Competition and specialization in credit markets

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Abstract

Competition in credit markets creates incentives for lenders to specialize in lending to particular types of borrowers. However, whether lenders have the ability to specialize at all and, if they can specialize how they will specialize is unclear. I analyze the impact of an exogenous increase in credit market competition, brought about by state-wide and national deregulation of U.S. commercial banking markets, on the degree to which commercial banks specialize in lending. I find that in more competitive lending markets after deregulation larger banks become more specialized relative to smaller banks. However, both groups of banks exhibit greater specialization, albeit in different ways. Larger banks specialize more in loans backed by real estate - loans arguably characterized as "hard-information" loans. Smaller banks specialize more in unsecured commercial loans, especially small business loans, and personal loans – loans arguably characterized as "soft-information" loans. When banks specialize in real-estate-backed loans, they exhibit larger fractions of loan defaults in these loans, which suggests they specialize in these loans by lowering the costs of lending to all borrowers, resulting in an overall expansion of credit in the market for real-estate-backed loans. In contrast, when banks specialize in unsecured business and personal loans, they exhibit lower default rates in these loans, suggesting that they specialize by becoming better at identifying good quality loans, rather than by lowering the overall costs of lending in these categories. Finally, I examine how banks may lower their lending costs in reaction to competition through the use of loan resale and derivatives markets. Overall, the analysis provides evidence that competition leads to greater specialization amongst lenders and provides evidence on how different types of lenders become specialists in lending.

Keywords: Credit market competition; Lender specialization; Banking deregulation

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1. Introduction

Competition creates incentives for firms to specialize, or differentiate themselves, in order to capture market share and maintain profits. Firms' incentives to specialize have been explored theoretically (e.g., Salop (1979), Shaked and Sutton (1982), Wolinsky (1984), Perloff and Salop (1985), Anderson, de Palma and Thisse (1992)) and tested empirically in the context of several non-finance industries (e.g., Berry (1990), Berry, Levinsohn and Pakes (1995) and Epple (1987)). However, comparatively little work has been done to examine the link between competition and firms' incentives and ability to specialize in the financial industries.[1] This is surprising given the growing importance of the financial sector as a percentage of economic activity in the U.S. and other developed countries. Moreover, governments and regulators are placing an increasing importance on maintaining competitive, yet accountable, practices amongst financial firms serving both the demanders of capital and their investors. Understanding whether and how financial firms specialize in reaction to competition is clearly important from the standpoint of both the consumers of financial services as well as policymakers.

I take steps to fill this gap, using the commercial bank lending market as a testing ground. The commercial banking market is a good setting for studying the effects of competition on firm specialization for several reasons. First, commercial banks provide the majority of debt financing in the U.S., and an even larger percentage of private debt financing. This is not only true for publicly-traded firms, for whom commercial banks comprise well over half of the private debt held by these firms, but especially true for private firms, for whom over seventy-five percent of private lending is done by commercial banks.[2] Clearly private bank debt is one of the most important sources of external financing for firms. Moreover, when it comes to lending to individuals, commercial banks are just as important, accounting for the majority of residential mortgages and personal consumption loans made to individuals in the U.S. according to statistics published by the Federal Reserve. Second, detailed commercial bank financial statement data exist by borrower category that allow for an examination of lending specialization within those categories. Third, over the last thirty years, commercial banking markets in the U.S. have experienced a wave of deregulation which has resulted in more competitive lending markets. These deregulations provide an opportunity to isolate exogenous changes in competition,

[1] Two notable exceptions are studies by Villas-Boas and Schmidt-Mohr (1999) and Hortacsu and Syverson (2004).
[2] These statistics are taken from Compustat and the National Survey of Small Business Finances.

allowing for a test of the causal impact of competition on bank lending specialization. Finally, there is an existing literature on the effects of credit market competition on economic activity that has emerged partly as a result of the wave of deregulatory activity (e.g., Petersen and Rajan (1994, 1995), Jayaratne and Strahan (1996), Berger, Saunders, Scalise and Udell (1998)). While the extant literature has made progress in understanding some of the economic effects of competition in credit markets, the degree to which banks specialize in making loans to certain kinds of borrowers in reaction to competition is an important dimension of this line of research that has to date been unexplored.

I first ask whether competition in the market for commercial bank loans causes banks to specialize in their lending behavior? I find that it does. I then ask how banks that specialize in more competitive lending markets are able to do so? Do they become more efficient in making certain kinds of loans by lowering the overall costs of lending to a group of borrowers? Or do they become better at screening individual borrowers relative to competing banks and are able to capture more rents in this manner? I find that the answer depends on the characteristics of the banks in question. Finally, I ask how banks that specialize in lending by lowering lending costs may do so? In particular, what role do recent development in loan resale and derivatives markets play in lowering banks' cost of lending?

I utilize two periods of deregulation to examine the impact of an increase in bank competition on specialization in lending – first a period of state-wide deregulation between 1976 and 1994 in which states differentially timed their allowance of competition by commercial banks via intra- and interstate bank branching, and second a period of national deregulation between 1990 and 2003 brought about by the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994. Both experiments yield similar findings. In more competitive banking markets following deregulation, larger banks become more specialized in their lending portfolios relative to smaller banks. However, both types of banks specialize in reaction to greater competition, but in different ways. Larger banks specialize in making loans secured by real estate, both real-estate-backed personal and commercial loans, loans arguably characterized more generally as "hard information" loans. Smaller banks specialize in making unsecured personal and commercial loans, as well as small business loans, loans arguably characterized more generally as "soft information" loans. Banks that fail to specialize along these dimensions do not

survive for long after deregulation, consistent with specialization in lending being a necessary means to secure market share and maintain profitability in the face of greater competition.

Using the deregulations as instrumental variables for banks' loan portfolio composition, I find that banks which specialize in real-estate-backed loans have larger fractions of loan defaults in these loans, which suggests they lend to more marginal borrowers rather than identifying better quality loans in this loan category. This is consistent with specialization by lowering the costs of making real-estate-backed loans and thus expanding the amount of credit extended in this category of loan. In contrast, I find that banks which specialize in unsecured personal and commercial loans as well as small business loans have lower fractions of loan defaults in these loan categories, which suggests these banks specialize in better assessing borrower quality rather than lowering costs across the board. Finally, I take a look at how banks may be able to lower the costs of lending. I find evidence consistent with banks using loan resale markets and derivatives to partly lower the costs of lending, especially to real-estate-backed loans.

The contributions of my analysis are threefold. First, the analysis provides a first look at how different types of lenders specialize in providing financing to different types of borrowers and how market competition creates an incentive for lenders to specialize. While the corporate finance literature makes broad distinctions between equity and debt, private and public equity and private and public debt (e.g., Diamond (1984, 1991) and Rajan (1992)), relatively little distinction has been made between different types of investors beyond these broad distinctions, despite claims by many investors themselves that they are different from one another and possess comparative advantages in certain types of activities. While there have been some empirical studies that assess whether and how certain types of investors specialize, there has been relatively little research which documents whether and how investors specialize in financing.[3] Moreover, the interaction between competition and firms' incentives and ability to specialize has been even less well-studied.[4]

Second, the analysis informs the debate over whether credit market competition has positive or negative effects on borrowers. Both theoretical and empirical literatures have emerged on the effect of credit market competition on the equilibrium amount of lending to

[3] Carey, Post and Sharpe (1998) examine specialization differences between commercial banks and financing companies in the private debt markets.

[4] An exception is a study by Degryse and Ongena (2007) which examines the correlation between banking market concentration and relationship lending.

different borrowers. Traditional theories (e.g., Tirole (1988) and Freixas and Rochet (1997)) predict that greater competition will increase supply and lower the price of credit in lending markets. However, another set of theories suggest a dark side to an increase in credit market competition (e.g., Petersen and Rajan (1995), Dell'Ariccia and Marquez (2004) and Hauswald and Marquez (2003, 2006)). These argue that information asymmetries between borrowers and lenders could reduce lenders' ex ante incentives to acquire information about borrower types, about whom little could be known or observed, since an increase in competition would raise the risk of other lenders free-riding on the initial lenders' investment. These theoretical arguments have largely ignored the possibility that banks may specialize in lending to certain kinds of borrowers, in particular informationally-opaque borrowers, affording them a degree of monopolistic rents.

Empirical studies have tested these competing hypotheses on the effects of credit market competition on equilibrium lending and other outcomes in various settings. The conclusions have been mixed, though have generally supported the view that an increase in credit market competition has first-order positive effects on both the equilibrium supply of credit and on reducing banking system (e.g., Jayaratne and Strahan (1996), Black and Strahan (2002) and Zarutskie (2006)). However, as a counterpoint to this evidence of the broad first-order positive effect of credit market competition, studies have also documented negative impacts of credit market competition on certain subsets of borrowers especially informationally sensitive borrowers, such as young firms (e.g., Cetorelli and Gambera (2001) and Zarutskie (2006)). If banks or other lenders become better able to assess the quality of these borrowers and structure better contracts with them in reaction to competitive forces, then this might mitigate the negative effects of competition on loan supply (e.g., Petersen and Rajan (1995)) over the long-run if certain banks become better at identifying and retaining good quality informationally opaque borrowers.

Finally, the analysis provides a new test of the theory of organizational form on information processing and transmission that has been argued to matter for the kinds of loans banks make (e.g., Stein (2002), Berger, Miller, Petersen, Rajan and Stein, (2004)). It has been argued that "soft information" loans are more likely to be made by smaller banks rather than larger banks due to smaller banks' organizational ability to act on soft information relative to larger banks. My analysis shows that smaller banks do indeed make more soft-information loans

relative to larger banks as a total fraction of their loan portfolios. In addition, the incentive effects of competition cause smaller banks to become even more specialized in making such loans.

The rest of the paper proceeds as follows. Section 2 outlines how banks may specialize in their lending behavior in reaction to greater competition and generates empirical predictions. Section 3 discusses the U.S. deregulatory events I use to identify the impact of greater credit market competition on bank specialization. Section 4 introduces the data used. Section 5 tests for evidence of specialization in reaction to deregulation. Section 6 examines how banks are able to specialize – via cost reduction or via better borrower assessment. Section 7 examines how banks may be able to lower costs through developments in loan resale and derivatives markets. Section 8 concludes.

2. How may banks specialize in lending?

When banks compete in a market for borrowers, they have an incentive to become better, or to specialize, relative to their competitors at making loans in that market. Doing so can allow a bank to capture a larger share of the borrowers and lead to greater profitability in that market.

In this paper, I consider two ways in which a bank may become better relative to its competitors at making loans. First, a bank may lower its costs of making loans in a given market, for example by being able to borrower the money it uses to make these loans more cheaply or by lowering the costs of originating and processing loan applications. If a bank can lower its costs of making loans, it will be able to increase its profitability and capture a larger share of the market by slightly lowering the price of its loans. Second, a bank may become better relative to its competitors at evaluating the quality of borrowers in a given market. If a bank can more accurately assess the likelihood a borrower will be able to repay a loan, it will be able to increase its profitability by choosing borrowers it knows to have higher probabilities of repayment and increase its market share of such borrowers by lowering the price of loans to these higher quality borrowers.

Both types of lending improvements – cost reduction and borrower quality assessment – allow a bank to undercut the market price of loans and capture a greater amount of market share in the market in which it has made the lending improvement, leading to specialization by the bank in that market. Before turning to the empirical predictions of these two types of lending

improvements on bank's loan portfolios across bank characteristics, I formalize the above intuition in a simple framework.

