

# Competition and Bank Fragility\*

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## Abstract

We present empirical evidence documenting how increased competition can affect the fragility of banks using U.S. banking data from 1990 to 2005. In particular, we find that local banks belonging to community (CBOs) and regional banking organizations (RBOs) increased their share of CRE loans as competition from large banking organizations (LBOs) increased. The paper traces the build-up in CRE concentrations in such local banks before the financial crisis to the expansions of LBOs into local banking markets. After instrumenting for LBO competition, we find a steady and continuous increase in CRE loan shares at local banks. CRE concentrations were a principal cause of post-crisis bank failures, and this paper presents evidence showing how competition has the potential to increase not just individual bank fragility, but the overall stability of the banking sector.

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# 1 Introduction

Since the 1970s, federal and local governments have increasingly lowered barriers to entry for banks and other financial institutions, effectively increasing competition [Claessens, 2009]. The years following these deregulatory events have arguably been characterized by more bank failures and greater financial instability in comparison to prior decades [Vives, 2011a]. While recognizing that banks are inherently fragile, it is important to understand the different ways in which competition can affect bank fragility, and ultimately, the stability of the financial system. Despite significant attention from policymakers and academics, however, gaps remain in our understanding of how competition affects bank fragility.

Theory suggests that while competition is not the source of fragility in banks, it can affect bank fragility in a variety of ways [Vives, 2011b]. Theory does not, however, offer a consensus view on the effects of bank competition [Vives, 2011a]. On the one hand, competition can increase bank fragility by raising deposit rates [Rochet and Vives, 2004; Goldstein and Pauzner, 2005], eroding charter values [Keeley, 1990], and exacerbating the winner's curse problem [Broecker, 1990; Sharpe, 1990]. On the other hand, competition could also reduce bank fragility by offering better terms, leading to increased borrower payoffs and improved asset quality [Caminal and Matutes, 2002; Boyd and De Nicolo, 2005]. Despite a number of empirical studies that have examined the effect of deregulation and increased competition in banking (see Berger, Demsetz and Strahan [1999], Gorton and Winton [2003] and references therein), the effect of lender competition on bank fragility remains fertile ground for additional empirical work.

We contribute to this ongoing debate by presenting empirical evidence documenting the effect of deregulation and increased competition on small bank portfolios. Using U.S. banking data from 1990 to 2005, we examine how increased competition from large banking organizations (LBOs) led smaller community (CBOs) and regional banking organizations (RBOs) to shift their balance sheet activity toward greater concentrations of informationally sensitive lending.<sup>1</sup> In particular, the key finding of this paper is that, after accounting for bank-specific and market factors, local CBO and RBO banks significantly increased their portfolio share of commercial real estate (CRE) lending while simultaneously lowering their shares of certain loans to households when faced with greater LBO competition. Specifically, local banks tend to reduce their share of low-risk, transactions-based retail lending segments, such as closed-end 1-4 family residential mortgages and consumer loans, in the face of increased competition from larger rivals, a conclusion supported by related studies [Favara and Imbs, 2015; Berger, Irresberger and Roman, 2017]. On the other hand, smaller incumbent banks counter these competitive forces by leveraging their local market knowledge and focusing on relatively riskier and informationally sensitive segments such as CRE.

We trace this shift in CBO and RBO lending to increased LBO competition which, in turn, was facilitated by deregulation. In the late 1970s and early 1980s, most U.S. states still prohibited banking across state lines [Strahan, 2003]. As a result, the U.S. banking landscape was dominated by thousands of small community banks operating

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<sup>1</sup>We define three distinct BHC groups in terms of their real total domestic banking assets at the holding company level measured in 2009 dollars. We define CBOs as BHCs with real assets less than \$10 billion, RBOs as BHCs with real assets greater than \$10 billion but less than \$50 billion, and LBOs as BHCs with at least \$50 billion in real assets.

locally [Kane, 1996]. A prolonged period of deregulation, though, led some, typically larger, banks to consolidate and expand their geographic footprint, while others continued to operate locally [Janicki and Prescott, 2006]. While the predominant vehicle of entry and expansion was the bank holding company (BHC), which acquired out-of-state banks, loan portfolio decisions were actively managed at the local bank level. Accordingly, we examine the effect of LBO entry and competition on loan portfolios of local incumbent banks (i.e., banks of CBOs and RBOs that operated in the market prior to LBO entry, hereafter “local banks”).

Our principal hypothesis is not without endogeneity concerns. Alternative explanations can be drawn as to how profitable local lending opportunities and economic conditions can drive loan portfolio choices of local banks together with LBO entry and competition. However, our hypothesis does not distinguish between alternative motives behind the local banks’ switch from retail to CRE lending. We address the endogeneity concern of local market factors by constructing bank-specific instrumental variables. We exploit the time-varying distance between each local bank and its closest large-bank competitor branch and pair these time-varying distances with the state-by-state progression of interstate banking deregulation from 1978 to 1994. Our identification bears resemblance to Goetz, Laeven and Levine [2013]; Levine, Lin and Xie [2016]; Jiang, Levine and Lin [2016], but unlike these studies, we are interested in the local banks that face competition, not the BHCs that enter these markets.<sup>2</sup>

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<sup>2</sup>Our instrument is built in two steps: First, we use the dates for state, regional, and national reciprocal agreements on interstate bank deregulation provided by Amel [1993] to determine whether the home state of the local bank allows LBO entry in a particular year. An LBO is allowed entry into a local bank’s state if the state in which the LBO is headquartered has a reciprocal agreement that matches the reciprocal agreement of the local bank’s state. It is possible for a state’s deregulation of entry to remain unmatched. Maine allowed BHC entry in 1978, but interstate deregulation took

For distance to be a valid instrument, it would have to affect the local bank’s portfolio choice only through its effect on LBO competition. We argue that this exclusion restriction is satisfied for our sample of local banks because the local bank is unlikely to significantly change its portfolio merely due to its proximity to an LBO (as would be plausible if an LBO set up a branch nearby). A large body of theoretical and empirical work on relationship lending argues that in comparison to large banks, small banks rely substantially more on lending relationships with their clients (Petersen and Rajan [1995], Berger, Miller, Petersen, Rajan and Stein [2005]; see also Boot [2000], Gorton and Winton [2003] and references therein). We argue that it is unlikely that a small bank would forgo lending opportunities with an arguably captive local customer base under the threat of entry [Broecker, 1990; Sharpe, 1990].

Our result that small incumbent banks shift their loan portfolios in response to the entry of large banks into local markets is predicted by theoretical models that focus on competition between heterogenous lenders. These models primarily contrast better-informed relationship-based lending with less-informed transactional methods of lending [Boot and Thakor, 2000; Dell’Ariccia and Marquez, 2004; Sengupta, 2007]. These theories predict borrower migration away from smaller, informed lenders, especially in market segments where information disadvantages are less acute. As a result, competition from large “foreign” lenders reduces portfolio diversification op-

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off only after 1982, when Alaska and New York passed similar laws [Kroszner and Strahan, 2014]. In the second step, we measure the distance between a local bank’s main office and any LBO branch in the United States in each year, but only if the LBO is allowed to enter the home state of the local bank. Our IV is the minimum distance or “proximity” between a local bank’s headquarters and a branch owned by an LBO headquartered in a state with an effective reciprocal agreement with the home state of the local bank.

portunities for small “local” lenders. Put differently, these theories suggest important entry and competition effects on local bank portfolios.

We also contribute to a set of empirical papers emphasizing the importance of lender heterogeneity in understanding the effects of loan market competition [Petersen and Rajan, 1995; Berger et al., 2005]. In particular, Berger et al. [2005] argues that “[s]mall banks are better able to collect and act on soft information than large banks”. Accordingly, a significant volume of empirical work shows that these smaller banks also rely more on lending relationships, which emerge as a prime source of their comparative advantage over larger banks (see Boot [2000], Strahan [2008] and references therein). In contrast, large banks are more likely to adopt a transaction or fee-based approach to lending [Cole, Goldberg and White, 2004].

Finally, our paper differs from many in a large strand of the empirical banking literature examining the effects of banking deregulation. Many of these studies focus on deregulation’s impact on economic outcomes [Jayaratne and Strahan, 1996, 1998; Black and Strahan, 2002; Cetorelli and Strahan, 2006; Huang, 2008; Kerr and Nanda, 2009, 2010; Rice and Strahan, 2010; Amore, Schneider and Žaldokas, 2013; Chava, Oettl, Subramanian and Subramanian, 2013; Favara and Imbs, 2015; Michalski and Ors, 2012] and large banks [Goetz et al., 2013; Levine et al., 2016; Jiang et al., 2016]. Instead, our study is among the few that examine deregulation’s impact on local, incumbent bank portfolios (see Berger et al. [1999] for other examples). Thus, our paper joins a small but growing body of recent work focused on the localized impact of deregulation such as small-business lending [Black and Kowalik, 2016] and non-bank lenders [Chu, 2016].

More broadly, our results point to the potential for large bank competition to not only increase the fragility of smaller regional and community banks but also affect broader financial stability. Needless to say, portfolio shifts of the type highlighted in this work have implications for asset valuations and increased lending based on those valuations. At the same time, increased loan portfolio concentrations by themselves have implications for financial stability because they leave banks vulnerable to sector-specific shocks. While local banks made portfolio choices individually, overall concentration among CBOs and RBOs increased as a group. Combined with rising asset valuations, such group dynamics have important systemic stability implications not just for local banks but non-local banks exposed to local loan markets as well.

Indeed, the pre-crisis increase in CRE concentrations at small banks and its consequences have been documented both in the literature and in practice. Concerns about rising CRE concentrations at CBOs and RBOs were most strongly reflected in the decision of all three U.S. bank regulatory agencies to issue interagency guidance just prior to the crash [[Federal Register, 2006a,b](#)]. Ex-post, CRE loan concentrations were found to be widespread among commercial banks and are now believed to have been a principal cause of bank failures following the U.S. financial crisis [[Friend, Glenos and Nichols, 2013](#); [Bassett and Marsh, 2017](#)]. [Friend et al. \[2013\]](#) find that “31 percent of all commercial banks in 2006 exceeded at least one of the concentration levels specified in the supervisory criteria.” Moreover, they report that banks exceeding just the construction loan criteria, “accounted for an estimated 80 percent of the losses to the Federal Deposit Insurance Corporation insurance fund from 2007 to 2011.” Our results suggest that at least one possible driver of these pre-crisis

concentration increases was the rise in local competition from large lenders spurred by deregulation.

