Credit Supply, Homeownership and Mortgage Debt

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Abstract

We analyse the effect of credit supply on households' homeownership and home equity outcomes. Banking deregulation together with states' autonomy to limit deregulation provides an exogenous shift in credit supply which shows variation across states and time. We find that a shift from full to no regulation increases the probability of homeownership by one percentage point, and of having a mortgage by two percentage points, explaining up to 43% of the increase in homeownership and the share of households with mortgages. Mortgage debt increases by up to 20%. Household leverage and debt exposure measured as debt to income ratio increase slightly for households outside of MSAs.

JEL classification: G21, G28, R21, R31

Keywords: Banking deregulation; Housing demand; Mortgage; Household debt; Credit supply; Homeownership; Household finance

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1 Introduction

The United States have experienced two major housing booms in the post WW2 period. During the first boom, between 1940 and 1960, the homeownership rate increased from 44 percent to 62 percent. After a long stable period, it started to rise again in the early 90s, from 64 percent in 1994 to 69 percent in 2004 (see Figure 1). Although the role of policy-induced credit availability in the first boom is also substantial,[1] the later boom benefited from a combination of homeownership promoting policy initiatives,[2] changes in the structure of the mortgage market and ever increasing house prices. All these developments spurred on a dramatic increase in the availability of mortgage credit and relaxed lending standards which created a feedback cycle in house prices and in the likelihood of becoming a homeowner.[3] The later part of this cycle in the early 2000s and the subsequent housing crash which triggered the Great Financial Crisis in 2008 have received vast attention. Discussions about the causes and the consequences of the so called "housing bubble" are still ongoing.[4]

Homeownership rates in the United States hovered around 64 percent in the 1980s and in early 1990s. From 1994 it started to increase steadily and reached its peak in 2004 where it reversed course back to its pre-boom levels.[5] This boom episode coincided with a major reform in the US banking system: The Interstate Banking and Branching Efficiency Act (henceforth IBBEA) of 1994 enabled banks to operate across state boundaries. However, states retained rights to enforce/remove a list of barriers for interstate branch entries which allow us to exploit IBBEA as an exogenous shift in credit supply. We analyze the effect of deregulation-induced credit supply on household homeownership and mortgage decisions between 1996 and 2005 using micro data from

[1] Fetter (2013) argues that the self-amortizing long-term fixed rate mortgage with lower down payments, introduced by the Federal Housing Administration, was a major factor in this increase.

[2] See Goodman and Mayer (2018) and Olsen and Zabel (2014) for an overview of housing policy developments.

[3] Agarwal et al. (2015) show that individuals who experience higher house price growth in their neighborhood become homeowners earlier. This is consistent with the survey evidence in Case et al. (2012) that demonstrates the role of expectations in future house price growth. For a theoretical argument see Kaplan et al. (2020).

[4] See Mian and Sufi (2009), Glaeser et al. (2013), Foote et al. (2016), Adelino et al. (2016), Di Maggio and Kermani (2017), and Saadi (2016) for thorough discussion.

[5] Most of the previous research has focused on the later parts of this boom episode as most of the plausible risk indicators — i.e. interest rates, mortgage-backed securities boom, loan-to-value, and price-to-rent ratios etc. — showed little or no sign of alarm until the beginning of the 2000s.

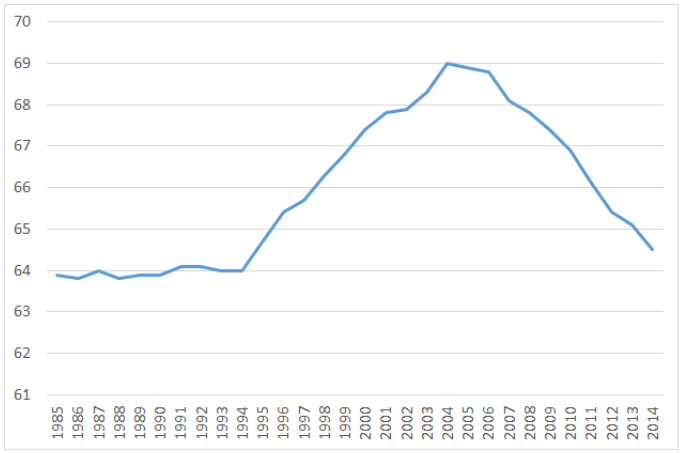

Figure 1: Homeownership rate in the United States. Source: U.S. Census

the Survey of Income and Program Participation (SIPP). The panel nature of the SIPP allows us to condition on fixed individual characteristics, hence we estimate the effect of a change in credit supply on changes in households' housing tenure and mortgage debt decisions.

IBBEA of 1994 made several provisions through which states could limit the entry of out-of-state banks. Rice and Strahan (2010) use the observation that some states chose to enforce these provisions while others lifted some or all of them over time. They construct a time-varying interstate branching deregulation index capturing these differences in regulatory constraints between 1994 and 2005. Following deregulation, states with lower barriers to entry experienced an increase in the share of interstate branches (Johnson and Rice, 2008) and supply of bank branches overall (Célerier and Matray, 2019). Moreover, this branching expansion constituted a major shock to the housing market: it increased mortgage supply both in originations and volume (Favara and Imbs, 2015). This rise in mortgage supply fueled housing demand and increased house prices. The previous literature has also shown that this index is unrelated to other real economic variables such as local economic growth, employment and wages (Célerier and Matray, 2019). We follow these papers in using the interstate branch deregulation index as an exogenous measure of credit supply, and analyze individual housing and mortgage decisions over the course of 2 to 4 years.

We find that credit supply induced by interstate branching expansion increases the likelihood of being a homeowner and having a mortgage. This result is more prominent among individuals residing in metropolitan areas (MSAs) which seem to benefit from a surge in credit as documented in Favara and Imbs (2015). Moreover, the effect is especially strong for young households, highlighting the life-cycle nature of the housing decision as pointed out in Agarwal et al. (2015), Fisher and Gervais (2011) and Attanasio et al. (2012). Low income households, on the other hand, do not seem to benefit from this credit expansion. The estimates suggest that a standard deviation change in deregulation (corresponding to a change by 1.4 index points) increases the probability of homeownership by 0.36 percentage points. The probability of having a mortgage increases by 0.70 percentage points. The implied effect of going from full to no regulation is an increase in the probability of homeownership by 1 percentage point and of having a mortgage by up to 2 percentage points. This suggests that not only do renters become homeowners due to this expansion of credit, but also outright homeowners take out loans on their houses. Our benchmark estimates are able to explain one fifth to one half of the aggregate rise in the homeownership rate and the share of mortgagors in the housing boom period.

We then show that the increases in the likelihood of being a homeowner and holding mortgage exclusively come from high income individuals (approximately 75% of individuals fall in this category). For young and low income individuals, who are more likely to have poor labor market prospects and no savings, the effect of deregulation is even negative in some specifications. More detailed analysis suggests that lower-middle income individuals have the highest increase in homeownership. These results resemble findings of Tewari (2014) who studies the effect of the removal of *intrastate* branching restrictions in the 1980s. Similarly, she finds that after the removal of these restrictions young and lower-middle income households' homeownership likelihood increased.

Finally, we separately analyse individuals who already own a home and investigate the effect of credit supply on mortgage debt, home values, and leverage as measured by debt-to-value and

debt-to-income as in Leth-Petersen (2010), Mian et al. (2013), and Sodini et al. (2016). We find that refinancing existing mortgages was only partially affected by this increase: only households that live outside of MSAs extended further mortgage debt. This suggests that deregulation-induced credit supply enabled individuals to access home-equity loans. On the other hand, in line with Mian and Sufi (2009), we observe that low income individuals experienced an increase in debt-to-home value ratio. Finally, we find that the increase in debt-to-income ratio only appears in non-MSAs and the magnitude of the effect is not large.[6]

The papers closest to ours are Tewari (2014), Favara and Imbs (2015) and Célerier and Matray (2019) in that they use branching deregulation to investigate the effects of credit supply on housing markets and households' investment and financial access decisions. However, our paper is distinct from these and the wider literature on finance and housing in the following ways. First, we use individual level panel data which substantially mitigates concerns with regards to selection of individuals into certain locations and its correlation with regulatory differences between states. While Tewari (2014) and Célerier and Matray (2019) also use individual-level data, they do not control for individual fixed effects. We argue in section 3 that a within-person analysis of the effect of credit supply is meaningful and adds to the knowledge base in the literature. Note also that the focus of Célerier and Matray (2019) is on access to finance while our interest is in housing related outcomes. Second, the individual level data enable us to analyze the effect of credit supply on different locations (MSAs vs. non-MSAs), demographics (young vs. old) and income groups (low income vs. high income). Tewari (2014) considers similar demographics, but her analysis focuses on intra-state deregulation in the 1980s. The context of inter-state deregulation however is distinct in that both ownership rates as well as house prices increased much more in the 1990s than in the 1980s. Third, we quantify the contribution of deregulation triggered by IBBEA to the overall rise in homeownership and mortgagor shares. Tewari (2014) conducts a similar exercise for the 1980s, and

[6]This also reinforces the finding that credit supply increases due to interstate branching deregulation do not affect economic development in terms of income and unemployment as in Célerier and Matray (2019).

Favara and Imbs (2015) quantify the impact of the IBBEA to house price changes. Furthermore, not uniquely but in contrast to the wider literature, our focus is on the evolution of ownership and mortgage credit in the earlier period of the housing boom rather than the period just before or around the start of the Great Recession in the late 2000s.