2.1. Specialization in loan cost reduction

I first consider the impact of a bank lowering its costs of lending in a particular market. Consider a loan category or market denoted by *H*. Each bank serving market *H* has a cost of lending per dollar of c_H.[5] For each loan *i* in market *H*, the probability that the loan is repaid is π_H^i. For each dollar lent in market *H*, banks charge a markup m_H, that is decreasing in the level of competition in lending market *H*. I do not explicitly model bank competition, but instead take the level of competition in a lending market as given. I use exogenous deregulations of commercial banking markets in the U.S. to estimate the impact of changes in the level of lending market competition on bank's loan portfolio specialization. The market interest rate, r_H^i, set on loan *i* is given by equation (1), which sets the expected payoff of lending one dollar equal to the cost of lending the dollar. The constraint that r_H^i must not exceed a maximum interest rate, $\bar{r}$, is meant to capture usury laws and prudent lending rules present in most government-regulated commercial banking markets.

$$\begin{aligned} &\pi_H^i(1+r_H^i) = (1+c_H+m_H) \\ &\quad s.t. \quad r_H^i \le \bar{r} \end{aligned} \tag{1}$$

Equation (1) can be solved for the interest rate on loan *i* as in equation (2).

$$\begin{aligned} &r_H^i = \frac{1+c_H+m_H}{\pi_H^i} \\ &\quad s.t. \quad r_H^i \le \bar{r} \end{aligned} \tag{2}$$

Since the markup, m_H, is decreasing in the level of competition in the lending market, as lending market *H* becomes more competitive the interest rate charged on loans in the market will

[5] We can think of the cost per dollar lent, c_H, as being comprised of the cost of raising a dollar from investors, r_D, plus other costs associated with originating and processing the loan.

decline. An increase in competition, and a decrease in m_H, creates an incentive for banks to lower the costs of lending c_H. If an individual bank *j* can decrease its cost of lending relative to other banks, $c_H^j < c_H$, it can increase its own markup m_H^j, such that $m_H^j = m_H + c_H - c_H^j$. Moreover, if bank *j* slightly lowers the interest rate it charges on loans, $r_H^i - \varepsilon$, then it can capture more market share as well as maintaining a higher profit margin, if $\varepsilon < (c_H - c_H^j)/\pi_H^i$.[6] Once a bank has lowered its costs in a particular market, it has an incentive to lower its loan prices to capture more of the market. Thus, an increase in competition in a lending market, by lowering the markup banks can charge on loans, creates an incentive for banks to lower the costs of making loans. A bank might be able to decrease the costs of lending by being able to lower the costs of raising a dollar to lend in market *H*, for example by tapping a new pool of investors who demand a lower cost of capital, or by reducing the costs to processing loans, for example by adopting more efficient information technology If a bank succeeds in lowering the costs of making loans in the more competitive market, it can preserve some of the former markup as well as increase its share of borrowers in the market by lowering its prices relative to its competitors. Of course, it is an empirical question whether and how banks lower their costs of lending in reaction to increased market competition.

In addition to being able to maintain its markup and increase market share, if a bank lowers its costs of lending in market *H*, there are implications for the marginal loan made in market *H*. When each bank has a cost of lending c_H, the marginal loan has probability of repayment $\bar{\pi}_H$, set by the interest rate constraint, as in equation (3).

$$\bar{r} = \frac{1 + c_H + m_H}{\bar{\pi}_H} \tag{3}$$

If a bank lowers its cost of lending, the marginal loan will have a lower probability of repayment, or a higher probability of default, as can be seen when taking the derivative of the marginal repayment probability in lending market *H* with respect to the bank's cost of lending in that market, as in equation (4).

[6] This inequality is derived by taking the cost savings of the specialized bank and dividing by the probability that loan *i* is repaid.

$$\frac{\partial \bar{\pi}_H}{\partial c_H} = \frac{1}{\bar{r}} > 0 \tag{4}$$

Thus, if some banks specialize in lowering the cost of making loans, not only will interest rates be lowered for firms that would have received loans when costs were higher, but new firms or projects will be financed which have lower probabilities of repayment. This implies that the average repayment rate of loans made by banks that specialize in loan cost reduction is lower than for higher cost banks in the same lending market.

2.2 Specialization in borrower quality assessment

I now consider the impact of a bank becoming better at observing the quality of borrowers in a particular lending market. Instead of being able to observe an individual borrower's repayment probability, as we assumed in lending market *H*, in lending market *S*, only the average repayment probability of all borrowers in the market is known, $\hat{\pi}_S$. An individual borrower *i* may have a repayment probability that is lower or higher than $\hat{\pi}_S$, but they will always be charged the same interest on their loans, $\hat{r}_S$, as given in equation (5).

$$r_S^i = \frac{1 + c_S + m_S}{\hat{\pi}_S} = \hat{r}_S$$
$$s.t. \quad r_S^i \leq \bar{r} \tag{5}$$

In lending market *S*, I assume that all banks have the same cost of lending c_S and that the markup charged by all banks in the market is given by m_S, once again taking the level of competition in the lending market as exogenous. We can see from equation (5) that as long as $\hat{r}_S$ does not exceed the maximum interest rate value, $\bar{r}$, all borrowers in market *S*, will receive loans. An increase in competition in market *S* will lower the markup banks are able charge and will create an incentive for banks to better understand individual borrowers' repayment probabilities, if possible. If a bank can observe the repayment probability of borrower *i* rather than just the average repayment probability in the market, then the bank can increase its

profitability by only funding borrowers with repayment probabilities π_S^i, such that $\pi_S^i > \hat{\pi}_S$. By continuing to charge the market interest rate on loans, bank *j* can increase its own markup m_S^j such that $m_S^j = (\pi_S^i / \hat{\pi}_S)(1 + m_S + c_S) - 1 - c_S$.[7] In addition, the bank can slightly lower the interest rate it charges on loans of type *i* to capture a larger fraction of the market of borrowers with higher than average repayment probabilities, while still maintaining a higher markup relative to its competitors.

As in the case of specializing in loan cost reduction, a bank which specializes in better assessing the quality of borrowers will also increase its share of the lending market. However, the implications for the repayment probability of the marginal borrower for both the specialized bank are different. A bank which can observe individual borrower repayment rates, will only lend to borrowers whose repayment probabilities are greater than or equal to $\hat{\pi}_S$, the market average repayment probability. This implies that the average repayment probabilities of borrowers funded by the specialist bank in lending market *S* will be higher than the average repayment rate. Moreover, other lenders which cannot distinguish individual loan repayment probabilities will increase their loan interest rates, or not lend at all, since they know that the better borrower types are being lent to by the specialist bank and that the remaining borrowers will have an average probability of repayment that is lower than $\hat{\pi}_S$.[8] In fact if the new average repayment probability of the remaining borrowers not funded by the specialist bank is lower than $\bar{\pi}_S$, as in equation (6), which shows the repayment probability which meets the interest rate ceiling constraint, then the remaining borrowers will not be funded at all.

$$\bar{r} = \frac{1 + c_S + m_S}{\bar{\pi}_S} \tag{6}$$

Thus, while both types of lending specialization – loan cost reduction and better borrower quality assessment – increase the specialist bank's share of the lending market in which it

[7] This equality if found by setting the interest rate charged by the specialist bank *j* equal to the market interest rate given in equation (5).

[8] I assume that competing banks cannot "free ride" on the ability of the specialist bank to assess individual borrower quality, for example, because of the nature of the contract the specialist bank is able to write with the borrower or because of the institutional nature of the competing banks preventing them from communicating this information effectively through the bank's hierarchy (e.g., Stein (2002)).

specializes, each type of specialization has very different predictions for the average repayment probabilities of borrowers that receive funding from the specialist bank.

2.3 Empirical predictions

If a bank specializes more in a particular lending market relative to the other lending markets it serves, we should expect that the bank's loan portfolio will have a greater share of loans from the market in which it specializes. This is true whether the bank specializes in loan cost reduction or in better assessing loan quality. While a bank will have an incentive to specialize at any point in time, an increase in competition in the markets it serves will magnify this incentive by lowering the markups that banks can charge on loans. Moreover, an increase in banking market competition due to deregulation that allows new entry of banks may serve to permit banks that have the ability to specialize to enter new markets. Thus, we should expect to see greater bank specialization along both cost reduction and quality assessment dimensions in reaction to an increase in competition in lending markets.

However, the predictions for default rates in the loan category in which a bank specializes differ depending on how the bank is able to specialize. If a bank specializes in a lending market by lowering the cost of making loans in that market, we should expect that the average repayment rate on these loans in the bank's portfolio will be lower, or that the average default rate will be higher, as shown in Section 2.1. If a bank specializes by becoming better able to assess borrower quality, we should expect that the average repayment rate on these loans in the bank's portfolio will be higher, or that the average default rate will be lower, as shown in Section 2.2.

Not all banks may be able to specialize relative to their competitors in certain lending markets. Certain types of banks may be better at lowering costs of lending or in assessing borrower quality, especially borrower quality in more opaque lending markets. Prior theoretical work suggests that larger banks should be able to lower loan costs relative to smaller banks, especially in markets such as lending market *H* in Section 2.1, in which borrower quality is accurately observed by all banks (e.g., Stein (2002), Almazan (2002), Berger, Demsetz and Strahan (1999)) . Such lending markets are often characterized as "hard-information" lending markets in which borrower quality is assessed using mostly quantitative information and credit-scoring algorithms. Larger banks may be able to exploit economies of scale in reducing loan

processing costs using large information technology networks in such hard-information lending markets. In addition, larger banks may be better able to tap alternative investor bases through loan re-sales in order to lower their cost of capital in these hard-information lending markets. Thus, theory predicts that we should expect to see larger banks specializing more in loan cost reduction relative to smaller banks in reaction to an increase in credit market competition.

Likewise, past theoretical work suggests that smaller banks and banks that have a longer established presence in a lending market may have an advantage in specializing in borrower quality assessment, especially in more opaque lending markets such as lending market *S* in Section 2.2. Being able to assess an individual borrower's quality relative to the average market quality is a task which often relies on "soft-information" collected by loan officers based on interactions with prospective borrowers. Older banks in a lending market who have interacted with the types of borrowers in that market more often may be better able to process soft information and distinguish amongst borrower types in that market (e.g., Acharya et al (2006) and Hauswald and Marquez (2006)). Likewise, smaller banks may be better able to credibly transmit soft-information collected by their loan officers through the flatter hierarchies that characterize these banks (e.g., Stein (2002)). Thus, we should expect that smaller and older banks will specialize more in assessing borrower quality in soft-information lending markets in reaction to an increase in credit market competition.

In sum, in reaction to an increase credit market competition, we should expect banks to become more specialized in their lending behavior. In particular, we should see that larger banks make more loans in hard-information lending markets in which they can reduce lending costs relative to other types of loan in their portfolios. We should see that smaller and older banks make more loans in soft-information lending markets in which they can better assess borrower quality relative to their larger and younger competitors. We should see that the average repayment rate of the increased share of hard-information loans in loan cost reducing banks' portfolios is lower. We should see that the average repayment rate of the increased share of soft-information loans is higher in banks that specialize in better borrower assessment.

