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House Price Shock and Changes in Inequality across Cities

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Abstract

Many studies have documented the increase in income inequality in the US during the past three decades. However, few studies have examined how housing cost, which accounts for a large proportion of household income, affects the income distribution. This paper investigates how incorporating the cost of housing into the calculation of inequality affects the cost-of-living adjusted income distribution. To do so, we compare changes in the nominal income inequality and real income inequality in response to house price changes. In a strong housing market, we find that nominal income inequality decreases in MSAs that experience greater house price increases. However, when we adjust for housing cost, we find that the real income inequality does not change. On the other hand, in a weak housing market, we find no changes nominal income inequality in response to the size of the house price shock but find a substantial increase in real income inequality. In both circumstances, low income households become worse off when housing cost is considered. We find that while housing cost increases more in a strong housing market in MSAs that experience a greater house price growth, the housing cost does not respond to the drop in the house prices in a weak housing market. Thus, when house prices falls, households' real income drops significantly, especially for low income households whose housing cost account for a greater proportion of their income.

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Introduction

The United States has experienced continuous increases in income inequality since the 1980s. While the long-term trend in inequality can be explained by structural changes in the labor market[3], the level of inequality can fluctuate, especially when economic conditions are rapidly changing. This study investigates how the recent housing market boom and the bust influenced households' income inequality. To examine this relationship, we use Metropolitan Statistical Areas (MSAs) as our unit of analysis and focus on the period since the 2000. This is a period when the skill premium of college graduates stayed relatively stable, after increasing significantly during the 1980s and 1990s (Autor, Katz and Kearney, 2008). One the other hand, income inequality continued to increase while the housing market was highly volatile.

Although the US housing market has recently experienced an unprecedented house price boom and subsequent bust, the changes in the house prices differed substantial across cities. For example, from 2000 to 2007, percent increase in the Federal Housing Finance Agency (FHFA) House Price Index (HPI) ranged from 10.18 in Kokomo Indiana to 180.71 in Miami, Florida. During this period, changes in Gini coefficients ranged from -11.70 percent in Hanford-Corcoran, CA to 19.86 percent in Eau Claire, WI. The substantial heterogeneity across MSAs enables us to test whether fluctuations in the house prices affect household income inequality, even after controlling for possible endogeneity using an instrumental variable. We use Saiz (2010) land unavailability measure as our instrumental variable and find that house prices were more volatile in MSAs with smaller proportions of land available for development.

Previous studies have mostly focused on nominal income inequality. We, however, incorporate housing cost into our inequality calculation to examine whether there are differences in nominal inequality and real inequality. Housing cost accounts for a huge proportion of household income. Also, when compared to other commodities, housing cost

[3] Numerous studies have documented the rising income inequality in the US. There are two most prominent theories that explain the rising income inequality. Skilled biased technological change (SBTC) explains that the adoption and diffusion of technology that prefers skill – especially personal computers – increased the wage of the college graduates more than the non-college graduates Katz and Murphy, 1992; Autor, Katz and Krueger, 1998, Acemoglu, 2002). On the other hand, other scholars (DiNardo, Fortin, and Lemieux 1996; Card and Dinardo, 2002, Card, Lemieux and Craig, 2003) explain that the deterioration of labor market institutions, such as labor unions and minimum wages, explains the rise in income inequality from the 1980s.

varies substantially according to its locations. Thus, including the cost of housing can significantly alter the income distribution.

Our results show that there is a negative relationship between the change in house prices and the change in nominal income Gini, especially in cities where house prices are increasing. However, this does not indicate that the gaps in the real income between the rich and the poor are decreasing in these cities. In fact, we find that changes in the housing cost fully offset the reduction in income inequality. Figure I illustrate this point. The top figure shows that the Gini coefficients of household income decrease with house prices increase. The bottom figure calculates real Gini coefficients of household income by subtracting housing cost from the household income for each household. We find that the line is flat. This indicates that while incomes of low income households increase more relative to high income households in cities where house price rises, this increase is nearly exactly offset by changes in housing cost.

In order to examine whether the change in inequality differs between renters and owners we further calculate the Gini coefficient separately for both tenure types. As shown in figure II, renters, on average, are younger and less educated and their employment is more sensitive to local labor market conditions. Moreover, the annual housing cost of renters may fluctuate more than owners, especially when house prices are volatile. Although the cost of buying and selling varies more where house prices are volatile, once the homeowners settle a contract, their annual housing cost is relatively stable over time, especially for those who live in the same house for a longer period. As a result, we find that renters' income inequality is more responsive to the house prices shock. When there is a positive house price shock, the nominal income inequality of renters decreases while that of owners remains unchanged.

We also examine whether changes in house prices affects income inequality differently in a strong and weak housing markets. In a strong housing market, where the change in house prices is positive, we find that increasing housing cost offsets the decrease in nominal income inequality. For homeowners, we find that real income inequality increases in MSAs that experience a greater increase in house prices, indicating that the cost of housing for low income households has increased relatively more than the higher income households. For renters, we also find that real income inequality does not decrease as much as the nominal income inequality in response to the housing shock. Overall, we find that real income

inequality for both homeowners and renters increases more than the nominal income inequality in a strong housing market.

On the other hand, in a weak housing market, where house prices are declining, we find that the changes in the house prices do not affect nominal income inequality.[4] However, when incorporating the change in the housing cost, we find that inequality increases more in cities that experience a greater drop in the house prices. The increase in real income inequality is higher for the renters. In other words, in a weak housing market, the difference between the changes in real income Gini and the changes in nominal income Gini is positively associated with the absolute changes in house prices. We also find that housing flow costs, i.e. rents, do not respond to changes in house prices when the house prices are falling, showing that there is a non-symmetric relationship between house prices and housing flow cost in strong and weak housing market. Overall, MSAs that experience a greater drop in house price do not show a greater decline in median housing costs, while median income in these MSAs drops significantly.

The real income of low income households is more sensitive to the changes in the housing flow costs as housing accounts for a large proportion of their income. Moreover, these households are more likely to experience greater income volatility in response to house price changes. Thus, incorporating housing cost into inequality calculation increases the measures of the income gap between the rich and the poor when house prices are either increasing or decreasing.

Beyond our attention to lower income households, we focus on the impact of falling house prices on renters, whose plight in the aftermath of the crisis the literature has largely ignored. In line with our findings, we show that the percent of households that is rent burdened grows both in strong and weak housing market. Along with results from the inequality analysis, this indicates that many renters become especially worse off when the housing market collapsed as the drop in their income was significant while their housing cost remained flat.

[4] Labor income could have dropped more for the low income households in MSAs that experienced a greater house price decline. However, our definition of household income includes government transfers, which may have mitigated the income gap between the rich and the poor in MSAs that were more negatively affected by the housing market shock. Rose (2015) find that income inequality did not increase following the crisis, once government transfers and tax benefits are added to household income.

Following the housing bust, housing affordability for renters decreased as more homeowners entered into the rental market and young adults deferred homeownership (Fry, 2013, Joint Center for Housing Studies, 2015). At the same time, a reduction in access to mortgage credit prevented renters from leaving that market and entering homeownership in a period when house prices were depressed (Goodman 2016). As places that experienced greater housing price volatility are places with less land available for development, supply is less likely to in respond to the growth in the rental demand in these cities. Thus, following the housing market crisis, many renters are likely to have experienced both a decrease in household income with no reduction in their cost of living.

