# Housing Dynamics without Homeowners. The Role of Investors.[!] ["]

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**Abstract**

This paper documents the arrival of institutional investors in the U.S. housing market and studies their dynamic real effects. Using an instrumental variable approach we show that investors initially caused increases in housing prices and rents, mostly in bottom-tier and single-family segments of the market. Investors brought liquidity and stimulated construction causing decreases in prices and rents over time. Thus, investors initially lowered housing affordability to later increase it. We also uncover a new fact post-financial crisis: housing prices have decoupled from homeownership in most MSAs in the U.S., as in many advanced economies. The presence of investors decouples housing dynamics from homeownership.

**Keywords**: Investors, Homeownership, Housing prices, Rents, Vacancies, Residential Investment, Housing

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# 1 Introduction

Following the 2008 Financial Crisis the housing market of the U.S. and many advanced economies saw an unprecedented increase in investment by institutional investors. The institutional investors, consisting of legal entities, more than surpassed in their purchases the traditional investors that boomed in the years leading to the financial crisis. The investors between 2000 and 2007 were typically households who purchased multiple properties speculating on housing price growth and benefiting from relaxed mortgage standards. In contrast, the investors after 2009 are incorporated in the form of legal entities and invest in the housing market in search for rental yield.

In this paper we study the dynamic effects of these new players in the housing market. We analyze a rich proprietary database from Zillow that covers the universe of U.S. deeds. Form a broad perspective, institutional investors are newcomers in the single-family segment of the housing market and have grown both in the single-family segment and in the more traditional multi-family investments. The vast majority of the institutional investors in the U.S. consist of relatively small local investors. The large "Wall Street landlords" invest in specific locations and their share of purchases is less than 1% of all U.S. investment purchases.

To quantify the real effects associated to the presence of investors we eliminate biases using an instrumental variable approach. The standard approach that regresses the investors' share on, for example, housing prices would be biased downward if investors selected MSAs that experienced sizeable housing price declines during the housing bust to take advantage of the low housing prices at the time and the high expected capital gains.

Our first instrument exploits heterogeneity across MSAs in exposure to banking institutions that suffered regulatory shocks following the Dodd-Frank Act, approved in 2010, following Gete and Reher (2018). MSAs with greater exposure to these credit supply shocks experienced larger contraction in credit towards borrowers. In the market for credit, contraction of lending leads institutions to lower their deposit rates. This increases demand for alternative investments, such as investments in housing. The instrument is the value of deposits' share in 2008 for lenders that underwent a capital stress test between 2011 and 2017 multiplied by the difference in denial propensity between stress-tested and non stress-tested lenders. Since the bank distribution that we use was determined prior to Dodd-Frank, there is no risk of reverse causality. Calem, Correa, and Lee (2016) document that stress tests are associated with tightened standards in credit markets.

Our second instrument exploits the cross-sectional differences in MSAs' exposure to the

capital markets and the Fed's Quantitative Easing (QE). MSAs with greater exposure to the capital markets experienced more liquidity and more capital available for investment. To measure the MSA exposure to the capital markets we calculate the beta of each MSA's housing market relative to the U.S. stock market, using an one-factor CAPM pre-2008. The instrument is the MSA beta multiplied by the Wu-Xia Shadow Federal Funds Rate. The shadow Fed funds rate can be negative to quantify the effects of unconventional policies. Since the beta that we calculate is determined prior to the implementation of the QE, there is no risk of reverse causality.

Our results of the instrumental variable estimations show that institutional investors initially significantly increase housing prices, especially for bottom-tier homes and in the single-family market segment. At the same time the investors increase the supply of housing through rise in new construction. The increase in supply of houses leads to subsequent decrease in housing prices. The institutional investors also increase liquidity in the market, illustrated by drops in owner-occupied and rental vacancies. The increased demand for rentals initially increases housing rents, however in the long-run the rise in the supply of rentals leads to a drop in rents. Institutional investors cause an immediate increase in price-to-income and rent-to-income ratios, but in the subsequent years they contribute to improving housing price and rent affordability.

Following the 2008 Financial Crisis, there is wide consensus that fluctuations in housing prices have important implications for the aggregate economy and financial stability (Jorda, Schularick and Taylor 2017; Leamer 2007 among others). Historically, housing prices have been strongly positively correlated with homeownership. Thus, most of the active literature in macroeconomics and finance that models housing markets assumes that it is households' demand for housing consumption or housing collateral what drives housing prices.[1] However, in this paper we document a new fact that challenges the existing consensus: for most MSAs and countries, after the financial crisis housing prices have decoupled from homeownership. That is, in many locations housing prices started to recover from the crisis around 2011 while homeownership continued declining.

Our instrumental variable results show that the increase in the value of purchases by institutional investors causes a significant part of the decpoupling. An increase of one standard deviation in the value of the investors' value of purchases leads to a drop in correlation by 0.93 over the 2009-2014 period. We also show formally that in 2008 there was a structural break in the correlation of housing prices and homeownership rate in the U.S.

[1] See, for example, Iacoviello (2005); Iacoviello and Neri (2010); Campbell (2017); Favilukis, Ludvigson and Van Nieuwerburgh (2017); Campbell, Clara and Cocco (2018), Piskorski and Seru (2018); Guren, Krishnamurthy and McQuade (2018), Kaplan, Mitman and Violante (2017), Garriga and Hedlund (2018), Gete and Zecchetto (2018).

This paper contributes to the growing literature that studies investors in the housing market. The first wave of the literature has focused on individual investors or flippers. See for example, Haughwout, Lee, Tracy and Van Der Klaauw (2011), Chinco and Mayer (2015), Gao and Li (2015), Gao, Sockin and Xiong (2017), Bayer, Mangum and Roberts (2016), Garcia (2017) or Albanesi (2018). The second wave of the literature focuses on institutional investors. So far the literature has focused on single-family housing and specific areas in the U.S. For example, Gay (2015) documents that purchases and sales of single-family houses by institutional investors were four times more in the years 2012 and 2013 compared to 2011. He finds that institutional investors buy more properties in lower income areas of the Chicago Metro Area and sell them at a premium after renovations, which is related to low affordability of buying a house in those areas. Allen, Rutherford, Rutherford and Yavas (2017) focusing on the Miami-Dade County in Florida, find that an increase in the share of houses purchased by investors in a census block is related to an increase in house prices. Raymond et al. (2018) find that large institutional owners of single-family rentals file more frequently eviction notices compared to small landlords in Fulton County in Atlanta. Mills, Molloy and Zarutskie (2017) show that large buy-to-rent investors appear to have increased house prices in the neighborhoods where they concentrated. This paper however does not use causal identification. In a thorough study of institutional investors, focusing on 20 large U.S. MSAs and conducting a zip code-level analysis, Lambie-Hanson, Li and Slonkosky (2019) find that single-family institutional buyers contributed to the increase in growth rates of prices and rents, and the decline in homeownership rate change. Verbrugge and Gallin (2019) find that multi-unit landlords, when renegotiating rent contracts, set rent increases that exceed the inflation rate, aided by the law of large numbers and exploiting tenant moving costs. In contrast, landlords with one unit offer tenants the identical contract to prevent search, since vacancy is very costly for them.

The rest of the paper is organized as follows. Section 2 shows the new facts. Section 3 discusses the theory that we will test. Section 4 presents our database. Section 5 analyzes the real effects of the investors and their dynamics. Section 6 studies the structural break in the correlation of housing prices and homeownership rate. Section 7 concludes. The Appendix has extra information about the stylized facts and the variables.

# 2 Stylized Facts

The U.S. housing market experiences a surge in house purchases by investors in the years following the 2008 financial crisis. Figure 1 plots the purchases by investors in all U.S. MSAs in dollar terms and as a share of the total dollar value of purchases. Figure 2 shows a novel fact:

institutional investors replace and surpass the households who invest by purchasing multiple homes and who experienced a boom in the years leading to the crisis. The largest value of purchases after the financial crisis is attributed to institutions, with legal forms, such as LLCs and LPs.

Figure 3 illustrates the geographical distribution of the institutional investors in the U.S. MSAs. The East and West coasts experienced the largest increase in the share of institutional investors post 2009.

Thus, in this Section we have shown a new fact: institutional investors dominate the U.S. housing market following the last financial crisis. The arrival of institutional investors coincides with the decoupling of housing prices from homeownership. Figure 11 plots housing prices and homeownership rate (HOR) in the U.S., while Figure 12 shows the rolling-window correlation of these series over a seven-year moving average. The figures show that following the last financial crisis, housing prices decoupled from homeownership. The correlation of the two series moves from being close to one to becoming close to -0.9. Figure A1 in the appendix shows that the previous fact is robust across U.S. MSAs. Housing prices and HOR used to move in tandem as demand for ownership drove housing prices. However, since the financial crisis the pattern has changed.

Next we formally study the real effects of the arrival of institutional investors, focusing especially on the dynamics of these effects over time. We also study the contribution of the institutional investors to the decoupling.

# 3 Theory

Following the financial crisis, institutional investors contribute to the recovery of the housing prices by purchasing the homes that households cannot purchase due to credit constraints. Institutional investors convert houses that were for sale to rentals, meeting the increasing demand for rentals and contributing to the decrease in homeownership rates. By contributing to increasing housing prices and decreasing homeownership rates, institutional investors play a significant role in the collapse of the correlation between housing prices and homeownership rates.

Institutional investors increasing demand for houses as investment assets increases at first instance the housing prices. Investors bring liquidity to the housing market, supported also by the increased liquidity in capital markets that follows the Fed's Quantitative Easing (QE).

Increase demand for houses also operates through new constructions and lower vacancies. Investors increase the supply of houses for sale, both new constructions and existing homes. Credit constrained households do not bring competition for housing purchases, as their demand for homeownership decreases. Increasing supply of houses for sale leads to an eventual decrease in housing prices. Investors eventually contribute to making houses more affordable to purchase.

Institutional investors provide rental housing to meet households' increasing demand for rentals. Increasing demand for rentals and the bargaining power of institutional investors who are supplying the rentals lead at first instance to the increase in housing rents.[2] As the demand for rentals is met and the supply of rentals keeps increasing, the housing rents eventually decrease. Institutional investors contribute to making rentals more affordable for households.

In this paper we also study formally the factors that determined the investors' presence. Following the financial crisis, households' demand for homeownership dramatically decreases because households' access to mortgage credit becomes more difficult. Stricter bank regulations such as the Dodd-Frank Act and putback risk results in banks increasing their loan denial rates to households with imperfect credit. Since downward house price rigidities prevent most households from buying without credit, households denied credit move from the market for homeownership to the rental market. Thus, investors increase their presence in MSAs where households are more credit constrained.

Households that are more credit constrained decrease their demand for homeownership and increase their demand for rentals. The drop in demand for homeownership causes the housing prices to fall relative to rents, increasing the rental yields for investors. Thus, investors are attracted to MSAs where the rental yields are higher.

At the same time, the Fed's QE keeps treasury yields at very low levels, making housing an appealing alternative investment. QE also increases liquidity in capital markets, which could be channeled towards the stock market or towards the housing market. With housing markets offering an appealing investment, investors increase their presence to MSAs more exposed to the capital markets.

# 4 Data

Data on investors in the U.S. housing market come from ZTRAX, a new database provided by Zillow. The database covers all property ownership transfers in the U.S., as recorded

[2] Gete and Reher (2018) show that a contraction in mortgage credit supply after the crisis has been a significant driver of increasing housing rents.

by the counties' deeds. We focus on ownership transfers of residential properties, including multi-family and single-family, in the period from January 2000 to December 2017. Our final sample, from which we construct the investors' share variable, consists of 85 million transactions nationally.

We use a rigorous methodology to identify institutional investors. First we distinguish between individual and non individual buyers based on the buyer name. Second, we filter-out buyers that are relocation companies, non profit organizations, construction companies and national and regional authorities, as well as banks, Ginnie Mae, Fannie Mae, Freddie Mac and other mortgage loan companies and credit unions, and the state taking ownership of foreclosed properties.

We calculate the share of institutional investors to be the value in U.S. dollars of purchases by institutional investors divided by the value in U.S. dollars of purchases by institutional investors and individuals in each MSA over a year. We use the dollar value of purchases instead of the number of purchases since the number of purchases would underestimate presence in the apartments market. For example the number of purchases would equate a purchase of one condominium to the purchase of one apartment building of 500 apartments. So the dollar value of purchases reflects more accurately the presence of individuals and institutional investors in the single-family and multi-family markets. Table 1 presents summary statistics of the presence of institutional investors in the U.S. housing market. Table 2 shows more detailed statistics of institutional investors' single- and multi-family purchases. Table A2 presents summary statistics of the investment horizon of institutional investors. Tables A3, A4 and A5 in the Appendix show the above statistics for purchases by individuals - not having legal entity form - who invest in the housing market.

The housing and affordability variables come from Zillow. Home prices come from the Zillow home value index for all homes, top tier homes and bottom tier homes at the MSA level. Top tier homes are homes in the top third, and bottom tier homes are homes in the bottom third of the home value distribution within an MSA. Rent comes from the Zillow monthly rent value index for all homes. Income comes from the Zillow median household income. We take the average price, rent and income values within year and MSA for the years 2000 to 2018.

We calculate price-to-rent ratio as the home value divided by twelve times the monthly rent. Price-to-income ratio is the home value divided by the median household income, and rent-to-income ratio is twelve times the monthly rent divided by the median household income.

We collect the homeownership and vacancy data from the American Community Survey. Homeownership rate refers to the share of occupied households that are owner-occupied. We

collect also the number of buildings and their dollar value in new construction permits from the Census Bureau's annual Building Permits Survey.

We finally collect MSA-year levels controls, which are population from the U.S. Census Bureau, median age from the American Community Survey One-Year Estimates, provided by the U.S. Census Bureau, and median income from Zillow.

More detailed description of the data sources is included in the Appendix $A$. After merging all data and instrumental variables, we have our final sample of 310 MSAs with a full set of housing variables, mortgage and control data. We use MSA-year panel data for the years 2009-2018 for the regressions of the dynamic real effects of investors, and the years 2009-2014 for the regressions of the investors' share on the factors attracting them.

Table 3 contains summary statistics of the key variables in our study.

# 5 Real Effects of Investors

We estimate the real effects of investors with the following specification:

$$y_{m,t} = \beta_0 + \beta_1 x_{m,t} + \gamma \mathbf{C}_{m,t} + \alpha_m + b_t + u_{m,t}, \tag{1}$$

where $t$ indexes years and $m$ MSAs. $y_{m,t}$ denotes the housing variables we want to study the effects of investors' presence on. These variables are the housing price growth rate from year $t$ ! 1 to year $t$, housing price growth rate specifically for top tier and bottom tier houses, the new construction value growth from year $t$ ! 1 to year $t$, the housing vacancy rate for owner-occupied houses and rentals, the housing rent growth rate from year $t$ ! 1 to year $t$, the price-to-income ratio change and rent-to-income ratio change from year $t$ ! 1 to year $t$, and the correlation between housing prices and homeownership. $x_{m,t}$ is the institutional investors' dollar value of purchases for the year $t$ in MSA $m$. $\mathbf{C}_{m,t}$ summarizes the time-varying MSA-specific controls that include the population growth rate, the income growth rate and the median age change, all lagged for one year. The location fixed effects $\alpha_m$ account for the time-invariant MSA-specific influences, and the time fixed effects $b_t$ account for the time-varying factors common to all MSAs. We estimate (1) for our final sample of 315 MSAs for the years 2009 to 2015.