Favara and Imbs (2015) and Célerier and Matray (2019) use the same deregulation episode (IBBEA) and find that deregulation-induced credit supply increased for-purchase mortgage loan originations, house prices and financial access of low income households. Along similar lines, we observe an increase in homeownership and mortgage likelihoods in deregulated states. Moreover, we find that deregulation enhances access to home equity loans in non-MSAs and for low income households in MSAs. Tewari (2014) uses the intrastate deregulation episode in the 1980s and investigates its consequences on household homeownership distribution. She finds that following the removal of intrastate branching restrictions mortgage lending increased by 5 percent and homeownership increased by 2 percent. This effect is particularly strong for young, black and lower-middle income households. Using the interstate branching expansion we find that very low income individuals do not become more likely to be homeowners or hold a mortgage, young individuals and lower-middle income groups take advantage of increased credit supply.

The US Housing boom and the subsequent bust in 2008 attracted a lot of attention to the role of credit supply on house prices and homeownership. The increase in credit supply has been attributed to a variety of policy measures such as the Community Reinvestment Act (Saadi, 2016), pre-emption of anti-predatory-lending laws (Di Maggio and Kermani, 2017) and the Interstate Banking and Branching Efficiency Act (Favara and Imbs, 2015). We contribute to this literature using the latter policy as a measure of credit supply and investigate its effects on individual housing tenure and mortgage debt outcomes. While most of this literature focuses on the years 2000 and after, we believe that it is also important to account for the sharp rise in homeownership and mortgagor shares in the 1990s.

Our paper provides empirical insight into the theoretical discussion with regards to the role of borrowing vs. lending constraints in promoting housing tenure decision and household leverage in Justiniano et al. (2019) and Favilukis et al. (2017). Our policy instrument, interstate branching expansion, has been shown to increase local bank competition with higher branch density and lower interest rates (Célerier and Matray, 2019; Rice and Strahan, 2010; Favara and Imbs, 2015). We point out that deregulation-induced competition and geographic diversification gains as argued by Favara and Imbs (2015) could jointly contribute to the expansion of credit.[7] We observe that low income households do not experience an increase in homeownership and for those households that do we do not find a sharp increase in leverage. These findings suggest that the effect of credit supply due to interstate branching would most likely work through a relaxation of lending constraints.

Our paper is further related to the literature that studies homeownership as a decision over the life-cycle. The theoretical models argue that housing demand is strongly related to a large menu of individual and aggregate factors such as marriage, earnings risk, local housing and rental price volatility and credit constraints (Fisher and Gervais, 2011; Attanasio et al., 2012; Sinai and Souleles, 2005; Ortalo-Magne and Rady, 2006). The empirical literature demonstrates that changes in these conditions have more profound effects on young households as they mostly affect the timing of the homeownership decision (Ortalo-Magne and Rady, 1999; Fetter, 2013; Agarwal et al., 2015). Our results suggest that the increase in credit supply due to interstate branching expansion strongly shifted housing and mortgage demand of young households.

Finally, our paper contributes to the discussion on the extent of rising mortgage debt along the income distribution. Mian and Sufi (2009) argue that despite stagnant growth in earnings low-income neighborhoods experienced an uneven increase in mortgage debt in the early 2000s. Adelino

[7]This is especially true in the early stages of expansion as multi-state banks carry their excess liquidity to the new market. Gilje et al. (2016) show that banks that enjoy local liquidity inflows originate new loans in other localities through their branches.

et al. (2012) and Foote et al. (2016) challenge this argument and claim that mortgage growth took place among all income groups. We show that although the deregulation episode does not yield an increase in housing demand for low income individuals in most of the cases, their leverage against home equity rises. Moreover, we also find a slight increase in households' leverage as measured by debt-to-home value and debt-to-income ratios.

2 Background

The housing boom of the 1990s and 2000s has been studied extensively. Earlier papers have attributed the boom to a relaxation of borrowing constraints by households (Kiyotaki et al., 2011; Sommer et al., 2013; Favilukis et al., 2017). In contrast, Justiniano et al. (2019) suggest a slackening of lending constraints as an explanation for the housing boom. A relaxation of lending constraints, they argue, matches four aggregate observations qualitatively and quantitatively: home prices increased and so did household debt. The debt to home value ratio remained stable and mortgage rates fell. In contrast, a relaxation in borrowing constraints should lead to an increase in mortgage rates and consequently a decrease in house prices.

While the aggregate data support the arguments in Justiniano et al. (2019), their calibration exercise does not give a clean identification of how key outcomes are affected by an increase in credit supply as they do not have arguably exogenous and precisely measured variation in credit supply. Instead, they argue that lending constraints have been relaxed by a general increase in available mortgage credit through the spreading use of mortgage-backed securities and other international factors.

One such exogenous change in credit supply has been identified and used by Johnson and Rice (2008) and Rice and Strahan (2010) and subsequent papers (Favara and Imbs, 2015; Célerier and Matray, 2019). They construct an index of banking and branching deregulation based on the In-

terstate Banking and Branching Efficiency Act (IBBEA), passed in 1994, which lifted restrictions on bank expansion across state limits, but gave states some discretion to limit the expansion of out-of-state banks. The act allowed for mainly four provisions to limit bank expansion: 1) setting a minimum age of the target institution for bank acquisitions, 2) prohibiting de-novo branching by out-of-state banks, 3) setting a cap on the state-wide deposit concentration that a merger with an out-of-state bank would create, and 4) prohibiting acquisition of bank branches by an out-of-state bank. The IBBEA is described in detail in Rice and Strahan (2010) who construct an index ranging from 0 to 4, measuring the number of restrictions that a state has in place in a given year to suppress banking competition. We reverse this index and call it deregulation index I for more intuitive interpretation. Thus, I exhibits variation across states, and over time, as states change the provisions that govern inter-state banking.

Historically, the US banking system has placed strict limitations on banks' ability to expand geographically. Since the mid-1970s states gradually loosened restrictions on intrastate and interstate banking. Between 1970 and 1994, 38 states relaxed restrictions on statewide branching. During the same time period, limits on Bank Holding Companies to operate across states were lifted on a reciprocal basis. This wave of branching deregulation was fully completed by the IBBEA of 1994. Johnson and Rice (2008) find that states that lifted restrictions on interstate branching experienced a higher share of interstate branches. Favara and Imbs (2015) demonstrate that interstate branching led to an increase in mortgage loans issued by commercial banks that operate across states. This in turn led to higher house prices. Célerier and Matray (2019) show that an expansion of bank branches triggered by deregulation increased low income households' access to finance.

Previous literature has identified several mechanisms by which interstate branching expansion triggered by the IBBEA can increase credit supply and profitability. Favara and Imbs (2015) argue that banks that operate across states can be more profitable through geographic allocation gains allowing them to serve credit in previously undersupplied markets. Larger, well-run banks are able

to increase their market share and exploit economies of scale. Chu (2018) argues that interstate branching leads to more competition in local credit markets. This further induces an increase in credit supply. While the mechanisms through which interstate branching affect mortgage loans are not mutually exclusive, all these arguments result in an increase in mortgage supply and have similar implications for housing tenure decisions and the household balance sheet. We therefore investigate the effect of interstate branching on homeownership and mortgage debt using individual data.

3 Data and Empirical Strategy

Our empirical models are of the form

$$Y_{ist} = \beta_0 + \beta_1 I_{st} + \beta_2' X_{it} + \beta_3' Z_{st} + c_i + d_{rt} + \epsilon_{ist} \tag{1}$$

where Y is our dependent variable (described below), I is the deregulation index described in the previous section, X is a vector of person characteristics, Z a vector of state characteristics, and the subscripts refer to person i, year t, state s and census region r. We index also by the latter because the regressions include census region–year fixed effects d_{rt}, which capture regional business-cycle effects. We also include individual fixed effects c_i to capture individual traits and characteristics which affect the outcome variable. Throughout the analysis here and henceforth we cluster the standard errors at the state-year level.

Our main coefficient of interest, β_1, measures the effect of a change in 1 index point on the outcome variable. This is obtained as a difference-in-differences estimate with different degrees of treatment. Holding X and Z fixed, for a person living in a state in census-region r which keeps deregulation unchanged, the change in the outcome is simply $d_{r,t+1} - d_{rt}$. For a person living in the same census region but whose state of residence deregulates by one index point, the change in the outcome variable would be $d_{r,t+1} - d_{rt} + \beta_1$. The inclusion of person fixed effects implies

that identification of the coefficients rests on within-person variation of the variables. This is important because previous research has demonstrated that owners and renters have substantially different demographic and economic characteristics. They also differ substantially in unobserved ways. Taşkın and Yaman (2019), for instance, show that owners are more likely to be married, with children, better educated, older and with higher household incomes. Moreover, ownership rates between states exhibit large differences. Individual fixed effects allow us to control for these large level differences that would otherwise dominate the decision of being a homeowner. Thus, β_1, is inherently identified by comparing changes in outcome Y for people living in a state where I changes to changes in outcome Y for people in another state in the same region where I does not change.

