Real Estate Investors and the 2007-2009 Crisis*

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Abstract

This paper studies the role of real estate investors in the 2001-2006 housing boom and in the 2007-2009 foreclosure crisis. The investor share of mortgage balances roughly doubled between 2004 and 2007 reaching a peak of approximately 30% and accounted for close to 50% of all foreclosures at the height of the crisis, even though their share in the borrower population peaked at 14%. Given the outsized role of real estate investors, what drives investor activity? Is it a response to an increase in credit supply, a consequence of house price expectations, or a response to housing demand factors determined by changes in the occupational and industry distribution? What role did investor activity play in exacerbating the fluctuations in housing values? Did the disproportionally high default rates of real estate investors exacerbate the decline in in consumption and employment that followed the housing crisis? And given the high default risk associated with investor mortgages, should these products be regulated, and how? This paper seeks to answer these questions by providing empirical evidence on investor activity and by developing an equilibrium model of the housing market with real estate investors that can be used as a laboratory to assess their impact on the housing and mortgage markets, and on the aggregate economy.

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1 Introduction

This paper seeks to gain insight into the determinants and consequences of real estate investor activity for the 2001-2006 housing boom and the 2007-2009 crisis. The premise of this work is based on the new facts about the distribution of mortgage borrowing and defaults described in Albanesi, DeGiorgi, and Nosal (2017). Contrary to most of the preceding literature, they show that it is not subprime borrowers, that is those with low credit score, that primarily drove the rise in mortgage debt during the boom and the rise in foreclosures in 2007-2009. Instead, they find that the distribution of mortgage borrowing was close to the historical pattern during the boom, with mid to high credit score borrowers accounting for most of outstanding mortgage balances, and that these same borrowers experienced an unprecedented rise in defaults during the crisis. Albanesi, DeGiorgi, and Nosal (2017) show that the rise in defaults among mid to high credit score borrowers was primarily driven by real estate investors, whose share of mortgage balances roughly doubled between 2004 and 2007 reaching a peak of approximately 30%. Real estate investors have higher default rates than regular borrowers and they accounted for close to 50% of all foreclosures at the height of the crisis, even though their share in the borrower population peaked at 14%. Albanesi, DeGiorgi, and Nosal (2017) also show that areas with a high share of young households, which tend to be urban and have high income inequality, displayed the largest rise in investor mortgage balances during the housing boom and foreclosures during the crisis, as well as a particularly accentuated house price cycle over the entire period.[1] These are the same areas that exhibited a particularly large drop in consumption and employment during the 2007-2009 recession, as shown among others by Mian and Sufi (2010), Mian and Sufi (2011), Mian, Rao, and Sufi (2013), Midrigan and Philippon (2011), and Kehoe, Pastorino, and Midrigan (2016).

The findings in Albanesi, DeGiorgi, and Nosal (2017) raise a number of questions that constitute the point of departure for this paper. Given the outsized role of real estate investors in the 2007-2009 crisis, what drives investor activity? Is it a response to an increase in credit supply, a consequence of house price expectations, or a response to housing demand factors determined by changes in the occupational and industry distribution? What role did investor activity play in exacerbating the fluctuations in housing values? Did the dispropor-

[1] This pattern in investor borrowing and default behavior may explain why despite large regional variation in predictable default risk, GSE mortgage rates for otherwise identical loans do not vary spatially, while the private market does set interest rates that vary with local risk, as shown in Hurst et al. (2016). GSE mortgages are mostly available for owner occupied properties and default rates among borrowers with only one first mortgage are low in all zip codes. By contrast, default rates on private market products would reflect the geographical variation in investor activity, and corresponding default propensity.

tionally high default rates of real estate investors exacerbate the decline in in consumption and employment that followed the housing crisis? And given the high default risk associated with investor mortgages, should these products be regulated, and how? This paper seeks to answer these questions by providing empirical evidence on investor activity and by developing an equilibrium model of the housing market with real estate investors that can be used as a laboratory to assess their impact on the housing and mortgage markets, and on the aggregate economy. Real estate investors have been overlooked in current work, since they are hard to identify in the data and it is difficult to incorporate real estate investment in equilibrium models of the housing market.[2] The proposed study aims to fill this void in the literature and can provide a basis to design policies that reduce the destabilizing effect of investors on the housing market.

There are a number of reasons to expect higher default rates for investors relative to non-investors. First, mortgages for non-owner occupied properties must meet stricter credit standards and are usually charged an additional premium to qualify for GSE insurance. This makes it more likely for real estate investors to contract non-standard mortgages, which are typically more expensive for the borrower. Second, if investors are motivated by the prospect of capital gains, they are more likely to default if the value of the mortgage is higher than the value of the property, especially with no recourse.[3] Finally, the financial and psychological costs of default for resident owners are typically quite substantial, including moving and storage costs, and longer commute times. Real estate investors are not subject to these costs.

This paper seeks to comprehensively examine the role of real estate investors. The first component of the analysis will be empirical. Specifically, building on the findings in Albanesi, DeGiorgi, and Nosal (2017), we will describe in detail the characteristics of real estate investors, with special reference to income, pattern of acquisition of investment properties and spacial distribution. The empirical analysis is based on several data sources. The primary data source is the Experian credit panel, which includes information on debt, delinquencies, income and public records, such as bankruptcies and foreclosures, for a representative panel of 1 million borrowers with an Experian credit report, from 2004 to 2012. This administrative data, reported at a quarterly frequency, allows an assessment of the full set of liabilities for each borrower, in addition to their age and location by zip code, and also includes credit scores for each borrower. For mortgages, the data distinguishes between first and second

[2] Kindermann and Kohls (2016) examine a housing model with investors to study the European rental market.

