides some support for the model. Branching restrictions did little to increase within-market concentration, but had a large impact on state-level deposit concentration. For free branching states, the k-firm concentration ratios and HHI are constant over time for MSA and NonMSA markets and for the state as a whole. For these states the concentrations measures are nearly identical when measured at the bank—rather than bank holding company—level. The state wide, k-firm concentration ratios are quite similar to those for MSAs. This is consistent with the model's prediction that the within-market and across-market patterns of market concentration are nearly identical. Also consistent with the model, in unit branching (one-bank-one-branch) states deposit concentration at the state level increases over time. By the end of the sample period (1997) these concentration measures had not fully converged to the levels found in "Free Branching" states.

The ability of banks to form holding companies did little to affect market level concentration, but did affect state level concentration. Consistent with the idea the holding companies are better vehicles for lending than deposit taking, the unrestricted formation of holding companies in limited branching states did not result in concentration levels that were equivalent to free branching states. In states where BHC formation was restricted, the state-level BHC concentration was (unsurprisingly) nearly identical to that of banks. Where BHC's could freely form holding company concentration was substantially higher than that of banks. With deregulation, this difference between bank and BHC concentration at the state level disappeared. By 1997, BHC and bank concentrations were nearly identical for unit branching states that allowed BHCs to form freely. BHC's did not, however, provide a perfect substitute for branching restrictions. By the end of the sample period, these concentrations were still not as high as those observed in free branching states. While state level BHC concentration increased from .08/.18 (K1/K3) in 1977 to .15/.31 in 1997 in states where BHC expansion had been restricted, they had not converged to the level attained by states without BHC restrictions (.23/.46) in 1997.

The relationship between market concentration and market size provides support for the model. There is negative correlation between market concentration and market size, but that the magnitude of this correlation falls by about 10% after deregulation in unit branching states. The relationship between deposit rates and bank size provides limited support for the model. In all states, deposit rates were positively correlated with bank size at the beginning of the sample period (1977). This is likely a result of the ability of large banks to offer different types of interest bearing accounts at a time when bank rates were highly regulated. These regulations were lifted under the Garn St. Germain Act of 1982. By the end of the sample period, this relationship is either flat or weakly negative in all states. There is some evidence that this process was the most pronounced in states that underwent branching deregulation. Finally, the evidence of lower price dispersion is inconclusive, but this may be a result of the quality of the price data available.

The empirical tests provide evidence consistent with hypothesis that strategic competition resulting in large branch networks plays some role in determining market structure. Further research can help determine (1) whether such a model of spatial competition with location externalities can explain the structure of other market, and (2) relative contributions of the asset and liability side of the balance sheet in determining banking market structure.

Chapter 10

A Spatial Model of Deposit Competition

I construct an equilibrium model of bank lending and deposit taking where the deposit side determines market structure. In this model consumer heterogeneity in willingness to pay for bank scope gives rise to differing deposit market shares. Deposit market shares are an equilibrium consequence of strategic competition among banks of differing scope, where scope is measured by the size of bank's branch network. The model is based on Miller [2010], but extended to multi-market entry and competition.¹ This family of models was investigated, in some detail, by Shaked and Sutton [1982, 1983, 1988]. A formal description of the game, existence proofs and equilibrium characterization results are contained in Appendix A.

In the first stage of the game, banks sequentially choose to enter a subset of $N + 1$ distinct neighborhoods or localities. Together these neighborhoods constitute a market. There are enough potential entrants that every neighborhood can contain at least one bank that is in $0, 1, 2, \dots, N$ other neighborhoods. In other words, each neighborhood can have a bank of every possible scope. Each bank pays a fixed entry cost F to enter an individual neighborhood. Subsequent to entry decisions, each bank chooses a deposit price r^d in every neighborhood they enter.

Conditional on bank entry decisions and deposit rates, consumers in each neighborhood choose the bank that maximizes their utility. Each neighborhood contains a continuum of depositors characterized by a preference parameter α distributed on $[0, 1]$ according to $F(\alpha)$. Let j index the set of banks who enter neighborhood n and order these banks by their scope—the total number of neighborhoods they enter. The utility of a consumer in neighborhood n when choosing bank j is given by:

$$u(\alpha, j) = r_{nj}^d + \gamma\alpha\left(\frac{N_{nj}}{N} - 1\right)$$

¹The model extends Miller [2010] to the case of multi-market competition and derives closed-form solutions for prices, shares, and markups that can be used to calculate the limiting distribution of market shares. While the specific application in this paper is commercial banking, model is to spatial competition with where the externality from multiple locations is analogous to vertical product differentiation.

where N_{nj} is the number of neighborhoods outside n in which bank j has a presence and N is the total number of outside neighborhoods. I refer to a bank's outside neighborhood presence (N_{nj}) as its *outside scope*.²

In order to characterize the sub-game perfect equilibrium of this game, I first consider the final-stage deposit competition in a neighborhood n . The J_n banks in neighborhood n are ordered in terms of their outside scope so that $N_{n1} < N_{n2} < \dots < N_{nJ_n}$. For a consumer in neighborhood n to be indifferent between bank j and $j-1$, it is required that:

$$\alpha_{nj} = \begin{cases} \frac{r_{n1}^d}{\gamma \cdot (1 - \frac{N_{n1}}{N})}, & j = 1 \\ \frac{r_{n,j-1}^d - r_{nj}^d}{\gamma \cdot (\frac{N_{nj} - N_{n,j-1}}{N})}, & j > 1 \end{cases}$$

It follows that the neighborhood shares in neighborhood n are given by:

$$s_{nj} = \begin{cases} F(\alpha_{n,j+1}) - F(\alpha_{nj}), & 0 \leq j < J_n \\ 1 - F(\alpha_{n,J_n}), & j = J_n \end{cases}$$

From here forward, I assume that $F(\alpha)$ is the uniform distribution on $[0, 1]$ in order to obtain analytic solutions where possible.

Consider a final-stage equilibrium in neighborhood n in which there exists some consumer who is indifferent between bank j and $j-1 \forall j > 1$. Each bank j chooses deposit price r_{nj}^d to maximize profits:

$$r_{nj}^d \in \arg \max_{r_{nj}^d} (r^l - r_{nj}^d) \cdot s_{nj}(\mathbf{r}_n^d, \mathbf{N})$$

where r^l is the competitive return on loans and a bank's neighborhood share $s_{nj}(\mathbf{r}_n^d, N_n)$ is a function of each bank's deposit rate ($\mathbf{r}_n^d$) and outside neighborhood scope (N_n). The first order conditions that define the above reaction functions are [Miller 2010]:

$$\begin{aligned} r_{n1}^d &= \frac{1}{2} \cdot (r^l + r_{n2}^d) \text{ if } r_{n1}^d \geq 0 \\ r_{nj}^d &= \frac{1}{2} \cdot (r^l + \frac{(N_{n,j+1} - N_{nj})}{(N_{n,j+1} - N_{n,j-1})} \cdot r_{n,j-1}^d + \frac{(N_{nj} - N_{n,j-1})}{(N_{n,j+1} - N_{n,j-1})} \cdot r_{n,j+1}^d), \quad 1 < j < J_n \\ r_{nJ_n}^d &= \frac{1}{2} \cdot (r^l + r_{n,J_n-1}^d - \gamma \cdot \frac{(N_{n,J_n} - N_{n,J_n-1})}{N}) \end{aligned}$$

It follows that the final-stage price equilibrium in any neighborhood n is the solution to this system of equations. From the logic of undifferentiated, Bertrand competition, two banks of the same scope cannot earn positive profits in equilibrium. Therefore, in any

²Because all consumers weakly value banks with greater outside scope, the model is one of vertical product differentiation described by Shaked and Sutton (1982, 1983, 1988). Competition across markets also has features of horizontal product differentiation, a la Hotelling, because all consumers choose a bank within their market n . I rely on well-known results for this class of models to characterize the sub-game perfect Nash equilibria of this game.

given neighborhood, at most $N + 1$ banks can earn positive profits. It can also be shown that r_{nj}^d is decreasing in j . Intuitively, banks of greater scope can offer consumers a lower deposit interest rate.

By backward induction, banks choose an entry strategy anticipating equilibrium profits in each neighborhood that they enter. These profits are a function of the entry decisions taken by other banks. In choosing to enter an additional neighborhood n , a bank must consider both its profits in neighborhood n and the change in profits in all (infra-marginal) neighborhoods due to its increase in scope. When choosing to enter an additional neighborhood a bank's profits will increase for every other neighborhood in which this increase in scope does not lead to undifferentiated price competition. For convenience, I restrict the strategy space so that banks must make positive variable profits in each neighborhood they enter. This rules out situations where a bank makes negative variable profits in one neighborhood, but increases overall profits due to its greater scope. Because banks can be indifferent across different entry strategies, the entry equilibrium need not be unique. Nevertheless, these equilibria share important properties.

I consider equilibria of this game where F can be considered small³. By the logic of Bertrand price competition, no two banks of equal scope can coexist in the same neighborhood. Let $N^*(N_j)$ denote the largest number of banks of outside scope N_j that can exist in any equilibrium across all $N + 1$ neighborhoods and let $\lfloor \cdot \rfloor$ denote the smallest integer part of the expression in brackets:

$$N^*(N_j) = \lfloor \frac{N+1}{N_j+1} \rfloor \quad \forall N_j \in \mathbb{Z}, 0 \leq N_j \leq N$$

It follows that $N^*(N_j)$ is decreasing in N_j . The largest number of banks that enter at least one neighborhood in equilibrium is given by $\sum_{N_j=0}^N N^*(N_j)$ ⁴. The number of banks that can enter at least one neighborhood in equilibrium grows arbitrarily large with the total number of neighborhoods ($N + 1$).

The model does not permit an exact calculation of equilibrium market share for each bank. It is still possible, however, to obtain a lower bound for the market share—across all $N + 1$ neighborhoods—of a bank with outside scope N_j . Such a bank would obtain its lowest market share in a neighborhood n where there exists a bank of every possible scope. A lower bound for its share across all $N + 1$ neighborhoods is therefore given by $(\frac{N_j+1}{N+1}) \cdot s_{nj}(\mathbf{r}_n^d, N_n)$ where $N_n = \{0, 1, 2, \dots, N\}$.

This lower bound can be obtained explicitly from the equilibrium deposit rates in a neighborhood with banks of every possible scope, that is, where $N_n = \{0, 1, 2, \dots, N\}$. In Appendix A I show that in such a neighborhood, the interest rate charged by any bank j , where j denotes its outside scope, is given by:

³Alternatively, this corresponds to a situation in which demand in each market is large, so that small market shares are sufficient to cover the fixed cost of entry.