The remainder of this paper is organized as follows: Section II explains how the housing market cycle can affect inequality by discussing previous theory and empirical results. Section III describes data and methodology. We present our results in section IV and discuss implication of our findings in the section V. The final section concludes.

Inequality and Housing Market Cycle

How can the housing market cycle affect inequality? Previous literature provides several channels that link house price fluctuation and labor market outcomes. First, changing house prices can directly affect construction activity. Charles, Hurst and Notowidigdo (2013) find that construction employment of non-college educated men increased significantly during the housing boom. The study also shows that MSAs that experienced greater housing price increases during the housing boom also experienced a larger decreases in house price during the bust, and employment, especially but not limited in the construction sector, also dropped more in these MSAs.

The second channel is effect housing wealth has on consumption. Studies, including Bostic, Gabriel and Painter (2009), find housing wealth has a positive impact on consumption. Mian and Sufi present several studies that show the relationship between house price changes, consumption and employment. Their 2011 paper shows that home equity extraction was substantial in MSAs that experienced the largest house price growth. In a subsequent paper, they find a large elasticity of consumption of 0.6 to 0.8 with respect to housing net worth during the period from 2006 to 2009 (Mian, Rao and Sufi, 2013). Finally, they find the employment drop was significant in counties that experienced greater decline in housing net

worth (Mian and Sufi, 2014). Their study finds that employment that relies on the demand for local goods and services reacted more to the changes in the housing net worth. Overall, the consumption to employment channel predicts that employment will increase in MSAs that experience a greater increase in house price, and decrease in MSAs that experience a greater house price decline. These changes in employment are also likely to affect household income.

Given that house price fluctuations affect employment through direct and indirect channels, we might ask why the impact would be greater for lower income households. First, a greater proportion of lower skilled workers may be employed in occupations that are directly affected by housing market condition. Construction is an obvious example. Greater proportions of low skilled workers may also be employed in occupations that are more sensitive to local demand, such as jobs in food and accommodation industry. Third, hiring and firing low skilled workers is more sensitive to the labor market conditions. Cairo and Cajner (2013) find that the more highly educated have much lower job-separation rates than less educated people. As highly educated people are likely to possess firm specific skills, firms are less likely to displace these people than the less educated people (Williamson, 1981; Becker, 1993). Moreover, development and diffusion of skilled bias technology and deterioration of labor institution are likely to have increased the weakened the job security of low skilled workers, making their employment status more responsive to the labor market condition. Finally, less skilled workers are likely to be more uncompetitive in the job market and thus may face greater barriers for getting jobs in other regions, especially when economic conditions are negative (Evans and McCormick, 1994). All these reasons predict that the income of low income households, that are typically made up of composed with less skilled workers, are likely to be more sensitive to the changing local market conditions arising from fluctuations in the house prices. Overall, the previous studies suggest that nominal income inequality would decrease with house price growth and increase with house price drops.

But what happens to real income inequality? As housing consumption accounts for a large fraction of household income, the change in the distribution of housing cost may significantly alter changes in the distribution of real income. Moretti (2013) calculates real income inequality by adjusting for changes in average housing costs.[5] This paper finds that when

[5] In the main analysis, Moretti (2013) uses the average change in the rental cost for two or three bedroom apartments.

housing costs are considered, real wage differences between college graduates and non-college graduates decrease, because college graduates tend to live in higher housing cost cities. Moretti (2013) shows that real income inequality can be lower than the nominal income inequality when changes in housing cost are considered. The study, however, does not examine how change in housing cost can affect income distribution within a MSA.

In a market where house prices fluctuate, the real incomes of low income household are affected more, because housing accounts for a larger proportion of these households' income. Thus, even when cost of housing changes increase by the same percent for all households, holding income constant, the percent of real income decline is greater for those with less income. The real income of renters can also be more affected than the homeowners, as homeowners have already avoided housing cost uncertainty by fixing their future payments when buying a property.[6] Although homeowners are still exposed to asset price risk, this is only realized if they decide to sell their property. Since the risk occurs in the future, the value is discounted. Also most homeowners are able to control their risk by deciding when to sell their property. Genesove and Mayer (2001) show that owners have strong tendencies not to sell unless they can do so at a nominal profit. Thus, the real income of homeowners, especially for existing owners with a long expected horizon of living in the current house, will be less affected by local house price volatility On the other hand, renters are more exposed to changes in housing price volatility, as their cost of housing will also fluctuate with prices (Sinai and Souleles, 2005). As renters are more likely to be low income, less educated households, their labor income is also more likely to be more volatile. Thus, real incomes of renters are more likely to be affected by house price shocks as both their income and housing costs are more sensitive to the house price movements than homeowners.

In this study we examine how house prices changes affect both nominal income and real income inequality. Instead of using average housing cost as Moretti (2013), we directly subtract actual housing cost that owners and renters pay annually to calculate real income for each individual, as there may be variability in the changes in the housing cost across within a MSA. As we do not adjust for the house and neighborhood characteristics or expected future value of house prices, there may be selection bias and measurement errors in our calculation.

[6] Indeed, homeowners have often can reduce their payment during recessions, by refinancing into lower interest loan.

However, our simple measurement reflects changes in the distribution of housing cost within MSAs by incorporating what households actually pay for their housing. We also calculate Gini coefficients for both homeowners and renters to examine whether the changes in house prices have different impacts on nominal and real income of homeowners and renters.

Data

We calculate our Gini coefficient using data from the Decennial Census for the year 2000 and American Community Survey for years 2005 to 2015 collected from IPUMS. Because the ACS covers only 1 percent of the population, our Gini estimates may be less accurate than the estimated Gini coefficients from the Census data, which covers 5 percent of the population. Therefore, we group ACS samples into three periods, 2005-2008, 2009-2012 and 2013-2015.[7] The three groups are matched to the housing market boom, housing market bust and housing market recovery period. We calculate a Gini coefficient for each MSA. The MSA boundaries are fixed using the 2013 definitions from the U.S. Office of Management and Budget. The total number of observations in the four periods is 1071.While we use unbalanced MSA panel data, we find no change to our results if we use only the MSAs that are available in every period.[8]

Gini coefficient is one of the most commonly used proxies of income inequality. The measure is defined as $1 - \frac{1}{\hat{y}}\int_y (1 - F(y))^2 dy$, where $\hat{y}$ is the mean income of households in the sample and $F(y)$ is the share of population with income less than y. To adjust for household size, we divide household income by the square root of total number of household members. We also adjust for inflation. The value of the Gini coefficient ranges between 0 and 1. If income is distributed equally across the population, then Gini equals 0.

The advantage of using the Gini coefficient is that the measure is not affected by the size of the population. Also, if the income in the sample changes by the same percent, then Gini remains unchanged. If, however, the growth of income for the rich households exceeds that of the poor, the Gini coefficient increases, reflecting a change in the income distribution. The

[7] Household income is the total value of pre-tax income for all members in the household. The income includes wage income, business and farm income, income from government transfers and personal investments. Also note that as the Census asks household income in the previous year, the 2000 data gives us income inequality in 1999. Same applies to the ACS sample.

[8] Inequality data is available for 229 MSAs in all four periods.

