Frictional rental markets and age inequality

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Abstract

I document a set of facts about the heterogeneity of paid rents. First, young people tend to pay higher rents and move more, and such effects are stronger in denser and less housing-elastic cities. Second, people who have recently moved, both from outside and within the city, pay more. These effects are heterogeneous across space and stronger in bigger, denser cities. I propose a simple model of directed search in the rental market that can rationalize these facts, and suggest an increase in housing supply could be disproportionately beneficial for young people.

1 Introduction

Housing is the most important component of most families' financial decisions, and it is a vital subject of study for economists. Housing costs are a key political issue and are often at the center of policy debates. While the role of mortgages and homebuying in macroeconomic fluctuations has been amply studied[1], the rental market is also extremely big (44 milion households in the US rent), and it is renters who are often the most burdened by housing cost[2]. In a context in which rent is the main expense for many, and rents seem to be growing everywhere[3], investigating the dispersion in rents at the individual level is very valuable. Who pays higher rent? Is rent dispersion explained by location, size, or individual characteristics? Is there a role for policy? And how does all of this interact with geography, which is such an important determinant of housing costs[4]?

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[1]See the influential research by Mian and Sufi (2009), for example.

[2]See the CENSUS article at https://www.census.gov/library/stories/2022/12/housing-costs-burden.html

[3]Some evidence and a simple model for this is in Howard and Liebersohn (2021).

[4]On the spatial dispersion of housing prices and rents, see among many Gyourko et al. (2013), or more recently, Chodorow-Reich et al. (2023).

This paper tries to answer these questions by offering two contributions. First, I document that there is a significant degree of rent dispersion across two dimensions. The highest-paying renters are young people and people who recently moved from out of town. I connect these findings to a broader discussion of rental markets across geography. Second, I rationalize such facts in a simple model of directed search in rental markets.

Specifically, in the empirical part of the paper, I use ACS data to analyze rent dispersion across individuals using rich individual controls, which include location up to the county level, income, household size, occupational status, sex, and other controls. I report that young people pay higher rents even before controlling for the size of the house and other characteristics. I then add controls for the migration status of agents. This shows that people who have recently moved pay higher rents, and this premium is increasing if people move from farther away. These two facts constitute the core of my results. I then document a set of interesting ancillary facts which, while they do not directly go into my model, help understand the spatial dynamics of the phenomenon. First, the rent premium is decreasing in housing supply elasticity across cities: young people's penalty with respect to the older ones is higher when they live in more inelastic cities. Second, young people move around more, changing houses locally. Third, the rent premium is higher in cities where people move around more, and this effect is driven mostly by young people. These last facts, are supportive of a model with search frictions where young agents relocate to pay lower rents.

In the second part of the paper, I develop a simple model of directed search. The mechanism is the same as in Delacroix and Shi (2006): there are no quality differences in houses, but rent dispersion can be generated even only by allowing agents to search 'on-the-house'. In a simple framework with fixed rent contracts, agents search for a low rent. Some agents sort to expensive markets, where they pay high rents in exchange for fast matching. Others will go to cheap markets, where finding landlords is hard. In equilibrium, agents will move through such markets sequentially: high rent payers will look for marginally lower rents, sacrificing big gains in order to match quickly. On the other end, low-rent payers will only look in the handful of markets where the cost is even lower than what they're already paying. Landlords are indifferent as they make equal expected profits in all active markets, exchanging high rents with low matching probabilities. In such a framework, tenure and rent are going to be strongly correlated, even with no heterogeneity in income, quality of the house or of the match, or other individual characteristics. I then exploit the model to perform a simple comparative statics exercise: I compare the baseline economy with an economy with 20% more housing. As a result of the increase in supply, not only the overall rent level goes down, but also the rent-tenure premium is decreased. While this illustration is clearly limited in scope, it illustrates the potential for rental policies to have distributional effects.

While my model is of a single location, I claim this framework is helpful in thinking about space. A lot of the recent literature focused on the role that geography and space play in economic choices has underlined how housing affordability is key. Cities are attractive to young and skilled people and enable the diffusion of knowledge and technology, and housing cost can be the main determinant in who and how reaps the benefits of agglomeration. A lot of these contributions discuss the potential returns to housing policy[5]. However, questions remain open on both the determinants of house prices and rents and their dispersion and how these interact with location choices.
The paper aims to contribute to different strands of literature. First, the literature on search in housing markets. The modeling of housing markets with search tools has a long history starting from Wheaton (1990). One of the first papers to introduce some spatial features is Head and Lloyd-Ellis (2012), which focuses on the idea that owning could potentially reduce moving and increase local unemployment. In their paper, however, there are no heterogeneous features of agents, who became owners stochastically and prefer to do so, and also no agglomeration force. In general, their paper aims more at talking about the employment differentials in space rather than the housing market variables. Halket and Pignatti Morano di Custoza (2015) incorporate the idea that expected duration in a house can be heterogeneous, and studies equilibria and liquidity frictions of such framework. They find, indeed, that long-duration households pay lower rents. In their paper, however, tenure choice plays a limited role, and there are no spatial features or life cycle components. A more recent interesting paper is Head et al. (2023), which develops a model with frictional assignment and tenure choice where sorting over the quality distribution is endogenous. Agents are homogeneous in their utility from housing but heterogeneous in income, and the equilibrium produces an interesting distribution over submarkets which is then calibrated to match some cross-sectional features of the U.S. economy. The importance of search frictions for the cross-sectional dynamics of housing has been recently outlined, for example, in Piazzesi et al. (2020), who show how it's important to account for cross-sectional search strategies to make sense of inventory and house price data in the Bay Area. Their paper is focused more on buying markets and the cross-sectional effects of dynamic location choices. This paper focuses on using 'on the job' search and on rental markets. In terms of tools, my paper borrows from the directed search literature, see e.g. Moen (1997), Menzio and Shi (2011), and in particular from models with on-the-job search: the construction here mimics very closely Delacroix and Shi (2006). The core intuition in that paper - a job ladder that can come out even with perfect homogeneity of agents - is central here too. See Wright et al. (2021) for a complete review of directed search models.

[5] For example Lhuillier (2024).

