How sensitive are homeownership decisions to tax subsidies?

The role of housing supply conditions and lending standards

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Abstract

In this paper we examine the impact of the combined state and federal mortgage interest tax subsidies to homeownership on homeownership attainment, using panel data from 1984 to 2007 and exploiting the fact that the value of these subsidies may vary by income group across states and over time and depending on local housing market conditions and lending standards. We also exploit the fact that households move across states, which generates another source of variation in tax subsidies. We test our proposition that capitalization of tax subsidies into higher house prices offsets the positive effect of tax subsidies on homeownership attainment by exploiting data on regulatory restrictiveness in the late 1970s/early 1980s as a proxy for the inelasticity of local housing supply. Controlling for household, MSA, state and year fixed effects as well as time-varying household and location characteristics, we find that in more restrictive places tax subsidies have a negligible effect on homeownership attainment whereas in less regulated places tax subsidies have a meaningful positive impact for all income groups except the lowest quartile. We also explore whether mortgage lending conditions affect the link between subsidies and homeownership attainment but find no supporting evidence. Our findings cast serious doubt on mortgage interest deduction as a policy for boosting homeownership and improving social welfare.

JEL classification: H22, H24, H71, R21, R31, R52

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I. Introduction

Various policies at U.S. state and federal level aim to increase homeownership attainment and some of these programs are sizable. For example, the federal mortgage interest deduction constitutes the second largest federal tax expenditure, valued at an estimated $80 billion in foregone tax revenue in 2007 (Congressional Budget Office, 2009). The mortgage interest deduction taken on state income taxes can be substantial as well. Moreover, there are large differences across U.S. states in this tax subsidy: some states such as California, Delaware, Maine, Massachusetts and North Carolina rely heavily on personal income taxation to raise revenue, permitting the deduction of mortgage interest, and other states such as Florida, Nevada, South Dakota, Texas and Wyoming levy no personal income tax at all (Minnesota Department of Revenue, 2009).

Tax subsidies – to the extent that they encourage homeownership – may be justified as efficiency improving: homeownership has been associated with various positive externalities[1] and social benefits associated with higher homeownership rates may well outweigh the corresponding deadweight loss. Relatively little is known, however, as to whether or not tax subsidies indeed induce households that are 'marginal' with respect to the housing tenure decision to become homeowners. The few studies that explore the impact of the combined federal and state tax subsidies on homeownership attainment – relying on data from the 1970s, 1980s or 1990s – yield mixed results.[2] Glaeser and Shapiro (2002) note that mortgage interest deduction is a poor instrument to encourage homeownership as it is targeted at high income

[1] See, for example, Dietz and Haurin (2003).

[2] Although a voluminous literature on tenure choice takes into account *federal* tax policy when constructing the user cost of housing (see e.g., Turner and Seo, 2007), and numerous papers examine the distribution of (primarily) *federal* tax benefits (see e.g., see Poterba and Sinai, 2008; Sinai and Gyourko, 2004; Glaeser and Shapiro, 2002), to our knowledge only three studies – discussed in the text – examine the combined *state and federal* tax subsidy. There is one other paper at the sub-national level: Coulson (2002) focuses on the determinants of the *regional* homeownership rate. A cross country panel study is provided by Hilber (2007), who examines the determinants of homeownership across Europe and finds that tax policy reforms at the country level have had only relatively minor impacts on individual (and collective) homeownership attainment.

households, who almost always own. Using 1990 and 2000 Census data, their correlation analysis suggests that state homeownership rates are unrelated to the size of state tax subsidies (p. 40). Using 1984 cross-sectional data on households residing in 38 states, Narwold and Sonstelie (1994) find a positive and significant coefficient on the household (combined) marginal tax rate in a tenure choice estimation, suggesting a positive effect of the combined federal and state tax subsidies (which, though not reported, corresponds to a large marginal effect). Bourassa and Min (2008) focus on a cross-section of young households in 1998 and find an adverse effect of combined state and federal mortgage interest deduction on homeownership attainment. They argue that tax subsidies are capitalized into house values and thereby reduce the likelihood that young households qualify for a mortgage.

To the extent that the tax subsidies have enabled more marginal renters to become homeowners, the tax subsidies may have further aggravated the severity of the current economic crisis, as 'marginal households' are most at risk of losing their homes and their corresponding down-payments; the latter often constitute the entire financial wealth of low- and moderate-income household (Turner and Luea, 2009). Given the magnitude of tax subsidies to homeownership and the corresponding role of lending standards, both from a welfare point of view and as potential 'accelerators' of housing related economic crises, it is surprising how little is known about the relationship between these variables.

We hypothesize that the impact of subsidies to owner-occupied housing on homeownership attainment will largely depend on the extent to which housing supply is inelastic. In places with inelastic housing supply, the tax subsidies are capitalized into house prices as suggested by Bourassa and Min, and the housing stock does not expand to facilitate higher homeownership rates. The fact that the impact of the subsidies likely varies by the degree to which housing supply is inelastic may reconcile previous findings. Analyses that use a

national dataset will fail to detect the role the subsidy may play in boosting homeownership rates in more elastically supplied housing markets as the positive effects are washed out by the negligible impacts in more inelastically supplied housing markets.[3] Studies based on primarily urban areas are more likely to detect house-price capitalization and a non-effect on homeownership rates.

Using household data from the Panel Study of Income Dynamics (PSID) from 1984 to 2007, this paper examines the impact of the combined state and federal mortgage interest tax subsidies to homeownership on homeownership attainment, allowing for the possibility that the value of these subsidies may vary by income group over time and depending on local housing market conditions and lending standards. We test our proposition that capitalization of tax subsidies into higher house prices offsets the positive effect of tax subsidies on homeownership attainment by exploiting data on regulatory restrictiveness in the late 1970s/early 1980s (compiled by Saks, 2008) as a proxy for the inelasticity of local housing supply. In addition, we hypothesize that mortgage lending conditions may enable households to overcome subsidy-induced house-price capitalization effects in more regulates places. As a preview of our findings: controlling for household, MSA, state and year fixed effects as well as time-varying household and location characteristics, we find that in more restrictive places tax subsidies have a negligible effect on homeownership attainment whereas in less regulated places tax subsidies have a meaningful positive impact for all income groups except the lowest quartile. The positive effect increases with income. Lending standards however have no discernible impact on the link between subsidies and homeownership attainment, regardless of regulatory status. These

[3] In a setting with a certain fraction of borrowing constrained households and inelastic supply of housing, it is in fact conceivable that homeownership attainment of the constrained group decreases. While the tax subsidy increases the benefits derived from owner-occupied housing and therefore increases demand for housing and, consequently, house prices, this also means that fewer constrained households will be able to afford the down-payment, decreasing housing demand and partially offsetting the price increase. These considerations are consistent with the finding by Bourassa and Min (2008) that the combined state and federal mortgage interest deduction has an adverse effect on homeownership attainment of the young.

findings cast serious doubt on the benefits of the mortgage interest deduction as a policy for boosting homeownership rates, particularly in more urbanized places.

The remainder of this paper is organized as follows. Section II provides a discussion of the implication of economic theory for the impact of tax subsidies on homeownership attainment. Section III details the data and sample issues. Section IV presents our empirical approach. Section V reports our empirical findings, and Section VI concludes.

II. Capitalization and the homeownership rate

Our theoretical predictions are straightforward. Tax subsidies to owner-occupied housing will increase demand for owner-occupied housing, all else equal. However, the degree to which tax subsidies benefits households depends upon the local elasticity of housing supply and likely differs by income as different income tax brackets are differentially affected. To see the importance of the supply elasticity, consider the standard model of housing market dynamics.[4] In the short run, the consumer's willingness to pay for new or expanded housing increases according to the present discounted value of the tax subsidy. The stock of housing is fixed in the very short run, thus the tax policy results in disequilibria in the housing market, and, depending on the extent to which a supply side adjustment is expected, the price of housing in the short run may rise by the full amount of the present discounted value of the tax subsidy.