Gini coefficient does have limitations: the coefficient is not additive, and subsets of sample cannot be averaged to obtain the Gini coefficient of the total sample. In order to compare Gini coefficient to other measures of inequality, we also estimated the income ratio between households at the 90^{th} and 10^{th} percentile and half the squared coefficient of variation of income. The Gini and other inequality measures show high correlation. The correlation coefficient of Gini and 90^{th} and 10^{th} percentile income ratio is 80.67 percent while the correlation coefficient between Gini and half the squared coefficient of variation is 86.72 percent. While we only present the results using the Gini coefficient in the current version of the paper, we also plan to use half the squared coefficient of variation. This measure complements Gini coefficient, as the measure is additive and thus enables us to measure how the income inequality between homeowners and renters has changed over time.

In order to calculate real income inequality, we adjust for household income by subtracting housing cost from the income. For renters, housing cost includes annual contract rent plus additional costs for utilities (water, electricity and gas) and fuels. For homeowners, we calculate cost of owning by adding mortgage payments, deeds of trust, contracts to purchase, real estate taxes and cost of utilities and fuels. This measure is less accurate than housing cost for renters as it does not include cost of maintenance and homeowner's tax deduction. The measure also does not capture the income changes that occur when selling and buying new properties. We may look at it as a liquidity – it allows us to capture most of the cash flow cost of owning.

House prices are obtained from Federal Housing Finance Agency (FHFA) MSA quarterly house price index. The FHFA index is a repeat sales housing price index and covers most of the MSAs in the US. For each year, we use the mean value of quarterly HPI levels to obtain the annual value. As household income is reported in the previous year of the survey we also use the HPI index in year 1999, 2004, 2007 and 2011 to match the four periods. To compare the FHFA index to the Census/ACS data we also calculate the median house value of each MSA for the four periods that we are studying. The correlation coefficient between the two measures is close to 80 percent. Using the median house value instead of the HPI ratio does not significantly change the main results of our analysis.

The purpose of this study is to investigate whether house price shocks affect the income distribution. An issue for us it is possibility that variation in the house prices across MSAs is

endogeneous with respect to unobserved determinants of income. Changes in the income distribution may also affect a household's decision to buy and sell or rent, thus affecting the house price and rental prices. We therefore use share of land that are not available for development ("land unavailability") from Saiz (2010) as an instrumental variable to isolate exogenous variation in housing prices. The measure is developed using the topographic characteristics of the MSAs which pre-exist local characteristics of housing and labor markets. Additional MSA level variables that could affect changes in income inequality, such as age and education distributions, are also calculated using the Census and the ACS data.[9]

Table I presents the descriptive statistics. On average, the real income Gini is higher than the nominal income Gini, reflecting the fact that the low income households spend a greater proportion of their income on housing cost. Renters have both higher nominal income Gini and real income Gini than the owners. From 2000 to 2015, the income inequality of renters increased more than the income inequality of owners. In particular, the real income inequality of renters increased 2.78 percent, which is almost 4 times higher than the increase of real income inequality for homeowners.

The average change in house price is slightly over 16 percent, with a sizable standard deviation. As expected, the variation in the changes of house prices across time and location is greater than the variation in the housing cost. Furthermore, the percent change in the median housing cost for owners has a smaller value of mean and standard deviation than the

[9] Although we do not present the result in the current version of the paper we also plan to include various variables that capture the labor market characteristics, such as percent of union members, industrial diversity and composition and minimum wages. We will use these variables to further identify whether labor market structure and institutions affect the relationship between housing market shock and inequality. Percent of union members and State minimum wage are obtained from the Bureau of Labor Statistics. For states where this data is not available or for those with minimum wage lower than the federal rate, we designate the federal amount, which is the legally binding amount. The industrial diversity and share of employment for industries including manufacturing and construction are calculated using the data from County Business Patterns. We use national average index as a proxy of industrial diversity. The national average index is measured by the following equation:

$$\mathrm{NA} = \sum_{i=1}^{N} \frac{(X_i - \bar{X}_i)^2}{\bar{X}_i} \qquad (2)$$

where X_i is the *i*th industry's share of employment in the MSA, $\bar{X}_i$ is the national average employment share in the *i*th industry and N is the number of industries in the MSA. We use three digit NAICS code to classify industry. The index measures the how the regional employment percentages in each industry deviates from the national averages. The index is based on location quotients (Siegal, Johnson and Alwang, 1995) and the value increases as the MSA becomes more specialized. A MSA that is perfectly representative of the national economy would get an index value of zero. When calculating the share of employment, we use the 2 digit NAICS code.

percent changes in median rent. This reflects that renters experience a greater fluctuation of housing cost than homeowners. The rent burden variable shows that, on average, about 49 percent of households were paying more than 30 percent of their income on rent. The percent of households that were rent burdened increased by 9.17 percent during the sample period. Among demographic variables (except for total population), the percent of college graduates for among those age 25 shows the greatest divergence across time and space.[10] The average share of land unavailable for development is 26.17 percent. There is a large variation of this value across MSAs, with a minimum value of 0.004 percent in Lubbock, TX to a maximum value of 86.01 percent in Santa Barbara-Santa Maria-Goleta, CA.

Figure III further presents how nominal income inequality and real income inequality changed in the four sample period. Again, we find that nominal income inequality is lower than real income inequality. Also, the growth in real income inequality is higher than the growth in the nominal income inequality. When dividing the sample into homeowners and renters, we find that the level of inequality using both measures of income and the growth in income inequality is always higher for renters than owners. Renters also show larger gaps between real income inequality and nominal income inequality and the gap between the two values of inequality increases more than the homeowners.

Empirical Model

In order to test how house price shocks affect inequality, we estimate the following equation:

$$\Delta Gini_{kt} = \beta_0 + \beta_1 \Delta \widehat{HPI}_{kt} + \gamma X_{kt} + \mu_s + \varepsilon_{kt}, \qquad (1)$$

Where $\Delta Gini_{kt}$ is the percent change in the nominal Gini coefficient for MSA k from time t-1 to t. $\Delta \widehat{HPI}_{kt}$ is the exogenous percent change in the house price index, X_{kt} is a vector of observable controls, μ_s is the state fixed effect and ε_{kt} is the error term. In order to identify how Gini coefficient changes may differ by negative and positive housing shock, we also separately estimate equation (1) for MSAs that experienced house price growth and those that experience house price decline during the sample period. We replace the dependent variable in equation (1) a with our house price adjusted Gini to further examine how the housing

[10] Manufacturing accounted for the greatest share of employment followed by food and accommodation industry. The average minimum wage is 6.5 dollars and the average share of workers who are in the union is 11.66 percent.

market shock affects real income inequality. We also run difference between percent changes in the real income and nominal income inequality
($\% \Delta Real\ Income\ Gini_{kt} - \% \Delta Nominal\ Income\ Gini_{kt}$) on house price changes to examine whether the two measures move differently in strong and weak housing market.

To control for endogeneity, $\Delta\widehat{HPI}_{kt}$ is predicted using the following first stage equation:[11]

$$\Delta HPI_{kt} = \delta_0 + \delta_1 Z_k + \rho X_{kt} + v_{kt} \qquad (2)$$

Where Z_k is the percent of land unavailable for development in MSA k. Before presenting our regression analysis, we check the strength of our instrumental variable by estimating equation (2). Table II shows that the land unavailability instrumental variable strongly predicts the changes in house prices. Furthermore, we find that the exogenous land unavailability measure predicts both house price increase and decrease between years 2000 and 2015. MSAs with less land available for development experienced significant growth in house prices in a strong housing market. These MSAs also experienced a substantial house price decline in a weak housing market. Even without including the controls, we find that F-statistic for the land unavailability measures are above 10, suggesting that there is no weak instrument problem.