[3] Ghent and Kudlyak (2011) show that foreclosure rates are 30% higher in non-recourse state during the crisis.

liens, as well as the issuing entity (VA, FHA, GSE or other). This credit file data is complemented with publicly available loan level data, which has more information on the mortgage at origination (such as loan to value ratio, intended use of the property, interest rate and so on). Sources of such information include the HAMDA (Home Mortgage Disclosure Act) database, the FreddieMac Single Family Loan-Level Dataset, the CoreLogic University Data Portal, and the Fannie Mae Single-Family Loan Performance Data.

The second part of the paper develops a quantitative model that explicitly incorporates investor activity, to be used as a framework to explore the determinants of investor activity, their role in the housing and mortgage markets. The model will also be used to derive insights into policies that might prevent or resolve episodes such as the mortgage crisis of 2007-2009 by restricting on regulating investor activity. The model, which extends Kaplan, Mitman, and Violante (2017), incorporates an equilibrium model of the housing market, in which households can rent or buy a home in which they live, and also purchase investment properties, which they place on the rental market. Home purchases can be financed by mortgages, which are subject to a collateral constraint. To capture the higher default risk associated with investor mortgages, we assume that the default cost for investor mortgages is higher than for owner-occupied properties. Additionally, to capture the fact that it is often harder to to verify income for real estate investors and the fact that investor mortgages are typically securitized on the more expensive private label market, we also assume that the origination cost for lenders is higher for investor mortgages than for owner-occupied properties. The differences in default and origination costs between owner occupied and investor mortgages will be calibrated to match the share of real estate investors prior to the surge of investment activity in 2004.

The first part of the quantitative analysis examines whether investor activity can amplify the response of housing values to aggregate shocks, such as changes in productivity or the tightness of collateral constraint in mortgage markets. The potential for this response arises from two sources. First, aggregate shocks that induce a rise in current and perspective wealth will increase the demand for leveraged investment properties. Though these properties have a risky return, there is an option value associated to holding such properties, because mortgages have no recourse. Investor activity then amplifies the response of housing values to aggregate shocks and reduces the correlation between rental rates and house prices, since when there is an increase in demand for investment properties, there will be an increase in supply of rental units from individual investors reducing the rental rate. This replicates the behavior of the rent to price ratio for housing during the 2001-2006 boom. We will also consider experiments designed to evaluate the role of investors specifically. One of these is a lowering of the origination cost associated with investment properties. This will reduce the spread between mortgages for investor and owner-occupied properties, and is equivalent to an increase in the supply of credit for investors, which may have driven the reduction in mortgage spreads, as argued by Justiniano, Primiceri, and Tambalotti (2017). The second experiment is to introduce a debt servicing requirement. Such a requirement is noticeably absent in the US mortgage market. Since an increase in investor activity is associated with a decline in rental rates in the model, income from investment properties will be low when demand for investment properties is high, which implies that certain investor mortgages will not satisfy this requirement. Hence, a debt servicing requirement may moderate the response of investor activity and dampen the response of housing values to aggregate shocks.

The second part of the quantitative analysis explores the role of location. Albanesi, DeGiorgi, and Nosal (2017) show that the areas with high fraction of subprime borrowers are relatively young, urban and display high levels of income inequality. These areas also exhibited the sharpest fluctuations in housing values. A natural question is then whether such urban locations where particularly attractive from a housing market perspective and whether this leads to both an increase in investor activity and a more pronounced housing cycle. There are several factors that suggest urban areas may have become particularly attractive. Gentrification likely contributed to a growth in housing values in cities.[4] At the same time, the rise of the service sector and the growth in professional occupations have determined a greater concentration of employment opportunities in urban areas.[5] Technological change leading to job polarization (see Acemoglu and Autor (2011)) may have been accelerated in urban areas, since the high costs of living increase firms' incentive to replace routine workers with automated technologies (Eeckhout, Hedtrich, and Pinheiro (2017)). These factors may have contributed to the rise of *superstar cities*, as argued in Gyourko, Mayer, and Sinai (2013), with a high concentration of wealthy households and very high housing values. Based on this evidence, we will explore the role of location for investor activity and the evolution of the housing and mortgage markets. Urban locations will have higher income and greater inequality, a higher share of young households and lower housing supply

[4] Guerrieri, Hartley, and Hurst (2013)) develop a model of gentrification, and Couture and Handbury (2017) show that cities experienced a higher concentration of young college graduates starting in the late 1990s. Ferreira and Gyourko (2011) show that local income was the only potential demand shifter for the housing market in metropolitan areas and that it had an economically and statistically significant change around the time that local housing booms began.

[5] Rossi-Hansberg et al. (2009) show that information technology allowed to separate production and management operations, leading to a concentration of management position in the city center. Liebersohn (2017) shows that the share of growing industries at the local level drives the size of housing demand shocks, the magnitude of the housing price increase and household consumption variation between 2000-2006.

elasticity. To assess the role of investors in different locations, we will explore the equilibrium response to aggregate shocks to shed light on the determinants of the spacial distribution of investors and account for the geographical variation house prices.

