How Does Competition Affect Bank Lending?

Quasi-Experimental Evidence from Bank Mergers

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Abstract

This paper studies the effects of bank competition on commercial lending. I find that greater competition causes a change in the quantity and composition of businesses receiving loans, with more loans going to larger and safer borrowers. To identify exogenous changes in bank competition, I exploit discontinuities in the application of bank antitrust rules governing mergers. In markets that fall narrowly below regulatory cutoffs, competition declines due to bank mergers. In markets above cutoffs, forced branch divestitures keep competition constant even though mergers occur. Using a difference-in-differences methodology comparing these types of markets, I estimate that antitrust rules cause the Herfindahl Index to fall in relative terms by 180 points and, consistent with greater competition, deposit rates to rise by 0.13 percentage points. Using loan-level data from commercial mortgages, I show that this change in competition is associated with a 5 percent increase in the likelihood that borrowers take a loan from a local bank and an increase in the average borrower size of 10 percent without a change in the average loan-to-value ratio. For banks not directly involved in a merger, lending to large borrowers increases and the nonperforming loan ratio falls by 0.38 percentage points. Overall, my findings support a model in which competition improves the efficiency and quality of bank lending.

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1 Introduction

How does competition affect banks' provision of financing? This question, which has broad relevance for credit markets and firms' access to capital, has become increasingly salient as the banking sector in the United States has consolidated. Since 1994, the number of commercial banks has declined by fifty percent from about 10,000 to 5,000. This consolidation has led to an unprecedented increase in bank concentration at the market level. It is therefore important to understand what effect competition has on the quantity and composition of credit available to businesses. This paper empirically investigates the effect of bank competition on credit supply, risk, and composition.

Theoretical predictions about the effect of competition on lending depend on assumptions about the role banks play in credit allocation. Petersen and Rajan (1995) emphasizes banks' ability to form long-term relationships with borrowers, arguing that monopolists lend more than competitive banks because monopolists can smooth profits over the course of their lending relationships. Alternatively, Jayaratne and Strahan (1996) and Bertrand et al. (2007) study banks' ability to allocate capital and argue that greater competition may improve the efficiency of bank lending, leading to more lending. Finally, in Keeley (1990) and Allen and Gale (2004), banks choose borrowers as they would choose a portfolio of risky assets; competition induces a shift toward riskier borrowers as it reduces the downside risk from bankruptcy.

This paper empirically evaluates theories of banking by studying how loan risks and volumes change following mergers whose competitive impact is exogenously restricted by antitrust regulation. I find that, for incumbent banks not involved in a merger, competition increases credit supply and decreases loan risks. These findings are most consistent with models in which competition increases the efficiency of the banking system by reducing market power.

The source of empirical variation is a quantitative cutoff rule used by U.S. antitrust authorities to determine the approval of bank mergers, which discontinuously changes the probablility that regulators intervene in a market. This results in some markets where mergers go through and others where regulators exogenously restrict consolidation. When banks plan to merge, regulators decide whether to intervene based on how the merger would change the Herfindahl Index (HHI) of bank deposits in any market where both the absorbing and acquired bank have branches.[1] The same

[1]The Herfindahl Index is a measure of market concentration widely used in competition research and policy. Throughout this article, I use the definition of "banking market" used by bank regulators in the United States.

proposed merger might induce intervention in some banking markets but not others. I show that the rule does not influence the banks' decision to merge, but it does mitigate the anti-competitive effects of mergers in the markets where regulators intervene. Regulators require merging banks to divest branches in any market where the HHI would rise by at least 200 points to a level above 1800. If the HHI would rise to a level below 1800, there is no such requirement. I exploit the heterogeneous application of antitrust rules above and below the 1800 HHI cutoff using a difference-in-differences design that compares banking markets whose HHI falls within a 500-point range of 1800. These effects are robust to using alternative HHI ranges above and below the cutoff.

The difference-in-differences estimates show that antitrust enforcement has a dramatic effect on the level of competition, which I then use to study the effect of competition on bank lending by banks uninvolved in the mergers. In markets with a predicted HHI from 1300-1800, mergers cause the HHI to increase by about 363 points on average. Due to enforcement, the HHI increases by 180 points less in markets in the predicted 1800-2300 region. For comparison, a 180-point change in HHI would be approximately equivalent to a change from eight to seven equally-sized banks. Price-based measures also show that this antitrust rule affects bank competition. The 180-point HHI decrease is associated with an increase in 3-month certificate of deposit (CD) spreads of 0.10 percentage points and an increase in 3-year CD spreads of 0.21 percentage points, both of which are consistent with increased competition and large compared to median annual percentage yields of 1.14% and 2.90%.

Having established that antitrust laws affect the level of competition in local banking markets, I investigate the effect of competition on bank lending. I investigate three empirical effects of competition that distinguish theories of banking. First, whether greater competition increases or decreases total bank lending. Second, how competition changes the composition of borrowers receiving loans. Third, how competition affects loan delinquency rates.

I evaluate these predictions using bank-level balance sheet data as well as loan-level microdata on commercial real estate (CRE) lending. Because CRE lending relies on banking relationships that are established over time and are therefore a real-world analogue to the type of loans studied by banking theory, CRE is an ideal setting to study theories of competition. Furthermore, CRE loans

Markets typically correspond to MSAs or non-MSA counties. The HHI for banks is measured using deposits data from the FDIC Summary of Deposits Database.

are the largest single source of financing for small businesses in the United States.[2] To isolate the effects on bank competition, the sample is limited to include only incumbent banks in each banking market, without the banks that are themselves merging. There are three main findings.

First, I find that greater competition is associated with an increase in bank lending, but only to larger businesses within the small business portfolio.[3] At the bank level, small business CRE lending increases relative to banks' total CRE lending, but only for small business CRE loans with a value of $250,000-$1,000,000. In the loan-level data, estimates indicate a 40% increase in loan origination at the market level for loans with collateral above the median value of $243,000, due to a combination of new lending and refinancing. In contrast, I estimate a small, positive, and not statistically significant effect on smaller loans in both loan- and bank-level data.

Second, the increase in lending for large borrowers changes the composition of borrowers receiving loans. Deeds records estimates show that, following mergers where antitrust law is applied, CRE loan sizes increase by 10 percent relative to mergers where laws are not applied. Average borrower collateral values and property prices increase, indicating a change in borrower composition, while loan-to-value (LTV) ratios change very little. Borrowers are five percent more likely to borrow from nearby banks located in the same market and the increase in loan size I estimate is driven entirely by local lenders. I show that large borrowers are generally less dependent on nearby banks for financing, so a straightforward interpretation of these findings is that greater competition in a local market attracts large borrowers who would otherwise borrow elsewhere.

The third finding is that greater competition is associated with less risky bank lending. In markets where the HHI falls by 180 points because of bank regulation, banks have a 0.36 percentage point overall lower non-performing loan ratio and a 0.34 percentage point lower non-performing loan ratio for commercial real estate loans. Using microdata from commercial mortgage-backed securities, I show that, in general, large CRE borrowers default at significantly lower rates than small ones. Therefore, when the composition of borrowers changes from smaller to larger borrowers, it is natural that the rate of delinquency should fall as well.

[2]Petersen and Rajan (1995) and Strahan (2003) use survey data from small businesses in the United States, although this does not contain data on individual loans. Research on European banking is more likely to include matched borrower-lender data, including Elsas (2005), Degryse and Ongena (2007) and Sapienza (2002).

[3]"Small business lending" in the bank–level data refers to loans with value less than $1,000,000. Within this loan range, a "large borrower" is one that borrows between $250,000-$1,000,000 and a "small borrower" is one that borrows less than $250,000.

The estimated effect of competition on bank capital structure, including leverage, regulatory capital, and deposit reliance, is small in magnitude and not statistically significant. Because the bank sample only includes local banks, the 180-point change in HHI is a significant change in competition. Therefore, these estimates are less consistent with the hypothesis that greater competition causes banks to adopt a riskier capital structure.

The identifying assumption for these estimates is that incumbent banks would not respond differently to mergers with antitrust intervention if it were not for the interventions themselves. The incumbent banks I study are observably similar in markets with and without intervention, making this assumption plausible. Moreover, I support this assumption with three pieces of empirical evidence. First, I show that mergers are not self-selected on the basis of whether antitrust rules will be applied (if they were, mergers that occur despite anticipated antitrust intervention might be unusual in some way).[4] In particular, there is no bunching of mergers below the 1800 cutoff, as one would expect if banks were merging selectively. Second, I show that mergers do not have a direct effect on the measured size and branch network of the incumbent banks. Third, I do not estimate an effect in a placebo sample which uses the HHI=1800 cutoff but restricts mergers to those where the HHI increases by fewer than 200 points and are therefore unaffected by antitrust law. A variety of other placebo tests and control variables provide further support for my identification.

What do the results imply for theories of banking? The empirical results support the theory that competition increases lending and improves the effectiveness of the financial system. This theory emphasizes the role of banks as efficient allocators of capital that have a special ability to determine which investments are the most profitable. By contrast, in the model proposed by Petersen and Rajan (1995), monopolistic banks know that they can recover losses incurred by lending to unknown borrowers using the rents they earn from borrowers who turn out to be successful. This model predicts that competition decreases the total amount of bank financing, but the empirical results are less supportive of this prediction. The empirical results also do not support the hypothesis that competition increases risky lending. This theory, which is known as the Charter Value Hypothesis, holds that deposit insurance incentivizes banks to make risky bets with depositors' money, but the incentive for risk-taking is lower for monopolistic banks who would lose their rents in bankruptcy

[4]This is not surprising, as bank mergers typically involve a large number of markets, and antitrust action in a handful of markets is unlikely to derail a merger altogether.

(Keeley, 1990; Allen and Gale, 2004). Instead, the results support the class of models in which competition is efficiency-enhancing.

This result is important because it suggests a possible downside to the increase in bank concentration that has occurred over the past twenty years. The findings therefore contribute to a debate on the effects of rising concentration that has occurred in the United States more generally (Gutierrez and Philippon, 2016; Grullon et al., 2017). The estimates shown here indicate that the rise in bank concentration may have negative effects on commercial lending.

The results also have implications for bank antitrust regulation. Bank regulators are uncertain about whether competition has positive or negative effects (Group of Ten, 2001; Beck, 2008). Theoretically, different effects may dominate in different settings and at different levels of competition but what is most relevant for bank regulators is the change in bank behavior that is induced by antitrust laws. Therefore, my results do not prove that competition never has a "dark side", but they provide evidence against a dark side at the most relevant policy margins.

The paper proceeds as follows. Section 2 reviews related literature. Section 3 presents a stylized framework used to analyze the empirical estimates. Section 4 describes the institutional setting, including a summary of the bank antitrust process in the United States and details on the quantitative screening process. Section 5 describes the main data sources and presents summary statistics. Section 6 describes the main difference-in-differences strategy used to identify the effects of bank competition. Section 7 provides evidence for the effectiveness of antitrust law enforcement, Section 8 presents the main empirical estimates, and Section 9 concludes.

2 Literature Review

This paper contributes to three areas of empirical research. The first is research on the effects of bank competition on lending to small businesses. The second is research on the relationship between bank competition and risk-taking. Third, this paper relates to studies on the effects of bank mergers on lending.

The most closely related research to this paper is about the effects of bank competition on lending to small businesses. Jayaratne and Strahan (1996) and Jayaratne and Strahan (1998) show that states relaxing branch restrictions had greater credit provision and economic growth as a result.

Related research by Rice and Strahan (2010) shows that restrictions on branch expansion raised interest rates and reduced credit supply without a change in borrowing amounts. Other papers examining the effects of branching restrictions include Jiang et al. (2017), Black and Strahan (2002), Cetorelli and Strahan (2006), and Goetz et al. (2016). Overall, these research show that relaxing restrictions leads to positive financial and real outcomes for firms. Relatedly, a number of papers study the cross-sectional relationship between competition and lending-related variables, including Elsas (2005), Degryse and Ongena (2007) and Love et al. (2015). Finally, Bertrand et al. (2007) studies the effects of the liberalization of the French banking system on business lending and real firm outcomes.

There are two differences between this paper and the literature on branching restrictions. First, Strahan (2003) and Jayaratne and Strahan (1998) show that removing branch restrictions affected credit supply not only because this change affected competition between banks, but because it allowed well-managed banks to take over poorly-managed ones, thus increasing the quality of bank management. In contrast, this paper studies changes to competition induced by a change in the number of competitors rather than bank management, which more directly tests the implications of theories of bank competition.[5] This method, along with the use of loan-level data, allows this paper to test theories of competition that focus on the number of competitors in a banking market rather than changes to bank management.

The findings in this paper are also related to research on the effects of competition on bank risk-taking. Much of the research in this area is framed as tests of the Charter Value Hypothesis (CVH), which predicts greater competition causes more bank risk-taking because of a decline in charter value. Overall, the results of this literature have been mixed.[6] The mixed findings may be due to theoretical ambiguity, difficulty in measuring bank risk-taking, or the endogeneity of bank market structure.

My estimates complement the findings of Williams (2017) and Nguyen (2016), which, rather than studying market-level competitive dynamics, focus on the effect of mergers on the merging

[5]Strahan (2003) shows that interstate branching restrictions have no effect the Herfindahl Index, which is one of the main measures that antitrust regulators target and which I study. By contrast, I show that the size and ownership structure of incumbent banks do not change as a result of antitrust law enforcement, ensuring that the causal channel is different from the one studied by research on branching restrictions.

[6]Pro-CVH: Keeley (1990); Demsetz et al. (1996); Beck et al. (2006); Dick (2006); Yeyati and Micco (2007); Ariss (2010); Jimenez et al. (2013); Beck et al. (2013) Anti-CHV: Nicolo (2001); Boyd and De Nicolo (2005); De Nicolo and Loukoianova (2007); Schaeck et al. (2009). Mixed: Berger et al. (2009).

banks themselves. Williams (2017) compares the effect of monetary policy on divested branches to its effect on non-divested branches by the same banks in the same banking market, finding that branches purchased by small banks become more sensitive to monetary policy. Nguyen (2016) shows that branch closings following mergers reduce credit provision for businesses located near the closed branches. Bank mergers are also important to this study, but rather than investigating the effect of mergers *within* a banking market, I study the effects of antitrust laws *across* banking markets, comparing markets where antitrust laws apply to markets where they do not apply. In order to study competition as a market-wide phenomenon, data in incumbent banks (rather than the banks that are actually involved in a merger) best demonstrates the effect of competition, as compared to bank ownership and structure.

3 Stylized Framework

A stylized framework illustrates the main theoretical relationships between competition and bank lending. The overall effect of competition on bank lending is ambiguous because it operates through different mechanisms that have opposing effects. This framework will clarify these different mechanisms and allow me to distinguish between them empirically.

The framework encompasses three mechanisms drawn from theoretical research on bank competition. First, monopolists do not take prices as given, so one would expect monopolists to lend less than competitive banks. I call this the *market power mechanism*. Second, when projects require repeated investments and are initially unprofitable, monopolists might make early-stage investments that competitive banks will not. The rents earned on late-stage loans subsidize early and sometimes unprofitable investments. This mechanism, which leads monopolists to lend more than competitive banks, is the *long term project mechanism* studied by Petersen and Rajan (1995) and Boot and Thakor (2000). Third, monopolists may take fewer risks because the rents are a valuable asset that are lost in bankruptcy. Research on this theory refers to this as the Charter Value Hypothesis. It predicts that monopolists make less risky loans than competitive banks do.