Before presenting the results, we point out that there are some limitations to our data and method. The two major caveats arise from the fact that we do not control for mobility across cities and also do not adjust for rent-owner transitions. As Census/ACS data does not follow the same households across time, we cannot examine whether households moved to a new location or switched tenure. Although we should consider the shortcomings of the data when interpreting our results, as our sample size is large and the proportion of households moving across MSAs and switching tenure is relatively small. Thus, adjusting for these moves within and across MSAs is unlikely to be large enough to alter our results significantly.

Results

Column (1) in Table III shows that nominal income inequality decreases in MSAs where

[11] In the IV regression we do not include state fixed effects. Including state fixed effects weakens the power of the instrumental variable as unavailability of land is highly correlated with state fixed effects. In fact, if regress land unavailability on state fixed effect we obtain R-squared of 49.65

house prices rise. In columns (2) and (3) we divide our sample into two: column (2) includes MSAs where house prices increase (strong housing market) and column (3) includes MSAs where house prices decrease (weak housing market). In a strong housing market, we find that house price changes are negatively associated with changes in nominal income inequality (Column (2)). On the other hand, in a weak housing market, house price changes do not affect nominal income inequality. We find similar results using instrumental variable in columns (4)-(6).[12] In sum, when prices go up, we find that income gap between the rich and the poor decreases. This can happen either due to direct employment increases, for example those in the construction sector, or due to indirect employment increase rising from greater consumption. If both effects works more favorably for the less educated population, then the income gap between the high and the low income households will decrease. When house prices fall, however, the size of the house price change does not seem to have any influence on the relative changes in income distribution across MSAs. Past studies led us to expect that income inequality would increase more in MSAs that experienced greater drops in house prices. One possible reason that our findings do not correspond to our expectation is because our measure of household income includes government transfers. We will further look into this issue in future versions of this paper by examining the impact of house price changes on employment and labor income.

In table IV, we run the same regression separately for owners and renters. OLS results in columns (1) to (3), show that house price shocks does not have a significant impact for the homeowners' income distribution. The IV regression results show some significant results: column (4) shows that house price increases reduce nominal income inequality, but only in a strong market. In fact, in a weak housing market, we find that nominal income inequality decreases in MSAs with larger falls in house prices, although the statistical power of the result is not strong.

For renters however, we find strong statistical relationships between changes in house prices and changes in nominal income inequality. Both OLS and IV results shows that increases in house prices significantly decreases renters' income inequality, especially in a strong housing

[12] Land unavailability is not available for all MSAs in our sample. Thus, the number of observations in columns (4)-(6) is smaller than the number of observations in columns (1)-(3). In order to directly compare our OLS and IV regression, we also run our OLS regressions with MSAs where land unavailability variable is non-missing. The results are similar to the results presented in Table IV.

market. While the size of the coefficient seems small, the total impact of house price shock on income inequality would have been large in MSAs that experienced larger house price changes, considering the size of the house price changes during this period: The average change in the house price in the four sample periods is 16.28 percent, with a minimum value of negative 54.22 percent in Merced, CA and maximum value of positive 131.97 percent in Riverside-San Bernardino-Ontario, CA. As renters are more likely to be younger and attain less education, this suggests that house price changes affect the income of those at the lower end of the income distribution more than those at the higher end.

While we find that increases in house prices reduce the nominal income gap between the rich and the poor, this does not necessarily mean that they leave low income people better off. Moreover, our finding that negative changes in house price has no statistical relationship with the changes in the nominal income inequality, does not necessarily mean that the impact of housing shocks on the incomes of the rich and poor is similar when house prices are falling. Thus, we now look at the impact of house price dynamics on Gini that is adjusted for housing cost.

Column (1) in Table V shows that real income inequality also decreases more in MSAs where house price growth is higher. However, after eliminating the possible endogeneity using the instrumental variable, we find that positive changes in house prices leads to positive changes in real income inequality (Column (4)). When the housing market is strong, real income inequality increases in MSAs with higher house price growth, which is opposite to what we find in Table II for nominal income inequality. This suggests that while the nominal income gap between the rich and the poor decreases in a rising housing market, the changes in the housing cost offsets this income gap decrease. On the other hand, in a weak housing market, results in columns (3) and (6) shows that real income inequality increases more in MSAs that experience a greater house price decrease. The previous result show that the nominal income inequality did not change significantly in response to the house price change when house prices are falling. However, once the cost of housing is incorporated, we find that low income households are losing a greater proportion of their incomes than the high income households.

In Table VI, we further examine how real income inequality changes for homeowners and renters. For homeowners, we find that the real income inequality increases in response to positive house price shocks when the housing market is strong. Both OLS and IV results in

columns (2) and (4) show that greater increases in house prices leads to greater increases in real income inequality. These results differ from the results shown in Table IV, where we find homeowners' nominal income inequality did not change in response to the changing house prices. Our findings suggest low income homeowners in MSAs where house prices are rising are experiencing a relatively greater increase in their cost of housing than those at with higher incomes in the same MSA, and also those in different MSAs with smaller increases in house prices. One possible explanation for this finding is related to the fact that many low income households were able to access the credit market during the housing boom (Mian and Sufi, 2009). Compared to the existing homeowners, the new homeowners in a rising market would need to pay for a relatively higher housing cost, owing to the higher price they paid for their house. As a result, real income inequality increases more in MSAs with greater house price growth.

For renters, we find that real income inequality do not change in response to the house price changes when the housing market is strong. Although the OLS result shows a negatively significant coefficient, the statistical significance disappears in the IV results. However, in a weak housing market, we find that the coefficients of OLS and IV regressions are both significantly negative. This shows that the real income inequality increase greater in MSAs where the extent of house prices fall more. The finding indicates that when house prices are falling, rental cost respond less than income to house prices changes.

Table VII directly compares changes in nominal income inequality and real income inequality in response to the housing market shock. The dependent variable is the percent change in nominal income Gini minus the percent change in real income Gini. We find that when house prices increase, the real Gini increases more than the nominal Gini. On the other hand, when house prices fall, real income inequality falls more than the nominal income inequality. Table VIII shows that similar trend is shown both for the owners and the renters. In sum, we find that when housing market is strong, nominal income inequality decreases but changes in the housing cost fully offset the decrease in income inequality. In contrast, when the house price is weak, real income inequality falls more than the nominal income inequality. This suggests that low income households seem to be relatively worse off than high income households both in the strong and weak housing market, if housing cost are considered in the income inequality calculation. The size of the coefficient suggests that the difference in real income

and nominal income inequality is greater for renters than the homeowners.[13]

To better understand what is driving these findings, we examine changes in income and housing costs separately under the strong and weak housing market conditions. Table IX and X show how median income and median housing costs change in response to housing market shocks. Since the result from the IV regression is similar to the OLS results, we provide the IV results for both tables in the appendix. First three columns of Table IX show that median income increases in response to positive house price changes. Renters' income is more sensitive to the house price changes, especially in the weak housing market, although at a fairly weak level of significance. This is in line with our hypothesis that employment of renters who are, on average, younger and less educated than homeowners are more sensitive to changes in housing market conditions.

