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 mortgage companies that should not be affected by the regulatory change. This sharpens the causal interpretation of our results. Deregulation acts to relax access to mortgage credit, and pushes the demand for house ownership outwards. Interestingly, the fraction of securitized mortgage loans remains unchanged through the process. We find evidence house prices rise with branching deregulation, and particularly in Metropolitan Areas where construction is inelastic for topographic reasons. We document these results in a large sample of counties across the U.S. We also focus on a reduced cross-section formed by counties on each side of a state border, where a regression discontinuity approach is possible. Our conclusions are strengthened.

JEL Classification Numbers: G21, G10, G12

Keywords: Credit Constraints, Mortgage Market, House Prices, Bank Branching.

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1 Introduction

Are asset prices affected by investors' access to credit? The answer is key to the modeling choices that underpin virtually any asset pricing model. A frictionless world implies drastically different pricing kernels than if credit constraints are empirically relevant. Asset prices become highly responsive to fundamentals if access to credit is constrained, and can overreact as demonstrated most prominently by Kiyotaki and Moore (1997). Yet a definitive answer is elusive, because of well known identification issues. The provision of credit is not an exogenous variable. It depends on asset prices themselves, because some of them can be used as collateral. In this paper, we identify exogenous shifts to competition in the banking sector, trace their effects on the size and standards of mortgage loans, and evaluate their end impact on house prices.

Identification rests on regulatory changes to bank branching in the U.S. We focus on post-1994 interstate branching deregulation. Even though interstate banking was fully legal with the passage of the Interstate Banking and Branching Efficiency Act of 1994 (IBBEA), various restrictions have remained available for states to hamper interstate branching. For instance, states are allowed to put limits on banks' size, implementing deposit or age restrictions that effectively prevent interstate branching. Thus, even after the passage of IBBEA, small and large banks have continued to struggle for the control of state-level regulation, as Krozner and Strahan (1999) document they had prior to 1994.

Rice and Strahan (2009) (RS) have constructed an index capturing these effective regulatory constraints. They use the index to instrument the conditions of bank credit supply, and their end effect on firms' financing choices. They show restrictions increase with the proportion of small banks in a state, and decrease with past growth performance. They find no systematic correlation with contemporaneous economic conditions, a result suggestive the index is abstracting from credit demand. Inasmuch as it focuses on politically driven changes in credit supply, the index provides a valuable empirical framework to trace the economic consequences of changes in the availability of credit. In this paper, we merge the deregulation episodes with county-level information on mortgage loans and house prices. Since the index runs until 2005, we are able to inform recent developments in the U.S mortgage and housing markets.

Like RS, Jayaratne and Strahan (1996), or many others, we implement a conventional treatment effect estimation, where identification obtains across states and over time. We use this framework to answer three questions: 1) how 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. Detailed information on the volume and terms of individual mortgage loans has been publicly available since the Home Mortgage Disclosure Act (HMDA), and we make extensive use of these data. County-level house price indexes, in turn, are compiled by Moody's Economy.com. We merge both data sources with RS index of branching deregulation.

We observe mortgage loans at the county level, which affords a large cross section. HMDA reports the number, volume, denial rates, securitization and loan-to-income ratios of mortgage originated both by depository institutions and Mortgage Companies (MC). By definition, MC are not affected by bank branching deregulations, and thus not by the treatment of interest either. 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 mortgage, it would also correlate significantly with the volume and conditions of loans originated by MCs. In fact, our results continue to obtain when we include directly observable controls for the demand for credit, such as lags of income or population growth rates, or indeed changes in house prices.

We also observe county-level house price indices. We ask whether their dispersion across states is significantly related with the chronology of branching deregulation, i.e. whether an exogenous change in the availability of credit has end effects on the price of housing. The price of real estate can of course differ geographically because of the supply of housing. Saiz (2009) has compiled information on local topographic characteristics to capture the amount of developable land in a given area. His measure builds from pre-existing geographic conditions, and is therefore exogenous to the contemporaneous economic context. We ask whether the (exogenous) shift in credit supply has a differential effect on the demand for houses — and ultimately house prices — depending on whether a county is situated in an area where house construction is particularly inelastic. Such differential response once again sharpens the causal interpretation of our results.

In the U.S., counties are grouped into Metropolitan Areas (MSA) that sometimes straddle state borders. These counties provide a focused sub-sample where a regression discontinuity approach is possible. In such a sub-sample, treated and control counties are neighbors, and presumably share other unobserved characteristics. The approach helps put to rest concerns that omitted variable biases plague our estimations. For instance, local amenities, industrial structure or growth performance can impact simultaneously the mortgage markets, house prices and perhaps the dynamics of deregulation as well. We begin to address these

concerns with county-level fixed effects, and attempts to ascertain the exogeneity of branching deregulation. A regression discontinuity approach does so in an exhaustive manner, as *any* local, unobserved county characteristic is held constant in a sample of border counties. We implement the approach for both mortgage and house prices regressions.

We find the number and volume of mortgage loans rise with the deregulation episodes, while denial rates fall. These responses are significant for banks classified as prime lenders, and larger but not always significant for sub-prime lenders. In addition, the effects we identify are not channeled via an increase in the fraction of loans that are securitized. Interestingly, no systematic change is discernible for mortgage loans originated by MCs. All our conclusions are sharpened in a sub-sample formed by counties neighboring a state border.

House prices increase significantly in response to deregulation. The effect prevails holding constant a battery of conventional controls for changes in the price of housing, including population and income growth rates. We also allow for an autoregressive component accounting for potential momentum. Interestingly, the response of house prices is non-linear, as it depends on the constructability at MSA level, captured by Saiz (2009) measure. The unconditional response of house prices to deregulation is barely significant, but it becomes strongly positive and significant with a control for the elasticity of housing supply. In MSAs where constructability is elastic, the effect of branching deregulations is muted. Once again, the results are sharpened in a sub-sample formed by border 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 deregulation episodes. The index passes the conventional tests for weak instruments with flying colors. The result suggests house prices respond to a lifting of credit constraints, triggered by an exogenous increase in the supply of mortgage credit. Credit constraints matter for house prices, and branching regulations affect the access to (mortgage) credit.

Our results that the volume and number of mortgage loans increase with branch deregulation stands in apparent contrast with RS. They find price effects but no overall quantity response. Bank debt rises, but not total borrowing by firms. RS focus on bank loans contracted by firms with fewer than 500 employees. They conclude the lack of a response in overall firm borrowing underlines the possibly ambiguous impact of competition in the banking sector, because of adverse selection or the destruction of privileged relationships. Banks choose to ration credit to firms, even though borrowing costs have decreased.