In response to the demand-side housing market shock, the quantity supplied of owner-occupied housing may increase along two dimensions: New construction and conversion of rental units into owner-occupied units. At one extreme, if the long run supply of owner-occupied housing is perfectly elastic, then the equilibrium purchase price of housing will return to its pre-tax change level. The subsidy in this case results in an expanded housing stock, an increased homeownership rate and zero capitalization. At the other extreme, if the owner-occupied

[4] Based on Poterba (1980) and presented in Sheffrin (1996), p. 150.

housing stock is perfectly inelastic, the subsidy is fully capitalized into the purchase price of owner-occupied housing, the owner-occupied housing stock does not expand and the subsidy does not increase the homeownership rate, although it likely changes the composition of owners.

There is ample evidence that indices of the restrictiveness of land use regulation are good proxies for the housing supply elasticity and thus for the potential for expansion of owner-occupied housing through new construction. For example, Saks (2008) derives a 'combined' measure of regulatory restrictiveness for the late 1970s and early 1980s (by using information from a number of surveys, see Saks (2008) for details) to demonstrate that locations with relatively few barriers to construction experience more residential construction and smaller increases in house prices in response to an increase in housing demand. Furthermore, housing supply constraints alter local employment and wage dynamics in locations where the degree of regulation is more severe. In a similar vein, Hilber *et al.* (2009) by employing the regulatory index derived by Saks demonstrate that economic shocks affect the nature and composition of new housing supply only in places where regulation is not too tight. Quigley and Raphael, use a cit-level index of regulatory stringency for California cities and relate this index to local house prices in 1990 and 2000. They document, consistent with the findings in Saks (2008) and in this paper, that more regulated cities have more expensive housing and a slower growth in housing stock. They confirm that these more regulated places also have a lower price elasticity of housing supply. Finally, Saiz (2008) uses a current measure of regulatory restrictiveness – the Wharton regulatory index that captures the restrictiveness of regulation around 2005 – and relates this directly to measures of supply elasticity, demonstrating that more regulated metro areas have more inelastic supply. In our empirical analysis we use the regulatory index compiled by Saks, since the regulatory stringency in the late 1970s / early 1980s is exogenous to (and not determined by) subsequent changes in tax policies and subsequent housing tenure decisions. (In

contrast, the Wharton regulatory index from around 2005 and other recent measures of regulation are plausibly endogenous to prior changes in tax policies and in homeownership rates.)

As we use the regulatory index compiled by Saks (2008) in our analysis, her finding that in more strictly regulated metro areas house prices respond more strongly to changes in housing demand is particularly reassuring, as it supports our implicit assumption that in more tightly regulated places (defined as in our study) the extent of capitalization of demand factors – e.g., the mortgage subsidy – is greater. In a further attempt to confirm our implicit assumption that house price capitalization effects are greater in more tightly regulated places, we conduct a simple test of the proposition that regulatory restrictiveness affects the extent to which the mortgage subsidy rate raises house prices within our sample. Table A1 in the Appendix reports the results of regressing the house-price appreciation rate on the percentage change in the mortgage subsidy rate, controlling for year, state and MSA fixed effects. The results confirm that more regulated places have a greater extent of capitalization of the mortgage subsidy rate: greater increases in the mortgage subsidy are associated with higher house prices, and this effect is more than twice as large for the more regulated half of the observations in our sample. While this is a preliminary and rather coarse look at capitalization, it is suggestive. It is also worth noting that other studies (e.g., Quigley and Raphael, 2005, for the US; Hilber and Vermeulen, 2009, for the UK) that use different measures to proxy for regulatory stringency also come to the same conclusion; house prices react more strongly to demand shocks (i.e., the extent of house price capitalization is greater) in more tightly regulated markets and hence, all else equal, housing is more expensive in those markets. Finally, in addition to the regulatory controls, the homeownership specifications control for housing stock composition in the census tracts in which the households reside in order to capture at least in part the other aspect of housing supply elasticity: the extent to which the existing rental stock can be converted to owner-occupied use.

III. Data and sample Issues

This paper uses data from multiple sources. The primary data source is three decades of data from the PSID, which is a longitudinal survey of families that has been carried out continuously since 1968 and provides a unique opportunity to follow households over time. We select all PSID households observed from 1984 to 2007. We begin the panel in 1984 because this is the first year in which the PSID collects information on the household wealth holdings. Data are collected annually until 1997 and biennially after 1997, providing up to 19 observations per household.[5] The data include (i) the original 1968 PSID core sample of 5,000 households selected as a random cross-section sample of the U.S. population with an additional low-income sample, and (ii) persons living within a household unit that enter the sample as a separate household when they form their own household. Note that the PSID reconstituted its sample in 1997 by dropping 1/3 of the core sample, changing to biennial data collection, and reformatting sample weights. Thus, our sample includes only those households observed from 1984 through 2007, roughly 2/3 of the original core sample. All of the household data used in this study are collected in each year of observation, except wealth data. Prior to 1997, the wealth data are collected every 5 years. After 1997, they are collected with each survey. For the pre-1997 wealth data, we apply a linear function to impute annual estimates of total net wealth.

In addition to the PSID, we use five secondary data sources that report data at the tract, metropolitan or state level: TAXSIM, U.S. Census, Federal Housing Finance Board, Federal Housing Finance Authority, and Saks (2008). We link this data to PSID households using PSID geographic location data.[6] Our key variable of interest, the subsidy to homeowners through use of the federal and state mortgage interest deductions, comes from the National Bureau of Economic

[5] Due to missing data, we allow for a slightly unbalanced panel in our analysis in order to include the greatest number of households. Most households are included from 1984 to 2007.

[6] The PSID tract and MSA location indicators are confidential data from the PSID GEOCODE data files and can be obtained from the PSID under special contract. These data are not available from the authors.

Research publicly available TAXSIM data. The TAXSIM data are generated by simulating the effects of the U.S. federal and state tax systems using micro data on individual tax returns. As detailed in Feenberg and Coutts (1993) and at http://www.nber.org/taxsim, the mortgage interest subsidy is calculated as follows. TAXSIM calculates state and federal income tax liabilities owed by a large sample of taxpayers in each state in each year. The mortgage interest is then increased by 1% for each taxpayer, the state and federal taxes are recalculated, and the mortgage interest subsidy is generated as the ratio of the additional tax (savings) to the additional mortgage interest. It measures the tax savings from an additional dollar of mortgage interest, or, equivalently, it is the marginal subsidy rate on mortgage interest. The average mortgage interest subsidy is then computed by state and year, using a fixed sample of taxpayers across time so that year to year changes in the mortgage subsidy reflect only changes in tax law and not changes in the income distribution. The property tax subsidy is similarly generated. Importantly, using the marginal subsidy to the average taxpayer in the state in which the PSID household resides (varying in each year from 1984 to 2007) provides an exogenous measure of the mortgage interest subsidy for our analysis.

To control for location specific factors that affect homeownership, we merge 1980 U.S. Census data on the composition of the housing stock at the tract level to the PSID households. The specific variables we examine include the share of housing units in the tract that are single family and the share of units that are in multiplexes (structures with 5 or more units). We use the 1980 composition of the housing stock as it will be exogenous in an analysis of the probability of homeownership post 1980. We use publicly available data from the Federal Housing Finance Board (FHFB) on metropolitan and state average effective mortgage interest rates and loan-to-value (LTV) ratios at the time of mortgage origination for conventional, single-family, non-farm loans. The data are from the FHFB Monthly Interest Rate Survey and are computed based on

fully amortized loans. Refinances, non-amortized loans, and balloon loans are excluded from the FHFB data as are non-conventional loans (www.fhfb.gov). We use the metropolitan data where available and the state level data for PSID households that are not residing in one of the FHFB reported metro areas. The effective mortgage interest rate is the contracted rate adjusted for fees and charges.

