Credit Supply and the Price of Housing*

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Abstract

We show that since 1994, branching deregulations in the U.S have significantly affected the supply of mortgage credit, and ultimately house prices. With deregulation, the number and volume of originated mortgage loans increase, while denial rates fall. But the deregulation has no effect on a placebo sample, formed of independent mortgage companies that should not be affected by the regulatory change. This sharpens the causal interpretation of our results. Deregulation boosts the supply of mortgage credit, which has significant end effects on house prices. We find evidence house prices rise with branching deregulation, particularly so in Metropolitan Areas where construction is inelastic for topographic reasons. We document these results in a large sample of counties across the U.S. To tighten identification, we also focus on a reduced cross-section formed by counties on each side of a state border. Our conclusions are strengthened.

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1 Introduction

Are asset prices affected by the supply of credit? The answer is key to the modeling choices that underpin virtually any asset pricing model. It is also central to understanding the market response to changes in the regulation of credit markets and financial intermediaries, a question of immediate topical interest. Empirically, a definitive answer is elusive because of well known identification issues. The provision of credit is not an exogenous variable. There is every reason to expect that credit supply depends on the price of assets, which may be used as collateral. Credit also responds endogenously to current and expected economic conditions. Reverse causality and omitted variable biases are both rampant issues.

In this paper, we identify exogenous shifts in the supply of credit through changes in the regulation of credit, trace their effects on the size and standards of mortgage loans, and evaluate their end impact on house prices. Our identification strategy rests on regulatory changes to bank branching in the U.S. post-1994. Even though *interstate banking* (i.e., cross-state ownership of banks) was fully legal after the passage of the Interstate Banking and Branching Efficiency Act (IBBEA) of 1994, U.S. states retained the right to erect roadblocks to hamper *interstate branching*. For instance, states were allowed to put limits to banks' size and deposits, or to forbid de novo branching. Rice and Strahan (2010) have constructed a time-varying index capturing these state-level differences in regulatory constraints. They show restrictions correlate with the lobbying power of small (insulated) banks relative to large (expansion-minded) banks, but not with contemporaneous economic conditions.

Like Rice and Strahan (2010) and many others, we implement a conventional treatment effect estimation, where identification obtains across states and over time. We use this framework to ask three questions: 1) did branching deregulation impact the mortgage market? 2) did branching deregulation impact house prices? and 3) is the end effect on house prices channeled via a response of the mortgage market? We find that branching deregulation affect the supply of mortgage loans and the price of housing in a causal sense. We are not aware of any paper that identifies such *causal* link from the supply of credit to asset prices.

Detailed information on mortgage loans is available from the Home Mortgage Disclosure Act (HMDA) database. HMDA reports information on mortgages originated both by depository institutions and Independent Mortgage Companies (IMCs). IMCs are non-depository lending institutions, that are not affected by the branching deregulations. They provide a natural placebo sample, which should not respond to the treatment. The possibility of a differential response across lending institutions sharpens the causal interpretation of our results. If deregulation were motivated by an expected increase in the demand for mortgages, it would also correlate significantly and simultaneously with the volume and conditions of loans originated by IMCs. If a differential response exists between depository banks, our treated population, and IMCs, our placebo sample, the expansion of credit induced by deregulation cannot be the outcome of demand conditions. Deregulation then must induce an exogenous shift in the supply of credit, as banks diversify their loan portfolios geographically. This takes care of the endogeneity bias.

We obtain county-level house price indexes from Moody's Economy.com. We ask whether their dispersion across counties is significantly related to the chronology of branching deregulation, i.e. whether an exogenous change in the availability of credit has end effects on the price of housing. We also verify the response of house prices is more pronounced in counties where construction is least elastic for topographic reasons. We use the index developed by Saiz (2010), who compiled information on local geographic characteristics to capture the amount of developable land in a given area. Clearly the index is orthogonal to local economic conditions. It can therefore be used to ask whether the (exogenous) shift in credit supply has a differential effect on house prices depending on whether a county is situated in an area where house construction is particularly inelastic. If it does, the channel we identify must work via increased demand for housing.

In the U.S., urban counties are grouped into Metropolitan Areas (MSA) that sometimes straddle state borders. These counties provide a focused sub-sample where treated and control counties are neighbors and presumably share observed and unobserved characteristics. A regression analysis on a sample of bordering counties takes care of omitted variables in an exhaustive manner, as any local, unobserved county characteristic is held constant. In addition, the state lines that separate MSAs into treated and control counties exist for historical reasons. The geography of deregulation is predetermined, and thus presumably orthogonal to local economic conditions, which sharpens further the causal interpretation of our results. We implement this approach for both mortgage and house prices regressions.

For commercial banks, which constitute our sample of deposit-taking institutions, we find that the number and volume of mortgage loans rise with the deregulation episodes, while denial rates fall. Interestingly, no systematic change is discernible for mortgage loans originated by IMCs. Such a differential effect suggests that the shift in credit we observe cannot be due to demand. If it were, IMCs would also react on impact, as we would observe a universal response of credit in equilibrium. All our conclusions are sharpened in the sub-sample formed by counties neighboring a state border. Such confirmation suggests deregulation, credit, and house prices are not all driven by unobservable variables. If they were, the relation we document would be weakened in neighboring counties that belong to the same metropolitan area. It also confirms deregulation is indeed exogenous to local activity.

These findings are significant for banks classified as prime lenders, and larger but typically insignificant for sub-prime lenders. In addition, the effects we identify are not channeled via an increase in the fraction of loans that are securitized. As in Jayaratne and Strahan (1996), we conjecture branching deregulation affects the supply of credit thanks to improved geographic diversification. Inasmuch as securitized loans are not subjected to geographic restrictions, diversification gains are smaller, and the end response of securitized mortgage insignificant. Finally, it is credit originated by out-of state banks that responds to deregulation. In-state banks, located in the same state as the property being purchased, remain unaffected. Deregulation therefore affects credit at the extensive margin, as new lenders enter a market that was hitherto out of bounds.

We find a significant response of house prices to deregulation. Interestingly, the effect is non-linear, as it depends on limits to housing constructability at the MSA level. The unconditional response of house prices to deregulation is positive and significant, and increases with a control for the elasticity of housing supply. Instead, in MSAs where housing supply is elastic, the effect of branching deregulations is muted. Once again, the results are sharpened in the sub-sample of bordering counties.

Finally, the end effect of branching deregulations on house prices works via the increase in the supply of mortgage credit. We regress house prices on the number, volume and denial rates of mortgage loans, instrumented by the Rice and Strahan deregulation index. The index passes the conventional tests for weak instruments with flying colors. Branching deregulations are important in accounting for the expansion of credit supply between 1994 and 2005: the geographic distribution of the credit since 1994 is well explained by branching regulations, in an instrumental variable sense. In addition, a shift in credit supply has *causal* consequences on house prices. Our estimates of this causal effect suggest that, on impact, branching deregulation can explain up to 3 percentage points of the annual growth rate in house prices.

Mian and Sufi (2009) and Glaeser, Gottlieb and Gyourko (2010) also use HMDA data to study mortgage credit and housing prices. Mian and Sufi show the rise in mortgage credit is associated with house price growth between 2002 and 2005. They refrain, however, from any causal interpretation, as they "do not have direct instruments for an expansion in the supply of credit" (page 1493). Glaeser, Gottlieb and Gyourko do not find evidence that mortgage credit correlates with changes in house prices. But they, too, refrain from drawing causal conclusions as they do not identify exogenous shifts in mortgage credit.

Our paper confirms the findings in Mian and Sufi (2009) that improved credit availability correlates with higher house prices. Mian and Sufi (2009) stress the role of securitization. In contrast, the effects we uncover work via an expansion of non-securitized mortgage loans, that depository banks can diversify across markets as interstate branching regulation is lifted. Thanks to liquid secondary mortgage markets, some diversification in securitized loans is arguably possible in spite of geographic restrictions. Our channel is therefore distinct from theirs. The mechanisms are not mutually exclusive.

Our results that the volume and number of mortgage loans increase with branch deregulation seem to contradict the findings of Rice and Strahan (2010). They focus on bank loans contracted by small firms and find price effects but no overall quantity response: interest rates fall, bank debt rises but not total borrowing by firms. In contrast, we find the number of loans increases and denial rates fall, which suggests a response of banks at the extensive margin. But we observe mortgage lending on the part of banks, not debtors' overall portfolios. It is entirely possible that overall household debt remains unchanged, as borrowers reallocate their debt towards mortgage loans. That would mimic exactly what Rice and Strahan find for firms. Since HMDA does not provide data on mortgage prices and total household debt, we cannot explore whether interest rates on mortgages and total household debt respond to deregulation in the same way that Rice and Strahan document for loans to firms.

That deregulation should account for the expansion of mortgage markets in an instrumental variable sense is useful. It suggests bank branching deregulations relax important constraints on the availability of mortgage loans. The ensuing changes in the mortgage market structure contribute to explaining in a causal sense the geographic dispersion in house prices across the U.S.

The rest of the paper is structured as follows. Section 2 introduces our data. In Section 3 we discuss the effect of branching deregulations on the mortgage market, and in Section 4 we describe the effect on house prices. We also examine both mechanism jointly in the context of an instrumental variable estimation. Section 5 concludes.

2 Data

This section discusses the three data sources used in this paper. We first explain the nature of the changes to bank branching regulations experienced in the US since 1994. We then discuss the mortgage and house price data, both collected at county level. We close with an illustration of our main results, established rigorously in subsequent Sections.

2.1 Branching deregulations

The U.S banking sector has gone through decades of regulatory changes regarding banks' geographic expansion (Kroszner and Strahan, 1999, 2007). These deregulation waves culminated in 1994 with the passage of the Interstate Banking and Branching Efficiency Act (IBBEA). Banks, national or state chartered, could then operate and open branches across state borders without any formal authorization from state authorities.

Even though the IBBEA authorized free interstate banking, it also granted individual states some power in deciding the rule governing entry by out-of-state branches. As discussed in Johnson and Rice (2008), several states exercised their authority under the new law, de facto hampering banking competition across states. The IBBEA gave states the right to oppose out-of-state branching by imposing restrictions on: (i) de-novo branching without explicit agreement by state authorities; (ii) the minimum age for the acquiring bank; (iii) the acquisition of individual branches without acquiring the entire bank; (iv) the total amount of statewide deposits controlled by a single bank or bank holding company. Rice and Strahan (2010) introduce a time varying index recording these restrictions on *interstate branching*. Their index runs from 1994 to 2005 and takes values between 0 and 4. We reverse their index so that higher values are for states more open to out-of-state entry.[1]

In Figure 1, we illustrate the geographic dispersion of the deregulation episodes over 3-year intervals. Nine states had already moved to full deregulation by 1996. But the bulk of deregulation took gradually place through 2002, as confirmed by the histograms in Figure 2. By 2005, the end of our sample, 26 states had effectively stopped resorting to three or more of the restrictions we are considering. Eight mid-western states still had not deregulated at all. Both figures suggest deregulation was bunched over time and geographically. Given

[1] As in Rice and Strahan, we assume every state is fully restricted in 1994. Prior to 1994 eight states permitted some limited interstate branching (i.e., Alaska, Massachusetts, New York, Oregan, Rhode Island, Nevada, North Carolina and Utah). But the option to branch out of state lines was never exercised, except in a few cases (Rice and Strahan, footnote 4). Johnson and Rice (2008) report that in 1994, just before the passage of the IBBEA act, the average number of out-of-state branches per state was 1.22, and the proportion of out-of-state branches to total branches was just 0.07.

such a pattern, it is the compounded effects of these policy steps taken in close succession that we seek to explore, rather than each of their components taken in isolation.

Figure 1 raises the question of the putative determinants of the speed of deregulation. These are the object of a large literature, starting with Krozner and Strahan (1999). A consensus view is that the timing of banking deregulation reflects the strength and political clout of large (expansion minded) banks relative to small (insulated) banks. The argument is consistent with the geography of deregulation in Figure 1, with relatively quick deregulation in costal areas — where large banks tend to be located. This obviously implies a correlation with the growth in house prices, as these very same regions saw real estate prices skyrocket over the sample period. The question is which way does the causality go. The placebo sample and the focus on counties adjoining a state border that we introduce in this paper are both meant to establish deregulation was an exogenous trigger.