In apparent contrast, we find positive end effects in the mortgage market. The number of loans increases and denial rates fall, which suggests a response at the extensive margin. Credit constraints on the mortgage market are relaxed, as borrowers who were denied a loan become eligible after the deregulation. But we observe mortgage lending on the part of banks, not debtors' overall portfolios. It is entirely possible overall household debt remains unchanged, as borrowers reallocate their debt towards mortgage loans. That would mimic exactly what RS find for firms, that resort increasingly to bank credit in response to the deregulation. No data on the financial terms of mortgages are available, so it is not possible to explore whether the financial terms of mortgage respond to the deregulation in the same way RS document loans to firms have.

In short, we observe the supply side of the mortgage market (banks), whereas RS observe the demand side of the credit market (firms). Our findings are not a contradiction with theirs, as our purpose is different. We seek to establish whether the relaxation of a credit constraint *in the mortgage market* has consequences on house prices. We remain agnostic as regards the implications our results have on the effect of banking competition on overall household debt and bank lending efficiency. They could be identical to what RS conclude.

Our finding that branching deregulations have an effect on house prices suggests at least some equilibrium asset prices are distorted by limits to the availability of credit. Because of the average size of the investment relative to available income, and its indivisibility, the purchase of a house is a top candidate for a transaction that is affected by the existence of credit constraints. A house is the ultimate big ticket item, and its purchase almost always necessitates some borrowing. Our findings are therefore natural, but do not generalize naturally to other assets. They do however confirm the findings in Mian and Sufi (2009a, 2009b) that improved credit availability facilitates access to house ownership, with end effects on house prices. Mian and Sufi (2009a) stress the role of securitization. The effects we uncover on the mortgage market do *not* work via heightened securitization. In fact, the deregulation index provides an instrument to changes in the mortgage market, and in house prices, that purges out the effects of securitization. Insofar as RS find the index to be exogenous to contemporaneous economic conditions, it opens the door for sharp causal interpretations. Changes in securitization, in contrast, potentially depend on (expected) developments on the real estate market.

That deregulation should account for a sizeable proportion of the change in the mortgage market since 1994 in an instrumental variable sense is useful. It suggests bank branching regulations impose quantitatively important constraints on the availability of mortgage loans,

and ultimately on the demand for houses. Since branching deregulation is distinct from securitization, and since it does not correlate with contemporaneous economic conditions, it provides an instrument for changes in the supply of mortgage credit. Branching restrictions, and the ensuing market structure in mortgage loans, contribute to explaining in a causal sense the geographic dispersion in house price dynamics 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 restrictions on the mortgage market, and in Section 4 we describe the effect on house prices. We also examine both mechanisms jointly in the context of an instrumental variable estimation. Section 5 concludes.

2 Data

The U.S banking sector has gone through decades of regulatory changes regarding geographic banking and branching restrictions. In this paper, we focus on branching restrictions. Even though some states had permitted interstate branching prior to it, it is with the passage of the IBBEA in 1994 that the formal deregulation of bank branching across state borders was finalized. Bank Holding Companies (BHC) could then formally open branches across state borders without any formal authorization from state authorities. RS argue forcefully states did still impose rules or limits after 1994, that de facto have hampered interstate branching. Even though the IBBEA authorized free interstate branching, it also made allowances for restrictions on the way it can be implemented. RS point to four such restrictions, explicit in the IBBEA itself. States can restrict (i) the minimum age of the branching bank, (ii) de novo branching, (iii) the acquisition of individual branches, and (iv) the total amount of deposits statewide.

According to restriction (i), states can still demand a minimum age for the acquiring bank – that cannot exceed five years. Restriction (ii) stipulates that the opening of new branches requires explicit agreement by state authorities. Restriction (iii) imposes that an interstate merger involving several branches rather than the whole target bank must be agreed explicitly by the state. Finally, the deposit cap allows states to limit the total amount in insured depository institutions that are controlled by a single bank or BHC. All four restrictions are likely to affect the intensity of competition in the banking sector, as RS describe thoroughly. They introduce a time varying index capturing the implementation of each of the four restrictions across the U.S. states. The index takes values between 0 and 4, and runs between 1993 and 2005.

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. Under the Act, any depository institution must report HMDA data if it has originated or refinanced a home purchase loan, and if its assets are above an annually adjusted threshold. Non-depositary institutions also must report if their house purchase loans portfolio exceeds 10 millions USD. HMDA data cover information on the borrowing individual (race, ethnicity, income), the loan's characteristics (response, reason for denial, amount - but not the interest rate), and the lending institution.

We aggregate the HMDA dataset up to the county level. We keep track of the number and volume of loans originated in each county for purchase of single family owner occupied houses. Loan volume is the total dollar amount aggregated at county level. We compute a denial ratio, given by the number of loan applications denied divided by the number of applications received. We also obtain the fraction of originated loans that are securitized. They are defined as loans originated and sold within a year to another financial institution or a government-sponsored housing enterprise. Finally, a loan to income ratio is computed as the principal dollar amount of originated loan divided by total gross annual applicant income. Importantly, the numerator is a flow variable, and captures only imperfectly the depth of individuals' indebtedness. The five variables are computed between 1993 and 2005.

County level house price indexes are circulated by Moody's Economy.com. The series starts in the 1970's, and refers 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 prices index from the Office of Federal Housing Enterprise Oversight (OFHEO). The sample covers metropolitan counties, where Moody's Economy.com index tracks annual changes in house prices. A prominent alternative would be to use the Case-Shiller index (CS), which does also provide county-level information. Unfortunately, coverage includes 383 counties only, as against 1047 for the data we use in the main text. We have verified our conclusions continue to hold when we implement our estimations on the CS data, in spite of the heavily reduced sample of counties.

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, between 1993 and 2005. Income per capita is converted in real dollars using the national Consumer Price Index from the Bureau of Labor Statistics. Finally, we take the index of house constructability from Saiz (2009). 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 slightly reduced relative to the rest of our data, but it still covers all metropolitan areas with more than 500,000 inhabitants with available satellite data.