⁴For example, if $M = 4$, then the largest number of banks of outside scope $\{0, 1, 2, 3, 4\}$, respectively, is $\{5, 2, 1, 1, 1\}$. The largest number of total banks is 10, and the largest number of branches is $\{5, 2, 1, 1, 1\} \cdot \{1, 2, 3, 4, 5\} = 21$.

$$\begin{aligned}
r_j^{d*} &= r^l - \frac{1}{3} \cdot \frac{1}{U_{N-1}(2)} \cdot T_{j-1}(2) \cdot \frac{2\gamma}{N} \\
&= r^l - \frac{\sqrt{3}}{3} \cdot \left[\frac{(2 + \sqrt{3})^{j-1} + (2 - \sqrt{3})^{j-1}}{(2 + \sqrt{3})^N - (2 - \sqrt{3})^N} \right] \cdot \frac{2\gamma}{N}
\end{aligned}$$

where $U(\cdot)$ and $T(\cdot)$ are Chebyshev polynomials, respectively, of the first and second type. It can be shown that deposit prices (markups) are decreasing (increasing) in scope. This expression can be used to calculate a lower bound of market share for a bank of any outside scope N_j . I focus on the case where $j = N$, the bank with largest scope and market share (s_{N+1}) across all $N + 1$ neighborhoods. For this bank:

$$\begin{aligned}
s_{N+1} &= 1 - \alpha_{N+1} \\
&= 1 - \frac{r_N^{d*} - r_{N+1}^{d*}}{\frac{\gamma}{N}}
\end{aligned}$$

By using ratio asymptotics for basis polynomials, it is possible to obtain the limiting market share of the largest bank as the number of neighborhoods grows arbitrarily large:

$$\begin{aligned}
\lim_{N \rightarrow \infty} s_{N+1} &= 1 - \frac{2}{3} \cdot \lim_{N \rightarrow \infty} \frac{1}{U_{N-1}(2)} \cdot [T_N(2) - T_{N-1}(2)] \\
&= \frac{2\sqrt{3}}{3} - 1 \approx .15
\end{aligned}$$

The model thus exhibits a characteristic of vertical differentiation models first described by Shaked and Sutton [1982]. The market share of the largest k-firms (k-firm ratio) has a non-zero lower bound, even if the market grows arbitrarily large. Intuitively, when consumers value scope, there is a limit to the ability of banks to attract consumers from the largest bank by offering a higher deposit rate.⁵

I can now state the empirical predictions that follow from increasing the ability of banks to compete for deposits by establishing networks of branches. These predictions follow from comparing the equilibrium outcome in the model above with one in which banks cannot build branch networks (the no-branch case). While this comparison is stark, it captures the simple logic behind varying the intensity of vertical differentiation in a continuous way.

First, the density of branches should increase within a market and neighborhood. In the no-branch case the equilibrium number of branches per market is $N + 1$ and branches per neighborhood is one. When branching is allowed, the number of branches per market

⁵As a theoretical matter, this limiting result on the concentration of the deposit market might be seen as distinct from loan-side explanations of the bank size distribution. As I show in Appendix B, however, a model of loan heterogeneity can produce almost identical results in this limiting case.

has an upper bound of $\frac{\sum_{N_j=0}^N (N_j+1) \cdot N^*(N_j)}{N+1}$ and the number of branches per neighborhood has an upper bound of $N + 1$.

Second, market concentration should increase, while neighborhood concentration may decrease. In the no-branch case, the HHI measure for deposit shares in a market is $\frac{1}{N+1}$ and the k-firm ratio is $\frac{k}{N+1}$. With branch networks, the corresponding measures for a market are strictly higher. In the no-branch case, the HHI measure and k-firm ratio for deposit shares in a neighborhood are both one. With branch networks the corresponding neighborhood measures are strictly lower. The intuition for the latter result is as follows. Within a small enough locality or neighborhood, vertical differentiation allows banks of different scope to co-exist without competing aggressively on price. Without such differentiation, fewer banks can coexist.

Third, the negative relationship between market concentration and market size should decrease in magnitude. In the model, market size is captured by N . Without bank branching, the market concentration as measured by the k-firm ratio where $k = 1$ is $\frac{1}{N+1}$. This approaches 0 geometrically in N . With branching, this ratio is:

$$s_{N+1} = 1 - \frac{r_N^{d*} - r_{N+1}^{d*}}{\frac{\gamma}{N}}$$

which, as we have seen, approaches .15 as N grows large. With branching, the slope of the concentration/market size relationship increases (and grows smaller in absolute value). Put differently, market concentration should increase more in larger markets than in smaller ones.

Fourth, with branching there should be a negative association between the size of a bank's branch network and its deposit rate. Consumers should be willing to accept a lower deposit rate from a bank with a large network. This negative association should increase in magnitude with the ability of banks to engage in branch network competition. Fifth, the variance in deposit interest rates should increase with branching. Greater product variety should lead to greater price dispersion.

Chapter 11

Historical Background, Data, and Empirical Analysis

11.1 Historical Background

In order to test these predictions, I exploit the history of bank regulation in the United States. I briefly outline the history of state bank-branching restrictions to explain their suitability for these tests. For most of the twentieth century, the United States consisted of at least 50 different banking markets. In the early part of the century, the charters of national banks were generally limited to individual states. After the Great Depression, a small number of bank holding companies formed across state lines. The Douglas Amendment to the Bank Holding Company Act of 1956, however, allowed states to restrict out-of-state bank holding companies from entering markets in their state.

Many states also severely restricted within-state branching. In so-called unit-branching states banks were allowed to have only one branch. This restricted both geographic competition for deposits and for loans. In some unit branching states, however, bank holding companies could own many individual, one-branch banks. Bank holding companies were free to organize their lending activity through an internal capital market. Individual banks within the holding company, however, still had to each comply with state and national banking regulations such as capital requirements. Depositors at one bank could not access accounts or services at another bank in the same holding company. As a result, a bank holding company was less able to compete for deposits than a multi-branch bank. I utilize this difference in institutional structure and in the timing of deregulation to measure the effects of increasing competition for deposits. I compare banking market structure in states that underwent regulatory changes to market structure free-branching states where no restrictions were placed on bank holding companies or banks. By doing so, I am able to separately consider the effect of allowing multi-branch bank holding companies to form and of allowing holding companies to consolidate into individual banks.

11.2 Data

I construct a unique panel dataset to test my predictions. The panel consists of MSA and non-MSA (county) markets from the 30 states from 1977-1997. These states include all those that had free branching during this period and all that were unit branching.¹ Unit branching include those for which the one-bank-one-branch rule was strictly binding² and those for which there was some within-market branching but no across-market branching.³ These unit branching states are also partitioned with respect to those that allowed BHCs to freely form throughout the sample period⁴ and those that did not allow BHC formation initially, but deregulated during the sample period.⁵ I merge the Summary of Deposits dataset from the Federal Reserve, which contains branch level information on deposits, with the Call Reports Data to create market-level measures of deposit growth, firm growth, and banking market characteristics such as the k-firm deposit ratio, the number of banks per market, and the Herfindahl index. I also create a bank level dataset which contains deposit rate information at the bank level. I add to this market level and state level economic measures such as per capita income, population, and unemployment from the Bureau of Economic Analysis.

In my data, a state undergoes within-state deregulation when it allows banks to expand by merger and acquisition and to manage all its branches as a single commercial entity. A state undergoes across-state deregulation when it allows banks or BHCs outside the state to acquire in-state branches. A state undergoes BHC deregulation when it allows bank holding companies to form.

11.3 Empirical Analysis

I next test the empirical predictions of the model using this data. The predictions were that, first, the density of branches should increase within a market and neighborhood. Second, across-market concentration should increase, while within-market concentration may decrease, but would likely increase. Further, concentration within a market and concentration across markets should be quite similar. Third, the negative relationship between market concentration and market size should decrease in magnitude. Fourth, with branching there should be a negative association between the size of a bank's branch network and its deposit rate. This negative association should increase in magnitude with the ability of banks to engage in branch network competition. Fifth, the variance in deposit interest rates should increase with branching.

Branching restrictions appear to have limited branch density. Table 1 presents time series data on branch densities for free branching states and unit branching states.

¹Free branching states were: AK, AZ, CA, DE, ID, MD, NC, NV, RI, SC, SD, VT.

²These states were: CO, IL, KS, MT, NE, OK, TX, WV, WY.

³These states were: FL, IN, KY, MA, MN, MO, ND, NM, TN.

⁴These states were: CO, FL, MA, MN, MO, MT, ND, NM, TN, TX, WY.

⁵These states were: IL, IN, KS, KY, NE, OK, WV.

Unit branching states are divided into those for which one bank/one branch laws were strictly binding at the beginning of the sample period (“Unit Within”) and those for which limited branching took place within market but not across market (“Unit Across”). In free-branching states branches per capita have remained largely constant over time. In states with unit branching (one bank/one branch) laws, in contrast, branches per capita increased substantially. In “Unit Within” states branches per capita increased by 98% from 1977 to 1997 in MSA markets, rising from .100 branches per thousand persons to .198. For NonMSA markets this increase was 30% (from .387 to .505.) The figure of .198 for “Unit Within” states in 1997 is similar to the figure of .197 for MSA markets in free branching states in that year, suggesting convergence to a common steady state. Table 2 presents data on “Unit Within” states that began the sample period with restrictions on branching by bank holding companies (“BHC Reg”) and states that allowed holding companies to own multiple branches (“BHC Free”). There is a greater increase in branch density for states that in which holding companies were regulated. The increase in branches per capita for states where multi-branch holding companies could form suggests that branching through a holding company structure was not a perfect substitute for branching within a single organization.

I also provide regression-based evidence for this increase. I estimate equations of the form:

$$y_{mst} = \alpha_s + \beta_0 t + \beta_1 t \cdot dereg_s + \beta_2 dereg_s \cdot post_{st} + \beta_3 t \cdot dereg_s \cdot post_{st} + \beta_4 \mathbf{x}_{mst} + \epsilon_{mst}$$

where y_{mst} represents branches per thousand persons for a given market m in state s at time t , t is a time trend, $t \cdot dereg_s$ is a time trend for states with branching restrictions, $dereg_s \cdot post_{st}$ is an indicator for years after deregulation, $t \cdot dereg_s \cdot post_{st}$ is a time trend interacted with years after deregulation, and $\mathbf{x}_{mst}$ is a vector of covariates. Table 3 presents these results. There is strong evidence for an increase branch density over time in all unit branching states ($\beta_1 > 0$). There is also evidence that this trend increased for “Unit Within” states after deregulation ($\beta_3 > 0$).