The remainder of the paper is structured as follows: Section 2 reviews trends in bank consolidation and asset concentration over the last two decades and discusses the related literature. Section 3 discusses the data used in the analysis. Section 4 presents the main empirical strategy, identification assumptions, and results of the tests. Section 5 examines loan level data to further test our key result that RRE was one of the affected channels. Section 6 offers some concluding thoughts and directions for future research.

## 2 Background

Bank branching was restricted both within and across state borders prior to the 1970s. Over the next four decades, branching restrictions were relaxed in one form or another [Kroszner and Strahan, 2014]. Intra- and interstate reforms and federal deregulation prompted a period of consolidation in the banking industry both within and across states, primarily through merger and acquisition (M&A) activity (figure 1a). During this consolidation wave, LBOs expanded geographically and entered markets previously served only by local banks. As a result, banking assets gradually became concentrated at LBOs while the number of smaller banks declined [Janicki and Prescott, 2006]. Indeed, McCord and Prescott [2014] observe (p.27) that banking industry consolidation “starts around 1990 and continues until the financial crisis.” Accordingly, this study focuses on the period of LBO expansion from 1990 to 2005.

This section presents the historical background to LBO expansion and the manner in which LBO competition increased for local banks.

## 2.1 Holding Companies and Interstate Banking

In the early-1980s, restrictions on statewide branching varied widely across states. However, banks were often able to circumvent these restrictions through the use of intrastate, multibank BHC operations.<sup>3</sup> Over time, nearly all states permitted BHCs to convert offices of subsidiary banks within the state (existing or acquired) into branches of a single bank [Kroszner and Strahan, 1999]. In this way, intrastate consolidation facilitated an increase in bank size and began a multi-decade decline in the number of multibank BHCs starting in the late 1980s (figure 1b).

Interstate deregulation of banking began around the mid-1980s after New York and Alaska followed Maine (which deregulated in 1978) and allowed out-of-state banks to acquire local banks on a reciprocal basis [Kroszner and Strahan, 1999]. The number of states that allowed interstate banking increased steadily through the late-1980s, often via regional reciprocal arrangements [Amel, 1993]. Indeed, while intrastate deregulation led to a decline in multi-bank BHCs in the late-1980s (figure 1b), the number of BHCs that operated banks in multiple states increased over the same period (figure 1c). However, while many BHCs quickly responded to intrastate deregulation by consolidating banks within the state, they were slow

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<sup>3</sup>For example, in 1980, 36 states prohibited unrestricted state-wide branching, but three of those states did allow branching through M&A activity. In contrast, only 13 states prohibited multi-bank holding company operations which allowed banking organizations to utilize the holding company structure to operate in several locations within the state. See Kroszner and Strahan [1999] and Kane [1996] for more details.

to take advantage of interstate banking reforms [McLaughlin, 1995]. McLaughlin [1995](p. 2) finds that those BHCs that did enter new states during this period typically “acquired banks in neighboring, rather than distant, states”. Between 1988 and 1993, “nearly 75 percent of all first-time entries represented moves into a neighboring state” [McLaughlin, 1995]. These considerations are important for our use of distance as an IV in Section 4.3.

## 2.2 LBO Expansion

We find that LBO entry into new markets followed a pattern similar to that of other BHCs. Over time, LBOs increased in number (figure 1d) and expanded their geographic footprint. In 1990, there were only 14 LBOs operating on the coasts with the densest branch networks located in the DC-New York-Boston and Los Angeles-San Francisco corridors (figure 2a). By 2005, the number of LBOs rose to 27 and their presence increased in non-major metro areas, particularly in the Southeast and Midwest. Cities such as Nashville, Memphis, Birmingham, Kansas City, St. Louis, and Denver, which had little or no LBO presence in 1990, had a notable number of LBO branches by 2005 (figure 2b)

The pattern of LBO expansion and consolidation during this period is best explained in terms of the increase in out-of-state branches. Figure 3 defines out-of-state branches as the number of branches in states outside a bank’s or BHC’s respective headquarter location. In 1985, there were just 63 multi-state BHCs (figure 1c) operating more than 3,000 out-of-state branches (figure 3). The number of multi-state BHCs, and their out-of-state branches, increased throughout the late 1980s and

early 1990s. Figure 3 also shows that while out-of-state branches of BHCs increased through the mid-1990s, the number of out-of-state branches held by their banking subsidiaries remained low. As a result, nearly all of the early interstate expansion of banking activity occurred using the holding company structure. Put differently, it was the multi-state BHC, and not the bank, that was the market entry vehicle.

The Interstate Banking and Branching Efficiency Act (IBBEA) of 1994 allowed BHCs to acquire banks nationwide, subject to certain limitations [Johnson and Rice, 2008]. The IBBEA also allowed BHCs to convert their branches in various states into branches of a single interstate bank beginning in 1997. Multi-state BHCs took this opportunity to consolidate. Accordingly, the number of multi-state BHCs peaked in 1997 and has declined steadily thereafter (figure 1c). However, the number of out-of-state subsidiary bank branches increased sharply around this time (figure 3). Indeed, the sharp increase in out-of-state bank branches following the IBBEA is largely a result of multi-state BHCs consolidating into a single branch network under a multi-state bank rather than a sudden increase in their geographic footprint. Figure 3 also suggests that the pattern of expansion for all banks and BHCs was mostly driven by LBOs and their subsidiary banks. In summary, figure 3 captures the consolidation of banking activity into LBOs and the geographic expansion of LBOs during this period.

### **2.3 Local Banks Facing LBO competition**

While LBOs expanded nationwide, a significant number of smaller banks chose to operate locally. Although M&A activity was common within these local bank pop-

ulations, the key distinction between these banks and LBOs lies in their asset size distribution and the geographical spread of their operations, as measured in terms of their branching network. Over the years in our sample, the median LBO has \$89 billion in real assets with branches in 110 counties. In contrast, the median RBO has \$19 billion in real assets with branches in 35 counties whereas the median CBO has \$83 million in assets and branches in just a single county.

Figure 4 charts the share of local banks operating a branch in a county where the LBO also operates a branch. The share is calculated separately for branches of the BHC (bold line) as well as its subsidiary banks (dotted line). As shown in figure 4, there is little difference whether the increase in competition is tabulated using the branches of the bank or its holding company. Still, in the analysis below, we examine the impact of LBO competition on the loan portfolios of individual banks. There are two reasons for focusing on the bank and not the BHC. First, individual lending decisions are typically made at the level of the bank and not its holding company. Second, focusing on the bank allows for a more granular analysis and helps to better identify the local effects of LBO competition.

With LBO entry and expansion in different parts of the country, figure 4 shows that the share of local banks facing LBO competition increased from about 10 percent in 1985 to more than 80 percent in 2005. Over the same period, there has been a notable change in the loan portfolios of local banks. CRE loans as a share of total assets at local banks increased considerably since the mid-1980s (figure 5). However, CRE loan shares remained relatively unchanged for LBO banks.

Interestingly, CRE loan shares of local banks continued to increase, peaking

around 2007. However, on December 6, 2006 all three federal regulatory agencies issued supervisory guidance concerning the increasing concentrations of CRE loans. [Bassett and Marsh \[2017\]](#) find that this regulatory guidance prompted banks to rebalance their loan portfolios away from CRE lending. Therefore, this study examines the effect on local bank loan portfolios until 2005, before any real or anticipated effects of the regulatory guidance.

To summarize, we examine the effects of LBO entry on local bank portfolios from 1990 to 2005. Since BHCs were the vehicle of entry, our data uses entry dates of the holding company and not the bank. On the other hand, we examine the effect of LBO competition on local bank (not BHC) portfolios.

### **3 Data**

Our goal is to determine how local bank loan portfolios change with LBO competition. To do this, we control for bank-specific factors as well as market-conditions that are likely to influence bank portfolio choice. Data for these variables are collected from various sources as described below.

#### **Bank Variables**

Bank data from the FFIEC's Reports of Condition and Income (Call Reports) provide quarterly, bank-level financial variables. We use second-quarter bank data on loan shares in different sectors as dependent variables. In addition, we use local banks' prior loan growth, net interest margins (NIMs), delinquency and charge-off

rates, and the Tier 1 leverage ratio to control for prior lending activity, profitability, risk, and capitalization, respectively.<sup>4</sup> Growth rates and income items are adjusted for bank mergers according to the methodology described in [English and Nelson \[1998\]](#). Loan growth rates are trimmed at the 1st and 99th percentile to account for large loan acquisitions that are not otherwise captured by merger adjustments and data reporting errors.

## County Variables

The FDIC’s Summary of Deposits (SOD) data report location and deposit holdings, as-of June of each year, in all branches operated by depository institutions in the United States. We use the reported location coordinates (latitude and longitude) to map each branch to a U.S. county using the 2014 Tiger/LINE shapefile definitions.<sup>5</sup> The mapping ensures that the geographic boundaries of counties are held constant over time. In other words, changes in a branch’s county location are due to openings, closings, or moves rather than changes in the county border definitions.

We construct five measures of LBO competition faced by local banks. The first two measures are the county-level market shares of LBO branches and deposits, respectively. The third and fourth measures are the Herfindhal-Hirschman (HHI) indices of county-level, LBO deposits and branches, respectively. They are the preferred measure of competition in most banking analyses [[Rhodes, 1993](#)]. The fifth measure is total county-level deposits held by LBOs. The HHI indices are calculated

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<sup>4</sup>The Tier 1 leverage ratio is estimated from balance sheet data prior to 2000.