Data We use data from the Survey of Income and Program Participation (SIPP), in particular the 1996, 2001, and 2004 panels. The SIPP is described in detail elsewhere,[8] so we highlight its features relevant to our study. The SIPP is a panel study covering three (the 2001 panel) to four (the 1996 and 2004 panels) years. Individuals are surveyed every four months. A battery of core questions are asked for each wave. In addition, each wave contains a changing topical module which can cover topics such as well-being, health, fertility history, and assets and liabilities. The assets and liabilities module is included in every third wave of the panels and forms the basis for our variables relating to mortgage characteristics. After merging the assets and liabilities module with the corresponding wave of the core data we obtain a panel at annual frequency — we do not use the waves whose topical modules did not cover assets and liabilities.[9] The sample is completely renewed with each new SIPP panel so that, even though our data span ten years, each person is observed for no more than four years.

[8]Data are available online: http://www.nber.org/data/survey-of-income-and-program-participation-sipp-data.html. User guides are available on the website of the US Census Bureau.

[9]This makes up a total of 9 waves that come from 1996 (4), 2001 (3) and 2004 (2) panels.

Our independent variable of interest — the deregulation index — varies across states and over time. We therefore remove observations in the SIPP who move across states as such a move would possibly endogenously determine the value of the index. To abstract from questions of how assets and liabilities are divided or pooled upon a division or merging of households we consider only observations whose marital status does not change over the panel period.[10] We define individuals to be homeowners based on their reported ownership of their residence and drop remaining household members who live in the same dwelling with no share in the ownership. We only consider individuals aged between 21 and 65 as changes in ownership and mortgage debt are rare outside of this age range. Finally, as we rely on person fixed effects for identification, we use individuals with multiple observations over time after these filters. This leaves us with 229,722 person-year observations between 1996 and 2005.

We consider the following dependent variables: 1) **Is Homeowner** is a dummy equal to 1 if the person is a (joint) owner of the occupied dwelling, 2) **Has Mortgage** is a dummy equal to 1 if the person has a mortgage or home equity loan on their home, and 0 otherwise (including if they rent). 3) **Log Mortgage Debt** is the natural logarithm of the amount of mortgage debt, 4) **Log Home Value** is the natural logarithm of the reported value of the home, 5) **Debt to Value** is the ratio of mortgage debt to the reported home value, and 6) **Debt to Income** is the ratio of mortgage debt to monthly household earned income.[11] We drop observations for whom wealth variables (including homeownership and mortgage status) are imputed, following Gruber and Yelowitz (1999) and Célerier and Matray (2019), due to the unreliability of imputed results regarding wealth variables.

Our person-specific variables are: whether the person's household has received any income from assets in the last four months (dummy), whether the person's household has received any unem-

[10] In the raw data interstate migration is around 3.5 percent and marital status change is 5.2 percent.

[11] Each SIPP wave collects information on income for the reference period, that is, the previous four months. We average these values to construct monthly household income.

ployment benefits in the last four months (dummy), dummies for belonging to each decile of the real household earned income distribution (across all years and observations), real income growth, the number of adults in the household, and the number of persons below 18 in the household. Our person fixed effects control for baseline differences in housing demand. We also control for changes in housing demand related to age and marital status by interacting an age indicator (1 if the individual is between 21 and 45) with year fixed effects and interacting marital status with year fixed effects. The former accounts for secular changes of the age at which people purchase their first home, and the latter permits differences in the demand for homeownership between married and unmarried individuals to change with time.

The state characteristics we control for are: the unemployment rate, the natural logarithm of the state population, the natural logarithm of per capita income, and state level gdp growth. We also interact metropolitan area (MSA) status of individuals with year fixed effects. This allows for year-specific effects which differ between cities and non-cities. Finally, we compile a measure of financial technology as proposed by Johnson (2022) at the state (metro vs. non-metro) level and interact this with a year trend. In particular, we use mortgage lending in 1996 from the Home Mortgage Disclosure Act (HMDA) data and we create market shares of banks that adopt automated underwriting technology which subsequently becomes dominant in the market. This is aimed at capturing the adoption of automated mortgage underwriting technologies which coincided with the timing of interstate branching regulation.[12] All nominal variables are deflated by the 1996 CPI.

In addition to the above we check for heterogeneous effects of deregulation on different demographic groups. We are particularly interested in how the expansion of credit due to deregulation has affected MSAs differently from non-metropolitan areas as ownership and bank branch saturations

[12]We thank an anonymous referee for pointing out this channel. During the early 1990s, use of computer technologies and better data availability created opportunities for financial institutions to adopt automated mortgage underwriting systems. The systems created by Fannie Mae and Freddie Mac eventually dominated the market. Johnson (2022) shows that early adopters of these systems expanded high leverage lending. Using Home Mortgage Disclosure Act (HMDA) data, she introduces a measure of county level mortgage market share of these early adopters. She finds that counties that are exposed to these lenders experienced an increase in house prices.

can be very different between the two. Since ownership outside of metropolitan areas is already high we would expect the effect of deregulation on ownership to be weaker there. The effect on mortgage debt is more ambiguous. In non-MSAs we would expect fewer mortgages for purchases, but we might observe more home-equity loans. The latter could be driven by there being more owners, or because deregulation has made borrowing against one's home easier in non-MSAs than in MSAs.

We further classify households by their age as the decision of housing and related debt instruments depend heavily on life-cycle stages and events.[13] Therefore, the credit demand response with respect to an expansion of credit supply is likely to be age dependent. To address these potentially diverse responses, we classify a person as 'Young' if they are between 21 and 45 when they are first observed in the panel, and 'Old' otherwise. Finally, we examine heterogeneity in income to assess the change in credit risk due to this deregulation. We classify a person as having low income if their household earned income, at all times, is below twice the poverty threshold as defined by the SIPP. This threshold adjusts for number of household members and age of the household head. For an average household, this threshold is around 2,250 dollars per month as of 1996.

In analysing heterogeneity along the above dimensions we decided to split the samples by location and age, but account for income heterogeneity by including an interaction term between the low income dummy and the deregulation index. Movements between MSAs and non-MSAs for individuals are negligible, and between age classifications impossible, while transitions between income classifications are more common. Splitting the sample by income could allocate the same individual to different sub-samples over time and be a source of sample selection bias.[14]

Table 1 presents an overview of our data. Each column reports average values for the first year of the 1996, 2001 and 2004 panels respectively. We observe a pronounced increase in the deregu-

[13] For modelling the housing tenure decision over the life cycle see Fisher and Gervais (2011) and Attanasio et al. (2012).

[14] Later, we relax this classification and separately analyze income quintiles.

Table 1: Summary Statistics: Main sample, by panel

Panel	1996	2001	2004
Main independent variable			
Deregulation index	0.946	1.971	1.995
Outcomes			
Is Homeowner (in %)	63.4	65.9	68.7
Has Mortgage (in %)	49.0	51.8	54.5
Log Mortgage Debt	10.89	11.04	11.21
Log Home Value	11.53	11.71	11.87
Debt to Value	0.59	0.58	0.58
Debt to Income	17.53	19.34	22.27
Household controls			
Age	42.5	43.2	44.0
Married	0.69	0.69	0.68
On Low Income (in %)	0.23	0.23	0.27
Low Income Threshold (in $)	2250	2246	2223
Income (in $)	3897	4164	4249
Log Income	8.03	8.10	8.11
Income Growth	4.08	-0.53	2.56
Has Asset Income (in %)	0.66	0.64	0.67
Receives Unemployment Benefit (in %)	0.03	0.03	0.03
Number Children in Household	0.97	0.93	0.90
Number Household Members	3.11	3.10	3.02
State controls			
Unemployment rate	5.53	4.01	5.89
Log per capita income	10.07	10.31	10.38
Log population	15.97	16.01	15.83
GDP growth rate	5.74	6.14	3.52
Observations	25,489	23,828	32,830

Notes: Table reports mean statistics for the sample of main analysis where individuals appear in multiple waves. Means based only on observations in first wave with asset and liability information (wave 3) from each panel. Low income threshold is two times the poverty threshold as defined by the SIPP. Low income households are those that are below this threshold at all waves. All nominal variables are deflated by 1996 prices.

lation index by more than one index point between the first years of the 1996 panel and the 2001 panel. This is consistent with the observation in Rice and Strahan (2010) that deregulation slowed down after 2001. Most of the variation in the deregulation index comes from the 1996 panel. The directions of the changes in our outcome variables are reflecting the aggregate observations documented for this period in Justiniano et al. (2019): the likelihood of being a homeowner and having a mortgage increased by more than 5 percentage points between 1996 and 2004. Mortgage debt and house prices also saw sharp increases (32 log points and 34 log points in real terms). We observe a small decrease in debt to value reflecting that home value increases exceeded debt increases slightly.

We also see that individual characteristics have not stayed fixed over time. For example, the average individual became older but less likely to be married. Households' earned income has increased by close to 8 log points but income growth and the fraction of individuals enjoying income from assets has fluctuated over the years. Although the low income threshold declined in real terms, the share of individuals on low incomes has slightly increased. These observations suggest that it is important to account for these potentially confounding changes at the household and state level to estimate the effect of deregulation on homeownership and mortgage debt outcomes.

One could question our estimation strategy that relies on within-person variation from individuals that have available data for multiple waves. Arguably, this could create selection bias if individuals that appear only once in the sample have different characteristics than those that appear two or more times. We produce summary statistics for individuals who are observed only once in Table A1 in the appendix. These individuals display important differences to our main sample in terms of ownership and mortgage status. In particular, they are more likely to be renters. Renters in turn are more likely to move and therefore more likely to attrite. Our regressions will thus underestimate the contribution of movers on the ownership and mortgage decisions. Our robustness tests discussed further below demonstrate that the effect of an increase in deregulation on households that move is, if anything, stronger.