Second, the paper is related to the literature on the cross-sectional dispersion of house prices and rents. In Gyourko et al. (2013), an increase in income inequality coupled with an inelastic land supply causes prices to increase more in 'superstar' locations. In Van Nieuweburgh and Weill (2010), a similar mechanism goes through productivity differentials. My paper suggests that rents in big cities could be affected by a demand channel related to the combination of location choices and search frictions. Recent literature has focused on the effects of housing supply and related restrictions on price levels and price dispersion, see Baum-Snow (2023) for a review. Howard and Liebersohn (2021) argue that the national increase in rents can be motivated by an increased desire to live in big cities in a spatial equilibrium with high population elasticity. My paper, while currently focused on cross-sectional aspects, would lend itself to explaining how much sorting patterns by age could have exacerbated the above phenomena, coupled with search frictions.
Third, the paper borrows from the literature on agglomeration and sorting, with a particular focus on the life cycle. The idea that young people sort into big cities to accumulate human capital is in Glaeser (1999) and later in Davis and Dingel (2019). Martellini (2022) explains patterns of urban wage divergence using a model with sorting and increasing returns to scale in the matching function in labor markets. I am particularly interested in the interaction of these channels with age. Recently, Crews (2024) rationalizes similar patterns into a dynamic model with human capital accumulation. This paper aims to use similar setups to study the interaction of location choices over the life cycle with housing markets. Lhuillier (2024) studies learning complementarities in a setting with sorting in cities and age. In his paper, similarly to the above, young people benefit from being in the right place at the right time in terms of their human capital when they're old. He puts emphasis on complementarities and shows how skilled people learn a lot from skilled people, with potential spillover effects. All papers in this strand of the literature end up naturally being drawn to one fundamental question: how much do housing constraints limit these benefits? What are the potential results of relaxing some constraints and driving down the price of housing? These questions are very relevant to the present paper.

The paper proceeds as follows. In section 2, I document some facts about paid rents across age ranges, tenure status, and space. In section 3, I develop a stylized search model with directed and 'on-the-house' search to rationalize some facts. In section 4, I comment on the solution of the model and perform some simple comparative statics. I then draw a plan for future developments and conclude.

2 Empirics

I use data from the American Community Survey 1-year sample to document some facts about rents, age, and cities [6]. The data is from 2005 to 2022. The geographical level of detail is the county or the Public Use Microdata Area (PUMA). The dataset includes various measures of income both at individual and household level, data on migration status, paid rent, number of bedrooms and other house amenities, location, and various other demographic controls. In all the analysis, I restrict myself to renters over age 18.
As explained, I am interested in studying how age and tenure in the city can affect paid rents. To do so, my main specification is

$$log(rent_{it}) = \beta_0 + \beta_1 agegroup_{it} + \beta_2 mig_{it} + \gamma_t + \delta_{j(i)} + \beta_x x_{it} + \varepsilon_{it}$$

where *agegroup* is a categorical variable that identifies age groups for agents, γ is year fixed effects, *mig* is a variable that identifies where the person lived one year ago, $\delta_{j(i)}$ is county fixed effects where $j(i)$ identifies the county of residence of agent i, and x is a vector of controls which includes income, occupational status, sex, number of household members, and the number of rooms in the house.

2.1 Fact 1: young people pay higher rents

Results from the regression are shown in Table 1. The first column shows the results without controlling for migration status and house size. The main finding is that age is negatively correlated with paid rent. For example, the table shows how 30-to-40-year-olds pay, on average, approximately 1.7% less in rent than people under 30 after the individual controls. This effect gets stronger for people aged 40 to 50, who pay almost 4% less rent. For older age groups, the effect gets smaller, but they still pay lower rents than the youngest people. It is important to underscore that the first specification controls for individual characteristics (household income, occupation, sex, location, etc..) but not for characteristics of the house. Even before taking into account the differences in the size of units, older people are systematically paying a lower total rent. While selection effects will be playing in the background, this suggests some support for the idea that older people have, indeed, optimized their shelter costs.
The second column contains controls for the size of the house[7] and some additional controls related to the house appliances [8], and it is interesting to see that the difference gets stronger

[6] The data was downloaded using IPUMS, see Ruggles et al. (2024).

[7] Square footage is not included in the dataset, so this is actually the number of rooms.

[8] These are not very detailed. They just show if the house has a stove, a kitchen, and a sink.

for the younger income groups while it actually gets slightly smaller for people over 50. Overall, the first two columns support the idea that young people pay higher rents, and this notion seems to hold independently from controls for house size.

A reasonable worry could be that quality should be measured by more than just size: a luxury studio might be significantly more desirable than a two-bedroom in a very old building with no amenities. There is not enough information in the ACS data to thoroughly analyze this, but elements in our specification can help mitigate these concerns. First, in many cases, it's reasonable to think that having available controls for detailed amenities and the specific location would make the results stronger. Indeed, in line with the size controls, if 20-somethings are already paying a rent premium *before* controlling for the quality of the building or the location, it's very likely that they are also probably living in lower quality real estate, in cheaper neighborhoods. This defense might be invalid in some cases: a young professional could prefer living in a very small house but in a popular location with many amenities, which ends up being very expensive. However, the availability of rich individual-level controls is helpful in alleviating such concerns, helping us compare such rich, young professionals with similarly rich, less young people [9].

2.2 Fact 2: people that moved recently pay higher rents

Columns 3 and 4 of Table 1 show the results of the same regression adding controls for a migration variable that indicates where people in the sample were living a year before. Column (3) reports results with no size controls, while Column (4) includes them. There are three interesting things to be noted here. First, paid rent is increasing in distance. People pay more if they lived farther away one year ago (with the exception of people who lived abroad, who are however a probably selected group). This is compatible with a story of access to information: in my model, agents will have to move to the city, paying an initially high rent, to start looking for a place and optimizing their expenditure. Second, the average rent movers pay is always higher than the one stayers pay. This is consistent with standard labor search models where tenure is positively correlated with wage. Here, tenure is negatively correlated with rents. This is compatible with a directed search model in which, on average, people who stay in their current contract are people who are happy with it and so, in expectation, pay a lower rent.

Third, adding the migration variable reduces the magnitude of the age coefficients, even rendering some insignificant. The effect of being 30-to-40, compared to being Under 30, is statistically zero. In the specification with size controls, being 40-to-50 implies paying

[9] It's very important to underline then that the analysis controls for the size of the household, accounting for the potential effect of kids and family decisions in explaining the difference between cohorts.