The evidence on concentration provides moderate support for the model. Branching restrictions did little to increase within-market concentration, but had a large impact on state-level deposit concentration. Table 4 presents data for market concentration, measured at the bank holding company level, for “Free Branching” and “Unit Within” states. For “Free Branching” states, the k-firm concentration ratios and HHI are constant over time for MSA and NonMSA markets and for the state as a whole. For “Free Branching” states, these figures are nearly identical when measured at the bank—rather than bank holding company—level. In addition, for “Free Branching” the state wide, k-firm concentration ratios are quite similar to those for MSAs. This is consistent with the model’s prediction that the within-market and across-market patterns of market concentration are nearly identical.

Consistent with the model, in “Unit Within” states deposit concentration at the state level increases over time from .12 (.26) to .19 (.38) for the 1-firm (3-firm) ratio. By the end of the sample period these concentration measures have not fully converged to the levels found in “Free Branching” states. The concentration measures for MSA and NonMSA markets for “Unit Within” states, however, do not change over time. This fact is

inconsistent with the model, which predicts that across-market expansion should increase within-market concentration levels. It is possible that the oversight of banking antitrust authorities produces an upper bound on within-market concentration that limits this effect. It is also possible that the gains in market share in the home market for a bank that moves into a neighboring market are small.

The ability of banks to form holding companies did little to affect market level concentration. Table 5 presents MSA and state level concentration ratios, measured at the bank holding company and bank levels, for “Unit Within” states. This includes states that began the sample period with restrictions on bank holding company formation (Unit Within BHC Reg”) and those that began the period with no restrictions on bank holding companies (Unit Within BHC Free”). There is hardly any difference between market concentration measured at the bank and bank holding company, even in states with unit branching and no restrictions on multi-bank holding companies (“Unit Within BHC Free”). It is possible that the marginal branch added was negligible in increasing a bank’s local market share or that branch expansion was mainly to make loans in new areas. It could also be that the measure of deposits is dominated by deposits by firms who own hold large accounts with commercial banks and so are very insensitive to distance in choosing their bank. If this is true the headquarter branch in a market will dominate its share of deposits in that market. In other words, these concentration measures may poorly capture retail, consumer deposits.

Expanding across markets through a bank holding company structure was an imperfect substitute for expansion at the bank level. Table 5 indicates that bank level concentrations were almost identical for “Unit Within BHC Reg” and “Unit Within BHC Free” states in 1977. The 1 and 3-firm concentration ratios at the state level for the former were .07 and .17, while they were .07 and .18 for the latter. Where BHC formation was restricted, the BHC concentration nearly identical to that of banks (.08/.18). Where BHC’s could freely form, however, concentrations were substantially higher (.17/.37). Bank holding companies, unsurprisingly, enabled larger state-level market shares. With deregulation, this difference between bank and BHC concentration at the state level disappeared. By 1997, BHC and bank concentrations were nearly identical for “Unit Within BHC Free” states (.23/.46), suggesting that the BHC’s had been consolidated into banks. BHC’s did not, however, provide a perfect substitute for branching restrictions. Table 5 indicates that for “Unit Within BHC Free” states, state level concentration increased over time when measured at the holding company level. By the end of the sample period, these concentrations were still not as high as those observed in “Free Branching” states. While state level BHC concentration increased from .08/.18 in 1977 to .15/.31 in 1997 in states where BHC expansion had been restricted (“Unit Within BHC Reg”), they had not converged to the level attained by states without BHC restrictions (.23/.46) in 1997.

The relationship between market concentration and market size provides support for the model. The model predicts that there should be a negative correlation between market concentration and market size, but that the magnitude of this correlation should fall after deregulation. To test this hypothesis, I estimate models of the form:

$$y_{mst} = \alpha_t + \beta_1 x_{mst} + \beta_2 x_{mst} t + \epsilon_{mst}$$

where y_{mst} is the k-firm measure of bank deposits market concentration measured at the bank holding company level, x_{mst} is the total deposits in a market, and $x_{mst}t$ interacts total deposits with time trend. In a related specification, deposits are interacted with year indicator variables. These models are estimated separately for “Free Branching” and “Unit Branching” states. Table 6 presents these results. For “Free Branching” states, β_2 is statistically insignificant from zero, while for “Unit Branching” states it is positive and statistically significant. When β_2 is estimated using year dummies, its magnitude is about 10% of β_1 . These estimates provide support for the hypothesis that deregulation dampened the relationship between market size and market concentration.

The relationship between deposit rates and bank size provides limited support for the model. The model predicts that there should be a negative relationship between deposit rate and bank size and that this relationship should be stronger as branching increases. To test this hypothesis, I again estimate equations of the form:

$$y_{bmst} = \alpha_t + \beta_1 x_{bmst} + \beta_2 x_{bmst}t + \epsilon_{mst}$$

where y_{bst} is the deposit rate offered by bank b in state s at time t and x_{bst} is the log of total deposits controlled by that bank in state s . In a related specification, deposits are interacted with year indicator variables. These models are estimated separately for “Free Branching” and “Unit Branching” states. “Unit Branching” states are further divided into states where unit branching was strictly binding (“Unit Within”), states where BHC formation was restricted at the beginning of the sample period (“Unit BHC Reg”), and states where BHCs could freely form (“Unit BHC Free”). Table 7 presents the results of this estimation. In all states, deposit rates were positively correlated with bank size at the beginning of the sample period. This is likely a result of the ability of large banks to offer different types of interest bearing accounts at a time when bank rates were highly regulated. These regulations were lifted under the Garn St. Germain Act of 1982. By the end of the sample period, this relationship is either flat or weakly negative in all states. There is some evidence that this process was the most pronounced in states that underwent branching deregulation.

Chapter 12

Conclusion

This paper develops a general model of spatial competition where consumer's willingness to pay for firms with more locations generates an externality in firm's location decisions. I characterize the equilibrium of such a model and provide analytical results for prices, markups and limiting market shares. The limiting market shares exhibit the fragmentation property described in Shaked and Sutton [1982]—the market share of the largest firm are bounded above zero even if the market becomes arbitrarily large. I consider the application of this model to market for bank deposits. The model predicts that, first, the density of branches should increase within a market and neighborhood. Second, across-market concentration should increase, while within-market concentration may decrease, but would likely increase. Concentration within a market and concentration across markets should be quite similar. Third, the negative relationship between market concentration and market size should decrease in magnitude. Fourth, with branching there should be a negative association between the size of a bank's branch network and its deposit rate. This negative association should increase in magnitude with the ability of banks to engage in branch network competition. Fifth, the variance in deposit interest rates should increase with branching.

The empirical evidence is broadly consistent with these predictions. In states that have always had free branching, branches per capita have remained largely constant over time. In states with unit branching (one bank/one branch) laws, in contrast, branches per capita increased dramatically. The evidence on concentration provides some support for the model. Branching restrictions did little to increase within-market concentration, but had a large impact on state-level deposit concentration. The state wide, k -firm concentration ratios are quite similar to those for MSAs. This is consistent with the model's prediction that the within-market and across-market patterns of market concentration are nearly identical.

The relationship between market concentration and market size provides support for the model. There is negative correlation between market concentration and market size, but that the magnitude of this correlation falls by about 10% after deregulation in unit branching states. The relationship between deposit rates and bank size provides limited support for the model. In all states, deposit rates were positively correlated with bank size at the beginning of the sample period (1977). By the end of the sample period,

this relationship is either flat or weakly negative in all states. There is some evidence that this process was the most pronounced in states that underwent branching deregulation. Finally, the evidence of lower price dispersion is inconclusive, but this may be a result of the quality of the price data available.

The empirical tests provide evidence consistent with the hypothesis that strategic competition in branch networks plays a role in determining market structure. Further research can help determine (1) whether such a model of spatial competition with location externalities can explain the structure of other markets, and (2) relative contributions of the asset and liability side of the balance sheet in determining banking market structure.

Chapter 13

References

Adams, Robert, Kenneth P. Brevoort, and Elizabeth K. Kiser, “Who Competes Whom: The Case of Depository Institutions,” *The Journal of Industrial Economics*, Vol. LV (2007), 141-167.

Amel, Dean, “State Laws Affecting the Geographic Expansion of Commercial Banks,” unpublished manuscript, Board of Governors of the Federal Reserve System, 1993.

Barth, James R., Gerard Caprio, and Ross Levine, *Rethinking Bank Regulation: Till Angels Govern*, Cambridge University Press (2006).

Berger, Allen N., and Timothy H. Hanan, “The Price-Concentration Relationship in Banking,” *The Review of Economics and Statistics*, Vol. 71 (1989) 291-99.

Berger, Allen N., and Timothy H. Hanan, “The Rigidity of Prices: Evidence from the Banking Industry,” *The American Economic Review*, Vol. 81 (1991) 938-945.

Berger, A.N., R.S. Demsetz, and P.E. Strahan, “The Consolidation of the Financial Services Industry: Causes, Consequences, and Implications for the Future,” *Journal of Banking and Finance* 23 (1999), 135–194.

Berger, A.N., A.K. Kashyap, and J.M. Scalise, “The Transformation of the U.S. Banking Industry: What a Long, Strange Trip It’s Been,” *Brookings Papers on Economic Activity* 2 (1995), 55–218.

Berger, Allen N. and Astrick A. Dick, “Entry into Banking Markets and the Early-Mover Advantage,” *Journal of Money, Credit, and Banking*, Vol. 39 (2006) 775-807.

Berry, Steven and Joel Waldfogel, “Product Quality and Market Size,” *The Journal of Industrial Economics*, Vol. 58 (2010), 1-31.

Bertrand, Marianne, Esther Dufo and Sendhil Mullainathan, “How Much Should We Trust Difference-in-Differences Estimators?” *Quarterly Journal of Economics*, CXIX (2004), 249–276.

Bronnenberg, Bart, Sanjay K. Dhar, and Jean-Pierre H. Dube, “Brand History, Geography, and the Persistence of Brand Shares,” *Journal of Political Economy*, Vol. 117, (2009).

Calomiris, Charles, *U.S. Banking Deregulation in Historical Perspective*, Cambridge University Press (2000).

Calomiris, Charles, and Carlos Ramirez, “The Political Economy of Bank Entry Restrictions: Theory and Evidence from the U.S. in the 1920s,” *Columbia University*

Working Paper (2004).

Campbell, J.R. and Hugo A. Hopenhayn, "Market Size Matters," *Journal of Industrial Economics*, Vol. 53 (2005) 1-25.

Claessens Stijn, "Competitive Implications of Cross-Border Banking," in *Cross-Border Banking: Regulatory Challenges*, Gerard Caprio, Douglas D. Evanoff, and George G. Kaufman, eds., 151-82, World Scientific Publishing (2006).