We also find that both median rent and median owners cost only increases in response to house price changes only in a strong housing market (Table X).[14] In a weak housing market, we find that housing costs do not respond to falls in house prices. While income falls more in MSAs that experience a greater house price decline, as housing cost do *not* fall, real income inequality increases more than the nominal income inequality in these places. We also find that the percent increase in the housing cost in response to the changes in the house prices is greater than the percent increase in median income in a strong housing market by comparing coefficients in Table IX and X. This explains why nominal income inequality decreases more

[13] We provide two simple examples to illustrate point. (Table A3 & A4). Suppose that there are two groups of living in a city, one earning 500,000 dollar (group H) a year and the other earning 50,000 (group L) dollar. Both consist of equal share of the total population. Scenario I presents an example in the strong housing market while scenario II presents an example in a weak housing market. In Scenario I, suppose that house price increase only affects the income of group L and income of group L increases by 10 percent to 55,000. In this case, the Gini coefficient of nominal income decreases from 0.409 to 0.401. Now suppose group H pays 120,000 dollar in housing costs while group L pays 30,000 dollar. The real income of group L is 380,000 while real income of group L is 20,000. Since housing cost account for a greater share of income for group L, real income inequality (Gini 0.450) is greater than the nominal income inequality. Now if housing costs also increase for both groups by 25 percent in response to the housing cost increase, then the real income for group H decreases to 350,000 and the real income for group L decreases to 17,500. The real income Gini becomes 0.452. This shows how the changes in housing cost can offset the decrease in nominal income inequality in a rising market.
In scenario II, suppose income for both group falls by 10 percent due to house price shock than the first group will earn 450,000 dollar and the second group earns 45,000 dollar. As the percent of income fell equally for both groups there are no changes in nominal income inequality. Now suppose that the rent price did not change at all for both groups. The high income group continues to pay 120,000 dollar on rent and low income group pays 30,000 dollar. In this case, real income Gini coefficient increases from 0.450 to 0.457. This shows that in a weak housing market real income inequality will increase more in MSAs that experience a greater house price drop, as house cost changes less than income changes in response to the changes in the house prices.

[14] When we use the instrument variable, we find that median owners cost does drop more when the house prices falls but median rent do not show a significant change.

in MSAs that experience greater income inequality while real income inequality does not. Why both owner cost and rental cost respond non-symmetric to the rise and fall in the house prices during this period is an interesting question with multiple possible explanations.[15] We leave it to future research to look deeper into this relationship.

Discussion

Housing costs as a share of income tend to fall with increasing income (i.e., the income elasticity of housing is less than one.) An implication of this fact, supported by our results, is that the net real income of low income households is more sensitive to changes in the house prices, which affect both income and housing costs. We also find that that difference between real and nominal income changes is greater for renters than homeowners. After the housing market crisis, many policy makers focused on helping homeowners who were having trouble paying for mortgages. However, less attention was given to renters, who also faced greater financial trouble as their housing costs did not decline, despite drops in their nominal incomes. Many of these renters may not have had sufficient financial assets to become homeowners during the housing boom, when credit conditions were relaxed. While the incomes of many renters living in a booming housing market increased, most of renters also experienced an increase in their cost of housing. On the other hand, when house prices fell, renters' income dropped substantially while the cost of housing remained unchanged. As a result, their real net income declined.

Figure IV and Table XI illustrate this point. We find that in both strong and weak housing markets, the percent of renters who pay more than 30 percent of income on rent (which is a commonly used criterion for determining whether a household is rent burdened) increased in

[15] House is a unique asset that is bought both for investment and consumption purposes. It is also a necessity that requires sufficient capital to purchase. For those who cannot buy a house thus must rent. During the housing boom, the investment demand increased, and local house price also increased. Housing cost of owners and renters who mainly consume houses were also affected by the increase in demand. Also the relaxation of credit constraint led more households to become homeowners at a higher cost, increasing the owner cost of housing for new homeowners. The investment demand fell in 2007 and house prices dropped as many mortgages became delinquent. However, as home is a necessity, consumption demand cannot fall as much as the investment demand. New home purchases were less likely to occur in the bust as the credit constraint tightened, resulting in small changes in the median owner cost. Rental demand, on the other hand, as those who defaulted moved into the rental market. Also, many households who would have become homeowners during the boom did not purchase home and remained as renters. All these factors may have resulted in less change in owner and rent cost in MSAs that experienced significant house price drop.

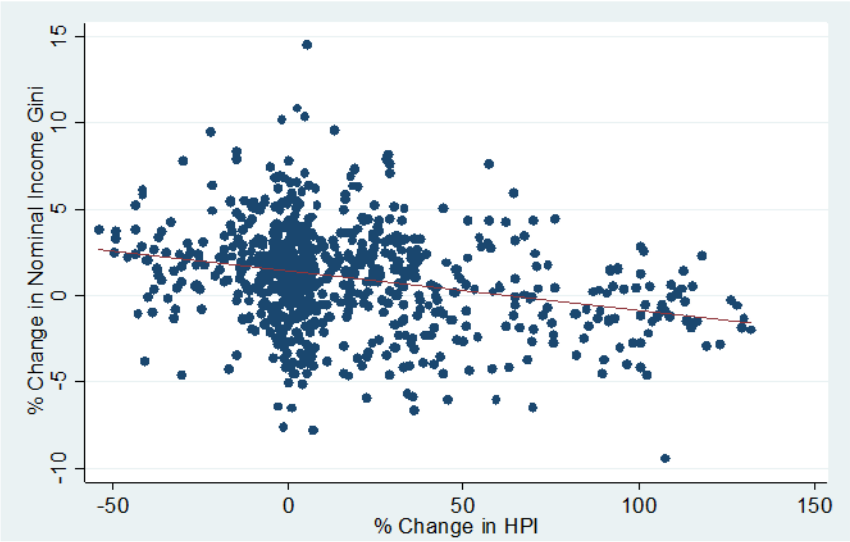
response to changes in house prices. In fact, when house prices increased we find that percent of rent burdened households increased more in MSAs that had increases in house prices. However, when house prices fell, we find that rent burdened households increased more in MSAs that experienced greater declines in house prices. These results show that the financial status of low income households, including renters, seems worse when housing costs and income is considered simultaneously than when income is considered alone, both in strong and weak housing markets. As MSAs that experienced greater housing price declines are places with less land available for development, the supply of rental housing in these places would have not responded to growth in the rental demand, causing a financial burden on renters.