2.2 Mortgage credit

The Home Mortgage Disclosure Act was passed in 1975 with a view to forcing discrimination cases out onto the public stage, and to fostering the dissemination of information about housing investment. Any depository institution must report to HMDA if it has received a loan application, and if its assets are above an annually adjusted threshold. In the paper, depository institutions are commercial banks ["banks" from now on] regulated by either the Office of the Comptroller of the Currency, or the Federal Reserve Board, or the Federal Deposit Insurance Company. Non-depositary institutions, such as Independent Mortgage Companies (IMCs), must also report if their house purchase loans portfolio exceeds 10 millions USD. IMCs are for-profit lenders which are neither affiliates nor subsidiaries of banks holding companies, and are supervised at the federal level by the Department of Housing and Urban Development.[2]

Banks and IMCs differ in many respects. For our purposes, the most important difference is that banks use branches to collect deposits and originate loans, while IMCs rely on wholesale funding and mortage brokers (Rosen, 2011). Only banks should respond to the branching deregulation we discuss in this paper, as their customer base changes when new branches can be opened across state borders. In contrast, IMCs cannot directly make use of

[2] Other depository institutions with information in HMDA are thrifts and credit unions. Neither are affected by the deregulation episodes we consider. But both finance most of their activity with deposits. Credit unions represent a negligible fraction of the mortgage market. In unreported results, we considered thrifts and credit unions as a separate placebo sample, and found no significant reaction to the deregulation, just as we find for IMCs in the main text.

the deregulation to gain access to new borrowers. This is the sense in which IMCs form a placebo sample. Their hypothetical response to the deregulation must happen over time if anything, through a change in the structure of the mortgage market.

Given the importance of the placebo sample formed by IMCs, Table 1 describes the main characteristics of mortgages originated by both banks and IMCs. Panel A of the Table reports data for conventional loans originated by both types of mortgage lenders. Over the whole time period we consider, IMCs tend to receive fewer loan applications, and originate fewer loans. IMC loans are on average slightly smaller, at 78,000 USD compared to 90,000 USD for commercial banks. Interestingly, denial rates are higher on average for IMCs, around 30 percent, than for banks, where they are only around 16 percent. The rates at which both markets have expanded since 1994 are virtually identical. For instance, in 2005 average denial rates are still 16 percent in commercial banks and 25 percent in IMCs. Between 1995 and 2005, loan values have increased by 90 percent for commercial banks, and by 100 percent for IMCs. Panel B illustrates that IMCs were more active in loans insured by the Federal Housing Administration (FHA) at the beginning of the sample. But that trend actually reversed in the late 1990s. By 2005, commercial banks lent the majority of FHA insured loans, with face values that are virtually identical across both type of lenders.

Table 1 suggests there are no systematic large differences in the markets catered by IMCs or by banks. Rosen (2011) reaches similar conclusions, especially over the period of intense branching deregulation until 2002. He shows markets shares of banks and IMCs remain virtually unchanged through the mid 2000's, with averages around 70% and 30%, respectively. He also shows the trends in loan-to-income ratios, and the shares of subprime mortgages for both type of lenders tend to track each other closely well into the 2000's.

For any reporting institution, HMDA provide information on the loan characteristics (response, reason for denial, amount — but not the interest rate), and applicants' characteristics (race, income). We aggregate the HMDA data up to the county level. We keep track of the number and total dollar amount of loans originated in each county for purchase of single family owner occupied houses.[3] Loan volume is the total dollar amount aggregated at the county level. We compute the denial ratio as the number of loan applications denied divided by the number of applications received. We also obtain the fraction of loans originated that are securitized. Securitized loans are defined as those sold within a year after origination to

[3] We exclude loans for the purchase of multi-family dwellings, second and vacation homes, as well as loans for refinancing and home improvement. In other words, we select mortgage loans contracted by first-time home buyers.

another non-affiliated financial institution or government-sponsored housing enterprise. Finally, the loan to income ratio is computed as the principal dollar amount of originated loan divided by total gross annual applicant income. The five variables are computed between 1994 and 2005.

2.3 House prices and controls

County level house price indexes are collected by Moody's Economy.com, and refer to the median house price of existing single family properties. The series compounds data from a variety of sources including the US Census Bureau, regional and national associations of Realtors, and the house price index computed by the Federal Housing Finance Agency (FHFA). We use price indexes for urban areas only, which affords a large cross-section of $1,054$ counties, illustrated in Figure 3. Figure 4 reports the sub-sample formed by those counties that are part of a single MSA traversed by one state border (or more). The coverage is reduced to 284 counties, but it continues to include the main metropolitan areas in continental US.

A prominent alternative to Moody's Economy.com is the Case-Shiller-Weiss index, which measures changes in housing market prices holding quality constant. But coverage includes a maximum of 356 counties, of which only 80 are adjacent to a state border. We privilege Moody's data in the main text. We have verified our conclusions continue to hold with the Case-Shiller-Weiss index, in spite of the heavily reduced sample of counties. The results are reported in the Appendix.

Controls for local economic conditions are obtained from the Bureau of Economic Analysis. We collect nominal income per capita and population growth rates at the county level. Income per capita is converted in real dollars using the national Consumer Price Index from the Bureau of Labor Statistics. With HMDA data, we identify the location of lenders, and compute a Herfindahl index of the concentration in loan origination at county level, a measure of local market power. Finally, we take the index of housing supply elasticity compiled by Saiz (2010). Saiz processed satellite-generated data on water bodies, land elevation, and slope steepness at the MSA level to compile an index of land constructability for all main metropolitan areas in the U.S. The sample is reduced and covers all metropolitan areas with more than 500,000 inhabitants with available satellite data.

2.4 Summary statistics

Table 2 lists the variables in our dataset, along with their definitions and data sources. Table 3 reports some summary statistics. We separate out loans characteristics originated by banks, independent mortgage companies, and banks classified as prime or subprime by the Department of Housing and Urban Development. For conventional banks the average annual growth rate in the number of loans is 13%, and the annual average growth rate in loan value is 18%. The fraction of these loans that are securitized grows at 4% per year. Denial rates fall on average by 3%, while loan to income ratios rise by 2.4%. During the same period, our measure of market concentration for mortgage loans falls on average by 5%, an indication that competition became keener between 1994 and 2005. For each measure, volatility comes mostly from the time dimension, rather than from the dispersion across counties. This will help identification, which in what follows is obtained in panel, and within counties over time.

Between 1994 and 2005, the average number and size of loans originated by mortgage companies grew less than banks, and denial rates remained virtually unchanged. In contrast, subprime banks expanded faster on average than prime ones, across all the measures we observe. Such averages are indicative of differential dynamics across market categories. But they are silent about the geographic dispersion, as they are merely first moments.

House prices increased at an average annual rate just below 3% between 1994 and 2005, more than twice as fast as average county per capita income. In fact, per capita income and population grew at virtually identical average rates, around 1.35%. The observed volatility in house prices comes mostly from time variation, just as loans characteristics did. The same is true of per capita income growth. The Rice and Strahan index of branching deregulation is observed at the state level. On average, the index equals 1.26, suggesting the average state is relatively restricted. Dispersion in the index comes from both state and time variation, which once again ensures identification. Finally, the Saiz index of housing supply elasticity is available for 270 MSAs, or 907 counties.

2.5 Preliminaries

We seek to establish a systematic relation between branching deregulations, activity in the mortgage market, and house prices. We combine two comparisons to establish causality. First, the response of treated versus untreated banks, which is possible thanks to the placebo sample formed by IMCs. Second, the response of treated versus untreated states, which is evaluated in MSAs straddling two or more states. It is the differential response of treated banks in treated counties that achieves identification, bearing in mind the very definition of counties is predetermined and probably exogenous.

In this section we focus on the geographic comparison of treated and untreated states. The purpose is to illustrate some basic properties of the data. A formal analysis that combines both comparisons to achieve identification is in the subsequent Sections. We consider counties in states where one or more branching restrictions were lifted between 1994 and 2005. For these counties, we measure the average response of mortgage loans and house prices three years before and after a change in the Rice and Strahan index. This response is then compared with counties in fully restricted states. We use three-year averages to smooth out year-on-year fluctuations.

Figures 5A, B and C report the differential response in the number, size and denial rates of originated loans. In each figure, the four panels correspond to the lifting of one, two, three, or all of the four branching restrictions considered in the Rice and Strahan index. Each point refers to a given geographic comparison, and measures the differential response of counties in treated and untreated states. Points are denoted by a state acronym, which can appear more than once if a state contains multiple bordering MSAs, or if a state deregulates more than once.

The upper left panels of figures 5A, B and C reveal the most frequent event in our data is an increment in the Rice and Strahan index equal to one. This can happen several times in the same county over successive three-year periods. In contrast, there are few instances of two or three restrictions being lifted over a period of three years. Quite a few cases involve a total liberalization within three years, as reported in the lower right panels of each figure. Restrictions tend to be lifted simultaneously, which makes it difficult to identify separately the impact of the individual components in the RS index.

All three figures suggest the number, size and acceptance rates of mortgage loans grew systematically faster in the three years that followed deregulation, relative to counties located in states that kept all restrictions. In addition, the lifting of all four restrictions over a short period of time results in more systematically positive responses of the mortgage variables. It seems it is the blanket lifting of the restrictions traced by the Rice and Strahan index that has effects on the mortgage market, rather than its individual components taken in isolation. That is particularly apparent in figure 5C. There, it is not clear that the response of denial rates is significant across counties that lifted one restriction only, but it is markedly negative when all four restrictions are lifted. The same conclusions hold for the growth rate of house prices, reported in Figure 5D. In counties where all four restrictions are lifted the acceleration in house prices is most pronouced.

For the results presented so far the control group consists of counties in states with full restrictions. The implied sample is reduced considerably relative to the universe of deregulation episodes between 1994 and 2005. In what follows, we perform conventional treatment regressions where the control group is defined less stringently. We compare deregulating states with non-deregulating states, not just *fully* regulated states. The approach is more general, and stacks the deck against finding a differential response.

It is worth renewed emphasis that such differential response across exogenously determined geographic areas is only one of the two lynchpins of our identification. The other one pertains to the use of a placebo sample formed by IMCs. We now perform both comparisons in the context of a treatment regression analysis.

3 Branching Deregulation and Mortgage Credit

U.S states provide a useful laboratory to study the consequences of changes in the market structure of the banking sector and the real economy. For instance, Jayaratne and Strahan (1996, 1998) and Stiroh and Strahan (2002) have shown that earlier episodes of *intrastate branching* and *interstate banking* deregulations triggered observable changes in the degree of competition amongst banks. With deregulations, banks have improved efficiency and the quality of lending has increased, implying lower loan prices, lower loan losses, and a revamping of the overall bank performance. We take inspiration from this literature, but focus on the most recent episodes of *interstate branching* deregulation and examine its effects on the mortgage market. This Section presents our empirical model, which we estimate in both the full and reduced samples of counties adjacent to a state border. We close with some sample splits and a robustness analysis.

3.1 Main specification

Identification is conventional and akin to a treatment effect, where deregulated states are treated. We estimate

$$\ln L_{c,t} - \ln L_{c,t-1} = \beta_1 D_{s,t-1} + \beta_2 \left(\ln X_{c,t} - \ln X_{c,t-1}\right) + \alpha_c + \gamma_t + \varepsilon_{c,t}, \tag{1}$$

where c indexes counties and s indexes states. $L_{c,t}$ is one of the five measures of county-level activity in the mortgage market we observe: number and volume of mortgages, denial rate, loan to income ratio, and loan securitization rate. $X_{c,t}$ summarizes time-varying county-specific controls. These include current and past values of income per capita, population, house prices, and the Herfindahl index of concentration in county-level loan originations.

The controls help ascertain that the effect we identify works through changes in the supply of mortgage credit. They hold constant conventional determinants of credit demand at the county level, and potential county-level heterogeneity in competition on the mortgage market, before and after deregulation.