Table 2: The effect of easier credit supply

Sample	FULL (1)	MSA (2)	NON-MSA (3)	FULL (4)	MSA (5)	NON-MSA (6)
A: Ownership Status	Is Homeowner			Has Mortgage		
Deregulation index	0.0025***	0.0025**	0.0014	0.0048***	0.0039**	0.0091*
	(0.0009)	(0.0011)	(0.0012)	(0.0017)	(0.0018)	(0.0047)
Observations	229,722	181,432	46,777	229,722	181,432	46,777
B: Home Equity	Log Mortgage Debt			Log Home Value		
Deregulation index	0.006	-0.0023	0.0537***	0.0063	0.0048	0.0133
	(0.0076)	(0.0086)	(0.0148)	(0.0047)	(0.0047)	(0.0124)
Observations	87,003	70,945	15,860	132,419	103,697	28,410
C: Leverage	Debt to Value			Debt to Income		
Deregulation index	0.0011	-0.0005	0.0100**	0.0902	0.0666	0.2836
	(0.0018)	(0.0019)	(0.0046)	(0.0755)	(0.0776)	(0.1747)
Observations	83,691	68,466	15,039	81,544	66,688	14,671

Notes: The coefficients report the estimated effect of a relaxation of inter-state banking by one index point. The full sample comprises all observations aged 21 to 65 at the beginning of the observation period who do not move across states and do not change their marital status over their observation period. The (non) MSA sample refers to observations (not) residing in metropolitan areas. All regressions control for individual, region-year, and MSA status-year fixed effects, household income growth, number of household members, number of children under 18 in the household, and dummies for: the presence of asset income, the receipt of unemployment benefit, each household earning decile and marital and young status interacted with year fixed effects. State-wide controls are the unemployment rate, population, per capita income, gdp growth and a measure of financial technology interacted with year trend. Standard errors are clustered by state-years and reported in parentheses. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

4 Main Results

Table 2 summarizes the main results. Panel A reports the effect of deregulation by one index point on the probability of becoming a homeowner (left) and on having a mortgage (right). For the full sample we observe that going from a state of full regulation (0) to full deregulation (4) of inter-state banking increases the probability of becoming a homeowner by one percentage point (4 $\times$ 0.0025) and the probability of having a mortgage by almost two percentage points (4 $\times$ 0.0048). Both effects are significant at the 1% level. Since the effect on having a mortgage is twice the effect on being a homeowner and both regressions are run on the same sample, some of the new mortgages taken out in response to deregulation are for new home purchases while others are home equity loans. In further regressions (not reported) we find that an increase in deregulation by one

index point increases the probability of having a mortgage by 0.59 and being a homeowner by 0.43 percentage points.[15]

Distinguishing by location we observe that most of the effect of deregulation on the likelihood of homeownership comes from observations in MSAs. Non-MSAs, on the other hand, experience a larger increase in the likelihood of having a mortgage — though the significance is only at 10%. This could be due to low demand for housing as the market is already saturated in non-MSAs (the homeownership rate was already above 70 percent in 1996). To test this hypothesis we split the sample based on individuals' ownership status that predates the estimation period. We use a SIPP module which surveys individuals' past residence and ownership status. We classify someone as an initial owner if they owned their dwelling five years ago – this might but need not be their current residence. For individuals who moved more than once in the previous five years we cannot determine their ownership status five years ago and we instead use their ownership status in their previous residence. The results in Table A2 suggest that for MSA residents that are initial renters, deregulation increases the likelihood of becoming a homeowner. In non-MSAs, the reverse is true: renters are not more likely to become homeowners. This contrast becomes sharper for mortgage status: While having a mortgage for the full sample was driven primarily by mortgages for new home purchases, in non-MSAs it is homeowners who take advantage of the expansion in mortgage credit via home equity loans.

How much of the observed increase in the share of homeowners and mortgagors could be explained by this deregulation? To answer this question we compute the counterfactual increase in the share of homeowners and mortgagors based on states' deregulation experiences over the expansion period (1994-2005) and corresponding estimates reported in Table 2. We first calculate

[15]We arrive at these results by regressing the Has Mortgage variable on the deregulation index, separately by homeownership status, while constraining all other variables' effects to be equal to the coefficients estimated for the full sample (so that a regression on the deregulation index on the full sample would again yield the original coefficient of 0.0048). Homeownership status is determined by the initial status observed in the panel.

Table 3: Deregulation and the housing market 1990 to 2005

	Is Homeowner		**Has Mortgage**	
	Actual	Age-adjusted	Actual	Age-adjusted
1990	0.612	0.612	0.478	0.478
2005	0.643	0.624	0.525	0.512
Change 1990 to 2005	0.031	0.013	0.047	0.035
Explained change	0.006	0.006	0.011	0.011
Share explained	18%	43%	22%	31%

Notes: Homeownership rates and share of mortgagors in 1990 (US census) and 2005 (American Community Survey). The age-adjusted share measures what the share of the respective variable would have been if the ratio of young to old people had been the same as in 1990. The explained change is the change in the respective variable that can be explained by the deregulation that occurred over this time period. It is the (population-) weighted average across states of the change in the deregulation index times the estimated effect of deregulation on ownership and mortgage status (Table 2). The last row quantifies the proportion of the change in the respective variable that can be accounted for by the explained change.

homeownership and mortgagor shares using Census data and the same age categories introduced in the previous section.[16] Table 3 shows that between 1990 and 2005 the homeownership rate increased by 3.1 percentage points and the mortgagor share increased by 4.7 percentage points. For each state, we multiply the coefficient on the deregulation index from Table 2 with the change in regulation observed in that state, thus obtaining its predicted change in ownership due to deregulation. We then take the population-weighted average of the predicted changes to calculate the explained change.

Interstate branching expansion due to deregulation alone induces a 0.6 percentage point increase in homeownership and 1.1 percentage point increase in the mortgagor share. Overall, this explains about one fifth of the increase in this period. This calculation, however, does not account for an ageing population in the same period. If we were to fix the young-old distribution to 1990 levels, the observed increases in the homeownership rate and the mortgagor share are much smaller. In this age-adjusted scenario the deregulation experience explains close to one-half of the observed

[16] We rely on the IPUMS 5 percent 1990 Census sample for the pre policy period and IPUMS 2005 American Community Survey for the post policy period.

change.[17]

Turning to variables characterizing home equity (Panel B) in the full sample we do not observe any effects on the value of mortgage debt nor on the home values as reported by the interviewees. However, we do find strong effects of deregulation on mortgage debt accumulation in the non-MSA sample which increases by 5.4 log points per index point. Note that this effect is not driven by new mortgage originations. Since we control for individual fixed effects, it is the change in existing mortgage debt as a response to a change in the deregulation index that identifies the coefficient. While the right side of panel A is informative on the extensive margin of the mortgage market, the left part of panel B tells us something about the intensive margin of existing mortgagors.

For households outside of MSAs it is remarkable that deregulation did not have an effect on ownership but that it increased both mortgage incidence as well as the amount of mortgage debt. This suggests that in non-MSAs deregulation resulted in existing homeowners obtaining new equity loans as well as extending existing mortgage debt. Deregulation has thus allowed households in non-MSAs to gain access to loans using their homes as collateral. This result is further reinforced in a restricted sample of households who do not change their dwellings over the observation period. When we focus on this stayer sample, thus abstracting away from cases such as purchasing a larger house, we still find similar results on mortgage debt accumulation in non-MSAs (see section 7).

While we find positive effects of deregulation on home values, they are not statistically significant. The coefficient for the MSA sample is particularly small. This contrasts with both theoretical predictions of a credit supply shock (Justiniano et al., 2019) as well as the empirical finding in Favara and Imbs (2015). Two caveats are in order. First, the effect of deregulation on home values is identified from the change in the house value as a response to a change in the deregulation index

[17]Share of young indidividuals in 1990 (2005) is 63 (55) percent. Age-adjusted homeownership rate in 2005 reflects the scenario where 2005 sample has the same share of young individuals as in 1990.

excluding any new home purchases of renters. For an accurate estimate of this effect interviewees would need to know how their home values change over time. In reality, homeowners might not be aware of year-to-year changes in the market value of their homes. Second, the fact that we use home values reported by the interviewees might introduce a bias. Chan et al. (2016) find that homeowners with mortgage debt systematically misreport home values against the developments in the housing market. For these reasons, we think home value estimations contain measurement error that would lead to an underestimation of the effect.[18]

Panel C focuses on variables relating to home equity and risk exposure. The (outstanding) loan to value ratios (left side) in the full sample are not affected. This is not surprising given that the effect of deregulation on debt and reported home values are very close (Panel B) and also in line with the argument in Justiniano et al. (2019) that relaxation of lending constraints would increase debt and asset prices in roughly equal measure. Only in non-MSAs did the increase in mortgage debt exceed the increase in home values somewhat, thus driving up the loan to value ratios. Going from full regulation to full deregulation implies a 4 percentage points increase in debt to value in non-MSAs. This result, however, comes with some caveats: Home prices might be overvalued and at any rate are much more volatile than income. Moreover, self-reported home values do not necessarily mark to market as argued in Chan et al. (2016).