The house price appreciation data used in this study in Table A1 come from the Federal Housing Finance Authority (FHFA), formerly known as Office of Federal Housing Enterprise and Oversight. FHFA produces public use house price indexes at the metropolitan and state level using a repeat sales methodology and data on single-family properties whose loans have been purchased or securitized by Freddie Mac or Fannie Mae over the years (see www.fhfa.gov). As with the FHFB data, we use the metro level indexes where available and the state level indexes for households that are not residing in one of the FHFA metro areas. Finally, as noted previously, we use the metropolitan-level regulatory index generated by Saks (2008) as a measure of the housing supply inelasticity.

The sample includes 4,197 households corresponding to 53,279 household-year observations residing in metropolitan and non-metro areas for the base empirical specifications, and 2,620 households corresponding to 29,621 household-year observations residing in metropolitan areas for which we have regulatory index data. The sample size is slightly smaller than the 29,621 household-year observations when the LTV is included as a control. Roughly 2.5% of households move to a different state and 4% of households move to a different MSA in any given year. All dollar amounts are adjusted to 2007 dollars using the urban Consumer Price Index. All analysis is weighted using the PSID 2005 sample weights.[7]

[7] The PSID sample is not representative of the U.S. population without the application of sample weights. The post-1997 weights are stratified to the U.S. population according to data from the Current Population Survey. See Heeringa and Connor (1999) for more discussion. We use the 2005 combined family weight because the more recent 2007 weight is preliminary and not available for as many households as the 2005 weight.

IV. Empirical approach

We estimate the following base specification for household *i* at time *t* (in location *j*) as a linear probability model:

$$\Pr\ own_{it} = \alpha_0 + \alpha_1 mrs_{it} + X_{it}'\beta + L_{it}'\delta + D_i'\lambda + e_i, \quad (1)$$

where *mrs* is the mortgage subsidy rate, which is expected to have a positive coefficient to the extent that it facilitates homeownership, *X* is a vector of household characteristics that vary over time, *L* is a vector of location characteristics that vary over time as households move locations, *D* is a vector of individual fixed effects.[8] The vector of time-varying household characteristics includes controls for total family income, total net wealth, age of head, marital status, children, and unemployment of head and spouse if present. The vector of time-varying location characteristics includes tract-level housing stock controls (the share of housing units that are single family units and the share of housing units in multiplexes), MSA fixed effects and state fixed effects. The rationale for including both MSA- and state fixed effects is that not all households reside in MSAs. The state fixed effects provide location controls for those places. Also, there could be unobservable time-invariant effects at the MSA and state level. We estimate (1) with a household cluster correction. This implies that the standard errors allow for intra-household correlation, relaxing the usual requirement that the observations be independent. That is, the observations are independent across groups (clusters) but not necessarily within groups. As noted previously, PSID households do move across MSAs and across states. Hence, there is variation in our MSA-specific as well as in our state-specific measures.

[8] Equation (1) can be estimated as a linear probability fixed effects model or a conditional fixed effects logit model. Note however that it is not feasible to estimate a conditional fixed effects probit model, as there does not exist a sufficient statistic allowing the fixed effects to be conditioned out of the likelihood. Unconditional fixed-effects probit models could be fitted with indicator variables for the panels. However, unconditional fixed-effects estimates would be biased.

One advantage of estimating equation (1) as a fixed effect model is that household fixed effects capture all unobserved heterogeneity in household characteristics – such as race/ethnicity of the household head – that are time invariant.[9] To the extent that households don't move, the fixed effects also capture time invariant location characteristics (at neighborhood-, municipality-, county-, state-, region-, and national-level). However, households do move across space and we observe such changes in our panel. As a result, we also include the location controls discussed above. Regarding total net wealth, note that changes in net asset wealth are driven in part by changes in income (Turner and Luea, 2009). Hence, once we control for fixed effects and household income, the impact of household net wealth on homeownership attainment may be quite limited. Our choice of using a fixed effects model over a random effects model is also driven by Hausman specification tests, which indicate that random effects models are not appropriate in this case.

To explore the impact of regulatory restrictiveness, we also estimate the following specification for household *i* at time *t* (in location *j*), again, as a linear probability model:

$$\Pr\ own_{it} = \alpha_0 + \alpha_1 mrs_{it} + \alpha_2 mrs_{it} * reg_{it} + \alpha_3 reg_{it} + X_{it}'\beta + L_{it}'\delta + D_i'\lambda + e_i, \qquad (2)$$

where *reg* equals the value of the regulatory index with higher values of the index indicating greater regulatory restrictiveness and hence more inelastic housing supply. Economic theory suggests that $\alpha_2 < 0$: the positive impact of the subsidy on homeownership attainment ought to be weaker in more regulated metro areas. Note that reg_{it} varies in the panel even though our regulatory proxy is time-invariant and only varies by location. This is because reg_{it} varies as

[9] Since we are interested in the effect of tax deductibility of mortgage interest on housing tenure decisions and not in say the effects of time-invariant household and location characteristics such as race/ethnicity or neighbourhood effects, the fixed effects specification is superior to an approach where the research attempts to add as many observable time-invariant controls.

households move between metro areas or states and thereby move from more to less restrictive places and vice versa.

One could make the case that more and less regulated places provide different environments for homeownership and the link between explanatory variables and homeownership attainment may vary across regulatory environments. To capture this we split our sample into two groups: households residing in more restrictive metro areas (as measured by a regulatory index value equal to or exceeding the median value of the index in the sample) and households residing in less restrictive metro areas (a regulatory index value less than the median value of the index), and re-estimate equation (1). Next, we re-estimate equation (1) by regulatory status allowing for a differential impact of tax subsidies depending on the household's income by interacting *mrs* with income. However, this specification does not capture the possibly non-linear effect of *mrs* by income. It also doesn't allow us to estimate the non-linear independent effect of income. To address these concerns, we also run specifications that control for income using income quartiles (defined based on the sample income distribution) and income quartiles interacted with *mrs.*

Missing from the analysis so far is a control for the relative cost of homeownership: the cost of housing services in the owner mode relative to the cost of housing services in the rental mode. In studies of homeownership, the annual cost of housing services in the owner mode is generally approximated as the user cost (UC) of housing, which is a household–specific variable measuring the expected consumption value of the housing services from purchasing a home. The user cost is the sum of depreciation and maintenance costs, the after-tax opportunity cost of the down payment, the after-tax mortgage interest payments and after-tax property tax payments minus the expected, nominal capital gain on the housing structure (Sheffrin, 1996).[10] Of these

[10] For user cost construction using household data in the PSID, see Turner and Seo (2007) or Turner and Smith (2009).

components of UC, equation (1) controls for the mortgage interest tax break using the TAXSIM data (*mrs*). We also run equation (1) adding controls for the FHFB reported effective mortgage interest rate and the TAXSIM property tax subsidy rate. (As we will document in the next section, the coefficients on these two variables are completely statistically insignificant. We do not report these results as central estimates because of potential endogeneity concerns related to the two variables. See the next section for a more in-depth discussion of the rationale.) We do not control for the expected house-price appreciation rate as this component for UC will be endogenous to the homeownership rate in light of the *mrs* and capitalization effects in the presence of regulatory restrictiveness. That is, an increase in the likelihood of homeownership as a result of the *mrs* will generate appreciation of the price of owner-occupied housing and this capitalization effect is greater in more regulated markets (i.e., the causation is reversed).[11] The remaining terms in UC, depreciation and maintenance, are each typically set to a value of 0.02 (e.g., see Poterba, 1992), and thus in equation (1) would be part of the constant. What remains to be taken into account is the cost of housing in the rental mode. We propose measuring this (in a future draft) as the weighted, average, annual, real rent in the state and year in which the family is observed, computed using the self-reported rent in the PSID. It is worth noting however, that this measure is too endogenous; an increase in demand for owner-occupied housing due to the *mrs* will at the same time reduce the demand for renter-occupied housing.