The modeling framework I use builds on the models and concepts used in Tirole (2010).

Setting

Banks' investment options in this setting are a simplified version of banks' choices in the models described by Keeley (1990), Petersen and Rajan (1995), Allen and Gale (2004) and Tirole (2010). I adopt the three key features of these models and show how they interact with each other: First, banks have the option to make repeated loans to the same borrowers. Second, some borrowers have outside financing options which may include borrowing in a different market or using other types of financing. Third, banks can make choices that could cause them to go bankrupt.

Banks have two non-mutually exclusive investment options: (a) standard lending projects where the net payoff to the bank is endogenously determined, and (b) a bet-the-bank project where the net payoff is exogenous even for the monopolist. In the standard lending projects, a unit mass of entrepreneurs approach the bank with projects that require investment I_1 in their first stage. Entrepreneurs' first-stage investments have unit payoff if they are successful, which occurs with probability p, and zero payoff otherwise. If the projects are funded, entrepreneurs may raise funds $I_2 < I_1$ which they invest in the project's second stage, which again pays off with probability p and has unit payoff if successful.[7] With probability α, entrepreneurs receive a take-it-or-leave-it outside financing offer in the first period that provides financing for both periods (whether the offer occurs is not observable to the banks). The outside financing offer gives investment I_1 and I_2 in each period in return for payment r in each period where $\frac{I_1+I_2}{2p} < r < 1$. Entrepreneurs repay banks only from the project payoff.

The bet-the-bank project pays off with probability p^R and has zero investment cost. If it pays off, it has unit payoff. If it is undertaken but fails, the bank goes bankrupt, earning no profits from either this investment or from the standard lending projects.

Banks only invest in weakly positive net present value (NPV) projects. Free entry ensures that the payoff competitive banks demand from lending to entrepreneurs is such that banks' profits are zero in expectation. Monopolists demand the payoff from entrepreneurs that maximizes their payoffs, limited only by the fact that entrepreneurs may accept an outside offer if it gives a better price and that entrepreneurs cannot repay more than they earn. Competition does not affect the payoff from the bet-the-bank project, which is 1 if it succeeds.

[7] An interpretation of this is that screening is required in period 1 so that $I_1 = I_2 + c$ with $c > 0$.

Competitive Banking Market

The zero profit condition implies that the payoff competitive banks require from successful projects in the first period is I_1/p and the payoff they require from successful standard lending projects in the second time period is I_2/p. Because each project's payoff is assumed to be 1 if successful, only projects where $I_1 < p$ will be funded. Otherwise, the bank will receive a return less than I_1/p . If a project is not funded in the first period, there is no second period investment opportunity. Therefore $I_2 < I_1$ by assumption; if a project is funded in period 1 , it will also be funded in period 2. So competitive banks either choose to fund the project in both periods (if $I_1 < p$) or not at all (if $I_1 > p$). The outside financing opportunity with cost r is more expensive than the average competitive rate offered by banks $\frac{I_1+I_2}{2p}$ by assumption, and therefore borrowers will take local bank financing whenever it is offered.

Competitive banks will always invest in the bet-the-bank project since their expected return is p^R and they do not risk losing any profits from the standard lending projects because of the zero-profit condition.

Monopolistic Banking Market

Monopolists lend whenever $2p - (I_1 + I_2) > 0$ because they can capture the rents from both periods. Since $I_2 < I_1$, there is a range of projects where p satisfies $I_1 > p > \frac{I_1+I_2}{2}$ where monopolists will lend but competitive banks will not. The fact that there is a wider range of projects where monopolists lend (as opposed to entrepreneurs) captures the central insight of the *long-term project mechanism* described by Petersen and Rajan (1995). The key insight is that projects may require high initial investments – for example, due to screening costs – which monopolists can recapture if they continue to lend to the same borrowers. Because borrowers are stuck going to the same bank in both periods, monopolistic banks have what amounts to an equity stake in projects.

Suppose now that $p > \frac{I_1+I_2}{2}$ so monopolists can lend profitably. If monopolists demand a payoff of between r and 1, their offer will be accepted by the $1 - \alpha$ borrowers who do not have the outside option. If they demand a payoff between 0 and r, their offer will be accepted by all borrowers. Therefore, to maximize their profits, monopolists will demand a payoff of either 1 or r from successful projects. Demanding 1 is optimal whenever the expected profits from lending at rate 1 to $1 - \alpha$ of the borrowers and earning profits $2p - (I_1 + I_2)$ on each is greater than the expected profits from lending at rate r to all borrowers and earning profits $2pr - (I_1 + I_2)$ on each. In other

words, demanding a payoff of 1 is optimal whenever $(1-\alpha)(2p-(I_1+I_2)) > 2pr-(I_1+I_2)$, or equivalently, whenever $\alpha < 1-\frac{2pr-(I_1+I_2)}{2p-(I_1+I_2)}$. This means that for sufficiently small α, monopolistic lenders do not mind losing the borrowers with the outside option. The loss of these borrowers exemplifies the *market power mechanism* as market power can lead to less lending at higher prices.

A monopolist's decision to invest in the bet-the-bank project depends on the profits from standard lending. Let x be the profits monopolists make from lending – either $(1-\alpha)(2p-I_1-I_2)$ or $2pr-I_1-I_2$, whichever is greater. Then the bet-the-bank project is worth investing in whenever $p^R(x+1) > x$ or equivalently $x < \frac{p^R}{1-p^R}$. Intuitively, profitable investments can dissuade banks from taking risks that put the whole company's profits at stake if the whole company's profits are high enough. This is the key insight of the Charter Value Hypothesis.

In summary, monopolistic banks will either invest in the bet-the-bank project or not, and will either require r or the full unit return from standard lending projects. The choices they make depend on the parameter values. Compared to competitive banks, monopolists are less likely to invest in the bet-the-bank project and may do either more or less standard lending in total. They are likely to lend more often if first-period investment costs are high enough to prevent competitive banks from making such loans, and they lend less often if it is worthwhile for them to charge interest rates high enough that some borrowers find it optimal to find financing elsewhere.

Empirical Predictions

The mechanisms in this framework yield several empirical predictions. I divide them into predictions for the total amount of bank lending, the composition of borrowers receiving loans, and the riskiness of bank capital structure.

Total Lending

The effect of competition on total lending depends on which mechanism dominates, which depends on parameter values. The long-term project mechanism predicts that monopolists do more overall lending, particularly for projects that require a high initial investment. By contrast, the market power mechanism predicts that competitive banks do more lending for borrowers who have an easy time getting outside sources of finance. From the perspective of borrowers, more lending may mean a shift from outside to nearby sources of finance.

Borrower Composition

Both the long-term project mechanism and the market power mechanism predict that greater competition is associated with more lending going to large and well-established borrowers. The long-term projects mechanism makes this prediction because empirical research shows that the newest, least-established firms require the largest initial investments and are therefore hurt when competition rises (Petersen and Rajan, 1995). This also implies a shift towards less risky lending as better-established firms are less likely to become delinquent. Section 8 confirms these cross-sectional relationships and also shows that large and old borrowers are more likely to borrow from far away than smaller borrowers are. The market power mechanisms predicts that the largest borrowers, who have the greatest access to outside sources of finance, can go outside the local market when competition is low, thus shifting the composition of borrowers to smaller and younger firms, much like the long-term project mechanism. Finally, the Charter Value Hypothesis predicts that competitive banks take more risks. In some formulations of this mechanism, such as the one modeled by Allen and Gale (2004), thism means a higher share of risky borrowers.

Bank Capital Structure

The Charter Value Hypothesis predicts that greater competition causes banks to take actions that increase their risk of bankruptcy. They could plausibly do this by lending to riskier borrowers or by adopting a riskier capital structure, such as one more prone to bank runs or with a smaller equity buffer. Neither the long-term project mechanism nor the market power mechanism predict changes in bank capital structure.

Table 1 summarizes the three mechanisms' main predictions.

4 Institutional Setting

U.S. banks that wish merge must receive the approval of the bank regulator in charge of the acquiring bank. Regulators take many laws and regulations into account when they evaluate mergers. Some of those laws govern the antitrust implications of bank mergers.[8] To make their antitrust-related decisions, both bank regulators and the Department of Justice (DOJ) perform a quantitative screening of each market where both the acquiring bank and the bank being acquired have branches.

[8]The laws governing antitrust are the Sherman and Clayton Antitrust acts. "Regulators" here means the Federal Reserve, FDIC, OCC, or the NCUA. Typically we think of antitrust enforcement as a matter for the court system, but administrative law allows bank regulators to make most antitrust decisions. Only when the U.S. Department of Justice (DOJ) disagrees with bank regulators, which happens in a minority of cases, do courts get involved.

The screening relies on a formal quantitative analysis of changes to the Herfindahl-Hirschman Index (HHI) due to the merger. When banking markets involved in a merger violate the quantitative screening, regulators generally do not block the merger altogether. Rather, they require antitrust remedies to be applied to the violating banking markets. Merging banks often have branches in many of the same banking markets, but only the banking markets violating the quantitative screening are affected; the merger can take place as planned in all other banking markets.

Regulators screen banking markets for antitrust concerns in three steps:

1. They calculate the HHI of bank deposit concentration in each market where both banks have branches.[9] The HHI is defined as the sum of squared deposit market shares, multiplied by 10,000. Market shares are measured using branch deposit data from the FDIC Summary of Deposits Database. The HHI ranges from 0, for perfectly competitive markets, to 10,000 for markets with one firm.

2. They calculate the resulting HHI in each market if the merger went through as planned.

3. Markets where the HHI would increase by at least 200 points ($\Delta HHI > 200$) to a level above $HHI = 1800$ are flagged for further review and antitrust remedies are required in these markets.

While the screening cutoffs ($\Delta HHI = 200$ and $HHI = 1800$) are important, they are not binding for bank regulators. These and other the guidelines may be waived, for example, if there is "evidence that the merging parties do not significantly compete with one another" or "evidence that rapid economic change has resulted in an outdated geographic market," according to reports published by the FDIC. Regulators also commonly allow mergers to go through in markets violating the screening when they believe the bank being acquired could not survive without being acquired. Moreover, they may require remedies even when the quantitative screening is not violated, for example because of concerns about a merger's effects on community lending or financial stability. Finally, antitrust

[9]Regional Federal Reserve Banks define the geographic banking markets which other regulators use as well; in urban areas, markets typically coincide with MSAs, and in rural areas, they may be single counties. However, there is widespread discussion in the legal and economic literature about the right definition of a banking "market." While there is evidence that banking is a local phenomenon (Petersen and Rajan, 1994), some authors have argued that innovations to the banking industry have enabled banks to compete effectively over large areas (Pekarek and Huth, 2008) and others that banks compete in a highly localized way Nguyen (2016). In order to exploit regulatory cutoffs, I use the Federal Reserve definitions for the antitrust analysis.

screening was partially suspended during the financial crisis. I exclude mergers taking place in 2007-2008 from the sample throughout this paper. Despite this regulatory discretion in the application of antitrust rules, Section 7 will show that the likelihood of branch divestiture rises discontinuously at the HHI=1800 cutoff.

Regulators do not block bank mergers altogether when a banking market fails the HHI screening. Instead, they require the merging banks to sell some of their branches to a third-party bank with no prior presence in the offending market. This is known as branch divestiture. The purpose of branch divestiture is to maintain a high level of competition in banking markets that would otherwise become non-competitive due to a merger. The details of which branches are divested and to whom they are sold are negotiated between regulators and banks, but regulators generally require that the former branches of the absorbed bank are the ones divested.

Regulators monitor the divestiture process to ensure that divested branches remain competitive after they are sold. To keep banks from sabotaging their divested branches, banks must bundle together each customer's complete bank services, including loans, deposits, credit cards, and so on, and all of these must be divested together or kept together. Potential buyers of divested branches must also prove that they are sufficiently large and experienced before they are allowed to buy the branches.[10] Finally, regulators monitor divested branches for several years to ensure that the level of competition stays high in the banking market. Pilloff (2002) and Burke (1998) provide empirical evidence that the branch divestiture process works well and divested branches remain competitive.

5 Data Sources and Summary Statistics

This section describes summary statistics for the sample used to identify the effects of bank competition. The data comes from several sources, including the FDIC Summary of Deposits Database, Call reports, RateWatch survey data on certificate of deposit (CD) rates, loan data from commercial mortgage-backed securities (CMBS), deeds records, and the 2003 Survey of Small Business Finances (SSBF).

This paper will exploit the $HHI = 1800$ cutoff rule as the basis for its empirical variation. As

[10] Regulators also carefully negotiate *which* branches are spun off to minimize disruption. Most often, the branches being spun off belong to the bank being acquired, to prevent customers from re-opening their accounts at a different branch of their old bank. Regulators may also accept a divestiture of branches by the acquiring bank, but they rarely involve a mix of the two (Pilloff, 2002; Burke, 1998).

I will show in Section 6, banking markets whose HHI falls narrowly above the cutoff have a far greater chance of failing regulators' quantitative screening than markets narrowly below the cutoff. The main empirical specification will study only those banking markets where the HHI rose by at least 200 points and was predicted to fall within 500 points of 1800. That is, markets involved in mergers where the HHI was between 1300 and 1800. This includes 200 banking markets involved in 348 mergers. (Not all data sources are available for the full set of mergers and markets, however.) I estimate the effects of competition on bank behavior in data from the FDIC Summary of Deposits Database, using bank call reports, and using loan-level microdata from deeds records. For these three datasets, the summary statistics shown here are only for the sample of banking markets used in the main regression specifications.

5.1 Merger and Branch Summary Statistics

I use the FDIC Summary of Deposits (SOD) database to investigate bank mergers. For each banking market involved in a merger where both the surviving and purchased bank have branches, I calculate: 1) The HHI immediately before the merger takes place, or the *pre-merger HHI;* 2) The HHI that would result if the merger went through as planned and no local branches were divested, the *predicted HHI;* 3) The difference between these, the *predicted change in HHI* due bank mergers. The Federal Reserve Bank of St. Louis provides a free online tool, CASSIDI, which performs these calculations for all bank branches that are currently in place. I verify the accuracy of my calculations by showing that they are the same as those calculated by the CASSIDI tool when applied to current branches.

Table 2 shows summary statistics for the sample of banking markets involved in bank mergers where the change in HHI is at least 200 points. For each banking market, I combine branching data from the SOD with market-level population and income averages from the U.S. Census Bureau and the Quarterly Census of Employment and Wages (QCEW). The banking markets in the sample are medium-sized towns: The population is 218,200 people, and median house price growth is 3.6%, which is well below the national average during this sample period. The average banking market HHI is 1996, equal to about five equally-sized banks. The average number of banks is 19, however, which means that deposits are concentrated in a handful of large banks, but there are many small banks as well, each having small market shares. Finally, the median bank in these banking markets

has, on average, 116 branches, indicating a large presence for major national and regional banks.