The final part of the quantitative analysis derives insights into policies to prevent or resolve episodes such as the mortgage crisis of 2007-2009. Given the misplaced emphasis on subprime borrowers as the main cause of the crisis, real estate investors, who accounted for most of the rise in defaults during the crisis, were overlooked. The higher default risk associated with investor mortgages is not captured in current credit scoring models. To the contrary, multiple first mortgages on a borrower's credit file would typically increase their credit score. This distorts the allocation of credit, and has implications that go well beyond the consumer debt market. As is well known, credit scores are used in a variety of settings as a signal of reliability and even character, and most notably they are increasingly used to evaluate job applicants. It is therefore paramount that credit scoring models be transparent and accurate. Currently, there is no mechanism to assess the ability of the widely used credit scoring models to capture default risk for investor mortgages. Our quantitative model can be used to examine the variation of idiosyncratic and systemic risk associated with investor activity, providing important evidence into the limitations of current scoring models and leading to insights that could improve macroprudential policies.

The main contribution of this paper is to provide the first comprehensive analysis of the role of investors for the 2007-2009 housing and mortgage crisis. The fact that it is real estate investors that drove the rise in mortgage borrowing and the foreclosure crisis leads to policy implications that are very different from those enacted based on the notion that the crisis was driven by subprime borrowers. Moreover, understanding investor activity is not only important from a historical perspective. Investor demand is currently causing an affordability crisis in housing markets for many American cities, and the higher default risk associated with investor mortgages increases systemic risk. Our analysis provides insights to mitigate and correct these outcomes.

2 Empirical Evidence

There are a number of reasons that would lead investor mortgages to display higher default rates than mortgages for owner occupied properties. First, defaulting on an investment property does not incur in the typical psychological and monetary costs associated with default, such as loss community, movings expenses and longer commuting time, among others. Additionally, GSE sponsored investor mortgages are subject to more stringent conditions than owner occupied mortgages, and therefore investors are more likely to seek funding from non-conventional lenders and use alternative products, such as Alt-A mortgages, adjustable rate mortgages, which typically charge higher rates.[6] Additionally, if investors are motivated by the prospect of capital gains, they have an incentive to maximize leverage, as this strategy increases potential gains, while the potential losses are limited, especially in states in which foreclosure is non-recourse. This strategy also increases default risk.

We follow Haughwout et al. (2011) and define investors as borrowers who hold 2 or more first mortgages. Figure 1 presents basic statistics on investor activity. The fraction of investors was stable at around 10% between 2001 and the end of 2004, when it started to rise, reaching a peak of 14% at the end of 2007. The investor share of mortgage balances was also stable at around 13% during the boom, but started to rise very rapidly at the end of 2004, reaching a peak of 29% by the end of 2007. The investor share of delinquencies and foreclosures is significantly higher throughout the sample period. Both the share of delinquencies and foreclosures for borrowers with 2 or more first mortgages are both close to 20% until early 2005, and then start rising rapidly. The investor share of delinquencies peaks at 30% in 2007Q4, and the investor share of foreclosure reaches 42% at the same date.

The investor share of defaults is close to 4 times larger than their share in the population of mortgage holders. This stems from the fact that defaults rates are much higher for investors. Figure 2 plots the foreclosure rates for investors (2 or more first mortgages) and non-investors (only 1 first mortgage). During the boom, the rates for the two groups are quite close and very low, around 0.04% for non-investors and 0.05% for investors. In mid 2006, these rates start rising. The increase for investors is large and very rapid, leading to a peak in their foreclosure rates at 2.2% in the second quarter of 2009, after which it declines equally rapidly, reaching 1% by 2011Q1 and dropping to 0.75% by the end of the sample. By contrast, the foreclosure rates grows slowly for non-investors for whom it reaches 0.75% by mid 2009, and stabilizes there until the end of 2010, when it starts to decline gradually, dropping to 0.45% by the end of the sample. Albanesi, DeGiorgi, and Nosal (2017) show that the rise in investor activity is primarily responsible for the rise in mortgage defaults among mid to high credit score borrowers.

To provide more comprehensive evidence on investor activity, we study individual investor

[6] Keys et al. (2012) document the sizable increase of Alt-A mortgages, that have low standard for income documentation and would be particularly appropriate for real estate investors who have variable and hard to document income. Further, Foote and Willen (2016) also discuss the role of alternative mortgage products and the fact that their structure may increase the risk of default. However, Elul and Tilson (2015) present evidence of substantial misrepresentation of home purchases as primary residences, for the purpose of qualifying for GSE sponsored mortgages.