	(1)	(2)	(3)	(4)
	Log(rent)	Log(rent)	Log(rent)	Log(rent)
Age (base=18 to 30)				
30 to 40	-0.0177***	-0.0152***	-0.00449	-0.00263
	(-6.39)	(-5.05)	(-1.61)	(-0.87)
40 to 50	-0.0380***	-0.0373***	-0.0193***	-0.0188***
	(-11.91)	(-10.88)	(-6.01)	(-5.47)
50 to 60	-0.101***	-0.0855***	-0.0792***	-0.0622***
	(-28.27)	(-22.67)	(-21.99)	(-16.35)
60 to 70	-0.169***	-0.138***	-0.145***	-0.111***
	(-37.84)	(-29.76)	(-32.27)	(-23.68)
Older than 70	-0.134***	-0.0882***	-0.108***	-0.0561***
	(-22.39)	(-13.80)	(-17.94)	(-8.74)
Migration Status (base= Same house 1 year ago)				
Different house, moved within state, within PUMA			0.0894***	0.0921***
			(30.87)	(29.93)
Different house, moved within state, between PUMAs			0.129***	0.135***
			(27.90)	(27.59)
Moved between contigious states			0.152***	0.173***
			(17.13)	(18.49)
Moved between non-contiguous states			0.190***	0.199***
			(36.02)	(35.26)
Abroad one year ago			0.173***	0.203***
			(18.37)	(20.04)
Constant	2.397***	2.133***	2.312***	2.065***
	(110.57)	(20.52)	(106.40)	(19.91)
Observations	353699	303906	353699	303906
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Size	No	Yes	No	Yes

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 1: Regression of Rent on age groups, migration status and controls. All regressions control for county and year FE, income, density of MSA of residence, sex, marital status, household size

approximately 2% less in rent than being Under 30, compared to an effect of more than 8% in the specification with no migration status (in column (2)). This points to two facts. First, it implies that a lot of the 'age gradient' is actually a 'tenure gradient', consistent with a story of search frictions and information. However, the fact that most coefficients still remain negative and significant signals that there is an effect related to age that is not explained by tenure in the city itself.
To summarize, there is evidence of heterogeneity in paid rents based on age and distance from the current residence in the recent past. These two facts are broadly consistent with a model with directed search and a rental ladder. Facts 1 and 2 are the main findings of my analysis and support the base construction of the model. I now present additional facts that help frame the question in the context of the space and housing literature.

2.3 Fact 3: the rent premium is decreasing in housing supply elasticity

Next, I analyze the effect of housing supply elasticity in different cities. To do so, I employ the popular measure from Saiz (2010) as an instrument. The specification is then

$$log(rent_{it}) = \beta_0 + \beta_1 age_{it} + \beta_2 mig_{it} + \beta_3 elasticity_{k(i)} + \beta_4 age_{it} * elasticity_{k(i)} + \gamma_t + \delta_{j(i)} + \beta_x x_{it} + \varepsilon_{it}$$

where all variables are as above and $elasticity_{k(i)}$ indicates the Saiz elasticity of city $k(i)$, where $k(i)$ is the MSA of residence of agent i, and $\delta_{j(i)}$ are county fixed effects, with $j(i)$ being the county of residence of agent i[10]. Results are in Table 2.

The first column shows the base effects as in Table 1, for comparison. The second table adds the Saiz elasticity but with no interactions. The negative sign here indicates that the average rent in more elastic cities is lower, a fairly non-controversial result confirming base intuitions about housing supply (see, for example, Baum-Snow (2023)). As we can see, the coefficients on the migration variable are not significantly affected. Finally, column (3) adds the interaction as in equation 2.3. The interaction coefficient is positive, indicating that, in more elastic cities, the age-rent-gradient is less strong. This points to a potentially important connection between housing supply and tenure effects on rents. Almost mechanically, more inelastic cities are also the bigger, denser, richer ones, and these are exactly the locations that have a younger population more inclined to rent. This suggests it would be very valuable to understand if and how much information and search frictions might be exacerbating the housing affordability issues in locations where housing is more scarce. My model will then

[10] The Saiz elasticity is available at the MSA level.

	(1)	(2)	(3)
	Log(rent)	Log(rent)	Log(rent)
Age	-0.002***	-0.002***	-0.004***
	(0.000)	(0.000)	(0.000)
Migration status (base= Same house 1 year ago)			
Different house, moved within state, within PUMA	0.088***	0.089***	0.090***
	(0.003)	(0.003)	(0.003)
Different house, moved within state, between PUMAs	0.141***	0.143***	0.145***
	(0.005)	(0.005)	(0.005)
Moved between contigious states	0.184***	0.187***	0.188***
	(0.010)	(0.010)	(0.010)
Moved between non-contiguous states	0.218***	0.211***	0.211***
	(0.006)	(0.006)	(0.006)
Abroad one year ago	0.194***	0.190***	0.189***
	(0.012)	(0.012)	(0.012)
Saiz elasticity		-0.083***	-0.126***
		(0.002)	(0.005)
Age × Saiz elasticity			0.001***
			(0.000)
Constant	2.870***	3.471***	3.527***
	(0.116)	(0.119)	(0.120)
Observations	275607	263397	263397

Standard errors in parentheses
Robust standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Regression Results with Elasticity. All regressions control for county and year FE, income, density of MSA of residence, sex, marital status, household size

be appropriate to begin such a discussion and potentially get a better understanding of the scope for housing policy.

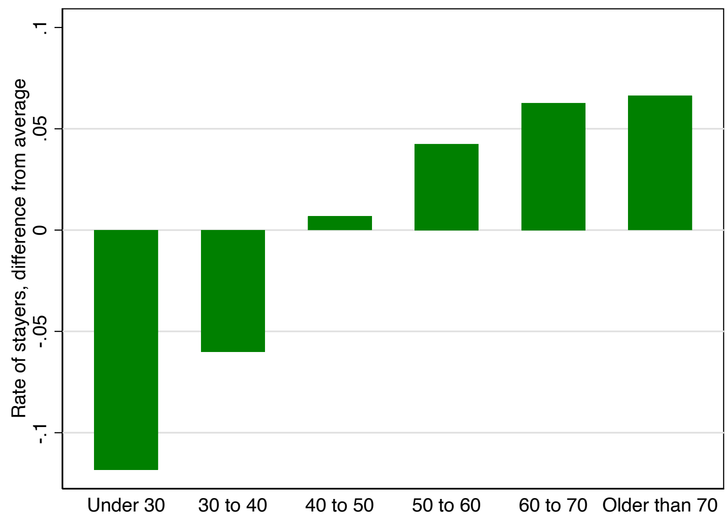


Figure 1: Percentage of individuals that live in a different house than one year ago, by group, difference from average of population (0.84).