If we estimate (1) using OLS, we would obtain biased estimates. This is because local shocks can drive both housing market dynamics and the share of investors. For example investors might target MSAs with decreasing housing price growth that would potentially give them

higher capital gains when they sell. As a result, the OLS estimate for housing price growth would be biased downward. Another possibility is that a positive shock to an MSA's economic activity would increase amenities and thus price growth, while raising the attractiveness of the houses as investment opportunities. In this case the OLS estimate for housing price growth would be biased upward.

Regardless of the direction of the bias, we aim to overcome it by using two instruments for the institutional investors' purchases. Our first instrument is the deposit share of stress-tested lenders in 2008 in MSA $m$ multiplied by the difference in denial propensity between stress-tested and non stress-tested lenders in year $t$ ! 1. The instrument captures an MSA's exposure to lenders facing regulatory risk over the post-2009 period, where the exposure is measured with predetermined variables unrelated to the factors the literature has identified as drivers of housing variables. This instrument exploits MSA exposure to lenders subject to a Comprehensive Capital Analysis and Review (CCAR) stress test from 2011 onwards. These tests are meant to ensure that the largest bank holding companies have enough capital to weather a financial crisis, but as a side-effect they have encouraged those institutions to tighten their standards in mortgage markets (Calem, Correa, and Lee 2016). In the market for credit, reduced demand for lending leads the lending institutions to lower their deposit rates. Facing lower deposit rates, investors' demand for alternative higher-yield investments, such as investment in housing, increases. There is extensive evidence that this instrument satisfy the exclusion restriction for housing prices and rents. Our key identification assumption is that, once we control for an array of factors and fixed effects, exposure to the stress-tested lenders is uncorrelated with other drivers of investors' presence over post-2009. Figure 9 plots the difference in the mortgage denial propensity per year between stress-tested and non stress-tested lenders.

Our second instrument exploits the cross-sectional differences in MSAs' exposure to the capital markets and the national shock in the federal funds rate caused by the Fed's QE. In one-factor CAPM the beta measures the sensitivity of the stock to the market. Using that reasoning here we create the beta of MSA $m$, calculated using 1985-2008 returns and one-factor CAPM with the value-weighted return of all U.S. firms listed on the NYSE, AMEX, or NASDAQ. Thus, the beta measures which MSAs are more exposed to capital markets. If QE is a shock that increases liquidity in capital markets, our theory is that those MSAs should attract more investors. To measure QE we use the Wu-Xia Shadow Federal Funds Rate over the post-2009 period. The shadow Fed funds rate can be negative to quantify the effects of unconventional policies. Figure 10 plots the effective federal funds rate and the Wu-Xia shadow rate. Then our instrument is the MSA beta multiplied by the Wu-Xia shadow rate in year $t$ ! 1.

More detailed description of how the instrumental variables are calculated is included in the Appendix $C$.

Table 4 contains the estimates of the specification (1). An increase of one million in investors' purchases increases housing price growth by 0.02 percentage points, increases the growth in the value of new constructions by 0.06 percentage points and decreases the vacancy rate of houses that are typically owner-occupied by 0.001 percentage points.

### 5.1 Dynamic Real Effects of Investors

The next step is to estimate how the response in housing prices and quantities change over time. Jorda (2005) introduces a method that estimates impulse response functions directly, without specifying or estimating the unknown true multivariate process. This method, applied by Favara and Imbs (2015) in their study of credit supply and housing prices, estimates local projections based on sequential regressions of the endogenous variable shifted forward. In the case of specification (1), the local projections are given by a vector of estimates $\{ \beta_1^{(i)} "_{i=0,1,...}$ collected from the estimations of the following specification:

$$y_{m,t+i} = \beta_0 + \beta_1^{(i)} x_{m,t} + \gamma \mathbf{C}_{m,t} + \alpha_m + b_t + u_{m,t}. \tag{2}$$

Each $\beta_1^{(i)}$ estimates the effect of investors' purchases at horizon $i$.

Tables 5-11 show the estimations of specification (2), and Figures 4-8 plot the impulse response functions implied by these estimates.

## 6 The Price-Ownership Decoupling

We use the Chow test for structural breaks to study the time series of the correlation between housing prices and homeownership rate, like in McConnell and Perez-Quiros (2010). Historically the correlation has been stable, so we use a simple linear model to represent the correlation:

$$Corr_t = c + \beta\tau + u_t, \tag{3}$$

where year $t$ # $[t_l, t_u]$, $c$ is a constant and $\tau = 1, 2, ..., t_u$ ! $t_l + 1$. For the full duration of the data $t_l = 1988$ and $t_u = 2015$.

When estimating the previous specification pre-2008, that is, for $t \# [1988, 2008]$, we find that the coefficient $\beta$ is insignificant, confirming that correlation has been at a stable level pre-crisis.

Table 12 shows that the constant $c$ is significantly different pre-2008 and post-2008. Robustness tests in the sub-intervals pre-2008 and post-2011 show that there is no evidence of such change in the value of $c$. The test confirms the visual evidence of a significant drop in the level of the correlation between housing prices and HOR in the U.S. that appeared during the 2008 financial crisis.

Table 13 contains the estimates of the specification (1) for the correlation of housing prices and HOR. An increase of one million in investors' purchases leads to a deacrease in the correlation between housing prices and HOR of 0.001 percentage points.

# 7 Conclusions

TBC

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# Figures

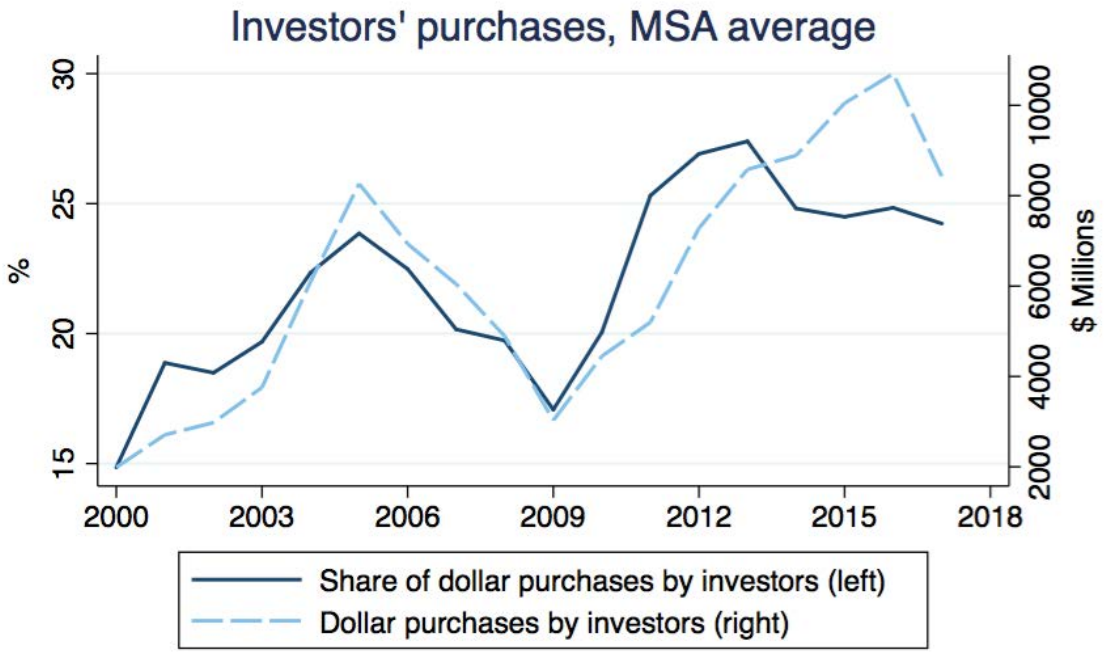


**Figure 1. Presence of investors in the U.S. housing market.** The figure plots the average annual share of the dollar value of purchases (left y-axis) and the average annual dollar value of purchases (right y-axis) by investors in 411 U.S. MSAs, from 2000 to 2017. The share of investors' purchases is calculated as the dollar value of purchases by investors over the total dollar value of purchases in the MSA-year. The MSA averages are weighted by the dollar value of all purchases in each MSA. The data come from ZTRAX. Detailed description of the variables and data sources is included in the Appendix $A$.

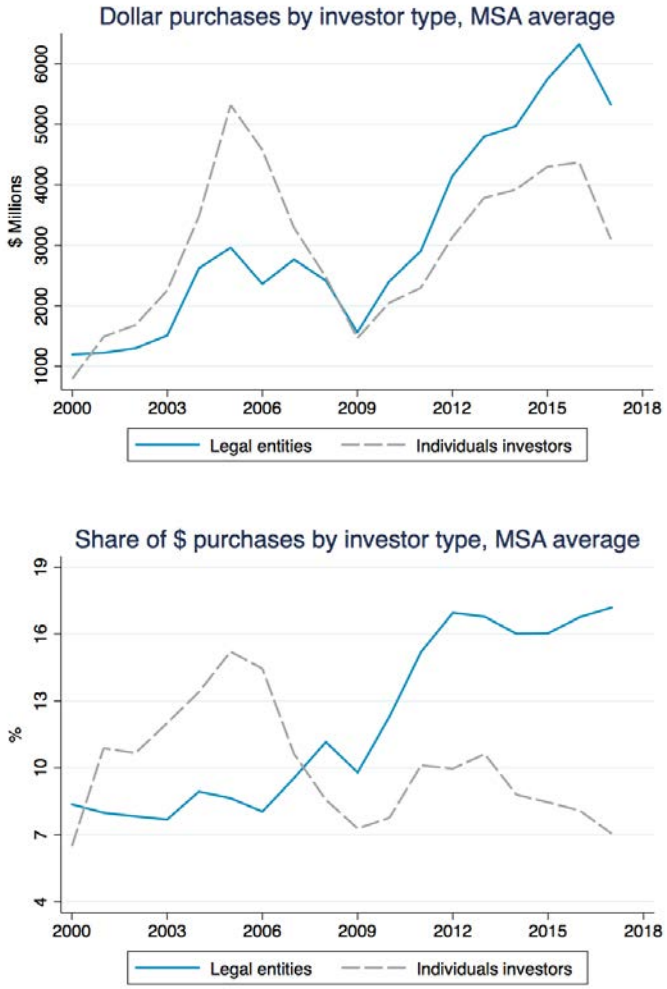


**Figure 2. Presence of investors in the U.S. housing market by investor type.** The top panel plots the average annual dollar value of purchases of investors in 411 U.S. MSAs, from 2000 to 2017. The bottom panel plots the average annual share of the dollar value of purchases of investors in 411 MSAs, over the same period. The MSA averages are weighted by the dollar value of all purchases in each MSA. The data come from ZTRAX. Investors that are legal entities are identified by the buyer name. Investors that are individuals are defined as individuals who purchase more than one house within the MSA in the current and previous year.

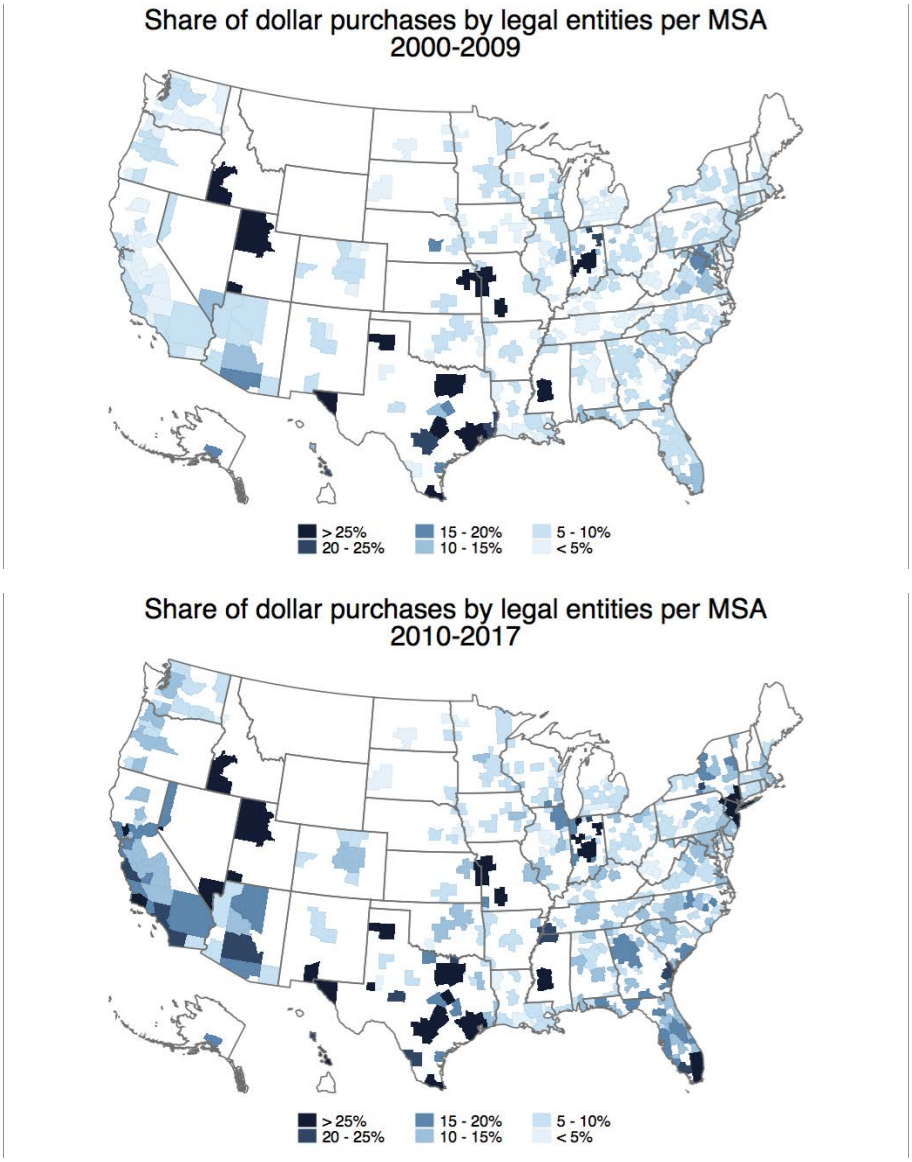


**Figure 3. Presence of investors in the U.S. MSAs.** The top panel plots the average annual share of the dollar value of purchases by legal entities per MSA over the 2000-2009 period and the bottom panel over the 2010-2017 period. The data come from ZTRAX.