Finally, we investigate whether lending conditions affect the link between mortgage subsidies and homeownership attainment and whether there are different effects for different income groups and different regulatory environments. Our prior is that in more regulated places, where subsidies are capitalized into higher house prices, lending conditions are important as they

[11] It is worth noting that if we include the house price appreciation rate as a control despite the concerns of reverse causation (results not reported in this paper but available from the authors upon request), the coefficient on the variable is completely statistically insignificant in all specifications and the impacts on the coefficients of the other variables including the *mrs* are negligible.

can help overcome the negative impact of the capitalization effect. In less regulated places, subsidies should not be capitalized into house prices to a great extent, and we would not expect lending conditions to affect the link between subsidies and homeownership attainment. Essentially, lending conditions only matter if the policy affects house prices and makes access to mortgage financing more difficult.

V. Empirical results

Table 1 presents the sample means for the full sample, the regulatory restrictiveness subsample, and by regulatory restrictiveness status. In Table 2 we document results for the baseline specifications (equation 1). Column (1) provides results for the specification that includes only the mortgage rate subsidy, household controls, and household fixed effects. Column (2) then adds locations controls (the housing stock variables, MSA fixed effects and state fixed effects). Column (3) adds year fixed effects, and column (4) finally allows for separate effects of *mrs* by income quartile. Across all four specifications, the key variable of interest, the mortgage rate subsidy, has no impact on the likelihood of homeownership in the baseline specifications, not even for the highest income households, in column (4), who tend to receive the greatest tax breaks from this feature of the tax code. This result is consistent with Glaeser and Shapiro (2002) and suggests that this very costly tax subsidy to U.S. homeowners is having no discernible impact on likelihood of homeownership attainment.

The control variables generate results that are sensible, intuitive and robust across all models. Income, wealth, age, being married and having children all positively impact the likelihood of homeownership, with income and being married having particularly large impacts: based on the coefficients reported in column (4), households in the highest income quartile are roughly 15 percentage points more likely to own than households in the lowest income quartile; being married increases the likelihood of homeownership by 17.2 percentage points. An episode

of head or spouse unemployment lowers the likelihood of homeownership by roughly 3 percentage points. The location controls indicate that the composition of the housing stock matters for homeownership attainment: a greater fraction of single family units boosts homeownership attainment whereas a greater fraction of multiplexes lowers it.

Table 3 reports results for specifications where we interact the mortgage subsidy rate with regulatory tightness as a proxy measure for the inelasticity of housing supply (equation 2). The proposition being tested is that in places with more inelastic supply (more regulated places), the tax subsidies get capitalized into house values rather than expanding the (owner-occupied) housing stock and thereby has little impact on homeownership attainment. Column (1) allows for the impact of the *mrs* to vary by regulatory restrictiveness on the full sample for which we have regulatory data. Columns (2) and (3) provide equivalent results, but here we allow all coefficients to vary between more and less regulated environments (and not just the coefficient on the tax subsidy rate). Column (1) indicates that the impact of the *mrs* is weaker in more regulated places. According to column (1), the marginal effect of a 10% increase in the *mrs* (from its sample mean of 0.276) is small, increasing the homeownership rate by just 0.4 percentage points. Columns (2) and (3) reveal that the tax subsidy can have a positive impact on homeownership attainment, but only in less regulated places, where housing supply is provided elastically. Column (3) implies that a 10% increase in the *mrs* from its sample mean increases the homeownership rate by 4 percentage points. Regarding the other results from Table 3; note that the household and location controls continue to be intuitive and plausible and are remarkably robust across samples and specifications. The Appendix Table A2 reports the year fixed effects corresponding to Table 3. One observation is interesting to note; in the more regulated subsample the year dummies become more negative over time and the negative coefficients start to become statistically significant in 1995 (the omitted year is the first year in our sample period;

1984). This is in contrast to the less regulated places where, if anything, a positive time trend can be identified (the year dummies are positive and statistically significant between 2001 and 2003). These results suggest that, controlling for all the other factors, homeownership attainment has been decreasing in the more regulated places during the housing boom period but was by trend increasing in the less regulated places, implying that perhaps raising house prices have made housing less affordable in the more regulated metro areas (despite looser lending standards[12]), while the opposite occurred in the less regulated places.

Table 4 provides further insights into the workings of the tax subsidy in different regulatory environments for different income groups. Columns (1) to (3) allow for income to enter linearly, whereas columns (4) to (6) control for effects using income quartiles. The coefficients reported in column (1) for the full sample of observations with regulatory information suggest that the impact of the mortgage rate subsidy varies by income status, with the effect being stronger for higher income households. Splitting the sample by regulatory restrictiveness (columns 2 and 3) indicates that the positive interaction effect of the tax subsidy and income is confined to less regulated places, that is, only in these places does a raise in household income increase the positive impact of the mortgage rate subsidy on homeownership attainment. The independent effect of the tax subsidy is statistically insignificant. Allowing for a non-linear effect of income, we see in columns (4) to (6) that, again, consistent with the findings thus far, the subsidy has a positive effective on homeownership attainment only in the less regulated areas and for higher income households. The *mrs* has no impact on the homeownership attainment of the lowest income quartile, and the strongest effect is for the

[12] Nearly 20% of the loans originated in 2007 had loan-to-value ratios exceeding 97%, a steep increase from a decade earlier (Gabriel and Quigley, 2009). Also see Mayer *et al.* (2009) for a comprehensive account of the deteriorating lending standards and the rise in mortgage defaults over the last several years.

highest income quartile, with a 10% increase in the subsidy increasing the likelihood of homeownership for these households by roughly 5 percentage points in the less regulated places.

Table 5 examines whether lending conditions affect the link between mortgage subsidies and homeownership attainment and whether there are different effects for different income groups and different regulatory environments. Our prior is that in more regulated places, where subsidies are capitalized into higher house prices, lending conditions may be important as they can help overcome the negative impact of the capitalization effect, particularly for lower income households. Referring to Table 5, however, we see that lending conditions as measured by the FHFB average LTV at the time of mortgage origination have no impact on homeownership attainment, regardless of the regulatory environment and the income status. We identify two reasons for why we may be seeing a lack of an effect. First, the LTV is defined as the MSA average LTV except for those households living in more rural areas outside of MSAs. For these households the LTV will be defined as the state average LTV. As such, the measure is not picking up the extent to which lower income households may be attaining higher LTVs relative to higher income households to finance housing in more regulated places. Second, the LTV measure is based only on conventional loans at the time of origination, and will therefore not reflect sub-prime loans which are more readily taken by lower income households. The measure will also not reflect home equity loans or lines of credit taken at the time of the conventional mortgage origination. Places with a high share of such activities will underreport the 'true' LTV. To investigate these issues, in a future draft we will generate LTV measures by income quartile at the state level based on the self-reported LTVs in the PSID.

We re-estimate the specifications in Tables 3 and 4 controlling for additional components of user cost: the TAXSIM combined state and federal property tax subsidy rate and the FHFB effective mortgage rate, and report these results in the Appendix Tables A3 and A4. Our sample

size is somewhat reduced as the effective mortgage interest rate is not available for all households in our base sample.