2.4 Fact 4: Young people move around more

As suggested, the evidence above can point us in the direction of exploring information and search frictions. This means that there is a potential to find better deals and value in moving to them. It's then interesting to investigate how different age groups move. To do so, Figure 1 reports the rate of 'stayers' by age group, that is the percentage of people in that age group that answer 'Same house' to the question: 'Where did you live one year ago?'. The population mean is 0.84. This shows how younger people tend to stay in the same place less. Around 74 % of people under 30 live in the same house as one year ago, compared to almost 90 % of people aged 60 to 70.

At the current level of analysis, this can be both a cause and an effect. If, as in the model below, there are search frictions, then two things happen: younger agents will move more because they are up on the rent ladder and desire to go down. On the other hand, older agents, as seen in Table 1, are already getting better deals and need to move less. Another possible analysis is that young people are more mobile 'by nature,' being more inclined to change living settings, upstart their life, change city, and so on. This could also potentially be a source of heterogeneity in rents independently from the mechanism in my model[11].

[11]This is the main point of Halket and Pignatti Morano di Custoza (2015): some agents have different expected duration of stay than others. The ones that expect to stay longer are going to pay lower rents in equilibrium in a model with adverse selection and search frictions in the style of Guerrieri et al. (2010). This could potentially be embedded in the present model, but it's not in the current version. It would be an extra channel exacerbating the results.

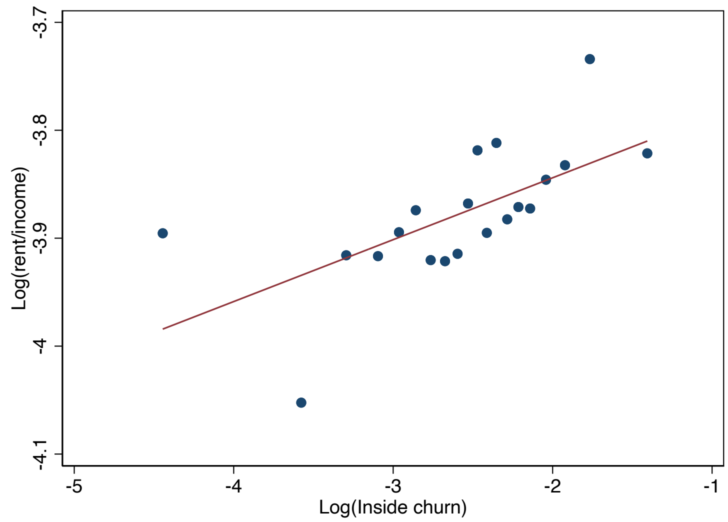


Figure 2: Rent to income and inside churn across US cities. Each dot is a cluster of US MSAs.

2.5 Fact 5: Inside churn and cities

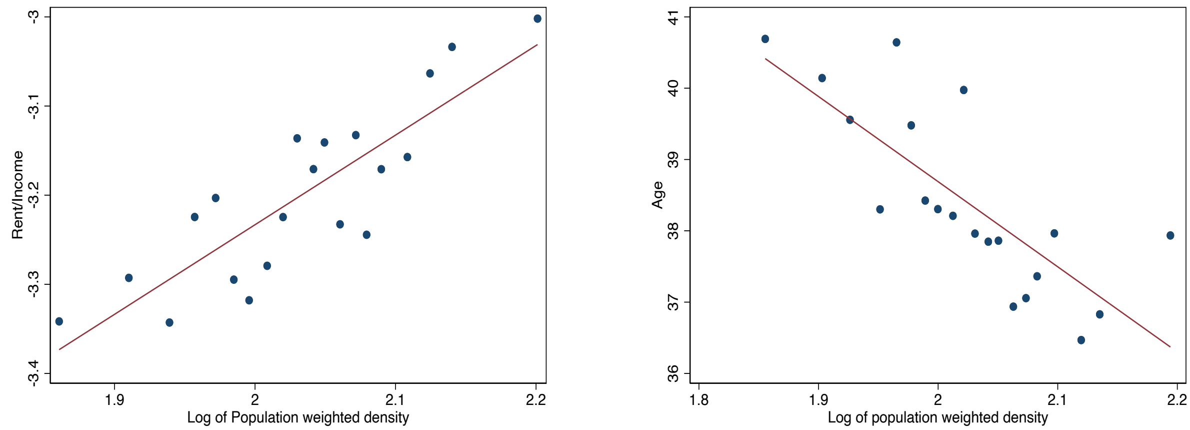
I now document some facts that about relocation comparing cities. To do, I consider a measure of 'Inside churn', which I define as the amount of people that relocated in a small geographical area over the population of that area [12]. Cities with a higher 'moved inside' rate are hence, approximately, cities that have a higher turnover of people changing houses at short range. First, Figure 2 shows the relationship between Rent to income ratio and inside churn at the MSA level with a binscatter. The relationship is clearly positive, indicating that high inside churn is correlated with higher rents. As discussed for Fact 4, this is also potentially both an equilibrium consequence of rents being high (people move more to look for better deals) and a characterization of some cities.

Finally, Table 3 shows a regression of rent to income on the inside churn rates, by age. The only significant coefficient is the one for the Under 30, which is positive. This shows how most of the effect in the previous picture is actually driven by the inside moves of young people. Again, this is consistent with the idea that there are search frictions in the housing market, which cause young people to hop around in search of good deals.

While Facts 1 and 2 are the core fundamentals of the paper, the other facts also help build the case for the story of this paper. Big cities are young, and rent is more expensive there. Young people move around a lot, paying higher rent and hopping to better opportunities.

[12] I use PUMAs, the smallest unit available to me. I define for an MSA i

$$(\text{Inside churn})_i = \frac{\text{Number of people that changed house but stayed in the same PUMA, in i}}{\text{Population in i}}$$



(a) Rent to Income and density, US MSAs

(b) Average age and density, US MSAs

Figure 3

The interaction of these forces opens the door to some fundamental questions. How much are these higher rents limiting young people's access to the best places? And how much of the rush of young people to these locations affects rent, especially when interacting with search frictions and the housing market microstructure? The stylized model in the next section begins to build a framework to answer this.