Cohen, Andrew M. and Michael J. Mazzeo, "Market Structure and Competition Among Retail Depository Institutions," *Review of Economics and Statistics* 89 (2007) 60-74.

D'Aspremont, C. J. Jaskold Gabszewicz, and J.F. Thisse, "On Hotelling's 'Stability in Competition,'" *Econometrica* 47, (1979) 1145-50.

Diamond, Douglas W., "Financial Intermediation and Delegated Monitoring," *The Review of Economic Studies*, Vol. 51, No. 3. (1984), 393-414.

Diamond, Douglas W., and Raghuram G. Rajan, "A Theory of Bank Capital," *The Journal of Finance*, Vol. LV, No. 6 (2000).

Dick, Astrid, "Market Size, Service Quality, and Competition in Banking," *Journal of Money, Credit, and Banking*, Vol. 39 (2007).

Ellickson, Paul B. "Does Sutton Apply to Supermarkets," *Rand Journal of Economics* 38(1), (2007) 43-59.

Ennis, Hubert, "On the Size Distribution of Banks," *Federal Reserve Bank of Richmond Economic Quarterly*, Vol. 87 (2001).

Houston, J.F., C.M. James, and D. Marcus, "Capital Market Frictions and the Role of Internal Capital Markets in Banking," *Journal of Financial Economics* 46 (1997), 135-164.

Hubbard, R. Glenn, Darius Palia, and Nicolas Economides, "The Political Economy of Branching Restrictions and Deposit Insurance," *Journal of Law and Economics*, XXIX (1996), 667-704.

Jayaratne, Jith and Philip E. Strahan, "Entry Restrictions, Industry Evolution and Dynamic Efficiency: Evidence from Commercial Banking," *Journal of Law and Economics*, 41:1 (1998), 239-74.

Jackson, William E., "Market Structure and the Speed of Price Adjustments: Evidence of Non-Monotonicity," *Review of Industrial Organization*, 12 (1997) 37-57.

Kashyap, Anil, Raghuram Rajan, and Jeremy Stein, "Banks as Liquidity Providers: An Explanation for the Coexistence of Lending and Deposit-Taking," *The Journal of Finance*, Vol VLII (2002).

Krasa, Stefan and Anne P. Villamil, "A Theory of Optimal Bank Size," *Oxford Economic Papers*, Vol. 44 (1992) 725-749.

Kroszner, Randall S., and Philip E. Strahan, "What Drives Deregulation: Economics and Politics of the Relaxation of Bank Branching Restrictions," *Quarterly Journal of Economics*, CXIV (1999), 1437-1467.

Macey, Jonathan and Miller, Geoffrey, *Banking Law and Regulation*, Little, Brown and Company (1992).

Milbourn, T.T. A.W.A. Boot, and A.V. Thakor, "Megamergers and Expanded Scope: Theories of Bank Size and Diversity," *Journal of Banking and Finance* 23, (1999) 195-214.

Neumark, David and Steven A. Sharpe, "Market Structure and the Nature of Price Rigidity: Evidence from the Market for Consumer Deposits," *Quarterly Journal of Economics*, Vol. 107 (1992) 657-680.

Rochet, Jean-Charles and Jean Tirole, "Cooperation Among Competitors: Some Economics of Payment Card Associations," *RAND Journal of Economics*, Vol. 33, No. 4 (2002), 549-570.

Shaked, Avner and John Sutton, "Relaxing Price Competition Through Product Differentiation," *The Review of Economic Studies*, Vol. 49, No. 1 (1982) 3-13.

Shaked, Avner and John Sutton, "Natural Oligopolies," *Econometrica*, Vol. 51, No. 5 (1983) 1469-1483.

Shaked, Avner and John Sutton, "Product Differentiation and Industrial Structure," *The Journal of Industrial Economics*, Vol. 36, No. 2 (1987), 131-146.

Stein, Jeremy, "Information Production and Capital Allocation: Decentralized Versus Hierarchical Firms," *Journal of Finance* 57 (2002), 1891-1921.

Sutton, John, *Sunk Costs and Market Structure: Price Competition, Advertising, and the Evolution of Concentration*, Cambridge, MA, MIT Press (1991).

Waldfogel, Joel, Preference Externalities: An Empirical Study of Who Benefits Whom in Differentiated-Product Markets, *RAND Journal of Economics*, Vol. 34 (2003) 557-568.

Chapter 14

Appendix

14.1 Definitions and Proofs for Deposit Competition Model

The game is extensive form, but it will simplify exposition to denote all entry decision nodes as the “first stage” and to denote the (simultaneous move) pricing decision node as a “second stage.” In the first stage banks sequentially choose to enter a subset of $N + 1$ distinct neighborhoods or localities. Sequential entry is assumed in order to guarantee the existence of an equilibrium in pure strategies. In the second stage banks set deposit interest rates in each neighborhood they enter. I assume there are $(N + 1)^2$ potential entrants, so it is possible for every bank to enter every neighborhood. Entry in each neighborhood is associated with a fixed cost F .

Definition 6 *An extensive form game is tuple of players, histories, strategies and preferences given by $\langle (N + 1)^2, \mathbf{H}, [\mathbf{e}, \mathbf{r}], \boldsymbol{\pi} \rangle$.*

Definition 7 *A strategy for bank l in any entry subgame associates every history $\mathbf{h}_{l-1}$ with a vector $\mathbf{e}_l(\mathbf{h}_{l-1}) \in \mathbf{E} \subset \mathbb{Z}^{N+1}$, where $e_{ln}(\mathbf{h}_{l-1}) = 1$ if a bank enters neighborhood n and $e_{ln}(\mathbf{h}_{l-1}) = 0$ otherwise.*

Each bank pays an entry cost $c(\mathbf{e}_l(\mathbf{h}_{l-1})) = F \cdot (N_l + 1)$ where $N_l + 1 = \sum_{n=1}^{N+1} e_{ln}(\mathbf{h}_{l-1})$ is the total number of neighborhoods that bank l enters given its strategy.

Definition 8 *A history $\mathbf{h}_{l-1} \in \mathbf{H}_{l-1} \subset \mathbb{Z}^{(l-1) \times (N+1)}$ of any entry subgame where player l is called upon to play is given by:*

$$h_{l-1} = \begin{bmatrix} \mathbf{e}_1(\mathbf{h}_1) \\ \mathbf{e}_2(\mathbf{h}_2) \\ \dots \\ \mathbf{e}_{l-1}(\mathbf{h}_{l-1}) \end{bmatrix}$$

For any bank l , the number of possible histories it faces at the time of entry is $2^{(M+1) \cdot (l-1)}$. Because the order of entry of banks 1 to $l-1$ is irrelevant for bank l 's entry decision, the number of strategically relevant histories is $\frac{2^{(M+1) \cdot (l-1)}}{(l-1)!}$. I restrict the set $\mathbf{H}_{l-1}$ to exclude matrices that are simply row permutations of one another.

Subsequent to entry decisions by all $(N+1)^2$ banks, each bank l simultaneously chooses deposit prices in every neighborhood for which $e_{ln}(\mathbf{h}_{l-1}) = 1$.

Definition 9 *A strategy in the second stage for bank l associates every entry history $\mathbf{h}_{(N+1)^2} \in \mathbf{H}_{(N+1)^2}$ with a vector of deposit interest rates $\mathbf{r}^d(\mathbf{h}_{(N+1)^2}) \subset \mathbb{R}^{N+1}$.*

Proposition 10 *An equilibrium exists in every second stage subgame.*

Proof. Consider a final-stage equilibrium in neighborhood n in which there exists some consumer who is indifferent between bank j and $j-1 \forall j > 1$ where j order a bank by outside scope. For any entry history of the game, a best response correspondence for each bank in neighborhood n is given by:

$$r_{nj}^d(\mathbf{r}_{n,/j}^d | N_{nj}, \mathbf{N}_{n,/j}) \in \arg \max_{r_{nj}^d} (r^l - r_{nj}^d) \cdot s_{nj}(\mathbf{r}_n^d, \mathbf{N}_n) \quad \forall \mathbf{r}_{n,/j}^d, \mathbf{N}_n$$

where $N_{nj} = \sum_{k=1, k \neq n}^{N+1} e_{jk}$ is the number of neighborhoods outside n in which bank j has a presence, and N is the total number of outside neighborhoods. I refer to a bank's outside neighborhood presence (N_{nj}) as its *outside scope*, so $\mathbf{N}_n$ is a vector of outside scope for all banks in market n . Within any neighborhood n , the actions of bank j 's competitors are summarized by $\mathbf{r}_{n,/j}^d$, a vector of prices in neighborhood n , and $N_{n,/j}$, a vector of outside scope¹. Shaked and Sutton (1982) Proposition 1 shows that the profit function is continuous and quasi-concave in r_{nj}^d . Let the firm choose prices from a suitable, compact, convex set. The best response correspondence is then non-empty, convex, and has closed graph. By Kakutani's theorem a Nash equilibrium in prices exists for each neighborhood n . ■

Proposition 11 *An subgame perfect equilibrium exists in the extensive form game $\langle (N+1)^2, \mathbf{H}, (\mathbf{e}, \mathbf{r}), \pi \rangle$.*

Proof. Each bank's best-response correspondence over entry must be optimal for any history of the game ($\mathbf{h}_{l-1}$) and any strategy profile of other banks [$\mathbf{e}_{/l}(\mathbf{h}_{l-1}), \mathbf{r}^d(\mathbf{h}_{(N+1)^2})$]. A best-response correspondence $e_{ln}(\mathbf{e}_{/l}(\mathbf{h}_{l-1}), \mathbf{r}^d(\mathbf{h}_{(N+1)^2}) | \mathbf{h}_{l-1})$ is therefore give by:

$$\arg \max_{\mathbf{e}_{ln} \in \{0,1\}} \sum_{n=1}^{n=N+1} e_{ln} \cdot \{ \pi_l[\mathbf{r}_n^d(\mathbf{h}_{(N+1)^2}) | \mathbf{h}_{l-1}, \mathbf{e}_{/l}(\mathbf{h}_{l-1})] - F \}$$

$$s.t. \quad \pi_l[\mathbf{r}_n^d(\mathbf{h}_{(N+1)^2}) | \mathbf{h}_{l-1}, \mathbf{e}_{/l}(\mathbf{h}_{l-1})] > 0, \forall e_{ln} = 1$$

¹All information on entry is contained in the first-stage history of the game ($\mathbf{h}_{(N+1)^2}$). The entries in the vector N_n , for example, are obtained by (1) forming a vector of row sums for any row in $\mathbf{h}_{(N+1)^2}$ in which the n^{th} column is non-zero, (2) subtracting one from each entry, and (3) reordering this vector from smallest to largest. I can thus equivalently represent this correspondence as:

$$r_{nj}^d(\mathbf{r}_{n,/j}^d | \mathbf{h}_{(N+1)^2}) \in \arg \max_{r_{nj}^d} (r^l - r_{nj}^d) \cdot s_{nj}(\mathbf{r}_n^d, \mathbf{h}_{(N+1)^2}) \quad \forall \mathbf{r}_{n,/j}^d, \quad \forall \mathbf{h}_{(N+1)^2}$$

Note that a strategy for banks other than j in market n is a mapping from the history of the game to a vector of prices $\mathbf{r}_{n,/j}^d(\mathbf{h}_{(N+1)^2})$.