<sup>5</sup>The Tiger/LINE shapefiles can be found on the U.S. Census Bureau’s website: <https://www.census.gov/geo/maps-data/data/tiger-line.html>

according to:

$$HHI_{ct}^{LBO} = \sum_{l=1}^{L_t} s_{l,c,t}^2 \quad (1)$$

where  $s_{l,c,t}$  denotes LBO  $l$ 's deposit or branch share in county  $c$  for year  $t$  and  $L_t$  is the total number of LBOs in year  $t$ .

In addition to local county-level LBO competition measures, the analysis also uses a set of variables that account for changes in county economic conditions over time. The set of county variables include county-level measures of population and building permits (on all new, privately-owned residential construction) from the U.S. Census Bureau. We also include county-level per capita income from the Bureau of Labor and Statistics' Quarterly Census of Employment and Wages. When data are reported quarterly, we use second quarter data to match the SOD reporting period.

### **Market Exposure Controls**

A local bank's market is defined as the set of counties in which the bank operates branches. Accordingly, we create bank-level market exposure controls using county-level variables that are weighted by the local bank's "exposure" to each county. In view of the discussion that underlies the importance of branches to local banking activity, we use the share of branches (instead of deposits) as weights to build market exposure controls. We build market exposure controls for the county-level economic variables and all five LBO competition measures according to the weighting scheme defined in [Cetorelli and Strahan, 2006; Chakraborty, Goldstein and MacKinlay, 2013; Glancy, 2015; Bassett and Marsh, 2017]:

$$x_{i,t} = \sum_{c=1}^{n_i} w_{i,c,t} * x_{c,t} \quad s.t. \quad \sum_{c=1}^{n_i} w_{i,c,t} = 1 \quad (2)$$

where the weights, denoted by  $w_{i,c,t}$ , are the share of branches held by local bank  $i$  in county  $c$  for year  $t$  and  $n_i$  is the total number of counties in which a local bank  $i$  has branches. These weights sum to unity so that the resulting bank-specific market exposure controls are a time-varying, branch-weighted average of county variables and LBO competition.

The resulting data form a panel indexed by bank and year. Local banks which operate in markets that never experienced LBO entry and in markets with LBO branches prior to 1990 are excluded from the sample. As a result, our sample consists of local banks that experienced LBO entry after 1990. Our sample period starts in 1990, the first date for which we have data county-level variables, and ends in 2005, the year just before the CRE supervisory guidance was issued for comment. Summary statistics are presented in table 1.

## 4 Determining LBO Market Competition Effects

This section examines how local bank loan portfolios changed with LBO entry and LBO competition. As a first step, we examine changes in loan shares prior to and following entry without accounting for the level of LBO competition. The next set of regressions measure these changes not only accounting for the level of LBO competition but also including other bank and market controls. Lastly, we examine the causal effect of increased LBO competition on local bank loan shares using an

instrumental variables approach.

#### 4.1 Local Bank Portfolio Shares before and after LBO Entry

LBO entry is indicated by a change in the bank-level market exposure to LBO competition, described in section 3, from zero to a non-zero level. This marks the presence of a deposit-holding LBO branch in any of the counties in which the local bank has a branch. To examine the dynamics of lending behavior around LBO entry, we estimate:

$$Loan\ Share_{i,t} = \alpha_i + \tau_t + \sum_{q=-5}^5 \beta_{t+q} D_{i,t+q} + \varepsilon_{i,t} \quad (3)$$

where  $Loan\ Share_{i,t}$  measures local bank loans in a particular category as a share of total assets and  $\alpha_i$  and  $\tau_t$  are bank and time fixed effects, respectively. The variables  $D_{i,t+q}$  are indicator variables for year  $t + q$  after LBO market entry. The coefficient  $\beta_{t+q}$  measures the changes in local bank loan shares (in each loan category)  $q$  years before (and after) LBO entry. Following Kerr and Nanda [2009, 2010], all periods before the five years prior to entry and all periods after the five years following entry are included in the -5 and +5 indicators, respectively. We omit the indicator for market entry ( $D_{i,t}$ ). These regressions tell us how average loan shares in each of the five years before and after LBO market entry compare with those prevailing at the year of LBO entry.

Figure 6 plots the estimated coefficients (along with 95 percent confidence intervals) in equation (3) for each of the four core loan categories in Call Report data:

CRE, RRE, C&I and consumer loans. Figure 6a shows that prior to LBO market entry, CRE shares at local banks were not statistically different from those at the reference year of LBO entry (shown as period 0 on the graph). In contrast, local banks increased their average CRE loan shares in the five years after LBO entry. Overall, we estimate a percentage point increase in CRE loan shares in the five years following LBO entry, but no change in the five years prior to entry.

We find that RRE shares of local banks remained unchanged (relative to the RRE share at the year of entry) in the years immediately following LBO entry before starting to decline in later years as shown in figure 6b. Interestingly, we also find a significant increase in the RRE loan shares of local banks prior to LBO entry. These estimates raise endogeneity concerns that LBO entry was led by increasing opportunities for RRE lending. Lastly, shares of C&I (figure 6c) and consumer lending (figure 6d) show little to no significant change in the five years prior to or in the five years following LBO entry.

## 4.2 Local Bank Portfolio Shares and LBO Competition

To examine how the loan shares change with the level of LBO competition, we estimate

$$Loan\ Share_{i,t} = \alpha_i + \tau_t + \beta_1 LBO\ competition_{i,t-1} + \gamma X_{i,t-1} + \varepsilon_{i,t} \quad (4)$$

Loan shares, bank, and year fixed effects are denoted by the same variables as in equation 3. Bank fixed effects allow us to account for bank-specific differences that are invariant over time. Year fixed effects are included to reflect time-varying factors

that are common to all banks. The matrix  $X_{i,t-1}$  represents the set of predetermined (lagged one period) bank and market controls described in Section 3.<sup>6</sup> These control for time-varying bank-specific and market-specific factors that may influence bank loan shares. The coefficient of interest is  $\beta_1$ , which estimates how bank loan shares in a particular category change with exposure to LBO competition in the previous year.

Table 2 presents the results for CRE loan shares as the dependent variable. The first row in each column shows the estimate for  $\beta_1$  using one of the five LBO competition exposure measures as denoted by the column header. HHI and deposit level measures are log transformed to account for their highly skewed distributions.<sup>7</sup> Across all competition measures, an increase in LBO activity is associated with an increase in the share of local bank CRE loans. These estimates lend support for our earlier results in figure 6a that show local banks increasing CRE loan shares following LBO entry. The difference here is that these estimates account for bank level differences in exposure to LBO competition as well as bank-specific and market-specific factors that are likely to influence local banks' loan shares.

The findings in table 2 are robust to the different LBO competition measures. On average, a one-standard deviation increase in LBO branch market share is associated with a 0.85(= 16.44  $\times$  0.0516) percentage point change in CRE loan shares of local banks. Likewise, a one-standard deviation increase in LBO deposit market share is

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<sup>6</sup>Alternative specifications that include both predetermined and contemporaneous county level controls yield similar results.

<sup>7</sup>We use one plus the variable for all logged variables included in the specifications following Jiang et al. [2016]. This preserves the difference-in-difference nature of the entry variables when entry has not yet occurred.

associated with 0.82 percentage point change in local bank CRE shares. Increases in LBO concentration and LBO deposit volume yield smaller changes: around 0.25 to 0.32 percentage point change in local bank CRE shares. Overall, the estimates show that increased exposure to LBO competition is associated with economically significant increases in local bank CRE shares in the following year.

Table 3 and Table 4 report the estimates of only  $\beta_1$  in equation 4 for each of the five LBO competition measures. The dependent variables in equation 4 for Table 3 are the local bank loan shares in major categories whereas those for Table 4 are the local bank loan shares in subcategories. In addition to the results on CRE in Table 2, the results in Table 3 indicate that greater exposure to LBO competition is also associated with significantly lower shares of consumer loans. However, the estimated coefficients for C&I and RRE loan shares in table 3 are not statistically significant.

Importantly, the positive and significant association between exposure to LBO competition and CRE loan shares (table 3) holds for both CRE subcategories, namely CLD and non-CLD loan shares (table 4). In contrast, the same regression for subcategories of RRE, as shown in table 4, yields a negative and significant association with 1-4 Family loans but a positive and significant association with HELOCs. While the HELOC result is somewhat surprising, table 1 shows that HELOC concentrations held by banks in our sample are very low with the median bank holding virtually no HELOC loans. Thus, the RRE results are most likely driven by a small number of outliers. Not surprisingly, the results for the non-credit subcategory (table 4) appears to be driving the results for all consumer loans shares in table 3. The results shown here are robust to using a sample of only CBO banks and including both lagged and

contemporaneous local market factors (as in Favara and Imbs [2015]).

Our results could be driven by selection issues. For example, if LBOs target local banks with a high share of RRE loans (or likewise, a low share of CRE loans) for acquisition, it is plausible that our results are driven by their exclusion from the sample of local banks post entry. In view of this, we form a subsample of local banks that were active (i.e., local banks that were not acquired and did not fail) throughout our sample period. Figure 7 plots the CRE loan shares from 1990 to 2005 for this balanced panel of active local banks. CRE loan shares for this subsample increased from around 10 percent of assets in 1990 to over 25 percent of assets in 2005, similar to that shown in figure 5. Clearly, factors other than selection issues related to LBOs' acquisition targets are also driving the increase in CRE loan shares for local banks.

### 4.3 Effect of LBO Competition: IV Estimation

Our measures of LBO competition prompt endogeneity concerns. The principal concern is that local lending opportunities and economic conditions drive loan portfolio choices of local banks together with LBO entry and competition. The results in Figure 6b presents some evidence along these lines: RRE loan shares of local banks were increasing prior to LBO entry. We used local market controls in our fixed effects regressions above to address these endogeneity concerns.

This section further strengthens the identification with an instrumental variables (IV) approach to determine the level of LBO competition in a local bank's market. To do so, we exploit both the geographical distance between the local bank and its nearest LBO competitor and the state-time variation in the dynamic process of

interstate banking deregulation in the U.S.