2.6 Fact 6: rent to incomes and age across cities

Finally, underlining some spatial patterns of rental dispersion is important for the scope of this paper. Figure 3(a) depicts the relationship between population-weighted densities and rent-to-income ratios in U.S. MSAs for the period 2005-2022, pooled. It shows clearly that rent affordability, measured as the fraction of income devoted to rent, is negatively correlated with density. Some places, the denser, more populated ones, tend to have higher rent to incomes. Figure 3(b), on the other hand, shows at a glance how these bigger, denser cities are also generally young, displaying how average age is negatively correlated with density. These facts are important for my inquiries. On the one hand, big cities are attractive, especially to young people, as outlined recently (Crews (2024)). On the other hand, young people willing to access these cities, likely through rental markets, are going to face a high burden in the cost of shelter. This paper touches on this issue from both directions.

First - in the spirit of the literature such as in Hsieh and Moretti (2019) - how much does the presence of high rents affect the decisions and opportunities of people, especially young, to locate in big cities? Second, how much does the fact that young people are more inclined to sort to these places - to reap the gains from agglomeration externalities and increase their

	(1)
	Log(Rent/Income)
Inside churn, U30	0.121**
	(0.044)
Inside churn, 30-40	0.0908
	(0.060)
Inside churn, 40-50	-0.0945
	(0.079)
Inside churn, 50-60	-0.0138
	(0.096)
Inside churn, 60-70	-0.130
	(0.091)
Inside churn, O70	0.0893
	(0.115)
Log(density)	0.552***
	(0.067)
Constant	-5.026***
	(0.139)
Observations	4570

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Rent to income and inside moves rates, by age

human capital- affect rent affordability? I aim to tackle these broad questions by focusing on the market microstructure of housing and, in particular, the presence of search frictions in rental markets.

3 Model

Motivated by the above facts, I develop a stylized model of directed search to rationalize them. The model is an application to the rental markets of Delacroix and Shi (2006)[13]. As shown in the empirical part, young people and newcomers pay higher rents, and tenure in the city explains part of the age variation. This is consistent with a model of a 'rent ladder'. In a model with search frictions and directed search, agents will sort themselves: some will look

[13]See also Wright et al. (2021) for a simplified treatment.

in cheap markets and will have a hard time matching. Some will go to expensive markets and match quickly. As they give priority to faster matching when they are paying a lot, agent climb the ladder progressively. Hence, people who have been around more pay, on average, lower rents, as in the data. This generates age inequality even with no contractual discrimination or any sort of heterogeneity or quality sorting.

3.1 Environment

There is a single city characterized by an income y. There is a continuum of agents born in the periphery who enter the city at rate δ. We also assume agents in the city die at rate δ so that the population of the city is constant over time and measure one[14].

When they first enter, agents have to go live in a very expensive location [15]. This place has fixed rent $\overline{r}$, and is available to everybody with no frictions. After that, agents can search in frictional rental markets to pay lower rent[16]. There is a mass H of homeowners who own houses of identical quality.

Search is directed: owners pay χ every period to advertise a contract that specifies a certain rent, and renters can choose which submarket to look at and 'apply' to. A submarket is then characterized by a rent r and a tightness $\theta(a, v) = \frac{a}{v}$ where a is the number of applicants and v the number of owners posting that specific rent. A prospective tenant that looks into submarket r will then match with probability $p(\theta_r)$, and a landlord will match with probability $q(\theta_r)$. I argue this is a realistic representation of the rental market: most prospective tenants research their place on online platforms using filters of various kinds (in our case just price), and usually have to compete with other prospective tenants when they decide their preferred one. the probability $p(.)$ in the model, which is essentially a function of the 'queue length', is going to be proportional to how much a place is desirable, in the same way in which some very attractive units get crowded open houses and many applications.

The timing of events is as follows: at the beginning of the period, housed people enjoy a flow value h from living in a house. At the same time, landlords decide which rent to post. At the end of the period, meetings happen, some people leave the city and some become housed in a different house, and the period ends.

[14]In the background, one can think there is a rest of the world where agents solve an entry problem. Extending the model to have multiple locations and a location decision would be a natural next step. One can think of the present model as one of a representative city.

[15]Such as a hotel. Or alternatively, agents have to live in the streets and get a very high disutility from it.

[16]Ideally, they could search in quality space, as in Head et al. (2023), who don't have a 'ladder' concept as they do not allow for search 'on-the-house'.

3.2 Values

The value function of living in the expensive entry location is

$$U = y + h - \overline{r} + \beta(1-\delta)\max_{r}\left(p(\theta_r)W(r) + (1-p(\theta_r))U\right)$$

$W(r)$ is the value of renting a house at rent r, which is

$$W(r) = y + h - r + \beta(1-\delta)\max_{r'}\Big(p(\theta_r')W(r') + (1-p(\theta(r'))W(r)\Big)$$

Define $H(r)$ the value of having a vacant house posted at price r. Let $\overline{H}_v = \max_r H(r)$. Then we can write

$$H(r) = \beta\left(-\chi + q(\theta(r))J(r) + (1-q(\theta(r))\overline{H}_v\right) \tag{1}$$

where $J(r)$ is the value of renting at rate r, that is

$$J(r) = r + \beta((1-\delta)(1-\rho(r))J(r) + (\delta + \rho(r) - \delta\rho(r))\overline{H}_v$$

in the model, then, the rate of departure from the city is constant, and there is no endogenous separation. ρ is the probability that a landlord renting at r loses their tenant because they move to a different place: $\rho(r) = p(\theta(r^*(r)))$, where $r^*(r)$ is the optimal search behavior of an agent who is currently paying r.