The additional UC controls are, perhaps surprisingly, not significant and the other results are essentially unchanged, except that the impact of the *mrs* in less regulated places is greater in magnitude once the additional UC controls are added in. Referring to column (3) of Table A3, we see that a 10% increase in the subsidy increases the likelihood of homeownership by 6.3 percentage points. The coefficients reported in column (3) of Table A4 imply that a 10% increase in the subsidy increases the likelihood of homeownership by 5.3 percentage points. In addition, column (6) in Table A4 reveals that the first income quartile is now positively impacted by the *mrs*, and the *mrs* impacts for all income quartiles are enlarged once the additional UC controls are added in. We should interpret these findings with some caution however as both additional controls are subject to potential endogeneity concerns. The property tax rate is affected by house prices; places with greater housing wealth can set lower property tax rates, all else equal, and can still offer better local public services. At the same time an increase in the local homeownership rate may cause higher prices for owner-occupied housing. Hence homeownership may affect property tax rates via house prices, that is, reverse causation may be present. In a similar vein, if the homeownership rate increases, demand for mortgage credit strengthens as well. This in turn can raise mortgage interest rates. Again, reverse causation may be present. For all these reasons we only report these results as Appendix Tables rather than as our main specifications.

VI. Conclusion

Using multiple data sources, including the household data from the Panel Study of Income Dynamics (PSID) from 1984 to 2007, this paper provides a first look at the impact of the combined state and federal mortgage interest tax subsidy on homeownership attainment taking into account housing supply conditions via measures of regulatory restrictiveness in local

housing markets. We hypothesize that the impact of subsidies to owner-occupied housing on homeownership attainment will largely depend on the extent to which housing supply is inelastic. In places with inelastic housing supply, the tax subsidies are capitalized into house prices, and the housing stock does not expand to facilitate greater homeownership. The fact that the impact of the subsidies varies by the degree to which housing supply is inelastic helps to reconcile previously inconclusive findings. Controlling for household, MSA, state and year fixed effects as well as time-varying household and location characteristics, we find that in more restrictive places tax subsidies have a negligible effect on homeownership attainment whereas in less regulated places tax subsidies have a meaningful positive impact and the effects are strongest for the highest income groups. Lending standards, however, appear to have no discernible impact on the link between subsidies and homeownership attainment, regardless of regulatory status.

The implications for the redistributive effects of mortgage interest rate subsidies are striking. The fact that the subsidies have no effect at all on homeownership attainment in the more regulated markets, implies that an increase in the subsidy rate only serves to make existing (typically higher-income) homeowners better off and the existing (usually lower-income) renters worse off. In the less regulated places we do find the intended tenure transitions but, again, the impacts on homeownership attainment are muted for the lowest income quartile. So again, the lower income households tend to be disadvantaged as they cannot take advantage of the mortgage rate subsidy.

The implications from a welfare economic point of view are similarly striking (and depressing). One argument in favor of the tax deductibility of mortgage interest is that it may help to increase homeownership attainment in highly urbanized (inner city) areas. These areas are often confronted with lack of social capital, underperforming public schools and poor

governance and recent research has highlighted that positive externalities associated with homeownership may help local communities to improve along those dimensions (Hoff and Sen, 2005; DiPasquale and Glaeser, 1999; Hilber and Mayer, 2009; Fischel, 2001). However, our research suggests that the deductibility of mortgage interest does not in fact increase homeownership attainment in the more regulated, typically more urbanized places in the first place. To make things worse, recent studies demonstrate that house price capitalization only provides an incentive to invest in social capital (Hilber, 2009) and in local public schools (Hilber and Mayer, 2009) in more developed areas. This suggests that in the less populated places, where the mortgage subsidy does have a positive effect on homeownership attainment (at least for the higher income groups), positive externalities associated with homeownership – the welfare economic rationale for subsidizing homeownership attainment – are weakest.

Some work remains to be done, as noted in the text. A more careful empirical examination of the capitalization effects of the mortgage rate subsidy by regulatory status would be enlightening to further motivate our key assumption that the tax subsidy gets capitalized into higher house prices to a greater extent in more regulated places. Controls for the rental cost of housing need to be added to the analysis. We also have work to do to come up with a better measure of the loosening of lending standards than the change in the FHFB LTV on conventional mortgage originations over time.

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TABLES

TABLE 1
Summary Statistics

Full regression sample					
Variable	Obs.	Mean	Std. Dev.	Min	Max
Owner-occupier = yes	53279	.665966	.4716561	0	1
TAXSIM mortgage rate subsidy (absolute)	53279	.2610171	.0281266	.1871	.4048
Household income in 2007 US-$10,000	53279	7.587344	8.856022	0	583.9124
Age of household head	53279	42.71514	12.70008	0	97
Married	53279	.6413221	.4796169	0	1
One child	53279	.2028004	.4020888	0	1
Two children	53279	.210308	.4075312	0	1
Three or more children	53279	.1250211	.330746	0	1
Head in labor force and unemployed last year	53279	.0941834	.2920865	0	1
Wife in labor force and unemployed last year	53279	.0366936	.1880103	0	1
Share units in tract that are single family	53279	.6347047	.2467646	0	1
Share units in tract in apartment b. (5+ units)	53279	.1532468	.1864746	0	1
Total net wealth in 2007 US-$1 million	53279	.2509459	1.007438	-1.304067	50.475
Year of observation	53279	1994.429	6.860725	1984	2007
Sample of observations with MSA-level information on regulatory restrictiveness					
Owner-occupier = yes	29621	.6287769	.4831401	0	1
TAXSIM mortgage rate subsidy (absolute)	29621	.2610904	.0290127	.1937	.4048
Household income in 2007 US-$10,000	29621	8.034847	9.589932	0	583.9124
Age of household head	29621	42.6726	12.67863	18	96
Married	29621	.6039296	.4890876	0	1
One child	29621	.2021539	.4016132	0	1
Two children	29621	.2143749	.4103949	0	1
Three or more children	29621	.1229871	.3284279	0	1
Head in labor force and unemployed last year	29621	.0933459	.2909215	0	1
Wife in labor force and unemployed last year	29621	.0321731	.1764626	0	1
Share units in tract that are single family	29621	.5935163	.2837022	0	1
Share units in tract in apartment b. (5+ units)	29621	.1900505	.2167736	0	1
Total net wealth in 2007 US-$1 million	29621	.2586991	1.063148	-1.304067	50.475
Year of observation	29621	1994.407	6.948473	1984	2007
Regulatory index compiled by Saks (2008)	29621	.1407792	.9733928	-2.399357	2.210875
Average loan-to-value ration in MSA/state	28906	76.83579	4.041043	60.7	88.2
TAXSIM property tax rate subsidy	28906	.2556239	.0406874	.1613	.5006
Effective mortgage interest rate	28906	.0835433	.0185621	.0543	.1317
House price appreciation rate (only years w/o move)	28062	.0347652	.0450833	-.1738142	.2763218

	More restrictive (>med.)		Less restrictive (<med.)	
Variable	Obs	Mean	Obs	Mean
Owner-occupier = yes	14983	.62938	14638	.6281596
TAXSIM mortgage rate subsidy (absolute)	14983	.2615307	14638	.2606398
Household income in 2007 US-$10,000	14983	8.435857	14638	7.624385
Age of household head	14983	43.03751	14638	42.29908
Married	14983	.6137623	14638	.5938653
One child	14983	.2036308	14638	.2006422
Two children	14983	.2073016	14638	.221615
Three or more children	14983	.1070547	14638	.139295
Head in labor force and unemployed last year	14983	.0928386	14638	.0938653
Wife in labor force and unemployed last year	14983	.0325035	14638	.031835
Share units in tract that are single family	14983	.5421691	14638	.6460737
Share units in tract in apartment b. (5+ units)	14983	.2050892	14638	.1746573
Total net wealth in 2007 US-$1 million	14983	.3218152	14638	.1940953
Year of observation	14983	1994.244	14638	1994.575
Regulatory index compiled by Saks (2008)	14983	.9563831	14638	-.6940475
Average loan-to-value ration in MSA/state	14510	75.85409	14396	77.82526
TAXSIM property tax rate subsidy	14510	.2521821	14396	.2590929
Effective mortgage interest rate	14510	.0837928	14510	.0832919
House price appreciation rate (only years w/o move)	14181	.0397994	13881	.0296222

TABLE 2
Baseline Specifications: To Tax Subsidies Increase Homeownership Attainment?