Table 1 lists the variables contained in our dataset, along with their definitions and data sources. Table 2 reports some summary statistics. We separate out loans characteristics originated by conventional banks, mortgage companies, and for banks classified as prime or sub-prime by their regulatory agencies. We have data for $1,047$ counties. 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 3.5% per year. Denial rates fall on average by 2.8%, while loan to income ratios rise by 2.4%. During the same period the Herfindahl index, a measure of market concentration for mortgage loans, falls by 5%. For each measure, volatility comes mostly from time variation, rather than dispersion across counties. On the whole, the mortgage market developed less on average for mortgage companies, with loans numbers and volume expanding less, and denial rates remaining virtually unchanged. In contrast, the sub-prime mortgage market expanded faster on average than prime banks, across all four measures we observe. Sub-prime lenders are not active in all counties, although they are in most. Such average trends are indicative of differential dynamics across market categories. But of course they are silent about geographic dispersion since they are merely first moments.

House prices increased at an average annual rate of 2.94% between 1994 and 2005, more than twice faster than 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 growth. RS index of branching deregulation is observed at the state level. On average, the index equals 1.26, so that the average state is relatively restrictive, with almost three out of four possible restrictions effectively implemented. Dispersion in the index comes from both state and time variation, which will help identification. Finally, Saiz index of housing supply elasticity is available for 93 MSAs only, or 485 counties.

3 Branching Regulation and Mortgage Credit

Regulations on the geographic expansion of U.S. banks have long been used to characterize the economic role of financial intermediation. Thanks to a history of sequential relaxation in both banking and branching regulations, U.S states provide a useful laboratory to study

the consequences of changes in the market structure of the banking sector. Jayaratne and Strahan (1996, 1998), or Stiroh and Strahan (2002) have for instance argued the lifting of within and between state banking regulations has resulted in observable changes in the degree of competition amongst banks. With deregulation, banks have improved efficiency, and lowered non-interest costs. The quality of lending has increased, with lower loan prices, lower loan losses, and revamping of the overall banks performance. But the regulatory changes in the banking sector are found to have had little significant impact on the quantity of credit borrowed by firms, even though they have observably enhanced competition amongst banks.

Such a non-result is usually explained by the specific consequences of competition in banking. With less market power, banks find it harder to develop privileged relations with individual borrowers, which acts to worsen issues of asymmetric information (see Petersen and Rajan, 1995). With more entry, issues of adverse selection become more pressing, so that banks respond by rationing credit (see Broecker, 1990, Marquez, 2002). The supply of credit to firms does not rise, even though competition in the sector has sharpened. Rice and Strahan (2009) confirm the conclusion continues to hold for bank lending to firms, even after 1994, in the most recent period with available data.

We take inspiration from the empirical approach in this literature. We trace the consequences of deregulation in the banking sector on the mortgage market. We depart from most of the literature in focusing on a specific type of bank lending, mostly aimed at households proposing to acquire real estate property. Identification is conventional and akin to a treatment effect, where deregulated states are treated. Thanks to the established fact branching deregulation has had mostly political determinants, treatment is exogenous to local economic conditions (see Kroszner and Strahan, 1999). We estimate

$$\Delta L_{c,t} = \beta_1 D_{s,t} + \beta_2 \Delta X_{c,t} + \alpha_c + \gamma_t + \varepsilon_{c,t}, \tag{1}$$

where c denotes county-level and s denotes state-level data. $\Delta L_{c,t}$ is one of the five measures of activity on the mortgage market we observe: growth in the number and volume of mortgages by county, changes in the denial rate, in the loan to income ratio, and in loan securitization. $\Delta X_{c,t}$ summarizes county-specific controls, which in practice include current and past growth rates in income per capita, population and house prices, and changes in the Herfindahl index of concentration in the mortgage market. Identification rests on the dispersion across states (and time) of deregulation, captured by $D_{s,t}$. The variable $D_{s,t}$ aggregates the four elements of de facto restrictions to interstate branching compiled by RS, and takes

values between 0 and 4.

The controls in $\Delta X_{c,t}$ help ascertain 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. Following RS, the Herfindahl index holds constant potential county-level heterogeneity in the competition on the mortgage market. It brings the focus on the dispersion across *states* that is caused by differences in branching restrictions. We focus on the consequences of deregulation on the growth of the mortgage market, which sets non-stationarity concerns to rest. As the estimation is in growth rates, it implicitly removes any county-specific determinants of mortgage loans that are constant over time. In addition, the intercept α_c controls for any county-specific time trend, and γ_t accounts for the overall U.S. credit cycle. Since deregulation is state-specific but loans are observed for each county, standard errors are clustered at the state level (see Bertrand, Duflo and Mullainathan, 2004).

Table 3 presents the results. Panel A focuses on loans originated by depository banks. The first three columns reveal the number of loans and their overall county value both increase significantly with deregulation, while denial rates fall. All three estimates suggest the actual size of the mortgage market expands, through a relaxation of the (non-interest) terms of the loans originated. Borrowers that were not eligible before the deregulation become so afterwards. The point estimate for β_1 in the first column implies that states where branching is de facto unfettered experience an annual rate of growth in originated loans 12 percent higher than states that impose full restrictions. The loan to income ratio, however, does not increase with deregulation. But the measure should be taken with a grain of salt, since it represents the ratio of debt flow to income. HMDA does not collect information on the total level of indebtedness of borrowers. So our measured loan to income ratio may not correlate significantly with deregulation, even while overall indebtedness increases as a fraction of income.

The last specification in Table 3 suggests β_1 is not different from zero for the proportion of originated loans that are resold to other financial institutions or government-housing sponsored enterprise, within the year. In other words, the increase in the overall size of the mortgage market is not accompanied by an increase in securitization. Banks originate more mortgages, but apparently not with the purpose of contracting credit risk that they propose to immediately diversify away onto other intermediaries. A shift in the supply of mortgage credit is observable in response to branching deregulation, but not because mortgage securitization became rampant at the same time.

A shift in the supply of mortgage loans is entirely compatible with unchanged overall

household debt level. Just as RS found firms increased bank debt in response to deregulation, but not their overall borrowing, it is possible more households contract a mortgage, while keeping their overall indebtedness constant. HMDA only reports loans originated: no information is available about the stock of debt on the demand side. A definite confirmation of RS's conclusions on the mortgage market is therefore not an option.

Panel B in Table 3 reports estimates of equation (1) for loans originated by Mortgage Companies (MCs). These institutions are unaffected by changes in branching regulations, that affect depository institutions only. We find deregulation has no effect on the lending practices of MCs. In particular, the point estimates of β_1 are observably closer to zero for MCs than for other lenders, up to an order of magnitude smaller. There is a differential effect of branching regulations across categories of lenders. This 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 3.