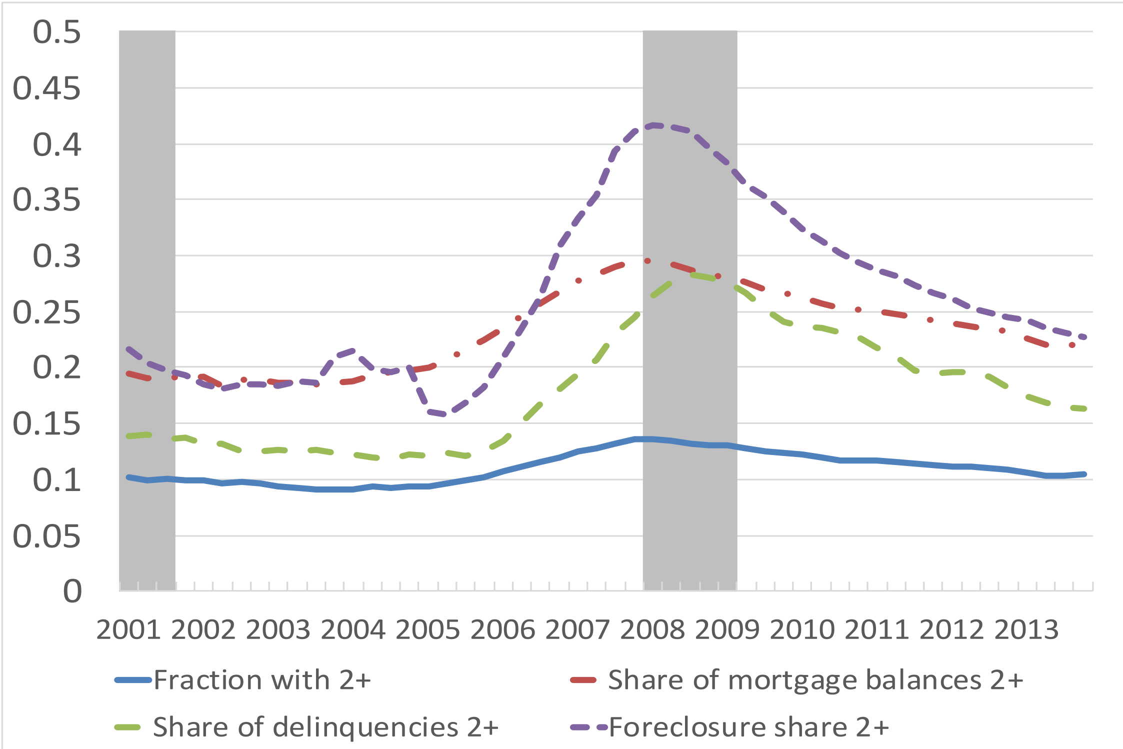

Figure 1: Statistics for borrowers with 2 or more first mortgages (investors), 3Q moving averages. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

characteristics, such as age, income, other debt holdings and the pattern of acquisition of investor mortgages, as well as their spacial distribution using the Experian credit file panel. We then use loan level evidence to examine specific characteristics of investor mortgages, such as loan to value ratios, specific purpose of the loan (vacation or rental), interest rates etc.

3 Theory

The model is an extension of Kaplan, Mitman, and Violante (2017).

Time is discrete. The economy is populated by a measure-one continuum of finitely-lived households.

3.1 Households

Age is indexed by $j = 1, 2, ..., J$. Households work from period 1 to $J^{ret} - 1$, and are retired from period $J^{ret}-$ to J. All households die with certainty after age J. In what follows,

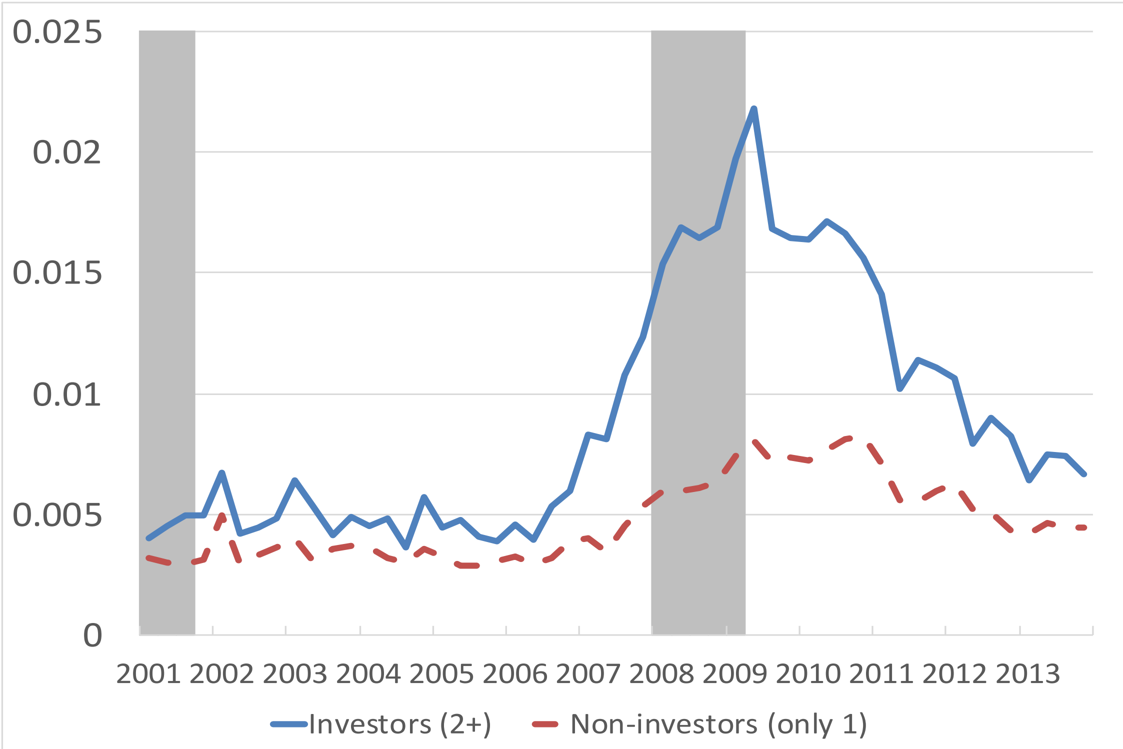

Figure 2: Fraction with new foreclosure in the last 4 quarters for borrowers with 2 or more (investors) and only 1 (non-investors) first mortgages, 3Q moving averages. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

we omit the dependence of variables on age j except in cases where its omission may be misleading.