A better measure of risk exposure is debt to earned income (right side) since the former needs to be served by the latter. Here we see a slight, albeit insignificant, increase in non-MSAs. Moreover, this increase in household leverage is not economically sizeable. For a given income the amount of mortgage debt would increase by a month's earned household income for states which go from full regulation to full deregulation. We conclude that interstate branching deregulation has limited effects on household credit risk due to leverage. However, we should note that this analysis excludes

[18]We perform the same analysis using a subsample of individuals who bought their houses in the last 5 years. The results confirm that recent homeowners – who are more likely to be better informed about their home values – report a significant increase in home values after deregulation. The results are available upon request.

households with (close to) zero earned income.[19]

Taken together we find several differences of the effect of deregulation between MSAs and non-MSAs. Specifically, the rise in mortgage credit due to branching deregulation as observed in Favara and Imbs (2015) boosted housing demand and caused higher homeownership and mortgage incidence rates in MSAs. New mortgages overwhelmingly came from new home purchases. Non-MSAs, on the other hand, saw more home equity borrowing, and higher loan-to-value and debt-to-income ratios. Célerier and Matray (2019) find that the same deregulation index increased bank branch densities in poorer counties within a state and the financial inclusion of poorer individuals. We see this expanding access to finance reflected in home equity borrowing in non-MSAs. These trends show in the aggregate data as well: the homeownership rate in MSAs moved from 61 to 67 percent between 1996 and 2004 while it changed from 73 to 74 percent in non-MSAs. On the other hand, average mortgage debt of homeowners increased by 47 percent in MSAs and 68 percent in non-MSAs. We next explore which demographic groups, segmented by age and income, were more affected by deregulation.

5 Results by Age and Income

5.1 Ownership Status

Table 4 and Table 5 present detailed results on the effect of deregulation on homeownership and having a mortgage respectively. Panels A to C distinguish the samples by location. Even-numbered columns present results from regressions which include the deregulation index, as well as the interaction of the index with a dummy for low income households, while odd-numbered columns refer to regressions which do not include this interaction term. Columns 3 and 4 restrict the sample to people younger than 46 when they were first observed in the data, and columns 5 and 6 to people

[19]Further analysis that separately estimates the effect of deregulation on income quintiles suggests that (very) low income individuals do not take more mortgages. Mian and Sufi (2009) and Mian and Sufi (2017) suggest that the credit expansion in the early 2000s yields a dramatic rise in household leverage. For an opposing view see Adelino et al. (2016) and Foote et al. (2016).

Table 4: The effect of easier credit supply on owning a home

	By age					
	All		Young		Old	
By location	(1)	(2)	(3)	(4)	(5)	(6)
A: All						
Deregulation index	0.0025***	0.0034***	0.0029**	0.0043***	0.0020*	0.0019
	(0.0009)	(0.0011)	(0.0014)	(0.0015)	(0.0010)	(0.0014)
Deregulation index ×		-0.0040*		-0.0079**		0.0002
Low income		(0.0021)		(0.0031)		(0.0023)
B: MSA						
Deregulation index	0.0025**	0.0036***	0.0028*	0.0043**	0.0021*	0.0021
	(0.0011)	(0.0013)	(0.0016)	(0.0018)	(0.0012)	(0.0015)
Deregulation index ×		-0.0051**		-0.0091**		0.0001
Low income		(0.0025)		(0.0036)		(0.0029)
C: Non-MSA						
Deregulation index	0.0014	0.0009	0.0026	0.0015	0.0001	0.0002
	(0.0012)	(0.0016)	(0.0023)	(0.0027)	(0.0016)	(0.0021)
Deregulation index ×		0.0015		0.0046		-0.0003
Low income		(0.0034)		(0.0052)		(0.0030)

Notes: Dependent variable: Dummy equal to one if observation owns dwelling. The deregulation index ranges from 0 to 4. Low income is a dummy equal to one if the observation's household income is below twice the poverty level. The Young (Old) sample includes observations aged 21(46) to 45(65). All regressions include the same controls as listed in the notes to Table 2. Standard errors in parentheses. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

aged 46 to 65. The first two columns do not restrict the sample by age.

The first columns of both tables repeat the results from Table 2, panel A, with the familiar result that deregulation leads to increased homeownership and mortgage origination in MSAs. Our extended results reveal that this effect is stronger and always significant for younger individuals (columns 3 and 4). This is not surprising as homeownership is a life-cycle decision and changes in credit conditions would affect individuals' timing of purchasing a home. In this particular case, homeownership among the young was in secular decline since the 1980s (Fisher and Gervais, 2011). The mortgage credit expansion seems to have decelerated this trend. Turning to income heterogeneity, in the complete sample (both by location and age), we see that the benefits of easier homeownership accrue entirely to high-income individuals (0.0034), suggesting that the marginal individual to benefit from deregulation did not fall into the low income category as we defined it.

In the MSA sample young and low income individuals become even less likely to be homeowners for a given change in the deregulation. This is an interesting finding as it may suggest that this part of the population might have been rationed out during this credit expansion. It is also possible that house prices increased in the MSAs to an extent that it became unaffordable to pay the required downpayments. This means that deregulation did not yield relaxation of borrowing constraints to a point that it allows people with low incomes to become homeowners.

The findings for holding a mortgage follow the general patterns in ownership with further refinements. For the full sample and MSAs the results are similar with stronger effects compared to ownership. The effect on the likelihood of being a homeowner is not significantly different between old low-income and old high-income individuals, but as above, young and low income individuals (especially in MSAs) became less likely to hold mortgages after the deregulation. As above, this might be an indicator of tight borrowing constraints for these individuals. In non-MSAs, on the other hand, the likelihood of having a mortgage (0.0091) becomes significant at the 10% level. For young people in non-MSAs the total effect of going from a state of full regulation to full deregulation exceeds 4 percentage points (4×0.0109).

The fact that we often find negative effects of deregulation on part of the low income population begs further inquiry as it seems to be in contrast with empirical findings in Tewari (2014). She finds that intrastate branching deregulations that took place in the 1980s increased the homeownership likelihood of low to middle income households. We note that this is a period that predates our estimation period and features two important differences: aggregate homeownership rates do not exhibit a secular increase in this period and intrastate branching deregulation did not coincide with an increase in house prices. Moreover, we require a household to be below the low income threshold for all waves to classify it as a low income household. To compare our results in more detail we split the sample into income quintiles based on the ratio of household earned income to

Table 5: The effect of easier credit supply on holding a mortgage

	By age					
	All		Young		Old	
By location	(1)	(2)	(3)	(4)	(5)	(6)
A: All						
Deregulation index	0.0048***	0.0052***	0.0054***	0.0073***	0.0041	0.0021
	(0.0017)	(0.0019)	(0.0017)	(0.0018)	(0.0029)	(0.0033)
Deregulation index ×		-0.0019		-0.0104***		0.0072
Low income		(0.0030)		(0.0031)		(0.0047)
B: MSA						
Deregulation index	0.0039**	0.0046**	0.0045**	0.0064***	0.0032	0.0016
	(0.0018)	(0.0019)	(0.0021)	(0.0023)	(0.0033)	(0.0036)
Deregulation index ×		-0.0033		-0.0115***		0.0064
Low income		(0.0031)		(0.0034)		(0.0043)
C: Non-MSA						
Deregulation index	0.0091*	0.0081	0.0109*	0.0101	0.0077	0.0055
	(0.0047)	(0.0055)	(0.0057)	(0.0069)	(0.0056)	(0.0075)
Deregulation index ×		0.0034		0.0034		0.0056
Low income		(0.0076)		(0.0099)		(0.0118)

Notes: Dependent variable: Dummy equal to one if observation holds a mortgage. See notes to Table 4 for further information.

the low income threshold.[20] As for our high and low income classification, we include an individual in the sample only if they are in the same quintile throughout. The results in Figure 2 suggest that it is indeed lower-middle income individuals (third and fourth quintiles) that benefit from deregulation. Very high or very low income individuals do not seem to benefit from the increased credit supply.[21] These findings are consistent with results in Tewari (2014). We conclude that the increase in homeownership comes exclusively from lower-middle income households as they are the marginal households who could afford downpayments to purchase a home.

[20]This roughly divides sample to below poverty threshold (quintile 1), above poverty threshold and below/around low income threshold (quintile 2), lower-middle income households (quintiles 3 and 4) and high income households (quintile 5).

[21]The household income of individuals in the third and the fourth quintiles are on average 2 times the low income threshold. The SIPP oversamples households around the poverty threshold. Households on high income are undersampled.

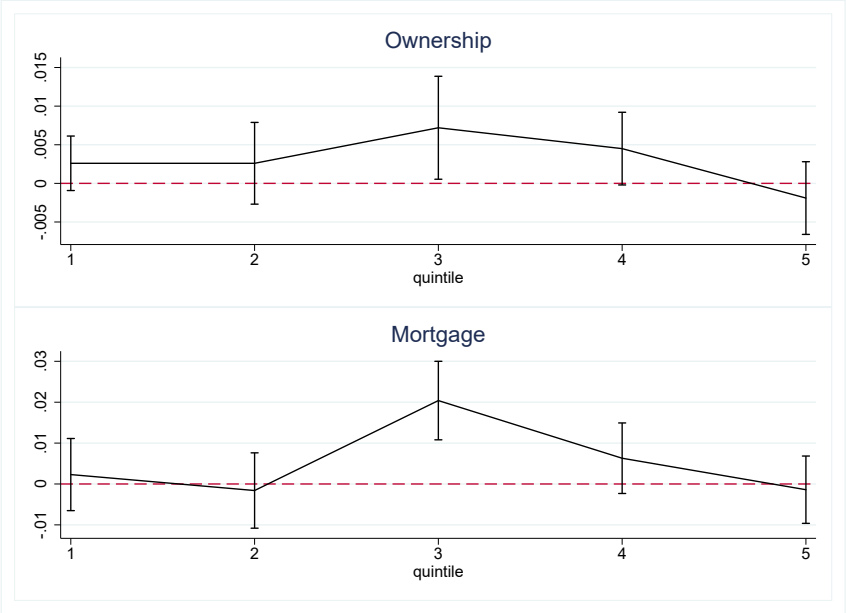

Figure 2: Graphs show the estimated effect of deregulation on ownership and mortgage status separately by each income quintile. Income quintiles are defined by the household earned income relative to low income threshold. All regressions include the same controls as listed in the notes to Table 2. The vertical bars cover the 95% confidence interval. The y-axes are not on the same scale.