In equation (1) county fixed effects, α_c, ensure that all county specific influences are controlled for, provided they are invariant over time. They also guarantee that other (time-invariant) state-specific laws, such as homestead and personal property exemptions or foreclosure laws are taken into account. This minimizes the concern that other state regulations are important confounding factors of our findings. We also include year fixed effects, γ_t, to account for time-varying factors common to all counties. A prominent example are fluctuations in the U.S. credit activity driven, for instance, by changes in the Federal Funds rate.

With county and time fixed effects, our approach is akin to a difference-in-difference model. Identification rests on the dispersion across states (and time) of deregulation, captured by $D_{s,t}$, which aggregates the four elements of restrictions to interstate branching compiled by Rice and Strahan.

The measures $L_{c,t}$ of the mortgage market and the controls $X_{c,t}$ all display heterogeneous trends across counties. Following Paravisini (2008), the most parsimonious treatment of these trends is to take first-differences, as in equation (1). With variables in differences, the presence of county fixed effects guarantees that we control for differential county specific trends in all variables. In our specification, changes in L within the year following deregulation capture the immediate response of the treated mortgage lenders. We later include lagged-dependent variables in equation (1) to allow for temporary responses.

Since deregulation is state-specific but loans are observed at the county level, the error tems, $\varepsilon_{c,t}$ in equation (1) have a potentially time-varying state component. We follow the recommendation in Moulton (1990), Bertrand, Duflo and Mullainathan (2004) and Angrist and Pischke (2009), and cluster $\varepsilon_{c,t}$ by state. This allows for maximum flexibility in the variance-covariance matrix of residuals. It is also more general than state-year clustering, which would leave intact the possibility of serial correlation in $\varepsilon_{c,t}$.[4]

[4]The standard errors in Table 4 almost halve when we cluster by state-year cells. With state level clustering, the number of clusters exceeds 40, which is large enough to obtain reliable inference (Angrist and Pischke, 2009).

3.2 Identification using the placebo sample of IMCs

Table 4 presents the results for the full sample of counties. Panel A focuses on loans originated by banks. The first three columns reveal the number and volume of mortgage loans both increase significantly with deregulation, while denial rates fall. All three estimates suggest the actual size of the mortgage market expands. The point estimate for β_1 in the first column implies that states where branching is de facto unfettered experience on impact an annual growth rate in originated loans 12 percent higher than states imposing full restrictions. The loan to income ratio, however, does not increase with deregulation. This can be indicative of a response of banks at the extensive margin, that contract loans with new customers, rather than augmenting the amount they lend to existing borrowers.

The last specification in Table 4 suggests β_1 is not different from zero for the proportion of originated loans that are resold within the year to other non-affiliated financial institutions and government sponsored enterprises.[5] It is the non-securitized segment of the mortgage market that expands when geographic restrictions on branching are lifted. The finding is consistent with geographic diversification gains for non-securitized loans. For securitized mortgage, in contrast, diversification is not constrained by interstate restrictions, and so it does not respond to their repeal. Securitization made it easier for all lenders to expand, but but it is likely to be least important for those lenders with a strong deposit base, i.e. for banks.

Panel B in Table 4 reports estimates of equation (1) for loans originated by Independent Mortgage Companies (IMCs). These institutions are unaffected by changes in branching regulations. Deregulation has no effect on the lending practices of IMCs. The point estimates of β_1 are observably closer to zero for IMCs than for banks, up to an order of magnitude smaller. The differential effect of branching regulations across categories of lenders sharpens the causal interpretation of our estimates. If deregulation were endogenous and simply responding to expected large increases in the demand for mortgage, β_1 should be significant across both panels in Table 4.

How are IMCs responding to a change in market structure triggered by the deregulation? One view is that IMCs could lend more aggressively in response to keener competition, as out-of-state commercial banks enter. But this argues against the differential effects we uncover. Another view is that branching restrictions provided IMCs with a competitive advantage in controlling market shares in regulated states. Deregulation then triggered a

[5]We have also examined the seperate responses of loans sold to either government sponsored enterprise or to private institutions. The results are, by and large, the same as those in Table 4.

reallocation of capital away from IMCs and towards commercial banks, as the latter gained efficiency. While this view explains the positive response of banks, it also implies a negative coefficient for IMCs, rather than the insignificant estimates we uncover.

There is no response of IMCs on impact. It must therefore be that an expansion in credit that matches the one originated by banks takes time to build. IMCs typically make use of mortgage brokers, rather than local branches like banks. Our findings suggest the reaction of IMCs to the change in competition as new bank branches open is sluggish. But it is not non-existent, as they manage to keep loan growth constant. Mortgage brokers may be hard to mobilize to match the efficiency gains afforded by the geographic diversification gains in banks' loans portfolios.

The absence of any significant consequence of deregulation in a placebo sample puts to rest the possibility that β_1 is significant because overall economic activity has improved with the deregulation. For instance, Jayaratne and Strahan (1996) show that earlier episodes of *intrastate branching* deregulation increased efficiency in the banking sector, which boosted state-level economic growth. But such systematic responses of the local economy to deregulation cannot explain a differential response across lenders. The deregulation only affected mortgage loans originated by treated banks, not the whole mortgage market.

3.3 Identification using counties adjoining a state border

In Table 4, equation (1) is estimated on the full sample of 1,054 counties with available data. Table 5 focuses instead on the sample formed by counties on each side of a state border. We select the 36 MSAs in our data that straddle a state border, and estimate equation (1) on implied sample of 248 border counties. Figure 4 illustrates the geographic coverage of the reduced cross-section. Our purpose is to implement a regression analysis that identifies the effects of deregulation using differences in branching restrictions at state borders. The main assumption is that control variables in equation (1) — observed or unobserved — vary continuously around the border. We maintain this assumption on the basis of the high degree of social and economic integration between adjacent counties in the same MSA. Such local sub-sample provides a rigorous treatment of a potential omitted variable bias.[6]

The focus on counties in MSAs that straddle a state border is important because it also alleviates concerns of reverse causality. Suppose positive estimates of β_1 were obtained

[6]Pence (2006), and Mian, Sufi and Trebbi (2011) use analogous "borders" identification strategies to study the effects of foreclosure laws on mortgage loans. Holmes (1998) and Black (1999) exploit border discontinuities in other contexts.

because demand conditions in deregulating states were looking up. Demand conditions are presumably homogeneous within a metropolitan area, whether it straddles a border or not. So a state-specific deregulation dummy should not be relevant to explaining differential characteristics of the mortgage market in a locally defined sub-sample, especially with predetermined state borders.

This approach is also important in relation to the recent findings in Huang (2008). Huang finds that the growth effects documented by Jayaratne and Strahan (1996) in response to earlier episodes of *intrastate branching* deregulations prevail only for a few contiguous states. It is therefore important to ascertain that our conclusions hold true in a sample of bordering counties, for some of the literature has concluded otherwise as regards growth effects.

In this reduced sample, identification is obtained from MSA-specific clusters of counties, separated by state borders. Just as in the full sample, it is important to allow for common components in $\varepsilon_{c,t}$ that can vary by state and over time. But now it is also important to ensure the residuals are not systematically correlated within each MSA, which would happen if spatial autocorrelation existed in the main US metropolitan areas. We use the multi-way clustering approach introduced in Cameron, Gelbach, and Miller (2011) and Petersen (2009) and cluster $\varepsilon_{c,t}$ at *both* state *and* MSA levels. The approach allows for unrestricted residual correlation within states and across counties that are in the same MSA but not in the same state. The estimation contains 37×36 state-MSA clusters.

Table 5 reports regression estimates of equation (1) in the restricted sample of 36 MSAs, for banks and IMCs. As before, we find the number and volume of mortgage loans originated by banks increase significantly, and denial rates fall. There is no change in the fraction of loans that are securitized. All these responses continue to be absent for loans originated by IMCs. In other words, the differential effect documented in Table 4 survives in a sample of relatively homogeneous counties. The mortgage market expands in counties of deregulating states, while their immediate untreated neighbor sees no change in the size of the market. What is more, only treated banks respond. It is remarkable that our main findings continue to hold in this reduced sample of counties, especially with double clustering that reduces power by imposing stringent conditions on the structure of the residuals.

3.4 Sample splits and robustness

Table 6 repeats the regression analysis in Table 5 for two samples of commercial banks classified according to the riskiness of their portfolio. Each year, the Department of Housing and Urban Development examines the overall risk content of banks portfolios, and issues a classification between prime and subprime depository institutions. The classification is out of the banks' control, and is meant to reflect an objective assessment of the riskiness of their lending policy.

The two panels in Table 6 reveal some differences. Panel A, focused on prime banks, implies estimates virtually identical to Table 5, which suggests the significant response of mortgage markets to deregulation is the result of decisions on the part of prime banks. Panel B, focused on subprime banks, reports estimates of β_1 that are almost all insignificant. The point estimates, however, are higher than for prime banks. Denial rates, in particular, fall dramatically, which could be indicative of subprime banks aggressively lowering their lending standards with the deregulation. However, the comparison ought to be taken with a grain of salt, as estimates are imprecise in the sample of subprime banks. There are fewer observations, and most sub-prime activity is concentrated towards the end of our sample. Table 6 does suggest, however, a heterogeneous response to deregulation on the part of subprime banks.

Table 7 splits the sample according to the location of the lending bank. We distinguish local from non local banks. A bank is non local if it is situated in a state that is different from the address of the property being purchased. Non local banks are the ones that are permitted to enter a deregulating state. Local banks are incumbent. The sample is focused on bordering counties, and standard errors are clustered at state and MSA levels.

Table 7 is informative. Results in the upper panel, focused on non local banks, reinforce our previous conclusions. The number, volume and acceptance rates of loans all increase. Non local banks enter the local market with deregulation. In other words, the response to deregulation occurs at the extensive margin, as new lenders gain access to a market previously closed to them. In contrast, the number, volume and denial rates of loans originated by local banks remain unchanged. The loan to income ratio and the proportion of securitized loans both fall significantly amongst local banks, perhaps an indication that part of their customer base is competed away. The results in Table 7 are strongly indicative that out of state banks enter new markets with deregulation. The loan market then expands, thanks to the realization of new geographic diversification gains.[7]

The rest of this section investigates the robustness of a response to deregulation on the mortgage market along two dimensions. First, we include a lagged dependent variable in

[7] In unreported regressions we also examined the differential response of banks to borrowers of different race. Using individual loan level characteristics in HMDA, we constructed denial rates and the number and volume of loans originated to Whites, Blacks and Hispanics in a given county. We did not find any systematic difference in lending practises across race groups before and after branching deregulation.

equation (1), so that the effects of $D_{s,t}$ are allowed to peter out over time. Second, we compute the growth rates in $L_{c,t}$ and $X_{c,t}$ over three-year averages, which leaves enough time for the reactions of both commercial banks and IMCs to unfold. In both cases, the estimations are performed on the reduced sample of contiguous counties, with all controls included, and standard errors clustered at the state and MSA level. This is the specification that makes it least likely for our results to obtain.

Table 8 reproduces Table 5, but includes as a regressor one lag of the relevant dependent variable for each specification. All our main results stand: the number and volume of loans originated by commercial banks increase, the denial rate falls and the loan to income ratio remains unchanged. The coefficients are virtually identical to those reported in Table 5. The response of IMCs, in turn, continues to be insignificant, with the exception of the loan to income ratio, that increases slightly. All lagged dependent variables are significant, with negative point estimates below one in absolute value. In other words, the effect of deregulations on $L_{c,t}$ peters out over time.[8]

Table 9 reports estimates of β_1 for three-year average values of the growth rate of $L_{c,t}$ and $X_{c,t}$. The time effects, γ_t, now refer to three-year intervals, i.e., 93-95, 96-98, 99-01 and 02-05. Once again standard errors are clustered at both state and MSA levels. For banks, the point estimates of β_1 are systematically larger after three years than on impact. Relative to Table 5, they approximately double in magnitude, and are significantly positive for number and volume of loans, and negative for denial rates. Interestingly, the point estimates of β_1 for IMCs do not increase relative to Table 5, and remain insignificant in all instances. Mortgage companies do not seem to respond to changes in market structure induced by the regulatory environment, not even after three years. The differential response present in yearly growth rates continues to hold for longer periods.[9]

[8] This specification of equation (1) suffers from a conventional bias due to the presence of lagged dependent variables in a regression with fixed effects. As the implied bias is bounded above by the coefficient estimated with an OLS estimator (see Blundell and Bond, 2000), we re-estimated equation (1) with OLS but without intercepts α_c. All our results were confirmed, with minimal changes in coefficient estimates. We conclude the bias is negligible in our dataset and specification.