	(1)	(2)	(3)	(4)
	Household controls only	Add location controls	Add year-FE	Tsmr varies by income quart.
Mortgage rate subsidy	-0.118	-0.0359	-0.172	
	(0.123)	(0.110)	(0.380)	
1st income quartile × Mortgage rate subsidy				-0.250
				(0.420)
2nd income quartile × Mortgage rate subsidy				-0.180
				(0.401)
3rd income quartile × Mortgage rate subsidy				-0.0727
				(0.393)
4th income quartile × Mortgage rate subsidy				-0.198
				(0.412)
2nd income quartile	0.0852***	0.0839***	0.0843***	0.0659
	(0.0103)	(0.00979)	(0.00978)	(0.0686)
3rd income quartile	0.148***	0.142***	0.143***	0.0966
	(0.0115)	(0.0109)	(0.0109)	(0.0728)
4th income quartile	0.171***	0.161***	0.161***	0.148**
	(0.0131)	(0.0121)	(0.0121)	(0.0737)
Total net wealth	0.00519**	0.00430**	0.00443**	0.00442**
	(0.00227)	(0.00188)	(0.00189)	(0.00190)
Age of head	0.0338***	0.0306***	0.0304***	0.0304***
	(0.00191)	(0.00178)	(0.00179)	(0.00179)
Age of head squared	-0.000247***	-0.000222***	-0.000220***	-0.000220***
	(1.96e-05)	(1.81e-05)	(1.87e-05)	(1.87e-05)
Married	0.192***	0.171***	0.172***	0.172***
	(0.0126)	(0.0116)	(0.0116)	(0.0116)
One child	0.0571***	0.0511***	0.0515***	0.0514***
	(0.00779)	(0.00730)	(0.00727)	(0.00728)
Two children	0.0985***	0.0874***	0.0874***	0.0872***
	(0.00907)	(0.00859)	(0.00859)	(0.00859)
Three or more children	0.126***	0.108***	0.109***	0.108***
	(0.0132)	(0.0119)	(0.0118)	(0.0119)
Head unemployed	-0.0414***	-0.0391***	-0.0390***	-0.0389***
	(0.00766)	(0.00726)	(0.00721)	(0.00720)
Wife unemployed	-0.0343***	-0.0334***	-0.0332***	-0.0332***
	(0.00995)	(0.00942)	(0.00945)	(0.00946)
Share of units that are single-family		0.0873**	0.0867**	0.0867**
		(0.0414)	(0.0414)	(0.0414)
Share of units that are in 5+ unit-buildings		-0.313***	-0.313***	-0.313***
		(0.0503)	(0.0504)	(0.0504)
Household FE	*Yes*	*Yes*	*Yes*	*Yes*
MSA FE	*No*	*Yes*	*Yes*	*Yes*
State FE	*No*	*Yes*	*Yes*	*Yes*
Year FE	*No*	*No*	*Yes*	*Yes*
Constant	-0.499***	-0.513	-0.486	-0.466
	(0.0550)	(0.358)	(0.362)	(0.364)
Observations	53279	53279	53279	53279
Number of households	4197	4197	4197	4197
R-squared overall model	0.310	0.298	0.299	0.299
R-squared within model	0.222	0.288	0.289	0.289
R-squared between model	0.376	0.316	0.316	0.316

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 3
Results for Specifications with Interaction 'Tax Subsidy × Regulatory Restrictiveness'

	(1)	(2)	(3)
	Sample of all MSAs with regulatory index from 1970s/80s	More regulated (regulatory index above median)	Less regulated (regulatory index below median)
Mortgage rate subsidy	0.205	-1.039	1.450**
	(0.499)	(0.768)	(0.686)
Mortgage rate subsidy × regulatory index	-0.336**		
	(0.137)		
Regulatory index	-0.00219		
	(0.0741)		
2nd income quartile	0.0652***	0.0525***	0.0783***
	(0.0139)	(0.0193)	(0.0202)
3rd income quartile	0.137***	0.126***	0.149***
	(0.0159)	(0.0227)	(0.0218)
4th income quartile	0.158***	0.155***	0.146***
	(0.0176)	(0.0262)	(0.0225)
Total net wealth	0.00339*	0.00338	0.00578**
	(0.00187)	(0.00236)	(0.00280)
Age of head	0.0304***	0.0338***	0.0264***
	(0.00253)	(0.00349)	(0.00364)
Age of head squared	-0.000208***	-0.000229***	-0.000185***
	(2.58e-05)	(3.61e-05)	(3.66e-05)
Married	0.165***	0.157***	0.167***
	(0.0162)	(0.0218)	(0.0249)
One child	0.0511***	0.0588***	0.0410***
	(0.0105)	(0.0145)	(0.0152)
Two children	0.0958***	0.102***	0.0815***
	(0.0121)	(0.0187)	(0.0148)
Three or more children	0.108***	0.112***	0.105***
	(0.0148)	(0.0225)	(0.0200)
Head unemployed	-0.0396***	-0.0428***	-0.0308**
	(0.00958)	(0.0114)	(0.0153)
Wife unemployed	-0.0434***	-0.0438***	-0.0410**
	(0.0123)	(0.0165)	(0.0177)
Share of units that are single-family	0.130**	0.0594	0.174**
	(0.0519)	(0.0704)	(0.0848)
Share of units that are in 5+ unit-buildings	-0.265***	-0.310***	-0.292***
	(0.0616)	(0.0805)	(0.104)
Household FE	*Yes*	*Yes*	*Yes*
MSA FE	*Yes*	*Yes*	*Yes*
State FE	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*
Constant	-1.156***	-0.140	-0.692**
	(0.203)	(0.258)	(0.277)
Observations	29621	14983	14638
Number of households	2620	1439	1430
R-squared overall model	0.353	0.333	0.326
R-squared within model	0.284	0.292	0.267
R-squared between model	0.363	0.356	0.297

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 4
Results for Specifications with Interaction 'Tax Subsidy × Income'
for More and Less Regulated Metro Areas