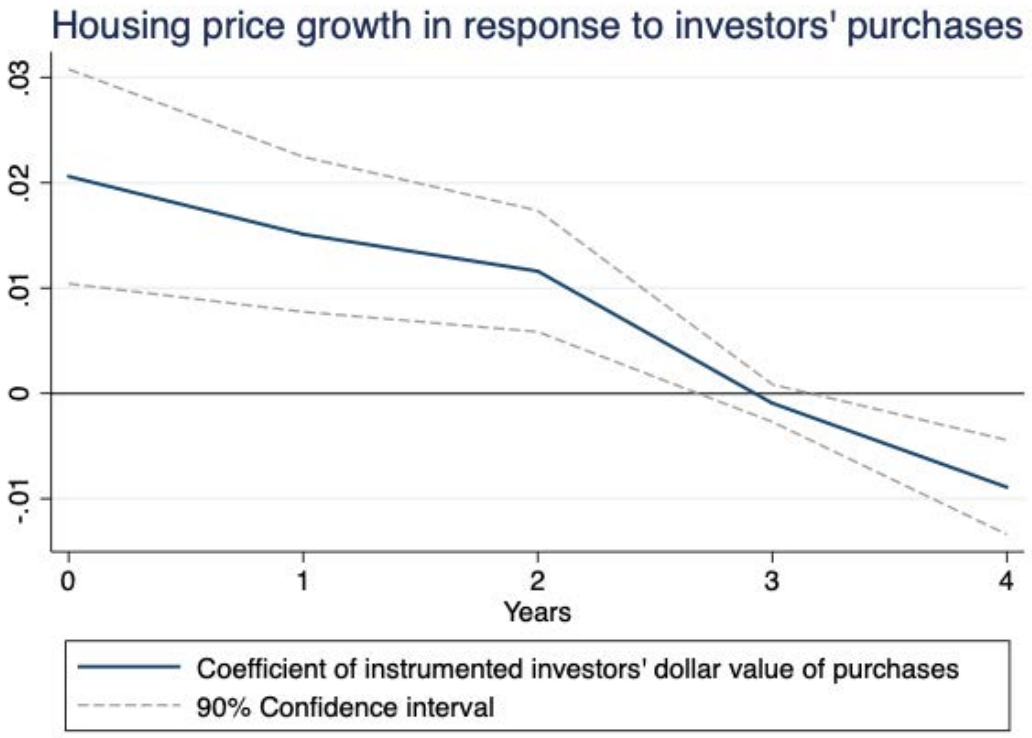


**Figure 4. Housing price growth in response to investors' purchases.** The figure plots the impulse response of the housing price growth to the arrival of investors. The response is estimated by sequential regressions of the housing price growth shifted forward, based on the methodology of Jorda (2005). The estimation at horizon zero is for 315 MSAs for the years 2009-2014.

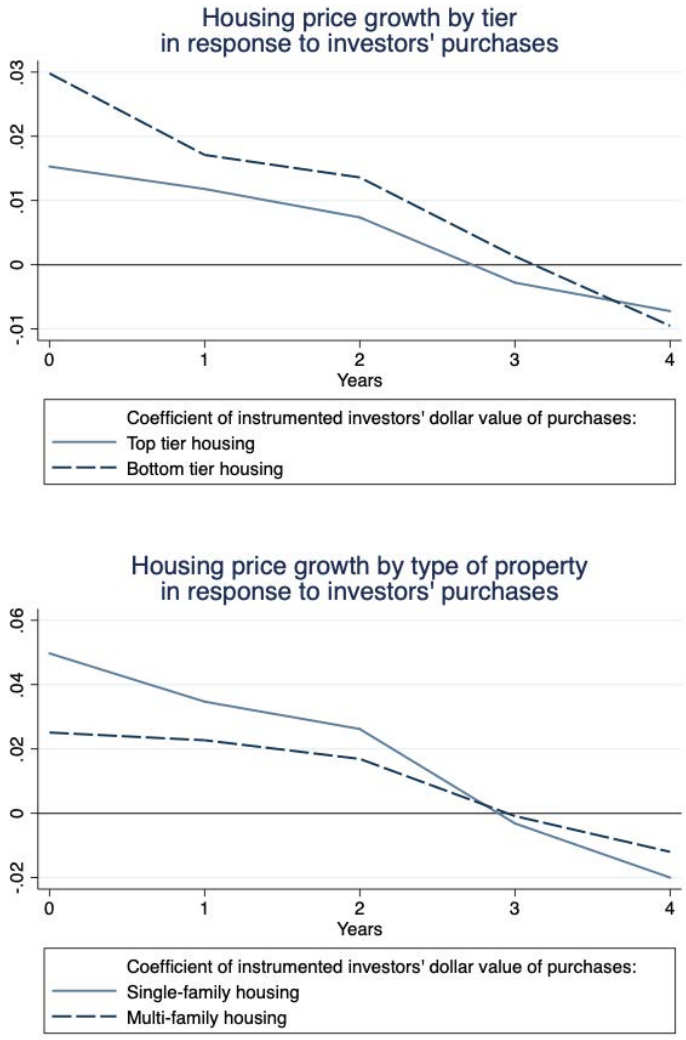


**Figure 5. Housing price growth in response to investors' purchases by tier and by type of property.** The top figure plots the impulse response of the housing price growth for top and bottom tier houses to the arrival of investors. Top tier houses are houses in the top third, and bottom tier houses are houses in the bottom third of the house value distribution within an MSA. The bottom figure plots the impulse response of housing price growth separately for investors' purchases in the single-family housing market and investors' purchases in the multi-family housing market. The estimation at horizon zero is for 315 MSAs for the years 2009-2014.

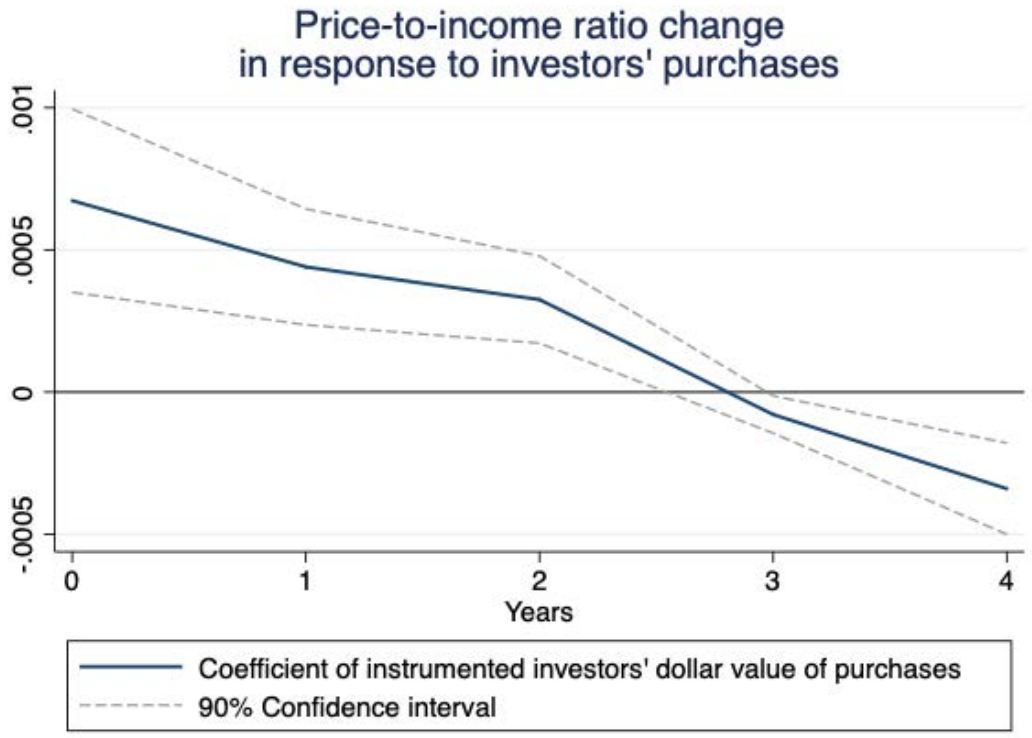


**Figure 6. Housing price affordability in response to investors' purchases.** The figure plots the impulse response of the housing price-to-income ratio change to the arrival of investors. The estimation at horizon zero is for 315 MSAs for the years 2009-2014.

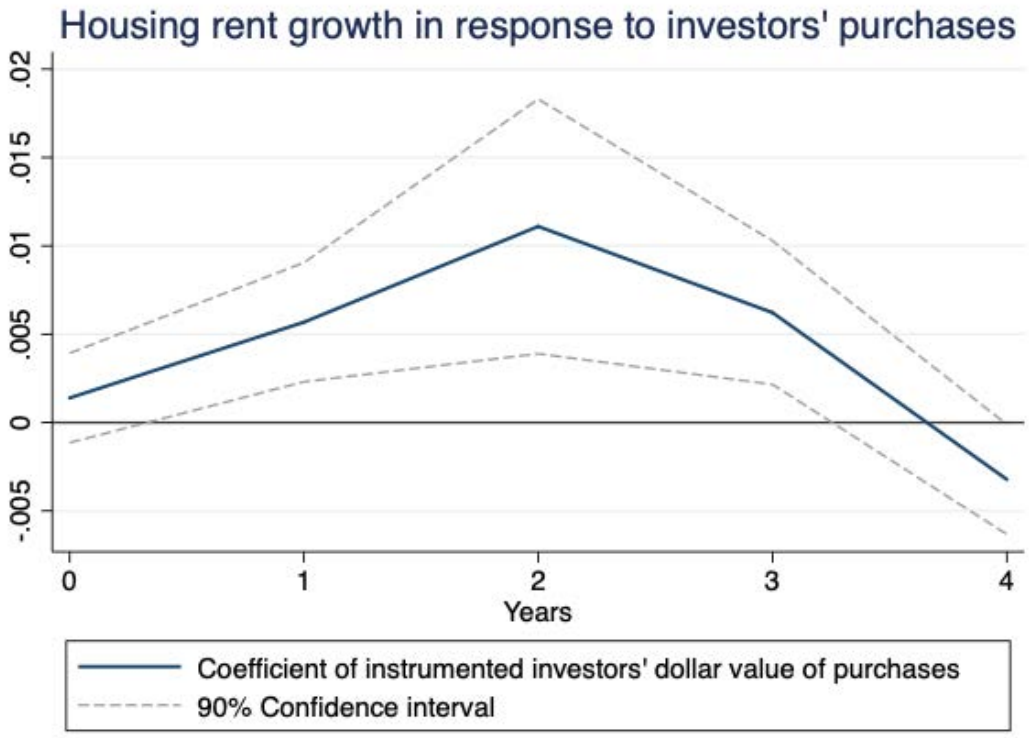


**Figure 7. Housing rent growth in response to investors' purchases.** The figure plots the impulse response of the housing rent growth to the arrival of investors. The estimation at horizon zero is for 315 MSAs for the years 2009-2014.

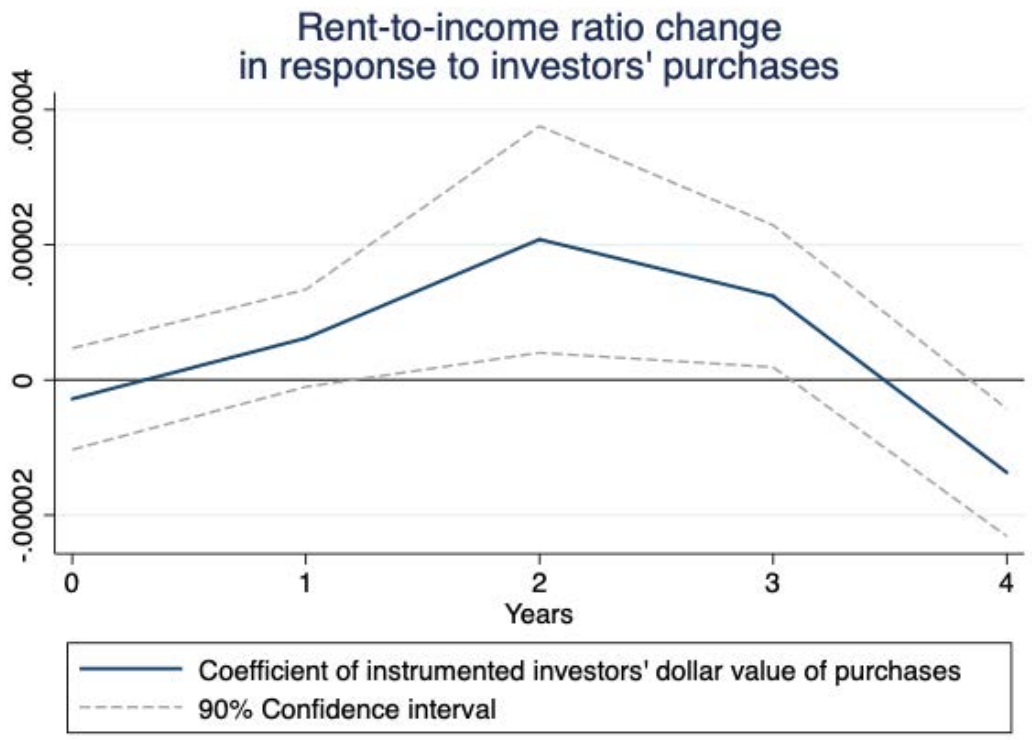


**Figure 8. Housing rent affordability in response to investors' purchases.** The figure plots the impulse response of the housing rent-to-income ratio change to the arrival of investors. The estimation at horizon zero is for 315 MSAs for the years 2009-2014.

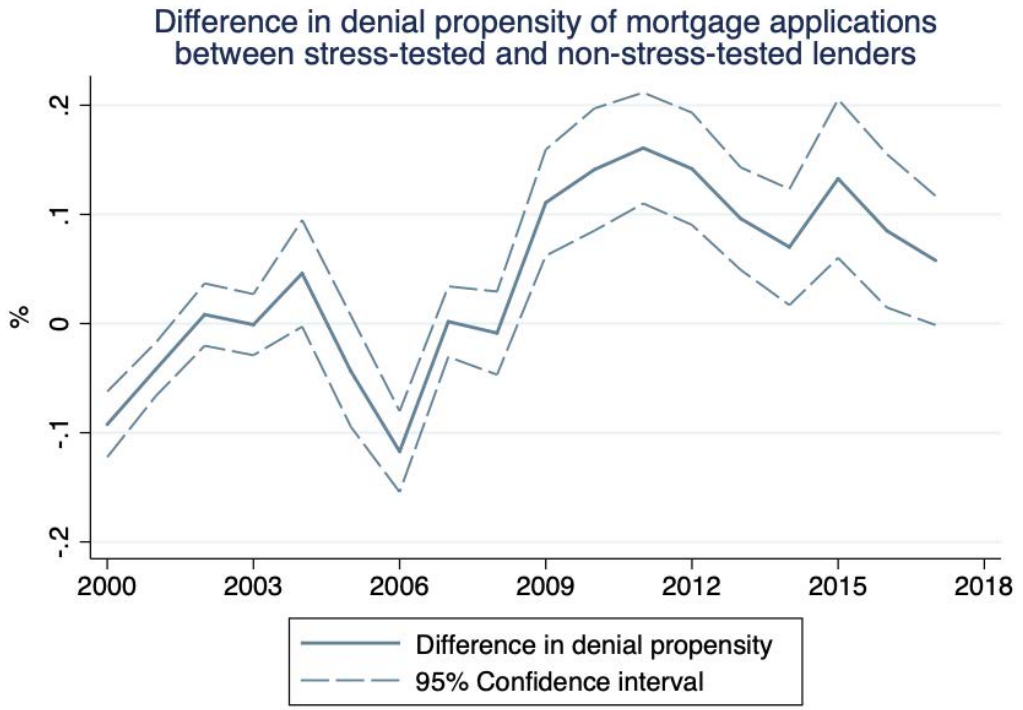


**Figure 9. Propensity to deny a mortgage application of stress-tested lenders over non stress-tested lenders.** The figure plots the coefficient of the tested-lender dummy in the probability model of mortgage denials per year, for the years 2000-2017. More detailed description of the calculation of the denial propensity of stress-tested and non stress-tested lenders is included in Appendix $C$.