3.3 Definition of equilibrium

Define $R^* = \{r \in \mathbb{R} : v(r) > 0\}$. An equilibrium is $U, W, H, \overline{H}_v, J, R^*$, measures $\mu_u, \mu_{e(r)}, \theta(r)$ and a polict function $r^*(r)$ such that:

- Unhoused agents maximize utility:

$$\begin{gathered} U^* = y - \overline{r} + \beta(1-\delta)\max_{r\in R^*}\left(p(\theta_r)W(r) + (1-p(\theta_r))U\right) \geq \\ y - \overline{r} + \beta(1-\delta)\max_{r}\left(p(\theta_r)W(r) + (1-p(\theta_r))U\right) \end{gathered}$$

  $\forall r$, with equality if $r \in R^*$

- Current tenants maximize utility:

$$\begin{aligned} W^*(r) =& y + h - r + \beta(1-\delta)\max_{r' \in R^*}\Big(p(\theta_r^{'})V(r') + (1 - p(\theta(r))W(r)\Big) + \beta\delta U \geq \\ & y + h - r + \beta(1-\delta)\max_{r' \in R}\Big(p(\theta_r^{'})V(r') + (1 - p(\theta(r))W(r)\Big) + \beta\delta U \end{aligned}$$

- Landlords maximize utility and profits are equalized :

$$\overline{H}_v \geq q(\theta(r))J(r) - \chi$$

$\forall r$, with equality if $r \in R^*$

- Markets clear:

$$\mu_u\left(\frac{1}{\theta(\hat{r}(\overline{r}))}\right) + \int_{r \in v(r)} \mu_{e(r)}\left(\frac{1}{(\theta(\hat{r}(r))} + 1\right) = H$$

3.4 Characterization

3.4.1 Existence and uniqueness

The model is a significantly simplified version of Menzio and Shi (2010), basically identical to Delacroix and Shi (2006) with no search cost from the agents. As such, it will have the same properties.

Proposition 1: Existence. There exists a block recursive equilibrium of the model.

Proof: see Theorem 6.7 in Menzio and Shi (2011)[17] The equilibrium with fixed rent contracts will not be efficient, as explained, for example, in Wright et al. (2021). Efficiency could be restored by contracts with duration-of-stay discounts.

4 Quantitative results

To characterize the model more precisely, I solve it using a fixed point algorithm[18]. I then proceed to simulate the steady state economy for many agents and look at the rent distribu-

[17] I need to complete my work by making sure everything goes through and the proofs apply, also considering the contractual environment is different. I also need to understand conditions for uniqueness and work on the parametric restrictions for existence as in Delacroix and Shi (2006).

[18] It is straightforward to show that the agent's value function is a contraction, see again, for example, Menzio and Shi (2010). We can then iterate on it using the free entry condition to pin down the profits of the firm and the tightnesses.

tion across tenure status. It's important to remark that, compared to the empirical analysis, my model does not differentiate between age and tenure.

4.1 Calibration

At the current stage, I calibrate externally all parameters. While I attempted to calibrate the matching function parameters to reproduce the empirical evidence reported, the model has issues matching quantitatively the values. I then decided to report the number for fairly standard parameters and offer some reflections on what I think is missing; see the discussion below. The matching function is assumed to be $M(u, v) = Au^{\alpha}v^{1-\alpha}$. For now, α is set to 0.5 and A to 0.2, as in many search models. H is a pure normalization, so it's set to 1 in

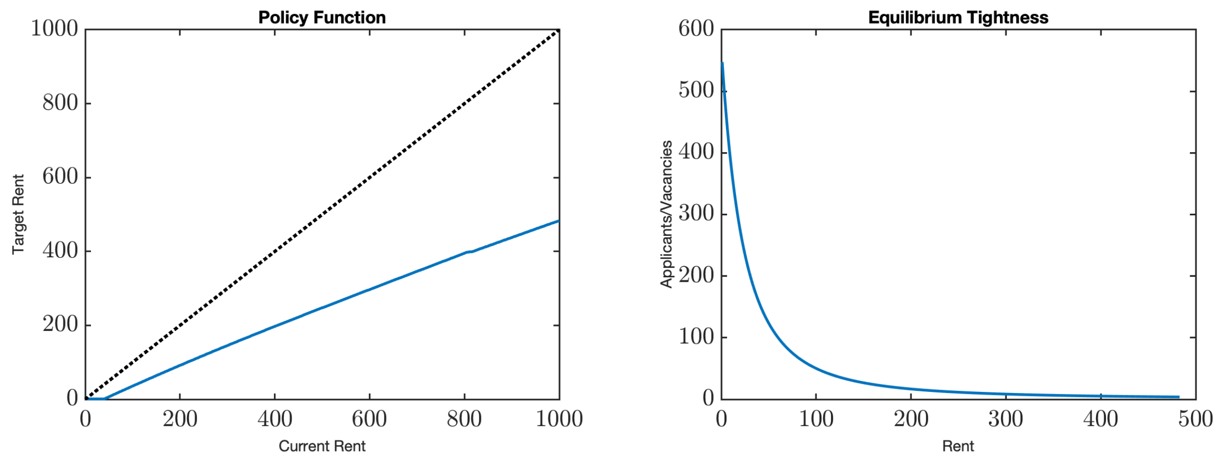
Parameter	**Value**
α	0.5
A	0.2
H	1
h	1
y	0
δ	0.15
β	0.97
$\overline{r}$	1000

Table 4: Calibrated paramters

the baseline model. Similarly for h and y. These values would only matter when the spatial comparisons are more meaningful. δ is set to 0.15 to replicate the rate of people that live in the city every period. $\overline{r}$ is also just a normalization but is, for now, set to 1000. A summary of the calibration is offered in Table 4.

4.2 Results

Figure 4 shows the policy function and the equilibrium market tightness. The nature of this is familiar from the literature, but it's worth commenting on the implications here. The policy is linear and increasing in the current rent. This implies that, upon entering the economy, all agents that live in the expensive housing and pay $\overline{r}$ will apply to the same target market, which in the model is around 400. From there on, agents keep applying to lower rents. The equilibrium is sustained by the tightness function in Figure 4 (b). The tightness function is decreasing, which corresponds to the matching probabilities displayed in Figure 5, and rationalizes the shape of the equilibrium. Agents that pay a high rent give