[9] We also interacted the deregulation variable with 3-year period dummies, to investigate which period witnessed the largest effects on the mortgage market. In unreported results, we find the responses of number and volume of loans are positive and the one of denial rates negative in any 3-year interval. They are significant only between 1996 and 2001. The response on the part of IMCs remains insignificant in any three-year period.

4 Credit Supply and the Price of Housing

We now study whether the lifting of branching restrictions has affected house prices. We verify whether house prices respond to deregulation *because of* the changes in mortgage loans. Following deregulation, an expansion of credit can affect house prices if it boosts the demand for housing as mortgage rates fall and/or more investors gain access to ownership.

4.1 Branching deregulation and house prices

It is well known that house prices display considerable geographic heterogeneity in the U.S. Such heterogeneity can arise from differences in housing supply elasticities, for instance because of local costs or land use regulation (Gyourko and Saiz, 2006; Gyourko, Saiz and Summers, 2006). But it can also come from the demand side of the market, simply because income, demographic factors, and amenities are geographically heterogeneous (Lamont and Stein, 1999, Gyourko, Mayer, Sinai, 2006, Glaeser and Gyourko, 2007, 2008, Favara and Song, 2010). Here, we propose to explain the geographic dispersion in house prices with differences in the availability of credit, themselves ultimately driven by heterogeneous branching regulations across states.

Our empirics follow the treatment approach described in the previous section. We estimate the consequences of state branching deregulations on the growth rate in house prices, making use of the fact that the deregulation episodes are exogenous to contemporaneous economic circumstances. We estimate

$$\ln H_{c,t} - \ln H_{c,t-1} = \beta_1 D_{s,t-1} + \beta_2 D_{s,t-1} \times \eta_c^S + \beta_3 \left(\ln X_{c,t} - \ln X_{c,t-1}\right) + \alpha_c + \gamma_t + \varepsilon_{c,t}, \quad (2)$$

where c indexes counties and s indexes states. The variable $D_{s,t}$ continues to denote the Rice-Strahan deregulation index. $H_{c,t}$ is the Moody's Economy.com county house price index, and $X_{c,t}$ summarizes additional determinants of house prices documented in the literature. Glaeser and Gyourko (2007, 2008) include rents as a regressor, while Lamont and Stein (1999) include contemporaneous and lagged per capita income. We have no information on rents at the county level, so we approximate local influences on the real estate market with contemporaneous and lagged per capita income and population. Following Case and Shiller (1989), we also allow for momentum in house prices with a lagged dependent variable.

We estimate equation (2) in first differences because house prices in the US display heterogeneous trends. More importantly, $H_{c,t}$ is effectively an index, whose level has no economic interpretaion (Himmelberg, Mayer and Sinai, 2005). As in equation (1), γ_t captures country-wide cycles in the growth of real estate prices. And α_c captures county-specific, time invariant trends in house prices.[10]

The coefficient of interest is β_1, which traces the consequences on real estate prices of deregulation episodes. A channel that works via increased demand for housing implies a larger price response wherever construction is restricted. We use the Saiz (2010) index of housing supply, η_c^S, to hold constant geographic limits to constructible land in equation (2). The variable is effectively observed at the MSA level, so we assume the topography is the same across the counties that form the MSAs Saiz considers. We expect $\beta_2 < 0$, as house prices should respond less to a credit boom in counties of MSAs with more elastic housing supply.

Table 10 presents our estimates of equation (2) for different control sets and for the full sample of counties, with standard errors clustered at the state level. Unconditional estimates of β_1 are insignificant, whether they are obtained from the total sample of counties with house price information (column 1), or if we constrain the sample to counties where η_c^S is available (column 2). But β_1 becomes positive when we control for the elasticity of house supply η_c^S. The interaction term, in turn, is significant and negative, with $\beta_2 < 0$ in all instances. These conclusions continue to prevail no matter the control set across the specifications in Table 10.

Suppose deregulation is in fact systematically correlated with η_c^S, as if restrictions were lifted fastest in states where construction is problematic. Then the results in Table 10 only mean house prices increase the most where supply is inelastic, since $D_{s,t}$ and η_c^S are effectively multi-collinear. Of course, deregulation is time-varying and so perfect multi-collinearity is implausible. More importantly, the lifting of branching restrictions is the outcome of lobbying on the part of banks. If banks were indeed manoeuvering to capture the rents associated with rising house prices, they would in fact argue *against* deregulation in counties with low η_c^S. We should thus expect a positive correlation between η_c^S and $D_{s,t}$, as regulation is kept tight wherever prices boom. This is the opposite from what we estimate in the data.

[10] As equation (1), specification (2) suffers from a conventional bias due to the presence of lagged dependent variables in a regression with fixed effects. We have verified that a version of equation (2) estimated with OLS but without intercepts α_c yields virtually identical coefficients. We conclude the bias continues to be negligible for the estimation of equation (2).

4.2 Branching deregulation and house prices in counties adjoining a state border

We re-estimate equation (2) on the sub-sample of counties straddling a state border, as we have done in Section 3.2 for the mortgage variables. Again, we cluster standard errors at both state and MSA level, to account for the possibility of spatial correlation within metropolitan areas, and for other state shocks. Table 11 presents the results. Interestingly, all coefficients become larger in magnitude, with unconditionally positive and significant estimates of β_1 in columns 1 and 2. House prices respond significantly to deregulation, irrespective of whether housing supply is inelastic or not. However, when an interaction term involving η_c^S is included, estimates for β_1 roughly double in magnitude, and continue to be significantly positive, while estimates of β_2 continue to be negative and significant. Table 11 is important, because it confirms controls for η_c^S are not crucial in establishing the results. They merely strengthen the interpretation.

The results suggest the relaxation of branching regulations has a causal impact on house prices at the county level. The end effect depends on the elasticity of housing supply. We classify a county as "highly inelastic" if it falls in the bottom 10% MSAs according to η_c^S. On the basis of column 4 in Table 11, full branching deregulation increases the growth rate of house prices by 3 percent per year on impact in these high inelastic counties. This is a large number, considering the mean growth in real house prices over the 1994-2005 period is also 3 percent.[11] A natural interpretation of such estimates is that bank branching deregulations affect the supply of mortgage credit, and stimulates the demand for houses. The next section investigates rigorously the empirical validity of this channel.

In Table 12, we consider pairs of counties around state borders, ranked by increasing distance from the border. The approach is more refined as we distinguish counties that are immediately near the border from ones that are a few miles removed. Standard errors are clustered by state and by county-pair and the distance is measured using geographic coordinates of a county centroid to its own state border. Interestingly, we find our results are absent in counties that are 10 miles or less from the state border. But they are restored as soon as we consider further counties. An intuitive interpretation is that some arbitrage is occurring in the immediate vicinity of state borders, with borrowers crossing over to contract loans from a deregulated state, presumably at better terms. Such arbitrage works against finding any differential response of house prices to the deregulation episodes. But as the

[11] We have verified our results are identical in the alternative dataset of counties based on the Case-Shiller-Weiss indices. The coverage is substantially smaller with only 356 counties, out of which 81 are straddling a state border. In Appendix Tables A1 and A2 we show the estimates of β_1 and β_2 are virtually identical.

distance increases, arbitrage becomes costly — perhaps because of conventional information costs — and the differential response of real estate prices obtains.

4.3 The credit channel: IV approach

In Section 3 we documented a significant effect of branching deregulations on the supply of mortgage loans. We showed the response exists only amongst treated banks located in treated states. This helped rule out explanations based on an endogenous demand for deregulation. In Section 4, we documented the very same deregulation episodes result in rising house prices. We showed the price response prevails mostly in counties of treated states where the development of new houses is physically limited, and continues to exist between neighboring counties on either side of a state border. In both Sections, we stressed a causal mechanism going from deregulation to the supply of mortgage credit, and from deregulation to the price of housing.

We now investigate whether the expansion in credit triggered by deregulation *causes* the response of house prices. We do so by combining the intuitions from equations (1) and (2). In particular, we perform an instrumental variable (IV) estimation of

$$\ln H_{c,t} - \ln H_{c,t-1} = \delta_1 \left(\ln L_{c,t} - \ln L_{c,t-1}\right) + \delta_2 \left(\ln X_{c,t} - \ln X_{c,t-1}\right) + \alpha_c + \gamma_t + \varepsilon_{c,t}, \quad (3)$$

where $\ln L_{c,t} - \ln L_{c,t-1}$ is instrumented by the deregulation episodes, i.e.

$$\ln L_{c,t} - \ln L_{c,t-1} = \beta_1 D_{s,t-1} + \beta_2 \left(\ln X_{c,t} - \ln X_{c,t-1}\right) + \alpha_c + \gamma_t + \varepsilon_{c,t}, \quad (4)$$

The notation is unchanged. Equation (3) continues to include conventional controls for house price dynamics. We perform the IV estimation on the reduced sample of border counties. The system formed by equations (3) and (4) investigates econometrically the relevance of branching deregulations to account for the cross-section in the growth rate of mortgage variables $L_{c,t}$, and ultimately house prices, $H_{c,t}$.

Table 13 presents regression results for three measures of $L_{c,t}$: the number and volume of loans, and the denial rate. The F-test for weak instruments evaluates the null hypothesis that the instruments $D_{s,t}$ are excludable from the first stage regression (4). Staiger and Watson (1997) and Stock, Wright and Yogo (2002) recommend the F-statistics should take values above 10, lest the end estimates become unreliable. Branching deregulations satisfy the recommendation in all three specifications in Table 13. The explanatory power of branching deregulations is satisfactory in an instrumental sense: the dispersion in county-level conditions of the mortgage market is well explained by $D_{s,t}$.

Estimates of δ_1 are always significant in Table 13. The expansion of the mortgage market that can be ascribed to bank deregulations has relevant explanatory power for house prices. Growing volume and number of loans, once instrumented by $D_{s,t}$, result in rising house prices. And low denial rates, instrumented by $D_{s,t}$, also affect house prices in a causal sense. The causal link holds unconditionally across all counties, irrespective of the elasticity of house construction, η_c^S. The coefficient estimates in Table 13 imply large economic consequences of branching deregulation on house price growth rates. On impact, full liberalization ($D_{s,t}$ going from 0 to 4) implies the growth rate of house prices increases by 1%.[12] This corresponds to the average response, irrespective of the constructability of housing in the county.

Interestingly, a sample focused on subprime banks implies fundamentally different conclusions. In unreported results, we estimated the system of equations (3)-(4) on subprime banks only. The instrument set never passed the Staiger-Watson test, with F-test close to zero, and δ_1 insignificant.

5 Conclusion

The price of housing is influenced by access to credit, and ultimately by the regulation of financial intermediaries. We establish this claim in a causal sense thanks to the index of bank branching deregulation compiled by Rice and Strahan (2010). We show deregulation increases the number, volume and acceptance rates of mortgage origination. More loans are contracted, but not subsequently securitized. Nor indeed are sub-prime banks clearly more active. Importantly, only treated banks in treated counties respond to deregulation, which rules out explanations for our results based on unobserved shifts in the demand for credit. What is more, such differential effects are sharpened in a sample of metro areas that include counties bordering two or more states.

House prices rise in deregulated counties, and this response is particularly pronounced in counties where the supply of housing is inelastic. We estimate an acceleration in house prices of up to 3 percentage points increase in annual growth. The effect prevails across all U.S counties with house price data, but also for counties neighboring state borders. There, unobserved determinants for house prices presumably change continuously across the border, and the focus is squarely on the consequences of bank deregulation on house prices. The

[12] Using column 1 in Tables 5 and 13, house prices growth rates increase by $\exp(0.063 \times 0.032 \times 4) \simeq 1.01$.

channel that goes from deregulation to house prices works via the response of mortgage credit supply.