5.2 Mortgage Debt and Leverage

Next we look in detail at components of mortgage debt in Table 6. We find that accumulation of mortgage debt significantly increased in non-MSAs both for young and old individuals. Young individuals in the non-MSA sample increase their mortgage debt by more than 7 percentage points per index point if they have high incomes, but not at all if their income is low (Table 6, panel C, column 4). We also find that, in MSAs, deregulation increases the mortgage debt amount of old individuals with low incomes compared to old individuals with high incomes. What drives these results? We think the most intuitive explanation is that young and high income individuals become more likely to take out a new mortgage (see Table 4) , while older — and poorer — individuals become more likely to draw more debt on their home equity. On the other hand, young and better-off individuals in non-MSAs might also be benefiting from increased access to finance in their locations to secure larger loans.

While the main effect of deregulation on home values is relatively small and not significant, we

Table 6: The effect of easier credit supply on amount of mortgage debt (in logs)

	By age					
	All		Young		Old	
By location	(1)	(2)	(3)	(4)	(5)	(6)
A: All						
Deregulation index	0.006	0.0035	0.0116	0.0119*	-0.0029	-0.0114
	(0.0076)	(0.0077)	(0.0071)	(0.0072)	(.)	(0.0149)
Deregulation index ×		0.0286		-0.0038		0.0644*
Low income		(0.0235)		(0.0329)		(0.0368)
B: MSA						
Deregulation index	-0.0023	-0.0065	0.0041	0.0032	-0.0126	-0.0239
	(0.0086)	(0.0086)	(0.0073)	(0.0075)	(0.0154)	(0.0175)
Deregulation index ×		0.0546**		0.0178		0.0905**
Low income		(0.0272)		(0.0411)		(0.0410)
C: Non-MSA						
Deregulation index	0.0537***	0.0684***	0.0602***	0.0749***	0.0451*	0.0570**
	(0.0148)	(0.0183)	(0.0170)	(0.0195)	(0.0245)	(0.0256)
Deregulation index ×		-0.1058*		-0.1239*		-0.0707
Low income		(0.0598)		(0.0703)		(0.0572)

Notes: Dependent variable: Log of amount of mortgage debt. Sample includes only observations with positive mortgage debt. See notes to Table 4 for further information.

find significant results for young individuals in the full sample and in MSAs (see appendix A3). Going from full regulation to full deregulation increases reported home values by 5 percentage points for younger individuals. Here, too, it is mainly young home owners with higher incomes who report higher home values after deregulation. Since this is the same demographic for which we see an increase in mortgage debt these individuals might have better or more recent information about home values. Alternatively, since their debt has increased they might be psychologically inclined to believe that the market value of their home has increased so as to keep their net position stable.[22]

Finally, we find that deregulation prompted only minor increases in debt to home value ratios (appendix Table A4), and mortgage debt to household income ratios (appendix Table A5). As suggested by our results for mortgage debt, individuals that live in non-MSAs experienced an increase in leverage. In MSAs we find an increase in debt-to-value ratios for low-income, but not for

[22]Results in Chan et al. (2016) suggest support for this phenomenon.

high-income individuals. Taking a closer look by age group we see that this effect is exclusively coming from older individuals with low income (Panel B, Column 6). Note that these results are coming from existing homeowners taking out home equity loans. This means that older low income homeowners take advantage of home equity lines of credit.[23] As expected, this prompts an increase in debt-to-income ratios for this group, though the coefficient is not significant.

The remaining results for debt-to-income portray a similar picture: A statistically stronger result is obtained for young individuals in non-MSAs whose debt relative to income increases by the equivalent of 51 percent of monthly household income, per index point. While this same demographic has benefited from banking deregulation in terms of financial inclusion (Célerier and Matray, 2019), they have slightly increased their vulnerability to income or home value shocks.

6 Discussion of Channels

In the previous section we have seen that the increase in credit supply resulted in a higher likelihood of being a homeowner and holding a mortgage in MSAs (extensive margin), while existing homeowners in non-MSAs experienced an increase in their existing mortgage debt (intensive margin). What is the mechanism that drives these results? As mentioned in Section 2, after the relaxation of interstate branching restrictions the share of interstate branches increased considerably. Favara and Imbs (2015) argue that this brought diversification benefits for commercial banks that operate across state boundaries. They find that these banks become more profitable and relax lending constraints in markets that they enter. This increases credit supply in the mortgage market and fuels housing demand. Chu (2018) on the other hand argues that entry of out-of-state banks prompted an increase in competition in commercial real estate lending. Finally, as during the intrastate branching expansion analyzed in Tewari (2014), entry of new banks to the market could increase productivity of mortgage lenders, both through economies of scale and competitive pressures. We

[23] If we include the extensive margin of becoming a homeowner with a new mortgage, unreported results suggest that in all areas mortgage debt to home value increases.

provide suggestive evidence to discuss the role of these channels.

To asses the role of the proposed channels we use information on bank branches and mortgage loan activity. We compile bank branch information from the Summary of Deposits (SOD) which contains annual branch data with identifiers of location and of the bank the branch belongs to. Mortgage loan data comes from the Home Mortgage Disclosure Act (HMDA) database which provides mortgage loan information for the near universe of all lenders in the country. Following Célerier and Matray (2019) and Favara and Imbs (2015) we use data at the county level. We estimate the effect of interstate branching deregulation on bank branch density, bank branch density of banks head-quartered in another state, measures of competition, mortgage supply and lender productivity. Table 7 reports results separately for counties in MSAs and non-MSAs.

We find that deregulating states saw an increase in total bank branch density (number of bank branches scaled by population) both for counties in MSAs and non-MSAs. In MSAs, the number of branches of banks head-quartered outside the state also increased significantly. While this does not directly imply increased competition, diversification gains that come from operating in multiple locations could increase credit supply.[24]

A higher density of branches does not necessarily imply less concentration or more competition. For example, density would increase if the dominant bank opened new branches, thereby increasing its market share. To address this concern, we provide two proxies for market power: county level bank density (number of banks with at least one branch scaled by population), and the Herfindahl index based on number of branches. The results suggest that while the number of operating banks per capita increased after deregulation (especially for non-MSA counties) the concentration of bank branches do not seem to change.

[24]Favara and Imbs (2015) find that out of state banks that later opened bank branches in deregulated states significantly increased mortgage lending.

Finally, we check whether expansion of (multi-location) bank branches affect mortgage lending for deregulated states. Here, we proxy lender productivity by number of mortgage loans per lender in a county while acknowledging that it is an imperfect, but suggestive, measure. The results suggest an increase in the number of for-purchase mortgage loans per capita both for MSA counties and non-MSA counties. Moreover, the number of loans per available lender increased significantly with deregulation, especially in MSAs. This implies that, as in Tewari (2014), after an expansion of bank branches from outside locations, lenders in the local mortgage market issued more mortgage loans. This finding suggests that deregulation might have resulted in productivity gains. Taken together, these findings suggest interstate branching deregulation affected mortgage supply both through diversification/productivity and competition channels. We believe that for non-MSA counties the latter channel is more powerful due to the fact that the initial structure of the banking market in those locations was more concentrated. MSA counties, on the other hand, take advantage of the former channel in line with the findings in Favara and Imbs (2015).

Another channel through which interstate branching could affect housing and mortgage outcomes is by increasing household incomes. Accordingly, households could fuel the demand for housing and mortgages not because deregulation-induced a rise in credit supply but because it increased household earnings. Although we control for a set of income variables in our baseline regression to address this issue, we repeat the same regression introduced in equation 1 with real income growth as the dependent variable. The coefficients in Table A6 are insignificant and small in magnitude which suggest that interstate branching deregulation did not increase household income. Therefore, we conclude that higher homeownership and mortgage debt is due to increased credit supply induced by interstate branching deregulation.