5.2 Deposit Rates

Data on retail deposit rates is provided by the firm RateWatch. This dataset includes branch-level retail deposit rates nationally. Banks hire RateWatch to conduct surveys of their competitors' interest rates in order to compete effectively.

Because interest rate data is collected at the request of banks, coverage varies by market and by year. However, it is nearly comprehensive for the entire urban U.S. beginning in 2000. I use exclusively deposit rates data for $10,000 CDs, which I match to the closest-maturity T-Bill rates to calculate spreads. I calculate the average of these across all branches in the market to calculate the market-by-maturity average spread. Overall market-level spreads are the average of each of the maturities.

RateWatch deposit rate data is widely used to investigate the effects of competition, for example by Drechsler et al. (2017) and Azar et al. (2016).

5.3 Bank Cross-Sectional Statistics

Bank-level data comes from publicly-available Call reports. I select a sample of local banks with at least half of their deposits located in a single banking market. There are two reasons to focus on local banks. First, the variation in bank competition I use is regional, so to estimate its effects I must identify banks within a particular region. Second, the Charter Value Hypothesis models the effects of competition which affect a bank's entire operations. This is most relevant for local banks.

I divide bank variables into three groups: Bank scale, capital structure, and lending behavior.

- *Bank scale:* Total assets and total bank lending.
- *Capital structure:* Tier 1 Capital Ratio, Equity/Total Assets, and Deposits/Total Assets. A bank has a riskier capital structure when any of these ratios is lower.
- *Lending behavior:* The non-performing loan ratio (NPL) and loan loss reserves (LLR) measure the riskiness of the loans. The NPL ratio is the fraction of all loans that are 90+ days delinquent, an *ex post* measure of bank risk-taking. Loan Loss Reserves, also measured as a fraction of total loans, are held in case of future non-performance and so are an *ex ante*

measure of risk taking. I measure small business lending using data by loan size. Interest and total earnings measure incumbent banks' size.

Summary statistics of bank characteristics for pre-merger years are shown in Table 3. The sample used in this paper encompasses banks with at least half of their deposits located in a banking market. The average bank has $531mn in loans and $921mn in total assets, although the medians are only $28mn and $45mn respectively, indicating a right-skewed distribution of bank characteristics by market. In this sample, banks have a loan loss reserve ratio of 1.5% and an NPL ratios of 0.8% on average. They have an equity/assets ratio of 10% and a slightly higher Tier-1 Capital/Risk-Weighted Asset Ratio of 15%. Because these are local banks, they are heavily deposit-reliant, with a deposit/assets ratio of 84% on average.

Further details about bank sample selection and variable construction are available in Appendix C.1.

5.4 Commercial Mortgage Statistics

I study the effects of bank competition on CRE lending using data on commercial mortgages. There are two main sources of loan-level data: Deeds records from CoreLogic and CMBS data provided by Trepp.

Companies that sell or mortgage their property generally record their transactions by filing deeds records with their county recorder. In most states, this is required by law. Even when not required by law, lenders typically require official recording. This both provides official documentation of land ownership and allows potential lenders to keep track of borrowers' existing debts. Once recorded, deeds transactions are available to the public, but collecting this data often requires a visit to the County Recorders office for every county of interest. I use data hand-collected by the company CoreLogic, which has a national staff that visits county recorders offices for every U.S. county. The CoreLogic data is widely used in research on residential real estate, but it is just as valuable for tracking CRE. Geographic coverage is spotty in the 1990s but becomes nearly comprehensive by 2000.

The available sample includes deeds records from banking markets where mergers take place in which the predicted HHI is 1800-2800 and the change in HHI is at least 200 points. This sample

includes 63,783 properties in 179 counties which are part of 109 banking markets. Included are years 1994-2015, or whatever years are available for each market.

Deeds records are available at the transaction level. The key variables are property price (if a sale occurs), mortgage amount and lender (if a mortgage exists), deed type, property location, and owner name and address. I focus on mortgage transactions and drop sales with no mortgage. Because many mortgages are used to roll over or refinance existing debt and therefore do not correspond to a sale, I extrapolate prices from previous or future sales to estimate property values and LTV ratios when prices are not available. (Details on this are available in Appendix C.2.)

My empirical variation affects the degree of bank competition in a single banking market. Therefore it is important to distinguish between mortgages from local banks, that are directly affected by competition, and mortgages from non-local banks, which are only indirectly affected. To distinguish local from non-local mortgages, I create an indicator variable equal to 1 if the borrower and the lender are located in the same city.

Table 4 shows summary statistics of the deeds records sample. The median mortgage has a value of $190,000 on a property with value $243,000, leading to an LTV of 80%. However, these variables are right-skewed, leading to an averages that are much larger than the medians. Furthermore, in the sample, 61% of mortgages include a price and so are likely part of a property sale. In 31% of cases, the address for the lending bank lists the same city as the property owner mailing address. Only 1.1% of the mortgages are for construction loans.

Detailed loan-level data on securitized mortgage loans comes from a database provided by Trepp. This database covers the near-universe of the securitized mortgage market, including data from 1998-2015. The sample used here includes all commercial property mortgages for either offices or retail space (i.e., excluding multifamily residential and less common property types such as hotels, storage units, mixed-use, etc.) Summary statistics for this database are shown in Table B.4. CMBS loans are larger than bank portfolio loans, with an average amount of $15mn. They also tend to be issued in properties located in the largest U.S. cities and during times with high demand for securitized products, such as 2004-2006. Because CMBS loans are common only in a small number of cities, this data is more useful for understanding loan attributes than for estimating the effect of regional changes in competition.

To understand how different types of borrowers use commercial mortgages, I use data from the

2003 Survey of Small Business Finances. This data comes from a survey of 4,240 small businesses conducted by the Federal Reserve Board from 2003-2005. It contains detailed data on financing and borrower/lender characteristics. Summary statistics are shown in Table B.5 for the 697 businesses in this survey with a mortgage. The average small business with a mortgage has 13 employees, $1.18m in assets, and $795,000 in debt, of which $583,000 is the mortgage. The median distance from its primary bank is 1 mile, with 85% having their primary bank within 10 miles and 96% within 25 miles. Regional identifiers are not available in this data, so I use it to study cross-sectional borrower characteristics rather than estimating difference-in-differences specifications.

6 Empirical Strategy

This paper's empirical variation exploits the heterogenous application of antitrust laws in banking markets above and below the 1800 HHI cutoff. Regulators do not require branch divestiture in banking markets where the predicted HHI rises by at least 200 points to a level below 1800. When the predicted HHI rises by at least 200 points to a level *above* 1800, however, regulators do require branch divestitures. This means that mergers in very similar banking markets can have very different effects on the level of bank competition, depending on which side of the HHI cutoff their HHI falls. To evaluate the effects of bank competition, I compare the change in competition and bank behavior in markets above and below the HHI=1800 cutoff.

This section describes the estimation strategy I use to exploit the 1800 HHI policy cutoff as well as the assumptions required for this to be a valid source of identifying variation. It also provides empirical evidence that supports the assumptions.

6.1 Difference-in-Differences Design

Figure 1 shows the predicted HHI and predicted change in HHI for every banking market involved in a merger where both the acquiring and absorbed bank had branches between 1994 and 2015. Banking markets that are part of more than one such merger appear once for each merger. The upper-right quadrant of the figure shows branches where the predicted change in HHI is at least 200 points and the predicted post-merger HHI level is at least 1800. The mergers taking place in these markets violate the quantitative antitrust screening used by bank regulators, which in principal

leads to branch divestitures.

I limit my analysis to markets within a 500-point range of 1800 in order to control for differences in market characteristics which could otherwise heterogeneously change how mergers affect competition.[11] The treatment group is defined as markets involved in mergers, where the predicted HHI increase is at least 200 points and the predicted HHI level is 1800-2300. The control group is defined as markets involved in mergers where the predicted HHI increase is at least 200 points but the predicted post-merger HHI level is 1300-1800. The treatment and control groups are marked in Figure 1.[12]

The main identification strategy used in this paper is a two-way fixed effects, difference-in-differences style estimator which compares treated and untreated banking markets before and after mergers occur. Equation 1 is the main regression specification.

$$Y_{it} = \beta_1 POST_{it} + \beta_2 ANTITRUST_i \times POST_{it} + \gamma_t + \delta_i + \beta_X X_{it} + \varepsilon_{it} \tag{1}$$

The main control variables include: Market fixed effects (δ_i), which control for time-invariant heterogeneity in market characteristics; and year fixed effects (γ_t), which control for national changes in bank lending that may be correlated with the timing of bank mergers. Since markets may appear more than once if they are involved in multiple bank mergers, each market has a different fixed effect each time it appears.[13] The main dependent variables are measures of bank competition and bank lending behavior. An $ANTITRUST$ main effect is unnecessary because it is banking market-specific and therefore is collinear with the market fixed effects δ_i. For robustness checks, I also include time-varying market-level controls X_{it}. Standard errors are clustered by banking market.

The coefficient on β_2 estimates the difference in post-merger behavior between treated and control markets due to the heterogeneous application of antitrust law. The interaction term $ANTITRUST_i \times POST_{it}$ is equal to one only in years following mergers in treated markets (where intervention is required). I refer to markets where $ANTITRUST = 1$ as "treated" markets. Because bank regulators typically do not announce when they intervene in banking markets, β_2 is an

[11] Hertzberg et al. (2011) and Mello (2017) use similar strategies to exploit interventions that are applied with fuzzy cutoff rules.

[12] Figure A.2 shows a map of the treatment and control markets; they are evenly distributed throughout the country and tend to be small- to medium-sized cities.

[13] Monte Carlo simulations show that this yields unbiased estimates of the coefficient of interest.

intent-to-treat (ITT) effect which measures the difference between markets where divestitures are required by antitrust rules and markets where they are not required.

The coefficient on $POST_{it}$, β_1, estimates the change in the independent variable from the pre-merger period to the post-merger period, for markets where no intervention is required and branches may be combined. $POST_{it}$ is equal to 1 in all years following official merger announcements and equal to 0 in years prior to announcements (the year of the official merger announcement is dropped). This value of this coefficient includes two combined effects. The first is the effect of the merger itself, which reduces the level of competition in each banking market. The second is changes in market-level bank behavior relative to other markets at that time, which coincide with the timing of the merger and may cause mergers to occur.

The main dependent variables measure total bank lending, borrower composition, and bank risk-taking. The first set of dependent variables measure total lending. The total lending measures I study in Call Reports are total bank lending and small business lending. To measure small business lending separately, I use the "Loans to Small Businesses and Small Farms" variables scaled by overall bank lending. In loan-level deeds data, I simply study the total volume and number of loans originated in each year, which includes both refinancing and new originations. In both datasets, I separately study lending by borrower size. Call reports define borrower size using loan amount buckets of \$0-\$100,000, \$100,000-\$250,000 and \$250,000-\$1mn, and in deeds records I study loans to borrowers with collateral above and below the median value of \$243,000. Borrower size is important to study because it is closely linked to banking theory. Petersen and Rajan (1994) argue that the long-term project mechanism is most relevant for the very smallest and newest firms because banks must make the greatest effort to learn about them. Confirming the results in Petersen and Rajan (1994) and Berger et al. (2005), Table B.6 shows that more established small businesses have more impersonal relationships with their mortgage lenders and are more likely to borrow from a distant lender, suggesting that large borrowers have easier access to outside sources of finance.

The second set of dependent variables measure borrower composition. I estimate the effect of competition on average borrower size as well as whether borrowers and lenders are located in the same city. Both of these variables are in deeds records.

The third set of dependent variables measure bank risk. I study loan risks and capital structure risks separately. Call reports contain data on non-performing loans (NPLs) by loan type, which are

a measure of ex post risk, as well as loan loss reserves, which are a measure of ex ante risk. Deeds data does not contain delinquency information, but I measure loan-to-value ratios which are closely related to risk. I also note that risk and borrower size are closely related, as large borrowers are less delinquent in CMBS records (Table B.7). To study capital structure risks, I use bank-level data on leverage, deposit reliance and Tier 1 Capital Ratio.

6.2 Identifying Assumptions

Differences in competition across banking markets may be correlated with differences in investment opportunities and borrower characteristics, biasing typical estimates of the relationship between competition and lending.[14] However, specification 1 includes market-by-merger fixed effects which non-parametrically control for differences in the characteristics of banking markets and bank mergers. Further, year fixed effects control for differences in the timing of bank mergers between the treatment and control groups. Compared to previous studies, the use of these fixed effects relaxes the assumptions needed to identify the effect of bank mergers on bank lending. Rather than assuming that treated and control banking markets are similar along all non-observable dimensions, the identifying assumption in this study is that incumbent banks' response to a merger of their competitors would be the same in treatment and control markets if antitrust intervention did not occur in either. This is, equivalently, the parallel trends assumption common to difference-in-differences studies. Three pieces of evidence support the identifying assumption: First, mergers are not self-selected in anticipation of antitrust enforcement. Second, the estimates are not due to spurious *ex ante* differences in bank or market characteristics. Third, there is no direct affect of competition on the structure of banks in the sample.

6.2.1 Bank mergers are not self-selected in anticipation of antitrust enforcement

If banks decide not to merge because they know that regulators will require branch divestitures in some of their markets, then the mergers that occur in spite of this might be a select sample. I argue that this is not the case using three pieces of evidence.

First, bank markets typically involve multiple banking markets. The acquiring and absorbed

[14]For example, banks may choose to enter banking markets where they believe investment opportunities will increase, leading to a spurious positive correlation between lending and competition.

banks also generally share branches in many banking markets, and antitrust remedies are generally acquired in no more than a few of these. Therefore, as long as violating bank markets are not pivotal for banks' merger decisions, it is plausible that this assumption is satisfied. Further, the main regression results are very similar in a sample of bank mergers where the absorbing and acquired banks both have branches in multiple banking markets.

Second, there is no evidence that bank mergers are avoided when they might cause potential antitrust violations. Figure 4 shows the density of predicted HHIs in banking markets where mergers occur, limited to a sample where the HHI increase is at least 200 points. If mergers were being avoided because of anticipated antitrust violation, one would expect to see fewer mergers just above the 1800 threshold, but this is not the case.

Third, if banks were failing to merge to avoid antitrust rules, they might manipulate the HHI in order to avoid the cutoff. The easiest way to do this would be to reduce their deposits in order to decrease a market's HHI. Figure A.3 shows bank deposits for branches near the threshold and further away, but there is no trend in deposits around the time of mergers in either group.

6.2.2 No effect in placebo tests of markets with similar characteristics

Banking markets where antitrust is applied have a higher *ex ante* HHI than markets where antitrust law is not applied. The difference in HHI is small, as I study mergers in a narrow range of 1800, but a potential concern is that the differential effect of bank mergers is due to the difference in *ex ante* HHI per se. To alleviate this concern, throughout the paper I re-estimate the specifications in a placebo sample of bank mergers where the HHI increase is below 200 points. These banking markets have a differential *ex ante* HHI level just as the main sample does, but are unaffected by antitrust law because the HHI increase is smaller. I perform further placebo tests using the sample of bank mergers where the HHI increase is above 200 points but the antitrust "cutoff" is set to a placebo value different from the true cutoff.