In every period, the instrument is the log of the minimum distance between a local bank's main office and *any* LBO branch in the U.S., but only for LBOs headquartered in states whose BHCs are allowed to enter the home state of the local bank. The instrument is derived in two steps. First, for each state and year, we use the information in [Amel \[1993\]](#) to determine the list of states whose BHCs were allowed entry into the state. The state-time variation in this list comes from the chaotic, staggered nature of state-by-state relaxation of interstate banking restrictions as described in [Amel \[1993\]](#). In the second step, we measure the distance from a local bank's main office to any branch held by a LBO that is headquartered in a state that has an effective agreement of entry with the local bank's home state. Our instrument is the minimum of these distances between a local bank and any LBO branch. In this way, we derive bank-specific, time-varying measures of minimum distance or proximity to LBOs as an instrument for LBO competition. Accordingly, our instrument is similar in spirit to the measures of competition in [[Jiang et al., 2016](#); [Jiang, Levine and Lin, 2017a,b](#)].

For proximity to be a valid instrument, it must affect the local bank's portfolio choice only through its effect on LBO competition. We argue that this exclusion restriction is satisfied for our sample of local banks because the local bank is unlikely to significantly change its portfolio merely due to the proximity to an LBO branch. In essence, we assume that local banks do not rebalance their loan portfolios in response to competitive threats from larger rivals, but respond to competition only after the larger rival has entered the local market and shown an ability to out-compete the

smaller banks for their “captive” customer base.

While this appears to be a strong assumption for most other businesses, we argue that it is plausible and likely given the existing literature of local banks and their operations. A large body of theoretical and empirical work on relationship lending argues that in comparison to large banks, local banks rely significantly on lending relationships with their clients (see [Boot \[2000\]](#), [Gorton and Winton \[2003\]](#) and references therein). For example, [Sharpe \[1990\]](#) argues that over time, these banks are able to retain relationship banking customers due to informational frictions that prevent borrowers from signaling their quality to other lenders. In other words, over time, relationship-based borrowers become “informationally captured”. Given the potential for extracting rents from these relationship customers, banks often enter into initial contracts that generate expected losses, but potentially have high future payoffs [[Petersen and Rajan, 1995](#); [Sharpe, 1990](#)]. In essence, the relationship banking literature argues that local banks are unwilling to relinquish their customer base on the basis of competitive threats such as proximity to an LBO. Instead, as our narrative suggests, large banks were successful in attracting these customers away from their local rivals, probably due to their funding, reputational, and technological advantages.

Table 3 reports the results of the IV regression for CRE loan shares as the dependent variable. These regressions show that CRE loan shares increased significantly in response to greater LBO competition. In unreported first stage regressions, the instrument is negatively correlated with the market exposure measures of LBO competition faced by local banks. A one-standard deviation increase in LBO branch

market share and deposit market share raises CRE loan shares of local banks by 0.86 and 0.93 percentage points, respectively. The estimated effects from the IV regressions are similar in magnitude to those from our fixed effects regressions. On the other hand, increases in concentration and deposit volume measures of LBO competition yield increases in local bank CRE loan shares of 0.52-0.57 percentage points--marginally greater in magnitude than the estimates from the fixed effects regressions. Lastly, IV estimates of  $\beta_1$  for the major loan categories are reported in table 6 and their subcategories in table 7. Again, the results are similar to those obtained for the fixed effects estimates in Tables 3 and 4. Overall, the LBO competition effect on loan shares in the IV regressions is similar to that found in the fixed effects regressions.

In sum, local banks facing increased competition from LBOs increase their CRE loan shares. And this effect holds for each of the two CRE subcategories CLD and non-CLD loans. Increases in LBO competition do not appear to significantly change the local bank RRE and C&I loan shares. Despite the lack of statistical significance with RRE loan shares, we find two opposing effects in each of its subcategories: a significant decrease in closed-end 1-4 family RRE loan shares accompanied by a significant increase in HELOC loan shares though HELOC concentrations remain very small for local banks throughout our sample. Lastly, an increase in LBO competition shows a significant decline in consumer loans for local banks. As results in table 6 show, a significant portion of this decline is largely due to the decline in the non-credit card subcategory--which includes retail-lending segments such as auto-loans. These results lend further support for our broader hypothesis that local banks tend to lose

market share in transaction-based lending segments like closed-end mortgages and auto-loans while increasing their lending to more information-based riskier lending segments, such as CRE.

## 5 Examining RRE Lending Effects

Our bank level results suggest that local banks facing LBO competition significantly reduced their shares of closed-end 1-4 family loans. In this section, we explore this result further using loan level data collected under the Home Mortgage Disclosure Act (HMDA). Our aim is to capture how competition affects loan growth for local and LBO lenders. Such an analysis highlights a key mechanism through which portfolio compositions changed within banks facing LBO competition. In so doing, it strengthens our earlier results. Unfortunately, loan-level data on is not available for all local bank portfolios. So, this analysis cannot be completed for the non-RRE loan categories. Still, the use of loan level RRE data highlights and confirms the mechanism through which competition affected loan growth and portfolio composition.

Both bank and non-bank reporting institutions report application and origination data under HMDA.<sup>8</sup> For our purposes, we classify observations into three groups, namely loans originated by LBOs and their subsidiaries, non-LBOs and their subsidiaries, and non-banks. This allows us to examine county-level variations in RRE loans by each group over time. In each case, we include both depository institutions as well as affiliated mortgage companies owned by BHCs. Non-banks include thrifts, credit unions, and non-depository independent mortgage companies.

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<sup>8</sup>We use a lender matching file to identify and classify the loan level information by lender.

To exploit this variation and examine how competition affects loan origination trends for each of the three groups, we use the exogenous measures of bank competition developed in [Rice and Strahan \[2010\]](#). [Rice and Strahan \[2010\]](#) use differences in state branching restrictions after the IBBEA and develop an index of bank competition that varies by year and state. The index has been widely used in the literature because its use of state level deregulatory changes provide an exogenous variation that is uncorrelated with local economic conditions [[Kroszner and Strahan, 1999](#)]. We reverse the index so that a higher value indicates more openness to out-of-state entry and therefore a higher likelihood of LBO competition for local banks. Using this index as a proxy measure of LBO competition allows us to avoid the spatial correlations that are typically associated with the use of distance or other proxies as instrumental variables. Therefore, if the index predicts differential rates of growth for non-LBOs and LBOs, these effects are unlikely to be driven by local economic conditions.

Our estimation strategy closely follows that of [Favara and Imbs \[2015\]](#). They show that the removal of state-level interstate branching restrictions leads to higher RRE loan growth by banks while non-banks are unaffected. We extend these results and show that the growth rate effects predominately occur through large banks while smaller banks actually grow more *slowly* following interstate branch deregulation.<sup>9</sup>

To determine the competitive effects of lower barriers to entry on community banks we run the regression shown in equation 5 where  $\alpha_{c,t}$  are county-time fixed effects,  $Type_{g,c,t}$  is an indicator for lender type  $g$ , and  $RS_{c,t}$  is the Rice-Strahan index

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<sup>9</sup>[Favara and Imbs \[2015\]](#) also show that the growth rate effects are driven by banks entering out-of-state markets but do not directly consider the size of the institution as done here.

of bank deregulation. The *Type* variable is split into indicators for LBO Banks and non-banks leaving Non-LBO banks as the omitted group. The Rice-Strahan index is inverted so that an increase is a relaxation of entry barriers. We run this regression for a variety of dependent variables: originations growth, applications growth, acceptance rate, and average debt-to-income ratio defined as the ratio of originated mortgage dollars to total income dollars.

$$y_{g,c,t} = \alpha_{c,t} + \beta_1 y_{g,g,t-1} + \beta_2 Type_{c,t} \times RS\ Index_{c,t-1} + \beta_2 Type_{g,c,t} + \varepsilon_{g,c,t} \quad (5)$$

In our model, the coefficients on the interaction of the type indicators and the Rice-Strahan index denote changes in relative growth rates across lender type groups. Importantly, our estimates hold aggregate demand in the county fixed due to the inclusion of county-time fixed effects. Therefore, a positive coefficient on the type interaction denotes an increase in the dependent category relative to non-LBO banks *within that county*. We include a variety of dependent variables to determine the dominant channel for increasing mortgage volume. Originations and DTI are supply-side measures while applications growth is a demand-side measure. An increase in the acceptance rate, therefore, denotes an increase in mortgage supply while a decline would indicate an increase in mortgage demand from a given lender type.

The results are shown in table 11.<sup>10</sup> First, we note that over the full sample

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<sup>10</sup>We also confirm the results of Favara and Imbs [2015] by running a similar equation separately for each subsample of lending institutions. These results are reported in tables 8, 9, and 10 and show that the effect of relaxing interstate branching restrictions is not significant for non-LBO banks.

period from 1994 to 2005, mortgage origination and application growth at LBO banks was faster than that of non-LBO banks while non-bank growth was significantly lower than non-LBO banks. However, following deregulation, both LBOs and non-banks experienced increased mortgage originations and applications. Faster application growth indicates that consumer demand for LBO and non-bank loans climbed following deregulation.

The mechanisms of this channel are unclear. One possible explanation is that better loan technology available to large banks and non-banks could have made application processing times faster compared to smaller banks. Consumers would prefer this because they could close on their home purchases sooner. A second explanation is that large banks and non-banks actually lowered application standards, driving new business. We find that debt-to-income ratios actually increased relative to small, non-LBO banks for both groups indicating at least a modest easing in lending standards. However, relative acceptance rates declined. This likely indicates that demand for LBO and non-bank mortgage loans outstripped supply increases. Overall, our story is consistent with large banks entering local markets, lowering loan standards, and thereby increasing demand for mortgage loans by enticing the marginal loan borrower to apply for financing.

## **6 Conclusion**

The theoretical literature on bank competition has shown that lender heterogeneity can unwittingly exacerbate market segmentation. Our results find strong support in

the predictions of these theories. In our sample of U.S. banks observed from 1990 to 2005, we find that the pre-crisis build-up in CRE concentrations of local banks can be traced to LBO entry and competition. Local banks struggle to retain their clients in low-risk retail segments prompted them to focus on riskier segments of the market such as CRE, where they could leverage their local information advantage. Competition from LBOs was a significant factor in the build-up of CRE concentrations in local CBO and RBO banks.