We offer three conjectures to account for the results. After deregulation, banks opened new branches, and collected more deposits. With more loanable funds, the supply of credit expanded and more borrowers became eligible for credit. Alternatively, deregulation triggered more bank competition. Loan costs fell and the terms of credit improved, so that more borrowers got access to credit. Third, deregulation meant banks could diversify risk, geographically. In all three cases, credit supply expands, with, as we have shown, sizeable consequences on the demand for houses and ultimately their price. In this paper, we have established the empirical relevance of such causal mechanisms.

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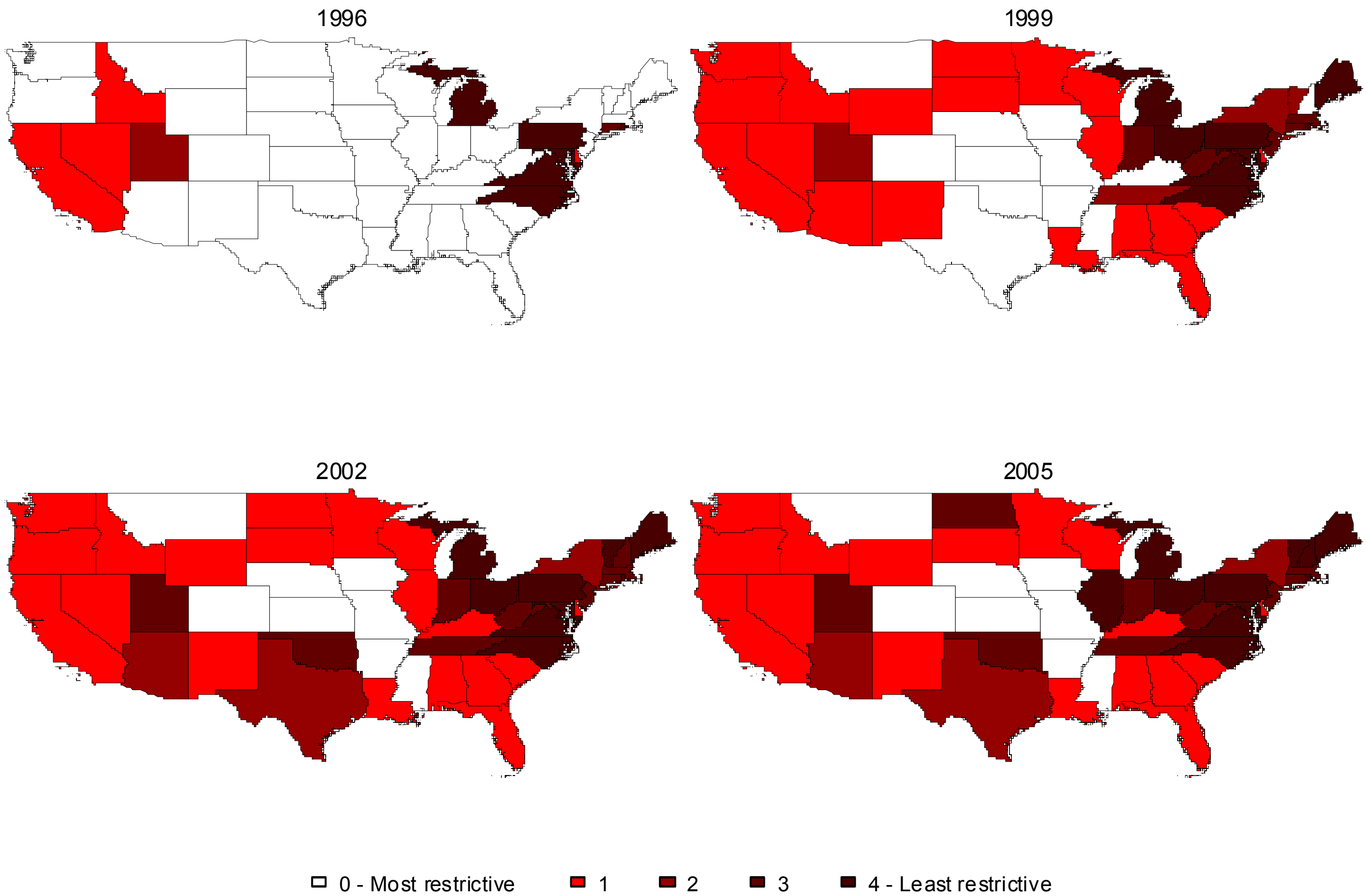
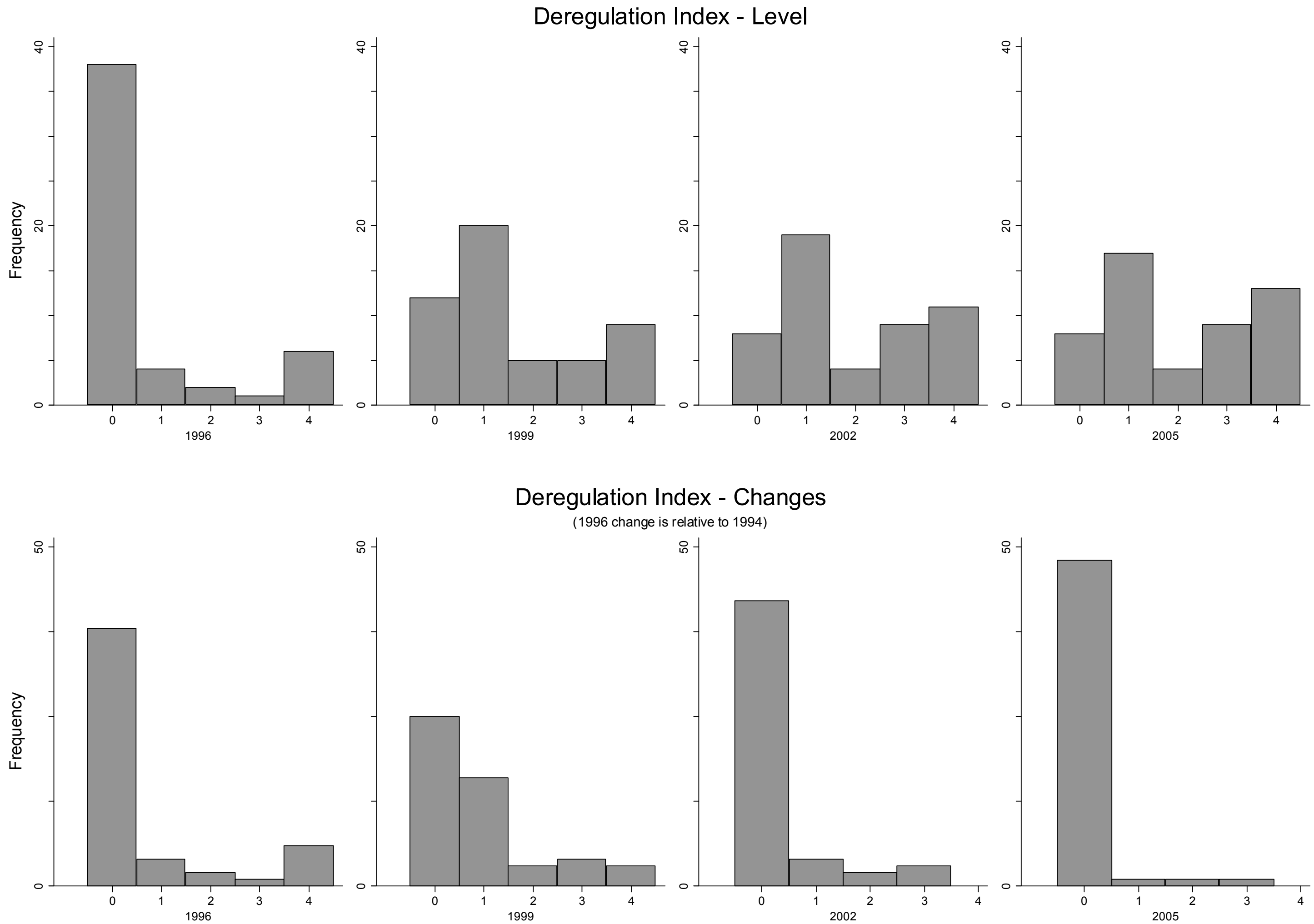
Figure 1. Rice-Strahan index of interstate branching deregulation (by state and year)



Source: Rice & Strahan (2010)

Figure 2. Rice-Strahan index of interstate branching deregulation: level (upper panel) and 3-year changes (lower panel)



Source: Rice & Strahan (2010)

Figure 3. Full sample of 1054 urban counties

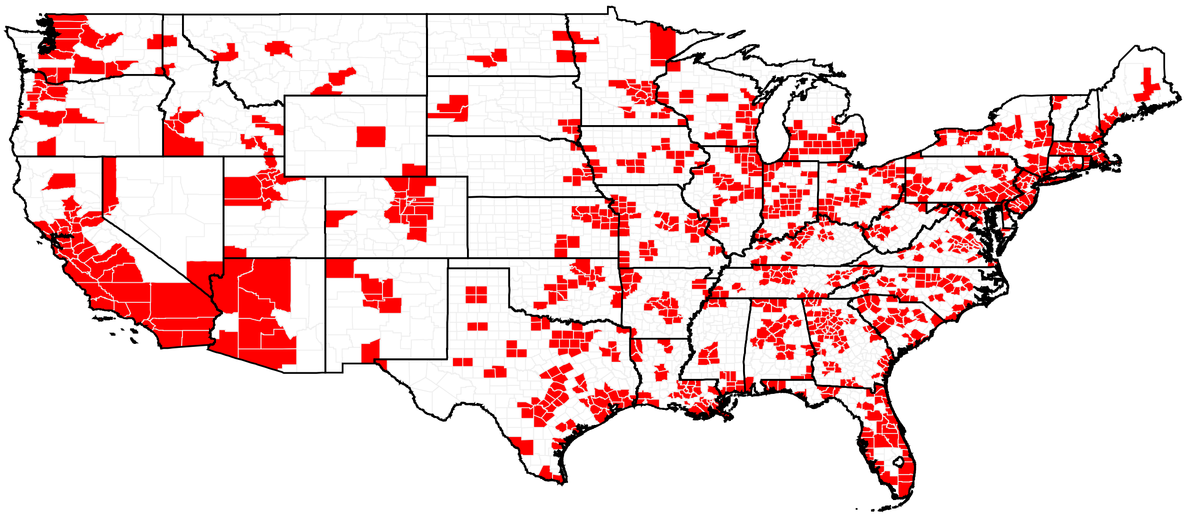
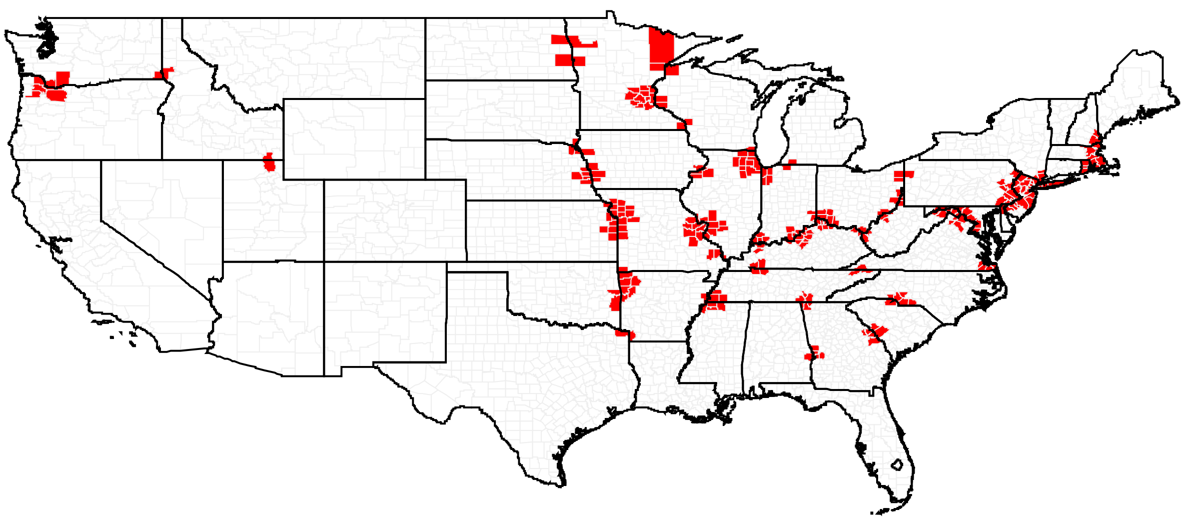