Conclusion

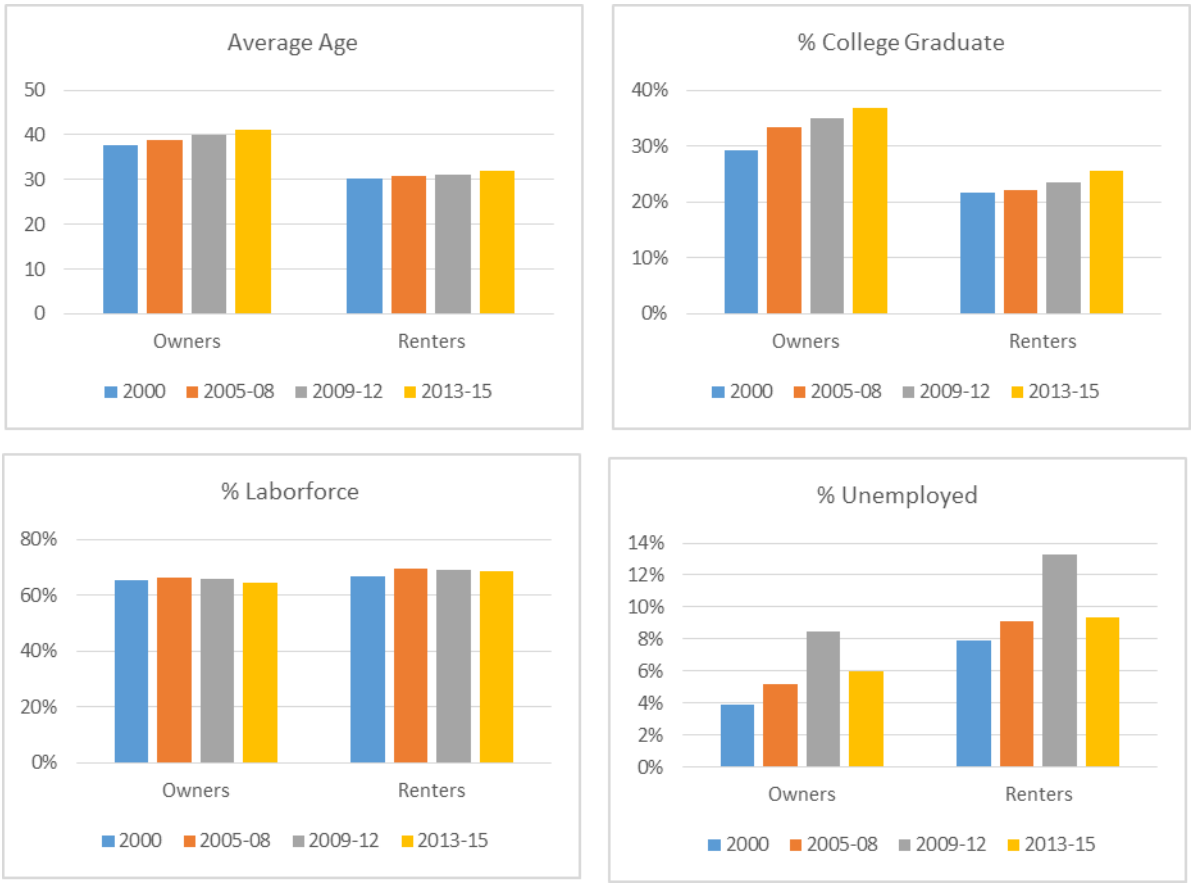
This study examines how nominal and real income inequality changes in response to the changes in the house prices. We find that real incomes of low income households is more sensitive to house price shocks as housing costs account for a higher proportion of their incomes. In a strong housing market, we find that nominal income inequality decreases as house prices increase. The increase in housing cost in this marker, however, offsets the reduction in nominal income inequality. On the other hand, when house prices falls, real income inequality increases more in MSAs that experience greater house price drops, as households experience a greater income drop in these MSAs, while their housing costs does not change more than the MSAs that experience smaller changes in house prices.

Compared to structural changes in the labor market such as revolutions in skilled bias technology and deterioration of labor institutions, changes in house prices may have a short run impact on changes in inequality. However, the finding that lower households are more sensitive to changes in house prices may not be independent from the long term changes in labor market structure. In fact, the increase in the flexibility in the labor market is likely to have led to greater volatility in the income of many lower income households response to house price shocks. As the flow cost of housing is relatively stable, especially in a weak housing market, low income households, with their volatile incomes, are vulnerable to changes in house price dynamics.