The key result has important implications for CRE asset valuations and increased lending based on those valuations. At the same time, increased concentrations by themselves have implications for financial stability because they leave banks vulnerable to sector-specific shocks. It is likely that the increased supply of credit from local banks into CRE may have fueled the sustained increase in CRE asset valuations leaving local bank portfolios increasingly vulnerable to a downturn. Moreover, while local banks individually make portfolio choices, overall concentration for the local bank group increase. Combined with asset valuations this has important systemic implications for financial stability not just for the local banks but LBOs exposed to CRE lending in other markets as well.

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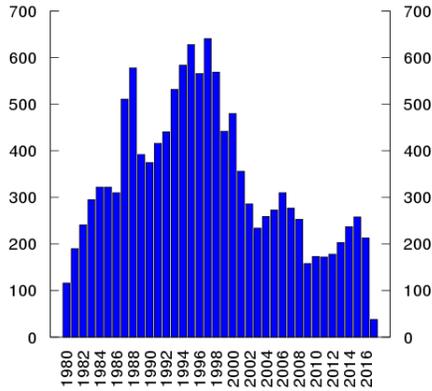
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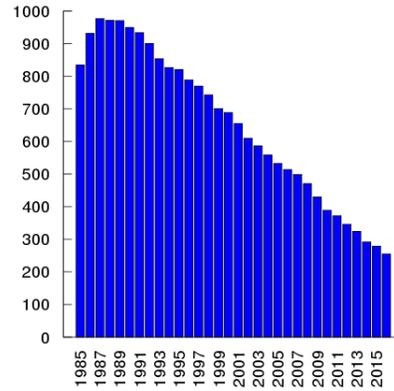
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# 7 Charts

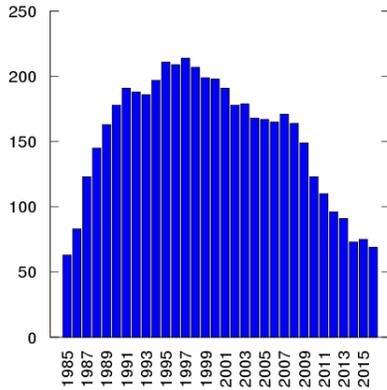
Figure 1: CBO and RBO Loan Shares After LBO Market Entry



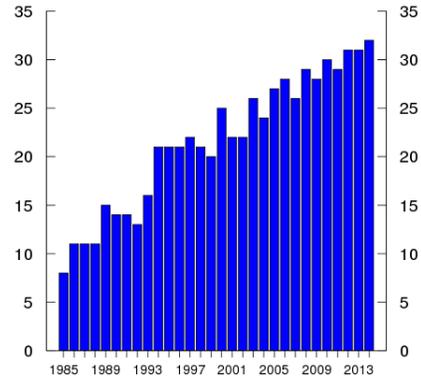
(a) Annual Bank Mergers



(b) Multibank BHCs



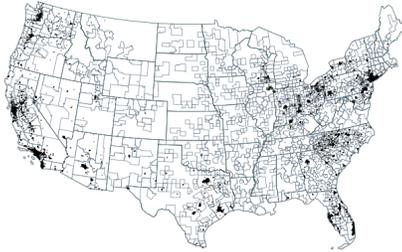
(c) Multistate BHCs



(d) LBO Count

Source: National Information Center (NIC), FDIC Summary of Deposits, and Call Reports.

Figure 2: CBO and RBO Loan Shares After LBO Market Entry



(a) June 1990



(b) June 2005

Figure shows branch locations of bank holding companies with consolidated banking assets of \$50 billion or more (in 2009 dollars) as-of June 1990 and 2005, respectively. State boundaries are shown in black while Census Designated CBSAs as-of 2014 are shown in gray.

Source: FFIEC Call Reports and FDIC's Summary of Deposits.

Figure 3: Out Of State Branches

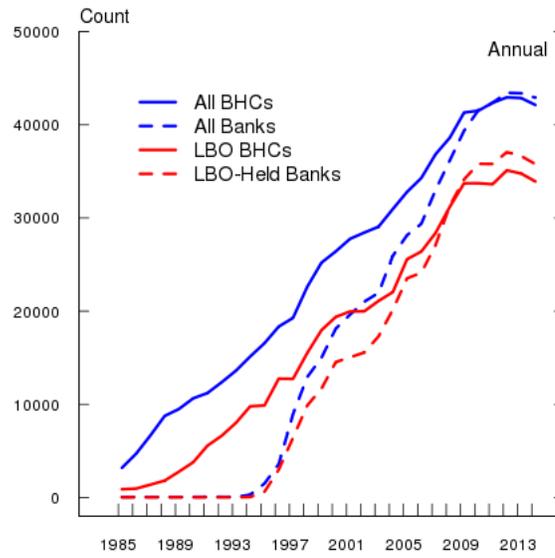


Figure shows number of out-of-state branches based on BHC/bank headquarters location in each year. Source: FFIEC Call Reports and FDIC's Summary of Deposits.

Figure 4: Share of CBOs and RBOs Facing LBO Competition

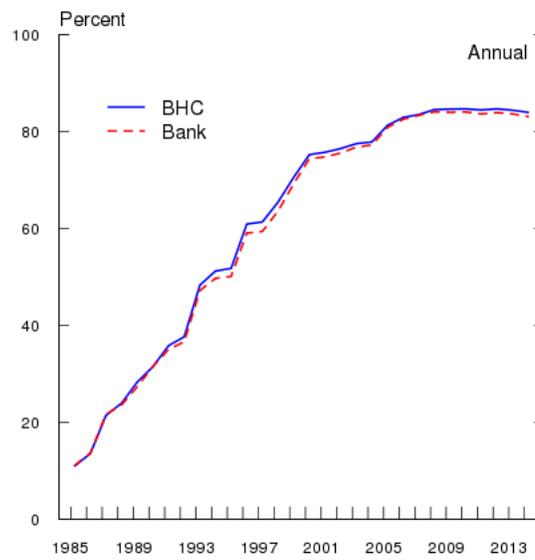


Figure shows share of CBOs and RBOs that operate a branch in a county where an LBO also operates a branch. Source: FFIEC Call Reports and FDIC's Summary of Deposits.

Figure 5: CRE shares at CBOs and RBOs

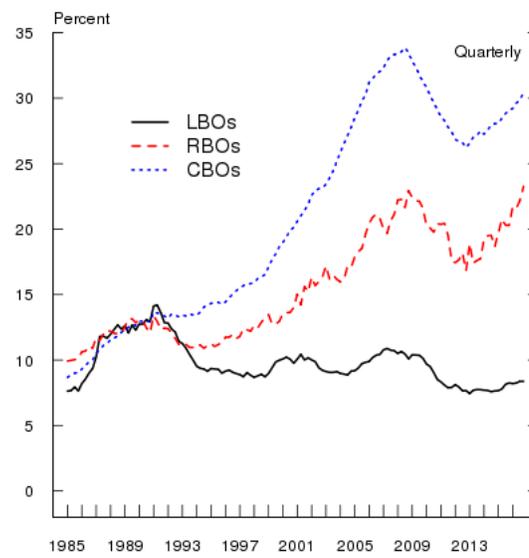
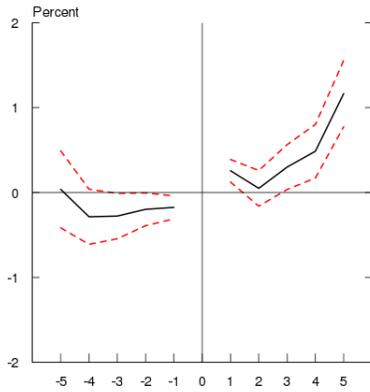
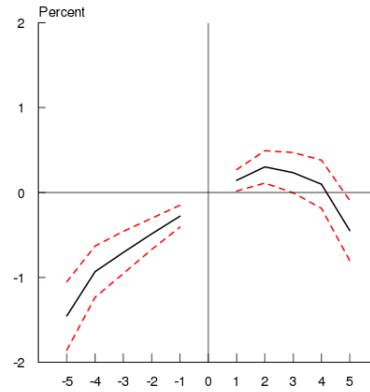


Figure shows share of CRE to total assets at CBOs and RBOs. Source: FFIEC Call Reports and FDIC's Summary of Deposits.

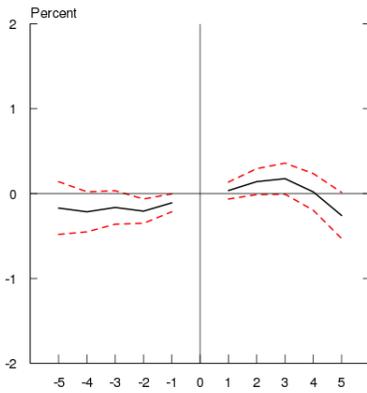
Figure 6: CBO and RBO Loan Shares After LBO Market Entry



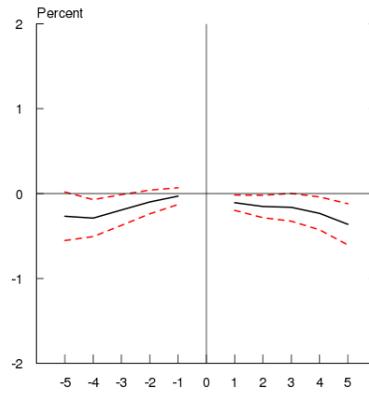
(a) CRE



(b) RRE



(c) C&I



(d) Consumer

Figure shows coefficient estimates from leads and lags after LBO market entry for CBOs and RBOs. Source: FFIEC Call Reports and FDIC's Summary of Deposits.