The absence of any significant consequence of deregulation in a placebo sample is also laying to rest the possibility that β_1 is significant because overall economic activity has accelerated with the deregulation. For instance, Jayaratne and Strahan (1996) show increased efficiency in the banking sector has boosted state-level economic growth. Black and Strahan (2002) estimate that new business formation has increased following banking reform. Morgan, Rime and Strahan (2004) find that deregulation has reduced the volatility of state-level business cycles, as cross-state banking helps insulate each state from shocks to its own banking system. But such systematic response of the local economy to deregulation episodes cannot explain a differential response across lenders. The deregulation only affected mortgage loans originated by affected banks, not the whole mortgage market.

In Table 3, equation (1) is estimated on the full sample of $1,047$ counties with available data. Table 4 focuses instead on the sample formed by counties on each side of a state border. We select in our data (35) MSAs that straddle a state border, and estimate equation (1) on the thus chosen sample of (248) border counties. Our purpose is to implement a regression analysis that identifies the effects of branching deregulation using the discontinuity in branching restrictions at state borders. The main assumption is that control variables in equation (1) – observed or unobserved – vary continuously around the border. Then, an estimation focused on a local area around the border holds constant all co-variates, including unobserved ones. The local sub-sample thus provides a rigorous treatment of a potential omitted variable bias.

A regression discontinuity framework is important in the current instance, most notably in relation to the recent finding in Huang (2008). Huang repeats the estimation in Jayaratne and Strahan (1996) on a sub-sample of contiguous counties. He finds the differential growth effects Jayaratne and Strahan document in response to intrastate banking deregulation prevail mostly in the early 80's, and for a few states only in later years. In other words, it is important to ascertain our conclusions hold true universally, for some of the literature has concluded otherwise as far as growth effects are concerned.

Table 4 reports regression-discontinuity estimates of equation (1) for depository institutions, and MCs. To account for spatial autocorrelation corresponding to potential border specific developments, standard errors are now clustered at the state *and* the border levels. We use the multi-way clustering approach introduced in Cameron, Gelbach, and Miller (2006) and Petersen (2009). As before, we find the number and volume of mortgage loans originated by depository institutions increase significantly, and denial rates fall. There is no change in the fraction of loans that are securitized. All these responses continue to be inexistent for loans originated by MCs. In other words, the differential effect documented in Table 3 survives a discontinuity regression approach. The mortgage market expands in counties that deregulate, while their immediate untreated neighbor sees no change in the size of the market. What is more, only treated banks respond.

Finally, Table 5 repeats the regression discontinuity estimation. But it is now performed on two samples chosen according to a classification of banks riskiness. Each year, the Department of Housing and Urban Development (HUD) examines the overall risk content of banks portfolios, and issues a classification between prime and sub-prime 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 5 reveal some differences. Panel A, focused on prime banks, implies estimates virtually identical to Table 4, 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. The comparison ought to be taken with a grain of salt, as estimates are imprecise in the sample of subprime banks. But Table 5 does suggest a heterogeneous response to deregulation on the part of subprime banks. Be that as it may, the Table confirms it is not via securitized lending that the mortgage market expanded with branching deregulations.

4 Credit Supply and the Price of Housing

We first show the lifting of branching restrictions has affected house prices. We then verify the response of mortgage loans is an empirically relevant channel from deregulation to house prices.

4.1 Branching Restrictions and House Prices

The existence of credit constraints alters considerably the pricing kernel of assets, and in particular the impact of fundamentals on asset prices, as demonstrated for instance in Kiyotaki and Moore (1997). Because of indivisibility constraints and the usual magnitude of the investment relative to disposable income, the purchase of a house is probably amongst the transactions most likely to be affected by a constrained access to credit. And the exogenous relaxation of such constraints should therefore affect the price of houses. For instance, Stein (1996), or Ortalo-Magné and Rady (2006) introduce theories where this happens. In both models, downpayments, or other borrowing constraints, add a self reinforcing mechanism to housing demand shocks. In Ortalo-Magné and Rady (2006), as more credit becomes available to first-time house buyers, the demand for and prices of starter homes increase. Thanks to the ensuing capital gain, households that already own a house see their access to credit improve, and choose to move up the property ladder. The number of transactions increases and so do house prices. As the removal of geographic restrictions on bank branching increases the supply of mortgage loans, it should shift up the demand for housing, along with its price.

A burgeoning literature has taken interest in the end effects of innovation in the financial sector on house prices. Dell'Ariccia, Igan and Laeven (2008), Keys, Mukherjee, Seru and Vig (2009) and Mian and Sufi (2009) find the securitization of mortgage loans has been associated with worsened lending standards, and an expansion in mortgage credit. In particular, Mian and Sufi show that the expansion of mortgage credit was particularly pronounced in U.S cities with high home price appreciation. These papers argue that the peak in mortgage lending to subprime borrowers has played an important role in explaining the recent house price booms. Securitization facilitates access to credit, and therefore to property as well. But that happens at the expense of the risk profile of the marginal borrower.

Our contribution relative to this literature is two-fold. First, securitization is likely to respond endogenously to (unobserved) changes in credit demand. The empirical link between

house prices and securitization can therefore conflate the effects of shocks to both the supply and demand sides of the credit market. Branching deregulation, in contrast, affects only the supply size of the credit market. Second, the channel we identify is effectively distinct from loan securitization. The increase in the supply of mortgage loans that we document occurs independently of a rise in the fraction of securitized loans. The exogenous shift in credit supply exists holding securitization constant.

It is well known house prices display considerable geographic heterogeneity in the U.S. Such heterogeneity can arise from differences in constructability, for instance because of local costs or land use regulation (see Gyourko and Saiz, 2006; Gyourko, Saiz and Summers, 2006). But it can also come from the demand side of the market, simply because income per capita and population are geographically heterogeneous in the U.S. Thus, Glaeser and Gyourko (2007, 2008), Stein and Lamont (1997), or Case and Shiller (1989) all control for the possibility house prices vary at the city level, and include MSA-specific intercepts whenever relevant. Here, we propose an explanation to the geographic heterogeneity of house prices, because of differences in the availability of credit across states. We hold constant county-level effects, with adequate intercepts. If state-specific regulations continue to be significant, that means the geographic dispersion of house prices in the U.S has a state component – which happens to correlate significantly with bank branching regulations.