(a) Model tightness

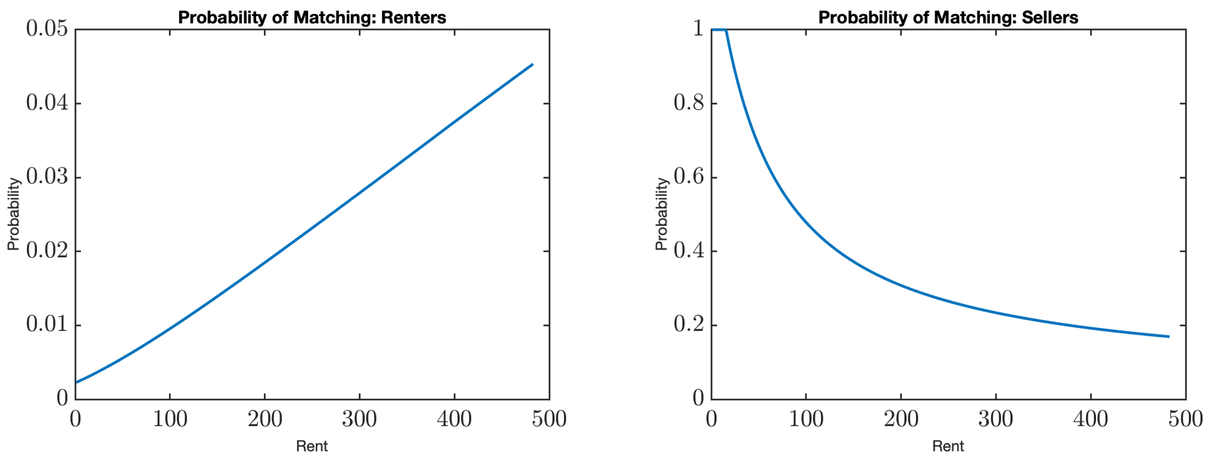
(b) Equilibrium tightness

Figure 4

a preference to decreasing it, and apply to a relatively expensive market. In exchange, they are compensated with a relatively high probability of matching. Agents that are already paying lower rents still try to decrease them, accepting low probabilities of matching. The reverse goes for landlords, who are indifferent in every active market. Some landlords post their houses at high prices: when matched, they get a high flow utility, but at two costs. First, it's harder for them to match in those markets (recall that $\theta = \frac{a}{v}$, which means a low θ implies it's hard to match for sellers). Second, upon matching it is more likely that their renters leave. This is because the policy function and the tightness function are monotonic: the agent that is paying the second more expensive rent is also applying to the second easiest market to match in, and so on. In equilibrium, then, landlords will make the same profits in every active market, balancing the two forces of high rent and low probability of matching. Note that these profits will be positive, contrary to other similar models such as Delacroix and Shi (2006). This is because housing is in fixed supply here, implying that the value of a house is $\overline{H}_v > 0$. This assumption here is meant to reproduce the role of the housing stock in these dynamics and to allow for counterfactuals between cities. A more realistic model would, of course, incorporate a construction margin.

To illustrate how the dynamics of the model relate to the evidence, figure 6 depicts the simulation of the life of one agent. Upon moving to the city, an agent pays the highest possible rent $\overline{r}$. After that, she progressively climbs the rent ladder, spending periods in different markets and applying to lower rents, until they reach the lowest possible, and at some period relocate outside the city.

To see how an economy with these features behaves, I simulate an economy with the above policies and 10,000 agents Figure 7 shows the resulting rent distribution. The figure



(a) Model tightness

(b) Model probability of matching

Figure 5: Probabilities of matching

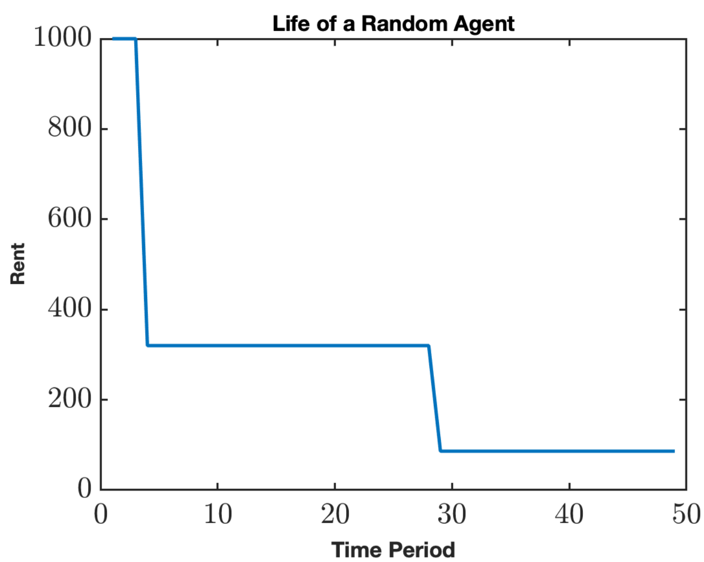


Figure 6: Life of a random agent

represents the 'age-tenure ladder' in the model[19]. As we can see, 'younger' people pay an average rent of around 800, which sharply goes down as we move down the distribution. The figure clearly mimics what we observe in the data qualitatively.
Table 5 presents the coefficients of the regression of $log(rent)$ on tenure, which is analogous to the regression in the model. As in the Figure, the numbers confirm the direction of the relationship.

While the sign is comforting and qualitatively supports the connection between the model and the data, the numbers are significantly bigger here than in the data. This is due to

[19] Again, it's helpful to note that, in the current model, the state is a sort of combination of both age and tenure in the city.

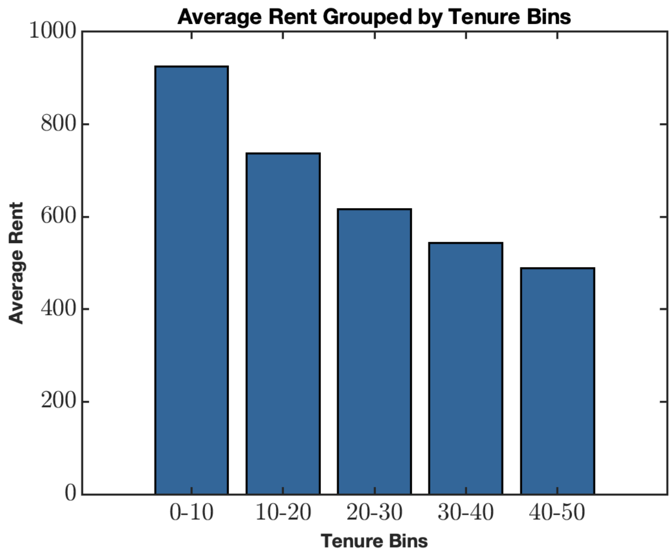


Figure 7: The rent ladder in the model

	Log(Rent)
Intercept	6.2547
	(0.0148)
Tenure 10-20	-0.9996
	(0.0292)
Tenure 20-30	-1.9183
	(0.0458)
Tenure 30-40	-2.6265
	(0.0758)
Tenure 40-50	-3.6401
	(0.1269)