Figure 7: CRE Shares in Balanced Panel

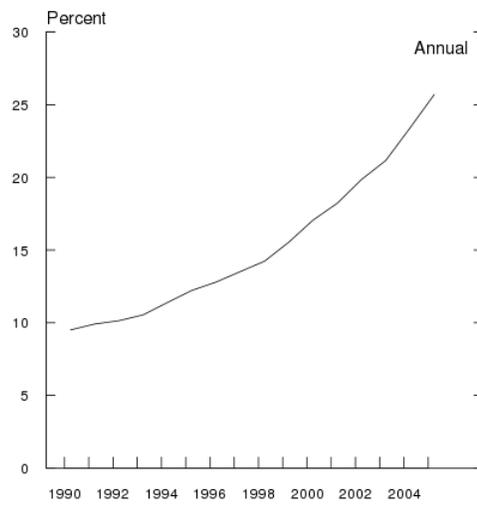
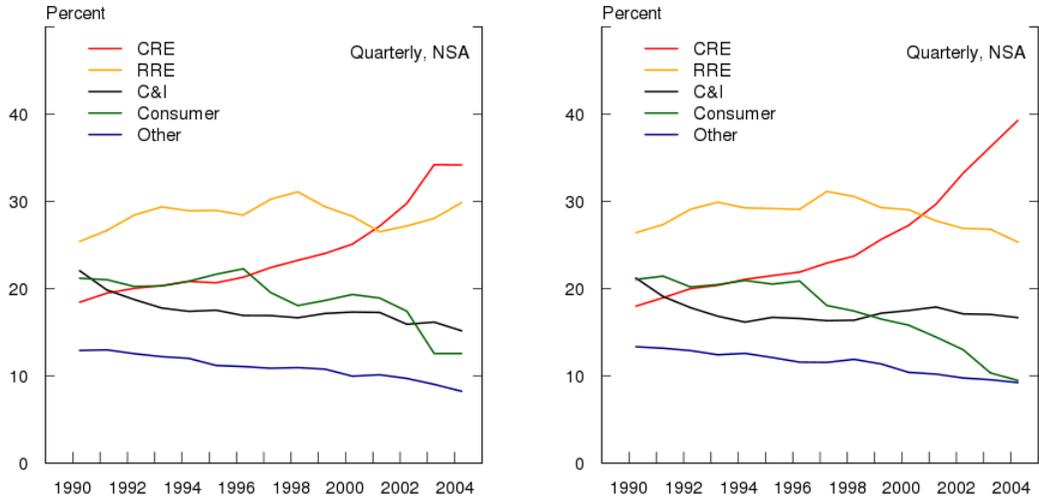


Figure shows CRE loans as a share of total assets CBOs and RBOs that were active and 1990 and unacquired at least through 2005.

Source: FFIEC Call Reports.

Figure 8: CBO and RBO Portfolio Composition



(a) CBO & RBO shares

(b) CBO Only Shares

Figure shows respective loan portfolios as a share of total loans at CBOs and RBOs.  
Source: FFIEC Call Reports.

Figure 9: RRE Marketshares by Institution Type

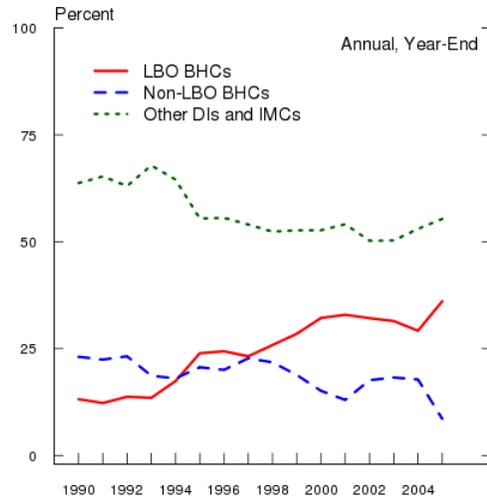


Figure shows marketshare of RRE originations by institution type.  
Source: Home Mortgage Disclosure Act (HMDA).

## 8 Tables

Table 1: Descriptive Statistics

	Mean	Median	Std. Dev
<b>Loan Asset Share (%)</b>			
<i>CRE</i>	13.89	10.39	12.04
<i>CLD</i>	2.94	1.19	4.76
<i>Non-CLD</i>	10.95	8.47	9.24
<i>RRE</i>	17.28	15.86	10.33
<i>Closed end 1-4 Family</i>	16.30	14.86	9.98
<i>HELOC</i>	0.98	0.06	1.97
<i>C&amp;I</i>	9.60	8.10	6.79
<i>Consumer</i>	8.32	6.88	6.29
<i>Non-Credit Card</i>	7.99	6.64	5.87
<i>Credit Card</i>	0.33	0.00	2.31
<b>Loan Growth (YoY %)</b>			
<i>CRE</i>	22.35	12.90	49.20
<i>CLD</i>	57.78	16.02	174.57
<i>Non-CLD</i>	22.16	11.12	55.13
<i>RRE</i>	47.39	16.81	232.93
<i>Closed End 1-4 Family</i>	11.98	7.24	28.03
<i>HELOC</i>	43.67	14.85	125.41
<i>C&amp;I</i>	12.96	7.53	35.91
<i>Consumer</i>	5.84	2.56	25.68
<i>Non-Credit Card</i>	5.91	2.54	26.15
<i>Credit Card</i>	20.14	4.65	79.77
<b>Other Bank Variables (%)</b>			
<i>NIM (Ann. %)</i>	4.43	4.36	0.97
<i>Chargeoff Rate (Ann. %)</i>	0.27	0.05	1.18
<i>Delinquency Rate (%)</i>	2.84	2.16	2.68
<i>Tier 1 Lev Ratio</i>	0.10	0.09	0.23
<b>LBO Competition Measures</b>			
<i>Marketshare (%)</i>			
<i>Branches</i>	12.82	7.14	16.44
<i>Deposits</i>	14.68	6.81	19.22
<i>Concentration (ln HHI)</i>			
<i>Branches</i>	3.17	4.16	2.80
<i>Deposits</i>	3.30	4.11	3.00
<i>Deposit Volume (in logarithms)</i>	7.08	10.22	6.12
<b>Local Economic Conditions (in logarithms)</b>			
<i>Population</i>	10.83	10.60	1.31
<i>Per Capita Income</i>	44	10.01	10.00
<i>RRE Permits</i>	5.02	5.07	2.09

Note: The sample includes only banks held by BHCs with real assets (in 2009 dollars) less than \$50 billion from 1991 to 2005. Local area conditions are county level measures weighted by branch shares as determined by the Summary of Deposits data.

Table 2: Effect of LBO Activity on Community and Regional Bank Shares

	(1)	(2)	(3)	(4)	(5)
	Branch MS	Deposit MS	Branch HHI	Deposit HHI	Deposit Vol.
<i>LBO Competition</i> <sub><i>i,t-1</i></sub>	0.0516*** (9.53)	0.0424*** (9.54)	0.0905*** (4.66)	0.0941*** (5.02)	0.0515*** (5.42)
<b>Bank-Specific Conditions</b>					
<i>Loan Growth</i> <sub><i>i,t-1</i></sub>	0.00801*** (17.78)	0.00798*** (17.72)	0.00792*** (17.52)	0.00791*** (17.52)	0.00791*** (17.49)
<i>NIM</i> <sub><i>i,t-1</i></sub>	0.301*** (4.14)	0.303*** (4.17)	0.297*** (4.10)	0.298*** (4.10)	0.299*** (4.11)
<i>Chargeoff Rate</i> <sub><i>i,t-1</i></sub>	-0.0635*** (-3.23)	-0.0639*** (-3.25)	-0.0647*** (-3.27)	-0.0645*** (-3.26)	-0.0645*** (-3.26)
<i>Delinq. Rate</i> <sub><i>i,t-1</i></sub>	-0.0759*** (-5.10)	-0.0765*** (-5.14)	-0.0786*** (-5.25)	-0.0786*** (-5.26)	-0.0792*** (-5.30)
<i>Tier 1 Lev Ratio</i> <sub><i>i,t-1</i></sub>	-0.120 (-1.03)	-0.117 (-1.00)	-0.122 (-1.02)	-0.120 (-1.01)	-0.120 (-1.01)
<b>Local Market Conditions</b>					
<i>Log (Population)</i> <sub><i>i,t-1</i></sub>	1.895*** (7.79)	1.885*** (7.73)	2.029*** (8.20)	2.008*** (8.10)	1.972*** (7.91)
<i>Log (Per Capita Income)</i> <sub><i>i,t-1</i></sub>	3.582*** (3.92)	3.521*** (3.85)	3.619*** (3.94)	3.634*** (3.96)	3.614*** (3.94)
<i>Log (RRE Permits)</i> <sub><i>i,t-1</i></sub>	0.307*** (4.35)	0.308*** (4.36)	0.283*** (4.00)	0.284*** (4.01)	0.282*** (3.99)
<i>Constant</i>	-48.04*** (-5.44)	-47.33*** (-5.36)	-49.57*** (-5.58)	-49.50*** (-5.57)	-48.92*** (-5.50)
Observations	68,936	68,936	68,936	68,936	68,936
Adjusted R <sup>2</sup>	0.40	0.40	0.40	0.40	0.40

Notes: Dependent variable is loans as a share of total assets. The sample includes only banks held by BHCs with real assets (in 2009 dollars) less than \$50 billion from 1991 to 2005. All regressions include year and bank fixed effects. Local area conditions are county level measures weighted by branch shares as determined by the Summary of Deposits data. Standard errors clustered at the bank level.