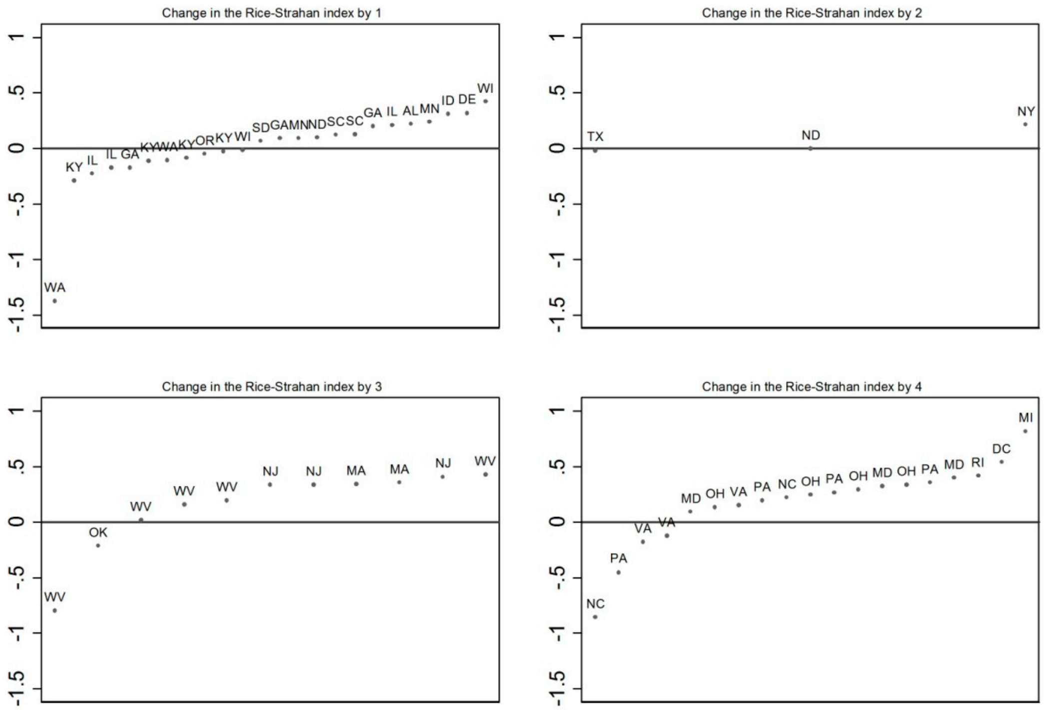
Figure 4. Sample of 248 urban counties in MSAs bordering two or more states



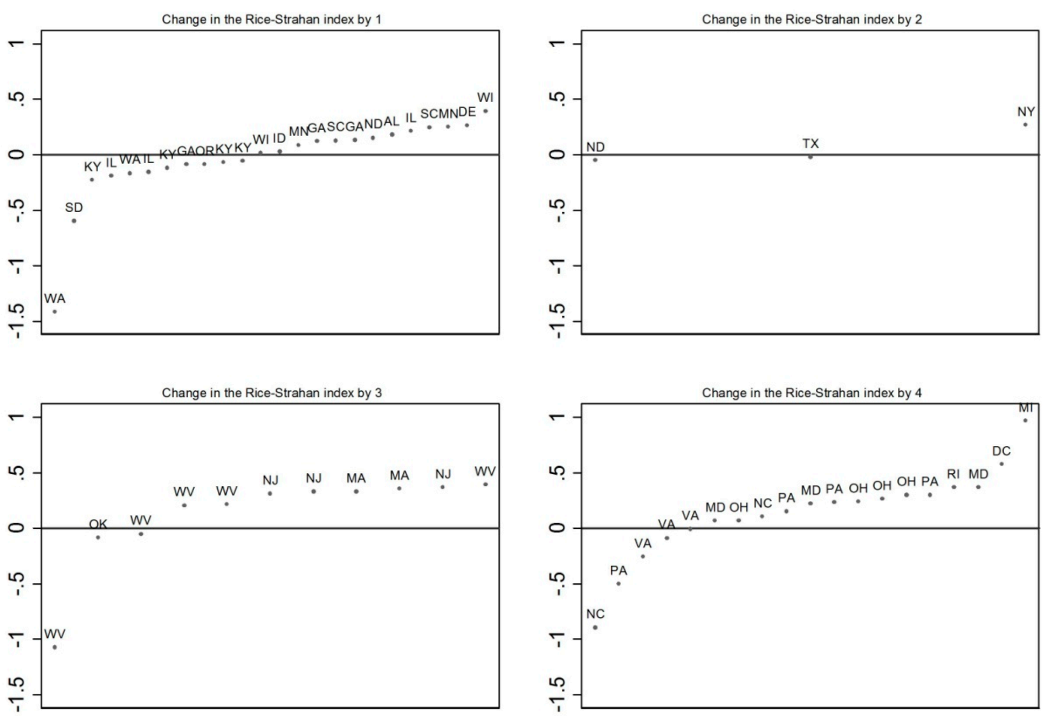
Source: HMDA and Moody's Economy.com

Figure 5. Change in the 3-year mean growth rate of mortgage variables and house prices before and after interstate branching deregulation. Treated states are deregulating states; control states are fully regulated states.

A. Number of loans originated

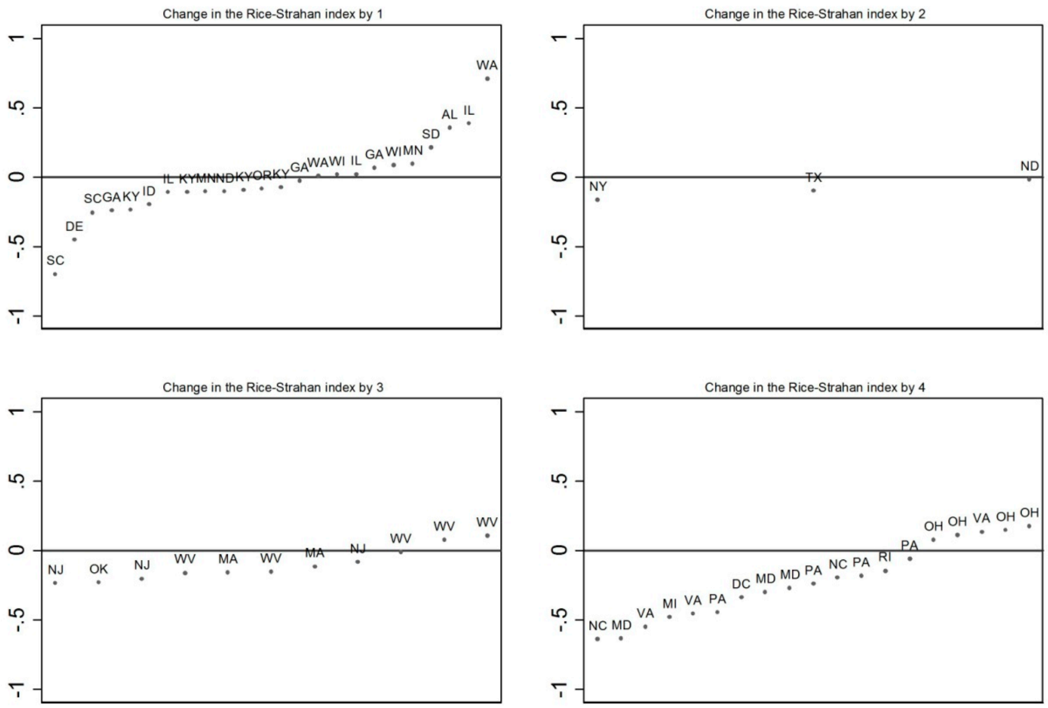


B. Volume of loans originated

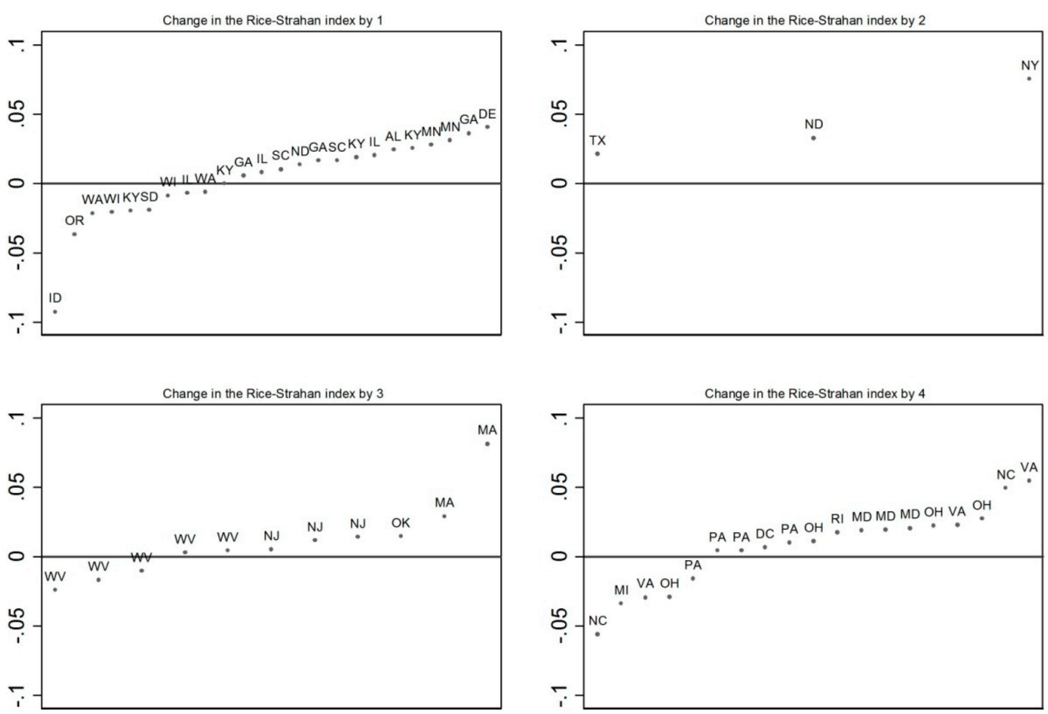


Continued

C. Denial rate



D. House prices



Sources: Rice & Strahan (2010), HMDA, Moody's Economy.com

Table 1. Conventional and FHA insured loans by commercial banks and independent mortgage companies

Mean values of county-year pooled data for conventional (Panel A) and FHA (Federal Housing Administration) insured mortgage loans (Panel B). Loans are for purchase of single-familiy owner occupied houses. Lenders are commercial banks and independent mortgage companies. The sample includes 1054 US counties in urban areas for which mortgage data is available for the period 1994-2005

	A.Conventional Loans			
	Full sample 1994-2005	1995	2000	2005
	Number of Applications Received			
Commercial banks	980	531	1136	2340
Independent mortgage companies	595	384	600	1348
	Number of Loans Originated			
Commercial banks	812	444	849	1968
Independent mortgage companies	408	261	396	1026
	Average Loan Originated (thousand of dollars)			
Commercial banks	90	72	89	137
Independent mortgage companies	78	56	80	112

	B. FHA Insured Loans			
	Full sample 1994-2005	1995	2000	2005
	Number of Applications Received			
Commercial banks	158	116	189	95
Independent mortgage companies	161	173	179	64
	Number of Loans originated			
Commercial banks	134	104	166	80
Independent mortgage companies	144	158	155	56
	Average Loan Originated (thousand of dollars)			
Commercial banks	86	64	82	117
Independent mortgage companies	85	67	79	112