Preferences Expected lifetime utility of the household is given by:

$$E_0 \sum_{j=0}^{J} \left[\beta^j u_j(c_j, s_j) + \beta^J v(b)\right] \tag{1}$$

where $\beta > 0$ is the discount factor, $c > 0$ is consumption of nondurables and $s > 0$ is the consumption of housing services. Nondurable consumption is the numeraire good in the economy. The expectation is taken over sequences of aggregate and idiosyncratic shocks that will be specified below. The function v measures the felicity from leaving bequests $b > 0$. We assume that the utility function u_j is given by

$$u_j(c, s) = \frac{e_j \left[(1-\phi)c^{1-\gamma} + \phi s^{1-\gamma}\right]^{\frac{1-\theta}{1-\gamma}} - 1}{1-\theta}, \tag{2}$$

where ϕ measures the relative taste for housing services, $1/\gamma$ measures the elasticity of substitution between housing services and nondurables, and $1/\theta$ measures the intertemporal elasticity of substitution (IES). The exogenous equivalence scale $\{e_j\}$ captures deterministic changes in household size and composition over the life cycle and is the reason why the intra-period utility function u is indexed by j. The warm-glow bequest motive at age J takes the functional form:

$$v(b) = \psi \frac{(b + \underline{b})^{1-\theta} - 1}{1 - \theta}, \tag{3}$$

where the term ψ measures the strength of the bequest motive, while $\underline{b}$ reflects the extent to which bequests are luxury goods.

Endowments Working-age households receive an idiosyncratic labor income endowment y_j given by

$$log y_j = \Theta + \varphi_j + \varepsilon_j \tag{4}$$

where Θ is an index of aggregate labor productivity. Individual labor productivity has two components: (i) a deterministic age profile φ_j that is common to all households and (ii) an idiosyncratic component ε_j that follows a first-order Markov process. We denote the resulting age-dependent transition matrix for individual earnings by π_j, which does not depend on Θ, and we denote the unconditional earnings distribution at age j by Π_j. Households are born with an endowment of initial wealth that is drawn from an exogenous distribution that integrates up to the overall amount of wealth bequeathed in the economy by dying households. The draw is correlated with initial productivity y_1.

Liquid Saving Households can save in one-period bonds, b, at the exogenous price q_b, determined by the net supply of safe financial assets from the rest of the world. For what follows, it is convenient to also define the associated interest rate on bonds $r_b := 1/q_b - 1$. Unsecured borrowing is not allowed.

Housing In order to consume housing services, households have the option of renting or owning a home. Houses differ by size, which belongs to the set $H = \{h_1, h_2\}$, where $h_1 < h_2$. Only houses of size h_1 are available to rent, while only houses of size h_2 are available for purchase. Markets for rental and owner-occupied housing are both competitive and frictionless. The rental rate of a unit of housing is denoted by $\rho(\Omega)$. The per-unit price of housing is denoted by $p_h(\Omega)$. Rental rates and house prices are determined in equilibrium and comprise the aggregate endogenous state (Ω). Renting generates housing services one-for-one with the size of the house, $s = h$. Owner-occupied house generates $s = \omega h$ units of housing services, with $\omega \geq 1$, so owning is more efficient. House ownership carries per-period maintenance, δ_h, and tax costs, τ_h for the owner. Maintenance fully offsets physical depreciation of the dwelling. Households can buy more than one property. Investment properties are restricted to size h_1 and are placed on the rental market. When a household sells its home, it incurs a transaction cost that is linear in the house value, $\kappa^o p_h(\Omega)h^o$ for residential properties and $\kappa^i p_h(\Omega)h^i$. We assume that $\kappa^i < \kappa^o$ to account for the fact that an investor does not incur moving costs when selling their property.

3.2 Mortgages

Housing purchases can be financed by mortgages. All mortgages are long-term, defaultable and subject to a fixed origination cost $\alpha_h > 0$. All mortgages are amortized over the remaining life of the buyer at the common real interest rate r_m which is equal to the bond rate r_b times an intermediation cost. A household of age j that obtains a new mortgage with principal balance m^o_j for owner occupied properties or m^i_j for investment properties receives from the lender $q^o_j(x^o_{j+1}, y; \Omega)m^o_j$ and $q^i_j(x^i_{j+1}, y; \Omega)m^i_j$ units of the numeraire good respectively, in the period that the mortgage is originated. The mortgage pricing functions $q^o < 1$, $q^i < 1$ depend on the age of the borrower, its choice of assets and liabilities for next period $x^o_{j+1} := \left\{b_{j+1}, m^o_{j+1}\right\}$ and $x^i_{j+1} := \left\{b_{j+1}, m^o_{j+1}, m^i_{j+1}\right\}$, its current income state y and the current aggregate state vector Ω. These variables predict the household-specific probability of future default. The higher is this default probability, the lower is the price of the mortgage. It follows that the downpayment made at origination by a borrower of age j who takes out a mortgage of size m' to purchase a house is $p_h(\Omega)h^o_{j+1} - q^o_j(x', y; \Omega)m^o_{j+1}$ for owner occupied homes and $p_h(\Omega)h^i_{j+1} - q^i_j(x', y; \Omega)m^i_{j+1}$ for investment properties. At the time of origination, borrowers must respect a maximum loan-to-value (LTV) constraint: the initial mortgage balance m must be less than a fraction λm of the collateral value of the house being purchased for each property purchased:

$$m' \leq \lambda^m p_h(\Omega)h'. \tag{5}$$

In each period, the household must make a minimum payment on each mortgage. For any pair (j, m), the minimum payment is determined by the constant amortization formula,

$$\pi^{min}_j(m) = \frac{r_m(1 + r_m)^{J-j}}{(1 + r_m)^{J-j} - 1} m. \tag{6}$$

The amortization formula is the same for owner occupied and investment properties. After origination, the borrower is required to make at most $J-j$ mortgage payments π that each exceed the minimum required payment 6 until the mortgage is repaid. The outstanding principal evolves according to $m' = m(1+r_m) - \pi$.