Table B.10 estimates the difference in several key variables between treated and untreated markets in the pre-treatment period for several of the most important bank-level variables I study. Of the six variables, only one is statistically significantly different between these groups, at the 10% level.[15]

[15]Pre-treatment balance between treatment and control markets is not an identifying assumption in this setting,

As further evidence, I include as control variables the interaction between *ex ante* bank and market characteristics and the $POST$ indicator. The inclusion of these controls does not change estimates. These robustness checks reduce the likelihood that the results could be driven by heterogeneous local bank characteristics.

6.2.3 Competition does not affect structure of incumbent banks

Previous research has shown that bank scale and structure affect lending behavior (Williams, 2017; Berger et al., 2005). If incumbent banks' size or structure changed in response to changing competition in a way that was different in treatment and control markets, the main results could be due to changing bank size rather than changing competition per se. However, Table B.8 shows that the incumbent bank size and branch network do not change as a result of changing competition. As an additional robustness check, I control for time-varying average bank characteristics at the market level.

7 Evidence That Antitrust Laws Are Applied

This section provides evidence that antitrust rules indeed affect bank competition.

7.1 Branch Spinoffs Following Mergers

Figure 5 shows the fraction of bank branches spun off by merging banks in markets both above and below the HHI=1800 cutoff, and above the $\Delta HHI > 200$ cutoff. The figure measures branches sold to competitors by merging banks within three years of bank mergers. In markets where the predicted HHI is below 1800, about 2% of branches are sold to competitors, whereas in markets above the 1800 cutoff, 7%-10% are. This indicates that antitrust rules on average affect about 5% of merging bank branches. The 2% of branches sold to competitors below the 1800 cutoff may be because regulators require antitrust remedies even though the market passes the quantitative screening. They may also reflect normal bank behavior, as the changes in ownership are not necessarily caused by regulatory requirements. The 7%-10% of branches that are spun off above HHI=1800 are only required to be enough for banking market concentration to return to HHI=1800. Mergers that lead to a higher

but balance on pre-treatment levels increases the plausability of parallel trends as well.

HHI level require more branches to be divested to restore the level of competition to what it was before. Appendix Figure A.5 replicates Figure 5, limited to markets where the predicted change in HHI is below 200 points – a placebo test. There is no discontinuity across the 1800 cutoff for this sample.

The timing of branch spinoffs is shown in Figure A.4. Spinoffs do not always happen in the year of bank mergers but may happen over the course of several years – as many as five years post-merger. Regulators allow banks to spend several years searching for a well-run buyer who will pay a fair price for the divested branches. This means that the difference in competition between the treatment and control markets can take several years to emerge. A fraction of banks below the official cutoff are sold, either because banks decide they are no longer needed post-merger or because regulators intervene in these mergers despite not being required to do so under official screening criteria.

To ensure that branch divestitures lead to greater competition, regulators require that acquiring banks be large and well-run – and do not have a prior local presence. Prior to mergers, these banks have almost no branches in the market where intervention occurs, but the banks have a large branch network elsewhere. Following mergers, they own a substantial number of branches in the market with intervention.

7.2 Effect of Intervention on HHI

Estimates indicate that the rules are effective at lowering bank concentration. Table 9 shows the average effect of antitrust rules on the HHI, estimated using Equation 1. In non-intervention markets, the HHI increases by 363 points following mergers with no antitrust intervention, but it increases by 180 points less less in markets where antitrust law applies. Estimates are similar using year fixed effects. Tables B.1, B.2 and B.3 show that there is no estimated difference between treatment and control markets when using placebo cutoffs.

Figure 2 is an event study graph showing how the HHI changes year-by-year before and after mergers occur. Prior to mergers, the HHI moves in parallel in treatment and control markets. Following mergers, the HHI initially rises in both groups, before declining to below its pre-merger level in treated markets, as the treated bank divests branches.

7.3 Effect of Intervention on Certificate of Deposit Rates

Price-based measures of competition are better than concentration-based measures such as the HHI. This is because price-based measures take into account market contestability and actual competitive behavior (Berger et al., 2004). Table 6 shows estimates of the treatment on certificate of deposit (CD) rates at incumbent bank branches. Placebo event studies and estimates show anomalous behavior in the years immediately around merger announcements, possibly due to the disruptive effects of mergers on data collection. Therefore I exclude data collected within 3 years of mergers in estimates of Equation 1.[16]

Estimates suggest that required antitrust rule application is associated with 10-18 basis point (0.1 to 0.18 percentage point) change in CD spreads. The effects are larger for longer maturity CDs. This is not just an artifact of their higher rates, as estimates are larger in percentage terms as well.[17]

Figure 3 is an event study graph showing the difference between treated and untreated banking markets around the time of mergers. CD rates rise significantly relative to what they were pre-merger in treated markets and stay elevated indefinitely even though the HHI does not fall in these markets and even rises immediately following mergers. Antitrust remedies may actually raise the level of competition in treated markets compared to their pre-treatment degree of competition. This is because regulators replace a generally small (and recently acquired) bank with a new outside competitor. Regulators also ensure that the bank which acquires divested branches is competitive and well-run.

8 Empirical Estimates: Effect of Competition on Lending

This section presents estimates of the effect of competition on bank balance sheets and loan market characteristics. Combining loan- and bank-level estimates with cross-sectional facts about CRE loans, a unified picture emerges about the effect of competition on business lending which largely supports the predictions of the market power mechanism.

[16] The main estimates are similar including these years, however.

[17] A plausible explanation for this is that competition has greater effect on longer-dated CDs because they have a greater demand elasticity, as it is more worthwhile for consumers to spend time finding a better rate when their money is tied up longer.

8.1 Overall Small Business Lending

In both bank-level and loan-level data, greater competition leads to more lending for small businesses, but only for the largest borrowers within this category. Table 7 estimates the effect of competition on small business CRE lending as a fraction of banks' total CRE lending. For loans below a value of $250,000, I estimate no effect of competition on small business lending. However, for loans from $250,000-$1,000,000, competition increases total lending by of 3% of banks' total CRE lending, an affect which is statistically significant at the 1% level. As I estimate an increase in lending for these borrowers, and no decrease for the smallest borrowers, the estimates are most consistent with the market power mechanism.[18]

Small business lending estimates from Call reports are scaled by banks' overall lending in order to increase precision, as bank lending is noisily measured when left unscaled. Therefore, I confirm the bank-level estimates using deeds records aggregated to the banking market level. Results are shown in Table 8 and are consistent with the bank-level estimates. The dependent variable in this table is total CRE loan origination volume for banking markets and years with at least 30 transactions. I estimate that competition is associated with an increase in CRE originations, both in terms of the number of loans and the loan volume. Consistent with the Call Report estimates, I find a large and statistically significant effect of competition on loans of above-median size but not for loans below median size. This is driven by an increase in the number of loans, rather than large loans, as the effect on loan count and loan volume are of a similar magnitude. While an estimated effect of 0.3-0.4 may seem large (approximately 30%-40%), these estimates this do not mean that the amount of borrowing or number of purchases increases by 0.3-0.4 log points, as the mortgages could be used to refinance existing debt or to make property purchases that would otherwise be financed in some other way or purchased in cash.[19]

Thus the first result is that estimates from both bank call reports and loan-level deeds records imply that competition increases lending to small businesses. This is true even as overall bank assets and liabilities, shown in Table 12, do not change in a statistically significant way. In both datasets, I estimate a statistically significant and large effect for the largest CRE borrowers, and

[18] Placebo checks are shown in Tables B.20, B.21 and B.22. Estimates for C&I lending, which show no statistically significant effect, are shown in Table B.19.

[19] Since the sample of deeds records available only includes those where $\Delta HHI > 200$ and $1300 < HHI < 2300$, placebo checks are not possible in deeds data.

positive but small and not statistically significant effect for the smallest borrowers. These estimates support the market power mechanism, as an overall increase in lending is one of this mechanism's main predictions. By contrast, they are less consistent with the long-term lending mechanism, which would imply a decrease in bank lending due to competition.

8.2 Borrower Composition

The second result is that greater competition is associated with an increase in the average CRE borrower size, consistent with the overall increase in lending I find for large borrowers (and providing further support for the market power mechanism). Tables 9 and 10 show estimates of the effect of competition on borrower characteristics in deeds data. Greater competition is associated with an increase in the average borrower size (measured by collateral value) of 10%, shown in Column 2 of Table 9. These borrowers receive larger mortgages, with little change in LTV ratios (Column 3). Businesses also borrow more locally, as the fraction of borrowers whose lender is located in the same city increases by 5% (Column 4).[20]

Further, I estimate a tight link between the increase in local borrowing and the increased borrower size. Table 10 partitions the sample into above- and below-median sized loans (Columns 2 and 3), and loans originated by lenders from other cities versus the same city (Columns 4 and 5). These estimates show that it is mainly the the larger borrowers who are switching to local banks, and similarly, it is the local banks whose average borrower size increases. It is not surprising that the effects of competition are greatest for larger borrowers, as they are generally more likely to borrow from far away and may have an easier time switching lenders because they are less reliant on close relationships with banks. The finding that borrowers switch from distant to nearby finding is thus a direct theoretical implication of the market power channel.

8.3 Bank Risk and Capital Structure

The third result is that that competition is associated with lower loan risks at the bank level, as measured by NPLs, and no change in capital structure, shown in Table 11. In treated markets, the non-performing loan ratio declines by 0.38 percentage points for all loans and by 0.34 points

[20]Data is available to me only for the set of markets where the main treatment variable is defined, so it is not possible to do placebo checks using alternative HHI cutoffs.

for real estate loans. I do not estimate an effect on NPLs for C&I lending. The loan loss reserve ratio declines by 0.04 percentage relative to untreated markets, but this change is not statistically significant. The smaller decline in loan loss reserves may indicate that banks were not aware that their lending was becoming more risky, although due to noise in the estimates I cannot reject a large negative effect. These findings are consistent with the market power channel, with the long-term lending channel, or with Boyd and De Nicolo (2005). Finally, table B.17 splits banks into those above and below the median size by total lending. The estimated effect on loan risks is larger for banks above the median size. As small banks are more relationship-dependent than large banks, this finding suggests that the decrease in risk was not due to changes in the nature of bank relationships. CMBS records show that large borrowers become delinquent less often than small borrowers do, implying that the increase in borrower size may be the reason that the non-performing loan ratio falls.

Competition is associated with no statistically significant change in overall bank size or capital structure, shown in Table 12. The estimated effect of competition on banks' capital structure is near zero and precisely estimated, capital structure is measured as the ratio of equity to total assets, deposits to total assets, or the ratio of Tier 1 Capital to Risk-Weighted Assets. The effect of competition on bank size is also not statistically significant but is measured with more noise and is roughly -7%.

Comparing these results to the empirical predictions described in Section 3 shows that the evidence is most in line with the predictions of the market power channel. Contrary to the predictions of the Charter Value Hypothesis, bank-level estimates show that greater competition is associated with less risky lending and no change to bank capital structure. The long-term lending channel predicts a shift towards larger borrowers, as I find, but also predicts a decrease in lending to the smallest borrowers, which I do not find.

8.4 Discussion

Why does this paper not find evidence in support of the Charter Value Hypothesis or relationship lending mechanism, when the results from many previous papers have supported these theories? There are three possible reasons why the results in this paper differ from the findings in previous studies. First, much of the previous evidence has been based on cross-sectional estimates of the

relationship between bank behavior and competition across markets or countries, whereas this paper studies a source of exogenous variation from economic policy. There are both advantages and disadvantages to using exogenous policy variation. The main advantage is that it deals with concerns about the endogeneity of bank mergers. The main disadvantage is that the effects estimated in this paper apply to the particular margin of bank competition that is determined by antitrust laws. Variation in bank competition on other margins might have different effects. For example, risk shifting incentives may be particularly strong for banks near bankruptcy, so increases in competition may induce these banks to make riskier loans when it has no such effect in general. Nonetheless, the results in this paper are still highly relevant as antitrust law is an important margin for policy-making and the estimates may be more generally applicable than results from banks in extreme circumstances.

The second reason for possible differences is that other models may be more relevant for types of financing that this paper does not study. For example, the loan-level estimates presented here come exclusively from CRE loans. However, it could be that, because CRE loans are collateralized, relationship lending motives are less important in this sector than for loans with less collateral. The null results I estimate for the effects of competition on C&I lending, for example, may be because the positive competitive effects of the market power mechanism and the negative competitive effects of the long-term project mechanism cancel each other out in the market for C&I lending. As CRE loans are the single largest source of financing for small businesses, and the estimates from bank balance sheets include a wide range of banking products, however, the estimates in this paper are economically relevant.

The third major difference between the methods in this paper and previous studies is that, in the language of Berger et al. (1999), I focus on the "external" effects of bank mergers, rather than the "internal" effects. The internal effects of bank mergers are those that affect the merging bank itself whereas the external effects are those that affect competitor banks through changing market structure. As an example of research that studies the internal effects of bank mergers, a substantial literature has studied how statewide branching deregulation in the United States affected financing, growth and economic activity (e.g., Jayaratne and Strahan, 1998; Demsetz et al., 1996; Rice and Strahan, 2010). A second example is Williams (2017), which studies the internal effects of bank mergers on banks' responses to monetary policy. These papers address a different set of models

from the ones studied here, and therefore yield complementary but different results. Estimates of external effects of bank mergers address theory about the effects of bank competition on bank behavior rather than theory about the effects of bank size or management.

9 Conclusion

This paper investigates the effects of competition on small business lending using a new source of exogenous variation in the competitive impact of bank mergers. The estimates show that greater bank competition is associated with more lending to above-median-sized small businesses and decreased risk at the bank level. However, the effects of greater competition are unevenly distributed. In both bank- and loan-level data, I find that lending increases for the largest borrowers and has no effect on the smallest. This does not mean that small borrowers do not benefit, however, as they may be paying lower interest rates for the same loans. Part of the increase in lending to large borrowers is because they switch from borrowing outside of the local market to borrowing from local banks.

These results emphasize the role of banks as specialists in the efficient allocation of capital to the economy whose effectiveness is improved when competition rises. My results provide less support for models that emphasize banks' ability to maintain long-term lending relationships or that model banks as entities optimizing their loans along a risk-reward frontier. Further, the class of models I support imply a "light side" rather than a "dark side" to bank competition.

The increase in bank concentration since the passage of the 1994 Riegle-Neal Act has mirrored a rise in concentration across all U.S. industries. The estimates in this paper suggest that rising bank concentration is a concern from the perspective of efficient capital allocation. However, the estimates also imply that antitrust rules may be a valuable policy tool for increasing bank competition.