3. Commercial banking market deregulation in the U.S.

I use two periods of commercial banking market deregulation in the U.S. to test the empirical predictions laid out in Section 2. The first period occurred from 1976 to 1994. During

this period individual states relaxed restrictions on commercial banks' ability to expand within and across state borders. States had previously been quite restrictive in allowing banks located within their borders from expanding within the state and in allowing banks located in other states to expanding into the state.[9] The state-wide deregulations took two forms – intrastate branching deregulations and interstate branching deregulations. The former allowed banks that already existed in a state to expand within the state by either acquiring existing branches of another bank or by establishing de novo branches within the state. The latter allowed banks based in other states to enter the state by acquiring existing branches of another bank. Once entering a state through acquisition, an out-of-state bank could then potentially establish more de novo branches. Interstate branching deregulation typically occurred on a bi-lateral or multi-lateral basis between two or more states.

The state-wide deregulations happened at different times for different states, allowing for a natural experiment design to identify the effects of greater credit market competition on bank specialization. The years in which states allowed interstate and intrastate branching are listed in the Appendix.

The second period of deregulation in U.S. commercial banking markets involved the passage of the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994. The Riegle-Neal Act struck down the final barriers to interstate branching by mandating that banks in all states could enter any other state. The Riegle-Neal Act was passed by the U.S. Congress and was national in scope. However, it did have a differential impact on states in two ways. First, states had discretion in when they adopted the provisions of the Riegle-Neal Act over the 1994 to 1997 period.[10] The Appendix lists the years in which each state adopted the Riegle-Neal provisions. Second, the Riegle-Neal Act had a different bite across states depending on how long a state had allowed interstate branching prior to the passage of the act. The longer a state had allowed some degree of interstate bank branching, the less the impact of the Riegle-Neal Act likely had on bank competition in that state. I exploit both the differential timing of the adoption of the Riegle-Neal Act across states as well as the differential timing across states in when they individually allowed limited interstate bank branching prior to the passage of the Riegle-Neal Act to identify the effects credit market competition on bank specialization.

[9] For a more detailed history of this period of state-wide commercial banking market deregulation as well as a discussion of the political economy of the deregulation see Kroszner and Strahan (1999).
[10] See Dick (2006) for a more detailed history of the impact of the Riegle-Neal Act across states.

4. Data

The data used in the empirical analysis are taken from the Call Reports of Condition and Income ("Call Reports") in June of each year from 1976 to 2003. The call reports are consolidated financial statements which commercial banks must file with U.S. banking regulators every quarter. They contain information on banks' income statements and balance sheets, as well as certain off-balance sheet items, such as derivatives usage and loan sales.

Table 1 presents summary statistics for the key variables used in the Call Reports. Averages are reported first followed by standard deviations in parentheses. The first columns report statistics for the period of state-wide banking deregulation, 1976-1994. The second columns report statistics for the period of national banking deregulation, 1990-2003. I begin the period of national banking deregulation in 1990 to allow me to observe a bank a minimum of four years prior to its state's adoption of the Riegle-Neal Act's provisions.

The Call Reports present loan information by loan type. In particular, they provide information on loans that are secured by real estate, including both personal and commercial loans ("RE Loans"), unsecured loans used for commercial and industrial use ("C&I Loans"), unsecured personal loans ("Personal Loans"), unsecured agricultural loans ("Agriculture Loans"), and other unsecured loans, such as interbank loans ("Other Loans"). While these loan categories are broad, they do allow an examination of the degree to which banks concentrate their lending in loans collateralized by real estate versus loans that are not, arguably an important dimension of loans and one that can plausibly distinguish a type of "hard information" loans versus "soft information" loans.

In Table 1, I first summarize the shares of bank's loan portfolios comprised of the five loan categories. In both time periods, loans collateralized by real estate represent the largest fraction of banks' loan portfolios. In the period of state-wide deregulation, the average fraction represented by real-estate-backed loans is around 40 percent. This fraction increases to around 55 percent in the later period of national deregulation. In both periods approximately 60 percent of the real-estate-backed loans in banks' portfolios are residential mortgages. Another 25 percent are commercial mortgages. Around 8 percent are construction and development loans and 10 percent are loans backed by farmland. Thus, the majority of real-estate-backed loans

over the 27-year sample period are loans backed by already existing structures, e.g. residential and commercial mortgages.

About 22 percent of banks' loan portfolios in the period of state-wide deregulation are represented by commercial and industrial loans, falling to 18 percent in the period of national deregulation. Likewise, about 23 percent of banks' loan portfolios in the period of state-wide deregulation are represented by personal loans, falling to around 16 percent in the period of national deregulation. Only about 3 percent of personal loans in the first sample period are represented by credit card loans and only 6 percent in the second sample period are represented by credit card loans. Beginning in 1993, the Call Reports also present information on the sizes of commercial and industrial loans. About 60 percent of commercial and industrial loans made by banks in the period of national deregulation are "small" business loans (10 percent of all loans divided 18 percent), defined as commercial and industrial loans with principal amounts of $250,000 or less.

Turning to the final two loan categories, we see that they make up the smallest fraction of banks' loan portfolios. Agriculture loans represent about 13 percent of banks' loan portfolios in the period of state-wide deregulation, falling to around 10 percent in the period of national deregulation. Other loan types make up less than 2 percent of banks' loan portfolios over both sample periods.

I use the loan category shares summarized above to create general measures of bank-level loan portfolio specialization. In particular, in each bank-year I calculate two general measures of specialization, HHI and Largest Loan Ratio. HHI is the Herfindahl-Hirshman Index of loan type shares in a bank's loan portfolio, i.e., the sum of squared loan type shares of a bank's portfolio. Largest Loan Ratio is the share of a bank's loan portfolio represented by the largest loan category. According to both measures, the average bank's loan portfolio is fairly concentrated among the five loan categories reported in Table 1 and increases from the period of state-wide deregulation to the period of national deregulation. Average bank-level loan HHI increases from 0.409 to 0.479. Likewise, the average share of a bank's portfolio represented by the largest loan category rises from 53 to 61 percent between the two periods of deregulation. Thus, over the entire sample period, the average bank makes over half of its loans to just one of the five loan categories.

Finally, Table 1 summarizes two key bank-level characteristics – size and age – which I use to test the empirical predictions laid out in Section 2.3. I measure bank size and age at the time the state in which the bank is headquartered enacted state-level interstate banking deregulation, in the case of the first sample period, or the Riegle-Neal Act provisions, in the case of the second sample period. Measuring bank-level size and age at the time of deregulation eliminates concerns that bank size and age are being endogenously determined by choices made by the bank subsequent to an increase in banking market competition brought about by deregulation, allowing me to use them to form control groups to distinguish how larger versus smaller and younger versus older banks react to deregulation. The average bank size during the period of state-wide deregulation, measured by total bank assets and reported in thousands of year 2000 dollars, is about $250 million, with much variation as indicated by the large standard deviation. The average bank age is around 52 years. In the period of national deregulation, the average bank size increases to about $375 million year 2000 dollars and the average bank age increases to 53 years. The increase in both average bank size and the standard deviation of bank size over the sample period reflects the fact that many banks consolidated in reaction to state-wide deregulation. Indeed, the 252,452 bank-year observations in the first sample period represent about 14,000 commercial banks, while the 135,410 observations in the second sample period represent about 10,000 commercial banks.

The statistics in Table 1 foreshadow the finding that larger banks specialize more and specialize in loans backed by real estate in reaction to greater competition resulting from deregulation. While the statistics in Table 1 are suggestive of some of the main results, they could be driven by other changes in the economy such as greater demand for credit in the form of real-estate-backed loans rather than an increase in banking market competition. Thus, I now turn to a more rigorous analysis of the relation between lending specialization and competition using the banking deregulations to isolate the effects of banking market competition on bank lending.

5. Deregulation and bank loan portfolio composition

I use a natural experiment empirical set-up to identify the impact of the increase in banking market competition brought about by the state-wide and national deregulations described in Section 3 on whether and how banks specialize in lending. Since different states allowed inter- and intrastate bank branching at different times and since they enacted the

provisions of the Riegle-Neal Act at different times and already had different histories of interstate banking deregulation, the first set of tests in both sample periods take the following general form. First, as in Equations (7), I regress a measure of the composition of a bank's loan portfolio in a given year (e.g., a specialization measure such as HHI or a loan ratio measure such as fraction of the bank's loan portfolio in real-estate-backed loans) on a dummy variable, *Deregulation*, which is zero in the years in which the relevant deregulation has not yet been enacted in the state in which a bank is headquartered and is one in the years in which it has been enacted. Thus, *Deregulation*, is a function of both time, *t*, and the state, *j*, in which a bank, *i*, is headquartered. In the first set of tests represented by Equation (7), I also control for the natural logarithm of a bank's asset size and age in the year in which its state deregulated. I also include state and year fixed effects and cluster all standard errors at the state level, since the relevant variation in banking market competition over the estimation period occurs at the state level.

Equation (7):

$$BankSpecialization_{i,t} = \alpha_0 + \alpha_1 Deregulation_{j,t} + \alpha_2 LogBankSize_i + \alpha_3 LogBankSize^2{}_i + \alpha_4 LogBankAge_i + \upsilon_t + \eta_j + \varepsilon_{i,t}$$

Equation (7) identifies the average impact of deregulation on banks' loan portfolios. However, as posited in Section 2.3, it may be the case that different kinds of banks react differently to changes in their competitive environments. In particular, banks may differ by size and age in how they strategically react to changes in competition. To identify the differential impact of competition resulting from deregulation on loan portfolios of different kinds of banks, I interact the *Deregulation* dummy variable with the bank-level size and age variables as in Equation (8). The coefficients on these interaction terms enable me to test for differential responses by larger and older banks to deregulation.

Equation (8):

$$BankSpecialization_{i,t} = \beta_0 + \beta_1 Deregulation_{j,t} + \beta_2 Deregulation_{j,t} * LogBankSize_i + \beta_3 Deregulation_{j,t} * LogBankSize^2{}_i + \beta_4 Deregulation_{j,t} * LogBankAge_i + \beta_5 LogBankSize_i + \beta_6 LogBankSize^2{}_i + \beta_7 LogBankAge_i + \omega_t + \psi_j + \mu_{i,t}$$

The first set of empirical tests examine whether the increase in banking market competition brought about by deregulation caused banks to strategically change their lending

behavior across the different loan categories described in Section 4. The natural experiment design allows me to test for the causal impact of the increase in competition resulting from deregulation on bank lending behavior. The inclusion of the state and year fixed effects control for state-level and year-level variation in the demand for certain loan types, allowing a more precise measurement of the effect of competition on banks' lending behavior.

5.1 State-wide deregulation 1976-1994

I first examine the impact of the state-wide inter- and intrastate deregulations on banks' loan portfolio composition. To begin, I examine the general measures of bank lending specialization – Bank-level Loan HHI and Largest Loan Ratio. OLS estimation results are reported in Table 2. Coefficients are reported followed by t-statistics adjusted for clustering at the state level in parentheses.

In the first sample period covering state-wide deregulation, there are two deregulation dummy variables per state – a dummy variable for when the state first allowed intrastate bank branching and a dummy variable for when the state first allowed interstate bank branching. I replace the *Deregulation* dummy variable in Equations (7) and (8) with two dummy variables – *Interstate* and *Intrastate* – and estimate them over the 1976-1994 period. The first two columns of Table 2 report estimation results when the dependent variable is Bank-level Loan HHI. The second two columns of Table 2 report estimation results when the dependent variable is Largest Loan Ratio.