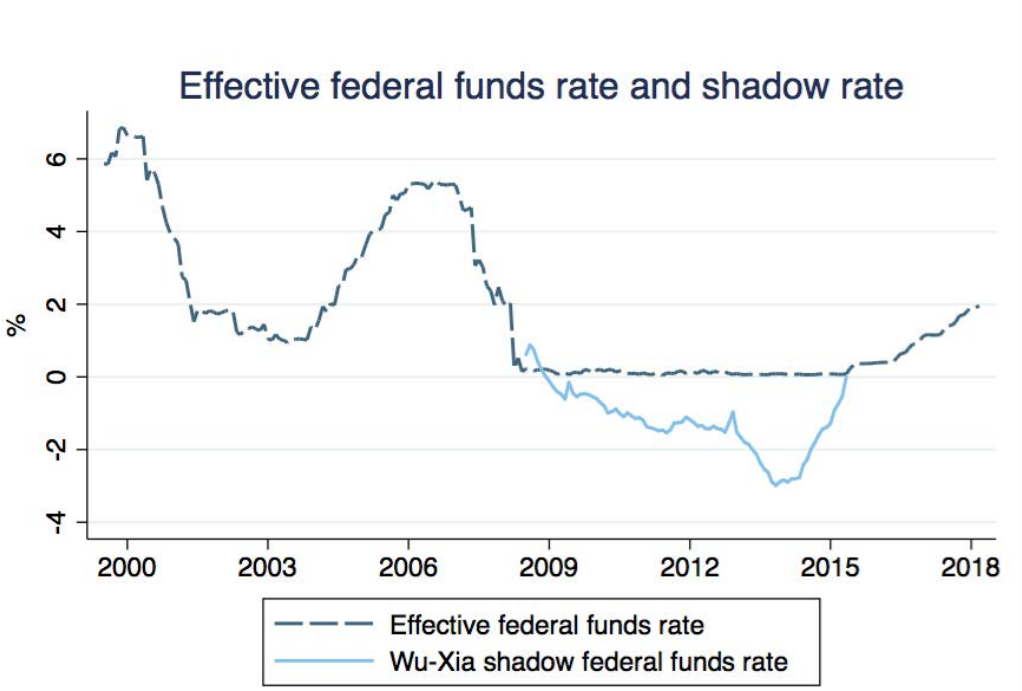


**Figure 10. Wu-Xia Shadow Federal Funds Rate.** The Wu-Xia shadow rate and the effective federal funds rate, monthly from January 2000 to December 2018. The x-axis labels show the middle of the year. Source: Federal Reserve Bank of Atlanta.

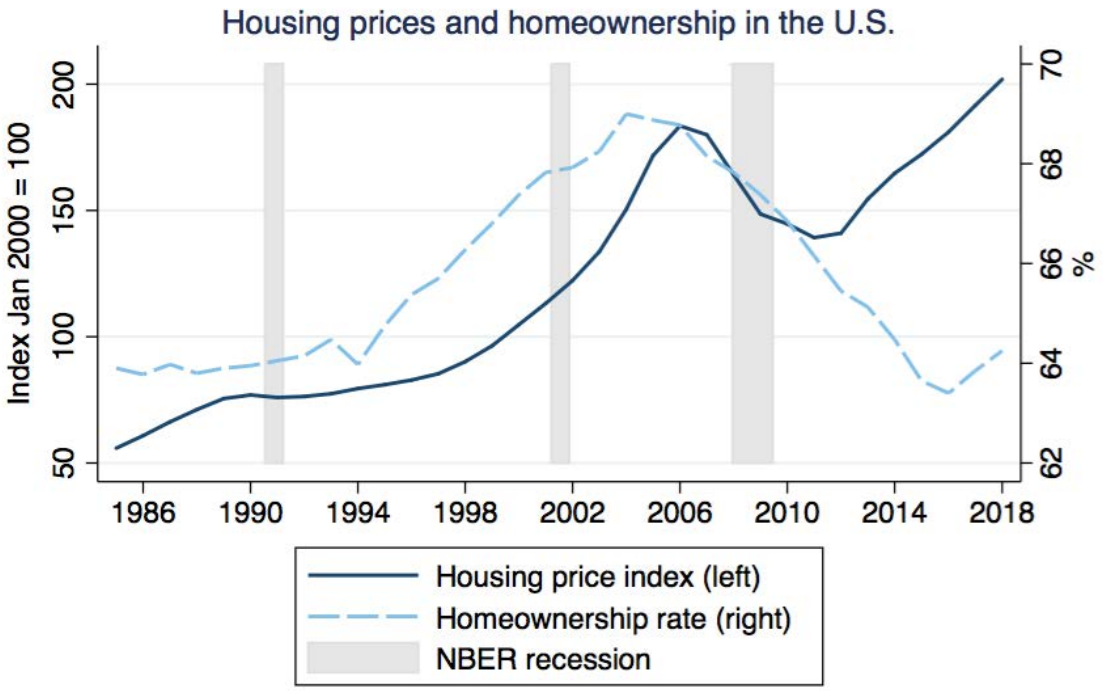


**Figure 11. Decoupling of housing prices and homeownership in the U.S.** The figure plots the home price index and the national homeownership rate in the U.S., from 1985 to 2018. The price data come from the website of Robert J. Shiller, where data from Shiller (2015) are updated monthly. The homeownership data come from the U.S. Census Bureau and are retrieved from FRED. The figure also shows the recession periods, starting at the peak of a business cycle and end at the trough, published by the National Bureau of Economic Research.

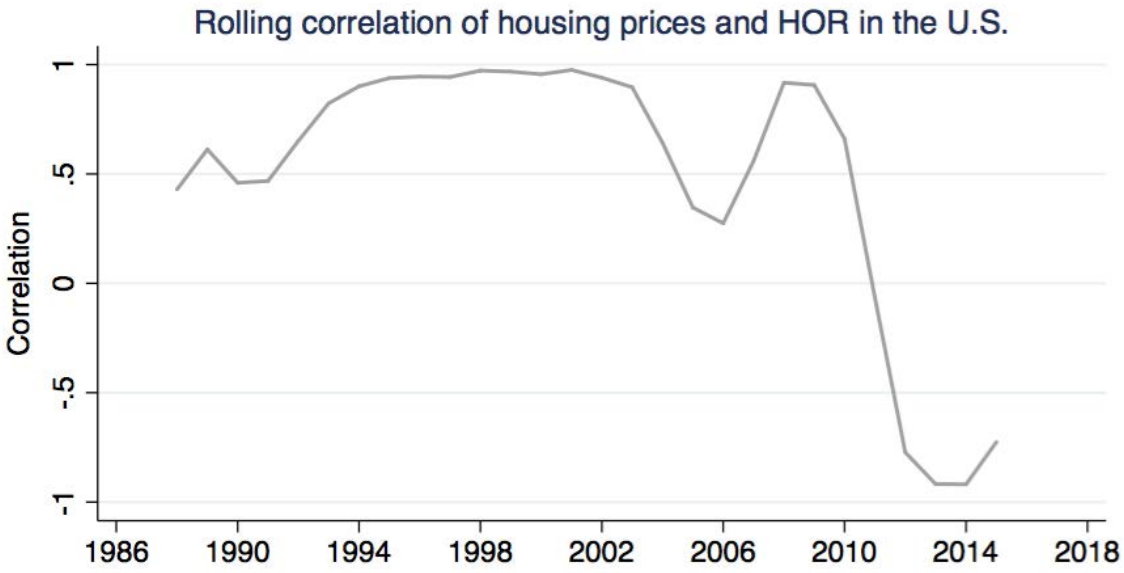


**Figure 12. Correlation of housing prices and HOR in the U.S.** The figure plots the rolling correlation of aggregate housing prices and the aggregate homeownership rate in the U.S., from 1988 to 2015. The correlation is calculated using a seven-year moving average (the given year and 3 years before and after). The data are as in Figure 11.

# Tables

Table 1. Investments by legal entities

| | Obs | Mean | SD | P10 | P90 |
|---|---|---|---|---|---|
| 2000-2017 | | | | | |
| Purchases ($ millions) | 6672 | 332.6 | 1428.0 | 0.9 | 640.1 |
| Share of value of purchases (%) | 6672 | 12.3 | 13.9 | 3.2 | 26.5 |
| Purchases (units) | 6672 | 875 | 3920 | 10 | 1805 |
| Holding duration (years) | 6164 | 2.3 | 1.7 | 0.5 | 4.3 |
| 2000-2009 | | | | | |
| Purchases ($ millions) | 3431 | 261.0 | 1218.9 | 0.5 | 545.0 |
| Share of value of purchases (%) | 3431 | 11.1 | 15.4 | 2.6 | 25.0 |
| Purchases (units) | 3431 | 798 | 4956 | 5 | 1553 |
| Holding duration (years) | 3191 | 3.4 | 1.6 | 1.9 | 4.9 |
| 2010-2017 | | | | | |
| Purchases ($ millions) | 3268 | 408.4 | 1616.9 | 1.6 | 756.9 |
| Share of value of purchases (%) | 3268 | 13.6 | 12.0 | 4.4 | 27.3 |
| Purchases (units) | 3268 | 956 | 2369 | 19 | 2203 |
| Holding duration (years) | 2973 | 1.1 | 0.7 | 0.3 | 2.0 |

This table presents summary statistics of the presence of investors with legal entity form in the U.S. The sample consists of 411 MSAs. The variables are calculated at the MSA-year level.[3] The top panel shows summary statistics for investors during the full period of our data, from 2000 to 2017. The middle panel shows the same statistics over the 2000-2009 period and the bottom panel over the 2010-2017 period.[4] Detailed description of the variables and data sources is included in the Appendix *A*. P10 denotes the 10th percentile and P90 the 90th percentile.

[3]The statistics are calculated for MSA-years with at least one purchase by legal entities. There are 512 MSA-years with zero purchases by legal entities during the 2000-2017 period, 485 during 2000-2009, and 27 during 2010-2017.

[4]Holding duration is calculated for the properties for which there is a purchase by a legal entity and subsequently a sale. Over the 2000-2017 period 48.7% of the properties that were purchased by legal entities have not been sold. Over the 2000-2009 period the percentage of not yet sold properties is 35.0%, and over the 2010-2017 period is 60.8%.

Table 2. Investments by legal entities by type of property

| | Obs | Mean | SD | P10 | P90 |
|---|---|---|---|---|---|
| 2000-2009 | | | | | |
| Purchases ($ millions) | | | | | |
| Single-family | 3413 | 156.1 | 958.0 | 0.5 | 304.5 |
| Multi-family | 2892 | 125.5 | 551.4 | 0.4 | 256.9 |
| Share of value of purchases (%) | | | | | |
| Single-family | 3413 | 9.4 | 15.0 | 1.9 | 22.9 |
| Multi-family | 2892 | 26.4 | 23.4 | 5.5 | 62.0 |
| Purchases (units) | | | | | |
| Single-family | 3413 | 652 | 4535 | 5 | 1217 |
| Multi-family | 2892 | 177 | 598 | 2 | 385 |
| 2010-2017 | | | | | |
| Purchases ($ millions) | | | | | |
| Single-family | 3236 | 202.6 | 660.8 | 1.4 | 442.6 |
| Multi-family | 2908 | 229.7 | 1185.9 | 0.4 | 383.5 |
| Share of value of purchases (%) | | | | | |
| Single-family | 3236 | 10.9 | 11.4 | 3.4 | 23.6 |
| Multi-family | 2908 | 39.9 | 24.6 | 11.8 | 77.7 |
| Purchases (units) | | | | | |
| Single-family | 3236 | 728 | 1760 | 17 | 1759 |
| Multi-family | 2908 | 256 | 875 | 2 | 516 |

This table presents summary statistics of the presence of investors with legal entity form by type of property in the U.S. The sample consists of 411 MSAs. The variables are calculated at the MSA-year level. The top panel shows summary statistics for investors over the 2000-2009 period and the bottom panel over the 2010-2017 period.[5]

[5]The statistics are calculated for MSA-years with at least one purchase by legal entities of the respective property type. There are 503 MSA-years with zero single-family purchases and 512 with zero multi-family purchases by legal entities during 2000-2009. There are 1024 MSA-years with zero single-family purchases and 360 with zero multi-family purchases by legal entities during 2010-2017.

Table 3. Summary statistics

| | Obs | Mean | SD | Min | Max |
|---|---|---|---|---|---|
| Investors' share (%) | 1856 | 13.00 | 12.96 | 0.00 | 94.99 |
| Investors' purchases ($ millions) | 1856 | 249.2 | 939.6 | 0.00 | 16216 |
| Corr prices & HOR (09-14) | 1531 | 0.04 | 0.50 | -0.93 | 0.96 |
| Homeownership rate (%) | 1549 | 64.43 | 6.37 | 32.89 | 80.55 |
| Housing price growth (%) | 1856 | -0.09 | 6.34 | -25.58 | 36.34 |
| Stress-test $\text{share}_{08}$ \$denial $\text{prop}_t$ lag | 1482 | 0.03 | 0.02 | -0.01 | 0.10 |
| $\text{Beta}_m$ \$ shadow $\text{rate}_t$ lag | 935 | -0.05 | 0.07 | -0.31 | 0.13 |
| Top tier price growth (%) | 1822 | 0.39 | 5.53 | -19.64 | 28.75 |
| Bottom tier price growth (%) | 1655 | -1.58 | 9.12 | -53.07 | 36.00 |
| Price-to-income ratio | 1753 | 2.43 | 1.19 | 1.05 | 9.77 |
| Construction value growth (%) | 1239 | 10.47 | 40.20 | -79.61 | 421.6 |
| Vacancy rate owned (%) | 1556 | 2.43 | 1.19 | 0.00 | 11.38 |
| Vacancy rate rentals (%) | 1556 | 7.97 | 4.19 | 0.00 | 40.23 |
| Housing rent growth (%) | 1814 | 1.55 | 7.39 | -37.94 | 75.70 |
| Rent-to-income ratio | 1658 | 0.28 | 0.04 | 0.13 | 0.47 |
| Population growth lag (%) | 1856 | 0.80 | 0.87 | -1.96 | 7.99 |
| Median income growth lag (%) | 1856 | 0.57 | 2.59 | -7.65 | 12.60 |
| Median age change lag | 1856 | 0.19 | 0.75 | -5.10 | 6.60 |

This table presents summary statistics of the key variables in our estimations. The final sample consists of 315 MSAs over the period from 2009 to 2014. Detailed description of the variables and data sources is included in the Appendix *A*.