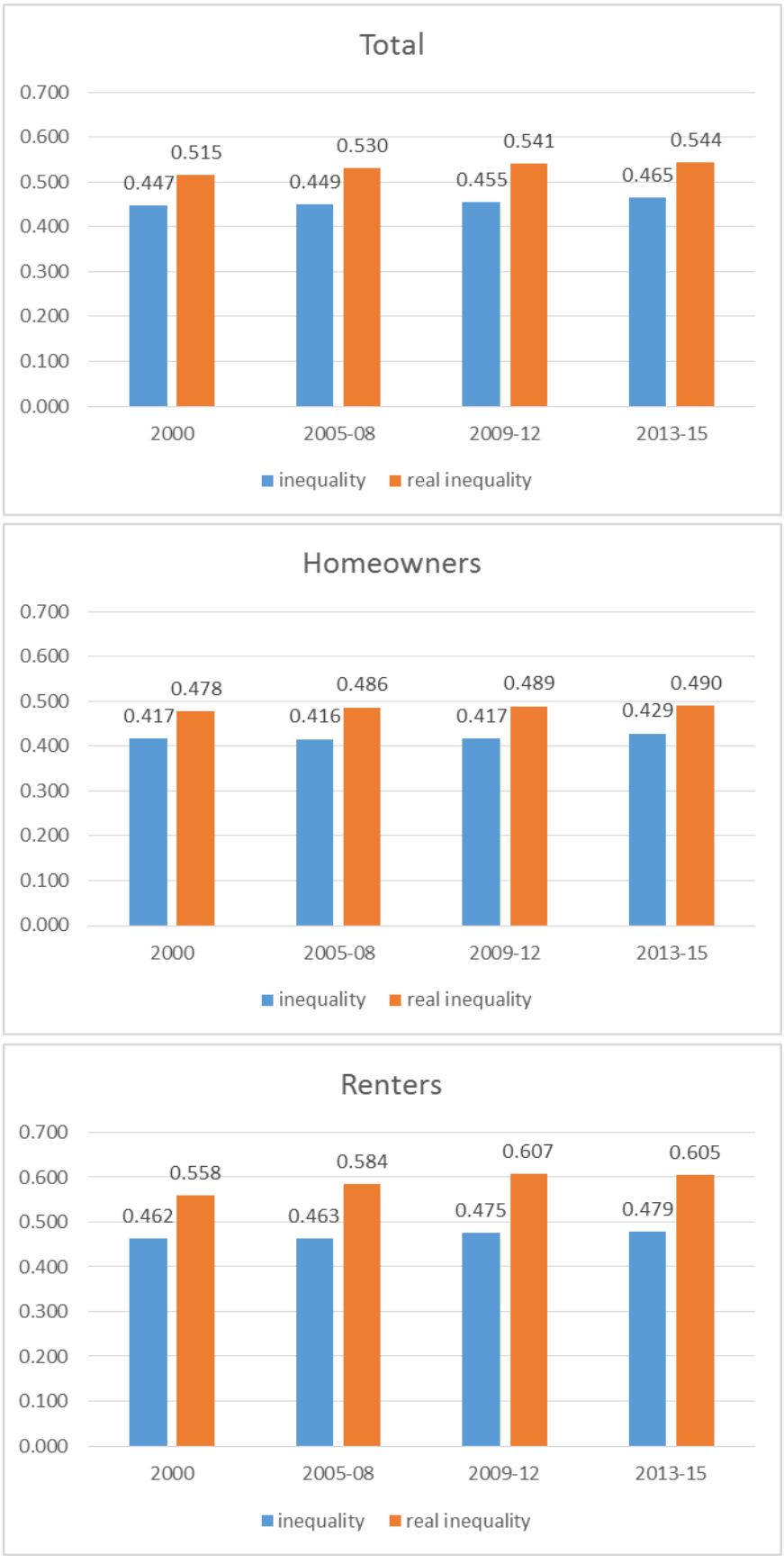
Figures



[Figure I] % Δ in Nominal & Real Income Gini to % Δ in HPI

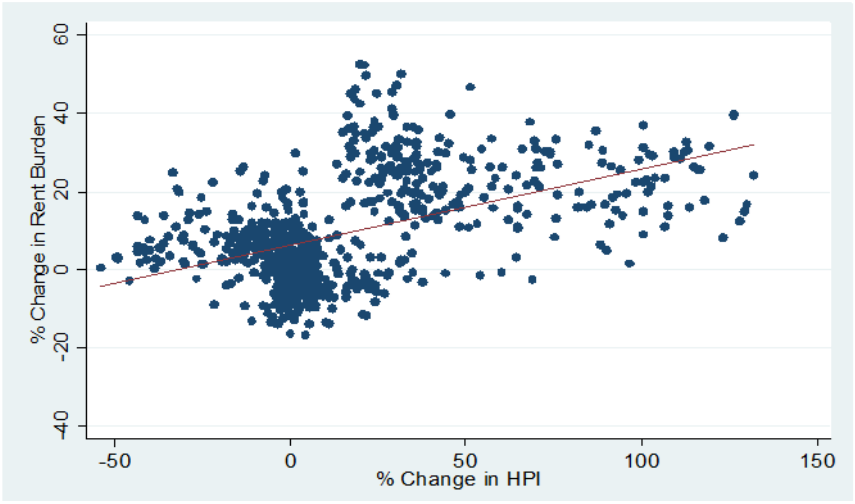


[Figure II] Owner vs. Renters - Age, Education and Employment

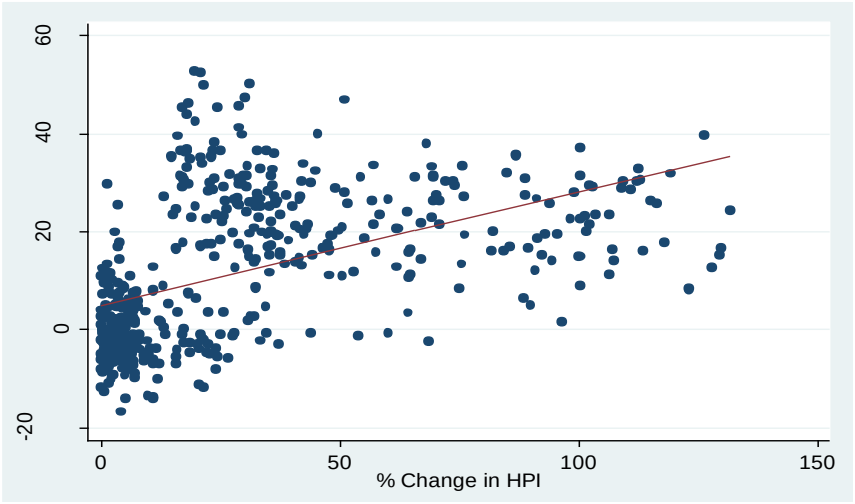


[Figure III] Nominal vs. Real Income Inequality

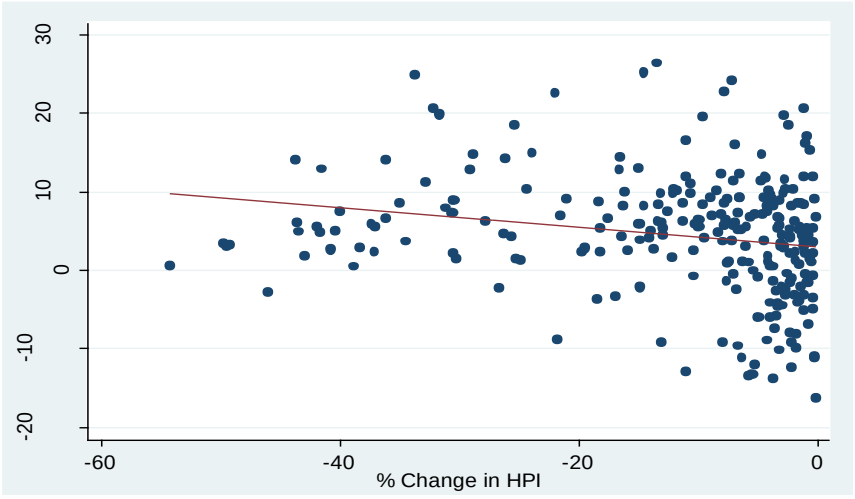
Total Sample



Strong Housing Market



Weak Housing Market



[Figure IV] % Δ in Rent Burden on % Δ in House Prices

Tables

[Table I] Descriptive Statistics

Variable	Mean	Std. Dev.
Gini		
Total	0.43	0.03
Owners	0.40	0.03
Renters	0.44	0.03
Real Gini		
Total	0.51	0.04
Owners	0.46	0.03
Renters	0.56	0.05
% Change in Gini		
Total	1.06	2.86
Owners	0.61	3.49
Renters	0.97	5.99
% Change in Real Gini		
Total	1.98	3.50
Owners	0.70	3.36
Renters	2.78	6.53
Rent & Income		
HPI	165.19	38.12
% House Price Index	16.28	34.31
Median Owncost	997	336
% Change in MedianOwn Cost	8.94	16.48
Median Rent	731	195
% Change in Median Rent	15.75	12.17
Median Income	31784	6320
% Change in Median Income	9.16	7.92
Rent Burden	48.36	6.94
% Change in Rent Burden	9.17	13.41
MSA Characteristics		
% Age 1625	13.93	2.91
% Age 2635	13.22	1.62
% Age 3645	13.79	1.86
% Age 4655	13.71	1.44
% Age 5665	10.89	2.23
% Age over65	12.49	3.66
% Bachelor	26.16	8.12
% Head	38.89	3.22
% Immigrant	0.04	0.03
Population	325264	646588
Land Unavailability	0.27	0.21
Observations	1071	

[Table II] First Stage Regression: % Δ of HPI on Land Unavailability

VARIABLES	(1) Total	(2) ΔHPI>0	(3) Δ HPI<0
% Land Unavailability	41.86***	52.97***	-14.92***
	(6.097)	(6.532)	(3.763)
Control	Y	Y	Y
Observations	607	389	218
R-squared	0.419	0.557	0.498

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The standard errors are clustered by MSAs.

[Table III] % Δ in Nominal Income Inequality on % Δ in HPI

VARIABLES	OLS			IV		
	(1) Total	(2) ΔHPI>0	(3) ΔHPI<0	(4) Total	(5) ΔHPI>0	(6) ΔHPI<0
% Δ in HPI	-0.019***	-0.019***	-0.005	-0.028***	-0.021*	0.025
	(0.004)	(0.006)	(0.031)	(0.012)	(0.013)	(0.053)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	N	N	N
Observations	748	491	257	607	389	218
R-squareΔ	0.176	0.254	0.228			

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The standard errors are clustered by MSAs.

[Table IV] Owners vs. Renters: % Δ in Nominal Income Inequality on % Δ in HPI

VARIABLES	OLS			IV		
	(1) Total	(2) ΔHPI>0	(3) ΔHPI<0	(4) Total	(5) ΔHPI>0	(6) ΔHPI<0
Owners						
% Δ HPI	0.006	-0.000	0.029	-0.035***	-0.015	0.132*
	(0.005)	(0.007)	(0.039)	(0.013)	(0.054)	(0.071)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	N	N	N
Observations	748	491	257	607	389	218
R-squareΔ	0.190	0.293	0.223			
Renters						
% Δ HPI	-0.075***	-0.051***	-0.019	-0.052**	-0.053**	-0.103
	(0.008)	(0.013)	(0.053)	(0.021)	(0.023)	(0.131)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	N	N	N
Observations	748	491	257	607	389	218
R-squareΔ	0.177	0.197	0.270			

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The standard errors are clustered by MSAs.