Focusing on columns (1) and (3), which exclude the interactive effects of deregulation on bank size and age, we see that after controlling for bank size, age and state and year fixed effects, there is no average effect of either inter- or intra-state deregulation on bank loan portfolio concentration. However, the specifications in columns (2) and (4) tell a very different story when we allow for differential effects of deregulation on banks of differing sizes and ages. Now the coefficient on *Interstate* is negative and economically and statistically significant, indicating that all else equal, greater banking competition leads to less concentration in banks' loan portfolios, which seems at odds with the suggestive evidence we saw in Table 1 that banks become more concentrated in their lending behavior after deregulation. However, examining the coefficients on the interaction between *Interstate* and bank size, we see that larger banks became more specialized after deregulation. In particular, most banks, including those of the average

size in terms of assets, experienced greater loan portfolio concentration after state-wide interstate branching deregulation. While interstate banking deregulation has a large impact, intrastate deregulations do not enter significantly, though they enter with the same sign as interstate deregulations. I do not observe a differential effect of deregulation on bank loan portfolio concentration across banks of different ages.

The evidence presented in Table 2 provides support for theories that argue that larger banks concentrate more of their lending to one or a few loan categories relative to smaller banks. However, the regressions in Table 2 cannot tell us in which loan categories larger banks specialize. Moreover, is it the case that smaller, or older banks, also specialize in certain loan categories in reaction to deregulation – just not to the same extent as larger banks? Thus, I next turn to an examination of how the composition of banks' loan portfolios reacted to state-wide deregulations.

From Table 1, we saw that the majority of lending by commercial banks over the 27-year sample period occurs in three loan categories – loans secured by real estate, unsecured commercial loans, and unsecured personal loans. I, therefore, focus on these three loan categories in my analysis of the impact of deregulation on loan portfolio composition. In particular, since loans secured by real estate are arguably characterized as "hard information loans" relative to unsecured commercial and personal loans, I contrast lending behavior in real-estate-backed loans to lending behavior in unsecured commercial and personal loans. I re-estimate Equations (7) and (8) using two new dependent variables – the fraction of a bank's loan portfolio in real-estate-backed loans and the fraction of a bank's loan portfolio in unsecured commercial and personal loans. The OLS estimates are reported in Table 3.

Examining columns (1) and (3), which exclude interactions between the state-level deregulation dummy variables and bank size and age, we see that after both inter- and intrastate deregulation on average banks make fewer real-estate-backed loans as a fraction of their total loan portfolios and just slightly more, though not statistically significant, commercial and personal loans as a fraction of their total loan portfolios. Including the interactions of bank size and age with the deregulation dummy variables in columns (2) and (4) shows that post-deregulation larger banks lend a greater fraction of their loan portfolios to real-estate-backed loans, while smaller banks lend a greater fraction of their loan portfolios to unsecured

commercial and personal loans.[11] A one standard deviation increase in bank size raises the fraction of real-estate-backed loans made by around eight percentage points. In contrast, a one standard deviation increase in bank size lowers the fraction of unsecured commercial and personal loans made by around twenty percentage points. In addition, the estimates in column (4) show that older banks lend a greater fraction of their loan portfolios to commercial and personal loans post-deregulation.

Overall, the evidence presented in Tables 2 and 3 indicates that increased competition in lending markets resulting from state-wide banking deregulations caused banks to specialize in lending. Although both large and small banks experienced greater specialization, the types of specialization differed. In particular, smaller and older banks concentrated in lending more to unsecured commercial and personal loans, while larger banks concentrated in lending more to loans secured by real estate. Although both groups of banks specialized in their lending behavior in reaction to greater competition, larger banks specialized more, as measured by bank loan portfolio HHI and top loan ratio concentration measures, relative to smaller banks.

5.2 National deregulation 1990-2003

I next turn to an examination of whether the results uncovered in Section 5.1 in the context of state-wide deregulation also hold in the context of the national deregulation which occurred in the later sample period. As above I estimate Equations (7) and (8) for the general bank loan portfolio concentration variables considered in Table 2 – Bank-level Loan HHI and Largest Loan Ratio – but alter the variables measuring deregulation to reflect regulatory events in this later sample period. In particular, I form two variables – *PostRN* and *Time* – and replace the variable *Deregulation* in equations (7) and (8) with them. *PostRN* is a dummy variable which equals zero in the years prior to a state's enactment of the provisions of the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 and which equals one in the years including and subsequent to the enactment of the provisions. *Time* is a continuous variable which measures the time in years since a state first adopted some type of interstate banking deregulation during the period of state-wide deregulation. This variable captures the extent to which a state already had opened up to interstate bank competition, allowing for a more nuanced

[11] The results are robust to estimating two separate regressions - one for the fraction of a bank's loan portfolio in unsecured commercial loans and one for the fraction of a bank's loan portfolio in unsecured personal loans.

test of the impact of the Riegle-Neal Act on bank lending behavior. I interact *PostRN* and *Time* and include this as a third deregulation variable in the estimation of equations (7) and (8).

Table 4 reports the estimation results for the impact of national deregulation on general loan portfolio concentration. Columns (1) and (3) report estimation results without interacting the deregulation variables with bank size and age. For both general loan portfolio concentration variables, banks become more concentrated in their lending behavior after the passage of the Riegle-Neal provisions in their states, between 1 and 2 percentage point increase in both cases as can be seen from the coefficient on *PostRN*. In addition, the longer a state had allowed its own limited interstate bank competition, the more concentrated banks' lending portfolios as can be seen by the positive coefficient on *Time*, again supporting the notion that increased competition leads banks to specialize in their lending behavior. The interaction between *PostRN* and *Time* is statistically insignificant.

Columns (2) and (4) of Table 4 report estimation results for equation (8) in which the deregulation variables are interacted with bank size and age. Here the story is similar to what we observed in the period of state-wide deregulation. Once I include the interaction effects, we see that the coefficients on *PostRN* and *Time* are both negative and statistically significant, indicating that on average banks become less concentrated in their lending after both state-wide and national deregulation. However, examining the interaction effects of *PostRN* and *Time* with bank size we see that this is only true for smaller banks. Banks at the average size level and above became more concentrated in their lending after deregulation. In addition, older banks become more concentrated in their lending after deregulation, though the coefficient is only statistically significant for the interaction between *Time* and bank age. Finally, focusing on the *PostRN*Time* interaction terms, we see that as predicted, the longer a state has allowed some form of interstate banking competition, the more diminished is the effect of the state's passage of the Riegle-Neal Act provisions as evidenced by the negative coefficient on *PostRN*Time*.

The evidence presented in Table 4 is consistent with the evidence for the period of state-wide deregulation. In both the periods of state-wide and national deregulation, we see that larger banks concentrated their lending portfolios more relative to smaller banks in reaction to greater competition resulting from the deregulations.

I next turn to an examination of how the loan portfolio composition of larger versus smaller and older versus younger banks changed in reaction to national deregulation. As before I

regress the fraction of each bank's loan portfolio held in real-estate-backed loans and the fraction of each bank's loan portfolio held in unsecured commercial and personal loans as a function of the deregulation variables and other controls. Since the Call Reports allow me to distinguish small commercial loans beginning in 1993, I also use the fraction of a bank's loan portfolio held in small commercial loans as a third dependent variable. Small commercial loans are arguably more likely to be "soft information" loans relative to real-estate-backed loans.

Table 5 reports regression estimates for the three loan portfolio composition dependent variables. Columns 1, 3 and 5 report estimates excluding the interaction effects between the deregulation variables and banks size and age. Columns 2, 4 and 6 report estimates including these interaction effects. As in the period of state-wide deregulation, we see that larger banks lend more to real-estate-backed loans and that smaller banks lend more to unsecured commercial and personal loans and small commercial loans. A one standard deviation increase in bank size increases the share of loans in real-estate-backed mortgages by around ten percentage points after a state adopts the Riegle-Neal Act provisions. In contrast, a one standard deviation increase in bank size decreases the share of loans made to small business loans by around four percentage points. There is no discernable relationship between bank age and lending to the three loan categories. The evidence is consistent with the evidence we saw in the period of state-wide deregulation.

5.3. Non-surviving banks

The previous empirical analysis documented that in the more competitive periods following deregulation in two separate experiments, banks became more specialized in their lending activities. In particular, larger banks and younger banks lent more to real-estate-backed loans, arguably "hard information" loans, and smaller and older banks lent more to unsecured commercial and personal as well as small commercial loans, arguably "soft information" loans. The evidence implies that increases in state-level banking market competition allowed or forced firms to specialize in order to maintain or create a competitive advantage for themselves based on their individual capabilities. As an additional test of this claim, I re-run the analysis on banks that are shut down three years after deregulation occurs in the state in which they are headquartered. If it is the case that in order to survive and maintain or gain loan market share

banks must specialize in lending in particular loan categories, then banks that do not survive should not exhibit the same type of specialization as banks that do survive.

Table 6a reports regression estimates for the first sample period of state-wide deregulation in which the estimation sample consists only of banks that are shut down within three years after their states enact interstate banking deregulation. Columns 1 and 2 report results for the general bank loan portfolio concentration measures – HHI and Largest Loan Ratio. Columns 3 and 4 report results for the shares of banks' portfolios that are lent to real-estate-backed loans and unsecured commercial and personal loans. In all columns the impact of deregulation on both loan portfolio concentration and composition is significantly diminished when we examine the coefficients on *Interstate* and its interactions with bank size. In the first three columns it disappears completely; in the last column it is reduced in statistical significance.

The same is true when I examine non-surviving banks in the second period of national deregulation. Table 6b reports regressions estimates for the latter sample period in which the estimation sample consists only of banks that are shut down within three years of their states enacting the Riegle-Neal provisions. The coefficients on *PostRN* and the interaction of *PostRN* with bank size are statistically insignificant in all specifications.

The lack of impact of competition on bank lending specialization on banks that do not survive for very long after deregulation further supports the hypothesis that bank specialize their lending in reaction to greater competition in the loan market. The banks that do not specialize do not survive.

6. Nonperforming loans and loan chargeoffs

The analysis in Section 5 showed that banks become more specialized in their lending in response to greater competition resulting from deregulation. While we observed the types of loans in which large and small banks specialized, we still do not know the mechanisms behind their ability to specialize. As discussed in Section 2, it is possible that banks specialized in particular types of loans by lowering the costs of lending to certain groups of borrowers or by becoming better at observing default probabilities of certain groups of borrowers.

In this section, I empirically examine these mechanisms by examining proxies for the default rates of different kinds of loans. Recall that if a bank specializes in a loan category by lowering the costs of lending, we should expect to see a higher average default rate in that loan

category. In contrast, if a bank specializes in a loan category by becoming better at assessing borrower quality, we should expect to see a lower average default rate in that loan category. Thus, the second set of tests I perform analyze how banks specialize in lending in reaction to greater competition take the form of equation (9):

Equation (9):

$$LoanPerformance_{i,t} = \gamma_0 + \gamma_1 BankSpecialization_{j,t} + \gamma_2 LogBankSize_i + \gamma_3 LogBankSize^2{}_i + \gamma_4 LogBankAge_i + \phi_t + \rho_j + \theta_{i,t}$$

LoanPerformance is a measure of the default rate in a loan category for bank *i* in year *t*. *BankSpecialization* is one of the variables we considered in Section 5 as dependent variables – general loan portfolio concentration and loan portfolio composition measures. *LogBankSize* and *LogBankAge* are measured at the time of deregulation as before. Also included in the specifications are state and year fixed effects. Because I am interested in capturing changes in loan performance resulting from changes in loan portfolio composition due to exogenous increases in banking market competition, I estimate equation (9) using two-stage least squares. The first stage regression is equation (7), which specifies *BankSpecialization* as a function of deregulatory variables.