Because mortgages are long-term, after origination there is no requirement that the principal outstanding on the mortgage be less than λ^m times the current value of the home. The only requirement for a borrower to not be in default is that they make its minimum payment on the outstanding balance of the loan. If house prices decline, a home owner could end up with negative equity but, as long as they continue to meet the minimum payment requirement, they are not forced to deleverage as it would be if debt was short-term.

If a household defaults, mortgages are the subject of the primary lien on the house, implying that the proceeds from the foreclosure are disbursed to the creditor. Foreclosing reduces the value of the house to the lender for two reasons: (i) it is the lender who must pay property taxes and maintenance, and (ii) foreclosed houses depreciate at a higher rate than regular houses, i.e. $\delta_h^d > \delta_h$. Thus, the lender recovers $min\left\{1 - \delta_h^d - \tau_h^d)p_h(\Omega))h, (1+r_m)m\right\}$. A household who defaults is not subject to recourse, but incurs a utility loss χ^o if they occupy the home or χ^i for an investment property, where $\chi^o > \chi^i$. This difference captures the additional psychological and monetary costs of loosing an owner occupied house, including relocation costs, additional commuting time and loss of community. Transfer of ownership to lender after foreclosure occurs at the end of the period, so that the home owner can still live in the house in during foreclosure. Households who foreclose are excluded from buying a house in that period, and must therefore be renters in the following period.

Financial Intermediaries The mortgage market is operated by competitive intermediaries who receive foreign funding. The price of mortgages is determined via a loan-by-loan zero profit condition of the financial intermediation market. Financial intermediaries pay an intermediation cost to convert one unit of foreign financing into 1 unit of mortgage lending. This intermediation cost is equal to ν^o for owner occupied properties and to $\nu^i > \nu^o$ for investment properties. This difference captures the fact that investor mortgages may be made for properties that are not in the location where the borrower resides, the fact that they are typically securitized at a higher price on the private labor market and the fact that it might be hard to verify the income of a real estate investor. All these features are abstracted from in the model, but play an important role in the market for investment properties. (See Albanesi, DeGiorgi, and Nosal (2017).)

Let $g_j^{o,n}(x_j^o, y; \Omega)$ and $g_j^{o,d}(x_j^o, y; \Omega)$ be the decision to sell or default on a residential home.

Then, the price of a mortgage satisfies:

$$
\begin{aligned}
&q_j^o(x_{j+1}^o, y; \Omega) = \\
&\tfrac{1-\nu^o}{(1+r_m)m'} E\left\{ g_j^{o,n}(1+r_m)m' + g^{o,d}(1-\delta_h^d - \tau_h - \kappa_h)p_h(\Omega)h' \right. \\
&\left. + \left[1 - g_j^{o,n} - g_j^{o,d}\right] \langle \pi^o(x_{j+1}^o, y'; \Omega') + q_{j+1}^o(x_{j+2}^o, y_{j+1}; \Omega') \left[(1+r_m)m' - \pi^o(x_{j+1}; \Omega')\right] \rangle \right\}
\end{aligned}
\tag{7}
$$

Let $g_j^{i,n}(x_j^i, y; \Omega)$ and $g_j^{i,d}(x_j^i, y; \Omega)$ denote the decision to sell or default on an investment property. Then, the price of an investor mortgage satisfies:

$$
\begin{aligned}
&q_j^i(x_{j+1}^i, y; \Omega) = \tfrac{1-\nu^i}{(1+r_m)m'} E\left\{ g_j^{i,n}(1+r_m)m' + g^{i,d}(1-\delta_h^d - \tau_h - \kappa_h)p_h(\Omega)h' \right. \\
&\left. + \left[1 - g_j^{i,n} - g_j^{i,d}\right] \langle \pi^i(x_{j+1}^i, y'; \Omega') + q_{j+1}^i(x_{j+2}^i, y_{j+1}; \Omega') \left[(1+r_m)m' - \pi^i(x_{j+1}^i; \Omega')\right] \rangle \right\}
\end{aligned}
\tag{8}
$$

Since borrowers face a lower cost of default on investment properties, which increases the default rate on such properties, and the intermediation cost is higher on investor mortgages, the price of an investor mortgage will be lower than the price of a mortgage for an owner occupied property, all other things equal. The average spread between owner occupied and investor mortgages will be calculated as

$$
\frac{1}{q^i(\overline{x}^i, \overline{y}; \Omega)} - \frac{1}{q^o(\overline{x}^o, \overline{y}; \Omega)} \tag{9}
$$

where $\overline{x}^i$ denotes the average state for investors and $\overline{x}^o$ average state for home owners, which can include investors and non-investors and $\overline{y}$ average income. This spread will vary systematically with age.

Government The government runs a PAYG social security system. Retirees receive social security benefits $y_{ret} = \rho_{ss} y^w_{J^{ret}}$, where ρ_{ss} is a replacement rate and the argument of the J^{ret} benefit function proxies for heterogeneity in lifetime earnings. We adopt the notation y for income, with the convention that if $j < J^{ret}$ then $y = y^w$, defined in (4), and $y = y^{ret}$ otherwise. Government tax revenues come from the proportional property tax τh levied on house values, a flat payroll tax τ_{ss} and a progressive labor income tax $\tau^y(y)$. Households can deduct the interest paid on mortgages against their taxable income. We denote the combined income tax liability function $T(y, m)$. In addition, the government gets revenue from the sale of new land permits for construction. The residual differential between tax revenues and pension outlays, which is always positive, is spent on services $G(\Theta)$ that are not valued by households.