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

$$\Delta H_{c,t} = \beta_1 D_{s,t} + \beta_2 D_{s,t} \cdot \eta_c^S + \beta_3 \Delta X_{c,t} + \beta_4 \Delta H_{c,t-1} + \alpha_c + \gamma_t + \varepsilon_{c,t}, \tag{2}$$

where c denotes county-level and s denotes state-level data. The variable $D_{s,t}$ continues to denote the deregulation index compiled by RS. $\Delta H_{c,t}$ is the county house price index put together by Economy.com, and $\Delta X_{c,t}$ summarizes additional determinants of house prices documented in the literature. For instance, Glaeser and Gyourko (2007, 2008) include rents as an independent variable, while Stein and Lamont (1997) 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 growth rates in per capita income and population. In addition, following Case and Shiller (1989), we allow for momentum in house prices, with a lagged dependent variable. We experimented with more than one lag, with no consequences on our results. Once again,

we perform regressions on first-differenced variables to put non-stationarity concerns to rest. We include county and year effects, which holds constant country-wide cycles and county-specific trends in house prices. The focus is squarely on the state-level dispersion in real estate prices. Standard errors are once again clustered at the state level.

The coefficient of interest is β_1, that traces the consequences on real estate prices of deregulation episodes. Even though $D_{s,t}$ affects exogenous change in the supply of credit, the end effect on house prices can reflect county-specific developments on the supply of houses. Unconditionally positive estimates of β_1 can be significant because deregulating states happen to be ones where house construction is severely restricted. Estimates of β_1 would be significant, but not because expanding mortgage credit stimulates the demand for housing. We need to hold constant the supply of houses in equation (2). We do so thanks to the index of topographic constructability put together by Saiz (2008), which we denote by η_c^S. The variable is effectively observed at the MSA level, so we actually assume the topography is the same across the counties that form the Metropolitan Areas Saiz considers. We expect $\beta_2 < 0$, as house prices should respond less to the lifting of credit constraints in counties with plentiful constructable land.

Table 6 presents our estimates of equation (2) for different control sets. Unconditional estimates of β_1 are insignificant, whether they are obtained from the total sample of counties with house price information (column 1), or we constrain the sample to counties where η_c^S is available (column 2). Interestingly, β_1 becomes positively significant 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 6. It is only in counties with a topography that makes house construction difficult that deregulations affect house prices significantly. Their effect is muted elsewhere.

Controls for population and income growth do not alter the impact of deregulation on house prices. It is difficult to think of shocks to the demand for credit that do not correlate with per capita income or population growth, but do correlate with $D_{s,t}$. Especially given the evidence in the previous section that deregulation only affects treated banks in treated states.

The results in Huang (2008) help assuage further such a concern for an omitted variable bias. Using counties bordering a state frontier, Huang concludes there are relatively few instances where banking deregulations have had differential growth effects. This is especially true of the most recent period. In other words, the border discontinuity in per capita income

growth rates is minimal in the recent time period. Income per capita growth rates are on the whole not affected by the border, and therefore not by the most recent deregulation chronology either. Observed or unobserved controls in equation (2) thus presumably vary continuously around state borders. A regression discontinuity estimation will help account for potential omitted controls. Table 7 presents the results. Interestingly, all coefficients become larger in magnitude, with unconditionally positive and significant estimates of β_1. When an interaction term involving η_c^S is included, estimates for β_1 roughly double in magnitude, and continue to be significantly positive. Estimates of β_2, in turn, continue to be negative and significant.

These results suggest the relaxation of branching regulations have a causal impact on house prices at the county level. The end effect, however, depends on the elasticity of housing supply. We classify a county as "highly elastic" if it falls in the top 10% MSAs according to η_c^S, and "highly inelastic" if it falls in the bottom 10%. On the basis of column 4 in Table 7, house prices do not react in highly elastic counties. But in highly inelastic counties, the lifting of branching restrictions increases the growth rate of house prices by 5 percent per year. This is a large number, considering the mean change in real house prices over the 1994-2005 period is 3%. A natural interpretation of such estimates is that bank branching deregulations affect the supply of mortgage credit, relax credit constraints in the housing market, and shift the demand for houses upwards. The next section investigates rigorously the empirical validity of this channel.

4.2 The Credit Channel

In Section 3 we document a significant effect of branching deregulations on the supply of mortgage loans. We show the response only exists amongst treated banks located in treated states. This rules out explanations based on an endogenous demand for deregulation, which would have to arise from both mortgage companies and treated banks located in the same county. In Section 4, we document the very same deregulation episodes result in rising house prices. We show the price response prevails mostly in treated counties where the constructability of houses is physically limited, and continues to exist between neighboring counties on either side of a state border. In both Sections, we stress a causal mechanism going from deregulation to the supply of mortgage credit, and from deregulation to the demand for housing.

We now investigate whether the expansion in credit triggered by deregulation is a quantitatively relevant reason for the response of house prices. We do so combining the intuitions

from equations (1) and (2). In particular, we perform an instrumental variable (IV) estimation of

$$\Delta H_{c,t} = \delta_1 \Delta L_{c,t} + \delta_2 \Delta X_{c,t} + \delta_3 \Delta H_{c,t-1} + \alpha_c + \gamma_t + \varepsilon_{c,t}, \tag{3}$$

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

$$\Delta L_{c,t} = \beta_1 D_{s,t} + \alpha_c + \gamma_t + \varepsilon_{c,t}, \tag{4}$$

The notation is unchanged. Equation (3) continues to include conventional controls for house price dynamics. We stack the deck against finding a quantitatively important role for deregulation, as equation (4) only proposes to explain the cross-section in $\Delta L_{c,t}$ with the RS index $D_{s,t}$. In addition, 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 $\Delta L_{c,t}$, and ultimately in house prices.

Table 8 presents regression discontinuity results for three measures of $\Delta L_{c,t}$, the number of loans, their volume 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) recommend the F-test should take values above 10, lest the end estimates become unreliable. Branching deregulations satisfy the recommendation in all three specifications in Table 8. 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 8. High 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. Thus, the deregulation-induced fraction of $\Delta L_{c,t}$ affect the price of houses significantly. Interestingly, a sample focused on subprime banks implies fundamentally different conclusions. In unreported results, we estimate the system of equations (3)-(4) on sub-prime banks only. The instrument set never passes the Staiger-Watson test, with F-test close to zero, and δ_1 is insignificant.