I use two different measures of loan default – loan chargeoffs and nonperforming loans. Loan chargeoffs are charges against a bank's income that reflect write-downs from loans not paying the expected interest payments due. Nonperforming loans are loans that have not paid interest due in the last 90 days or which have been placed in nonaccrual status. Table 7 reports averages and standard deviations (in parentheses) for both of these variables by loan category in the latter sample period of national deregulation 1990-2003. The Call Reports only begin reporting nonperforming loan data by loan category beginning in 1989, eliminating a test of default rates in the earlier sample period of 1976-1994. Panel A reports summary statistics for nonperforming loans; Panel B reports summary statistics for loan chargeoffs.

Examining both panels of Table 7, we can see that there is variation in the default propensity across loan categories. In particular, real-estate-backed loans have the lowest default propensities with average nonperforming loans to all real-estate-backed loans of about 1.4 percent and average chargeoffs to all real-estate-backed loans of about 0.1 percent. In contrast, commercial loans have the highest default propensities with average nonperforming loans to all

commercial loans of about 4.5 percent and chargeoffs to all commercial loans of about 1 percent. The default propensities of personal loans lie in between. The importance of using two-stage least squares in identifying the impact of loan portfolio specialization on default propensities amongst loan categories is highlighted by the inherent differences in these propensities across loan types. I am interested in changes in default rates due to changes in banks' loan portfolios due to an increase in market competition.

Table 8 reports both 2SLS and OLS estimates of equation (9) using nonperforming loans as the dependent variable. Panel A reports the 2SLS estimates; Panel B reports the OLS estimates. The first column regresses total nonperforming loans to total loans as a function of bank-level loan HHI. This regression captures whether the greater general specialization observed in banks after the passage of the Riegle-Neal Act lead to higher or lower default propensities. The next three specifications test for default propensities within loan categories in reaction to changes in bank-level lending in those categories. Since I cannot observe which fraction of nonperforming commercial loans are small commercial loans, I regress the fraction of nonperforming commercial loans to all commercial loans as a function of the fraction of a bank's loan portfolio in small commercial loans to test for changes in the default propensities in this loan category when a bank increases its lending to small commercial loans.

The 2SLS estimates in Table 8 Panel A show that changes in general bank loan portfolio specialization resulting from deregulation leads to general higher default propensities in banks' loan portfolios. Likewise, when banks specialize more in real-estate-backed lending in response to deregulation, the fraction of the real-estate-backed loans that are nonperforming rises. In contrast, however, when banks specialize more in commercial and personal loans, as well as small commercial loans, the fraction of these loans that are nonperforming actually decreases, despite the higher average propensities for these loan categories to experience default as seen in the summary statistics in Table 7.[12] When we compare the OLS estimates in Panel B to the 2SLS estimates in Panel A, we see the importance of isolating changes in bank's loan portfolio composition stemming from changes in deregulation, rather than simply looking at the raw partial correlation between loan portfolio composition and nonperforming loan ratios. All of the coefficients in Panel B are much smaller than in Panel B and in general negative.

[12] The coefficient on nonperforming C&I loans for the final 2SLS regression for small C&I loans is statistically insignificant. This is likely due to the fact that I cannot observe small C&I nonperforming loans directly, but rather all C&I performing loans instead.

Table 9 reports 2SLS and OLS estimates for equation (9) using loan chargeoffs as the dependent variable. The results are similar to those in Table 8. Banks which specialize in real-estate-backed lending as a result of deregulation have higher default rates in that loan category. Banks which specialize in commercial and personal loans have lower default rates in those loan categories. Once again, instrumenting for loan portfolio composition changes with the deregulation variables is important.

The evidence in this section combines proxies for loan default rates to show that banks which specialize in commercial and personal loans do so by becoming better at assessing borrower quality. Banks which specialize in real-estate-backed loans do so by lowering the cost of making those loans. Thus, I have found evidence consistent with both types of specialization discussed in Section 2.

7. Loan sales, derivatives usage and loan portfolio composition

The evidence presented shows that greater competition leads larger banks to specialize in the lending activity via loan cost reduction and smaller banks to specialize in lending via better borrower quality assessment. A related question is how do larger banks lower lending costs? One obvious way is by reducing overhead costs of loan processing in larger banks (e.g., Berger, Demsetz and Strahan (1999) and Jayaratne and Strahan (1998)) . Another way is that a bank may be able to lower its cost of lending in a loan category if the expected rate a bank must pay investors on a dollar lent to a loan category. One way a bank can achieve this is to hedge the risk of lending to a loan category through the secondary market. Another way is to use derivatives, such as interest rate swaps, which allow the bank to better match the interest rate payments it receives from its lenders with the interest rates it must pay to its investors. Given the increasing prominence and importance of both loan resale and derivatives markets, it is interesting to study whether developments in these markets affected commercial bank lending costs (e.g., Winton (1999) and Loutskina and Strahan (2007)).

In Table 10, I examine whether the loan portfolio composition of a bank is related to the ratio of mortgage-backed securities to total loans and whether or not a bank reports owning interest rate swaps.[13] Mortgage-backed securities are a way for a bank to potentially diversify its risk in real-estate-backed loans since these securities allow the bank to hold a more diverse

[13] Comprehensive data in the Call Reports only exist on the extensive margin for interest rate swaps.

portfolio of real-estate-backed loans than just the loans the bank originates. Holding mortgage-backed securities effectively lowers the overall cost of making real-estate-backed loans from the bank's perspective since the rate it has to charge its own borrowers is lowered due to the ability to hedge away some of the idiosyncratic default risk of individual loans. The first specification in Table 10 shows that, all else equal, a bank having invested more of its loan portfolio in real-estate-backed loans also holds more mortgage-backed securities as a fraction of its total loan portfolio. However, a bank having invested more of its loan portfolio in unsecured commercial and personal loans has fewer mortgage-backed securities as a fraction of its total loan portfolio. This suggests that banks that specialize in making real-estate-backed loans use mortgage-backed-securities to lower the costs of making these loans, consistent with the evidence in the previous section that banks that specialize in real-estate-backed lending lend expand credit supply and lend to more marginal borrowers.

Interest rate swaps are contracts which allow a bank to hedge differences in interest rates between loans outstanding and notes due to their depositors. They are another way in which a bank might be able to lower its cost of lending. The second regression in Table 10 reports maximum likelihood Probit estimates which speak to which banks are more likely to use these hedging contracts. Here both banks that specialize in real-estate-backed loans and unsecured commercial and personal loans are more likely to use interest rate swap contracts. This is perhaps not so surprising since interest rate swaps are not specific to a particular type of loan. However, not many banks use interest rate swaps. Only around 3 percent of the estimation sample report using swaps, usually the very largest banks, consistent with derivatives usage by commercial banks uncovered in other studies (e.g., Gorton and Rosen (1995) and Purnanandam (2007)). Over seventy-five percent of banks hold mortgage-backed securities in contrast.

Overall, the evidence in this section indicates that banks in part lower their lending costs by using newly developed contracts and hedging strategies in the wake of deregulation in the 1990s and early 2000s. In particular, banks that specialize in real-estate-backed loans use mortgage-backed securities to lower lending costs. This is interesting in that it shows another way that banks may be able to specialize in lending by lowering costs, besides lowering overhead costs, especially larger banks with access to loan resale and derivatives markets.

8. Conclusion

Using bank-level loan portfolio data from the Call Reports of Income and Condition, I examined the impact of exogenous changes in credit market competition on banks' incentives to specialize in lending to certain borrower types. I find that after deregulation, larger banks become more specialized in their lending portfolios relative to smaller banks. However, both groups of banks exhibit greater specialization, albeit in different ways. Larger banks specialize more in loans backed by real estate - loans arguably characterized as "hard-information" loans. Smaller banks specialize more in unsecured commercial loans, especially small business loans, and personal loans – loans arguably characterized as "soft-information" loans. When banks specialize in real-estate-backed loans, they exhibit larger fractions of loan defaults in these loans, which suggests they specialize in these loans by lowering the costs of lending to all borrowers, resulting in an overall expansion of credit in the market for real-estate-backed loans. In contrast, when banks specialize in unsecured business and personal loans, they exhibit lower default rates in these loans, suggesting that they specialize by becoming better at identifying good quality loans, rather than by lowering the overall costs of lending in these categories. Finally, I examine how banks may lower their lending costs in reaction to competition through the use of loan resale and derivatives markets. Overall, the analysis provides evidence that competition leads to greater specialization amongst lenders and provides evidence on how different types of lenders become specialists in lending.

The analysis and evidence in this paper raises several future research questions. Are there other dimensions of specialization, such as loan contracting or industrial sectors, which become more attractive to lenders in the wake of market competition? What does greater specialization in lending mean for banking system risk?

Appendix: Timing of commercial bank deregulations in the U.S.

This appendix lists the dates at which states enacted the three types of deregulation considered in the empirical analysis. The first column shows the year in which states first allowed some sort of interstate bank branching. The second column shows the year in which states first allowed some sort of intrastate bank branching. The third column shows the year in which a state enacted the provisions of the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994.

State	Year allowed interstate branching	Year allowed intrastate branching	Year enacted Riegle-Neal provisions
Alabama	1987	1981	1997
Alaska	1982	<1970	1994
Arizona	1986	<1970	1996
Arkansas	1989	1994	1997
California	1987	<1970	1995
Colorado	1988	1991	1997
Connecticut	1983	1980	1995
Delaware	1988	<1970	1995
District of Columbia	1985	<1970	1996
Florida	1985	1988	1997
Georgia	1985	1983	1997
Hawaii	n.a.	1986	1997
Idaho	1985	<1970	1995
Illinois	1986	1988	1997
Indiana	1986	1989	1996
Iowa	1991	n.a.	1996
Kansas	1992	1987	1997
Kentucky	1984	1990	1997
Louisiana	1987	1988	1997
Maine	1978	1975	1997
Maryland	1985	<1970	1995
Massachusetts	1983	1984	1996
Michigan	1986	1987	1995
Minnesota	1986	1993	1997
Mississippi	1988	1986	1997
Missouri	1986	1990	1997
Montana	1993	1990	1997
Nebraska	1990	1985	1997
Nevada	1985	<1970	1995
New Hampshire	1987	1987	1997
New Jersey	1986	1977	1996
New Mexico	1989	1991	1996
New York	1982	1976	1996
North Carolina	1985	<1970	1995
North Dakota	1991	1987	1997

Ohio	1985	1979	1997
Oklahoma	1987	1988	1997
Oregon	1986	1985	1995
Pennsylvania	1986	1982	1995
Rhode Island	1984	<1970	1995
South Carolina	1986	<1970	1996
South Dakota	1988	<1970	1996
Tennessee	1985	1985	1997
Texas	1987	1988	1995
Utah	1984	1981	1995
Vermont	1988	1970	1995
Virginia	1985	1978	1995
Washington	1987	1985	1996
West Virginia	1988	1987	1997
Wisconsin	1987	1990	1997
Wyoming	1987	1988	1997

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Table 1. Bank-level Summary Statistics

The data are taken from the June Call Reports of Income and Condition. The unit of observation is a commercial bank-year. Sample averages are reported; standard deviations are reported in parentheses. RE loans are loans secured by real estate. All other loan categories contain loans that are not secured by real estate. C&I loans are commercial and industrial loans. Small C&I loans are C&I loans with principal amounts of less than $250,000. Bank-level loan HHI is the sum of squared loan category shares (i.e., RE loans, C&I loans, Personal loans, Agriculture loans, and Other loans) in a bank's loan portfolio in a given year. Largest loan ratio is the value of the largest loan category share in a bank's loan portfolio in a given year. Bank-level assets are reported in thousands of year 2000 dollars. Bank age is reported in years. Bank assets and age at deregulation are the assets and age of a bank in the year in which a state first allows interstate branching, in the case of the period of state-wide deregulation, and are assets and age of a bank in the year in which a state enacts the provisions of the Riegle-Neal Act, in the case of the period of national deregulation.