While notationally cumbersome, the above program has a natural interpretation. For any given history $\mathbf{h}_{l-1}$ at which bank l must make an entry decision, the bank chooses the best outcome along the path of the game induced by $\mathbf{h}_{l-1}$ and other bank's entry ($\mathbf{e}_{/l}(\mathbf{h}_{l-1})$) and pricing ($\mathbf{r}^d(\mathbf{h}_{(N+1)^2})$) strategies². Fix the strategies of other banks [$\mathbf{e}_{/l}(\mathbf{h}_{l-1}), \mathbf{r}^d(\mathbf{h}_{(N+1)^2})$], fix the pricing strategy of bank l after any history $h_{(M+1)^2}$, and consider the entry choice of bank l after some history of the game $\mathbf{h}_l$. This is a discrete choice over 2^{N+1} entry choices, where payoffs are an outcome of the second stage subgame induced by other banks' strategies and bank l 's own pricing strategy. It follows that the set of best responses is nonempty for any history of the game and that a sub-game perfect equilibrium exists by Kuhn's Theorem. ■

Because banks can be indifferent across entry decisions, the equilibrium need not be unique. As a result, the model does not permit an exact calculation of equilibrium neighborhood share for each bank. It is still possible to obtain a lower bound for the neighborhood share, across all $N+1$ neighborhoods, of a bank with outside scope N_j . Such a bank would obtain its lowest neighborhood share in a neighborhood n where there exists a bank of every possible scope. A lower bound for its share across all $N+1$ neighborhoods is therefore given by $(\frac{N_j+1}{N+1}) \cdot s_{nj}(\mathbf{r}_n^d, N_n)$ where $N_n = \{0, 1, 2, \dots, N\}$. I derive an expression for this lower bound.

Lemma 12 *Equilibrium prices in any market n where $N_n = \{0, 1, 2, \dots, N\}$ are given by*

$$r_j^d(r^l, N, \gamma) = r^l - \left(\frac{1}{2^2 - 1}\right) \cdot \frac{1}{U_{N-1}(2)} \cdot T_{j-1}(2) \cdot \frac{2\gamma}{N}$$

Proof. *The first order conditions for r_j^d can be expressed in matrix form as:*

$$\begin{bmatrix} 1 & -\frac{1}{2} & 0 & \dots & \dots & \dots \\ -\frac{1}{4} & 1 & -\frac{1}{4} & 0 & \dots & \dots \\ 0 & -\frac{1}{4} & 1 & -\frac{1}{4} & 0 & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & 0 & -\frac{1}{4} & 1 & -\frac{1}{4} \\ \dots & \dots & \dots & 0 & -\frac{1}{2} & 1 \end{bmatrix} \cdot \begin{bmatrix} r_1^d \\ \dots \\ \dots \\ \dots \\ \dots \\ r_{N+1}^d \end{bmatrix} = \begin{bmatrix} \frac{1}{2}r^l \\ \dots \\ \dots \\ \dots \\ \frac{1}{2}r^l \\ \frac{1}{2}r^l - \frac{1}{2}\frac{\gamma}{N} \end{bmatrix}$$

The $(N+1) \times (N+1)$ matrix of coefficients in this system is tridiagonal and almost-Toeplitz. For the $(N+1) \times (N+1)$ tridiagonal, almost-Toeplitz matrix:

$$\begin{bmatrix} -\lambda & 1 & 0 & \dots & \dots & \dots \\ 1 & -2\lambda & 1 & 0 & \dots & \dots \\ 0 & 1 & -2\lambda & 1 & 0 & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & 0 & 1 & -2\lambda & 1 \\ \dots & \dots & \dots & 0 & 1 & -\lambda \end{bmatrix}$$

²The history h_{l-1} must agree with h_{l-1} for all banks that enter before bank l and be determined by $\mathbf{e}_{/l}(\mathbf{h}_{l-1})$ subsequently. The history $\mathbf{h}_{(M+1)^2}$ at which banks make their pricing decisions is thus completely specified by $\mathbf{h}_{l-1}, \mathbf{e}_l(\mathbf{h}_{l-1})$, and $\mathbf{e}_{/l}(\mathbf{h}_{l-1})$. Together with $\mathbf{r}(\mathbf{h}_{(M+1)^2})$, these objects determine an outcome of the game.

an exact solution for the (symmetric) inverse is known and given by:

$$a_{jk}^{-1} = \frac{1}{(1-\lambda^2)U_{N-1}(\lambda)} \cdot T_{j-1}(\lambda) \cdot T_{N+1-k}(\lambda), \quad 1 \leq j \leq k \leq N+1$$

where T and U are, respectively, Chebyshev polynomials of the first and second kind. To utilize this result, re-express the above system as:

$$\begin{bmatrix} -2 & 1 & 0 & \dots & \dots & \dots \\ 1 & -4 & 1 & 0 & \dots & \dots \\ 0 & 1 & -4 & 1 & 0 & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & 0 & 1 & -4 & 1 \\ \dots & \dots & \dots & 0 & 1 & -2 \end{bmatrix} \cdot \begin{bmatrix} r_1^d \\ \dots \\ \dots \\ \dots \\ \dots \\ r_{N+1}^d \end{bmatrix} = \begin{bmatrix} -2r^l + r^l \\ -2r^l \\ \dots \\ \dots \\ -2r^l \\ -2r^l + r^l + \frac{1}{2} \frac{\gamma}{N} \end{bmatrix}$$

An exact expression for equilibrium prices is then:

$$r_j^d(r^l, N, \gamma) = r^l \cdot [-2 \cdot \sum_{k=1}^{N+1} a_{jk}^{-1} + a_{j1}^{-1} + a_{j,N+1}^{-1}] + a_{j,N+1}^{-1} \cdot \frac{2\gamma}{N} \quad (14.1)$$

$$= r^l + a_{j,N+1}^{-1} \cdot \frac{2\gamma}{N} \quad (14.2)$$

$$= r^l - \left(\frac{1}{2^2 - 1}\right) \cdot \frac{1}{U_{N-1}(2)} \cdot T_{j-1}(2) \cdot \frac{2\gamma}{N} \quad (14.3)$$

$$= r^l - \frac{\sqrt{3}}{3} \cdot \left[\frac{(2 + \sqrt{3})^{j-1} + (2 - \sqrt{3})^{j-1}}{(2 + \sqrt{3})^N - (2 - \sqrt{3})^N} \right] \cdot \frac{2\gamma}{N} \quad (14.4)$$

where the lines 3 and 4 follow, respectively, from the matrix inverse given above and the non-recursive representation of the Chebyshev polynomials. The sum that is multiplied by r^l collapses to 1 in line 2 by the following argument:

$$-2 \cdot \sum_{k=1}^{N+1} a_{jk}^{-1} + a_{j1}^{-1} + a_{j,N+1}^{-1} = \quad (\text{Eq. A})$$

$$-2 \cdot \left[\sum_{k=j}^{N+1} a_{jk}^{-1} + \sum_{k=1}^{j-1} a_{kj}^{-1} \right] + a_{j1}^{-1} + a_{j,N+1}^{-1} =$$

$$\frac{1}{(\lambda^2 - 1)U_{N-1}(\lambda)} \cdot \left[2 \sum_{k=j}^{N+1} T_{j-1}(\lambda) \cdot T_{N+1-k}(\lambda) + 2 \sum_{k=1}^{j-1} T_{k-1}(\lambda) \cdot T_{N+1-j}(\lambda) - T_{j-1}(\lambda) - T_{N+1-j}(\lambda) \right]$$

Where the first equation follows from the symmetry of the matrix inverse. Using standard rules for the algebra of Chebyshev polynomials, these sums can be simplified:

$$\sum_{k=j}^{N+1} T_{j-1}(\lambda) \cdot T_{N+1-k}(\lambda) = \frac{1}{2} \sum_{k=j}^{N+1} T_{N+j-k}(\lambda) + \frac{1}{2} \sum_{k=j}^{N+1} T_{|j-1-N-1+k|}(\lambda) \quad (*)$$

$$\sum_{k=1}^{j-1} T_{k-1}(\lambda) \cdot T_{N+1-j}(\lambda) = \frac{1}{2} \sum_{k=1}^{j-1} T_{N-j+k}(\lambda) + \frac{1}{2} \sum_{k=1}^{j-1} T_{|j-1-N-1+k|}(\lambda) \quad (**)$$

Combining (*) and (**):

$$\begin{aligned} & 2 \sum_{k=j}^{N+1} T_{j-1}(\lambda) \cdot T_{N+1-k}(\lambda) + 2 \sum_{k=1}^{j-1} T_{k-1}(\lambda) \cdot T_{N+1-j}(\lambda) = \\ & \sum_{k=j}^{N+1} T_{N+j-k}(\lambda) + \sum_{k=1}^{j-1} T_{N-j+k}(\lambda) + \sum_{k=1}^{N+1} T_{|j-1-N-1+k|}(\lambda) = \\ & \sum_{k=0}^{N-1} T_k(\lambda) + T_{N+1-j}(\lambda) + \sum_{k=0}^N T_k(\lambda) + T_{j-1}(\lambda) - 1 \end{aligned}$$

Equation A can then be simplified to yield:

$$\begin{aligned} & -2 \cdot \sum_{k=1}^{N+1} a_{jk}^{-1} + a_{j1}^{-1} + a_{j,N+1}^{-1} = \\ & \frac{1}{(\lambda^2 - 1)U_{N-1}(\lambda)} \cdot \left[\sum_{k=0}^{N-1} T_k(\lambda) + \sum_{k=0}^N T_k(\lambda) - 1 \right] = \\ & \frac{\frac{1}{(\lambda^2 - 1)}}{U_{N-1}(\lambda)} \cdot \left\{ 1 + 2\lambda + \sum_{k=2}^{N-1} \frac{1}{2} [U_k(\lambda) - U_{k-2}(\lambda)] + \sum_{k=2}^N \frac{1}{2} [U_k(\lambda) - U_{k-2}(\lambda)] \right\} = \\ & \frac{1}{(\lambda^2 - 1)U_{N-1}(\lambda)} \left[\frac{1}{2} U_N(\lambda) + U_{N-1}(\lambda) + \frac{1}{2} U_{N-2}(\lambda) \right] = \\ & \frac{1}{(\lambda^2 - 1)} \left[1 + \frac{1}{2} \cdot \frac{U_N(\lambda) + U_{N-2}(\lambda)}{U_{N-1}(\lambda)} \right] = \\ & \frac{1}{(\lambda^2 - 1)} [1 + \lambda] \end{aligned}$$

When $\lambda = 2$ this expression is equal to 1. ■

Using this closed form expression for $r_j^d(r^l, N, \gamma)$ it is possible to obtain, for any given scope, a lower bound for the neighborhood share of a bank and to characterize this share as the number of neighborhoods N grows arbitrarily large. I focus on the case of a bank of scope $N + 1$, that is, a bank that enters every neighborhood. The existence of such a bank corresponds to the case where the fixed cost of entry is low. The neighborhood share for this bank is given by $1 - F(\alpha_{N+1}) = 1 - \alpha_{N+1}$ in case of the uniform distribution, where α_{N+1} represents a consumer who is indifferent between a bank of scope $N + 1$ and N .