All in all, we have evidence relaxation of credit constraints on the prime mortgage market is caused by branching deregulations. There is no such response in the credit supplied by subprime banks. Such improved access to credit markets causes an increase of house prices, in a quantitatively significant manner. We conclude the pricing of housing is affected by the relaxation of credit constraints.

5 Conclusion

The price of housing is influenced by constrained access to credit. We establish this claim in a causal sense thanks to an index of bank branching deregulation compiled by Rice and Strahan (2009). 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 regression discontinuity estimation.

House prices rise in deregulated counties, and this response is particularly pronounced in counties where the supply of housing is inelastic. This holds true 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 with distance from the border, and the focus is squarely on the consequences of state deregulation on house prices. The channel that goes from deregulation to house prices works via the response of mortgage credit supply. It is because the lifting of branching restrictions relaxes the conditions for mortgage origination that the price of housing increases.

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Figure 1: Full sample of (1047) US counties

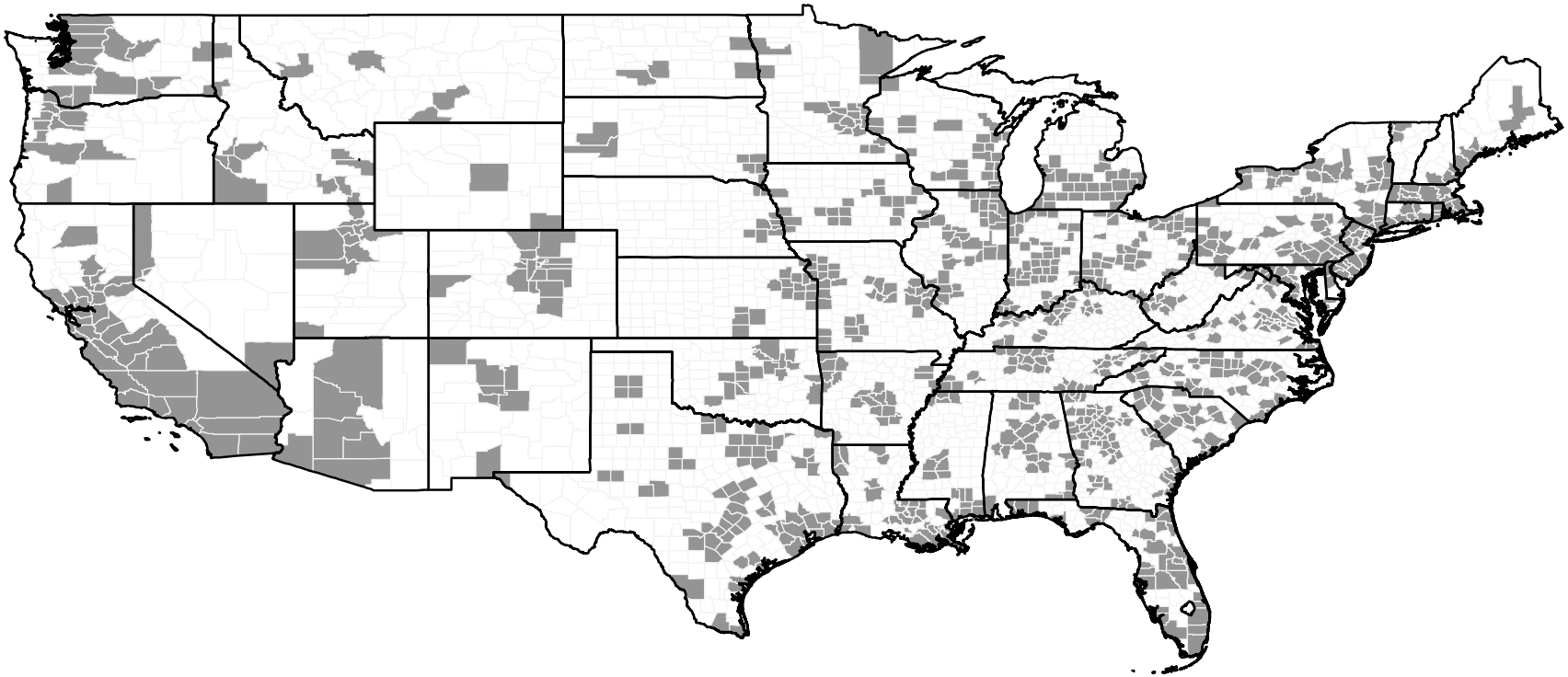

Figure 2: US counties (248) in MSAs bordering two or more states

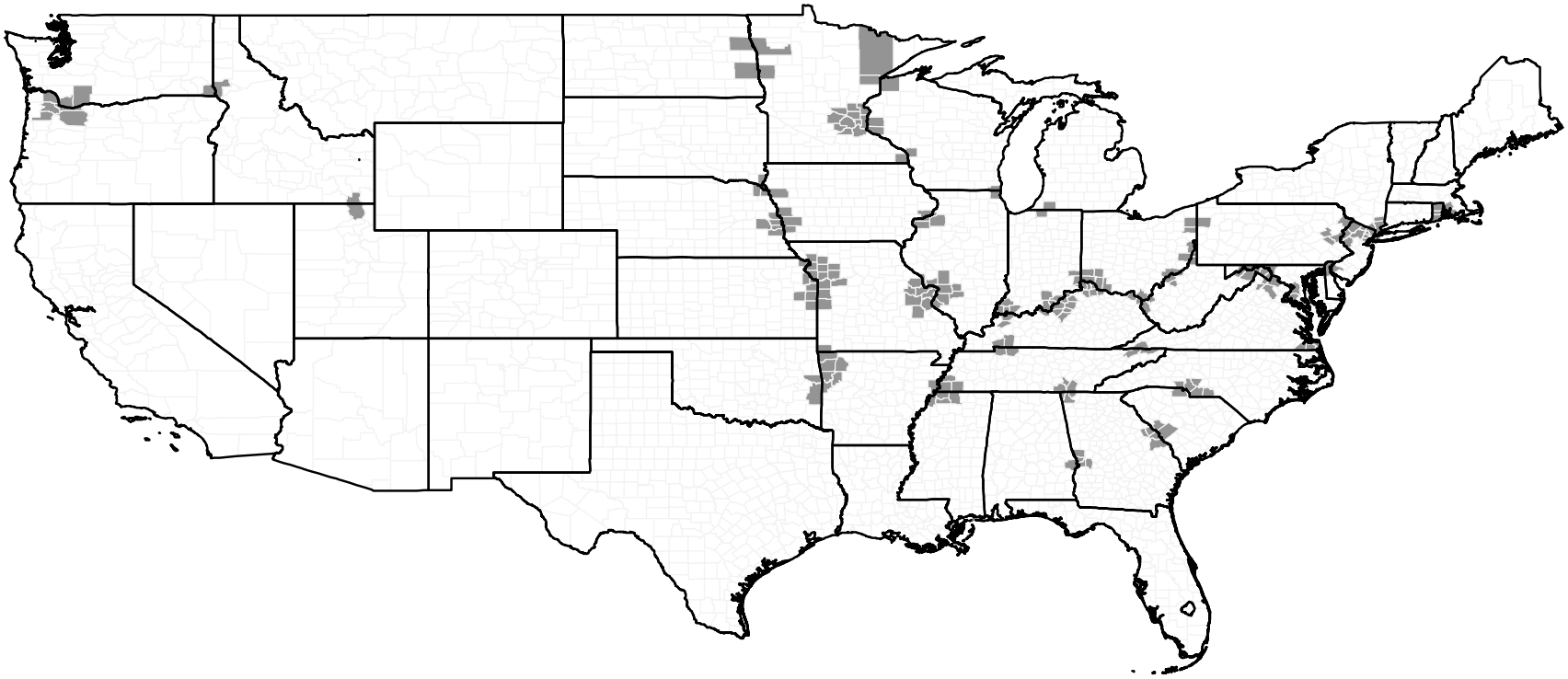

Table 1. Description of Variables and Data Sources

Variable name	Variable description	Source
Index of interstate branching deregulation	Index of US interstate branching deregulation based on no limits 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 (less restrictive). The index is set to zero in 1993, the year before the passage of the 1994 Interstate Banking and Branching Efficiency Act (IBBEA).	Rice and Strahan (2009)
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 loans sold	Fraction of loans originated for purchase of single family owner occupied houses sold within the year of origination to another financial institution or a 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.	Ecomony Moody's.com
Housing supply elasticity	Land-topology based measure of housing supply elasticity.	Saiz (2008)
Income per capita	County income per capita	BEA
Population	County population (in thousands)	BEA

Table 2 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 1993-2005.

	Mean	SD	Between SD	Within SD	10th pc	90th pc	Number of Counties/ MSAs/States
HMDA DATA -- county data							
Banks							
Number of loans	0.1302	0.4890	0.1324	0.4710	-0.2039	0.4321	1047
Loan Volume	0.1847	0.5239	0.1398	0.5051	-0.1376	0.1902	1047
Denial rate	-0.0280	0.3681	0.0553	0.3642	-0.4473	0.3633	1047
Loan to income ratio	0.0245	0.1244	0.0245	0.1221	-0.0666	0.1126	1047
Fraction of loans sold	0.0346	0.3164	0.0600	0.3116	-0.2299	0.3144	1047