	State-wide deregulation: 1976-1994 (N = 252,451)		National deregulation: 1990-2003 (N = 135,410)	
RE Loans/Total Loans	0.408	(0.214)	0.548	(0.221)
C&I Loans/Total Loans	0.218	(0.161)	0.182	(0.155)
Small C&I Loans/Total Loans	----	----	0.108	(0.084)
Personal Loans/Total Loans	0.233	(0.151)	0.157	(0.131)
Agriculture Loans/Total Loans	0.129	(0.188)	0.098	(0.153)
Other Loans/Total Loans	0.014	(0.072)	0.016	(0.055)
Bank-level Loan HHI	0.409	(0.129)	0.479	(0.168)
Largest Loan Ratio	0.530	(0.154)	0.609	(0.170)
Bank-level Assets at Deregulation	246,831	(1,718,399)	375,270	(2,578,732)
Log(Bank-level Assets at Deregulation)	11.0	(1.28)	11.1	(1.40)
Bank Age at Deregulation	51.7	(38.1)	53.2	(38.9)
Log(Bank Age at Deregulation)	3.7	(1.14)	3.5	(1.42)

Table 2. Loan Portfolio Concentration After State-wide Deregulation - 1976-1994

The data are taken from the June Call Reports of Income and Condition between 1976 and 1994. The unit of observation is a commercial bank-year. Interstate is a dummy variable equal to one in the year a state allows branching of banks across state lines and in all subsequent years. Intrastate is a dummy variable equal to one in the year a state allows branching of banks within state lines and in all subsequent years. Bank assets (age) at deregulation are bank assets (age) in the year in which a state first allows interstate branching. Bank-level loan HHI is the sum of squared loan category shares in a bank's loan portfolio in a given year. Largest loan ratio is the value of the largest loan category share in a bank's loan portfolio in a given year. All regressions are estimated using OLS. Coefficients are reported followed by t-statistics adjusted for clustering within a state. ***, **, * indicate two-tailed statistical significance at the 1%, 5% and 10% levels, respectively.

Dependent variable:	Bank-level Loan HHI		Largest Loan Ratio	
	(1)	(2)	(3)	(4)
Interstate	-0.0082	-0.6712 ***	-0.0026	-0.8936 ***
	(-0.87)	(-4.27)	(-0.25)	(-5.00)
Intrastate	-0.0147	-0.1026	-0.0135	-0.0685
	(-1.59)	(-0.51)	(-1.26)	(-0.27)
Interstate*Log(Bank Assets at Deregulation)		0.1132 ***		0.1500 ***
		(4.22)		(4.94)
Interstate*Log(Bank Assets at Deregulation)^2		-0.0046 ***		-0.0060 ***
		(-4.14)		(-4.94)
Interstate*Log(Bank Age at Deregulation)		-0.0055		-0.0076
		(-1.39)		(-1.63)
Intrastate*Log(Bank Assets at Deregulation)		0.0114		0.0075
		(0.34)		(0.18)
Intrastate*Log(Bank Assets at Deregulation)^2		-0.0006		-0.0005
		(-0.43)		(-0.27)
Intrastate*Log(Bank Age at Deregulation)		0.0091 *		0.0074
		(1.91)		(1.35)
Log(Bank Assets at Deregulation)	0.0239	-0.0279	0.0227	-0.0413 **
	(1.48)	(-1.54)	(1.22)	(-2.03)
Log(Bank Assets at Deregulation)^2	-0.0014 **	0.0008	-0.0014 *	0.0012
	(-2.08)	(1.18)	(-1.86)	(1.51)
Log(Bank Age at Deregulation)	-0.0125 ***	-0.0149 ***	-0.0088 ***	-0.0093 *
	(-3.98)	(-3.26)	(-2.76)	(-1.80)
State Fixed Effects?	Yes	Yes	Yes	Yes
Year Fixed Effects?	Yes	Yes	Yes	Yes
N	252,451	252,451	252,451	252,451
R2	0.196	0.200	0.1651	0.1707

Table 3. Loan Portfolio Composition After State-wide Deregulation - 1976-1994

The data are taken from the June Call Reports of Income and Condition between 1976 and 1994. The unit of observation is a commercial bank-year. Interstate is a dummy variable equal to one in the year a state allows branching of banks across state lines and in all subsequent years. Intrastate is a dummy variable equal to one in the year a state allows branching of banks within state lines and in all subsequent years. Bank assets (age) at deregulation are bank assets (age) in the year in which a state first allows interstate branching. RE loans are loans secured by real estate. C&I loans are commercial and industrial loans not secured by real estate. All regressions are estimated using OLS. Coefficients are reported followed by t-statistics adjusted for clustering within a state. ***, **, * indicate two-tailed statistical significance at the 1%, 5% and 10% levels, respectively.

Dependent variable:	RE Loans / Total Loans		C&I + Personal Loans / Total Loans	
	(1)	(2)	(3)	(4)
Interstate	-0.0342 ***	-0.2481	0.0088	0.9478 ***
	(-3.54)	(-1.42)	(0.70)	(7.33)
Intrastate	-0.0182 *	0.1012	0.0081	-0.0680
	(1.90)	(0.48)	(0.53)	(-0.30)
Interstate*Log(Bank Assets at Deregulation)		0.0659 **		-0.1822 ***
		(2.33)		(-8.59)
Interstate*Log(Bank Assets at Deregulation)^2		-0.0031 ***		0.0072 ***
		(-2.82)		(8.69)
Interstate*Log(Bank Age at Deregulation)		-0.0348 ***		0.0508 ***
		(-4.82)		(12.90)
Intrastate*Log(Bank Assets at Deregulation)		-0.0365		0.0225
		(-0.95)		(0.56)
Intrastate*Log(Bank Assets at Deregulation)^2		0.0016		-0.0016
		(1.01)		(-0.91)
Intrastate*Log(Bank Age at Deregulation)		0.0214 **		0.0080
		(2.31)		(1.53)
Log(Bank Assets at Deregulation)	0.2268 ***	0.2225 ***	0.0524 **	0.0898 ***
	(9.71)	(10.29)	(2.21)	(3.51)
Log(Bank Assets at Deregulation)^2	-0.0096 ***	-0.0094 ***	-0.0009	-0.0019 *
	(-9.69)	(-9.54)	(-0.82)	(-1.74)
Log(Bank Age at Deregulation)	0.0031	0.0100	-0.0470 ***	-0.0769 ***
	(0.51)	(1.63)	(-12.32)	(-14.63)
State Fixed Effects?	Yes	Yes	Yes	Yes
Year Fixed Effects?	Yes	Yes	Yes	Yes
N	252,451	252,451	252,451	252,451
R2	0.372	0.379	0.312	0.338

Table 4. Loan Portfolio Concentration After National Deregulation - 1990-2003

The data are taken from the June Call Reports of Income and Condition between 1990 and 2003. The unit of observation is a commercial bank-year. PostRN is a dummy variable equal to one in the year a state enacts the provisions of the Riegle-Neal Act. Time measures the time in years from the year in which a state independently first allowed some type of interstate bank branching. Bank assets (age) at deregulation are bank assets (age) in the year in which a state enacts the provisions of the Riegle-Neal Act.

Bank-level loan HHI is the sum of squared loan category shares in a bank's loan portfolio in a given year. Largest loan ratio is the value of the largest loan category share in a bank's loan portfolio in a given year. All regressions are estimated using OLS. Coefficients are reported followed by t-statistics adjusted for clustering within a state. ***, **, * indicate two-tailed statistical significance at the 1%, 5% and 10% levels, respectively.

Dependent variable:	Bank-level Loan HHI		Largest Loan Ratio	
	(1)	(2)	(3)	(4)
Post-Riegle-Neal (aka "PostRN")	0.0171 ***	-0.5476 ***	0.0153 **	-0.5618 ***
	(3.19)	(-6.33)	(4.13)	(-6.96)
Time from state interstate deregulation (aka "Time")	1.34E-05 ***	-0.0001 ***	1.16E-05 ***	-4.68E-05 ***
	(27.01)	(-11.40)	(23.17)	(-5.91)
PostRN*Time	1.89E-07	0.0001 ***	1.33E-07	0.0001 ***
	(0.45)	(7.19)	(0.32)	(10.87)
PostRN*Log(Bank Assets at Deregulation)		0.0871 ***		0.0885 ***
		(6.03)		(6.71)
PostRN*Log(Bank Assets at Deregulation)^2		-0.0033 ***		-0.0033 **
		(-5.36)		(-6.02)
PostRN*Log(Bank Age at Deregulation)		0.0011		0.0020
		(0.40)		(0.80)
Time*Log(Bank Assets at Deregulation)		1.81E-05 ***		1.11E-05 ***
		(14.99)		(8.68)
Time*Log(Bank Assets at Deregulation)^2		-8.68E-07 ***		-5.45E-07 ***
		(-17.34)		(-10.54)
Time*Log(Bank Age at Deregulation)		3.22E-06 ***		2.12E-06 ***
		(11.59)		(8.07)
PostRN*Time*Log(Bank Assets at Deregulation)		-1.42E-05 ***		-1.87E-05 ***
		(-6.92)		(-10.57)
PostRN*Time*Log(Bank Assets at Deregulation)^2		4.57E-07 ***		6.83E-07 ***
		(5.17)		(8.95)
PostRN*Time*Log(Bank Age at Deregulation)		3.52E-06 ***		3.99E-07
		(-5.50)		(0.70)
Log(Bank Assets at Deregulation)	0.1081 ***	0.0797 ***	0.1233 ***	0.0950 ***
	(6.45)	(5.38)	(7.43)	(6.44)
Log(Bank Assets at Deregulation)^2	-0.0046 ***	-0.0035 ***	-0.0052 ***	-0.0041 ***
	(-6.53)	(-5.70)	(-7.62)	(-6.91)
Log(Bank Age at Deregulation)	-0.0102 ***	-0.0108 ***	-0.0083 ***	-0.0093 ***
	(-3.10)	(-3.26)	(-2.89)	(-2.98)
State Fixed Effects?	Yes	Yes	Yes	Yes
Year Fixed Effects?	Yes	Yes	Yes	Yes
N	135,410	135,410	135,410	135,410
R2	0.363	0.365	0.334	0.337

Table 5. Loan Portfolio Composition After National Deregulation - 1990-2003

The data are taken from the June Call Reports of Income and Condition between 1990 and 2003. The unit of observation is a commercial bank-year. PostRN is a dummy variable equal to one in the year a state enacts the provisions of the Riegle-Neal Act. Time measures the time in years from the year in which a state independently first allowed some type of interstate bank branching. Bank assets (age) at deregulation are bank assets (age) in the year in which a state enacts the provisions of the Riegle-Neal Act. RE loans are loans secured by real estate. C&I loans are commercial and industrial loans not secured by real estate. Small C&I loans are C&I loans with principal amounts less than $250,000. All regressions are estimated using OLS. Coefficients are reported followed by t-statistics adjusted for clustering within a state. ***, **, * indicate two-tailed statistical significance at the 1%, 5% and 10% levels, respectively.