Lemma 13 *The limiting market share of bank of greatest scope in a any market n where $N_n = \{0, 1, 2, \dots, N\}$ is given by*

$$\lim_{N \rightarrow \infty} s_{N+1} \approx 15$$

Proof. It was shown above that, in equilibrium, the neighborhood share for the firm of greatest scope is given by:

$$\begin{aligned}
 \lim_{N \rightarrow \infty} s_{N+1} &= 1 - \lim_{N \rightarrow \infty} \alpha_{N+1} \\
 &= 1 - \lim_{N \rightarrow \infty} \frac{r_N^d(\cdot) - r_{N+1}^d(\cdot)}{\frac{\gamma}{N}} \\
 &= 1 - \left(\frac{2}{2^2 - 1}\right) \lim_{N \rightarrow \infty} \frac{1}{U_{N-1}(2)} \cdot [T_N(2) - T_{N-1}(2)]
 \end{aligned}$$

To characterize this share as N grows arbitrarily large, I rely Nevai's (1979) results for the asymptotic ratios of orthogonal polynomials. For a Chebyshev polynomial of the second type:

$$\begin{aligned}
 \lambda U_N(\lambda) &= \frac{1}{2} U_{N+1}(\lambda) - \frac{1}{2} U_{N-1}(\lambda) \Rightarrow \\
 \lim_{N \rightarrow \infty} \frac{U_{N-1}(\lambda)}{U_N(\lambda)} &= \lambda - \sqrt{\lambda^2 - 1}
 \end{aligned}$$

It follows that:

$$\begin{aligned}
 \lim_{N \rightarrow \infty} \frac{T_N(2)}{U_{N-1}(2)} &= \lim_{N \rightarrow \infty} \frac{\frac{1}{2} U_N(2) - \frac{1}{2} U_{N-2}(2)}{U_{N-1}(2)} \\
 &= \lim_{N \rightarrow \infty} \frac{\frac{1}{2} (4U_{N-1}(2) - U_{N-2}) - \frac{1}{2} U_{N-2}(2)}{U_{N-1}(2)} \\
 &= 2 - \lim_{N \rightarrow \infty} \frac{U_{N-2}(2)}{U_{N-1}(2)} \\
 &= \sqrt{3} \\
 \lim_{N \rightarrow \infty} \frac{T_{N-1}(2)}{U_{N-1}(2)} &= \frac{\frac{1}{2} U_{N-1}(2) - \frac{1}{2} U_{N-3}(2)}{U_{N-1}(2)} \\
 &= \frac{1}{2} - \frac{1}{2} \left[\frac{4U_{N-2}(2) - U_{N-1}(2)}{U_{N-1}(2)} \right] \\
 &= 2\sqrt{3} - 3
 \end{aligned}$$

It then follows that:

$$\begin{aligned}
 \lim_{N \rightarrow \infty} s_{N+1} &= 1 - \left(\frac{2}{2^2 - 1}\right) \lim_{N \rightarrow \infty} \frac{1}{U_{N-1}(2)} \cdot [T_N(2) - T_{N-1}(2)] \\
 &= 1 - \frac{2}{3} (\sqrt{3} - (2\sqrt{3} - 3)) \\
 &= \frac{2\sqrt{3}}{3} - 1 \\
 &\approx .15
 \end{aligned}$$

■

The share of the largest bank is approximately .15 even as the number of neighborhoods—and banks—grows arbitrarily large.

14.2 Limiting Market Shares in a Model of Loan Competition

I show that a model of lending can deliver an asymptotically equivalent result for the share of the largest bank. The result illustrates the difficulty in empirically distinguishing the effects of loan and deposit side phenomenon in banking market structure. I present a simple equilibrium model of bank lending and deposit taking where the loan side determines market structure. In this model:

- (1) firm heterogeneity with respect to lending gives rise to differing loan market shares
- (2) loan market shares reflect differences in the underlying technology of lending or, alternatively, a bank's span of control
- (3) a right-skewed distribution of technology or organizational ability implies right-skewed market structures, and a small fraction of banks or a small number of banks can dominate lending even if the market is arbitrarily large, and
- (4) deposit market shares passively reflects loan market shares

I assume banks can acquire funds in a competitive borrowing market at rate r^b and lend in a competitive lending market with interest rate r^l where $r^l > r^b$. Each bank can make $\$x$ worth of loans with expected return $p(x, \theta) \cdot x$ where θ is a firm-specific attribute distributed on $[\underline{\theta}, \infty)$ according to $F(\theta)$. The probability of a loss $(1 - p(x, \theta))$ increases with total lending, but this probability is smaller for firms with a high θ . I assume that:

$$\begin{aligned} p(0, \theta) &= 0, \frac{\partial p(0, \theta)}{\partial x} = 0 \quad \forall \theta \\ \frac{\partial p(x, \theta)}{\partial x} &< 0, \frac{\partial p(x, \theta)}{\partial \theta} > 0, \frac{\partial^2 p(x, \theta)}{\partial x^2} < 0, \text{ and } \frac{\partial^2 p(x, \theta)}{\partial x \partial \theta} > 0 \quad \forall \theta, \forall x > 0 \end{aligned}$$

This simple framework is consistent with several empirical interpretations. Banks can differ in their lending technologies, so that different banks can “safely” handle different portfolio sizes. Banks could also differ in their span of control, or organizational capability to effectively monitor a large team of loan officers³.

Banks make an entry decision with associated fixed cost C before they realize their value of θ . Conditional on entry, banks observe their value of θ and choose a level of loans so as to:

$$\max_x r^l \cdot p(x, \theta) \cdot x - r^b \cdot x$$

The solution function $x(r^l, r^b, \theta)$ and profit function $\pi(r^l, r^b, C, \theta)$ are then strictly increasing in θ :

³Alternatively, banks can possess comparative advantage in different types of loans, indexed by θ . A matching process in the loan market would then result in different loan types associating with different banks. In this setting, the size of a bank's optimal lending portfolio would follow from characteristics of the underlying borrowers as opposed to the bank's technology or organizational capability.

$$\begin{aligned}\frac{\partial x(r^l, r^b, \theta)}{\partial \theta} &= \frac{-[\frac{\partial^2 p(x(\cdot), \theta)}{\partial x \partial \theta} + \frac{\partial p(x(\cdot), \theta)}{\partial \theta}]}{\frac{\partial^2 p(x(\cdot), \theta)}{\partial x^2} + \frac{\partial p(x(\cdot), \theta)}{\partial \theta}} = \frac{(-) \cdot (+)}{(-)} = (+) \\ \frac{\partial \pi(r^l, r^b, C, \theta)}{\partial \theta} &= r^l \cdot \frac{\partial p(x(\cdot), \theta)}{\partial \theta} \cdot x(r^l, r^b, \theta) = (+)\end{aligned}$$

Banks lend more and make higher profits if they have a lower probability of loss for any given level of loans.

I next define an upward-sloping market supply curve for credit such that (1) the number of potential entrants can vary, and (2) a heterogeneous set of banks make loans. I modify a standard competitive model to obtain these two features. In a short-run equilibrium, an upward sloping supply curve is derived by *fixing* the number of potential entrants. In a long run equilibrium, only banks at minimum efficient scale make loans. With free entry the supply curve is perfectly elastic and the efficient loan amount for each bank—its minimum efficient scale—is given by the intersection of the average cost curve with the maximum over the set of average revenue curves. A long run supply curve can be defined in this way when the set of θ 's has an upper bound with strictly positive mass. The set of banks that make loans in a long-run equilibrium are those that achieve this upper bound⁴. This conclusion does not follow when, as here, there is no such upper bound with strictly positive mass.

I first partially endogenize the set of potential entrants. For any pair of market prices $\{r^l, r^b\}$, I define the number of potential entrants be the largest number of firms that can each expect to make weakly positive profits:

$$\begin{aligned}N(r^l, r^b, C) &= \max\{N \in \mathbb{Z} \mid E_\theta[\min\{\pi_i(r^l, r^b, C, \theta)_{i=1}^N\}] \geq 0\} = \\ &\max\{N \in \mathbb{Z} \mid \int_\theta \pi(r^l, r^b, C, \theta) dF_{N,N}(\theta) \geq 0\}\end{aligned}$$

where $F_{N,N}(\theta)$ is the distribution of the N th order statistic, the minimum of N independent draws from $F(\theta)$. I assume that potential entrants make an entry decision before realizing their values of θ , so they will enter if they make weakly positive profits in expectation. The definition of potential entrants guarantees that all banks will enter⁵. If $E_\theta[x(r^l, r^b, \theta)]$ exists, the expected market supply function is given by:

$$X^s(r^l, r^b) = E_\theta[x(r^l, r^b, \theta)] \cdot N(r^l, r^b, C)$$

⁴If the set of possible θ 's has a maximum at $\bar{\theta}$, then the maximum average revenue curve is well-defined ($r_l \cdot p(x, \bar{\theta})$). The average cost curve is identical across banks. Define an equilibrium price r_l^* such that average revenue equals average cost at an optimum for a bank of type $\bar{\theta}$:

$$(r_l^* \cdot p(x(r_l^*, r^b, \bar{\theta}), \bar{\theta}) - r^b) \cdot x(r_l^*, r^b, \bar{\theta}) - C = 0$$

By the monotonicity of the profit function, profits must be strictly negative for all banks with $\theta < \bar{\theta}$.