[Table V] Owners vs. Renters: % Δ in Real Income Inequality on % Δ in HPI

VARIABLES	OLS			IV		
	(1) Total	(2) ΔHPI>0	(3) ΔHPI<0	(4) Total	(5) ΔHPI>0	(6) ΔHPI<0
% Δ in HPI	-0.019**	0.015*	-0.060*	0.029**	0.024	-0.116*
	(0.005)	(0.008)	(0.036)	(0.015)	(0.017)	(0.066)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	N	N	N
Observations	748	491	257	607	389	218
R-squared	0.163	0.241	0.287	0.090	0.291	0.308

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The standard errors are clustered by MSAs.

[Table VI] Owners vs. Renters: % Δ in Real Income Inequality on % Δ in HPI

VARIABLES	OLS			IV		
	(1) Total	(2) ΔHPI>0	(3) ΔHPI<0	(4) Total	(5) ΔHPI>0	(6) ΔHPI<0
Owners						
% Δ HPI	0.020***	0.043***	-0.012	0.017	0.028*	0.030
	(0.005)	(0.008)	(0.039)	(0.013)	(0.015)	(0.060)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	N	N	N
Observations	748	491	257	607	389	218
R-squared	0.107	0.182	0.210	0.079	0.208	0.230
Renters						
% Δ HPI	-0.070***	-0.040***	-0.102*	0.028	-0.007	-0.346**
	(0.008)	(0.015)	(0.053)	(0.024)	(0.026)	(0.142)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	N	N	N
Observations	748	491	257	607	389	218
R-squared	0.207	0.259	0.298			

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The standard errors are clustered by MSAs.

[Table VII] Difference in % Δ in Real and Nominal Income Inequality on % Δ in HPI

VARIABLES	OLS			IV		
	(1) Total	(2) ΔHPI>0	(3) ΔHPI<0	(4) Total	(5) ΔHPI>0	(6) ΔHPI<0
% Δ in HPI	0.008***	0.034***	-0.056***	0.057***	0.044***	-0.141***
	(0.003)	(0.005)	(0.020)	(0.007)	(0.009)	(0.048)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Observations	748	491	257	607	389	218
R-squared	0.440	0.579	0.475			

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The standard errors are clustered by MSAs.

[Table VIII] Owners vs. Renters:
Difference in % Δ in Real and Nominal Income Inequality on % Δ in HPI

VARIABLES	OLS			IV		
	(1) Total	(2) ΔHPI>0	(3) ΔHPI<0	(4) Total	(5) ΔHPI>0	(6) ΔHPI<0
Owners						
% Δ HPI	0.014***	0.043***	-0.041*	0.051***	0.043***	-0.102**
	(0.003)	(0.005)	(0.021)	(0.006)	(0.009)	(0.045)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Observations	748	491	257	607	389	218
R-squared	0.449	0.602	0.407	0.247	0.566	0.382
Renters						
% Δ HPI	0.005	0.012	-0.083**	0.080***	0.047***	-0.243***
	(0.004)	(0.007)	(0.034)	(0.012)	(0.015)	(0.091)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Observations	748	491	257	607	389	218
R-squared	0.367	0.482	0.340			

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The standard errors are clustered by MSAs.

[Table IX] % Δ in Median Income on % Δ in HPI

VARIABLES	Total			Owner			Renters		
	(1) Total	(2) ΔHPI>0	(3) ΔHPI<0	(4) Total	(5) ΔHPI>0	(6) ΔHPI<0	(7) Total	(8) ΔHPI>0	(9) ΔHPI<0
% Δ in HPI	0.227***	0.228***	-0.245	0.205***	0.197***	-0.157	0.142***	0.209***	1.075*
	(0.0277)	(0.0406)	(0.377)	(0.0280)	(0.0384)	(0.327)	(0.0429)	(0.0714)	(0.649)
Control	Y	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	607	389	218	607	389	218	607	389	218
R-squared	0.726	0.715	0.198	0.732	0.754	0.270	0.375	0.412	0.189

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The standard errors are clustered by MSAs.

[Table X] % Δ in Median Housing Costs on % Δ in HPI

VARIABLES	Median Rent			Median Owners Cost		
	(1) Total	(2) ΔHPI>0	(3) ΔHPI<0	(4) Total	(5) ΔHPI>0	(6) ΔHPI<0
% Δ in HPI	0.351***	0.289***	-0.146	0.412***	0.305***	-0.541**
	(0.0308)	(0.0383)	(0.120)	(0.0445)	(0.0554)	(0.252)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Observations	607	389	218	607	389	218
R-squared	0.651	0.770	0.081	0.562	0.697	

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The standard errors are clustered by MSAs.

[Table IX] % Δ in Rent Burden on % Δ in HPI

VARIABLES	OLS			IV		
	(1) Total	(2) ΔHPI>0	(3) ΔHPI<0	(4) Total	(5) ΔHPI>0	(6) ΔHPI<0
% Δ HPI	0.037***	0.069***	-0.213**	0.277***	0.141***	-0.839***
	(0.014)	(0.025)	(0.092)	(0.035)	(0.052)	(0.272)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	N	N	N
Observations	731	477	254	601	384	217
R-squared	0.611	0.689	0.416			

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The standard errors are clustered by MSAs.

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Appendix

[Table A1] IV: % Δ in Median Income on % Δ in HPI

VARIABLES	Total			Owner			Renters		
	(1) Total	(2) ΔHPI>0	(3) ΔHPI<0	(4) Total	(5) ΔHPI>0	(6) ΔHPI<0	(7) Total	(8) ΔHPI>0	(9) ΔHPI<0
% Δ in HPI	0.227***	0.228***	-0.245	0.205***	0.197***	-0.157	0.142***	0.209***	1.075*
	(0.0277)	(0.0406)	(0.377)	(0.0280)	(0.0384)	(0.327)	(0.0429)	(0.0714)	(0.649)
Control	Y	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	607	389	218	607	389	218	607	389	218
R-squared	0.726	0.715	0.198	0.732	0.754	0.270	0.375	0.412	0.189

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The standard errors are clustered by MSAs.

[Table A2] IV: % Δ in Median Rent on % Δ in HPI

VARIABLES	Median Rent			Median Owners Cost		
	(1) Total	(2) ΔHPI>0	(3) ΔHPI<0	(4) Total	(5) ΔHPI>0	(6) ΔHPI<0
% Δ in HPI	0.351***	0.289***	-0.146	0.412***	0.305***	-0.541**
	(0.0308)	(0.0383)	(0.120)	(0.0445)	(0.0554)	(0.252)
Control	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Observations	607	389	218	607	389	218
R-squared	0.651	0.770	0.081	0.562	0.697	

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The standard errors are clustered by MSAs.

[Table A3] Scenario I: Income Inequality in a Strong Housing Market

	Nominal Income		Real Income		Housing Cost	
	T=0	T=1	T=0	T=1	T=0	T=1
High Income Household	500,000	500,000	380,000	350,000	120,000	150,000
Low Income Household	50,000	55,000	20,000	17,500	30,000	37,500
Gini	0.409	0.401	0.450	0.452		

[Table A4] Scenario II: Income Inequality in a Weak Housing Market

	Income		Real Income		Housing Cost	
	T=0	T=1	T=0	T=1	T=0	T=1
High Income Household	500,000	450,000	380,000	330,000	120,000	120,000
Low Income Household	50,000	45,000	20,000	15,000	30,000	30,000
Gini	0.409	0.409	0.450	0.457		