Dependent variable:	RE Loans / Total Loans		C&I + Personal Loans / Total Loans		Small C&I Loans / Total Loans	
	(1)	(2)	(3)	(4)	(5)	(6)
Post-Riegle-Neal (aka "PostRN")	0.0141 ***	-0.5959 ***	-0.0053	0.2378	0.0053 **	0.1895 ***
	(-3.59)	(-3.45)	(-1.38)	(1.61)	(2.10)	(3.12)
Time from state interstate deregulation (aka "Time")	1.45E-05 ***	-5.83E-05 ***	-9.63E-06 ***	0.0001 ***	-5.08E-06 ***	1.43E-05 **
	(27.14)	(-4.16)	(-15.78)	(6.04)	(-37.84)	(1.98)
PostRN*Time	-2.22E-08	0.0002 ***	-1.13E-06 ***	-0.0002 ***	1.06E-06 ***	-5.97E-05 ***
	(-0.06)	(12.88)	(-2.67)	(-13.59)	(8.40)	(-8.45)
PostRN*Log(Bank Assets at Deregulation)		0.0958 ***		-0.0365		-0.0308 ***
		(3.43)		(-1.50)		(-3.10)
PostRN*Log(Bank Assets at Deregulation)^2		-0.0040 ***		0.0012		0.0012 ***
		(-3.50)		(1.29)		(3.05)
PostRN*Log(Bank Age at Deregulation)		0.0108 **		0.0023		0.0032 ***
		(2.43)		(0.78)		(3.05)
Time*Log(Bank Assets at Deregulation)		1.26E-05 ***		-1.89E-05 ***		-4.10E-06 ***
		(6.12)		(-7.13)		(3.61)
Time*Log(Bank Assets at Deregulation)^2		-6.00E-07 ***		7.68E-07 ***		2.18E-07 ***
		(-6.95)		(7.03)		(4.81)
Time*Log(Bank Age at Deregulation)		3.31E-06 ***		7.38E-07 ***		-9.73E-07 ***
		(6.45)		(1.17)		(-4.86)
PostRN*Time*Log(Bank Assets at Deregulation)		-2.99E-05 ***		3.34E-05 ***		9.46E-06 ***
		(-12.29)		(13.41)		(8.59)
PostRN*Time*Log(Bank Assets at Deregulation)^2		1.15E-06 ***		-1.29E-06 ***		-3.75E-07 ***
		(11.67)		(-12.55)		(-8.54)
PostRN*Time*Log(Bank Age at Deregulation)		-1.42E-06 ***		5.95E-07 ***		8.20E-07 ***
		(-4.58)		(1.08)		(5.25)
Log(Bank Assets at Deregulation)	0.2358 ***	0.2039 ***	-0.1028 ***	-0.0913 ***	0.0041	0.0196 *
	(10.96)	(9.00)	(-4.45)	(-3.24)	(0.60)	(1.76)
Log(Bank Assets at Deregulation)^2	-0.0099 ***	-0.0085 ***	0.0050 ***	0.0046 ***	-0.0007 **	-0.0013 ***
	(-10.99)	(-9.01)	(5.36)	(4.11)	(-2.57)	(-2.98)
Log(Bank Age at Deregulation)	-0.0042	-0.0094	-0.0170 ***	-0.0181 ***	-0.0065 ***	-0.0085 ***
	(-0.84)	(-1.60)	(-6.32)	(-5.22)	(-7.21)	(-8.01)
State Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes
N	135,410	135,410	135,410	135,410	96,793	96,793
R2	0.349	0.352	0.209	0.210	0.181	0.183

Table 6a. Non-Surviving Bank Loan Portfolio Concentration and Composition After State-wide Deregulation - 1976-1994

The data are taken from the June Call Reports of Income and Condition between 1976 and 1994. The unit of observation is a commercial bank-year. Only banks that do not survive three years past interstate deregulation are included in the estimation sample. Interstate is a dummy variable equal to one in the year a state allows branching of banks across state lines and in all subsequent years. Intrastate is a dummy variable equal to one in the year a state allows branching of banks within state lines and in all subsequent years. Bank assets (age) at deregulation are bank assets (age) in the year in which a state first allows interstate branching. Bank-level loan HHI is the sum of squared loan category shares in a bank's loan portfolio in a given year. Largest loan ratio is the value of the largest loan category share in a bank's loan portfolio in a given year. All regressions are estimated using OLS. Coefficients are reported followed by t-statistics adjusted for clustering within a state. ***, **, * indicate two-tailed statistical significance at the 1%, 5% and 10% levels, respectively.

Dependent variable:	Bank-level Loan HHI	Largest Loan Ratio	RE Loans / Total Loans	C&I + Personal Loans / Total Loans
	(1)	(2)	(3)	(4)
Interstate	-0.2407	-0.5330	0.3245	0.6056 *
	(-0.69)	(-1.56)	(0.64)	(1.68)
Intrastate	-0.0296	-0.1803	0.1514	0.1844
	(-0.07)	(-0.39)	(0.31)	(0.40)
Interstate*Log(Bank Assets at Deregulation)	0.0441	0.0932	-0.0362	-0.1201 *
	(-0.71)	(1.54)	(-0.41)	(1.94)
Interstate*Log(Bank Assets at Deregulation)^2	-0.0021	-0.0040	0.0009	0.0048 *
	(-0.75)	(-1.52)	(0.24)	(1.75)
Interstate*Log(Bank Age at Deregulation)	0.0036	0.0035	-0.0217 ***	0.0430 ***
	(0.79)	(0.73)	(-3.18)	(8.34)
Intrastate*Log(Bank Assets at Deregulation)	-0.0026	0.0275	-0.0441	-0.0181
	(-0.03)	(0.34)	(-0.49)	(-0.22)
Intrastate*Log(Bank Assets at Deregulation)^2	0.0002	-0.0012	0.0026	1.26E-05
	(0.07)	(-0.33)	(0.64)	(0.00)
Intrastate*Log(Bank Age at Deregulation)	0.0048	0.0039	0.0006	0.0046
	(1.10)	(0.78)	(0.07)	(0.58)
Log(Bank Assets at Deregulation)	-0.0392	-0.0768 **	0.1497 ***	0.2453 ***
	(-1.31)	(-2.52)	(4.00)	(6.53)
Log(Bank Assets at Deregulation)^2	0.0016	0.0031 **	-0.0059 ***	-0.0091 ***
	(1.31)	(2.47)	(-3.80)	(-6.03)
Log(Bank Age at Deregulation)	-0.0239 ***	-0.0202 ***	0.0128 **	-0.0717 ***
	(-6.96)	(-4.86)	(2.24)	(-8.00)
State Fixed Effects?	Yes	Yes	Yes	Yes
Year Fixed Effects?	Yes	Yes	Yes	Yes
N	30,719	30,719	30,719	30,719
R2	0.134	0.094	0.287	0.355

Table 6b. Non-Surviving Bank Loan Portfolio Concentration and Composition After National Deregulation - 1990-2003

The data are taken from the June Call Reports of Income and Condition between 1990 and 2003. The unit of observation is a commercial bank-year. Only banks that do not survive three years past the year in which a state enacts the Riegle-Neal Act provisions are inclued in the estimation sample. PostRN is a dummy variable equal to one in the year a state enacts the provisions of the Riegle-Neal Act. Time measures the time in years from the year in which a state independently first allowed interstate bank branching. Bank assets (age) at deregulation are bank assets (age) in the year in which a state enacts the provisions of the Riegle-Neal Act.

Bank-level loan HHI is the sum of squared loan category shares in a bank's loan portfolio in a given year. Largest loan ratio is the value of the largest loan category share in a bank's loan portfolio in a given year. All regressions are estimated using OLS. Coefficients are reported followed by t-statistics adjusted for clustering within a state. ***, **, * indicate two-tailed statistical significance at the 1%, 5% and 10% levels, respectively.

Dependent variable:	Bank-level Loan HHI	Largest Loan Ratio	RE Loans Total Loans	C&I + Personal Loans Total Loans	Small C&I Loans Total Loans
	(1)	(2)	(3)	(4)	(5)
Post-Riegle-Neal (aka "PostRN")	0.1947	0.1135	-0.1101	0.1716	0.0740
	(0.99)	(0.66)	(-0.43)	(0.77)	(0.79)
Time from state interstate deregulation (aka "Time")	-0.0003 ***	-3.66E-04 ***	-3.31E-04 ***	0.0014 ***	3.85E-04 ***
	(-12.75)	(-17.89)	(-16.55)	(60.31)	(40.28)
PostRN*Time	-0.0010 ***	-0.0009 ***	-0.0008 ***	-0.0001 **	4.88E-05 ***
	(-28.47)	(-27.88)	(-27.89)	(-2.50)	(4.67)
PostRN*Log(Bank Assets at Deregulation)	-0.0261	-0.0153	0.0196	-0.0239	-0.0116
	(-0.83)	(-0.57)	(0.48)	(-0.68)	(-0.80)
PostRN*Log(Bank Assets at Deregulation)^2	0.0009	0.0005	-0.0010	0.0008	0.0004
	(0.71)	(0.46)	(-0.62)	(0.61)	(0.78)
PostRN*Log(Bank Age at Deregulation)	-0.0015	0.0003	0.0048	-0.0013	0.0005
	(-0.53)	(0.12)	(2.19)	(-0.55)	(0.27)
Time*Log(Bank Assets at Deregulation)	3.23E-05 ***	5.01E-05 ***	4.50E-05 ***	-2.26E-04 ***	-6.23E-05 ***
	(9.13)	(15.25)	(14.14)	(-59.53)	(-41.66)
Time*Log(Bank Assets at Deregulation)^2	-8.05E-07 ***	-1.66E-06 ***	-1.47E-06 ***	9.02E-06 ***	2.55E-06 ***
	(-5.50)	(-12.33)	(-11.41)	(58.93)	(43.99)
Time*Log(Bank Age at Deregulation)	1.73E-05 ***	1.39E-05 ***	1.36E-05 ***	-1.93E-05 ***	-6.81E-06 ***
	(36.60)	(31.73)	(24.03)	(-43.54)	(-31.94)
PostRN*Time*Log(Bank Assets at Deregulation)	1.68E-04 ***	1.46E-04 ***	1.34E-04 ***	9.28E-06 **	-1.02E-05 ***
	(28.47)	(27.88)	(29.20)	(2.02)	(-6.10)
PostRN*Time*Log(Bank Assets at Deregulation)^2	-7.07E-06 ***	-6.20E-06 ***	-5.70E-06 ***	-3.26E-07 *	4.70E-07 ***
	(-28.34)	(-27.66)	(-30.65)	(-1.72)	(6.98)
PostRN*Time*Log(Bank Age at Deregulation)	6.33E-06 ***	4.31E-06 ***	3.57E-06 ***	4.11E-06 ***	2.32E-06 ***
	(17.63)	(13.84)	(13.14)	(11.17)	(12.30)
Log(Bank Assets at Deregulation)	0.1599 ***	0.1793 ***	0.2721 ***	-0.0713 **	0.0140
	(7.11)	(7.32)	(9.84)	(-2.07)	(0.74)
Log(Bank Assets at Deregulation)^2	-0.0069 ***	-0.0077 ***	-0.0112 ***	0.0038 ***	-0.0011
	(-7.90)	(-8.00)	(-10.06)	(2.88)	(-1.46)
Log(Bank Age at Deregulation)	-0.0054	-0.0056	0.0011	-0.0161 ***	-0.0091 ***
	(-0.93)	(-1.07)	(0.15)	(-2.74)	(-3.77)
State Fixed Effects?	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects?	Yes	Yes	Yes	Yes	Yes
N	14,349	14,349	14,349	14,349	9,442
R2	0.321	0.299	0.301	0.186	0.223

Table 7. Nonperforming Loans and Loan Chargeoffs Summary Statistics

The data are taken from the June Call Reports of Income and Condition. The unit of observation is a commercial bank-year. Nonperforming loans are loans that are past 90 days due or that have been placed in nonaccrual status. RE loans are loans secured by real estate. C&I loans are commercial and industrial loans not secured by real estate. Sample averages are reported followed by standard deviations in parentheses.