	(1)	(2)	(3)	(4)	(5)	(6)
	Full sample	More reg.	Less reg.	Full sample	More reg.	Less reg.
Mortgage rate subsidy	0.0437	-1.192	1.059			
	(0.512)	(0.763)	(0.725)			
Mortgage rate subsidy	0.0236*	0.0105	0.0421*			
× household income	(0.0127)	(0.0145)	(0.0220)			
Household income	-0.00478	-0.00138	-0.00946*			
	(0.00303)	(0.00371)	(0.00504)			
1st income quartile ×				0.210	-0.754	0.651
Mortgage rate subsidy				(0.541)	(0.789)	(0.734)
2nd income quartile ×				0.273	-1.163	1.464**
Mortgage rate subsidy				(0.520)	(0.788)	(0.706)
3rd income quartile ×				0.243	-1.151	1.548**
Mortgage rate subsidy				(0.519)	(0.776)	(0.725)
4th income quartile ×				0.400	-1.060	1.717**
Mortgage rate subsidy				(0.565)	(0.882)	(0.723)
2nd income quartile				0.0494	0.160	-0.131
				(0.0837)	(0.125)	(0.111)
3rd income quartile				0.129	0.229*	-0.0831
				(0.0903)	(0.128)	(0.126)
4th income quartile				0.109	0.235	-0.130
				(0.0972)	(0.147)	(0.119)
Total net wealth	0.00150	0.00132	0.00336	0.00345*	0.00335	0.00619**
	(0.00212)	(0.00238)	(0.00447)	(0.00188)	(0.00234)	(0.00264)
Age of head	0.0362***	0.0395***	0.0322***	0.0302***	0.0338***	0.0265***
	(0.00245)	(0.00338)	(0.00362)	(0.00253)	(0.00348)	(0.00363)
Age of head squared	-0.000266***	-0.000283***	-0.000244***	-0.000207***	-0.000228***	-0.000187***
	(2.51e-05)	(3.50e-05)	(3.64e-05)	(2.58e-05)	(3.60e-05)	(3.64e-05)
Married	0.195***	0.191***	0.190***	0.164***	0.157***	0.167***
	(0.0166)	(0.0227)	(0.0249)	(0.0163)	(0.0218)	(0.0248)
One child	0.0529***	0.0604***	0.0442***	0.0502***	0.0588***	0.0391**
	(0.0105)	(0.0146)	(0.0151)	(0.0105)	(0.0145)	(0.0152)
Two children	0.0954***	0.101***	0.0821***	0.0959***	0.103***	0.0799***
	(0.0123)	(0.0193)	(0.0149)	(0.0121)	(0.0187)	(0.0148)
Three or more children	0.105***	0.111***	0.0990***	0.108***	0.113***	0.104***
	(0.0151)	(0.0231)	(0.0202)	(0.0149)	(0.0226)	(0.0200)
Head unemployed	-0.0479***	-0.0495***	-0.0407***	-0.0391***	-0.0429***	-0.0269*
	(0.00968)	(0.0113)	(0.0156)	(0.00952)	(0.0114)	(0.0151)
Wife unemployed	-0.0455***	-0.0452***	-0.0427**	-0.0435***	-0.0439***	-0.0413**
	(0.0123)	(0.0162)	(0.0178)	(0.0123)	(0.0165)	(0.0176)
Share of units that are	0.141***	0.0722	0.173**	0.131**	0.0599	0.175**
single-family	(0.0521)	(0.0711)	(0.0839)	(0.0521)	(0.0704)	(0.0847)
Share of units that are in	-0.260***	-0.304***	-0.300***	-0.264***	-0.309***	-0.290***
5+ unit-buildings	(0.0616)	(0.0809)	(0.103)	(0.0616)	(0.0804)	(0.104)
Household FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
MSA FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
State FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Constant	-1.125***	-0.155	-0.754***	-1.035***	-0.258	-0.467*
	(0.167)	(0.265)	(0.285)	(0.190)	(0.249)	(0.280)
Observations	29621	14983	14638	29621	14983	14638
Number of households	2620	1439	1430	2620	1439	1430
R-squared overall model	0.314	0.294	0.289	0.352	0.332	0.326
R-squared within model	0.272	0.281	0.255	0.283	0.292	0.268
R-squared between model	0.307	0.307	0.256	0.360	0.356	0.297

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 5
Results for Specifications with Interaction 'Tax Subsidy × LTV'
for More and Less Regulated Metro Areas

	(1)	(2)	(3)	(4)	(5)	(6)
	Full sample	More reg.	Less reg.	Full sample	More reg.	Less reg.
Mortgage rate subsidy	-1.840	-1.559	1.765			
	(1.892)	(2.535)	(3.367)			
Mortgage rate subsidy	0.0297	0.00377	-0.00523			
× LTV-ratio	(0.0232)	(0.0351)	(0.0403)			
Average LTV-ratio	-0.00670	-0.00298	0.00404	-0.00662	-0.00328	0.00255
	(0.00640)	(0.00979)	(0.0110)	(0.00628)	(0.00983)	(0.0110)
1st income quartile ×				-1.030	0.453	0.173
Mortgage rate subsidy				(1.879)	(2.498)	(3.498)
2nd income quartile ×				-1.977	-1.831	1.717
Mortgage rate subsidy				(1.912)	(2.602)	(3.480)
3rd income quartile ×				-2.149	-1.808	1.093
Mortgage rate subsidy				(1.878)	(2.524)	(3.454)
4th income quartile ×				-1.832	-2.300	1.917
Mortgage rate subsidy				(1.932)	(2.626)	(3.312)
Mortgage rate subsidy ×				0.0179	-0.0198	0.00446
LTV for 1st inc. quart.				(0.0232)	(0.0351)	(0.0421)
Mortgage rate subsidy ×				0.0312	0.00581	-0.00415
LTV for 2nd inc. quart.				(0.0233)	(0.0358)	(0.0417)
Mortgage rate subsidy ×				0.0330	0.00576	0.00418
LTV for 3rd inc. quart.				(0.0230)	(0.0353)	(0.0412)
Mortgage rate subsidy ×				0.0317	0.0142	-0.00370
LTV for 4th inc. quart.				(0.0235)	(0.0366)	(0.0398)
2nd income quartile	0.0653***	0.0505***	0.0812***	0.0465	0.145	-0.144
	(0.0139)	(0.0186)	(0.0205)	(0.0839)	(0.123)	(0.113)
3rd income quartile	0.137***	0.122***	0.153***	0.127	0.211*	-0.0790
	(0.0160)	(0.0227)	(0.0218)	(0.0899)	(0.124)	(0.128)
4th income quartile	0.156***	0.149***	0.148***	0.0887	0.202	-0.139
	(0.0176)	(0.0260)	(0.0225)	(0.0958)	(0.142)	(0.121)
Total net wealth	0.00323*	0.00285	0.00651**	0.00336*	0.00317	0.00693***
	(0.00187)	(0.00224)	(0.00279)	(0.00187)	(0.00227)	(0.00258)
Household controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Housing stock controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Household FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
MSA FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
State FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Constant	-0.112	0.0702	-1.015	-0.579	-0.0768	-0.665
	(0.573)	(0.739)	(0.909)	(0.515)	(0.721)	(0.905)
Observations	28906	14510	14396	28906	14510	14396
Number of households	2608	1431	1422	2608	1431	1422
R-squared overall model	0.357	0.335	0.325	0.351	0.337	0.325
R-squared within model	0.285	0.295	0.269	0.286	0.297	0.270
R-squared between model	0.372	0.357	0.295	0.361	0.358	0.294

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

APPENDIX

TABLE A1
Are tax subsidies capitalized to a greater extent in more regulated locations?

	Dependent variable: House price appreciation rate	
	(1)	(2)
	More regulated	Less regulated
Percent change in mortgage rate subsidy	0.102***	0.0431***
	(0.0187)	(0.0138)
Year fixed effects	*Yes*	*Yes*
State fixed effects	*Yes*	*Yes*
MSA fixed effects	*Yes*	*Yes*
Constant	0.00921	0.0167*
	(0.00904)	(0.00883)
Observations	14181	13881
Adjusted R-squared	0.4329	0.2564

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE A2
Year Fixed Effects Corresponding to Table 3

	(1)	(2)	(3)
VARIABLES	Full sample	More regulated	Less regulated
Year = 1984 (omitted)			
Year = 1985	-0.00736	-0.00639	-0.00485
	(0.00738)	(0.00963)	(0.0114)
Year = 1986	-0.0148	-0.00393	-0.0299**
	(0.00991)	(0.0134)	(0.0151)
Year = 1987	-0.0103	-0.0323	0.0121
	(0.0184)	(0.0255)	(0.0287)
Year = 1988	-0.00645	-0.0546	0.0532
	(0.0280)	(0.0384)	(0.0443)
Year = 1989	-0.00242	-0.0447	0.0433
	(0.0280)	(0.0392)	(0.0429)
Year = 1990	0.00631	-0.0403	0.0628
	(0.0296)	(0.0407)	(0.0460)
Year = 1991	0.0111	-0.0451	0.0838
	(0.0343)	(0.0474)	(0.0529)
Year = 1992	-0.00293	-0.0628	0.0725
	(0.0350)	(0.0484)	(0.0537)
Year = 1993	-0.00736	-0.0672	0.0699
	(0.0315)	(0.0427)	(0.0496)
Year = 1994	0.00424	-0.0517	0.0730
	(0.0311)	(0.0426)	(0.0482)
Year = 1995	-0.0109	-0.0718*	0.0654
	(0.0297)	(0.0403)	(0.0463)
Year = 1996	-0.0142	-0.0750*	0.0580
	(0.0282)	(0.0387)	(0.0429)
Year = 1997	-0.0176	-0.0777**	0.0511
	(0.0265)	(0.0373)	(0.0391)
Year = 1999	-0.0155	-0.0690**	0.0463
	(0.0231)	(0.0319)	(0.0347)
Year = 2001	-0.00707	-0.0785**	0.0781*
	(0.0268)	(0.0362)	(0.0409)
Year = 2003	0.00405	-0.0875	0.119*
	(0.0402)	(0.0546)	(0.0619)
Year = 2005	-0.0127	-0.0908*	0.0819
	(0.0361)	(0.0487)	(0.0556)
Year = 2007	-0.0214	-0.0924*	0.0682
	(0.0371)	(0.0497)	(0.0583)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE A3
Table 3 but adding additional user cost controls