Table 4. Housing prices and quantities and investors' purchases

| Outcome: | Housing price growth | Construction value growth | Owner-occupied vacancy rate |
|---|---|---|---|
| Investors' value of purchases | 0.022 | 0.055 | -0.001 |
| | (0.002) | (0.004) | (0.010) |
| Estimation | IV | IV | IV |
| MSA-year controls | Yes | Yes | Yes |
| MSA fixed effects | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes |
| Underidentification test ($p$-value) | 0.006 | 0.006 | 0.006 |
| J-statistic ($p$-value) | 0.257 | 0.988 | 0.369 |
| Observations | 1,813 | 1,813 | 1,813 |

$p$-values are in parentheses. Housing prices come from the Zillow home value index for all homes. Investors' value of purchases are in millions of U.S. dollars. Investors' data come from ZTRAX. Controls are the population growth, income growth and median age change at the MSA level. All controls are lagged for one year. The instruments for the investors' dollar value of purchases are (a) the beta of MSA $m$, calculated using 1985-2008 returns and one-factor CAPM with the value-weighted return of all U.S. listed firms listed multiplied by the lagged Wu-Xia shadow federal funds rate and (b) the share of the value of the deposits of stress-tested lenders in 2008 in MSA $m$ multiplied by the lagged difference in denial propensity between stress-tested and non stress-tested lenders subject to CCAR. The sample consists of 300 MSAs over the period from 2009 to 2015. Each observation is an MSA-year. Standard errors are clustered by MSA.

Table 5. Housing price growth in response to investors' purchases

| Outcome: | Housing price growth$_{t+i}$ | | | | |
|---|---|---|---|---|---|
| | $i = 0$ | $i = 1$ | $i = 2$ | $i = 3$ | $i = 4$ |
| Investors' value of purchases$_t$ | 0.021 | 0.015 | 0.012 | -0.001 | -0.009 |
| | (0.001) | (0.001) | (0.001) | (0.388) | (0.001) |
| Estimation | IV | IV | IV | IV | IV |
| MSA-year controls | Yes | Yes | Yes | Yes | Yes |
| MSA fixed effects | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,872 | 1,872 | 1,872 | 1,872 | 1,872 |

$p$-values are in parentheses. Housing prices come from the Zillow home value index for all homes. Investors' value of purchases are in millions of U.S. dollars. Investors' data come from ZTRAX. Controls are the population growth, income growth and median age change at the MSA level. All controls are lagged for one year. The instruments for the investors' dollar value of purchases are (a) the beta of MSA $m$, calculated using 1985-2008 returns and one-factor CAPM with the value-weighted return of all U.S. listed firms listed multiplied by the lagged Wu-Xia shadow federal funds rate and (b) the share of the value of the deposits of stress-tested lenders in 2008 in MSA $m$ multiplied by the lagged difference in denial propensity between stress-tested and non stress-tested lenders subject to CCAR. The sample consists of 315 MSAs over the period from 2009 to 2018. Each observation is an MSA-year. Standard errors are clustered by MSA.

Table 6. Housing price growth by tier in response to investors' purchases

| | $i=0$ | $i=1$ | $i=2$ | $i=3$ | $i=4$ |
|---|---|---|---|---|---|
| Outcome: | Top tier housing price growth$_{t+i}$ | | | | |
| Investors' value of purchases$_t$ | 0.015 | 0.012 | 0.007 | -0.003 | -0.007 |
| | (0.001) | (0.001) | (0.001) | (0.007) | (0.002) |
| Estimation | IV | IV | IV | IV | IV |
| MSA-year controls | Yes | Yes | Yes | Yes | Yes |
| MSA fixed effects | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,620 | 1,621 | 1,622 | 1,623 | 1,623 |
| Outcome: | Bottom tier housing price growth$_{t+i}$ | | | | |
| Investors' value of purchases$_t$ | 0.029 | 0.017 | 0.014 | 0.001 | -0.009 |
| | (0.001) | (0.001) | (0.001) | (0.472) | (0.002) |
| Estimation | IV | IV | IV | IV | IV |
| MSA-year controls | Yes | Yes | Yes | Yes | Yes |
| MSA fixed effects | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,620 | 1,621 | 1,622 | 1,623 | 1,623 |

$p$-values are in parentheses. Housing prices come from the Zillow home value index for all homes. Investors' data come from ZTRAX. Controls are the population growth, income growth and median age change at the MSA level. All controls are lagged for one year. The instruments for the investors' dollar value of purchases are (a) the beta of MSA $m$, calculated using 1985-2008 returns and one-factor CAPM with the value-weighted return of all U.S. listed firms listed multiplied by the lagged Wu-Xia shadow federal funds rate and (b) the share of the value of the deposits of stress-tested lenders in 2008 in MSA $m$ multiplied by the lagged difference in denial propensity between stress-tested and non stress-tested lenders subject to CCAR. The sample consists of 275 MSAs over the period from 2009 to 2018. Each observation is an MSA-year. Standard errors are clustered by MSA.

Table 7. Housing price growth by property type in response to investors' purchases

| | $i=0$ | $i=1$ | $i=2$ | $i=3$ | $i=4$ |
|---|---|---|---|---|---|
| Outcome: | Single-family housing price growth$_{t+i}$ | | | | |
| Investors' value of single-family purchases$_t$ | 0.050 | 0.035 | 0.026 | -0.003 | -0.020 |
| | (0.001) | (0.001) | (0.001) | (0.192) | (0.001) |
| Estimation | IV | IV | IV | IV | IV |
| MSA-year controls | Yes | Yes | Yes | Yes | Yes |
| MSA fixed effects | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,859 | 1,862 | 1,865 | 1,866 | 1,866 |
| Outcome: | Multi-family housing price growth$_{t+i}$ | | | | |
| Investors' value of multi-family purchases$_t$ | 0.025 | 0.023 | 0.017 | -0.001 | -0.012 |
| | (0.022) | (0.023) | (0.024) | (0.752) | (0.034) |
| Estimation | IV | IV | IV | IV | IV |
| MSA-year controls | Yes | Yes | Yes | Yes | Yes |
| MSA fixed effects | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,354 | 1,361 | 1,370 | 1,375 | 1,379 |

$p$-values are in parentheses. Housing prices come from the Zillow home value index for all homes. Investors' data come from ZTRAX. Controls are the population growth, income growth and median age change at the MSA level. All controls are lagged for one year. The instruments for the investors' dollar value of purchases are (a) the beta of MSA $m$, calculated using 1985-2008 returns and one-factor CAPM with the value-weighted return of all U.S. listed firms listed multiplied by the lagged Wu-Xia shadow federal funds rate and (b) the share of the value of the deposits of stress-tested lenders in 2008 in MSA $m$ multiplied by the lagged difference in denial propensity between stress-tested and non stress-tested lenders subject to CCAR. The sample consists of 315 MSAs over the period from 2009 to 2018. Each observation is an MSA-year. Standard errors are clustered by MSA.

Table 8. Construction value growth in response to investors' purchases

| Outcome: | Construction value growth$_{t+i}$ | | | |
|---|---|---|---|---|
| | $i = 0$ | $i = 1$ | $i = 2$ | $i = 3$ |
| Investors' value of purchases$_t$ | 0.048 | 0.016 | 0.005 | -0.012 |
| | (0.002) | (0.194) | (0.585) | (0.408) |
| Estimation | IV | IV | IV | IV |
| MSA-year controls | Yes | Yes | Yes | Yes |
| MSA fixed effects | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes |
| Observations | 1,872 | 1,867 | 1,861 | 1,859 |

$p$-values are in parentheses. Investors' data come from ZTRAX. Controls are the population growth, income growth and median age change at the MSA level. All controls are lagged for one year. The instruments for the investors' dollar value of purchases are (a) the beta of MSA $m$, calculated using 1985-2008 returns and one-factor CAPM with the value-weighted return of all U.S. listed firms listed multiplied by the lagged Wu-Xia shadow federal funds rate and (b) the share of the value of the deposits of stress-tested lenders in 2008 in MSA $m$ multiplied by the lagged difference in denial propensity between stress-tested and non stress-tested lenders subject to CCAR. The sample consists of 315 MSAs over the period from 2009 to 2017. Each observation is an MSA-year. Standard errors are clustered by MSA.

Table 9. Housing vacancy rates in response to investors' purchases

| | $i = 0$ | $i = 1$ | $i = 2$ | $i = 3$ |
|---|---|---|---|---|
| Outcome: | Owner-occupied vacancy rate$_{t+i}$ | | | |
| Investors' value of purchases$_t$ | -0.001 | -0.001 | -0.0003 | -0.00009 |
| | (0.009) | (0.009) | (0.189) | (0.665) |
| Estimation | IV | IV | IV | IV |
| MSA-year controls | Yes | Yes | Yes | Yes |
| MSA fixed effects | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes |
| Observations | 1,561 | 1,546 | 1,536 | 1,545 |
| Outcome: | Rental vacancy rate$_{t+i}$ | | | |
| Investors' value of purchases$_t$ | -0.001 | -0.002 | -0.002 | -0.002 |
| | (0.133) | (0.060) | (0.069) | (0.032) |
| Estimation | IV | IV | IV | IV |
| MSA-year controls | Yes | Yes | Yes | Yes |
| MSA fixed effects | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes |
| Observations | 1,561 | 1,546 | 1,536 | 1,545 |

$p$-values are in parentheses. Investors' data come from ZTRAX. Controls are the population growth, income growth and median age change at the MSA level. All controls are lagged for one year. The instruments for the investors' dollar value of purchases are (a) the beta of MSA $m$, calculated using 1985-2008 returns and one-factor CAPM with the value-weighted return of all U.S. listed firms listed multiplied by the lagged Wu-Xia shadow federal funds rate and (b) the share of the value of the deposits of stress-tested lenders in 2008 in MSA $m$ multiplied by the lagged difference in denial propensity between stress-tested and non stress-tested lenders subject to CCAR. The sample consists of 275 MSAs over the period from 2009 to 2018. Each observation is an MSA-year. Standard errors are clustered by MSA.

Table 10. Housing rent growth in response to investors' purchases

| Outcome: | Housing rent growth$_{t+i}$ | | | | |
|---|---|---|---|---|---|
| | $i = 0$ | $i = 1$ | $i = 2$ | $i = 3$ | $i = 4$ |
| Investors' value of purchases$_t$ | 0.001 | 0.006 | 0.011 | 0.006 | -0.003 |
| | (0.368) | (0.006) | (0.011) | (0.012) | (0.089) |
| Estimation | IV | IV | IV | IV | IV |
| MSA-year controls | Yes | Yes | Yes | Yes | Yes |
| MSA fixed effects | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,872 | 1,872 | 1,872 | 1,872 | 1,872 |

$p$-values are in parentheses. Housing rents come from the Zillow home value index for all homes. Investors' data come from ZTRAX. Controls are the population growth, income growth and median age change at the MSA level. All controls are lagged for one year. The instruments for the investors' dollar value of purchases are (a) the beta of MSA $m$, calculated using 1985-2008 returns and one-factor CAPM with the value-weighted return of all U.S. listed firms listed multiplied by the lagged Wu-Xia shadow federal funds rate and (b) the share of the value of the deposits of stress-tested lenders in 2008 in MSA $m$ multiplied by the lagged difference in denial propensity between stress-tested and non stress-tested lenders subject to CCAR. The sample consists of 315 MSAs over the period from 2009 to 2018. Each observation is an MSA-year. Standard errors are clustered by MSA.

Table 11. Housing price and rent affordability in response to investors' purchases

| | $i=0$ | $i=1$ | $i=2$ | $i=3$ | $i=4$ |
|---|---|---|---|---|---|
| Outcome: | Price-to-income ratio change$_{t+i}$ | | | | |
| Investors' value of purchases$_t$ | 0.001 | 0.0004 | 0.0003 | -0.00008 | -0.0003 |
| | (0.001) | (0.000) | (0.001) | (0.048) | (0.001) |
| Estimation | IV | IV | IV | IV | IV |
| MSA-year controls | Yes | Yes | Yes | Yes | Yes |
| MSA fixed effects | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,872 | 1,872 | 1,872 | 1,872 | 1,872 |
| Outcome: | Rent-to-income ratio change$_{t+i}$ | | | | |
| Investors' value of purchases$_t$ | -0.000003 | 0.000006 | 0.00002 | 0.00001 | -0.00001 |
| | (0.538) | (0.159) | (0.041) | (0.054) | (0.017) |
| Estimation | IV | IV | IV | IV | IV |
| MSA-year controls | Yes | Yes | Yes | Yes | Yes |
| MSA fixed effects | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,872 | 1,872 | 1,872 | 1,872 | 1,872 |

$p$-values are in parentheses. Housing prices come from the Zillow home value index for all homes. Investors' data come from ZTRAX. Controls are the population growth, income growth and median age change at the MSA level. All controls are lagged for one year. The instruments for the investors' dollar value of purchases are (a) the beta of MSA $m$, calculated using 1985-2008 returns and one-factor CAPM with the value-weighted return of all U.S. listed firms listed multiplied by the lagged Wu-Xia shadow federal funds rate and (b) the share of the value of the deposits of stress-tested lenders in 2008 in MSA $m$ multiplied by the lagged difference in denial propensity between stress-tested and non stress-tested lenders subject to CCAR. The sample consists of 315 MSAs over the period from 2009 to 2018. Each observation is an MSA-year. Standard errors are clustered by MSA.

Table 12. Structural break in correlation of housing prices and HOR

| $[t_l, t_u]$ | Break year $T$ | Chow test: Wald-statistics |
|---|---|---|
| A. | | |
| $[1988, 2015]$ | 2008 | 59.54 |
| | | (0.000) |
| B. | | |
| $[1988, 2008]$ | 1998 | 0.066 |
| | | (0.797) |
| $[2011, 2015]$ | 2013 | 0.170 |
| | | (0.680) |

This table presents the results of the structural break test for the correlation between housing prices and HOR, following McConnell and Perez-Quiros (2010). The specification is $Corr_t = c + \beta\tau + u_t$, where year $t$ # $[t_l, t_u]$ and $\tau = 1, 2, ..., t_u$ ! $t_l + 1$. The Chow test tests for a structural break in the constant term $c$, at time $T$. That is, $c = c_1$ if $t$ % $T$, and $c = c_2$ if $t > T$. The null hypothesis is that $c_1 = c_2$. Panel A uses the full duration of the data and tests for a structural break in 2008. For robustness, panel B splits the sample pre- and post-crisis and tests for a structural break in the mid-point of each subsample.