*t* statistic in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 3: LBO Competition Effect on Loan Shares

	(1) CRE	(2) RRE	(3) C&I	(4) All Consumer
<i>Branch MS</i>	0.0516*** (9.53)	-0.0293*** (-6.00)	-0.0101** (-2.57)	-0.0198*** (-6.49)
<i>Deposits MS</i>	0.0424*** (9.54)	-0.0213*** (-5.25)	-0.00407 (-1.22)	-0.0154*** (-5.88)
<i>Branch HHI</i>	0.0905*** (4.66)	-0.0131 (-0.69)	-0.0114 (-0.80)	-0.0575*** (-4.45)
<i>Deposit HHI</i>	0.0941*** (5.02)	-0.00466 (-0.26)	-0.00468 (-0.34)	-0.0569*** (-4.62)
<i>Deposit Vol.</i>	0.0515*** (5.42)	-0.00515 (-0.55)	-0.00547 (-0.81)	-0.0302*** (-4.73)

Notes: Table shows the coefficient estimates on LBO activity measures corresponding the specification given by equation 4. The dependent variable is loans as a share of total assets. LBO activity is measured using each of three market concentration measures based on deposit and branch shares of LBO banks. The sample includes only banks held by BHCs with real assets (in 2009 dollars) less than \$50 billion from 1991 to 2005. All regressions include year and bank fixed effects. Standard errors clustered at the bank level.  $t$  statistic in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 4: LBO Competition Effect on Loan Shares

	(1)	(2)	(3)	(4)	(5)	(6)
	CLD	Non-CLD	1-4 Fam CE	HELOC	Credit Card	Non-Credit Card
<i>Branch MS</i>	0.0227*** (7.24)	0.0262*** (6.02)	-0.0331*** (-7.01)	0.00381** (1.97)	-0.000673 (-0.29)	-0.0182*** (-6.27)
<i>Deposits MS</i>	0.0168*** (6.66)	0.0239*** (6.57)	-0.0262*** (-6.65)	0.00632*** (3.73)	0.000186 (0.11)	-0.0146*** (-5.81)
<i>Branch HHI</i>	0.0300*** (2.70)	0.0466*** (2.86)	-0.0379** (-2.07)	0.0210*** (2.75)	0.00480 (0.52)	-0.0545*** (-4.41)
<i>Deposit HHI</i>	0.0292*** (2.75)	0.0527*** (3.36)	-0.0309* (-1.76)	0.0265*** (3.42)	0.000262 (0.03)	-0.0528*** (-4.48)
<i>Deposit Vol.</i>	0.0155*** (2.78)	0.0294*** (3.69)	-0.0214** (-2.39)	0.0137*** (3.49)	0.00229 (0.48)	-0.0285*** (-4.70)

Notes: Table shows the coefficient estimates on LBO activity measures corresponding the specification given by equation 4. The dependent variable is loans as a share of total assets. LBO activity is measured using each of three market concentration measures based on deposit and branch shares of LBO banks. The sample includes only banks held by BHCs with real assets (in 2009 dollars) less than \$50 billion from 1991 to 2005. All regressions include year and bank fixed effects. Standard errors clustered at the bank level.  $t$  statistic in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 5: Instrumented LBO Activity Effect on Local Bank Shares

	(1)	(2)	(3)	(4)	(5)
	Branch MS	Deposit MS	Branch HHI	Deposit HHI	Deposit Vol.
<i>LBO Activity</i> <sub><i>i,t-1</i></sub>	0.0523*** (5.26)	0.0482*** (5.26)	0.187*** (5.24)	0.186*** (5.24)	0.0925*** (5.26)
<b>Bank-Specific Conditions</b>					
<i>Loan Growth</i> <sub><i>i,t-1</i></sub>	0.00802*** (16.97)	0.00800*** (16.94)	0.00791*** (16.70)	0.00790*** (16.68)	0.00789*** (16.65)
<i>NIM</i> <sub><i>i,t-1</i></sub>	0.271*** (4.13)	0.273*** (4.17)	0.268*** (4.08)	0.269*** (4.10)	0.271*** (4.11)
<i>Chargeoff Rate</i> <sub><i>i,t-1</i></sub>	-0.0638*** (-3.13)	-0.0640*** (-3.13)	-0.0641*** (-3.12)	-0.0638*** (-3.11)	-0.0640*** (-3.12)
<i>Delinq. Rate</i> <sub><i>i,t-1</i></sub>	-0.0812*** (-5.28)	-0.0814*** (-5.30)	-0.0840*** (-5.45)	-0.0841*** (-5.45)	-0.0851*** (-5.52)
<i>Tier 1 Lev Ratio</i> <sub><i>i,t-1</i></sub>	-0.110 (-1.03)	-0.106 (-0.99)	-0.109 (-1.00)	-0.105 (-0.97)	-0.106 (-0.98)
<b>Local Market Conditions</b>					
<i>Log (Population)</i> <sub><i>i,t-1</i></sub>	1.944*** (7.74)	1.904*** (7.53)	1.997*** (7.95)	1.963*** (7.78)	1.918*** (7.56)
<i>Log (Per Capita Income)</i> <sub><i>i,t-1</i></sub>	3.431*** (3.62)	3.362*** (3.55)	3.497*** (3.67)	3.518*** (3.70)	3.477*** (3.66)
<i>Log (RRE Permits)</i> <sub><i>i,t-1</i></sub>	0.319*** (4.41)	0.322*** (4.45)	0.291*** (4.00)	0.293*** (4.03)	0.291*** (4.01)
Observations	65,765	65,765	65,765	65,765	65,765
Adjusted R <sup>2</sup>	0.34	0.33	0.33	0.33	0.33

Notes: Dependent variable is CRE loans as a share of total assets. The LBO activity measure is instrumented with the minimum distance between a CBO's main office and the closest LBO branch. The sample includes only banks held by BHCs with real assets (in 2009 dollars) less than \$50 billion from 1991 to 2005. All regressions include year and bank fixed effects. Local area conditions are county level measures weighted by branch shares as determined by the Summary of Deposits data. Standard errors clustered at the bank level.

*t* statistic in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 6: LBO Market Activity Effect on Loan Shares

	CRE	RRE	C&I	Consumer
<i>Branch MS</i>	0.0523*** (5.26)	-0.00922 (-0.97)	0.00361 (0.50)	-0.0189*** (-2.83)
<i>Deposit MS</i>	0.0482*** (5.26)	-0.00848 (-0.97)	0.00332 (0.50)	-0.0174*** (-2.82)
<i>Branches HHI</i>	0.187*** (5.24)	-0.0330 (-0.97)	0.0129 (0.50)	-0.0678*** (-2.83)
<i>Deposit HHI</i>	0.186*** (5.24)	-0.0328 (-0.97)	0.0128 (0.50)	-0.0674*** (-2.83)
<i>Deposit Vol.</i>	0.0925*** (5.26)	-0.0163 (-0.97)	0.00638 (0.50)	-0.0335*** (-2.83)

Notes: Table shows the coefficient estimates on LBO activity measures corresponding the specification given by equation 4. The dependent variable is loans as a share of total assets. LBO activity is measured using each of three market concentration measures based on deposit and branch shares of LBO banks. The sample includes only banks held by BHCs with real assets (in 2009 dollars) less than \$50 billion from 1991 to 2005. All regressions include year and bank fixed effects. Standard errors clustered at the bank level.  $t$  statistic in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 7: LBO Market Activity Effect on Loan Shares

	(1)	(2)	(3)	(4)	(5)	(6)
	CLD	Non-CLD	1-4 Family CE	HELOC	Credit Card	Non-Credit Card
<i>Branch MS</i>	0.0194*** (3.77)	0.0242*** (2.96)	-0.0227** (-2.48)	0.00798** (2.26)	0.000982 (0.15)	-0.0175*** (-2.78)
<i>Deposit MS</i>	0.0182*** (3.77)	0.0223*** (2.96)	-0.0209** (-2.48)	0.00721** (2.26)	0.000875 (0.15)	-0.0161*** (-2.78)
<i>Branch HHI</i>	0.0689*** (3.75)	0.0869*** (2.95)	-0.0814** (-2.47)	0.0270** (2.26)	0.00333 (0.15)	-0.0627*** (-2.78)
<i>Deposits HHI</i>	0.0690*** (3.75)	0.0864*** (2.95)	-0.0808** (-2.47)	0.0264** (2.26)	0.00326 (0.15)	-0.0623*** (-2.78)
<i>Deposit Vol.</i>	0.0340*** (3.76)	0.0430*** (2.96)	-0.0403** (-2.47)	0.0130** (2.27)	0.00161 (0.15)	-0.0310*** (-2.78)

Notes: Table shows the coefficient estimates on LBO activity measures corresponding the specification given by equation 4. The dependent variable is loans as a share of total assets. LBO activity is measured using each of three market concentration measures based on deposit and branch shares of LBO banks. The sample includes only banks held by BHCs with real assets (in 2009 dollars) less than \$50 billion from 1991 to 2005. All regressions include year and bank fixed effects. Standard errors clustered at the bank level.  $t$  statistic in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 8: Effect of Deregulation on LBO Mortgage Lending

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Orig Amt	Orig Count	App Amt	App Count	Accept Amount	Accept Count	DTI
<i>Dependent</i> <sub>c,g,t-1</sub>	-0.0707*** (-12.93)	-0.0663*** (-12.61)	-0.0324*** (-6.38)	-0.0248*** (-4.72)	0.139*** (18.80)	0.267*** (19.56)	0.0962*** (13.41)
<i>Rice Strahan</i> <sub>c,g,t-1</sub>	2.160*** (4.74)	2.114*** (5.17)	2.656*** (6.00)	1.446*** (3.44)	-0.0497 (-0.63)	0.205** (2.32)	0.862*** (4.40)
<b>Local Area Conditions</b>							
$\Delta \text{Log}(\text{Population})_{c,t}$	63.41*** (3.95)	52.80*** (3.88)	82.38*** (5.78)	62.85*** (5.09)	7.612** (2.32)	7.054* (1.85)	12.10 (1.63)
$\Delta \text{Log}(\text{Population})_{c,t-1}$	65.11*** (3.97)	63.45*** (3.99)	80.29*** (5.54)	69.77*** (5.42)	4.805 (1.46)	-1.403 (-0.38)	24.96*** (3.79)
$\Delta \text{Log}(\text{Per Capita Income})_{c,t}$	-12.48* (-1.69)	-12.96** (-2.11)	-0.811 (-0.13)	-13.82** (-2.50)	1.852 (1.16)	-2.530 (-1.40)	-10.03*** (-3.41)
$\Delta \text{Log}(\text{Per Capita Income})_{c,t-1}$	10.74 (1.50)	15.93** (2.45)	13.95** (2.01)	14.32** (2.35)	4.911*** (2.98)	2.103 (1.00)	-6.758** (-2.37)
$\Delta \text{Log}(\text{RRE Permits})_{c,t}$	1.167** (2.39)	1.275*** (2.77)	1.591*** (3.49)	1.462*** (3.42)	0.163 (1.47)		-0.715*** (-3.46)
$\Delta \text{Log}(\text{RRE Permits})_{c,t-1}$	1.334** (2.48)	0.614 (1.29)	1.323*** (2.94)	0.975** (2.31)	0.104 (0.95)		-0.318 (-1.57)
$\Delta \text{Log}(\text{HPI})_{c,t}$						-2.303 (-1.60)	
$\Delta \text{Log}(\text{HPI})_{c,t-1}$						0.752 (0.46)	
<i>Constant</i>	53.92*** (28.42)	46.62*** (29.23)	67.23*** (35.03)	61.95*** (36.82)	61.49*** (100.02)	49.38*** (46.57)	105.1*** (108.92)
Observations	28,588	28,572	29,174	29,149	30,253	10,914	29,988
Counties	3,006	3,005	3,014	3,014	3,014	1,019	3,013
Adjusted R <sup>2</sup>	0.31	0.29	0.35	0.35	0.29	0.50	0.42