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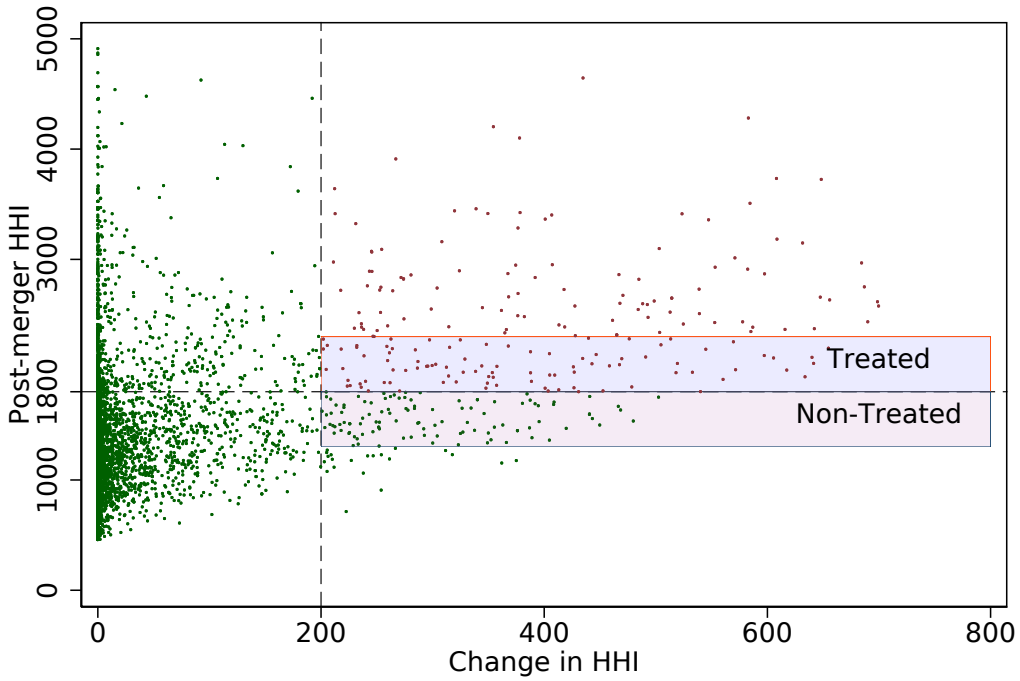
Figures

Figure 1: Predicted HHI and predicted ΔHHI in all markets

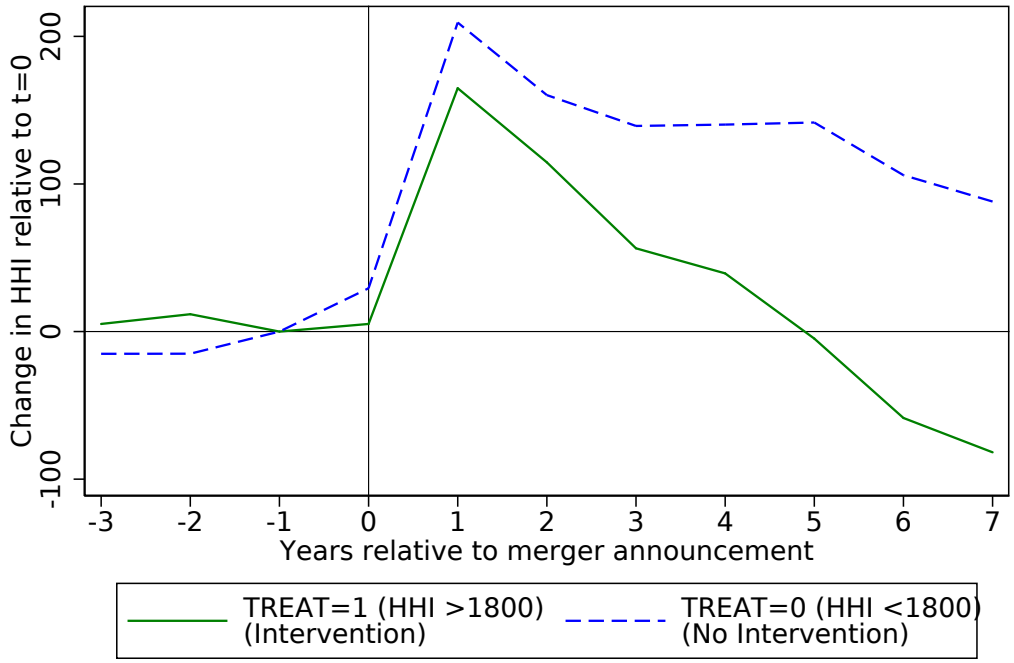
Predicted ex post HHI and predicted change in HHI for every commercial bank or bank holding company merger in the United States, 1994-2015. Source: Author's calculations using FDIC Summary of Deposits Database.



Each point is a combination of one market and one market. Data from merger simulation result of 5614 mergers. Calculations from FDIC SOD data, 1994-2006 2009-2015.

Figure 2: HHI Event Study Graph

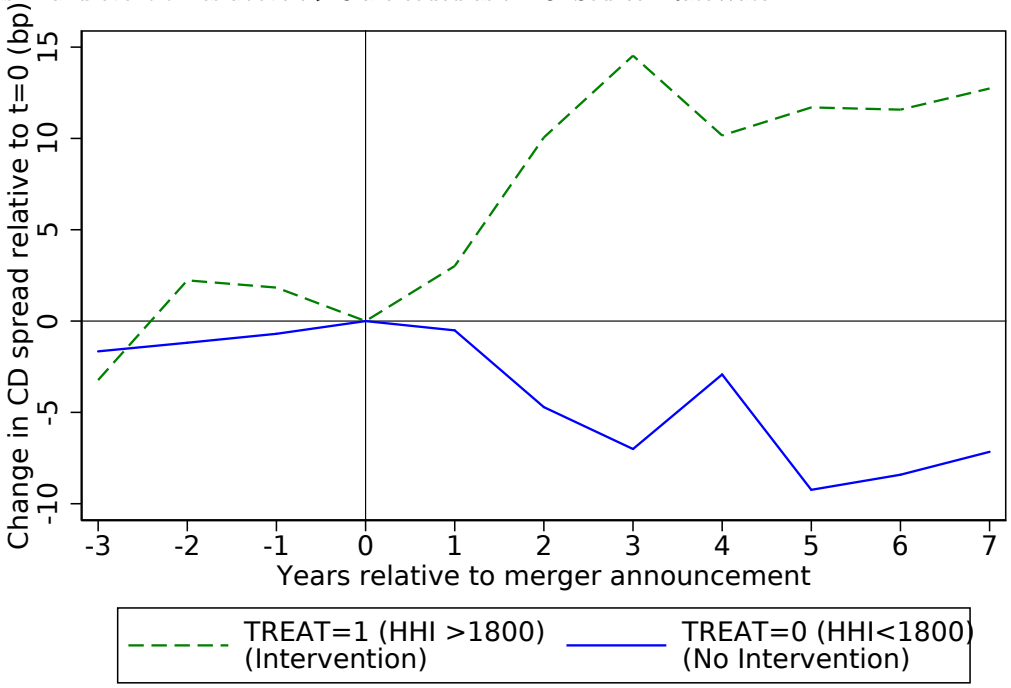
Event study graph of deposit rates. TREAT=1 are defined as mergers with a predicted HHI increase of at least 200 points and a predicted HHI level of 1800-2300. TREAT=0 are defined as mergers with a predicted HHI increase of at least 200 points and a predicted HHI level of 1300-1800. Lines created using event study regression estimates from a specification of the form $Rate = \sum_{t\in[-4,8]} \beta_{gt} \times TREAT_g \times I_{EventTime=t} + \beta + \varepsilon_{it}$ where event-times less than $t < -4$ are coded as -4 and event-times above $t > 8$ are coded as $t = 8$. Source: FDIC Summary of Deposits Database.



Each observation is a market in a particular year. SE's clustered by market. Limited to mkts with ΔHHI>200. Source: FDIC SOD, 1994-2006 and 2009-2015.

Figure 3: CD Rate Event Study

Event study graph of deposit rates. TREAT=1 are defined as mergers with a predicted HHI increase of at least 200 points and a predicted HHI level of 1800-2300. TREAT=0 are defined as mergers with a predicted HHI increase of at least 200 points and a predicted HHI level of 1300-1800. Lines created using event study regression estimates from a specification of the form $Rate = \sum_{t\in[-4,8]} \beta_{gt} \times TREAT_g \times I_{EventTime=t} + \beta + \varepsilon_{it}$ where event-times less than $t < -4$ are coded as -4 and event-times above $t > 8$ are coded as $t = 8$. Source: RateWatch.



Each observation is a market in a particular year. SE's clustered by market. Limited to mkts with ΔHHI>200. Source: Author's calculations from Ratewatch.

Figure 4: Density of HHI around HHI=1800 cutoff for realized mergers

Predicted ex post HHI for bank mergers with a predicted HHI increase of at least 200 points. Mergers are those with merger dates from 1994-2015. Source: FDIC Summary of Deposits Database.

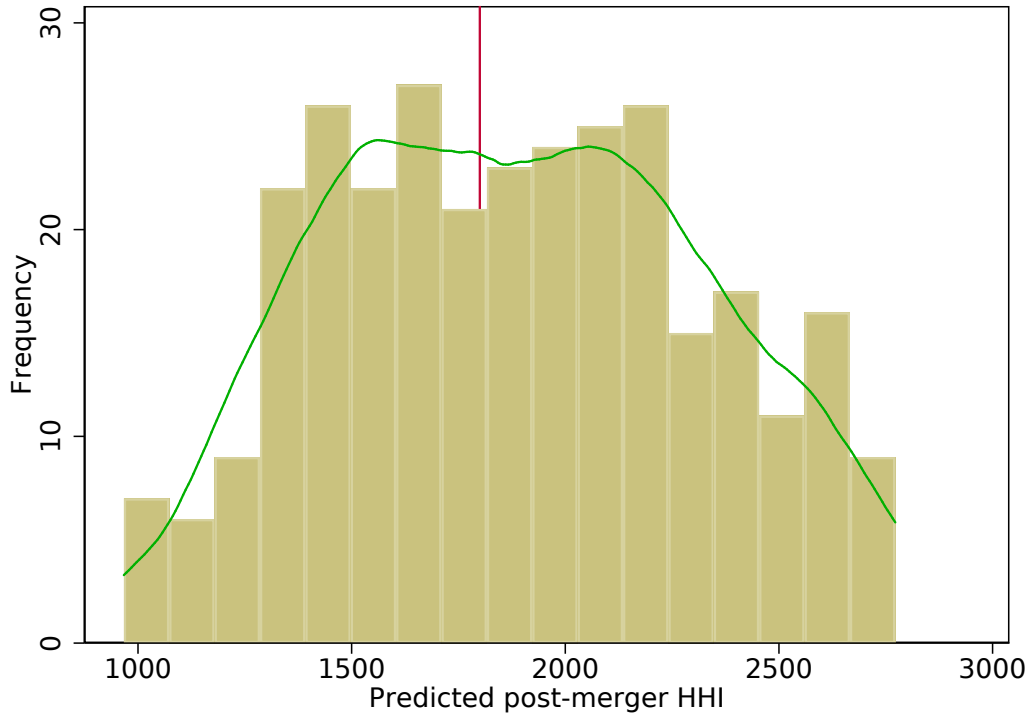
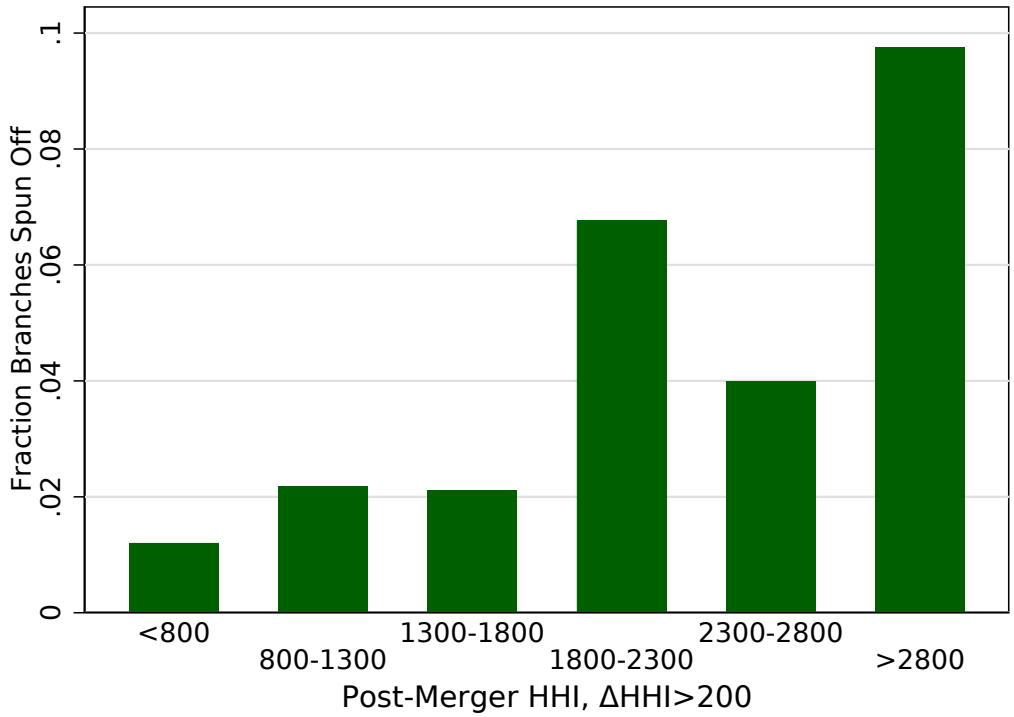


Figure 5: Density of HHI around HHI=1800 cutoff for realized mergers

Fraction of branches spun off within two years of bank mergers, by predicted HHI for mergers with a predicted HHI increase of at least 200 points. Mergers are those with merger dates from 1994-2015. Source: FDIC Summary of Deposits Database.



Tables

Table 1: Empirical Predictions from Banking Theory

This table shows the main empirical predictions from theories of bank competition. See Section 3 for more details.

Effect of competition	**Long-Term Project Mechanism**	**Market Power Mechanism**	**Charter Value Hypothesis**
Total Lending	Lower, esp. borrowers with high initial investments	Higher, esp. borrowers with outside options	
Borrower Composition	Older, larger, safer	Older, larger, safer	Riskier
Capital Structure			Risker; run- or bankruptcy-prone

Table 2: Banking Market Summary Statistics

Summary statistics of banking markets involved in mergers, that caused a predicted HHI increase of at least 200 points and a predicted HHI level of 1300-1800. Sources: U.S. Census Bureau (population), IRS Statistics of Income (Wages and AGI), FDIC Summary of Deposits (bank statistics).