Herfindahl index of bank concentration	-0.0475	0.3349	0.0739	0.3267	-0.4055	0.2980	1047
Mortgage companies							
Number of loans	0.0861	0.3923	0.0726	0.3862	-0.3575	0.5219	1047
Loan Volume	0.1424	0.4198	0.0797	0.4127	-0.3968	0.3533	1047
Denial rate	-0.0031	0.3103	0.0440	0.3073	-0.3481	0.3333	1047
Loan to income ratio	0.0243	0.2060	0.0269	0.2043	-0.1265	0.1821	1047
Fraction of loans sold	-0.0047	0.1514	0.0175	0.1504	-0.1349	0.1266	1047
Herfindahl index of mortgage companies concentration	-0.1233	0.3669	0.0680	0.3610	-0.5837	0.2974	1047
Banks prime lenders							
Number of loans	0.1278	0.4870	0.1312	0.4692	-0.2070	0.4317	1047
Loan Volume	0.1823	0.5204	0.1380	0.5020	-0.1398	0.1895	1047
Denial rate	-0.0295	0.3798	0.0563	0.3761	-0.4657	0.3714	1047
Loan to income ratio	0.0244	0.1229	0.0231	0.1209	-0.0680	0.1134	1047
Fraction of loans sold	0.1449	0.4874	0.1186	0.4734	-0.2325	0.3171	1047
Herfindahl index of prime bank concentration	-0.0448	0.3357	0.0745	0.3274	-0.4042	0.2985	1047
Banks subprime lenders							
Number of loans	0.1865	1.1352	0.3829	1.1035	-1.1787	1.6094	1015
Loan Volume	0.2545	1.2050	0.4321	1.1692	-1.2855	1.6511	1015
Denial rate	-0.0617	0.7614	0.2918	0.7385	-0.9760	0.8473	1000
Loan to income ratio	0.0358	0.4814	0.1885	0.4648	-0.4426	0.5279	1015
Fraction of loans sold	0.2326	1.1952	0.4026	1.1535	-1.0117	1.0986	950
Herfindahl index of subprime bank concentration	-0.0015	0.5029	0.1039	0.4977	-0.6729	0.6931	1036
MOODY'S ECONOMY.COM -- county data							
House price index	0.0294	0.0455	0.0171	0.0421	-0.0212	0.0799	1047
BEA -- county data							
Income per capita	0.0139	0.0497	0.0135	0.0479	-0.0157	0.0453	1047
Population	0.0134	0.0162	0.0137	0.0087	-0.0032	0.0342	1047
STRAHAN and RICE (2009) -- state data							
Index of interstate branching deregulation	1.2631	1.4791	1.0043	1.0863	0	4	51
SAIZ (2009) -- msa data							
Index of housing supply elasticity	1.7517	0.8042	0.8048	0.0000	0.83	2.82	93

Table 3. Interstate branching deregulation and loan decisions of banks and no-bank 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 another financial institution or a government-sponsored housing enterprise, on the 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 for banks or mortgage companies concentration. 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 1993-2005. Panel A reports regression results for mortgage loans originated by commercial banks and savings institutions. Panel B reports regression results for the placebo sample of mortgage loans originated by non-bank 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. Depository Banks

	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Sold
Index of interstate branching deregulation	0.030***	0.026***	-0.036***	0.001	0.005
	(0.008)	(0.006)	(0.011)	(0.002)	(0.006)
Observations	11,351	11,439	11,293	11,351	11,212
N. of counties	1,046	1,046	1,046	1,046	1,046
N. of MSAs	372	372	372	372	372
N. of states	51	51	51	51	51
R2 within	0.135	0.138	0.179	0.087	0.072