3.3 Firm Sector

Production of consumption goods is carried out by competitive firms with a linear technology that only uses labor. Aggregate output is $Y = \Theta N_c$, where N_c denotes units of labor services on the consumption good sector, so that wages are equal to $w = \Theta$.

Rental Sector The rental sector is operated by perfectly competitive rental firms that manage investment properties owned by individual households and may also purchase rental units directly from the construction sector. This process is frictionless and incurs an operating cost ζ per unit rented. The properties owned directly by the rental sector are denoted with $\tilde{H}$, those managed are denoted with $\hat{H}$, and the total supply of rental properties is $H = \tilde{H} + \hat{H}$.[7] The rental firms manage all the properties offered to them and pay a return $\hat{\rho}(\Omega) = \rho(\Omega) - \zeta$ to the households. Therefore, we can abstract from the managed properties in the rental firms' profits. The problem for a representative rental company is:

$$J(\tilde{H};\Omega) = max_{\tilde{H}'} \left[\rho(\Omega) - \zeta\right] - p_h(\Omega)\left[\tilde{H}' - (1-\delta_h - \tau_h)\tilde{H}\right] + \left(\frac{1}{1+r_b}\right) E_\Omega J(\tilde{H}';\Omega') \quad (10)$$

The optimality condition for this problem is:

$$\rho(\Omega) = \zeta + p_h(\Omega) - \frac{1-\delta_h-\tau_h}{1+r_b} E_\Omega \left[p_h(\Omega')\right], \quad (11)$$

which equates the rental rate to the user cost of housing for the rental company.

Construction Sector Production of houses occurs in the construction sector which has constant returns to scale technology and uses labor and and land. As in Favilukis, Ludvigson, and Van Nieuwerburgh (2017) and Kaplan, Mitman, and Violante (2017), the government sells building permits, traded on a competitive market, to firms in the construction sector. The production technology is: $I_h = (\Theta N_h)^\gamma \left(\overline{L}\right)^{1-\gamma}$ with $\gamma \in (0,1)$ and N_h is the number of units of labor services used in the construction sector. A developer's optimization problem is:

$$max_{H_h} p_h(\Omega) I_h - \omega N_h \text{ s.t. } I_h = (\Theta N_h)^\gamma \left(\overline{L}\right)^{1-\gamma}, \quad (12)$$

[7] Since each rental unit is of size h_1, H will be a multiple of h_1.

giving rise to the following optimality condition, which uses $\omega = \Theta$:

$$I_h = [\gamma p_h(\Omega)]^{\frac{\gamma}{1-\gamma}} \overline{L}, \tag{13}$$

where $\frac{\gamma}{1-\gamma}$ is the elasticity of housing supply.

3.4 Equilibrium

Equilibrium on the housing market is obtained by equating the supply housing to the demand of housing on the purchase and rental markets.

They face a dynamic problem and discount future revenues at the risk free rate r_b. Optimization by rental firms implies that the equilibrium rental rate is equal to the user cost of housing for the rental firms, and that the service fee charged for management of properties not held directly is equal to the operations cost.

4 Analysis

We will use the model to conduct a series of experiments designed to assess the role of investors. To do so, we calibrate the model closely following Kaplan, Mitman, and Violante (2017), though there are two notable differences between the two models. First, there is no debt servicing requirement on mortgages, to be consistent with pre-crisis practice. Second, there is an explicit and separate speculative demand for housing. The differences in default and origination costs between owner occupied and investor mortgages will be calibrated to match the share of real estate investors prior to the surge of investment activity in 2004.

Amplification of Aggregate Shocks We allow for two types of exogenous shocks in the model: variation in aggregate labor productivity and variation in credit conditions, as captured by the collateral constraint. The first component of the analysis examines whether investor activity can amplify the response of housing values to aggregate shocks even without shocks to expectations to the value of housing. The potential for this response arises from two sources. First, since house sizes are restricted, aggregate shocks that induce a rise in current and perspective wealth will increase the demand for leveraged investment properties. Though these properties have a risky return, there is an option value associated to holding such properties, because mortgages have no recourse. Investor activity then amplifies the response of housing values to aggregate shocks and reduces the correlation between rental rates and house prices, since when there is an increase in demand for investment properties, there will be an increase in supply of rental units from individual investors which reduces the rental rate.

We will consider shocks to aggregate productivity and to the collateral constraints and assess their impact on the housing and mortgage markets. Following Kaplan, Mitman, and Violante (2017), we will also consider shocks to house price expectations. Additionally, we will consider experiments designed to evaluate the role of investors. In the model, there is an endogenous spread between the price of mortgages for owner occupied and investment properties, which depends both on the higher intermediation cost and the higher default probability associated to investment mortgages. One of the experiments that we will consider is to lower the origination cost associated with investment properties. This will reduce the spread between the two types of mortgages, and is equivalent to an increase in the supply of credit for investors. This experiment is meant to capture the decline in mortgage spreads for non conventional mortgages discussed in Justiniano, Primiceri, and Tambalotti (2017), which coincides with the rise in investor activity. The question is whether this increases both investor activity and housing values and generates a bigger increase in defaults and decline in house prices in response to a recession that in a version of the model where that spread is larger.