	(1)	(2)	(3)	(4)	(5)
VARIABLES	mean	sd	p10	p50	p90
Population (th)	218.2	370.4	23.50	107.7	462.0
Wages/Capita (th)	12.63	2.628	9.262	12.48	15.57
AGI/capita (th)	17.61	3.722	12.89	17.58	21.74
House Price Growth	3.569	2.153	0.865	3.647	5.976
Weighted HHI	1,996	849.1	1,343	1,739	2,832
Avg Branch Deposits	3,128	6,810	182.4	957.1	6,956
# Banks	19.20	19.06	8	13.85	34.17
Median Bank # branches	115.5	144.2	4.132	61.08	306.1

Table 3: Bank Summary Statistics

Summary statistics of average bank-level variables for banks located in main sample of banking markets.The main sample of banking markets is defined as markets involved in mergers that caused a predicted HHI increase of at least 200 points and a predicted HHI level of 1300-1800. Averages are taken at the banking market level, and statistics are shown across banking markets for the years prior to bank mergers. Includes data from 2,130 banks. Sources: Call Reports.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	mean	sd	p10	p50	p90
CRE Ln <100k (mn)	2.28	5.27	0.00	0.93	4.96
CRE Ln 100k-250k (mn)	5.45	14.50	0.03	2.36	10.90
CRE Ln 250k-1mn (mn)	17.91	55.45	0.00	7.20	35.53
Loans (mn)	530.54	5,098.97	27.52	78.03	528.95
Assets (mn)	921.45	10,406.32	45.16	121.53	811.82
Loan Int. Inc.	19,434.96	181,936.67	1,131.85	3,025.62	19,986.42
100xLn Loss Reserves/Lns	1.46	0.55	0.86	1.35	2.22
100xNPLs/Lns	0.84	0.65	0.13	0.69	1.75
Equity/Assets	0.10	0.03	0.07	0.09	0.14
T1 Cap Ratio	0.15	0.05	0.10	0.14	0.22
Deposits/Assets	0.84	0.07	0.74	0.85	0.90

Table 4: Deeds Records Summary Statistics

Summary statistics of business data for the 63,783 deeds records available in banking markets where mergers occur, for mergers where the HHI increase is at least 200 points and the predicted HHI value is 1300-2300. This corresponds to in 179 counties in 109 banking markets. Mortgages are weighted so that all banking markets receive equal weight in the statistics. "Sale" is an indicator equal to 1 if a property price is recorded that corresponds to the mortage. Properties with Sale=0 do not have a property price listed, so prices are instead extrapolated using historical or future sales for the same property. Source: CoreLogic.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	mean	sd	p10	p50	p90
Mortgage Amt (th)	1,311	20,891	44	190	1,150
Property Price (th)	742	3,798	63	243	1,350
LTV	3.8	313	.31	.8	1.7
Same City	.31	.46	0	0	1
Sale	.61	.49	0	1	1
New Construction	.011	.11	0	0	0

Table 5: Rules lower HHI in short-and long-run

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on market-level HHI. HHI is calculated as the sum of squared deposit market shares by bank, multiplied by 10,000. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: FDIC summary of Deposits database.

	(1)	(2)	(3)	(4)
VARIABLES	HHI	HHI	Log(HHI)	Log(HHI)
POST	362.8***	344.3***	0.183***	0.178***
	(55.90)	(55.34)	(0.0219)	(0.0205)
t>=5		117.5**		0.0174
		(58.63)		(0.0227)
POSTxTREAT	-179.6**	-147.8**	-0.0778**	-0.0682**
	(71.92)	(59.81)	(0.0313)	(0.0264)
t>=5 X TREAT		-68.08		-0.0185
		(63.64)		(0.0285)
Observations	5,635	5,635	5,635	5,635
R-squared	0.693	0.695	0.730	0.730
Market FE	X	X	X	X
Year FE	X	X	X	X
Clusters	207	207	207	207

Table 6: Difference in Differences results with $10k CD spreads by maturity

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on market-level CD spreads. Spreads calculated as difference between rate and nearest-maturity constant-maturity Treasury rate. CD spreads of banks involved in each bank merger is dropped. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers. Limited to market-year combinations with at least CD spread observations available. Observations within 3 years of relevant bank mergers are dropped. Standard errors clustered by banking market. Source: Ratewatch.

	(1)	(2)	(3)	(4)	(5)	(6)
	Avg					
VARIABLES	3M-3Y	CD 3M	CD 6M	CD 1Y	CD 2Y	CD 3Y
POST	-4.168	0.612	-2.832	-3.612	-5.596	-14.76***
	(3.952)	(4.570)	(3.845)	(4.149)	(4.465)	(4.592)
POSTxTREAT	13.02**	9.777*	12.82**	12.18**	13.58**	20.72***
	(5.620)	(5.351)	(5.630)	(5.568)	(6.259)	(7.180)
Observations	2,580	2,514	2,563	2,572	2,649	2,598
R-squared	0.906	0.918	0.907	0.887	0.873	0.858
Market FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X
Clusters	185	184	184	184	187	186

Table 7: Effect of Competition on Small CRE Loans

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on bank-level variables. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only for banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)
	Frac. CRE Lns	Frac. CRE Lns	Frac. CRE Lns
VARIABLES	<100k	100k-250k	250k-1mn
POST	0.00201	-0.000446	-0.0314**
	(0.00512)	(0.00895)	(0.0150)
POSTxTREAT	0.00812	0.00182	0.0311*
	(0.00617)	(0.0106)	(0.0171)
Observations	18,213	18,664	18,645
R-squared	0.536	0.413	0.186
Market FE	X	X	X
Year FE	X	X	X
Clusters	98	98	98

Table 8: Effect of Competition on Loan Volume, Deeds Records

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on aggregated CRE loan counts from deeds records. Limited to sample of office or commercial property CRE loans and banking markets with at least 30 transactions. See Appendix C for more details on data set construction. Each observation represents one market in one merger. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only for banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors *clustered* by banking market. Source: CoreLogic.

	(1)	(2)	(3)	(4)	(5)	(6)
	Loan Vol	Loan Vol	Loan Vol	Loan Count	Loan Count	Loan Count
VARIABLES	All	> Median Size	<Median Size	All	> Median Size	<Median Size
POST	-0.130	-0.147**	0.0628	-0.0349	-0.0644	0.0954
	(0.102)	(0.0726)	(0.112)	(0.0746)	(0.0701)	(0.103)
POSTxTREAT	0.372	0.404**	0.237	0.246	0.345*	0.239
	(0.246)	(0.190)	(0.244)	(0.221)	(0.206)	(0.235)
Observations	1,527	1,525	1,527	1,527	1,525	1,527
R-squared	0.784	0.880	0.801	0.882	0.894	0.832

Table 9: Effect of Competition on Loan Characteristics, Deeds Records

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on loan-level variables from deeds records. Limited to sample of office or commercial property CRE loans. See Appendix C for more details on data set construction. Estimates weighted by inverse number of loans by market, ensuring all markets are weighted equally. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only for banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: CoreLogic.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Log(Mtg Amt)	Log(Prop. Value)	Log(LTV)	Same City	Purchase Mtg
POST	-0.0573**	-0.0595**	-0.00478	-0.00599	-0.00386
	(0.0261)	(0.0288)	(0.0153)	(0.0134)	(0.0200)
POSTxTREAT	0.0872*	0.101*	-0.00432	0.0456**	0.113***
	(0.0518)	(0.0562)	(0.0216)	(0.0201)	(0.0404)
Observations	421,245	421,245	421,245	346,872	421,245
R-squared	0.111	0.171	0.041	0.089	0.090
Market FE	X	X	X	X	X
Year FE	X	X	X	X	X
Clusters	145	145	145	139	145

Table 10: Effect of Competition on Loan Characteristics, Deeds Records by Type

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on loan-level variables from deeds records. Limited to sample of office or commercial property CRE loans. See Appendix C for more details on data set construction. Estimates weighted by inverse number of loans by market, ensuring all markets are weighted equally. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: CoreLogic.

	(1)	(2)	(3)	(4)	(5)
	Same City	Same City	Same City	Log Size	Log Size
VARIABLES	All	<Median Size	>Median Size	Same City	Not Same City
POST	-0.00708	-0.00598	-0.00668	-0.0594	-0.0336
	(0.0124)	(0.0147)	(0.0152)	(0.0410)	(0.0374)
POSTxTREAT	0.0443**	0.0301	0.0694**	0.174***	0.00278
	(0.0194)	(0.0225)	(0.0336)	(0.0655)	(0.0839)
Observations	344,808	166,034	178,773	194,259	249,554
R-squared	0.075	0.087	0.073	0.173	0.165
Clusters	141	138	137	141	141

Table 11: Effect of Competition on Bank Loans

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on bank-level variables. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)	(4)	(5)
			NPLs/Lns	NPLs/Lns	
VARIABLES	Log(Lns)	NPLs/Lns	(RE)	(CI)	LLRs/Lns
POST	0.129	-0.0132	0.00207	0.0749	-0.0685
	(0.122)	(0.124)	(0.124)	(0.0585)	(0.0631)
POSTxTREAT	-0.0897	-0.377**	-0.335**	-0.0485	-0.0454
	(0.188)	(0.159)	(0.145)	(0.0725)	(0.0990)
Observations	21,516	20,879	20,619	20,481	21,516
R-squared	0.422	0.317	0.483	0.451	0.242
Market FE	X	X	X	X	X
Year FE	X	X	X	X	X
Clusters	100	100	100	100	100

Table 12: Effect of Competition on Bank Assets and Liabilities

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on bank-level variables. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)	(4)
VARIABLES	Eqty/Asst	T1CR/RWA	Log(Asst)	Deposits/Assets
POST	0.000279	-0.00312	0.107	-0.000580
	(0.00238)	(0.00402)	(0.119)	(0.0105)
POSTxTREAT	-0.00166	-0.00442	-0.0702	-0.00574
	(0.00285)	(0.00472)	(0.183)	(0.0158)
Observations	21,516	17,599	21,516	21,516
R-squared	0.131	0.179	0.418	0.212
Market FE	X	X	X	X
Year FE	X	X	X	X
Clusters	100	94	100	100

A Supplementary Figures

Figure A.1: HHI by Market; Total Commercial Banks

Total number of commercial banks in the United States and average market-level HHI. Average is weighted by bank deposits. Source: Commercial banks retrieved from FRED, Federal Reserve Bank of St. Louis. HHI calculated from FDIC Summary of Deposits Database.

Figure A.2: Map of Treated vs Untreated

Map of banking markets that appear as treated or untreated following bank mergers 1994-2015. Treated is defined as a predicted HHI increase of at least 200 points to a level 1800-2300. Untreated is defined as a predicted HHI increase of at least 200 points to a level 1300-1800. Markets with bank mergers but with no HHI increase in these ranges do not appear.

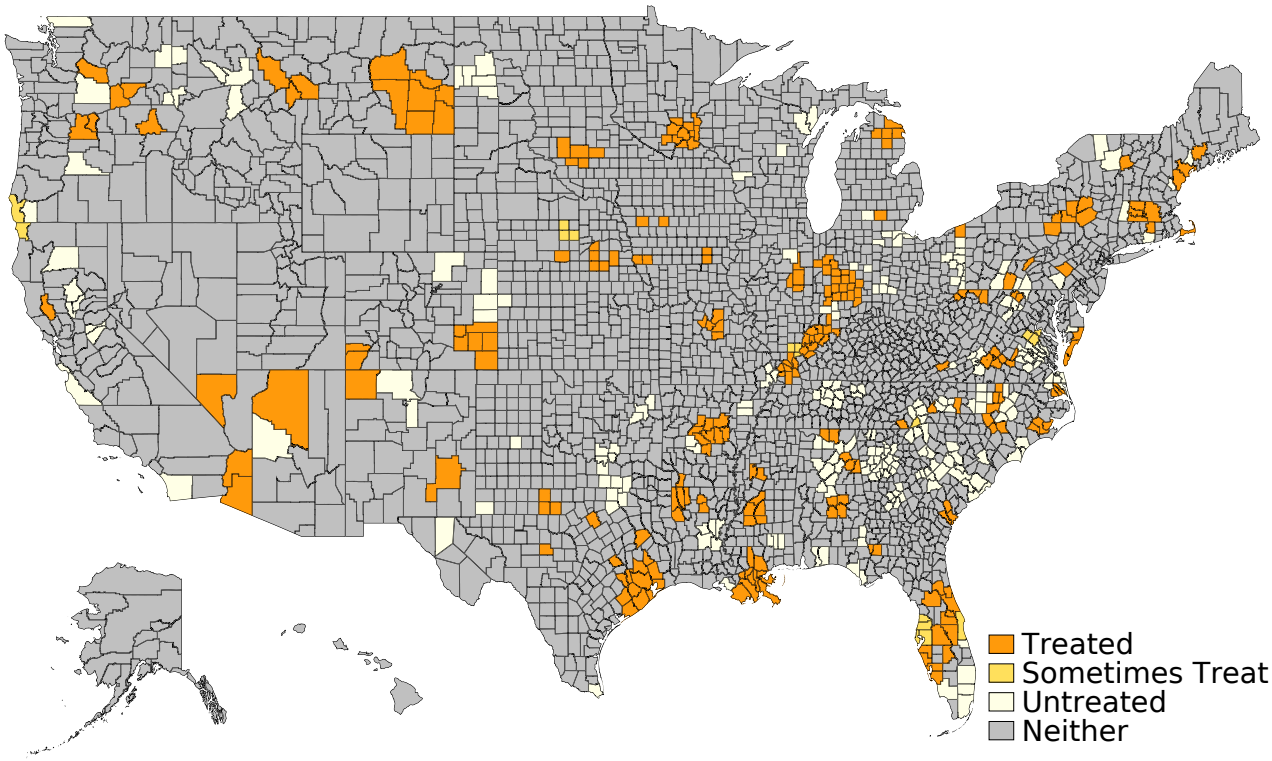
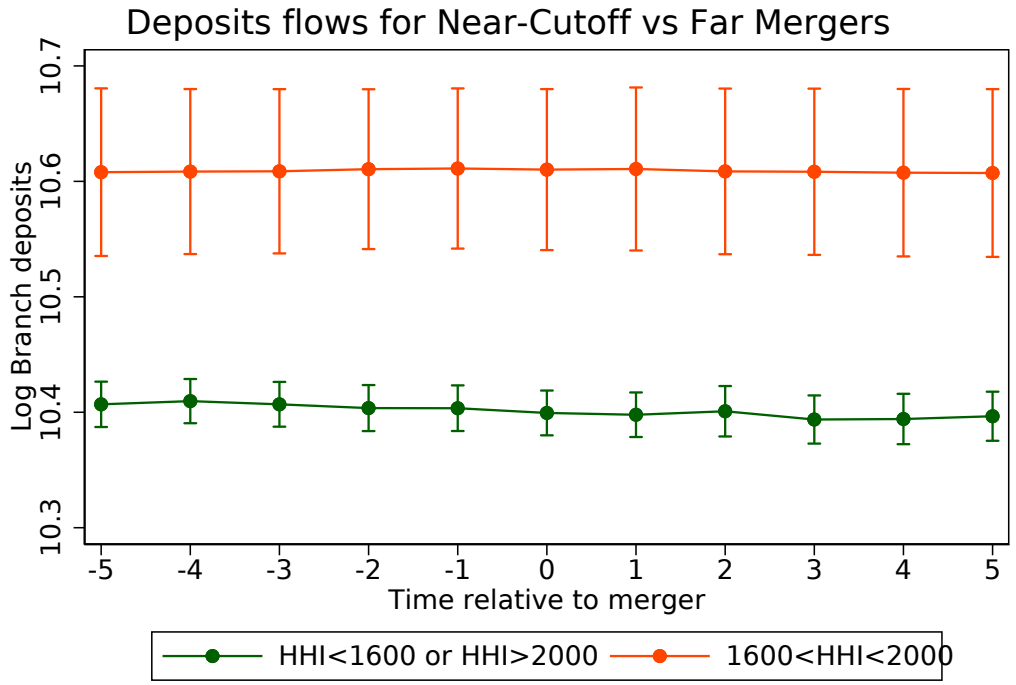