Table 13. Correlation of housing price and HOR and investors' purchases

| Outcome: | Correlation of housing price and HOR |
|---|---|
| Investors' value of purchases | -0.001 |
| | (0.002) |
| Estimation | IV |
| MSA-year controls | Yes |
| MSA fixed effects | Yes |
| Year fixed effects | Yes |
| Underidentification test ($p$-value) | 0.004 |
| J-statistic ($p$-value) | 0.354 |
| Observations | 1,839 |

$p$-values are in parentheses. Housing prices come from the Zillow home value index for all homes. Homeownership rate refers to the share of occupied households that are owner-occupied, and comes from the American Community Survey. Correlation between housing prices and homeownership is calculate using a seven-year moving average. Investors' data come from ZTRAX. Controls are the population growth, income growth and median age change at the MSA level. All controls are lagged for one year. The instruments for the investors' dollar value of purchases are (a) the beta of MSA $m$, calculated using 1985-2008 returns and one-factor CAPM with the value-weighted return of all U.S. listed firms multiplied by the lagged Wu-Xia shadow federal funds rate and (b) the share of the value of the deposits of stress-tested lenders in 2008 in MSA $m$ multiplied by the lagged difference in denial propensity between stress-tested and non stress-tested lenders subject to CCAR. The sample consists of 310 MSAs over the period from 2009 to 2014. Each observation is an MSA-year. Standard errors are clustered by MSA.

# APPENDIX

# A Data Sources

In this section we describe our data sources, how we cleaned the data, and the key variables used in our analysis.

### Investors' share

The investors' data come from ZTRAX, a large new raw database of U.S. deeds data. The transactions database of ZTRAX contains all property ownership transfers that are documented in the County deeds. We keep transactions between January $1^{st}$, 2000 and December $31^{st}$, 2017. We restrict the data to ownership transfers, dropping observations that refer exclusively to mortgages or foreclosures.[6] Ownership transfers contain the buyer and seller name. We drop transactions with deed type "Life Estate", since this is not an immediate transfer of ownership. We also drop transactions that had "Cancellation" in the deed type. We restrict the data to residential property transfers based on the ZTRAX property land use standard codes, which include both single-family and multi-family properties. Table 1 contains the classification of the property land use standard codes in single-family and multi-family from ZTRAX. This amounts to 139 million transactions nationally. We then drop transactions with purchase price missing or smaller than $10,000, a common practice with deeds data (Bernstein, Gustafson and Lewis 2018; Stroebel 2016(Stroebel 2016)). This leaves 85 million observations.

To identify institutional investors, we first use the ZTRAX classification of buyer names into individual and non-individual names. The non-individual names frequently end with the words "LLC", "LP", "INC", "TRUST", "CORPORATION", "PARTNERS", but they also contain entity names without the description in the end of the name.[7] Our institutional investors' identifier contains the deeds where the buyer had a non-individual name. From these names we filter out names of relocation companies, non profit organizations, construction companies, national and regional authorities, banks, Ginnie Mae, Fannie Mae, Freddie Mac and other mortgage loan companies and credit unions, homeowner associations, hospitals, universities

[6] The mortgage and foreclosure deeds have a separate corresponding deed for the ownership transfer.

[7] For example "Invitation Homes" and "Invitation Homes LP" are both included as non-individual names.

(not when is university housing), churches, airports, and the state, names of the county, city and municipality. To identify relocation companies, non profit organizations and construction companies we use public data of lists of the top relocation companies, non profit organizations and construction companies in the U.S. We also manually check the names of the 200 largest non-individual buyers in each state using online search engines to classify them in the right category, and iterate this procedure several times to ensure the largest buyers are correctly classified.

To further increase the accuracy of the institutional investors' classification we collect from industry reports and news reports the names of the top 20 institutional investors in the single-family rental market. We also collect the names of the residential real estate companies that belong to the S&P 500 Real Estate Index, most of which are apartment REITs. We then search for the names of these top investors and their subsidiaries in the ZTRAX database and ensure they are classified as institutional investors. These procedure also results in calculating the exact holdings of the top single-family and multi-family institutional investors.[8]

Finally, we use the crosswalk file from Census Bureau to match the County FIPS codes to the Census Bureau MSA' s 2017 core based statistical area (CBSA) code. For submetro areas of the largest MSAs, we use the CBSA division code.

To classify non-institutional buyers into individual investors we start from the ZTRAX classification of buyer names as names of individuals. We calculate the number of purchases of each individual name within the MSA within the given year and the year before. We define individuals that are investors as individuals who purchase more than one house within the MSA in the given year and the year before.

The share of institutional investors' purchases is the sum of the purchase prices across all institutional investors' purchases over the sum of the purchase prices by institutional investors and individuals, per year per MSA. Similarly the share of individual investors' purchases is the sum of the purchase prices across all individual investors' purchases over the sum of the purchase prices by institutional investors and individuals, per year per MSA.

The holding duration is the duration between the purchase and sale of the property. We define long-term investments the purchases that are held for more than one year, and short-term investments the purchases that are sold within a year.

[8]The code for the classification of institutional investors is available upon request.

**Housing Prices and Rents**

Our price and rent data cover 316 MSAs from 2000 through 2017. Data for prices and rents are from Zillow. To measure house prices, we use the Quarterly Historic Metro Zillow Home Value Index (ZHVI). The ZHVI measures the median monthly price for each MSA and has units of nominal dollars per month. Zillow imputes this price based on a proprietary machine learning model taking into account the specific characteristics of each home and recent sale listings for homes with similar characteristics. The median price is computed across all homes in an MSA, not only those that are currently for sale. Thus, unlike pure repeat-listing indices, the ZHVI is not biased by the current composition of for-sale properties. To measure the price of top tier and bottom tier homes we use the Zillow's Top Tier Index and Bottom Tier Index, which measure the median house price among homes in the top third and bottom third of the price distribution within an MSA respectively. To measure rents, we use the Quarterly Historic Metro Zillow Rent Index (ZRI). The ZRI measures the median quarterly rent for each MSA and has units of nominal dollars per month. Zillow imputes this rent using an analogous methodology to ZHVI. Importantly, the ZRI does not impute a property' s rent from its price. To convert the prices and rents to annual, we take the last value of each year.

Housing price growth is the percentage growth of housing prices from year $t$ ! 1 to year $t$. Housing rent growth is the percentage growth of housing rents from year $t$ ! 1 to year $t$.

**Mortgage Data**

Data on mortgage credit come from the Home Mortgage Disclosure Act (HMDA). The frequency of the data is yearly. HMDA data contain application-level information on the requested loan size, loan purpose, property type, and application status. We observe the self-reported income and race of the borrower, as well as an identifier of the lender receiving the application. Since our focus is on how households' credit constraints affect investors's presence, we only retain mortgage applications for the purchase of an owner-occupied homes for 1 to 4 families. In terms of HMDA variables, we retain applications satisfying the following conditions: occupancy = 1 (owner occupied), property type = 1 (1- to- 4 families), loan purpose = 1 (for-purchase), and action taken & 6 (loan not purchased by institution). To maximize data quality, we additionally require that applications were not flagged for data quality concerns (edit status = "NA") and have a non-empty MSA code. We identify denied and originated loans as those with action taken = 3 and action taken = 1, respectively.

Some lenders require applicants to go through a pre-approval process before allowing them

to formally apply. After excluding applications that underwent pre-approval, the denial rate over 2008–2014 was 13%; since this is close to the unconditional average of 11.1%, we perform our analysis including applications that underwent pre-approval beforehand, around 15% of the sample. We checked that this decision does not affect the results.

We merge the HMDA' s application-level data by lender and year with the HMDA reporter panel. The reporter panel contains each lender' s name and top holding company. We classify lenders in HMDA as being subject to a CCAR stress test between 2011 and 2014 if their top holder was subject to this test. These holding companies are Ally Financial Inc., American Express Co., Bancwest Co., Bank of America Corp., Bank of NY Mellon Corp., BB&T Corp., BBVA Compass Bancshares, BMO Financial Corp., Capital One Financial Corp., Citigroup Inc., Comerica Inc., Deutsche Bank, Discover Financial Services, Fifth Third Bancorp, Goldman Sachs Group, HSBC North America Holdings Inc., Huntington Bancshares Inc., JP Morgan Chase & Co., Keycorp, M&T Bank Corp., MetLife Inc., Morgan Stanley, Northern Trust Corp., PNC Financial Services Group Inc., RBS/Citizens, Regions Financial Corp., Santander Holdings USA Inc., State Street Corp., Suntrust Banks Inc., TD Group US Holdings LLC, MUFG Americas Holding Corp., US Bancorp, Wells Fargo & Co., and Zions Corp.

**Homeownership, and vacancy data**

Homeownership and vacancy data come from the American Community Survey One-Year Estimates. Data are available annually and they cover 311 MSAs over the 2008-2017 period. We start from the original data at the county level, for example number of occupied households and number of owner-occupied households. We then crosswalk to the 2017 CBSA codes and sum the number of households in the counties within the MSAs. Starting from county-level data results in more accurate MSA values for the most recent CBSA codes.

Homeownership rate is the share of the number of owner-occupied housing units over the number of occupied housing units. Owner vacancy rate is the share of the number of vacant housing units for homeowners over the total housing units for homeowners. Rental vacancy rate is calculated as the share of the number of vacant rental housing units over the total number of rental housing units.

**Other Variables**

We also rely on the following data sources:

' Data on construction permits at the MSA-year level come from the Census Bureau' s annual Building Permits Survey.

' Data on median age at the MSA-year level are from the American Community Survey One-Year Estimates.

' Data on population at the MSA-year level come from the U.S. Census Bureau.

' Data on median income at the MSA-year level come from Zillow.

To summarize, there are 305 MSAs with a full set of housing variables, investors' data, mortgage, betas and control data. We use MSA-year panel data for the years 2009-2017 for the regressions of the dynamic real effects on the investors' share, and the years 2009-2014 for the regressions of the factors that attract investors to the housing market.

# B Dynamic Real Effects of Investors: Alternative Specification

We estimate the dynamic real effects of investors with the following alternative specification:

$$y_{m,t} = \beta_0 + \beta_1 x_{m,t} + \beta_2 x_{m,t\,!\,3} + \beta_3 x_{m,t\,!\,6} + \gamma \mathbf{C}_{m,t\,!\,7} + \alpha_m + b_t + u_{m,t}. \tag{1}$$

where $y_{m,t}$ denotes the housing variables we want to study the effects or investors' presence on, for the year $t$ in MSA $m$. These variables are the housing price growth rate from year $t$ ! 1 to year $t$, housing price growth rate specifically for top tier and bottom tier houses from year $t$ ! 1 to year $t$, new construction value growth, vacancy rate of owner occupied houses, vacancy rate of rentals, housing rent growth rate from year $t$ ! 1 to year $t$, price-to-income ratio, and rent-to-income ratio. $x_{m,t}$ is the investors' share of dollar purchases for the year $t$ in MSA $m$. To estimate the dynamic effects we include in the specification lags of the investors' share variable, for 3 and 6 years. The controls $\mathbf{C}_{m,t\,!\,7}$ are the population growth rate and income growth rate from year $t$ ! 8 to $t$ ! 7. In this specification we ommit the median age control since the data only begin in 2005 and this would restrict our sample that begins in 2001. The controls are lagged by 7 years since we don't want to control for variables that are affected by the investors' share. For example the presence of investors in an MSA might affect population growth in that MSA by supplying more housing, and population growth might help stimulate the economy and increase prices. Thus, if we had controlled for population growth at a later

time this would have biased downwards the effects of investors on housing prices. $\alpha_m$ denotes location fixed effects and $b_t$ denotes time fixed effects. We estimate (1) for our final sample of 305 MSAs for the years 2009 to 2017.

To estimate (1) we instrument the three institutional investors' share variables with the tested shock and capital markets shock instruments, lagged for one year relative to the year of the investors' share. The instrumental variable take the value zero before 2008. We estimate (1) using 3-stage least squares, to allow for correlation of the error terms.

Tables A7 and A8 contain the estimates of the specification (1) for housing price growth and housing rent growth respectively.

# C Instrumental Variables

In this section we describe in detail the construction of the instrumental variables used in our estimation.

## Households' credit constraints

### Lenders' propensity to deny

Following the methodology of Khwaja and Mian (2008), we estimate a fixed effect for a given lender or group of lenders. Specifically, let $L$ denote the set of lenders we observe in HMDA, and consider a partition of $L$ into disjoint subsets $l_1, l_2, ..., l_n$. In this case we partition lenders according to whether or not they underwent the CCAR test between 2009 and 2014. Then $l_1 =$ (Tested", $l_2 =$ (Not Tested".

To extract a credit supply shock experienced by lenders of set $l_j$, we estimate the probability of loan denial at the application level, $\Pr(\text{Denied}_{i,m,t,l_j} = 1)$, as a linear probability model:

$$\Pr(\text{Denied}_{i,m,t,l_j} = 1) = \sum_j \Lambda_{t,l_j} + \gamma X_{i,m,t,l_j} + \alpha_{m,t} + \alpha_{m,l_j}, \tag{A1}$$

where our focus is on the $\Lambda_{t,l_j}$, which is a vector of fixed effects for lenders of set $l_j$ in year $t$.[9] The controls in $X_{i,m,t,l_j}$ account for the characteristics of borrowers: income, requested loan-to-

[9] We estimate the $\Lambda_{t,l_j}$ using a series of indicator functions for whether the application was received by lenders of set $l_j$ in year $t$. The reference category will be applications to lenders of some set $l_r$ in some year $t_r$.

income, and race of borrower $i$ applying for a loan from lender type $l_j$ in MSA $m$ in year $t$.[10] The terms $\alpha_{m,t}$ and $\alpha_{m,l_j}$ control for lender, time, and regional shocks. The value $\alpha_{m,t}$ is the coefficient on an indicator variable which equals 1 if the borrower applies from MSA $m$ in year $t$ and equals 0 otherwise. Likewise the indicator variable $\alpha_{m,l_j}$ equals 1 if the borrower applies from MSA $m$ to a lender of type $l_j$ and equals 0 otherwise.

The vector $\Lambda_{t,l_j}$ captures the lender specific component of denial rates. For example, it may reflect a higher cost of funds or greater regulatory risk borne by lenders of set $l_j$ in a given year. Importantly, $\Lambda_{t,l_j}$ does not confound either borrower or regional effects, since these are already captured by $X_{i,m,t,l_j}$ and the pair $(\alpha_{m,t}, \alpha_{m,l_j})$, respectively. To emphasize this interpretation, we refer to $\Lambda_{t,l_j}$ as the propensity to deny.