Table 7: The effect of deregulation on concentration and loan origination

	Total branch density		**Out-of-state branch density**	
	MSAs	Non-MSAs	MSAs	Non-MSAs
Effect of deregulation	0.0031**	0.0034**	0.0040**	0.0004
	(0.0012)	(0.0014)	(0.0018)	(0.0018)
	Total bank density		**Branch Herfindahl**	
	MSAs	Non-MSAs	MSAs	Non-MSAs
Effect of deregulation	0.0009**	0.0025**	0.0000	-0.0008
	(0.0004)	(0.0012)	(0.0005)	(0.0006)
	Mortgage loans per capita		**Mortgage loans per lender**	
	MSAs	Non-MSAs	MSAs	Non-MSAs
Effect of deregulation	0.1479	0.1621***	0.4972***	0.1638***
	(0.0949)	(0.0556)	(0.1282)	(0.0398)

Notes: Observations are county-years. The observation period is 1994-2006. Branch and bank density are defined as branches, respectively distinct banks, per 1000 population. The first column includes counties within MSAs, the second column includes counties not within any MSA. All variables are at the county level, except the deregulation index, which is at the state level. All regressions include the value of dependent variable in 1994 interacted with time fixed effects, county and region-year fixed effects, county level change in income per capita, log of income per capita, log of population, unemployment rate, and poverty rates. Standard errors are clustered by state-year and reported in parentheses. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

7 Robustness Tests

7.1 Household level results

Our identification in section 4 comes from housing and mortgage debt decisions at the individual level. However, home purchase decisions are typically made at the household level. Our results could be affected by differences in family composition between renters and homeowners and between MSA and non-MSA households.[25] To address this concern, we reproduce results in Table 2 using just the sample of household heads. The qualitative conclusions in section 4 also hold for this sample (Table A7). Therefore, our results do not depend on differences in family composition. For all remaining robustness tests we proceed with this household rather than the individual-level sample.

[25]We thank our anonymous referee to point out this possibility.

7.2 Stayers vs. Movers

We have argued that deregulation has led to both new home purchases and mortgages. Moreover, it induced new home equity loans for outright homeowners as well as an increase in borrowing against existing homes. If this is the case then we would expect to see more new mortgages and more borrowing among both households who move between dwellings (e.g., buy a new home) and those who do not move (e.g., by borrowing more against their existing home). We divide our sample into households who do not move during the observation period (stayers) and those who do change their dwelling at least once (movers).[26] Both samples include renters and homeowners with and without debt. The regression for the stayer households enables us to isolate the effect of credit supply on the likelihood of having a mortgage and on the amount of mortgage debt on an existing house. Detailed results for stayers are reported in appendix Table A8. Not surprisingly, the effect on ownership is smaller in magnitude as households usually move to a different address to become homeowners.[27] The remaining results are very close to the results reported for the full household sample in appendix Table A7.

We then repeat the same analysis for the mover sample. With this sampling restriction we are able to focus on the effect of the credit supply on house purchases and corresponding mortgage debt. Arguably, this is the main driver of the housing boom as demonstrated in Favara and Imbs (2015). However, the mover sample is about 15% of the baseline sample which considerably reduces available observations for further analysis. Moreover, the higher non-response rate in the mover sample increases measurement error. Therefore, the results for this sub-sample are only suggestive and should be evaluated together with previous findings. The results reported in appendix Table A9 confirm that the increase in credit supply induced individuals to become homeowners. Although, the coefficients in columns 1 and 2 are insignificant, they are considerably larger than

[26] This corresponds to 85% and 15% of our sample respectively.

[27] It is possible that households purchase the dwelling that they previously rented. Moreover, they could also take over the home from family members. Unfortunately, we cannot distinguish the reasons behind this change in ownership status.

the coefficients in Table A7.

This confirms that it is indeed the households who move from one dwelling to another that drive our results. As indicated in baseline regressions, the increase in the likelihood of becoming homeowner is overwhelmingly taking place in MSAs. We find positive effects of deregulation on mortgage holding and mortgage debt. Movers seem to purchase more expensive houses as we also see an increase in home values. We conclude from these results that the increase in credit supply induced households to obtain new mortgages on their current dwelling and accumulate more mortgage debt. We also provide tentative evidence with regards to credit supply's effect on new — and more expensive — house purchases and consequent increases in mortgage debt.

7.3 Sample Selection

Our descriptive statistics exhibit important differences between the sample of households that have available information in multiple waves and households that appear only in one wave. One major reason for this difference is that single-wave households often move to a new address and cannot be located by the survey. Therefore, we are underestimating the role of movers on housing tenure decisions. To address this concern we use past mobility information from a topical module in SIPP which records whether the household has moved into the current residence, the time of the move, and the location and the ownership status of the previous residence. This allows us to retain all observations who are present in the first wave of our panel. We construct housing tenure status of the household 5 years prior to the survey year based on this information.[28]. We then only use ownership and deregulation in the first wave and five years prior in a regression of ownership on deregulation, effectively estimating a first-difference model.

The advantage of using such a specification is that we can include a group of households that

[28]For households who moved into their previous residence less than 5 years ago, we use their tenure status in the year in which they moved into the previous residence.

are selectively not included in our main analysis while keeping the same identification strategy as introduced above. The caveat is that we could only use ownership status as a dependent variable and could not control for the same extensive set of household controls. For the analysis here we follow a simpler specification with just person (the household head) and region-year fixed effects together with age controls. The results in appendix Table A10 confirm our previous findings. We find that deregulation indeed increased the ownership likelihood and this effect comes from the younger households. Finally, when we focus on a sample of households that changed residence over the last 5 years, we find that the effect of deregulation becomes larger in size and more significant.

8 Conclusion

We have analysed the effect of an increase in credit supply on the homeownership and mortgage status as well as other housing related aspects of individuals' balance sheets. To isolate changes in credit supply from confounding factors we have employed an index measuring the restrictions on interstate branching. Previous literature has shown that this is a plausibly exogenous measure of credit supply which increased competition among banks and provided diversification gains to them. We include a rich set of individual and local economic characteristics to account for changes in demand. Moreover, we also include individual fixed effects which allow us to rule out concerns with regard to selection into living in a particular state and into a particular tenure status.

Our main findings show that increases in credit supply in the period 1996 to 2005 have considerably added to increasing ownership and mortgage rates. Consequently, households' mortgage debt has increased which led to a slight rise in household leverage measured by debt to value and debt to income ratios.

However, the data revealed considerable heterogeneity in the effect of deregulation. Most importantly, deregulation-induced a higher likelihood of homeownership and having a mortgage in

MSAs and resulted in an increase in mortgage debt for individuals in non-MSAs. Deregulation-induced credit supply increased mortgage availability overall. It has also facilitated home equity financing in non-metropolitan areas. We conjecture that this result stems from the observation that the branch network in metropolitan areas was already dense to begin with, while room for increased competition existed in less populous locations. Furthermore, most of the effects of deregulation are concentrated on young individuals as they are more likely to change ownership status and have a longer investment horizon. Low income households were not able to take advantage of the opportunities provided by increased credit supply, at least with regard to the housing market.

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Appendix: Further results

Table A1: Summary Statistics: Single wave individuals, by panel

Panel	1996	2001	2004
Main independent variable			
Deregulation index	1.014	1.980	2.014
Outcomes			
Is Homeowner (in %)	50.0	57.1	62.7
Has Mortgage (in %)	38.9	44.1	49.1
Log Mortgage Debt	10.95	11.07	11.21
Log Home Value	11.55	11.69	11.90
Debt to Value	0.60	0.60	0.57
Debt to Income	18.93	21.58	22.48
Household controls			
Age	40.17	40.87	41.93
Married	0.59	0.61	0.64
On Low Income (in %)	0.40	0.35	0.34
Low Income Threshold (in $)	2226	2235	2242
Income (in $)	3660	4064	4294
Log Income	7.93	8.05	8.10
Income Growth	2.77	-0.70	3.54
Has Property Income (in %)	0.59	0.56	0.62
Receives Unemployment Benefit (in %)	0.04	0.04	0.04
Number Children in Household	0.89	0.83	0.85
Number Household Members	3.06	3.07	3.05
State controls			
Unemployment rate	5.56	4.00	5.92
Log per capita income	10.08	10.32	10.38
Log population	16.00	16.01	15.83
GDP growth rate	5.76	6.19	3.49
Observations	5,264	3,730	8,151

Notes: Table reports mean statistics for the sample of individuals that only appear in the first wave with asset and liability information (wave 3) from each panel. Low income threshold is two times the poverty threshold as defined by the SIPP. Low income households are those that are below this threshold at all waves. All nominal variables are deflated by 1996 prices.

Table A2: The effect of easier credit supply by previous ownership status

Sample	Full	MSA	Non-MSA	Full	MSA	Non-MSA
	(1)	(2)	(3)	(4)	(5)	(6)
A: Is Homeowner	Initial Owner			Initial Renter		
Deregulation index	0.0011	0.001	0.0024**	0.0025	0.0024	-0.0011
	(0.0008)	(0.0009)	(0.0012)	(0.0019)	(0.0022)	(0.0039)
Observations	140,545	107,074	32,913	89,177	74,358	13,864
B: Has Mortgage	Initial Owner			Initial Renter		
Deregulation index	0.0053**	0.0036	0.0137**	0.0013	0.0014	-0.0014
	(0.0026)	(0.0027)	(0.0068)	(0.0022)	(0.0024)	(0.0057)
Observations	140,545	107,074	32,913	89,177	74,358	13,864

Notes: The coefficients report the estimated effect of a relaxation of inter-state banking by one index point. The sample is split by ownership status on previous residence 5 years ago. All regressions include the same controls as listed in the notes to Table 2. Standard errors are clustered by state-years and reported in parentheses. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

Table A3: The effect of easier credit supply on amount of reported value of home (in logs)

	By age					
	All		Young		Old	
By location	(1)	(2)	(3)	(4)	(5)	(6)
A: All						
Deregulation index	0.0063	0.0072	0.0151**	0.0163**	-0.0033	-0.0033
	(0.0047)	(0.0052)	(0.0061)	(0.0064)	(0.0058)	(0.0067)
Deregulation index ×		-0.0061		-0.0153		-0.0001
Low income		(0.0069)		(0.0125)		(0.0077)
B: MSA						
Deregulation index	0.0048	0.0053	0.0112*	0.0114*	-0.0032	-0.0024
	(0.0047)	(0.0050)	(0.0062)	(0.0063)	(0.0073)	(0.0081)
Deregulation index ×		-0.005		-0.0037		-0.0041
Low income		(0.0070)		(0.0165)		(0.0084)
C: Non-MSA						
Deregulation index	0.0133	0.0162	0.0294*	0.0374*	-0.0009	-0.0068
	(0.0124)	(0.0168)	(0.0160)	(0.0200)	(0.0168)	(0.0219)
Deregulation index ×		-0.0118		-0.0453		0.0189
Low income		(0.0218)		(0.0352)		(0.0214)

Notes: Dependent variable: Log of amount of reported home value. Sample includes only home owners. See notes to Table 4 for further information.