Figure A.3: Deposits constant, near and away from cutoff

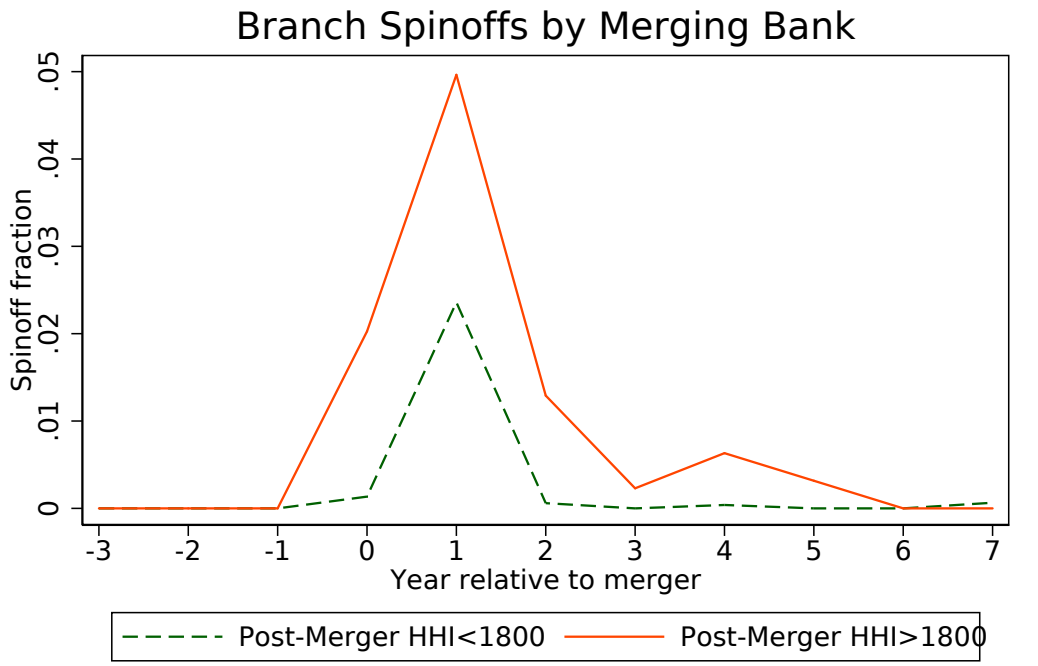
Bank branch average log deposits around the time of bank mergers with an HHI increase of at least 200 points. Limited to branches of merging banks. Mergers split by the predicted ex post HHI. Source: FDIC Summary of Deposits.



Data source: FDIC Summary of Deposits; Chicago Fed Mergers data

Figure A.4: Spinoffs over Time

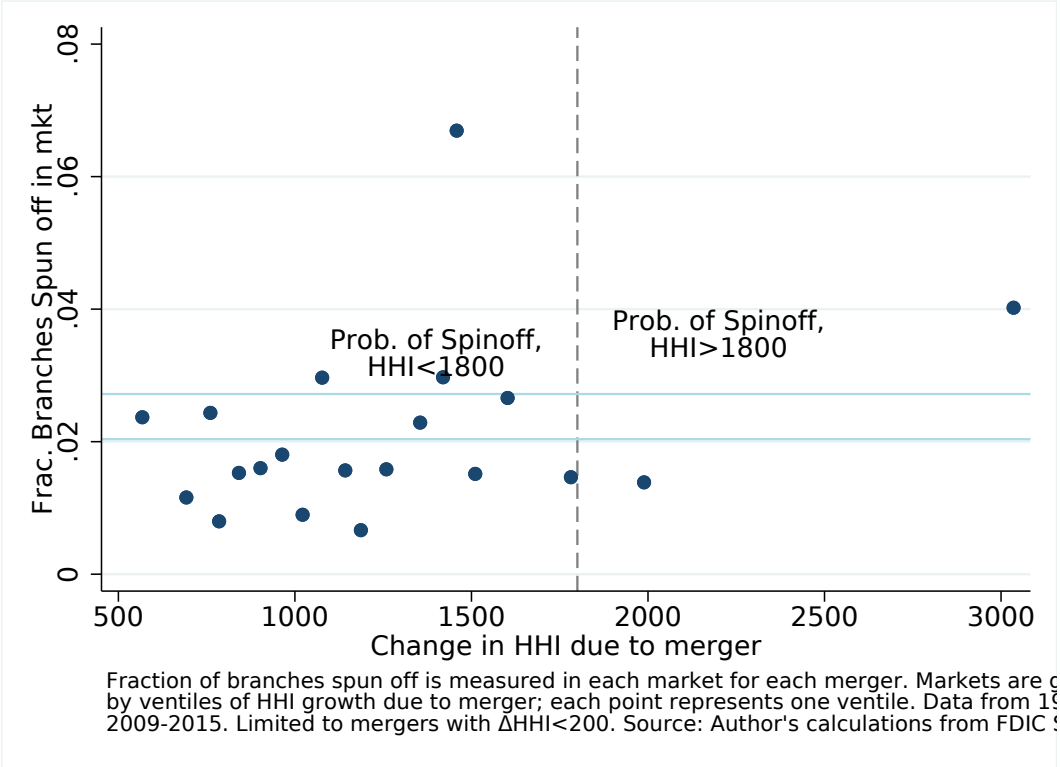
Branch spinoffs for merging banks around the time of bank mergers. Spinoffs are defined as branches whose ownership changes from one bank to another. Calculated using the sample of bank branches that exist in time t=-1 year relative to mergers. Source: FDIC Summary of Deposits.



Source: FDIC Summary of deposits. Conditions on branch existing and owned by merging in t=-1.

Figure A.5: Branch spinoff likelihood, mkts with $\Delta HHI < 200$

Binscatter plot showing the fraction of branches spun off for bank mergers with a predicted HHI increase of below 200 points. X axis shows the predicted HHI change. Y axis shows the realized fraction of branches that are spun off within each bin of the X variable. Source: FDIC Summary of Deposits.



B Supplementary Tables

Table B.1: HHI Placebo at HHI=1300

Placebo difference in differences regression estimates of Equation 1, estimating the effect of required bank competition on market-level HHI. HHI is calculated as the sum of squared deposit market shares by bank, multiplied by 10,000. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: FDIC summary of Deposits database.

	(1)	(2)	(3)	(4)
VARIABLES	HHI	HHI	Log(HHI)	Log(HHI)
POST	402.0***	419.6***	0.163***	0.163***
	(99.43)	(101.0)	(0.0331)	(0.0331)
t>=5		67.20		0.00801
		(85.61)		(0.0259)
POSTxTREAT	-111.6	-143.0	-0.0380	-0.0394
	(100.3)	(99.40)	(0.0375)	(0.0374)
t>=5 X TREAT		54.28		0.00244
		(72.06)		(0.0275)
Observations	4,094	4,094	4,094	4,094
R-squared	0.697	0.698	0.752	0.752
Market FE	X	X	X	X
Year FE	X	X	X	X
Clusters	160	160	160	160

Table B.2: HHI Placebo at HHI=2800

Placebo difference in differences regression estimates of Equation 1, estimating the effect of required bank competition on market-level HHI. HHI is calculated as the sum of squared deposit market shares by bank, multiplied by 10,000. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 2300-2800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: FDIC summary of Deposits database.

	(1)	(2)	(3)	(4)
VARIABLES	HHI	HHI	Log(HHI)	Log(HHI)
POST	266.6***	251.6***	0.166***	0.161***
	(37.14)	(35.18)	(0.0204)	(0.0195)
t>=5		42.66		0.00425
		(51.61)		(0.0236)
POSTxTREAT	66.02	138.2	0.0277	0.0545
	(89.83)	(122.8)	(0.0486)	(0.0570)
t>=5 X TREAT		-135.0		-0.0496
		(108.1)		(0.0513)
Observations	3,680	3,680	3,680	3,680
R-squared	0.581	0.582	0.616	0.617
Market FE	X	X	X	X
Year FE	X	X	X	X
Clusters	135	135	135	135

Table B.3: HHI Placebo, $10 < \Delta HHI < 200$

Placebo difference in differences regression estimates of Equation 1, estimating the effect of required bank competition on market-level HHI. HHI is calculated as the sum of squared deposit market shares by bank, multiplied by 10,000. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of less than 200 points to a level 1300-1800. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of less than 200 points to a level 1800-2300. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: FDIC summary of Deposits database.

	(1)	(2)	(3)	(4)
VARIABLES	HHI	HHI	Log(HHI)	Log(HHI)
POST	77.89	48.27	0.0406**	0.0283
	(52.10)	(44.77)	(0.0206)	(0.0176)
t>=5		85.93		0.0219
		(62.62)		(0.0249)
POSTxTREAT	-49.21	-9.931	-0.0198	-0.00301
	(66.65)	(49.17)	(0.0265)	(0.0201)
t>=5 X TREAT		-66.64		-0.0292
		(69.55)		(0.0284)
Observations	14,674	14,674	14,674	14,674
R-squared	0.620	0.620	0.684	0.685
Market FE	X	X	X	X
Year FE	X	X	X	X
Clusters	345	345	345	345

Table B.4: Borrower Characteristics in CMBS Records

Summary statistics of loan-level securitized mortgage characteristics. Data is from 30,776 loans from offices and retail buildings. Source: Trepp.

VARIABLES	(1) mean	(2) sd	(3) p10	(4) p50	(5) p90
Term (Months)	117	40	60	120	120
Loan Amt (th)	14,558	37,668	1,500	5,400	28,600
LTV	68	12	52	71	79
Occupancy	95	7	86	99	100
Interest Spread	1.7	.76	.91	1.6	2.7

Table B.5: Borrower Characteristics in the SSBF

Summary statistics of business data for the 697 firms in the 2003 Survey of Small Business Finances that report having a mortgage. Observations include all implicates and are weighted by Final Weight. Missing data is dropped casewise.

VARIABLES	(1) mean	(2) sd	(3) p10	(4) p50	(5) p90
D&B Credit Score	3.5	1.5	1	4	5
Total employees	13	30	2	5	24
Dist to Primary Bank	12	66	1	1	15
Total Assets	1,181,876	5,063,634	22,697	249,000	2,106,616
Impersonal Rel.	.67	1.7	0	0	4
Total Mortgage	582,904	4,016,602	20,000	108,000	711,659
Total Debt	795,140	4,720,999	40,000	199,000	1,222,000

Table B.6: Cross-Sectional Characteristics in SSBF

Regression estimates for the 697 firms in the 2003 Survey of Small Business Finances that report having a mortgage. Robust standard errors. Observations include all implicates and are weighted by Final Weight. Missing data is dropped casewise.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Log Rel. Mnths	Log Dist	Impersonal	Log Rel. Mnths	Log Dist	Impersonal
Log Mortgage	-0.00183	0.0609*	0.119**			
	(0.0301)	(0.0321)	(0.0590)			
Log Assets				0.0765***	0.0396	0.0765
				(0.0281)	(0.0258)	(0.0480)
Constant	4.388***	0.574	-0.726	3.420***	0.802**	-0.268
	(0.362)	(0.382)	(0.692)	(0.358)	(0.325)	(0.597)
Observations	697	697	697	694	694	694
R-squared	0.000	0.009	0.012	0.019	0.005	0.006

Table B.7: Cross-Sectional Characteristics of Large CMBS Loans

Cross-sectional regression estimates for CMBS loans. Includes full sample of available CMBS loans originated from 1998-2015. "Days Dlq, 3 yrs" refers to the number of days that a loan is in delinquency within three years of loan origination. Int. rate is the original interest rate paid on loans. Property value is calculated by multiplying the original loan balance by the origination LTV. DSCR is the debt service-cashlflow coverage ratio. Source: Trepp. Robust standard errors.

	(1)	(2)	(3)	(4)	(5)
	Mths Dlq	Mths Dlq			
VARIABLES	3 yrs	3 yrs	Int. Rate	Int. Rate	Int. Rate
Log Prop. Val	-0.000679***	-0.00143***	-0.483***	-0.574***	-0.408***
	(7.51e-05)	(9.56e-05)	(0.00308)	(0.00327)	(0.00304)
LTV		0.000198***		0.0209***	0.0175***
		(8.08e-06)		(0.000328)	(0.000337)
DSCR					-0.0640***
					(0.00215)
Mths Dlq, 3 yrs					1.896***
					(0.138)
Mths Dlq, 2 yrs					0.0225
					(0.229)
Constant	0.0144***	0.0124***	13.33***	13.30***	10.82***
	(0.00115)	(0.00110)	(0.0467)	(0.0443)	(0.0453)
Observations	132,702	132,702	131,703	131,703	99,526
R-squared	0.001	0.005	0.194	0.225	0.164

Table B.8: Bank Size and Small Business Lending

Estimates of the relationship between log(total bank lending) and the composition of bank loans. Sample includes universe of U.S. commercial banks with assets above $20,000,000 from 1994-2015. Estimates are unweighted. Sources: Call Reports.