	National deregulation (1990-2003) (N = 135,410)	
Panel A - Nonperforming Loans		
Total Nonperforming Loans/Total Loans	0.0139	(0.0205)
RE Nonperforming Loans/RE Loans	0.0141	(0.0280)
C&I Nonperforming Loans/C&I Loans	0.0453	(0.1029)
Personal Nonperforming Loans/Personal Loans	0.0088	(0.0265)
Panel B - Loan Chargeoffs		
Total Loan Chargeoffs/Total Loans	0.0024	(0.0082)
RE Loan Chargeoffs/RE Loans	0.0009	(0.0043)
C&I Loan Chargeoffs/C&I Loans	0.0098	(0.0428)
Personal Loan Chargeoffs/Personal Loans	0.0042	(0.0136)

Table 8. Deregulation, Loan Portfolio Composition Changes and Nonpeforming Loans

The data are taken from the June Call Reports of Income and Condition between 1990 and 2003. The unit of observation is a commercial bank-year. Nonperforming loans are loans that are past 90 days due or that have been placed in nonaccrual status. Bank-level loan HHI is the sum of squared loan category shares in a bank's loan portfolio in a given year. RE loans are loans secured by real estate. C&I loans are commercial and industrial loans not secured by real estate. Small C&I loans are C&I loans with principal amounts less than $250,000. Bank assets (age) at deregulation are bank assets (age) in the year in which a state enacts the provisions of the Riegle-Neal Act. In Panel A, Bank-level Loan HHI, RE Loans/Total Loans, C&I + Personal Loans/Total Loans and Small C&I Loans are instrumented with PostRN, Time and PostRN*Time. PostRN is a dummy variable equal to one in the year a state enacts the provisions of the Riegle-Neal Act. Time measures the time in years from the year in which a state independently first allowed interstate bank branching. 2SLS estimates are reported in Panel A. OLS estimates are reported in Panel B. T-statistics adjusted for clustering by state are reported in parentheses. ***, **, * indicate two-tailed statistical significance at the 1%, 5% and 10% levels, respectively.

Panel A - 2SLS

	Total Nonperforming Loans		RE Nonperforming Loans		C&I + Personal Nonperforming Loans		C&I Nonperforming Loans	
Dependent variable:	Total Loans		RE Loans		C&I + Personal Loans		C&I Loans	
	2SLS		2SLS		2SLS		2SLS	
Bank-level Loan HHI	0.2970	**						
	(2.35)							
RE Loans/Total Loans			0.3829	***				
			(4.45)					
C&I + Personal Loans/Total Loans					-0.2767	*		
					(-1.93)			
Small C&I Loans/Total Loans							-1.4079	
							(-1.54)	
Log(Bank Assets at Deregulation)	-0.0151	*	-0.0112	***	-0.0381		0.0922	
	(-1.95)		(-0.78)		(-1.47)		(0.87)	
Log(Bank Assets at Deregulation)^2	0.0005	***	-0.0001		0.0016		-0.0055	
	(1.57)		(-0.11)		(1.33)		(-1.04)	
Log(Bank Age at Deregulation)	0.0036	**	0.0044	*	-0.0025		-0.0093	
	(2.03)		(1.94)		(-0.95)		(-0.79)	
State Fixed Effects?	Yes		Yes		Yes		Yes	
Year Fixed Effects?	Yes		Yes		Yes		Yes	
N	133,055		99,494		99,658		65,718	
R2	0.043		0.067		0.060		0.040	

Table 8 continued.

Panel B - OLS

Dependent variable:	Total Nonperforming Loans / Total Loans		RE Nonperforming Loans / RE Loans		C&I + Personal Nonperforming Loans / C&I + Personal Loans		C&I Nonperforming Loans / C&I Loans	
	OLS		OLS		OLS		OLS	
Bank-level Loan HHI	-0.0031	*						
	(-1.89)							
RE Loans/Total Loans			-0.0116	***				
			(7.54)					
C&I + Personal Loans/Total Loans					-0.0483	***		
					(-6.95)			
Small C&I Loans/Total Loans							-0.1316	***
							(8.54)	
Log(Bank Assets at Deregulation)	-0.0046	**	0.0071	***	-0.0003		-0.0421	**
	(-2.55)		(1.43)		(0.04)		(-2.51)	
Log(Bank Assets at Deregulation)^2	0.0002	**	-0.0004	*	-0.0002		0.0013	*
	(2.19)		(1.85)		(-0.48)		(1.66)	
Log(Bank Age at Deregulation)	0.0006	***	0.0009	***	0.0016	**	0.0069	***
	(3.87)		(5.51)		(2.38)		(6.94)	
State Fixed Effects?	Yes		Yes		Yes		Yes	
Year Fixed Effects?	Yes		Yes		Yes		Yes	
N	133,055		99,494		99,658		65,718	
R2	0.083		0.069		0.069		0.059	

Table 9. Deregulation, Loan Portfolio Composition Changes and Loan Chargeoffs

The data are taken from the June Call Reports of Income and Condition between 1990 and 2003. The unit of observation is a commercial bank-year. Bank-level loan HHI is the sum of squared loan category shares in a bank's loan portfolio in a given year. RE loans are loans secured by real estate. C&I loans are commercial and industrial loans not secured by real estate. Small C&I loans are C&I loans with principal amounts less than $250,000. Bank assets (age) at deregulation are bank assets (age) in the year in which a state enacts the provisions of the Riegle-Neal Act. In Panel A, Bank-level Loan HHI, RE Loans/Total Loans, C&I + Personal Loans/Total Loans and Small C&I Loans are instrumented with PostRN, Time and PostRN*Time. PostRN is a dummy variable equal to one in the year a state enacts the provisions of the Riegle-Neal Act. Time measures the time in years from the year in which a state independently first allowed interstate bank branching. 2SLS estimates are reported in Panel A. OLS estimates are reported in Panel B. T-statistics adjusted for clustering by state are reported in parentheses. ***, **, * indicate two-tailed statistical significance at the 1%, 5% and 10% levels, respectively.

Panel A - 2SLS

	Total Loan Chargeoffs		RE Loan Chargeoffs		C&I + Personal Loan Chargeoffs		C&I Loan Chargeoffs
Dependent variable:	Total Loans		RE Loans		C&I + Personal Loans		C&I Loans
	2SLS		2SLS		2SLS		2SLS
Bank-level Loan HHI	0.0504	***					
	(2.74)						
RE Loans/Total Loans			0.0392	**			
			(2.49)				
C&I + Personal Loans/Total Loans					-0.0952	**	
					(-2.47)		
Small C&I Loans/Total Loans							-0.2976
							(-1.42)
Log(Bank Assets at Deregulation)	-0.0085	***	-0.0018		-0.0153	**	0.0063
	(5.62)		(-1.07)		(-2.17)		(-0.26)
Log(Bank Assets at Deregulation)^2	0.0004	***	2.73E-05		0.0007	**	-0.0006
	(5.76)		(0.35)		(2.13)		(-0.47)
Log(Bank Age at Deregulation)	0.0004	*	0.0004		-0.0015	***	-0.0027
	(1.22)		(1.29)		(2.80)		(-0.99)
State Fixed Effects?	Yes		Yes		Yes		Yes
Year Fixed Effects?	Yes		Yes		Yes		Yes
N	135,410		99,494		99,342		65,718
R2	0.022		0.021		0.019		0.010

Table 9 continued.

Panel B - OLS								
	Total Loan Chargeoffs		RE Loan Chargeoffs		C&I + Personal Loan Chargeoffs		C&I Loan Chargeoffs	
Dependent variable:	Total Loans		RE Loans		C&I + Personal Loans		C&I Loans	
	OLS		OLS		OLS		OLS	
Bank-level Loan HHI	0.0002							
	(0.21)							
RE Loans/Total Loans			-0.0006	***				
			(-4.16)					
C&I + Personal Loans/Total Loans					-0.0071	***		
					(-6.97)			
Small C&I Loans/Total Loans							-0.0396	***
							(-6.51)	
Log(Bank Assets at Deregulation)	-0.0031	***	4.52E-05		-0.0017		-0.0209	***
	(-7.79)		(0.05)		(-0.95)		(-2.80)	
Log(Bank Assets at Deregulation)^2	0.0001	***	-6.32E-06		0.0001		0.0008	**
	(8.26)		(0.17)		(0.71)		(2.42)	
Log(Bank Age at Deregulation)	-0.0001	**	2.60E-06		-0.0001		0.0006	**
	(-2.30)		(0.14)		(0.49)		(2.30)	
State Fixed Effects?	Yes		Yes		Yes		Yes	
Year Fixed Effects?	Yes		Yes		Yes		Yes	
N	135,410		99,494		99,342		65,718	
R2	0.036		0.032		0.024		0.019	

Table 10. Loan Portfolio Composition, Loan Sales and Derivatives Usage

The data are taken from the June Call Reports of Income and Condition between 1990 and 2003. The unit of observation is a commercial bank-year. Bank-level loan HHI is the sum of squared loan category shares in a bank's loan portfolio in a given year. RE loans are loans secured by real estate. C&I loans are commercial and industrial loans not secured by real estate. Bank assets (age) at deregulation are bank assets (age) in the year in which a state enacts the provisions of the Riegle-Neal Act. The first specification is estimated using OLS. T-statistics adjusted for clustering by bank are reported in parentheses. The second specification is a probit estimated using maximum likelihood estimation. Z-statistics adjusted for clustering by bank are reported in parentheses. Marginal probabilities calculated at sample means are reported in brackets. ***, **, * indicate two-tailed statistical significance at the 1%, 5% and 10% levels, respectively.

	Mortgage-Backed Securities / Total Loans	Owns Interest Rate Swaps?
	OLS	Probit - MLE
RE Loans/Total Loans	0.058 ***	0.687 **
	(4.52)	(2.33)
		[0.014]
C&I + Personal Loans/Total Loans	-0.026 *	1.321 ***
	(1.93)	(5.03)
		[0.027]
Bank-level Loan HHI	-0.093 ***	-0.236
	(-7.81)	(-1.22)
		[-0.005]
Log(Bank Assets at Deregulation)	0.005	1.351 ***
	(0.27)	(5.97)
		[0.028]
Log(Bank Assets at Deregulation)^2	0.001	-0.038 ***
	(1.01)	(-4.52)
		[-0.001]
Log(Bank Age at Deregulation)	0.006 ***	-0.056 ***
	(6.41)	(-3.50)
		[-0.001]
State Fixed Effects?	Yes	Yes
Year Fixed Effects?	Yes	Yes
N	57,019	135,410
R2/Pseudo-R2	0.095	0.228