Table 2. Description of Variables and Data Sources

Variable name	Variable description	Source
Index of interstate branching deregulation	Index of US interstate branching deregulation for commercial banks based on restrictions to: (1) de novo interstate branching, (2) acquisition of individual branches, (3) statewide deposit cap and, (4) minimum age of the target institution. The index ranges from zero (most restrictive) to four (least restrictive). The index is set to zero in 1994, the year of the passage of Interstate Banking and Branching Efficiency Act (IBBEA).	Rice and Strahan (2010)
Number of loans	Number of loans originated for purchase of single family owner occupied houses. County level aggregation of loan level data.	HMDA
Loan volume	Dollar amount (in thousands of dollars) of loans originated for purchase of single family owner occupied houses. County level aggregation of loan level data.	HMDA
Denial rate	Number of loan applications denied divided by the number of applications received. County level aggregation of loan level data.	HMDA
Loan to income ratio	Principal amount of loan originated (in thousands of dollars) for purchase of single family owner occupied houses divided by total gross annual applicant income (in thousands of dollars). County level aggregation of loan level data.	HMDA
Fraction of originated loans securitized	Fraction of loans originated for purchase of single family owner occupied houses sold within the year of origination to other non affiliated financial institutions or government-sponsored housing enterprises. County level aggregation of loan level data.	HMDA
Herfindahl Index	Sum of squared shares of mortgage loans. The shares are based on the number of loans originated by a lender relative to the total number of mortgage loans originated in a county. Loans are for purchase of single family owner occupied houses.	HMDA
House price index	County median price of existing single-family homes, and Case-Shiller-Weiss repeat sales index of existing single-family homes.	Ecomony Moody's.com
Housing supply elasticity	Land-topology based measure of housing supply elasticity.	Saiz (2010)
Income per capita	County personal income per capita.	BEA
Population	County population (in thousands).	BEA

Table 3. Summary Statistics

Summary statistics of county-year pooled data. Except for the index of interstate branching deregulation and the index of housing supply elasticity, summary statistics refer to the annual log change of each variable during the period 1994-2005.

	Mean	SD	Between SD	Within SD	10th pc	90th pc	Number of Counties/ MSAs/States
HMDA DATA -- county data							
Commercial Banks							
Number of loans	0.1269	0.4941	0.1336	0.4760	-0.2102	0.4264	1054
Loan Volume	0.1820	0.5343	0.1422	0.5153	-0.1693	0.5025	1054
Denial rate	-0.0300	0.3690	0.0557	0.3650	-0.4602	0.3681	1054
Loan to income ratio	0.0237	0.1390	0.0256	0.1368	-0.0792	0.1220	1054
Fraction of originated loans securitized	0.0400	0.3397	0.0706	0.3343	-0.2671	0.3643	1054
Herfindahl index of bank concentration	-0.0447	0.3334	0.0739	0.3252	-0.3978	0.2992	1054
Independent Mortgage Companies							
Number of loans	0.0861	0.3915	0.0726	0.3853	-0.3567	0.5205	1054
Loan Volume	0.1423	0.4191	0.0799	0.4120	-0.3251	0.6039	1054
Denial rate	-0.0029	0.3099	0.0440	0.3069	-0.3479	0.3335	1054
Loan to income ratio	0.0251	0.1574	0.0259	0.1554	-0.1162	0.1747	1054
Fraction of originated loans securitized	-0.0045	0.1930	0.0247	0.1915	-0.1753	0.1660	1054
Herfindahl index of mortgage companies concentration	-0.1230	0.3663	0.0679	0.3605	-0.5829	0.2974	1054
Commercial Banks -- prime lenders							
Number of loans	0.1240	0.4899	0.1321	0.4720	-0.2124	0.4253	1054
Loan Volume	0.1791	0.5283	0.1399	0.5097	-0.1724	0.5044	1054
Denial rate	-0.0316	0.3813	0.0562	0.3774	-0.4755	0.3721	1054
Loan to income ratio	0.0236	0.1378	0.0247	0.1357	-0.0797	0.1228	1054
Fraction of originated loans securitized	0.0394	0.3412	0.0769	0.3357	-0.2719	0.3639	1054
Herfindahl index of prime bank concentration	-0.0416	0.3335	0.0744	0.3251	-0.3956	0.2985	1054
Coomercial Banks -- subprime lenders							
Number of loans	0.1869	1.1357	0.3818	1.1042	-1.1708	1.6094	1023
Loan Volume	0.2546	1.2065	0.4309	1.1709	-1.1801	1.7377	1023
Denial rate	-0.0616	0.7595	0.2909	0.7368	-0.9725	0.8473	1008
Loan to income ratio	0.0334	0.5068	0.1909	0.4908	-0.4930	0.5684	1023
Fraction of originated loans securitized	0.0646	1.1449	0.3740	1.1142	-1.2856	1.3863	882
Herfindahl index of subprime bank concentration	-0.0014	0.5024	0.1039	0.4973	-0.6729	0.6931	1044
MOODY'S ECONOMY.COM -- county data							
County median house price index	0.0296	0.0459	0.0173	0.0426	-0.0211	0.0809	1081
Case-Shiller-Weiss house price index	0.0046	0.0887	0.0179	0.0868	-0.0822	0.1072	358
BEA -- county data							
Income per capita	0.0139	0.0491	0.0134	0.0473	-0.0156	0.0453	1081
Population	0.0133	0.0162	0.0137	0.0087	-0.0032	0.0342	1081
STRAHAN and RICE (2010) -- state data							
Index of interstate branching deregulation	1.2631	1.4791	1.0043	1.0863	0	4	51
SAIZ (2010) -- msa data							
Index of housing supply elasticity	2.4454	1.3416	1.3420	0.0000	0.9216967	3.992975	270

Table 4. Interstate branching deregulation and loan decisions of commercial banks and independent mortgage companies

County level linear regressions of the log change in the Number of Mortgage Loans, Volume of Mortgage Loans, Mortgage Denial Rate, Loan to Income Ratio, and Fraction of Originated Loans Sold to other financial institutions and government-sponsored housing enterprises, on the Rice and Strahan (2010) Index of Interstate Branching Deregulation. Each regression includes the following controls: current and lagged log change in county's Income per capita, Population, House Price, and the Herfindahl Index of loan concentration for commercial banks and independent mortgage companies. All variables are defined in Table 1. The sample includes all US counties in urban areas for which mortgage data is available for the period 1994-2005. Panel A reports regression results for mortgage loans originated by commercial banks. Panel B reports regression results for the placebo sample of mortgage loans originated by independent mortgage companies. The index of interstate branching deregulation ranges from 0 (most restricted) to 4 (least restricted). All regressions include county and year fixed effects. Standard errors are clustered by state. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	A. Commercial Banks				
	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Securitized
Index of interstate branching deregulation	0.029***	0.030***	-0.034***	-0.000	0.001
	(0.010)	(0.010)	(0.011)	(0.001)	(0.008)
Observations	11498	11498	11435	11498	11312
N. of counties	1054	1054	1054	1054	1054
N. of MSAs	359	359	359	359	359
N. of states	51	51	51	51	51
R2 within	0.174	0.151	0.183	0.075	0.062

	B. Independent Mortgage Companies				
	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Securitized
Index of interstate branching deregulation	-0.003	-0.003	0.000	0.001	0.000
	(0.008)	(0.008)	(0.005)	(0.003)	(0.003)
Observations	11543	11543	11541	11543	11508
N. of counties	1054	1054	1054	1054	1054
N. of MSAs	359	359	359	359	359
N. of states	51	51	51	51	51
R2 within	0.232	0.190	0.227	0.075	0.044

Table 5. Interstate branching deregulation and loan decisions of commercial banks and independent mortgage companies operating in counties within MSAs that straddle two or more US states

County level linear regressions of the log change in the Number of Mortgage Loans, Volume of Mortgage Loans, Mortgage Denial Rate, Loan to Income Ratio, and Fraction of Originated Loans Sold to other financial institutions and government-sponsored housing enterprises, on the Rice and Strahan (2010) Index of Interstate Branching Deregulation. Each regression includes the following controls: current and lagged log change in county's Income per capita, Population, House Price, and the Herfindahl Index of loan concentration for commercial banks and independent mortgage companies. All variables are defined in Table 1. The sample includes all US counties in MSAs straddling two or more US states, and for which mortgage data is available for the period 1994-2005. Panel A reports regression results for mortgage loans originated by commercial banks. Panel B reports regression results for the placebo sample of mortgage loans originated by independent mortgage companies. The index of interstate branching deregulation ranges from 0 (most restricted) to 4 (least restricted). All regressions include county and year fixed effects. Standard errors are clustered at the state level and the border level. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

A. Commercial Banks

	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Securitized
Index of interstate branching deregulation	0.032**	0.030**	-0.037***	-0.005***	0.005
	(0.012)	(0.013)	(0.012)	(0.002)	(0.012)
Observations	3101	3101	3087	3101	3067
N. of counties	284	284	284	284	284
N. of borders	36	36	36	36	36
N. of states	37	37	37	37	37
R2 within	0.239	0.229	0.187	0.110	0.110

B. Independent Mortgage Companies

	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Securitized
Index of interstate branching deregulation	0.007	0.009	0.004	0.006	-0.001
	(0.014)	(0.012)	(0.008)	(0.004)	(0.006)
Observations	3117	3117	3117	3117	3106
N. of counties	284	284	284	284	284
N. of borders	36	36	36	36	36
N. of states	37	37	37	37	37
R2 within	0.234	0.192	0.234	0.092	0.052

Table 6. Interstate branching deregulation and loan decisions of prime and subprime commercial banks operating in counties of MSAs that straddle two or more US states

County level linear regressions of the log change in the Number of Mortgage Loans, Volume of Mortgage Loans, Mortgage Denial Rate, Loan to Income Ratio, and Fraction of Originated Loans Sold to other financial institutions and government sponsored housing enterprises, on the Rice and Strahan (2010) Index of Interstate Branching Deregulation. Each regression includes the following controls: current and lagged log change in county's Income per capita, Population, House Price, and the Herfindahl Index of loan concentration for commercial banks and independent mortgage companies. All variables are defined in Table 1. The sample includes all US counties in MSAs straddling two or more US states, and for which mortgage data is available for the period 1994-2005. Panel A report regression results for mortgage loans originated by non subprime commercial banks. Panel B reports regression results for subprime commercial banks. Subprime banks are identified using, for each year since 1994, the U.S. Department of Housing and Urban Development (HUD) list of commercial banks that specialize in subprime lending. The index of interstate branching deregulation ranges from 0 (most restricted) to 4 (least restricted). All regressions include county and year fixed effects. Standard errors are clustered at the state level and the border level. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	A. Prime-Mortgage-Loan Commercial Banks				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Securitized
Index of interstate	0.033***	0.030***	-0.037***	-0.006***	0.004
branching deregulation	(0.012)	(0.013)	(0.011)	(0.002)	(0.012)
Observations	3101	3101	3087	3101	3067
N. of counties	284	284	284	284	284
N. of borders	36	36	36	36	36
N. of states	37	37	37	37	37
R2 within	0.234	0.227	0.190	0.106	0.110

	B. Subprime-Mortgage-Loan Commercial Banks				
	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Securitized
Index of interstate	0.074	0.105	-0.108***	0.019	-0.014
branching deregulation	(0.063)	(0.072)	(0.031)	(0.032)	(0.065)
Observations	1719	1791	1589	1791	1129
N. of counties	275	275	275	275	275
N. of borders	36	36	36	36	36
N. of states	37	37	37	37	37
R2 within	0.302	0.230	0.183	0.124	0.558

Table 7. Interstate branching deregulation and loan decisions of non-local and local commercial banks operating in counties of MSAs that straddle two or more US states

County level linear regressions of the log change in the Number of Mortgage Loans, Volume of Mortgage Loans, Mortgage Denial Rate, Loan to Income Ratio, and Fraction of Originated Loans Sold to other financial institutions and government sponsored housing enterprises, on the Rice and Strahan (2010) Index of Interstate Branching Deregulation. Each regression includes the following controls: current and lagged log change in county's Income per capita, Population, House Price, and the Herfindahl Index of loan concentration for commercial banks and independent mortgage companies. All variables are defined in Table 1. The sample includes all US counties in MSAs straddling two or more US states, and for which mortgage data is available for the period 1994-2005. Panel A report regression results for mortgage loans originated by non local banks. Panel B reports regression results for local commercial banks. A bank is non local if its address is located in a state that is different from the property's address for which a loan application is recorded The index of interstate branching deregulation ranges from 0 (most restricted) to 4 (least restricted). All regressions include county and year fixed effects. Standard errors are clustered at the state level and the border level. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	A. Non Local Commercial Banks				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Securitized
Index of interstate branching deregulation	0.038**	0.036**	-0.034***	-0.009	0.011
	(0.015)	(0.015)	(0.01)	(0.006)	(0.01)
Observations	3101	3101	3087	3101	3067
N. of counties	284	284	284	284	284
N. of borders	36	36	36	36	36
N. of states	37	37	37	37	37
R2 within	0.234	0.227	0.190	0.106	0.110

	B. Local Commercial Banks				
	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Securitized
Index of interstate branching deregulation	0.024	0.017	0.003	-0.013**	-0.038*
	(0.015)	(0.016)	(0.013)	(0.006)	(0.022)
Observations	1791	1791	1589	1791	1129
N. of counties	284	284	284	284	284
N. of borders	36	36	36	36	36
N. of states	37	37	37	37	37
R2 within	0.302	0.230	0.183	0.124	0.558

Table 8. Regressions with lagged dependent variables for interstate branching deregulation and loan decisions of commercial banks and independent mortgage companies operating in counties within MSAs that straddle two or more US states.