	(1)	(2)	(3)	(4)	(5)	(6)
	Frac CRE	Frac CRE	Frac CRE	Frac CI	Frac CI	Frac CI
VARIABLES	<100k	100k-250k	250k-1mn	<100k	100k-250k	150k-1mn
Log(Tot Loans)	-0.03***	-0.04***	-0.05***	-0.05***	-0.03***	-0.03***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	0.49***	0.61***	0.93***	0.87***	0.51***	0.62***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	155,044	157,129	156,309	156,496	154,446	150,858
R-squared	0.11	0.15	0.12	0.11	0.14	0.06

Table B.9: Effect of Mergers on Incumbent Bank Size

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on bank-level variables measuring bank size. Limited to incumbent banks not taking part in bank mergers. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)	(4)
VARIABLES	Mkt Branches	Mkt Banks	Avg # Branches	HMDA DTI
POST	-0.0131**	-0.0344*	0.139	0.00136
	(0.00548)	(0.0207)	(0.110)	(0.0201)
POSTxTREAT	0.00272	0.0192	0.0675	0.00836
	(0.00623)	(0.0311)	(0.141)	(0.0229)
Observations	4,928	4,928	4,928	4,685
R-squared	0.990	0.961	0.871	0.847
Market FE	X	X	X	X
Year FE	X	X	X	X
Clusters	193	193	193	192

Table B.10: Bank Characteristics in Treated vs Untreated Markets

Balance table estimating the effect of treatment on bank balance sheet variables limited to markets and mergers where POST=0. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 800-1300. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)	(4)	(5)	(6)
			CRE/Lns	CRE/Lns	CRE/Lns	
VARIABLES	LLRs/Lns	NPLs/Lns	<100k	100k-250k	250k-1mn	Log(Lns)
TREAT	0.0269	0.139*	0.00301	0.0138	-0.0226	-0.213
	(0.0580)	(0.0817)	(0.00919)	(0.0120)	(0.0150)	(0.184)
Observations	6,460	6,441	5,241	5,263	5,195	6,460
R-squared	0.047	0.048	0.077	0.040	0.038	0.026
Year FE	X	X	X	X	X	X

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table B.11: Effect of Competition on Bank Assets and Liabilities: Placebo, HHI=1300

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on bank-level variables. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 800-1300. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)	(4)
VARIABLES	Eqty/Asst	T1CR/RWA	Log(Asst)	Deposits/Assets
POST	-0.00465	-0.0129***	0.292*	-0.0163
	(0.00312)	(0.00424)	(0.154)	(0.0171)
POSTxTREAT	-0.000283	0.000323	-0.300	0.0191
	(0.00290)	(0.00846)	(0.317)	(0.0120)
Observations	11,857	9,506	11,857	11,857
R-squared	0.154	0.234	0.499	0.266
Market FE	X	X	X	X
Year FE	X	X	X	X
Clusters	62	56	62	62

Table B.12: Effect of Competition on Bank Assets and Liabilities: Placebo, HHI=2300

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on bank-level variables. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 2300-2800. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)	(4)
VARIABLES	Eqty/Asst	T1CR/RWA	Log(Asst)	Deposits/Assets
POST	0.000161	-0.00293	0.0279	0.00924
	(0.00252)	(0.00429)	(0.114)	(0.0109)
POSTxTREAT	-0.00250	-0.00712	0.292*	-0.0246*
	(0.00309)	(0.00615)	(0.150)	(0.0144)
Observations	18,394	15,047	18,394	18,394
R-squared	0.129	0.159	0.456	0.213
Market FE	X	X	X	X
Year FE	X	X	X	X
Clusters	74	73	74	74

Table B.13: Effect of Competition on Bank Assets and Liabilities: $10 < \Delta HHI < 200$

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on bank-level variables. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of between 10 and 200 points to a level 1800-2300. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at between 10 and 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)	(4)
VARIABLES	Eqty/Asst	T1CR/RWA	Log(Asst)	Deposits/Assets
POST	-0.00152	-0.000635	-0.0262	0.00248
	(0.000966)	(0.00189)	(0.0433)	(0.00394)
POSTxTREAT	0.00123	-0.00227	-0.185	0.00981
	(0.00198)	(0.00392)	(0.164)	(0.0129)
Observations	708,367	563,266	708,367	708,367
R-squared	0.146	0.158	0.487	0.272
Market FE	X	X	X	X
Year FE	X	X	X	X
Clusters	288	273	288	288

Table B.14: Effect of Competition on Bank Lending: Placebo, HHI=1300

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on bank-level variables. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 800-1300. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Log(Lns)	NPLs/Lns	NPLs/Lns (RE)	NPLs/Lns (CI)	LLRs/Lns
POST	0.299*	-0.145	-0.169	-0.00376	-0.0908
	(0.153)	(0.156)	(0.149)	(0.0705)	(0.131)
POSTxTREAT	-0.275	-0.252	0.00129	-0.223	-0.144
	(0.316)	(0.328)	(0.198)	(0.146)	(0.223)
Observations	11,857	11,702	11,603	11,119	11,857
R-squared	0.500	0.240	0.425	0.469	0.244
Market FE	X	X	X	X	X
Year FE	X	X	X	X	X
Clusters	62	62	62	62	62

Table B.15: Effect of Competition on Bank Lending: Placebo, HHI=2300

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on bank-level variables. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 2300-2800. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)	(4)	(5)
			NPLs/Lns	NPLs/Lns	
VARIABLES	Log(Lns)	NPLs/Lns	(RE)	(CI)	LLRs/Lns
POST	0.0474	0.00838	0.0261	0.0911	-0.00325
	(0.118)	(0.130)	(0.128)	(0.0655)	(0.0677)
POSTxTREAT	0.257*	-0.353*	-0.261*	-0.308***	-0.0306
	(0.152)	(0.187)	(0.151)	(0.0911)	(0.0811)
Observations	18,394	17,832	17,608	17,346	18,394
R-squared	0.458	0.320	0.494	0.456	0.220
Market FE	X	X	X	X	X
Year FE	X	X	X	X	X
Clusters	74	74	74	74	74

Table B.16: Effect of Competition on Bank Lending: $10 < \Delta HHI < 200$

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on bank-level variables. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of between 10 and 200 points to a level 1800-2300. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at between 10 and 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)	(4)	(5)
			NPLs/Lns	NPLs/Lns	
VARIABLES	Log(Lns)	NPLs/Lns	(RE)	(CI)	LLRs/Lns
POST	-0.0225	0.0694	0.0545	-0.0261	0.0161
	(0.0422)	(0.0442)	(0.0598)	(0.0226)	(0.0308)
POSTxTREAT	-0.172	0.0465	-0.0285	0.0247	0.0752
	(0.161)	(0.0889)	(0.0881)	(0.0541)	(0.0737)
Observations	708,367	692,744	683,227	654,981	708,367
R-squared	0.484	0.285	0.458	0.409	0.223
Market FE	X	X	X	X	X
Year FE	X	X	X	X	X
Clusters	288	288	288	288	288

Table B.17: Effect of Competition on Bank Loans by Bank Size

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on bank-level variables. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Estimates split by median banks size of $86mn, where median bank size is calculated using pre-merger total lending. Source: Call reports.

	(1)	(2)	(3)	(4)	(5)	(6)
	Small	Small	Small	Large	Large	Large
VARIABLES	Log(Lns)	NPLs/Lns	LLRs/Lns	Log(Lns)	NPLs/Lns	LLRs/Lns
POST	0.124	-0.155	-0.165	0.201	-0.0251	-0.0545
	(0.117)	(0.196)	(0.103)	(0.132)	(0.133)	(0.0706)
POSTxTREAT	0.115	-0.173	-0.0326	-0.182	-0.450***	-0.0676
	(0.151)	(0.239)	(0.162)	(0.209)	(0.169)	(0.0978)
Observations	6,869	6,712	6,869	14,640	14,160	14,640
R-squared	0.579	0.326	0.380	0.451	0.358	0.256
Market FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X
Clusters	85	85	85	99	99	99

Table B.18: Effect of Competition on Bank Lending: Bank Controls

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on bank level variables, with added controls. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Controls are the log number of branches per banking market, the average bank size (where bank size is the log total number of branches), bank *ex ante* log assets fully interacted with POST, bank *ex ante* total lending fully interacted with POST, and bank *ex ante* equity/assets fully interacted with POST. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Log(Lns)	NPLs/Lns	NPLs/Lns (RE)	NPLs/Lns (CI)	LLRs/Lns
POST	1.867***	0.193	-0.201	-0.525	0.976**
	(0.546)	(0.654)	(0.713)	(0.404)	(0.453)
POSTxTREAT	-0.123	-0.348*	-0.426***	-0.0173	-0.0606
	(0.0755)	(0.177)	(0.153)	(0.0757)	(0.0966)
Log # Branches in Mkt	0.751**	0.744	0.797	0.161	0.446*
	(0.315)	(0.538)	(0.510)	(0.272)	(0.266)
Avg Log # Branches per Bank	9.09e-05	7.93e-05	1.42e-05	7.77e-05**	0.000154*
	(7.11e-05)	(0.000149)	(0.000160)	(3.55e-05)	(7.82e-05)
Observations	13,758	13,471	13,344	13,128	13,758
R-squared	0.832	0.395	0.533	0.492	0.339
Market FE	X	X	X	X	X
Year FE	X	X	X	X	X
Clusters	94	94	94	93	94

Table B.19: Effect of Competition on Small Bank C&I Loans

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on C&I lending by loan size. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)
	Frac. CI Lns	Frac. CI Lns	Frac. CI Lns
VARIABLES	<100k	100k-250k	150k-1mn
POST	0.0113	-0.00743	-0.00779
	(0.0145)	(0.00683)	(0.00931)
POSTxTREAT	0.0144	0.00795	0.00160
	(0.0229)	(0.0115)	(0.0200)
Observations	18,261	17,897	17,414
R-squared	0.316	0.180	0.163
Market FE	X	X	X
Year FE	X	X	X
Clusters	98	98	98

Table B.20: Effect of Competition on Small Bank CRE Loans: Placebo Estimates at HHI=1300

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on CRE lending by loan size. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 2300-2800. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 2300-2800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)
	Frac. CRE Lns	Frac. CRE Lns	Frac. CRE Lns
VARIABLES	<100k	100k-250k	250k-1mn
POST	-0.00324	-0.0129	-0.0130
	(0.00719)	(0.0133)	(0.0182)
POSTxTREAT	0.00427	0.0120	0.0144
	(0.0115)	(0.0145)	(0.0268)
Observations	9,921	10,083	10,054
R-squared	0.570	0.402	0.145
Market FE	X	X	X
Year FE	X	X	X
Clusters	60	60	60

Table B.21: Effect of Competition on Small Bank CRE Loans: Placebo Estimates at HHI=2300

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on CRE lending by loan size. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1800-2300. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of at least 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)
	Frac. CRE Lns	Frac. CRE Lns	Frac. CRE Lns
VARIABLES	<100k	100k-250k	250k-1mn
POST	0.00106	-0.00211	-0.0180
	(0.00496)	(0.00855)	(0.0169)
POSTxTREAT	-0.00282	0.00799	-0.0177
	(0.00771)	(0.0138)	(0.0189)
Observations	15,312	15,658	15,573
R-squared	0.513	0.416	0.222
Market FE	X	X	X
Year FE	X	X	X
Clusters	74	74	74

Table B.22: Effect of Competition on Small Bank CRE Loans: $10 < \Delta HHI < 200$

Difference-in-differences regression estimates of Equation 1, estimating the effect of required bank competition on CRE lending by loan size. Limited to sample of banks with more than 50% of SOD deposits in a single banking market and total loans of at least $20mn. Estimates weighted by bank loan market share within banking market (loans/(loans of all banks in market)). Sample limited to banking markets with at least four local banks. TREAT is equal to 1 only for banks in banking markets where a merger leads to a predicted HHI increase between 10 and 200 points to a level 1800-2300. TREAT is equal to 0 only for banks in banking markets where a merger leads to a predicted HHI increase of between 10 and 200 points to a level 1300-1800. POST=1 in years following bank mergers, POST=0 in years prior to bank mergers, and the year of bank mergers is dropped. Standard errors clustered by banking market. Source: Call reports.

	(1)	(2)	(3)
	Frac. CRE Lns	Frac. CRE Lns	Frac. CRE Lns
VARIABLES	<100k	100k-250k	250k-1mn
POST	0.00192	0.00146	-0.00186
	(0.00212)	(0.00263)	(0.00636)
POSTxTREAT	-0.00707	-0.00279	0.00850
	(0.00665)	(0.00726)	(0.0161)
Observations	584,893	612,496	618,737
R-squared	0.532	0.421	0.242
Market FE	X	X	X
Year FE	X	X	X
Clusters	286	285	285

Table B.23: Effect of Competition on CMBS Loans

Difference-in-differences estimates for CMBS loans, estimating effect of required antitrust interventions on CMBS loan characteristics in local banking market. "Dlq 3 yrs" refers to the number of months a loan is delinquent within three years of origination. Estimates of Equation 1. Variables measured at time of securitization. Limited to sample of loans backed by retail or office properties. Source: Trepp. Standard errors bootstrapped and clustered by banking market.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Rate Spread	LTV	Occupancy	Log(Loan)	Term (mths)	Dlq 3 yrs	(mean) Rate
POST	0.0226	0.312	0.0790	-0.0583	-4.559	0.0228	0.0226
	(0.0365)	(0.721)	(0.362)	(0.0680)	(3.459)	(0.0199)	(0.0340)
POSTxTREAT	-0.0753*	0.879	0.238	0.293**	2.751	0.00202	-0.0753*
	(0.0434)	(0.722)	(0.544)	(0.117)	(5.485)	(0.0326)	(0.0400)
Observations	335	333	333	333	335	335	335
R-squared	0.936	0.614	0.591	0.752	0.773	0.747	0.984
Markets	45	44	44	44	45	45	45

C Data Construction

C.1 Call Reports Variables

C.1.1 Sample Selection

The following sample selection is used for local banks:

- Banks are matched to FDIC SOD data. Banks are selected if more than 50% of their deposits are located in a single banking market.
- Banks must have at least $10mn in total assets.
- Regression sample requires there to be at least four commercial banks satisfying these criteria in each year.
- Bank-year observations are removed if the bank is part of any merger within two years.
- Variables are Winsorized at the 5% level. Non-performing loan measures are dropped if they are above 10.

C.1.2 Variable Definitions

Not all variables are available for all years. Variables are defined as follows:

- Log Assets - Log(RCFD2170)
- Log Lending - Log(RCFD2122)
- Equity/Assets - RCFD3210/RCFD2170
- Tier 1 Capital / Risk-Weighted Assets - RCFD8274/RCFDA223
- Non-Performing Loans (NPL) / Total Loans - (RCFD1407+RCFD1403)/RCFD2122
- Loan Loss Reserves (LLR) / Total Loans - RCFD3123/RCFD2122
- Non-Performing Loans (Real Estate) / Real Estate Loans - (RCFD1247+RCFD1250+RCON1212+RCFD1246+RCFD1249+RCON1211)/RCFD1410

- Non-Performing Loans (C&I) / C&I Loans - (RCON1222+RCON1251+RCON1254+ RCON1224+RCON1253+RCON1256)/RCFD1766
- Total C&I Lending: RCFD1766
- C&I Lending <$100k, $100k-$250k, $250k-$1mn respectively: RCON5571, RCON5573, RCON5575 These variables are only defined for banks that do nonzero total lending for these types of loans.
- Total CRE Lending - RCON1480
- CRE Lending <$100k, $100k-$250k, $250k-$1mn respectively: RCON5565, RCON5567, RCON5569 These variables are only defined for banks that do nonzero total lending for these types of loans.
- Loan interest income - RIAD4010

C.2 Deeds Records

C.2.1 Sample Selection

- The purchased data sample only includes commercial properties, either retail or office. The sample is the sample of properties available in counties that partially or wholly overlap a banking market where the treatment variable is either 0 or 1, i.e., in which a merger took place from 1994-2015 in which the predicted HHI change was at least 200 points and the predicted HHI level was 1300-2800.
- I drop multi-market sales.
- In regression estimates I weight properties by the inverse number of properties per banking market and year so that weights total to 1 within banking market-year pairs. I require a minimum of 10 sales per banking market for use in sample estimates.

C.2.2 Variables

- Reported property prices are used only for properties that are coded as arms-length transactions and resales and either grant deeds or quitclaim deeds, excluding inter-family sales. For

properties without a price, prices are filled in as follows. First, a state-level price index is created by estimating a specification of the following form:

$$Log(Price_{it}) = P_{st} \times Price_{st} + \beta_i Property_i$$

where i indexes prices, s indexes states and t indexes years. The P_{st} coefficients create a state-specific price index. For a property sold at time t' and time t, where the log price is available at time t, p_{it} but no price is available at time t', I estimate $p_{it'} = p_{it} + P_{st} - P_{st'}$. If a price is available at two dates, one before time t' and after time t', I take the average of both prices estimated in this way.

- Lenders and borrowers are in the same city if the borrower mailing address city matches the lender address city.
- The LTV ratio is calculated as the loan amount divided by the property price.
- The mortgage amount is as reported.
- Prices and mortgage amounts are Winsorized at 5%.