Table A4: The effect of easier credit supply on mortgage debt to home value ratio

	By age					
	All		Young		Old	
By location	(1)	(2)	(3)	(4)	(5)	(6)
A: All						
Deregulation index	0.0011	0.0006	0.0015	0.0017	0.0004	-0.0015
	(0.0018)	(0.0018)	(0.0019)	(0.0019)	(0.0031)	(0.0031)
Deregulation index ×		0.0061		-0.0034		0.0145*
Low income		(0.0049)		(0.0063)		(0.0078)
B: MSA						
Deregulation index	-0.0005	-0.0013	0.0003	0.0006	-0.0018	-0.0047
	(0.0019)	(0.0018)	(0.0021)	(0.0022)	(0.0032)	(0.0034)
Deregulation index ×		0.0100*		-0.0061		0.0227**
Low income		(0.0053)		(0.0076)		(0.0090)
C: Non-MSA						
Deregulation index	0.0100**	0.0118**	0.0098**	0.0097*	0.0108	0.0159
	(0.0046)	(0.0047)	(0.0050)	(0.0050)	(0.0086)	(0.0099)
Deregulation index ×		-0.0139		0.0011		-0.0314*
Low income		(0.0103)		(0.0133)		(0.0169)

Notes: Dependent variable: Ratio of mortgage debt to reported home value. Sample includes only observations with positive mortgage debt. See notes to Table 4 for further information.

Table A5: The effect of easier credit supply on mortgage debt to household income ratio

	By age					
	All		Young		Old	
By location	(1)	(2)	(3)	(4)	(5)	(6)
A: All						
Deregulation index	0.0902	0.0883	0.1483*	0.1771*	-0.0136	-0.0927
	(0.0755)	(0.0774)	(0.0845)	(0.0904)	(0.1615)	(0.1830)
Deregulation index ×		0.0329		-0.5664		1.1663
Low income		(0.4613)		(0.6591)		(1.2084)
B: MSA						
Deregulation index	0.0666	0.0459	0.0793	0.1032	0.0283	-0.0932
	(0.0776)	(0.0802)	(0.0981)	(0.1012)	(0.1477)	(0.1606)
Deregulation index ×		0.4255		-0.5576		2.034
Low income		(0.6741)		(0.7294)		(1.4069)
C: Non-MSA						
Deregulation index	0.2836	0.4119**	0.5121***	0.5649***	-0.085	0.1247
	(0.1747)	(0.1651)	(0.1779)	(0.1796)	(0.4139)	(0.3990)
Deregulation index ×		-1.2563		-0.5408		-1.9277*
Low income		(0.9001)		(1.2677)		(1.1242)

Notes: Dependent variable: Ratio of mortgage debt to household income. Sample includes only observations with positive mortgage debt. See notes to Table 4 for further information.

Table A6: The effect of easier credit supply on real income growth

	By age		
	All	Young	Old
By location	(1)	(2)	(3)
A: All	0.0037	0.0058	0.0011
	(0.0044)	(0.0054)	(0.0061)
B: MSA	0.0067	0.0082	0.0048
	(0.0051)	(0.0064)	(0.0073)
C: Non-MSA	-0.0059	-0.0027	-0.0098
	(0.0106)	(0.0135)	(0.0119)

Notes: Dependent variable: Real income growth. See notes to Table 4 for further information.

Table A7: The effect of easier credit supply: household level analysis

Sample	Full	MSA	Non-MSA	Full	MSA	Non-MSA
	(1)	(2)	(3)	(4)	(5)	(6)
A: Ownership Status	Is Homeowner			Has Mortgage		
Deregulation index	0.0021**	0.0020*	0.0016	0.0040***	0.0037**	0.0059
	(0.0010)	(0.0011)	(0.0013)	(0.0015)	(0.0017)	(0.0045)
Observations	136,224	108,113	27,186	136,224	108,113	27,186
B: Home Equity	Log Mortgage Debt			Log Home Value		
Deregulation index	0.0035	-0.0035	0.0441***	0.0072	0.0067	0.0107
	(0.0073)	(0.0085)	(0.0136)	(0.0048)	(0.0047)	(0.0113)
Observations	49,489	40,426	8,955	74,997	58,943	15,880
C: Leverage	Debt to Value			Debt to Income		
Deregulation index	0.0006	-0.0005	0.0065	0.0827	0.0611	0.2500
	(0.0020)	(0.0021)	(0.0048)	(0.0811)	(0.0846)	(0.1783)
Observations	47,548	38,953	8,493	45,953	37,667	8,185

Notes: The table repeats the analysis in Table 2 using only the head of households at the beginning of the sample. See notes to Table 2 for further information.

Table A8: The effect of easier credit supply on non-movers

Sample	Full	MSA	Non-MSA	Full	MSA	Non-MSA
	(1)	(2)	(3)	(4)	(5)	(6)
A: Ownership Status	Is Homeowner			Has Mortgage		
Deregulation index	0.0010*	0.0011	0.0006	0.0042**	0.0036*	0.0058
	(0.0006)	(0.0008)	(0.0013)	(0.0018)	(0.0019)	(0.0042)
Observations	113,571	89,145	24,426	113,571	89,145	24,426
B: Home Equity	Log Mortgage Debt			Log Home Value		
Deregulation index	0.0007	-0.0084	0.0447***	0.0053	0.0041	0.0127
	(0.0086)	(0.0105)	(0.0146)	(0.0051)	(0.0051)	(0.0113)
Observations	45,273	36,789	8,484	69,511	54,289	15,222
C: Leverage	Debt to Value			Debt to Income		
Deregulation index	-0.0008	-0.0024	0.0061	0.042	0.0227	0.2367
	(0.0021)	(0.0022)	(0.0048)	(0.0895)	(0.0929)	(0.1762)
Observations	43,462	35,434	8,028	42,010	34,247	7,763

Notes: The coefficients report the estimated effect of a relaxation of inter-state banking by one index point. The sample only includes households who have stayed in the same dwelling throughout the panel. The sampling restriction is the same as in A7. See notes to Table 2 for further information. Standard errors are clustered by state-years and reported in parentheses. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

Table A9: The effect of easier credit supply on movers

Sample	Full	MSA	Non-MSA	Full	MSA	Non-MSA
	(1)	(2)	(3)	(4)	(5)	(6)
A: Ownership Status	Is Homeowner			Has Mortgage		
Deregulation index	0.0087	0.0086	0.004	0.0051	0.0054	-0.0024
	(0.0055)	(0.0058)	(0.0118)	(0.0047)	(0.0048)	(0.0157)
Observations	21,478	18,911	3,183	21,478	18,911	3,183
B: Home Equity	Log Mortgage Debt			Log Home Value		
Deregulation index	0.0211	0.0156	0.0909	0.0249*	0.0251	0.0245
	(0.0280)	(0.0287)	(0.0823)	(0.0143)	(0.0153)	(0.0283)
Observations	4,075	3,707	520	5,300	4,773	736
C: Leverage	Debt to Value			Debt to Income		
Deregulation index	0.0089*	0.0085	0.0296	0.2359	0.1353	0.3025
	(0.0054)	(0.0054)	(0.0197)	(0.4008)	(0.4013)	(1.6653)
Observations	3,949	3,587	512	3,806	3,470	463

Notes: The coefficients report the estimated effect of a relaxation of inter-state banking by one index point. The sample only includes households who have changed their dwelling throughout the panel. The sampling restriction is the same as in A7. See notes to Table 2 for further information. Standard errors are clustered by state-years and reported in parentheses. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

Table A10: The effect of easier credit supply on ownership over 5 years

	All	Young	Old
A: All observations			
Deregulation index	0.0028	0.0045*	-0.0009
	(0.0019)	(0.0025)	(0.0016)
Observations	107,672	73,258	34,414
B: Movers last five years			
Deregulation index	0.0071	0.0097**	-0.0055
	(0.0044)	(0.0046)	(0.0073)
Observations	47,852	38,876	8,976

The table presents the estimated effects of deregulation on ownership. The sample consists of all households in the first wave of the three SIPP panels. Ownership is determined for the survey year based on the assets and liabilities module and for five years prior (or less depending on availability - see explanation in text) based on survey questions on past mobility. The analysis is restricted to household heads. The Young (Old) sample includes observations aged 21(46) to 45(65) based on the first year they appear in the estimation sample. Panel B only includes households who have changed their dwelling at most 5 years prior to the first wave of the estimation period. Regressions include person and region-year fixed effects and young status interacted with time fixed effects. Standard errors are clustered by state-years and reported in parentheses. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.