⁵If the expected value of the minimum profit over N draws from $F(\theta)$ is weakly positive then the expected profit of any individual bank is also weakly positive.

After entering, banks realize their value of θ and set loan levels so as to maximize expected profits, conditional on θ .

To obtain closed-form expressions, I assume:

$$p(x, \theta) = \begin{cases} 1 - \frac{x}{\theta} & x \leq \theta \\ 0 & x > \theta \end{cases}$$

It is easily verified that this functional form satisfies the restrictions given above. It follows that:

$$\begin{aligned} x(r^l, r^b, \theta) &= \frac{\theta}{2} \left(1 - \frac{r^b}{r^l}\right) \\ p(r^l, r^b, \theta) &= \frac{1}{2} \left(1 + \frac{r^b}{r^l}\right) \\ \pi(r^l, r^b, C, \theta) &= \frac{\theta}{4} (r^l - r^b) - C \end{aligned}$$

A convenience of the functional form chosen is that the equilibrium probability of loss does not depend on θ so both loans and profits are affine functions of θ . It follows that the expected market supply function as well as the distribution of loans and profits across banks can be derived from $F(\theta)$ ⁶.

⁶To illustrate, suppose θ is distributed uniformly on the interval $[\underline{\theta}, \bar{\theta}]$. Then expected profits of the firm with the lowest draw of θ is given by:

$$E_\alpha[\min\{\pi_i(r_l, r_b, C, \theta)_{i=1}^N\}] = \left(\frac{r_l - r_b}{4}\right) \cdot \left(\frac{\bar{\theta} + N\underline{\theta}}{N+1}\right) - F$$

The number of entrants is:

$$N(r_l, r_b) = \min\{N \in \mathbb{Z} \mid N \geq \frac{\frac{\bar{\theta}}{4}(r_l - r_b) - C}{C - \frac{\underline{\theta}}{4}(r_l - r_b)}\}$$

Because at least one entrant must achieve positive profits in expectation, the minimum r_l for which banks enter is given by:

$$r_l \geq r_b + \frac{4C}{\frac{\bar{\theta} + \underline{\theta}}{2}}$$

Similarly, if r_l is high enough, then even bank of type $\underline{\theta}$ will earn weakly positive profits. A bank with any value $\theta \geq \underline{\theta}$ will earn positive profits in expectation if:

$$r_l \geq r_b + \frac{4C}{\underline{\theta}}$$

so that the number of potential entrants is unbounded (and the expected market supply function has infinite slope) as r_l approaches this value from below. It follows that the expected market supply function is given by:

$$\begin{aligned} X^s(r_l, r_b, C) &= E_\alpha[x(r_l, r_b, \theta)] \cdot N(r_l, r_b, C) \\ &= \begin{cases} 0 & r_l \in [0, r_b + \frac{4C}{\frac{\bar{\theta} + \underline{\theta}}{2}}) \\ N \cdot \frac{\bar{\theta} + \underline{\theta}}{4} \left(1 - \frac{r_b}{r_l}\right) & N \in \mathbb{Z}, r_l \in [r_b + \frac{4C}{\frac{\bar{\theta} + N\underline{\theta}}{N+1}}, r_b + \frac{4C}{\underline{\theta}}) \end{cases} \end{aligned}$$

With this definition of the expected market supply function, I can then examine the pattern of expected market shares across banks as the size of the market increases, that is, as the market demand function shifts out. It is easily seen that the number of entrants is unbounded and that the distribution of θ governs the expected market shares across banks. The Lorenz curve provides a useful way of characterizing the concentration of bank lending⁷. I assume that θ follows a Pareto distribution:

$$F(\theta) = \begin{cases} 1 - (\frac{\theta}{\underline{\theta}})^a & a > 1, \theta \geq \underline{\theta} \\ 0 & \theta < \underline{\theta} \end{cases}$$

The Lorenz curve takes the form:

$$L(F(\theta)) = 1 - (1 - F(\theta))^{1 - \frac{1}{a}}$$

so that $1 - L(F(\theta')) = (1 - F(\theta'))^{1 - \frac{1}{a}}$ is the fraction of total loans made by firms with $\theta \geq \theta'$. As $a \rightarrow 1^+$ the concentration of loans made becomes increasingly skewed toward the largest banks⁸. For any quantile of the largest banks $(1 - F(\theta))$, the fraction of loans made by this quantile becomes arbitrarily close to 1. This model of loans is thus consistent with extreme skewness in the size distribution of banks when size is measured by loan portfolios.

This model is also consistent with a high degree of skewness measured in the terms of number, as opposed to the quantile, of the largest banks. Market concentration is often measured by the k - *firm* ratio, here, the fraction of total loans made by the largest k banks. I focus on the case where $k = 1$ and show that this model is also consistent with a non-zero market share for the largest bank as demand shifts out and the number banks in the market grows arbitrarily large. For any sequence of i.i.d. random variables, the ratio $R_n = \frac{\max\{x_i\}_{i=1}^n}{\sum_{i=1}^n x_i}$ converges to 0 almost surely in n if $E(x_i) < \infty$ (O'Brien 1980). It follows that for Pareto-distributed random variables, a necessary condition for the market share of the largest firm to remain positive in the limit is that $a \leq 1$. For this distribution⁹, it can be shown (Bingham and Teugels, 1981) that as $n \rightarrow \infty$:

$$(i) \quad E[\frac{1}{R_n}] \rightarrow \frac{1}{1-a}, \quad a \in (0, 1)^{10}$$

$$(ii) \quad R_n \xrightarrow{d} y_a, \text{ where } y_a \text{ has a non-degenerate distribution}$$

Because $R_n \in [0, 1]$ with probability one, $E[R_n] > 0$ exists. It follows that when $a < 1$, the largest bank accounts for a non-zero proportion of total market lending in expectation even if the market grows arbitrarily large.

⁷If, as was assumed for illustration, θ has a uniform distribution, the largest 10% of banks account for 19% of lending.

⁸The Lorenz curve for the Pareto distribution is not defined if $a \leq 1$ because the first moment no longer exists.

⁹These results hold where x is an *iid* random variable with distribution function $F(x)$ on $\mathbb{R}_+$, $F(0) = 0$, and $F(x) \in D(\alpha)$ for some $\alpha \in (0, 1)$, that is, a normalized sum of x converges in distribution to an α -stable random variable.

¹⁰This result is straightforward to derive in the special case of the Pareto distribution (Zaliapin et al 2003).

With this flexible apparatus for considering loan market shares, I consider a simple, spatial model of competition for deposits. I assume there are $M + 1$ markets in which banks can locate¹¹. In each market consumers inelastically supply $\frac{1}{M+1}$ units of deposits to banks. As noted above, banks can access a market for debt at cost r^b . I assume Bertrand competition in deposit prices (r^d) in each market. Banks pay a fixed cost F to enter each market. Banks simultaneously make an entry and price decision across each market conditional on their realization of θ . By the usual logic of Bertrand competition, an equilibrium outcome for any particular market consists of one bank entering and charging a price r^{d*} so that its average cost for deposits equals that of its cost of outside funds ($\frac{\frac{1}{M+1} \cdot r^{d*} + F}{\frac{1}{M+1}} = r^b$).

As there are many equilibria in this game, I impose a selection rule so that deposit shares across markets passively reflect loan shares. The intuition for this assumption is that banks with a greater need for funds are more likely to enter more markets. I assume the number of markets in which bank i enters in equilibrium and takes all the deposits is $[s_i \cdot (M + 1)]$ where s_i is a bank's share of the loan market and $[\cdot]$ represents the lowest integer part of the expression. This holds for all banks i except the largest bank. For the largest bank (s_N) this number of markets is given by $[s_N \cdot (M + 1)] + M + 1 - \sum_{i=1}^{N-1} [s_i \cdot (M + 1)]$. If the number of deposit markets is large, then deposit market shares approximate loan market shares arbitrarily closely.

¹¹I have therefore assumed that firms can costlessly move across these $M + 1$ markets in order to acquire funds. This would be a reasonable assumption for loan and deposit competition across a large metropolitan area made up of $M + 1$ neighborhoods.

14.3 Tables and Figures

Table 1
Branches per Capita Across States with Varying Branch Restrictions

	Free Branching		Unit Within Market		Unit Across Market	
	MSA (1)	NonMSA (2)	MSA (3)	NonMSA (4)	MSA (5)	NonMSA (6)
1977	0.215	0.362	0.100	0.387	0.171	0.334
1982	0.230	0.385	0.115	0.388	0.217	0.380
1987	0.225	0.396	0.134	0.422	0.234	0.407
1992	0.212	0.390	0.164	0.470	0.248	0.431
1997	0.197	0.386	0.198	0.505	0.264	0.450

Notes: The table presents branches per capita figures for MSA and NonMSA markets across different states. "Free Branching" refers to states that never had branching restrictions: AK, AZ, CA, DE, ID, MD, NC, NV, RI, SC, SD, VT. "Unit Within Market" refers to unit-banking states where the one-bank-one-branch rule was a binding constraint: CO, IL, KS, MT, NE, OK, TX, WV, WY. "Unit Across Market" refers to unit-banking states where some branching occurred within a market but no branching occurred across markets: FL, IN, KY, MA, MN, MO, ND, NM, TN.

Table 2
Branches per Capita Across States with Varying Branch Restrictions

	Unit Within Market		Unit Within BHC Reg		Unit Within BHC Free	
	MSA (3)	NonMSA (4)	MSA (3)	NonMSA (4)	MSA (5)	NonMSA (6)
1977	0.100	0.387	0.119	0.443	0.086	0.320
1982	0.115	0.388	0.146	0.453	0.092	0.312
1987	0.134	0.422	0.175	0.500	0.103	0.332
1992	0.164	0.470	0.216	0.559	0.124	0.366
1997	0.198	0.505	0.253	0.600	0.158	0.394

Notes: The table presents branches per capita figures for MSA and NonMSA markets across different states. "Unit Within Market" refers to unit-banking states where the one-bank-one-branch rule was a binding constraint: CO, IL, KS, MT, NE, OK, TX, WV, WY. "Unit Within BHC Reg" refers to the subset of these states where, at the beginning of the sample period, unit branching could not be circumvented through a holding company structure: IL, KS, NE, OK, WV. "Unit Within BHC Free" refers to the subset of these states bank holding companies were always free to own multiple branches: CO, MT, TX, WY.