Table 5: Regression coefficients for different age bins. The excluded group is 0-10.

different reasons, but mostly boils down to the fact that my model bunches together all the heterogeneity in the distribution of rents into one single factor, tenure. There is no location, quality, income, or other characteristics that can explain heterogeneous rents here. Due to this fact, the equilibrium distribution of rents is very sparse, with only a few markets active. This means that agents make big discrete jumps between rents, which exacerbates differences, especially from the initial very high rent. A first step to improving this would be to calibrate the model appropriately to have a better shape of the policy function and a finer distribution of paid rents. Other more ambitious steps involve extending the model on some of these dimensions.

To summarize, the equilibrium has some fundamental properties. First, the equilibrium is a rent ladder, and agents go down on it progressively, one rung at a time, like in Delacroix and Shi (2006). Second, a landlord is more likely to succeed in finding a tenant at a lower rent, whereas an applicant will be more successful in getting a high-rent place than a low-rent place. Third, a worker's rent, on average, decreases with their tenure in the city. Note that this last observation is true in the sense of both our Facts 1 and 2. Tenure in the city and age are the same thing in the model, and so older agents are agents that have been around a lot in the model. These agents pay a lower rent, consistent with Fact 1. But also, exactly as in Delacroix and Shi (2006), rent will be higher for agents that have stayed longer in their current place. Indeed, at lower rungs of the ladder, moving gets harder as the probabilities of matching go down. So, on average, picking an agent that hasn't moved in a while will give a lower rent than picking a recent mover, as it's more likely that the recent mover was paying a very high rent and moved to the rung just below.

4.3 Comparative statics: change in the housing supply

As returns to location vary a lot across space and across age, an often relevant question is how housing supply could affect affordability. As we have seen in the data, cities with a higher housing supply elasticity generally tend to have a lower rent premium. It is interesting then to investigate what happens in our model when we change the total housing supply in the economy[20]. To do so, I compare the baseline economy with a counterfactual economy where $H = 1.2$, that is, with a 20% increase in housing supply. Table 6 reports the result fits of a regression that pools the two economies together.

	Log(Rent)
Intercept	6.8421
	(0.0158)
Tenure	-0.0240
	(0.0094)
Housing Supply	-0.0030
	(0.0223)
Tenure*Housing Supply	-0.0682
	((0.0085)

Table 6: Log Rent and tenure in the joint economy

Of course, as in the baseline, the tenure coefficient is negative, which is our main result: 'younger' people pay higher rent. It is interesting to see, however, that the housing supply coefficient is also negative, indicating that the economy with more housing has generally

[20]Similar experiments are, for example, in Martellini (2022), Lhuillier (2024), Giannone et al. (2023). Of course, these models are spatial while here we focus, for now, on comparative statics.

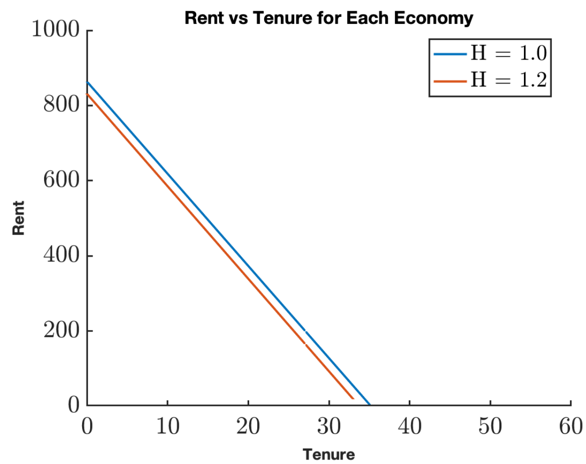


Figure 8: Age and tenure in the two economies

lower rent. Most importantly, the interaction coefficient is negative and equal to -0.06. The same point is illustrated by Figure 8, which plots the fits of two separate regressions run in the two economies. This shows how the age premium is negative in both economies, but it is consistently lower for all ages in the economy with more housing. Such results, in line with our empirics, suggest that the economy with more housing doesn't only have a lower rent but displays an overall smaller age premium. From this very limited analysis, one can suggest that housing supply could have heterogeneous benefits across the age and tenure distribution. Given that most of the literature has suggested that pro-building policies - such as 'de-zoning' - might generate benefits in terms of increased agglomeration and lower housing costs, this paper suggests that extra support from these policies might come from the fact that these benefits would go to young people and newcomers, who probably benefit more from them.

5 Conclusion

Housing markets are very important for the economy and for the lives of millions of people. Over 40 million households in the US rent, and the dynamics of very important labor markets, especially the ones of big, growing cities, are affected by rental markets. In this paper, I document some evidence that rental markets are frictional, and that such frictions are generating inequality in paid rents across the age distribution, and imposing a premium on newcomers to a locations.

I believe the findings of the paper are very relevant. The recent spatial literature recognizes a lot of return to agglomeration, especially for young people who acquire human capital. The cost of shelter is the main burden agents, especially young ones, have to face, and this is generally higher in the most competitive, high-paying labor markets. Given this, there are a lot of returns to better understanding who pays the highest rents and if and how policy could work on making life easier for such disadvantaged agents. As an exercise, I study an increase in housing supply and argue it would significantly decrease inequality in paid rents. While a lot of work is still needed, the paper hopefully provides a relevant contribution to the housing debate.

In future work, I plan to extend the model to incorporate space and age into it. Allowing for flexible location of agents over heterogeneous locations would make it possible to match the data significantly better and to perform more interesting counterfactuals. Similarly, having an explicit age dimension of the model would allow the disciplining of the age channel and the 'tenure in the city channel better.' Also, incorporating a quality dimension would make the quantitative fit significantly better. Whether available, the use of panel data or data with richer quality measures would allow for an improved empirical analysis. Despite all of these shortcomings, I argue the paper points out an important channel and rationalizes it with a simple yet effective mechanism, opening the door to a renovated role for microstructure elements in the study of the macro dynamics of housing and the economy.

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