	(1)	(2)	(3)
VARIABLES	Full sample	More regulated	Less regulated
Mortgage rate subsidy	0.231	-0.530	2.283**
	(0.699)	(0.948)	(1.102)
Mortgage rate subsidy × regulatory index	-0.336**		
	(0.140)		
Regulatory index	-0.00476		
	(0.0744)		
2nd income quartile	0.0649***	0.0496***	0.0811***
	(0.0139)	(0.0187)	(0.0205)
3rd income quartile	0.136***	0.121***	0.153***
	(0.0161)	(0.0228)	(0.0219)
4th income quartile	0.155***	0.148***	0.148***
	(0.0177)	(0.0260)	(0.0226)
Total net wealth	0.00321*	0.00299	0.00633**
	(0.00186)	(0.00221)	(0.00277)
TAXSIM property tax rate subsidy	-0.0130	-0.593	-0.414
	(0.275)	(0.577)	(0.345)
Effective mortgage interest rate	-0.153	1.842	-1.817
	(1.264)	(1.752)	(1.936)
Age of head	0.0299***	0.0332***	0.0264***
	(0.00259)	(0.00358)	(0.00373)
Age of head squared	-0.000203***	-0.000220***	-0.000184***
	(2.66e-05)	(3.72e-05)	(3.77e-05)
Married	0.165***	0.157***	0.170***
	(0.0165)	(0.0223)	(0.0250)
One child	0.0522***	0.0622***	0.0407***
	(0.0106)	(0.0147)	(0.0152)
Two children	0.0972***	0.106***	0.0808***
	(0.0121)	(0.0186)	(0.0150)
Three or more children	0.109***	0.118***	0.103***
	(0.0151)	(0.0229)	(0.0205)
Head unemployed	-0.0400***	-0.0456***	-0.0293*
	(0.00963)	(0.0113)	(0.0156)
Wife unemployed	-0.0406***	-0.0415**	-0.0372**
	(0.0122)	(0.0163)	(0.0176)
Share of units that are single-family	0.143***	0.0752	0.169**
	(0.0523)	(0.0715)	(0.0841)
Share of units that are in 5+ unit-buildings	-0.257***	-0.300***	-0.294***
	(0.0616)	(0.0808)	(0.104)
Household FE	*Yes*	*Yes*	*Yes*
MSA FE	*Yes*	*Yes*	*Yes*
State FE	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*
Constant	-0.616*	-0.345	-0.608*
	(0.338)	(0.244)	(0.351)
Observations	28906	14510	14396
Number of households	2608	1431	1422
R-squared overall model	0.358	0.335	0.326
R-squared within model	0.286	0.295	0.268
R-squared between model	0.373	0.357	0.295

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE A4
Table 4 but adding additional user cost controls

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Full sample	More reg.	Less reg.	Full sample	More reg.	Less reg.
Mortgage rate subsidy	0.171	-0.637	1.923*			
	(0.708)	(0.944)	(1.133)			
Mortgage rate subsidy	0.0259**	0.0117	0.0476**			
× household income	(0.0127)	(0.0144)	(0.0225)			
Household income	-0.00534*	-0.00177	-0.0107**			
	(0.00301)	(0.00366)	(0.00515)			
1st income quartile ×				0.231	-0.524	1.807*
Mortgage rate subsidy				(0.702)	(0.938)	(1.083)
2nd income quartile ×				0.209	-0.777	2.177**
Mortgage rate subsidy				(0.700)	(0.941)	(1.106)
3rd income quartile ×				0.344	-0.559	2.376**
Mortgage rate subsidy				(0.707)	(0.946)	(1.121)
4th income quartile ×				0.526	-0.424	2.532**
Mortgage rate subsidy				(0.741)	(1.016)	(1.124)
2nd income quartile				0.0710	0.114*	-0.0132
				(0.0476)	(0.0662)	(0.0633)
3rd income quartile				0.107*	0.129	0.00608
				(0.0624)	(0.0919)	(0.0789)
4th income quartile				0.0794	0.121	-0.0382
				(0.0763)	(0.115)	(0.0901)
Total net wealth	0.00130	0.00103	0.00392	0.00330*	0.00306	0.00660**
	(0.00214)	(0.00224)	(0.00439)	(0.00187)	(0.00221)	(0.00265)
TAXSIM property tax rate	-0.0983	-0.649	-0.464	-0.0286	-0.581	-0.417
subsidy	(0.275)	(0.576)	(0.347)	(0.275)	(0.576)	(0.345)
Effective mortgage interest	-0.415	1.843	-1.072	-0.709	1.779	-1.755
rate	(1.257)	(1.798)	(1.945)	(1.241)	(1.771)	(1.929)
Age of head	0.0358***	0.0388***	0.0323***	0.0298***	0.0332***	0.0265***
	(0.00251)	(0.00345)	(0.00372)	(0.00260)	(0.00358)	(0.00372)
Age of head squared	-0.000260***	-0.000274***	-0.000244***	-0.000202***	-0.000220***	-0.000185***
	(2.59e-05)	(3.59e-05)	(3.76e-05)	(2.66e-05)	(3.73e-05)	(3.76e-05)
Married	0.194***	0.189***	0.192***	0.164***	0.156***	0.170***
	(0.0167)	(0.0231)	(0.0250)	(0.0165)	(0.0223)	(0.0249)
One child	0.0539***	0.0638***	0.0441***	0.0510***	0.0616***	0.0390**
	(0.0106)	(0.0148)	(0.0151)	(0.0106)	(0.0147)	(0.0152)
Two children	0.0967***	0.105***	0.0812***	0.0970***	0.106***	0.0794***
	(0.0123)	(0.0191)	(0.0150)	(0.0121)	(0.0186)	(0.0149)
Three or more children	0.105***	0.116***	0.0972***	0.109***	0.117***	0.102***
	(0.0154)	(0.0234)	(0.0208)	(0.0151)	(0.0229)	(0.0205)
Head unemployed	-0.0481***	-0.0519***	-0.0388**	-0.0393***	-0.0457***	-0.0263*
	(0.00973)	(0.0112)	(0.0159)	(0.00958)	(0.0113)	(0.0153)
Wife unemployed	-0.0433***	-0.0438***	-0.0393**	-0.0408***	-0.0423***	-0.0376**
	(0.0122)	(0.0159)	(0.0178)	(0.0122)	(0.0160)	(0.0176)
Household FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Housing stock controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
MSA FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
State FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Constant	-0.619*	-0.297	-0.649*	-0.431	-0.344	-0.480
	(0.318)	(0.296)	(0.364)	(0.329)	(0.247)	(0.352)
Observations	28906	14510	14396	28906	14510	14396
Number of households	2608	1431	1422	2608	1431	1422
R-squared overall model	0.320	0.298	0.289	0.357	0.335	0.326
R-squared within model	0.275	0.286	0.257	0.285	0.296	0.269
R-squared between model	0.318	0.312	0.254	0.372	0.358	0.296

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1