The second experiment is to introduce a debt servicing requirement. This can be modeled as a maximum payment to income (PTI) ratio limit: the minimum debt payment, $\pi min(m')$ must be less than a fraction π of income at the time of purchase:

$$\pi min(m') + d' \leq \lambda \pi y. \tag{14}$$

Such a requirement is noticeably absent, at least in explicit form, in the US mortgage markets, while it is explicitly incorporated mortgage approval criteria in other countries, such as Canada and the United Kingdom. It is also recommended in the 2010 Dodd-Frank Act. Since an increase in investor activity is associated with a decline in rental rates other things equal, income from investment properties will be low when demand for investment properties is high, which implies that certain investment mortgages will not satisfy this requirement. We will assess the degree to which a debt servicing requirement reduces the response of housing values to technology and credit supply shocks, thus moderating the destabilizing effects of investor activity.

Location Albanesi, DeGiorgi, and Nosal (2017) show that investors in areas with a high fraction of subprime borrowers exhibited much greater growth in mortgage balances during the housing boom and a particularly sharp increase in foreclosure rates during the crisis. They also show that the areas with high fraction of subprime borrowers are relatively young, urban and display high levels of income inequality. These areas also exhibited the sharpest fluctuations in housing values. A natural question is then whether such urban locations where particularly attractive from a housing market perspective and whether this lead to both an increase in investor activity and a more pronounced housing cycle.

There are several factors to suggest that urban areas may have become particularly attractive. The reduction in inner city crime during the late 1990s increased the appeal of urban living for higher income households, leading to gentrification, which could have contributed to a growth in housing values in cities (see Guerrieri, Hartley, and Hurst (2013)). Along these lines, Couture and Handbury (2017) show that cities experienced a higher concentration of young college graduates. Ferreira and Gyourko (2011) show that local income was the only potential demand shifter for the housing market in metropolitan areas and that it had an economically and statistically significant change around the time that local housing booms began. At the same time, the rise of the service sector and the growth in professional occupations have determined a greater concentration of employment opportunities in urban areas. Rossi-Hansberg et al. (2009) show that information technology allowed to separate production and management operations, leading to a concentration of management position in the city center. Liebersohn (2017) shows that the share of growing industries at the local level drives the size of housing demand shocks, the magnitude of the housing price increase and household consumption variation between 2000-2006. Technological change leading to job polarization (see Acemoglu and Autor (2011)) also contributes to the growth of inequality as wages stagnate for occupations that were previously in the middle of the income distribution. Eeckhout, Hedtrich, and Pinheiro (2017) argue that this process is accelerated in urban areas, since the high costs of living induce firms to replace clerical and other routine workers with automated technologies. This suggests that both job polarization and income inequality should be greater than in urban areas. These factors, in conjunction to low housing supply elasticity, may have contributed to the rise of *superstar cities*, as argued in Gyourko, Mayer, and Sinai (2013), that display a concentration of high income households and very high housing values.

Based on this evidence, we will explore the role of location for investor activity and the evolution of the housing and mortgage markets. To examine this question, we will extend the model so that there are two separate locations, urban and non-urban. For simplicity, we will initially assume that households cannot move across locations, so that the comparison of these two locations can also be interpreted as a comparative statics exercise.[8] Locations differ along several dimensions. First, the urban location will have higher average labor productivity and higher income dispersion, leading to greater inequality. This feature will be captured by the labor income process. Second, the urban location will have a higher share of young households. Third, the urban location will have lower housing supply elasticity. This is based on evidence in Saiz (2010) showing that housing supply elasticities in urban areas are typically lower than in non-urban areas, due to both geographical constraints and zoning restrictions. To assess the the role of investor activities in different locations, we will explore the equilibrium response to both a technology shock and a credit supply shock. These experiments have a potential to shed light on the determinants of the spacial distribution of investors and account for the geographical variation house prices.

Implications for Policy We will also use the quantitative analysis to derive insights into policies that might prevent or resolve episodes such as the mortgage crisis of 2007-2009. Given the misplaced emphasis on subprime borrowers as the main cause of the crisis, the main policy response was simply to raise credit score thresholds for mortgage applications, a response shared by both private and public mortgage lenders, such as the Federal housing Administration. Real estate investors were overlooked, even if they accounted for most of the rise in defaults during the 2007-2009 crisis. One justification for this response may lie in the fact that the higher default risk associated with investor mortgages is not captured in current credit scoring models. To the contrary, additional first mortgages on a borrower's credit file would typically increase their credit score. This distorts the allocation of credit, and has implications that go well beyond the consumer debt market, since credit scores are used in a variety of settings as a signal of reliability and even character. Currently, there is no mechanism to assess the ability of the widely used credit scoring models. Our quantitative model can be used to examine the variation of idiosyncratic risk associated with investor activity. In conjunction with the Experian credit panel data that allows tracking of the joint evolution of credit scores and investor activity, the analysis can provide important evidence into the limitations of current scoring models and lead into insights that may encourage policy makers to consider mechanisms for greater accountability and transparency for these models.

[8] Couture and Handbury (2017) explore a model of locational choice. Parro, Rossi-Hansberg, and Sarte (2017) explore a model with mobility of labor and production structures in which the effects on income of increases in local productivity depends on spacial factors, such as land use elasticity.

5 Conclusion

This paper makes several contributions to our understanding of housing and mortgage markets by examining the role of real estate investors. This class of borrowers has been overlooked, because they are hard to identify in the data and because it is difficult to incorporate real estate investment in equilibrium models of the housing market. This extensive study of investor activity can provide a basis to design policies that reduce the destabilizing effect of investors on the housing market.

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