Table 3
Growth of Branches Per Capita After Within State Branching Deregulation

	Dependent Variable - Total Market Branches Per One Thousand Persons					
	Treatment - Within State Deregulation					
	MSA			NonMSA		
	Unit (1)	Unit Within (2)	Unit Across (3)	Unit (4)	Unit Within (5)	Unit Across (6)
Time	-0.0013** (0.0005)	-0.0013** (0.0005)	-0.0013** (0.0005)	0.0029* (0.0015)	0.0029* (0.0015)	0.0029* (0.0015)
Time*Dereg	0.0065*** (0.0012)	0.0051*** (0.0010)	0.0076*** (0.0015)	0.0072*** (0.0019)	0.0078*** (0.0020)	0.0058** (0.0021)
Dereg*Post	-0.0505 (0.0709)	0.0444 (0.0686)	-0.1582 (0.1009)	0.2072 (0.1266)	0.2137* (0.1125)	0.0506 (0.2065)
Time*Dereg*Post	-0.0004 (0.0020)	0.0040*** (0.0009)	-0.0046* (0.0024)	0.0008 (0.0015)	0.0028* (0.0016)	-0.0032 (0.0032)
N	4284	2814	2856	29892	19644	15864
R-sq	0.63	0.7	0.42	0.41	0.44	0.36

Notes: The table presents an OLS regression of the number of branches in a market per one thousand persons on a time trend and the log of bank deposits. These covariates are interacted with indicator variables for deregulating states and post-deregulation years. Deposit level data are from the Federal Reserve's Summary of Deposits, county business data are from the County Business Patterns, and market and state level covariates are from the Bureau of Economic Analysis. All regressions contain state level fixed effects and are clustered at the state level.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4
Deposit Concentration (BHC) Across States with Varying Branch Restrictions

	Free Branching States									Unit Within States								
	MSA (1)			NonMSA (2)			State (3)			MSA (4)			NonMSA (5)			State (6)		
	K1	K3	HHI	K1	K3	HHI	K1	K3	HHI	K1	K3	HHI	K1	K3	HHI	K1	K3	HHI
1977	0.38	0.75	0.25	0.57	0.94	0.48	0.30	0.62	0.17	0.30	0.65	0.19	0.54	0.90	0.46	0.12	0.26	0.04
1982	0.37	0.73	0.24	0.56	0.93	0.46	0.30	0.63	0.18	0.29	0.62	0.18	0.54	0.89	0.45	0.12	0.27	0.04
1987	0.35	0.71	0.23	0.55	0.92	0.45	0.28	0.59	0.16	0.30	0.63	0.18	0.54	0.89	0.45	0.15	0.30	0.05
1992	0.37	0.74	0.25	0.54	0.92	0.44	0.33	0.67	0.20	0.29	0.62	0.18	0.54	0.89	0.45	0.15	0.31	0.05
1997	0.35	0.70	0.23	0.52	0.90	0.42	0.32	0.65	0.19	0.31	0.64	0.19	0.52	0.89	0.43	0.19	0.38	0.07

Notes: The table presents 1 firm and 3 firm concentration ratios and HHI for bank deposits--all measured at the bank holding company level--for MSA markets, NonMSA markets, and states. "Free Branching" refers to states that never had branching restrictions: AK, AZ, CA, DE, ID, MD, NC, NV, RI, SC, SD, VT. "Unit Within Market" refers to unit-banking states where the one-bank-one-branch rule was a binding constraint: CO, IL, KS, MT, NE, OK, TX, WV, WY.

Table 5
Deposit Concentration Across States

	Unit Within BHC Reg								Unit Within BHC Free							
	MSA BHC				MSA Bank				State BHC				State Bank			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	K1	K3	K1	K3	K1	K3	K1	K3	K1	K3	K1	K3	K1	K3	K1	K3
1977	0.26	0.59	0.26	0.58	0.08	0.18	0.07	0.17	0.32	0.69	0.30	0.66	0.17	0.37	0.07	0.18
1982	0.26	0.56	0.25	0.55	0.08	0.18	0.08	0.17	0.31	0.67	0.28	0.62	0.16	0.39	0.06	0.17
1987	0.30	0.61	0.28	0.57	0.12	0.23	0.07	0.16	0.29	0.64	0.26	0.58	0.20	0.40	0.06	0.15
1992	0.30	0.62	0.29	0.59	0.13	0.27	0.10	0.19	0.28	0.62	0.27	0.59	0.19	0.36	0.16	0.28
1997	0.31	0.63	0.30	0.61	0.15	0.31	0.12	0.26	0.31	0.64	0.30	0.63	0.23	0.46	0.23	0.46

Notes: The table presents 1 firm and 3 firm concentration ratios--measured at the bank holding company and bank level-- for different states. "Unit Within Market" refers to unit-banking states where the one-bank-one-branch rule was a binding constraint: CO, IL, KS, MT, NE, OK, TX, WV, WY. "Unit Within BHC Reg" refers to the subset of these states where, at the beginning of the sample period, unit branching could not be circumvented through a holding company structure: IL, KS, NE, OK, WV. "Unit Within BHC Free" refers to the subset of these states bank holding companies were always free to own multiple branches: CO, MT, TX, WY.

Table 6
Change in Relationship of Concentration to Market Size

	Dependent Variable - Log of K-Firm Deposit Concentration							
	Free Branching				Unit Branching			
	K1 (1)	K2 (2)	K3 (3)	K4 (4)	K1 (5)	K2 (6)	K3 (7)	K4 (8)
Log(Deposits)	-0.1649*** (0.0129)	-0.1169*** (0.0079)	-0.0779*** (0.0057)	-0.0533*** (0.0043)	-0.2669*** (0.0093)	-0.1775*** (0.0069)	-0.1236*** (0.0058)	-0.0921*** (0.0050)
Log(Deposits)*Time	0.0003 (0.0005)	0.0000 (0.0003)	-0.0002 (0.0002)	-0.0003 (0.0002)	0.0026*** (0.0004)	0.0013*** (0.0003)	0.0011*** (0.0003)	0.0011*** (0.0002)
N	7014	7014	7014	7014	27174	27174	27174	27174
R-sq	0.46	0.52	0.54	0.54	0.48	0.45	0.43	0.41
Log(Deposits)	-0.1601*** (0.0124)	-0.1115*** (0.0073)	-0.0723*** (0.0052)	-0.0485*** (0.0039)	-0.2545*** (0.0084)	-0.1684*** (0.0062)	-0.1152*** (0.0050)	-0.0849*** (0.0044)
Log(Deposits)*(Year=82)	-0.002 (0.0068)	-0.005 (0.0039)	-0.0073*** (0.0027)	-0.0064*** (0.0019)	-0.0066* (0.0034)	-0.0083*** (0.0024)	-0.0079*** (0.0018)	-0.0051*** (0.0016)
Log(Deposits)*(Year=87)	-0.0118 (0.0094)	-0.0115* (0.0063)	-0.0137** (0.0054)	-0.0127*** (0.0044)	0.0188*** (0.0054)	0.0065 (0.0042)	0.0059* (0.0034)	0.0071** (0.0029)
Log(Deposits)*(Year=92)	0.0142 (0.0093)	0.0068 (0.0055)	-0.0007 (0.0040)	-0.0041 (0.0031)	0.0272*** (0.0066)	0.0116** (0.0056)	0.0096** (0.0045)	0.0115*** (0.0038)
Log(Deposits)*(Year=97)	0.0077 (0.0106)	-0.0031 (0.0064)	-0.0087** (0.0043)	-0.0085** (0.0034)	0.0391*** (0.0070)	0.0150** (0.0058)	0.0117** (0.0048)	0.0140*** (0.0040)
N	7014	7014	7014	7014	27174	27174	27174	27174
R-sq	0.47	0.52	0.54	0.54	0.48	0.46	0.43	0.41

Notes: The table presents an OLS regression of the log of the market k-firm concentration ratio, measured at the bank holding company level, on log of total deposits in the market. Markets are counties and MSAs. Deposits are interacted with a time trend in the top specification and with year dummies in the bottom specification. Deposit level data are from the Federal Reserve's Summary of Deposits and market and state level covariates are from the Bureau of Economic Analysis. All regressions contain year level fixed effects and are clustered at the state level.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7
Change in the Relationship of Deposit Rate to Bank Size

	Dependent Variable - Deposit Rate					
	Free (1)	Unit (2)	Unit Within (3)	Unit BHC Reg (5)	Unit BHC Free (6)	Unit Within BHC Reg (7)
Log(Deposits)	0.2051** (0.0710)	0.2181*** (0.0408)	0.2848*** (0.0443)	0.2390*** (0.0452)	0.2034** (0.0690)	0.2514*** (0.0501)
Log(Deposits)*Time	-0.0117* (0.0057)	-0.0158*** (0.0025)	-0.0203*** (0.0023)	-0.0176*** (0.0024)	-0.0144*** (0.0042)	-0.0185*** (0.0027)
N	18060	158168	95926	70008	88160	56496
R-sq	0.56	0.72	0.72	0.75	0.7	0.75
Log(Deposits)	0.0837* (0.0411)	0.1334*** (0.0249)	0.1719*** (0.0206)	0.1775*** (0.0290)	0.0920** (0.0356)	0.1908*** (0.0299)
Log(Deposits)*(Year=82)	0.123 (0.1341)	-0.0711 (0.0511)	-0.0245 (0.0569)	-0.1028*** (0.0231)	-0.0246 (0.0715)	-0.1204*** (0.0233)
Log(Deposits)*(Year=87)	-0.0403 (0.1125)	-0.1291*** (0.0411)	-0.1408 (0.0785)	-0.2057*** (0.0436)	-0.0705* (0.0330)	-0.2152** (0.0485)
Log(Deposits)*(Year=92)	-0.0884 (0.0854)	-0.1976*** (0.0225)	-0.2333*** (0.0265)	-0.2143*** (0.0439)	-0.1785*** (0.0221)	-0.2345*** (0.0472)
Log(Deposits)*(Year=97)	-0.0414 (0.0413)	-0.1266*** (0.0244)	-0.1636*** (0.0179)	-0.1633*** (0.0236)	-0.0887** (0.0392)	-0.1670*** (0.0259)
N	18060	158168	95926	70008	88160	56496
R-sq	0.57	0.72	0.73	0.76	0.7	0.76

Notes: The table presents an OLS regression of the deposit rate paid by a bank on its total deposit holdings in a state. Deposits are interacted with a time trend in the top specification and with year dummies in the bottom specification. Deposit level data are from the Federal Reserve's Summary of Deposits and market and state level covariates are from the Bureau of Economic Analysis. All regressions contain year level and state level fixed effects and are clustered at the state level.

* significant at 10%; ** significant at 5%; *** significant at 1%