Notes: Dependent variables are growth of originated mortgage loans in dollar volume and counts. LBOs are institutions with more than \$50 billion in real banking assets (in 2009 dollars). All regressions include year and county fixed effects. Local area conditions are county level measures. Standard errors clustered at the county level.

*t* statistic in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 9: Effect of Deregulation on Non-LBO Mortgage Lending

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Orig Amt	Orig Count	App Amt	App Count	Accept Amount	Accept Count	DTI
$Dependent_{c,g,t-1}$	-0.0778*** (-14.88)	-0.0706*** (-14.13)	-0.0416*** (-7.84)	-0.0377*** (-7.55)	0.264*** (33.14)	0.282*** (35.16)	0.0613*** (2.69)
$Rice\ Strahan_{c,g,t-1}$	0.000517 (0.00)	0.0746 (0.16)	0.525 (1.12)	0.867* (1.90)	0.510*** (5.04)	0.455*** (4.47)	-0.441** (-2.33)
<b>Local Area Conditions</b>							
$\Delta Log (Population)_{c,t}$	75.74*** (4.12)	52.61*** (2.94)	107.6*** (7.06)	84.81*** (5.70)	-1.512 (-0.35)	-8.239** (-2.14)	-2.178 (-0.29)
$\Delta Log (Population)_{c,t-1}$	49.21** (2.44)	25.19 (1.30)	37.28* (1.94)	13.28 (0.77)	0.540 (0.14)	-2.315 (-0.58)	13.31* (1.83)
$\Delta Log (Per\ Capita\ Income)_{c,t}$	-2.254 (-0.27)	-3.543 (-0.44)	1.767 (0.24)	5.750 (0.82)	9.642*** (5.09)	6.374*** (3.65)	-19.85*** (-5.91)
$\Delta Log (Per\ Capita\ Income)_{c,t-1}$	-12.32 (-1.50)	-18.75** (-2.45)	-7.164 (-0.97)	-7.617 (-1.10)	7.062*** (3.76)	6.959*** (3.88)	-11.30*** (-3.11)
$\Delta Log (RRE\ Permits)_{c,t}$	0.677 (1.11)	-0.293 (-0.50)	0.695 (1.29)	0.164 (0.32)	0.210 (1.63)	0.112 (0.94)	-0.229 (-1.07)
$\Delta Log (RRE\ Permits)_{c,t-1}$	1.454** (2.47)	0.696 (1.22)	1.171** (2.12)	0.637 (1.19)	0.266** (2.09)	0.159 (1.29)	-0.443** (-2.00)
<i>Constant</i>	39.14*** (22.89)	34.06*** (21.54)	52.21*** (32.48)	49.03*** (32.60)	52.26*** (78.04)	47.80*** (73.03)	100.9*** (40.39)
Observations	29,297	29,300	30,282	30,267	30,446	30,413	30,260
Counties	3,008	3,009	3,010	3,011	3,010	3,013	3,014
Adjusted R <sup>2</sup>	0.39	0.36	0.40	0.41	0.44	0.55	0.24

Notes: Dependent variables are growth of originated mortgage loans in dollar volume and counts. Non-LBOs are institutions with less than \$50 billion in real banking assets (in 2009 dollars). All regressions include year and county fixed effects. Local area conditions are county level measures. Standard errors clustered at the county level.

$t$  statistic in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 10: Effect of Deregulation on Non-Bank Mortgage Lending

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Orig Amt	Orig Count	App Amt	App Count	Accept Amount	Accept Count	DTI
<i>Dependent</i> <sub>c,g,t-1</sub>	-0.135*** (-24.21)	-0.150*** (-27.12)	-0.0865*** (-15.94)	-0.0907*** (-15.77)	0.260*** (29.17)	0.286*** (32.89)	0.0402*** (6.34)
<i>Rice Strahan</i> <sub>c,g,t-1</sub>	0.925*** (3.29)	0.951*** (3.80)	1.058*** (4.49)	1.127*** (5.58)	-0.492*** (-5.76)	-0.451*** (-5.98)	-0.807*** (-5.36)
<b>Local Area Conditions</b>							
$\Delta \text{Log}(\text{Population})_{c,t}$	94.70*** (7.47)	72.18*** (6.10)	72.61*** (6.85)	49.11*** (5.44)	0.511 (0.15)	-0.507 (-0.16)	3.793 (0.58)
$\Delta \text{Log}(\text{Population})_{c,t-1}$	61.84*** (4.77)	49.24*** (4.03)	36.40*** (3.37)	24.08** (2.56)	6.399** (2.12)	6.134** (2.13)	0.170 (0.03)
$\Delta \text{Log}(\text{Per Capita Income})_{c,t}$	10.57** (1.96)	11.21** (2.28)	2.668 (0.57)	6.348 (1.55)	0.366 (0.23)	0.423 (0.30)	-4.970* (-1.82)
$\Delta \text{Log}(\text{Per Capita Income})_{c,t-1}$	37.22*** (6.76)	33.76*** (6.57)	26.54*** (5.54)	16.02*** (4.01)	5.138*** (3.44)	4.864*** (3.52)	-7.716*** (-2.80)
$\Delta \text{Log}(\text{RRE Permits})_{c,t}$	1.564*** (3.97)	0.953*** (2.69)	1.299*** (4.20)	0.957*** (3.40)	0.263*** (2.81)	0.0945 (1.09)	0.0305 (0.17)
$\Delta \text{Log}(\text{RRE Permits})_{c,t-1}$	1.591*** (3.86)	1.341*** (3.77)	1.295*** (4.02)	0.912*** (3.22)	0.0540 (0.56)	-0.0699 (-0.80)	0.419** (2.39)
<i>Constant</i>	6.829*** (7.75)	3.708*** (4.77)	17.27*** (22.42)	15.46*** (23.58)	39.55*** (69.65)	33.48*** (66.71)	111.2*** (130.45)
Observations	31,238	31,433	31,433	31,439	31,333	31,327	31,283
Counties	3,009	3,010	3,014	3,013	3,012	3,009	3,011
Adjusted R <sup>2</sup>	0.43	0.40	0.47	0.46	0.17	0.22	0.40

Notes: Dependent variables are growth of originated mortgage loans in dollar volume and counts. Non-Banks are thrifts, credit unions, and independent mortgage companies. All regressions include year and county fixed effects. Local area conditions are county level measures. Standard errors clustered at the county level.

*t* statistic in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 11: Effect of Deregulation on Mortgage Lending

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Orig Amt	Orig Count	App Amt	App Count	Accept Amount	Accept Count	DTI
<i>Dependent</i> <sub>c,g,t-1</sub>	-0.225*** (-43.44)	-0.184*** (-37.32)	-0.196*** (-36.16)	-0.145*** (-28.64)	0.441*** (83.68)	0.500*** (106.72)	0.0344** (1.99)
<i>LBO</i> <sub>c,g</sub> × <i>RS Index</i> <sub>c,g,t-1</sub>	1.371*** (5.59)	1.729*** (7.33)	0.632*** (2.79)	0.980*** (4.57)	-0.282*** (-4.43)	-0.128** (-2.15)	0.667*** (3.95)
<i>Non-Bank</i> <sub>c,g</sub> × <i>RS Index</i> <sub>c,g,t-1</sub>	6.326*** (27.69)	6.123*** (27.83)	7.135*** (31.17)	6.809*** (30.62)	-0.274*** (-4.11)	-0.0260 (-0.41)	0.501*** (3.00)
<b>Lender Type</b>							
<i>LBO</i> <sub>c,g</sub>	9.253*** (16.10)	6.972*** (12.81)	13.92*** (25.93)	11.58*** (22.58)	-4.425*** (-30.26)	-5.467*** (-39.77)	4.609*** (10.43)
<i>Non-Bank</i> <sub>c,g</sub>	-13.70*** (-26.10)	-13.68*** (-27.49)	-14.52*** (-29.69)	-14.60*** (-31.29)	-8.113*** (-49.76)	-7.624*** (-50.16)	17.88*** (37.18)
Observations	99,302	99,302	103,109	103,109	104,135	104,135	104,036
Counties	3,131	3,131	3,135	3,135	3,137	3,137	3,137
Adjusted R <sup>2</sup>	0.31	0.28	0.32	0.29	0.58	0.60	0.41

Notes: Dependent variables are growth of originated mortgage loans and applications in dollar volume and counts, acceptance rate of new mortgages measured as percent of application dollars and counts, and weighted average debt-to-income ratio of newly originated mortgages. Non-LBO banks are defined as institutions with real banking assets (in 2009 dollars) less than \$50 billion. Other institutions include thrifts, credit unions, and independent mortgage companies. All regressions include year, county, and county-year fixed effects. Standard errors clustered at the county level.

*t* statistic in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$