County level linear regressions of the log change in the Number of Mortgage Loans, Volume of Mortgage Loans, Mortgage Denial Rate, Loan to Income Ratio, and Fraction of Originated Loans Sold to other financial institutions and government sponsored housing enterprises, on the Rice and Strahan (2010) Index of Interstate Branching Deregulation. Each regression includes the following controls: lagged dependent variable, current and lagged log change in county's Income per capita, Population, House Price, and the Herfindahl Index for loan concentration of commercial banks and independent mortgage companies. All variables are defined in Table 1. The sample includes all US counties in MSAs straddling two or more US states, and for which mortgage data is available for the period 1994-2005. Panel A reports regression results for mortgage loans originated by commercial banks. Panel B reports regression results for the placebo sample of mortgage loans originated by independent mortgage companies. The index of interstate branching deregulation ranges from 0 (most restricted) to 4 (least restricted). All regressions include county and year fixed effects. Standard errors are clustered at the state level and the border level. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

A. Commercial Banks

	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Securitized
Index of interstate branching deregulation	0.025**	0.025**	-0.027**	-0.004	-0.003
	(0.011)	(0.012)	(0.012)	(0.003)	(0.015)
Lag dependent variable	-0.056**	-0.091***	-0.368***	-0.324***	-0.335***
	(0.024)	(0.027)	(0.022)	(0.037)	(0.026)
Observations	3071	3071	3035	3071	3015
N. of counties	284	284	284	284	284
N. of borders	36	36	36	36	36
N. of states	37	37	37	37	37
R2 within	0.220	0.227	0.326	0.235	0.267

B. Independent Mortgage Companies

	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Securitized
Index of interstate branching deregulation	0.004	0.006	0.011	0.007*	0.001
	(0.016)	(0.014)	(0.01)	(0.004)	(0.005)
Lag dependent variable	-0.224***	-0.235***	-0.298***	-0.465***	-0.300***
	(0.037)	(0.036)	(0.032)	(0.026)	(0.021)
Observations	3115	3115	3112	3115	3098
N. of counties	284	284	284	284	284
N. of borders	36	36	36	36	36
N. of states	37	37	37	37	37
R2 within	0.277	0.245	0.303	0.300	0.148

Table 9. 3-year interval regressions of interstate branching deregulation and loan decisions of commercial banks and independent mortgage companies operating in counties within MSAs that straddle two or more US states

County level linear regressions of the log change in the Number of Mortgage Loans, Volume of Mortgage Loans, Mortgage Denial Rate, Loan to Income Ratio, and Fraction of Originated Loans Sold to other financial institutions and government-sponsored housing enterprises, on the Rice and Strahan (2010) Index of Interstate Branching Deregulation. Each regression includes the following controls: current and lagged log change in county's Income per capita, Population, House Price, and the Herfindahl Index of loan concentration for commercial banks and independent mortgage companies. All variables are defined in Table 1. Variables are average over 4 time periods: 93-95, 96-98, 99-01, 02-05. The sample includes all US counties in MSAs straddling two or more US states, and for which mortgage data is available for the period 1993-2005. Panel A reports regression results for mortgage loans originated by commercial banks. Panel B reports regression results for the placebo sample of mortgage loans originated by independent mortgage companies. The index of interstate branching deregulation ranges from 0 (most restricted) to 4 (least restricted). All regressions include county and year fixed effects. Standard errors are clustered at the state level and the border level. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

A. Commercial Banks

	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Securitized
Index of interstate branching deregulation	0.058**	0.058**	-0.095***	-0.003	0.015
	(0.024)	(0.024)	(0.03)	(0.006)	(0.016)
Observations	1116	1116	1111	1116	1095
N. of counties	284	284	284	284	284
N. of borders	36	36	36	36	36
N. of states	37	37	37	37	37
R2 within	0.355	0.340	0.358	0.269	0.317

B. Independent Mortgage Companies

	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Securitized
Index of interstate branching deregulation	-0.001	-0.007	0.008	0.006	0.003
	(0.03)	(0.034)	(0.019)	(0.011)	(0.011)
Observations	1133	1133	1133	1133	1129
N. of counties	284	284	284	284	284
N. of borders	36	36	36	36	36
N. of states	37	37	37	37	37
R2 within	0.397	0.373	0.439	0.327	0.285

Table 10. Interstate branching deregulation and house prices

County level linear regressions of the log change in House Prices on the Rice and Strahan (2010) Index of Branching Deregulation. Control variables include the lagged log change in House Prices, the Elasticity of Housing Supply, the current and lagged log change in county Income per capita, and the current and lagged log change in county Population. All variables are defined in Table 1. In column (1) the sample includes all US counties in urban areas for which mortgage and house price data is available for the period 1994-2005. In columns (2)-(4) the sample is limited to counties in MSAs for which Saiz (2010)'s measure of housing supply elasticity is available. The index of interstate branching deregulation ranges from 0 (most restricted) to 4 (least restricted). All regressions include county and year fixed effects. Standard errors are clustered by state. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	Dependent Variables			
	House Prices			
	(1)	(2)	(3)	(4)
Index of interstate branching deregulation	0.001	0.000	0.014***	0.007***
	(0.003)	(0.003)	(0.004)	(0.003)
Index of interstate branching deregulation × house supply elasticity			-0.006***	-0.004***
			(0.001)	(0.001)
Lagged house price				0.487***
				(0.029)
Income per capita				0.032
				(0.038)
Lagged income per capita				0.106***
				(0.024)
Population				0.453***
				(0.099)
Lagged Population				0.295***
				(0.079)
Observations	12646	10870	10870	9966
N. of counties	1054	907	907	907
N, of MSAs	366	270	270	270
N. of states	51	48	48	48
R2 within	0.131	0.123	0.150	0.380

Table 11. Interstate branching deregulation and house prices in counties within MSAs that straddle two or more US states

County level linear regressions of the log change in House Prices on the Rice and Strahan (2010) Index of Branching Deregulation. Control variables include the lagged log change in House Prices, the Elasticity of Housing Supply, the current and lagged log change in county Income per capita, and the current and lagged log change in county Population. All variables are defined in Table 1. In column (1) the sample includes all US counties in MSAs straddling two or more US states, and for which mortgage and house price data is available for the period 1994-2005. In columns (2)-(4) the sample is limited to counties in MSAs straddling two or more US states and for which Saiz (2010)'s measure of housing supply elasticity is available. The index of interstate branching deregulation ranges from 0 (most restricted) to 4 (least restricted). All regressions include county and year fixed effects. Standard errors are clustered at the state level and the border level. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	Dependent Variables			
	House Prices			
	(1)	(2)	(3)	(4)
Index of interstate branching deregulation	0.006*	0.006*	0.021***	0.012***
	(0.003)	(0.003)	(0.007)	(0.003)
Index of interstate branching deregulation × house supply elasticity			-0.008***	-0.005***
			(0.003)	(0.001)
Lagged house price				0.568***
				(0.065)
Income per capita				0.153***
				(0.057)
Lagged income per capita				0.075
				(0.057)
Population				0.411***
				(0.126)
Lagged Population				0.282
				(0.174)
Observations	3528	3324	3324	3047
N. of counties	294	277	277	277
N. of borders	36	32	32	32
N. of states	37	35	35	35
R2 within	0.291	0.298	0.328	0.558

Table 12. House price distance regressions on the index of branching deregulation. The sample includes county-pair located in MSAs straddling two or more US states

Regressions of the log change in House Prices on the Rice and Strahan (2010) Index of Branching Deregulation by county-pair distance to a state border. Control variables include the lagged log change in House Prices, the Elasticity of Housing Supply, the current and lagged log change in county Income per capita, and the current and lagged log change in county Population. All variables are defined in Table 1. The sample of county-pair is determined by two restrictions: (i) one county belongs to a deregulating state, the other does not , and (ii) the two counties are within a certain mileage of each other. We consider distance increments of 10 miles, with bilateral distance ranging from 0 to above 80 miles. Counties' distance is measured using geographic coordinates of a county centroid to its own state border. The index of interstate branching deregulation ranges from 0 (most restricted) to 4 (least restricted). All regressions include county and year fixed effects. Standard errors are clustered at the state level and the pair level. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	Dependent Variables House Prices								
	Mile-border windows								
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81 +
Index of interstate branching deregulation	0.005	0.016***	0.013***	0.015***	0.013***	0.012***	0.007	0.006	0.005*
	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)	(0.005)	(0.003)
Index of interstate branching deregulation × house supply elasticity	-0.005***	-0.007***	-0.006***	-0.007***	-0.006***	-0.005***	-0.001	-0.001	0.003**
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.004)	(0.001)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	286	2068	2904	2860	2464	2420	1518	858	1112
N. of counties	22	121	163	154	134	125	83	56	42
N. of county-pair	13	94	132	130	112	110	69	39	51
N. of states	13	29	34	29	29	27	18	19	13
R2 within	0.775	0.652	0.589	0.573	0.633	0.596	0.628	0.647	0.648

Table 13. Instrumental variable regressions for house prices in counties within MSAs that straddle two or more US states

Second stage county level linear regressions of an IV specification of the log change in House Prices on the Number of loans or the Loan volume or the Denial rate of commercial banks. Number of loans, Loan volume, and Denial rate are instrumented with the Rice and Strahan (2010) Index of Branching Deregulation. Control variables include the lagged log change in House Prices, the current and lagged log change in county Income per capita, and the current and lagged change in county Population. All variables are defined in Table 1. The sample includes all US counties in MSAs straddling two or more US states, and for which mortgage and house price data is available for the period 1994-2005. All regressions include county and year fixed effects. Standard errors are robust to heteroskedasticity and autocorrelation. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	Dependent Variables		
	House Prices		
	(1)	(2)	(3)
Instrumented Number of loans	0.063**		
	(0.030)		
Instrumented Loan volume		0.068**	
		(0.034)	
Instrumented Denial rate			-0.052**
			(0.023)
Lagged House price	0.553***	0.526***	0.587***
	(0.023)	(0.030)	(0.022)
Income per capita	0.060	0.050	0.090**
	(0.048)	(0.053)	(0.040)
Lagged income per capita	0.061*	0.046	0.072**
	(0.034)	(0.037)	(0.035)
Population	0.029	-0.007	0.246*
	(0.193)	(0.229)	(0.143)
Lagged Population	0.338***	0.260*	0.383***
	(0.125)	(0.141)	(0.123)
First stage F-test of excluded instruments	15.91	11.74	18.45
(p value)	(0.000)	(0.000)	(0.000)
Observations	3101	3101	3087
N. of counties	284	284	284
N. of borders	36	36	36
N. of states	37	37	37