**Stress-test shock**

We use the stress-test shock as instrument for our estimations of the investors' real effects. This instrument is based on the denial propensities of stress-tested lenders. We estimate first (A1) using the partition $L =$ (Tested, Not Tested" and the stress-test shock as:

$$S_{m,t} = (\Lambda_{t,\text{Tested}} \; ! \; \Lambda_{t,\text{Not Tested}}) \; \$ \; \text{Stress-Test Share}_{m,08}. \tag{A2}$$

We define stress-tested lenders as those which underwent a CCAR test between 2011 and 2014, and Stress-Test $\text{Share}_{m,2008}$ as the 2008 value of deposits' share of these lenders. In words, $S_{m,t}$ captures the relative stringency of stress-tested lenders in a given year $(\Lambda_{t,\text{Tested}} \; ! \; \Lambda_{t,\text{NonTested}})$ and the degree to which this tightening is felt in a given MSA, as measured by the deposit share of the tested lenders, Stress Test $\text{Share}_{m,08}$.

We use the stress test shock instruments to estimate (**??**). Since much of the temporal variation in credit tightness occurred after 2010, we begin the analysis in 2009. In our estimation we cluster standard errors by MSA to allow for serial correlation throughout the sample period. Finally, we follow Favara and Imbs (2015) and lag our stress-test shock by one period.[11]

[10] We use 21,709,935 observations to estimate (A1) over 2007-2014.

[11] That is, we use $S_{m,t\,!\,1}$ as an instrument for Investors' $\text{share}_{m,t}$.

## Exposure to capital markets

### MSA betas

To calculate the MSA betas, we first construct the returns of the housing market in each MSA. For the returns we use the housing prices and rents from the quarterly historical MSA-level indices from Zillow. The indices begin in the third quarter of 1979. The MSA annual return is calculated as follows:

$$R_{m,t} = \frac{P_{m,t} + 12R_{m,t}}{P_{m,t\,!\,1}} \;!\; 1, \tag{2}$$

where $P_{m,t}$ is the housing price and $R_{m,t}$ the monthly housing rent in MSA $m$ in year $t$. We then estimate $\beta_m$, the beta of MSA $m$, using the one-factor CAPM:

$$R_{m,t} = a_m + \beta_m R_t^M, \tag{3}$$

where the market return $R_t^M$ is the value-weighted return of all CRSP firms incorporated in the U.S. and listed on the NYSE, AMEX, or NASDAQ. We get the market return from the Keneth R. French data library. We estimate (3) for the period 1985-2008, so the sensitivity of the MSAs to the market is pre-determined relative to our benchmark sample period.

### Capital markets shock

We consider QE as a shock that increases liquidity in capital markets. To measure QE we use $S_t$, which is the Wu-Xia Shadow Federal Funds Rate for year $t$. The shadow Fed funds rate can be negative to quantify the effects of unconventional policies. Then we calculate the capital markets shock variable as follows:

$$B_{m,t} = \beta_m S_t. \tag{4}$$

This variable measures the exposure of each MSA to the unconventional monetary policy and the increased liquidity in the capital markets. To instrument for investors' share we lag our capital markets shock by one period, consistently with the stress-test shock instrument.

# Figures for the Appendix

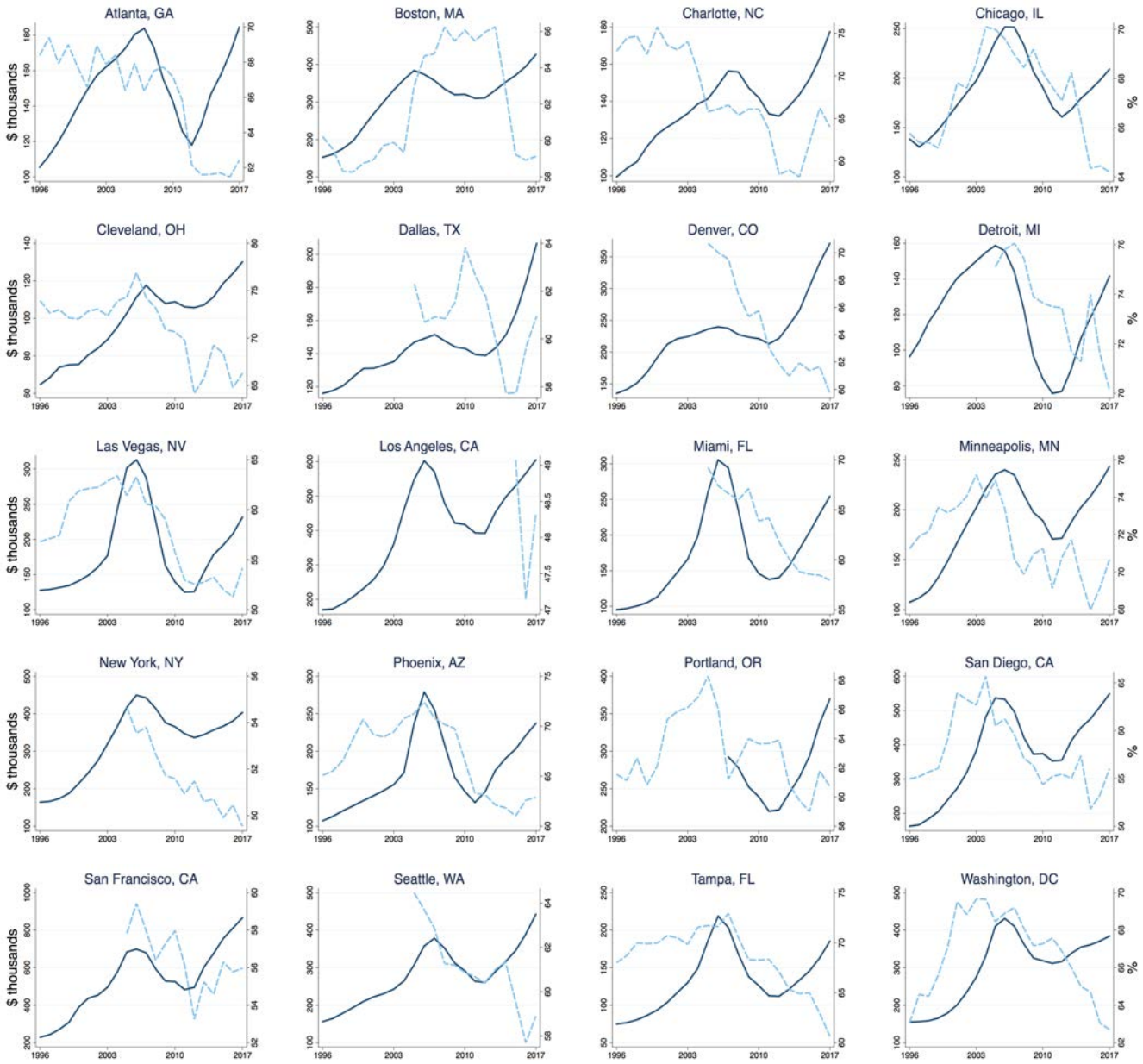


Figure A1. Decoupling of housing prices and homeownership in U.S. MSAs. The figure plots the housing prices and the homeownership rate (HOR) in twenty large MSAs for which we have annual HOR and housing price data from 1996 to 2017.[12] The solid line is the housing price in thousands of dollars, shown in the left y-axis, and the dashed line is the HOR in percentage, shown in the right y-axis. The price data come from the Zillow Home Value Index. The HOR data come from the U.S. Census Bureau.

[12] The final sample we use in the regressions covers 285 MSAs for which we have homeownership and housing price data over the 2009-2014 period.

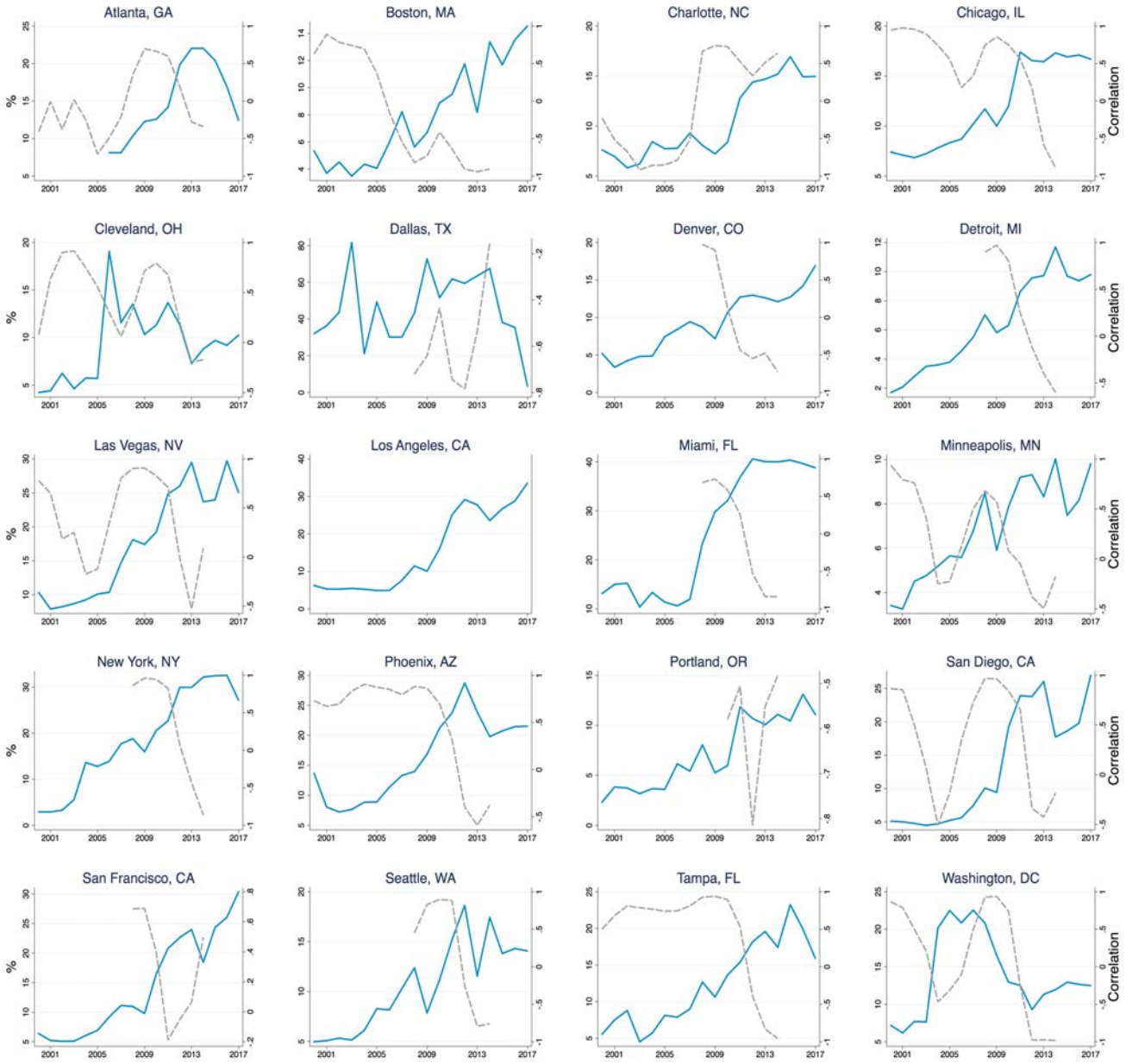


Figure A2. Investors' presence and correlation of housing prices and homeownership in U.S. MSAs. The figure plots the annual share of the dollar value of purchases by legal entities and the rolling correlation of housing prices and homeownership rate in twenty MSAs from 2000 to 2017. The correlation is calculated using a seven-year moving average. The solid line is the share of investors' purchases (left y-axis) and the dashed line is the correlation of housing prices and homeownership rate (right y-axis). The investors' purchases come from ZTRAX, housing prices from Zillow and homeownership rates from the U.S. Census Bureau.

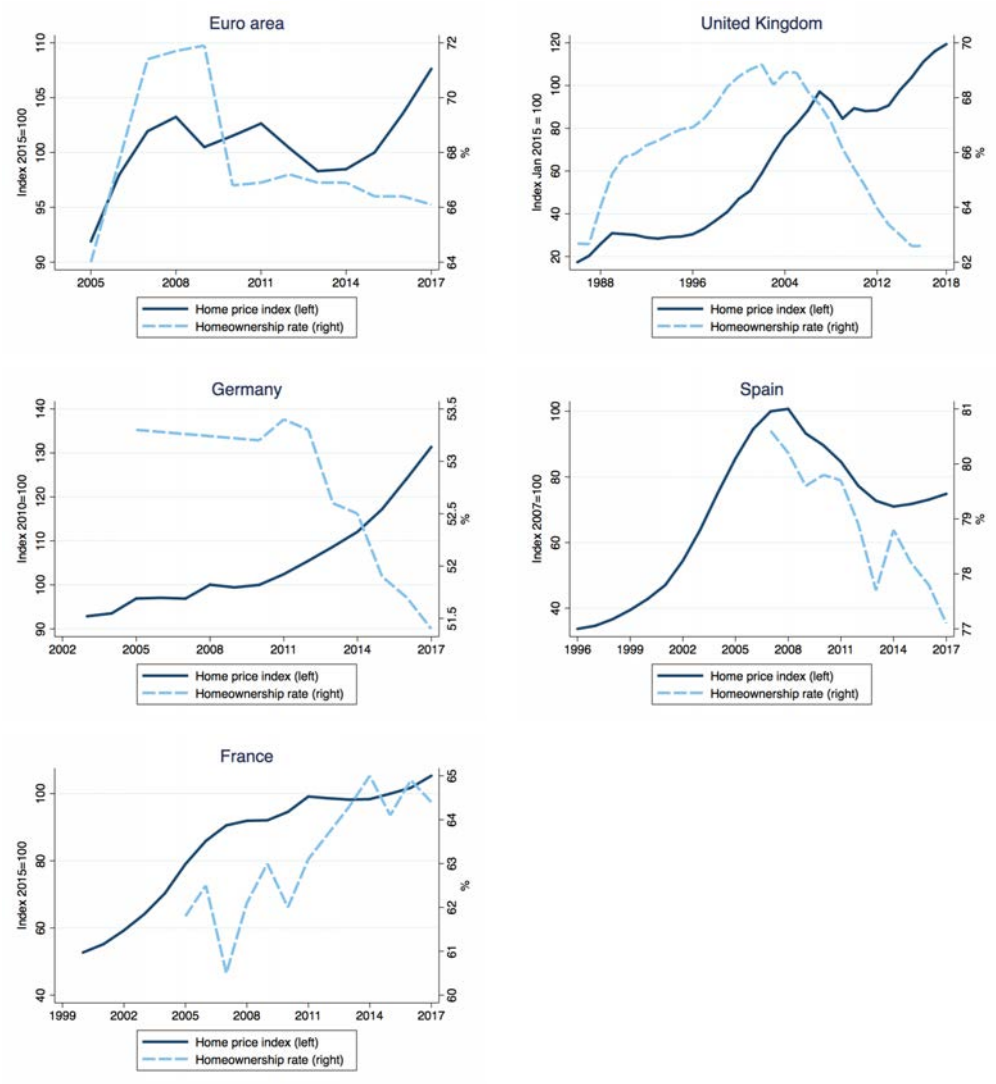


Figure A3. Decoupling of housing prices and homeownership in advanced economies in Europe. The figure plots the housing prices and the homeownership rate in the Euro Area, and the U.K., Germany, Spain and France. Homeownership rate for the U.K. comes from the Ministry of Housing, Communities & Local Government. Homeownership rates for the rest of the regions come from Eurostat. Housing prices for the Euro Area come from Eurostat, for the U.K. from the HM Land Registry, for Germany from the Bank of International Settlements, for Spain from the European Central Bank, and for France from INSEE, the National Institute of Statistics and Economic Studies.