B. Mortgage Companies

	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Sold
Index of interstate branching deregulation	0.004	-0.008	0.001	0.006	-0.002
	(0.008)	(0.007)	(0.005)	(0.008)	(0.003)
Observations	11,439	11,397	11,438	11,439	11,420
N. of counties	1,046	1,046	1,046	1,046	1,046
N. of MSAs	372	372	372	372	372
N. of states	51	51	51	51	51
R2 within	0.233	0.138	0.227	0.180	0.493

Table 4 Interstate branching deregulation and loan decisions of banks and no-bank 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 another financial institution or a government-sponsored housing enterprise, on the 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 for banks or mortgage companies concentration. All variables are defined in Table 1. The sample includes all US counties of 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 and savings institutions. Panel B reports regression results for the placebo sample of mortgage loans originated by non-bank 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

	A. Depository Banks				
	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Sold
Index of interstate branching deregulation	0.032*** (0.012)	0.023*** (0.007)	-0.041*** (0.015)	0.002 (0.004)	0.002 (0.013)
Observations	2,687	2,685	2,673	2,687	2,664
N. of counties	248	248	248	248	248
N. of borders	35	35	35	35	35
N. of states	36	36	36	36	36
R2 within	0.201	0.205	0.183	0.143	0.126

	B. Mortgage Companies				
	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Sold
Index of interstate branching deregulation	-0.002 (0.016)	-0.007 (0.013)	0.004 (0.009)	0.006 (0.009)	-0.003 (0.005)
Observations	2,709	2,699	2,706	2,709	2,702
N. of counties	248	248	248	248	248
N. of borders	35	35	35	35	35
N. of states	36	36	36	36	36
R2 within	0.236	0.119	0.221	0.217	0.054

Table 5 Interstate branching deregulation and loan decisions of prime and subprime 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 another financial institution or a government-sponsored housing enterprise, on the 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 for prime or sub-prime bank concentration. All variables are defined in Table 1. The sample includes all US counties belonging to MSAs straddling two or more US states, and for which mortgage data is available for the period 1993-2005. Panel A report regression results for mortgage loans originated by non subprime commercial banks and savings institutions. Panel B reports regression results for subprime commercial banks and saving institutions. Subprime banks are identified using, for each year since 1993, the U.S. Department of Housing and Urban Development (HUD) list of 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 Banks

	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Sold
Index of interstate branching deregulation	0.033***	0.023***	-0.041***	0.002	0.001
	(0.011)	(0.007)	(0.015)	(0.004)	(0.013)
Observations	2,687	2,685	2,673	2,687	2,664
N. of counties	248	248	248	248	248
N. of borders	35	35	35	35	35
N. of states	36	36	36	36	36
R2 within	0.199	0.197	0.188	0.147	0.126

B. Subprime-Mortgage-Loan Banks

	Dependent Variables				
	Number of Loans	Volume of Loans	Denial Rate	Loan to Income Ratio	Fraction of Loans Sold
Index of interstate branching deregulation	0.082	0.101	-0.096**	0.009	-0.038
	(0.055)	(0.060)	(0.039)	(0.022)	(0.041)
Observations	1,322	1,322	1,160	1,322	950
N. of counties	248	240	233	240	240
N. of borders	35	35	35	35	35
N. of states	36	36	36	36	36
R2 within	0.329	0.245	0.202	0.168	0.642

Tab 6 Interstate branching deregulation and house prices

County level linear regressions of the log change in House Prices on the 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 data is available for the period 1993-2005. In column (2)-(4) the sample is limited to counties in MSAs for which Saiz (2008)'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	-0.002	0.015***	0.009***
	(0.003)	(0.003)	(0.005)	(0.004)
Index of interstate branching deregulation × house supply elasticity			-0.009***	-0.006***
			(0.002)	(0.002)
Lagged house price				0.496***
				(0.027)
Income per capita				0.015
				(0.030)
Lagged income per capita				0.015***
				(0.033)
Population				0.472***
				(0.116)
Lagged Population				0.323***
				(0.078)
Observations	12,539	5,806	5,806	5,321
N. of counties	1,047	485	485	484
N, of MSAs	372	93	93	93
N. of states	51	41	41	41
R2 within	0.130	0.134	0.167	0.398

Tab 7 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 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 belonging to MSAs straddling two or more US states, and for which mortgage data is available for the period 1993-2005. In column (2)-(4) the sample is limited to counties in MSAs straddling two or more US states and for which Saiz (2008)'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*	0.009**	0.030***	0.020***
	(0.003)	(0.004)	(0.012)	(0.004)
Index of interstate branching deregulation × house supply elasticity			-0.014**	-0.009***
			(0.007)	(0.002)
Lagged house price				0.553***
				(0.062)
Income per capita				0.206**
				(0.094)
Lagged income per capita				0.097
				(0.069)
Population				0.611***
				(0.164)
Lagged Population				0.496***
				(0.219)
Observations	2,976	1,896	1,896	1,738
N. of counties	248	158	158	158
N. of borders	35	16	16	16
N. of states	36	27	27	27
R2 within	0.271	0.285	0.319	0.560

Tab 8 Interstate branching deregulation and 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 banks. Number of loans, Loan volume, and Denial rate are instrumented with the 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 belonging to MSAs straddling two or more US states, and for which mortgage data is available for the period 1993-2005. 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	0.064**		
	(0.031)		
Instrumented Loan volume		0.091**	
		(0.042)	
Instrumented Denial rate			-0.052**
			(0.022)
Lagged House price	0.542***	0.563***	0.576***
	(0.026)	(0.023)	(0.024)
Income per capita	0.077	0.158***	0.126***
	(0.056)	(0.036)	(0.041)
Lagged income per capita	0.058*	0.081**	0.064*
	(0.035)	(0.036)	(0.036)
Population	0.059	0.298**	0.298**
	(0.202)	(0.134)	(0.151)
Lagged Population	0.302**	0.187*	0.337***
	(0.124)	(0.107)	(0.121)
First stage F-test of excluded instruments	10.70	11.99	23.71
(p value)	(0.001)	(0.000)	(0.000)
Observations	2,701	2,699	2,684
N. of counties	248	248	248
N. of borders	35	35	35
N. of states	36	36	36