# Tables for the Appendix

Table A1. Land use and buildings' classification

| | |
|---|---|
| Single-family | SINGLE FAMILY RESIDENTIAL; TOWNHOUSE; ROW HOUSE; MOBILE HOME; CLUSTER HOME; SEASONAL, CABIN, VACATION RESIDENCE; BUNGALOW; ZERO LOT LINE; PATIO HOME; MANUFACTURED, MODULAR, PREFABRICATED HOMES; GARDEN HOME; PLANNED UNIT DEVELOPMENT; RURAL RESIDENCE; RESIDENTIAL GENERAL; INFERRED SINGLE FAMILY RESIDENTIAL |
| Multi-family | CONDOMINIUM; COOPERATIVE; LANDOMINIUM; DUPLEX (2 UNITS, ANY COMBINATION); TRIPLEX (3 UNITS, ANY COMBINATION); QUADRUPLEX (4 UNITS, ANY COMBINATION); APARTMENT BUILDING (5+ UNITS); APARTMENT BUILDING (100+ UNITS); HIGH-RISE APARTMENT; GARDEN APARTMENT, COURT APARTMENT (5+ UNITS); MOBILE HOME PARK, TRAILER PARK; DORMITORY, GROUP QUARTERS (RESIDENTIAL); FRATERNITY HOUSE, SORORITY HOUSE; APARTMENT (GENERIC); MULTIFAMILY DWELLING (GENERIC ANY COMBINATION 2+); BOARDING HOUSE ROOMING HOUSE APT HOTEL TRANSIENT LODGING; RESIDENTIAL CONDOMINIUM DEVELOPMENT (ASSOCIATION ASSESSMENT); RESIDENTIAL INCOME GENERAL (MULTI FAMILY) |

This table shows the classification of homes into single-family and multi-family based on the ZTRAX land use standard codes.[13]

[13]We excluded from the data the following land use standard codes that do not refer to homes: "RESIDENTIAL COMMON AREA", "TIMESHARE", "RESIDENTIAL PARKING GARAGE" and "MISCELLANEOUS IMPROVEMENT".

Table A2. Investment horizon of legal entities

| | Obs | Mean | SD | P10 | P90 | Not sold (%) |
|---|---|---|---|---|---|---|
| 2000-2009 | | | | | | |
| Long-term holding duration (days) | | | | | | |
| Single-family | 3135 | 1809.5 | 522.5 | 1317.2 | 2324.4 | 44.8 |
| Multi-family | 2488 | 2103.1 | 632.9 | 1424.5 | 2791.0 | 48.4 |
| Short-term holding duration (days) | | | | | | |
| Single-family | 2939 | 153.9 | 39.9 | 112.2 | 196.2 | 0.0 |
| Multi-family | 2059 | 147.5 | 63.2 | 72.7 | 220.9 | 0.0 |
| 2010-2017 | | | | | | |
| Long-term holding duration (days) | | | | | | |
| Single-family | 2478 | 874.2 | 322.6 | 463.8 | 1297.5 | 79.2 |
| Multi-family | 1780 | 1003.1 | 405.0 | 483.5 | 1528.6 | 80.8 |
| Short-term holding duration (days) | | | | | | |
| Single-family | 2906 | 149.8 | 42.9 | 101.4 | 192.6 | 0.0 |
| Multi-family | 1894 | 141.3 | 62.7 | 65.5 | 216.3 | 0.0 |

This table presents summary statistics of the investment horizon of legal entities in the U.S. The sample consists of 411 MSAs. The variables are calculated at the MSA-year level. The top panel shows summary statistics over the 2000-2009 period and the bottom panel over the 2010-2017 period. Not sold percentage is the percentage of purchases for which we do not calculate the holding duration since we do not observe a sale up to the end of 2017.

Table A3. Investments by individuals

| | Obs | Mean | SD | P10 | P90 |
|---|---|---|---|---|---|
| 2000-2017 | | | | | |
| Purchases ($ millions) | 6399 | 299.7 | 1344.7 | 0.8 | 532.9 |
| Share of value of purchases (%) | 6399 | 7.6 | 7.9 | 2.5 | 13.5 |
| Purchases (units) | 6399 | 1131 | 3120 | 10 | 2630 |
| Holding duration (years) | 5957 | 2.6 | 1.7 | 0.5 | 4.6 |
| 2000-2009 | | | | | |
| Purchases ($ millions) | 3262 | 367.7 | 1283.7 | 0.7 | 778.0 |
| Share of value of purchases (%) | 3262 | 9.1 | 8.8 | 3.0 | 16.1 |
| Purchases (units) | 3262 | 1487 | 3730 | 9 | 3586 |
| Holding duration (years) | 3101 | 3.8 | 1.3 | 2.4 | 4.9 |
| 2010-2017 | | | | | |
| Purchases ($ millions) | 3137 | 228.9 | 1402.0 | 0.9 | 317.5 |
| Share of value of purchases (%) | 3137 | 6.0 | 6.5 | 2.2 | 9.6 |
| Purchases (units) | 3137 | 760 | 2263 | 11 | 1740 |
| Holding duration (years) | 2856 | 1.4 | 0.9 | 0.3 | 2.6 |

This table presents summary statistics of the presence of individual investors in the U.S. The sample consists of 411 MSAs. The variables are calculated at the MSA-year level. The top panel shows summary statistics for investors during the full period of our data, from 2000 to 2017. The middle panel shows the same statistics over the 2000-2009 period and the bottom panel over the 2010-2017 period[14]. Investors' data come from ZTRAX. Individual investors are defined as individuals who purchase more than one properties in an MSA in a given year and the year before. Holding duration is the duration between the purchase and sale of the property, measured in years[15]. P10 denotes the 10th percentile and P90 the 90th percentile.

[14]The statistics are calculated for MSA-years with at least one purchase by legal entities. There are 785 MSA-years with zero purchases by legal entities during the 2000-2017 period, 654 during 2000-2009, and 131 during 2010-2017.

[15]Holding duration is calculated for the properties for which there is a purchase by an individual investor and subsequently a sale. Over the 2000-2017 period 46.8% of the properties that were purchased by individual investors have not been sold. Over the 2000-2009 period the percentage of not yet sold properties is 34.8%, and over the 2010-2017 period is 71.6%.

Table A4. Investments by individuals by type of property

| | Obs | Mean | SD | P10 | P90 |
|---|---|---|---|---|---|
| 2000-2009 | | | | | |
| Purchases ($ millions) | | | | | |
| Single-family | 3255 | 272.5 | 834.8 | 0.7 | 593.4 |
| Multi-family | 2792 | 111.8 | 668.8 | 0.3 | 183.2 |
| Share of value of purchases (%) | | | | | |
| Single-family | 3255 | 8.8 | 8.8 | 2.8 | 15.4 |
| Multi-family | 2792 | 14.4 | 13.4 | 3.7 | 28.0 |
| Purchases (units) | | | | | |
| Single-family | 3255 | 1165 | 2830 | 8 | 2911 |
| Multi-family | 2792 | 380 | 1164 | 3 | 853 |
| 2010-2017 | | | | | |
| Purchases ($ millions) | | | | | |
| Single-family | 3133 | 142.3 | 498.9 | 0.8 | 264.7 |
| Multi-family | 2613 | 104.3 | 1210.0 | 0.2 | 72.7 |
| Share of value of purchases (%) | | | | | |
| Single-family | 3133 | 5.9 | 6.7 | 2.2 | 9.3 |
| Multi-family | 2613 | 8.5 | 9.7 | 1.9 | 17.3 |
| Purchases (units) | | | | | |
| Single-family | 3133 | 587 | 1726 | 10 | 1354 |
| Multi-family | 2613 | 209 | 819 | 2 | 396 |

This table presents summary statistics of the presence of individual investors by type of property in the U.S. The sample consists of 411 MSAs. The variables are calculated at the MSA-year level. The top panel shows summary statistics for investors over the 2000-2009 period and the bottom panel over the 2010-2017 period[16]. Individual investors are defined as individuals who purchase more than one properties in an MSA in a given year and the year before. Share is the share of dollar value of purchases by individual investors to the total dollar value of all purchases in the respective market (i.e. total market, single-family or multi-family). A unit can be a detached home, a condominium, or an apartment building etc. Classification of single-family and multi-family homes is in Table A1.

[16]The statistics are calculated for MSA-years with at least one purchase by individual investors of the respective property type. There are 661 MSA-years with zero single-family purchases and 1124 with zero multi-family purchases by individual investors during 2000-2009. There are 135 MSA-years with zero single-family purchases and 655 with zero multi-family purchases by individual investors during 2010-2017.

Table A5. Investment horizon of individual investors

| | Obs | Mean | SD | P10 | P90 | Not sold (%) |
|---|---|---|---|---|---|---|
| 2000-2009 | | | | | | |
| Long-term holding duration (days) | | | | | | |
| Single-family | 3021 | 1886.3 | 421.4 | 1465.2 | 2249.6 | 41.9 |
| Multi-family | 2492 | 1998.9 | 526.3 | 1492.1 | 2530.0 | 40.0 |
| Short-term holding duration (days) | | | | | | |
| Single-family | 2928 | 147.1 | 45.2 | 95.8 | 189.6 | 0.0 |
| Multi-family | 2136 | 148.5 | 66.1 | 57.3 | 223.7 | 0.0 |
| 2010-2017 | | | | | | |
| Long-term holding duration (days) | | | | | | |
| Single-family | 2335 | 964.4 | 364.1 | 473.3 | 1461.6 | 82.0 |
| Multi-family | 1596 | 1042.1 | 424.5 | 493.9 | 1595.0 | 81.1 |
| Short-term holding duration (days) | | | | | | |
| Single-family | 2786 | 138.6 | 49.0 | 74.9 | 188.7 | 0.0 |
| Multi-family | 1673 | 135.0 | 70.8 | 36.0 | 218.7 | 0.0 |

This table presents summary statistics of the investment horizon of individual investors in the U.S. The sample consists of 411 MSAs. The variables are calculated at the MSA-year level. The top panel shows summary statistics over the 2000-2009 period and the bottom panel over the 2010-2017 period. Individual investors are defined as individuals who purchase more than one properties in an MSA in a given year and the year before. Holding duration is the duration between the purchase and sale of the property, measured in days. We define long-term investments the holdings of more than one year, and short-term investments the purhases that are sold within a year. Not sold percentage is the percentage of purchases for which we do not calculate the holding duration since we do not observe a sale up to the end of 2017. Classification of single-family and multi-family homes is in Table A1.

Table A6. First Stage: Investors' purchases and the instrumental variables

| Outcome: | Investors' value of purchases |
|---|---|
| Stress-test deposit share$_{m,2008}$ \$ Denial propensity$_{t\,!\,1}$ | 4,470 |
| | (0.018) |
| Beta$_{m,1985\,!\,2008}$ \$ Shadow rate$_{t\,!\,1}$ | -694.0 |
| | (0.025) |
| Lagged population growth | 95.96 |
| | (0.017) |
| Lagged income growth | 13.52 |
| | (0.042) |
| Lagged median age change | 29.55 |
| | (0.009) |
| Estimation | OLS |
| MSA fixed effects | Yes |
| Year fixed effects | Yes |
| R-squared | 0.864 |
| Observations | 1,813 |

$p$-values are in parentheses. Investors' value of purchases is in millions of U.S. dollars. Investors' data come from ZTRAX. Stress-test share is the deposits share of stress-tested lenders in 2008 in MSA $m$. Denial propensity is the difference between the mortgage denial rate of stress-tested and non stress-tested lenders in year $t$ ! 1. Stress-tested lenders are those subject to CCAR between form 2011 onwards. The beta of the housing market of MSA $m$ is calculated using 1985-2008 returns and one-factor CAPM with the value-weighted return of all U.S. firms listed on the NYSE, AMEX, or NASDAQ. Shadow rate is the Wu-Xia Shadow Federal Funds Rate for year $t$ ! 1. The sample consists of 300 MSAs over the period from 2009 to 2015. Each observation is an MSA-year. Standard errors are clustered by MSA.

Table A7. Dynamic effects: Housing price growth and investors' purchases

| Outcome: | Housing price growth |
|---|---|
| Investors' value of purchases$_t$ | 0.025 |
| | (0.000) |
| Investors' value of purchases$_{t\,!\,3}$ | -0.009 |
| | (0.019) |
| Investors' value of purchases$_{t\,!\,6}$ | -0.025 |
| | (0.000) |
| Estimation | 3SLS |
| MSA-year controls | Yes |
| MSA fixed effects | Yes |
| Year fixed effects | Yes |
| Observations | 2,770 |

$p$-values are in parentheses. Housing prices come from the Zillow home value indices. Investors' value of purchases is in millions of U.S. dollars. Investors' data come from ZTRAX. Controls are the population growth and income growth at the MSA level. All controls are lagged for seven years. The instruments for the investors' dollar value of purchases are (a) the beta of MSA $m$, calculated using 1985-2008 returns and one-factor CAPM with the value-weighted return of all U.S. listed firms listed multiplied by the lagged Wu-Xia shadow federal funds rate and (b) the share of the value of the deposits of stress-tested lenders in 2008 in MSA $m$ multiplied by the lagged difference in denial propensity between stress-tested and non stress-tested lenders subject to CCAR. The sample consists of 305 MSAs. Year $t$ ranges from from 2009 to 2017. Each observation is an MSA-year.

Table A8. Dynamic effects: Housing rent growth and investors' purchases

| Outcome: | Housing rent growth |
|---|---|
| Investors' value of purchases$_t$ | 0.001 |
| | (0.427) |
| Investors' value of purchases$_{t\,!\,3}$ | 0.010 |
| | (0.000) |
| Investors' value of purchases$_{t\,!\,6}$ | -0.0003 |
| | (0.927) |
| Estimation | 3SLS |
| MSA-year controls | Yes |
| MSA fixed effects | Yes |
| Year fixed effects | Yes |
| Observations | 2,772 |

$p$-values are in parentheses. Housing rents come from the Zillow rent indices. Investors' value of purchases is in millions of U.S. dollars. Investors' data come from ZTRAX. Controls are the population growth and income growth at the MSA level. All controls are lagged for seven years. The instruments for the investors' dollar value of purchases are (a) the beta of MSA $m$, calculated using 1985-2008 returns and one-factor CAPM with the value-weighted return of all U.S. listed firms listed multiplied by the lagged Wu-Xia shadow federal funds rate and (b) the share of the value of the deposits of stress-tested lenders in 2008 in MSA $m$ multiplied by the lagged difference in denial propensity between stress-tested and non stress-tested lenders subject to CCAR. The sample consists of 305 MSAs. Year $t$ ranges from from 2009 to 2017. Each observation is an MSA-year.