

Homeownership and Unemployment: The Effect of Market Size

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August 2018

Abstract

This paper explores the effects of local labor market size on the unemployment hazard rate differential between renters and homeowners. Through a partial labor search-theoretic model, by explicitly modeling renters and owners, we find an asymmetric effect of the local labor market size on the unemployment hazard rate difference between renters and homeowners. We show that homeownership introduces additional frictions into the labor market especially when the local labor market is weak. We also show that these additional frictions make homeowners less mobile, and they become less likely to accept outside job offers, and more likely to accept local offers. Using data from the Survey of Income and Program Participation (SIPP), we find empirical evidence for the theoretical predictions of the model: (i) as local labor market opportunities deteriorate, homeowners become more likely to remain unemployed, (ii) homeowners have lower post unemployment wages than renters in local labor markets.

Keywords: unemployment, homeownership, mobility

JEL Codes: J61, J64, R23

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1 Introduction

It is widely acknowledged that homeownership reduces internal migration, which has direct consequences for labor mobility.¹ Oswald (1996) provides positive correlation between aggregate homeownership and unemployment rates at the country level, and argues that the lack of mobility caused by high levels of homeownership corresponds to a rise in unemployment. Several papers obtain similar findings using different aggregations (Nickell and Layard (1999) for OECD countries; Partridge and Rickman (1997) for US states and Pehkonen (1999) for Finland.). While these findings are suggestive, based on macro level analysis, it is difficult to conclude that homeownership brings strong frictions to labor markets. This study attempts to model housing and labor markets, and postulates a parsimonious mechanism between individual homeownership and unemployment. We identify the conditions under which ownership affects unemployment and test these predictions using individual-level data from the US. We show that owning a house lowers the likelihood of finding a job, and that this is especially true in regions with smaller local labor market and/or distressed economic conditions.

We present a simple framework in line with McCall(1970) that allows ex-ante identical individuals to search for housing in the local market and look for jobs in multiple locations: local vs outside as in Head and Lloyd-Ellis (2012) and Guler et al (2012). Being a homeowner is strictly preferred by the individuals since there is a utility premium for housing. However, it takes time for renters to find an owner-occupied unit due to search frictions. At the same time, existing homeowners are forced to sell their units with some exogenous probability and become renters. Moreover, owners face an additional cost, like home buying and selling costs, if they accept an outside job offer.

We prove that, since owners face an additional cost for moving, they have a higher reservation wage for outside job offers, which imply lower unemployment hazard rates for them compared to renters, as suggested by Munch et al. (2006). Homeowners partially offset this by reducing the local reservation wage; hence, they have higher hazard rates for local offers. However, in equilibrium, they turn down more job offers in total, which leads to longer unemployment durations.² Moreover, we also find that the unemployment hazard rate for homeowners, compared to renters, exhibits an asymmetric response to the changes in the composition of local job offers, i.e. market size. More specifically, we show that owners' unemployment duration is higher in regions where the local labor demand is weak compared to regions where local labor demand is strong. Given reasonable parameter values that reflect the US housing and labor markets, we show that the direct effects of housing

¹Boehm, 1981, Smith et al., 1988, Hammnett, 1991, South and Deane, 1993, Rohe and Stewart, 1996, Henley, 1998, Boheim and Taylor, 2002

²Dohmen (2005), van Vuuren and van Leuvensteijn (2007), Coulson and Fisher (2009), Morescalchi (2016), and Head and Lloyd-Ellis (2012) reach similar conclusions.

frictions on the unemployment rate are negative but quantitatively small. However, we find that housing frictions can have quantitatively larger amplification effects.

We use Survey of Income and Program Participation (SIPP) data from 1996 to 2003 to test the quantitative predictions of the model. We characterize labor markets at the state and Metropolitan Statistical Area levels. We use average unemployment rates as a proxy for the local labor market; a high unemployment rate for a state implies weak labor demand. The unemployment hazard rate estimation using household data suggests that unemployed homeowners are less likely to find jobs in areas where the local labor demand is weak. We show that the positive relationship between homeownership and unemployment duration comes from these distressed regions. Moreover, we use SIPP and Current Population Survey's Displaced Worker Supplement to check post-unemployment wages. We find that compared to renters post-unemployment wages of homeowners are smaller for local job offers, consistent with the predictions of the model.

Dohmen (2005) and Munch et al. (2006) present models of labor market search in which the individuals are pre-set as owners and renters and these two groups are assumed to behave differently. Coulson and Fisher (2009) move a step forward and include endogenous job creation. Their bargaining and wage posting models produce mixed results around the wage margin, although they find that owners are more likely to be unemployed.

Our paper is closest to Head and Lloyd-Ellis (2012) and Rupert and Wasmer (2012). Head and Lloyd-Ellis (2012) analyze the relationship between geographical mobility, ownership, and unemployment by explicitly modeling the housing (owner-renter) and labor (employed-unemployed) choices of individuals. They find that owners are more likely to be unemployed, but the aggregate effect of ownership on unemployment under plausible parametrization of the US economy is not quantitatively significant. They argue that one needs higher average unemployment rates and higher mobility for this effect to be quantitatively larger. Our theoretical model extends their model by introducing wage heterogeneity and on-the-job search to the model. We confirm their result that housing frictions have small effects on unemployment hazard rates. However, we show that during recessions, in which unemployment increases due to higher job separation rate, housing frictions can have quantitatively significant amplification effects on unemployment. Moreover, our theoretical model emphasizes the role of local market size on the interaction between housing frictions and the unemployment duration. More importantly, using micro data for the US economy, we provide empirical evidence for the theoretical predictions of the model.

Rupert and Wasmer (2012) also investigate the same problem with a model based on mobility, but they do not distinguish between ownership and renting; rather, they focus on the spatial dimensions of the problem through commuting in a single labor market. Finally, Karahan and Rhee (2013) and Nenov (2015) study the mobility and unemployment implications of liquidity constraints and find that the contribution of housing bust to the

sharp increase in unemployment rate during the great recession is rather marginal.

Another strand of the literature, using micro data, investigates whether owners are more likely to stay unemployed than renters. Although it has been widely reported that owners move less often, and they have a lower probability of job changes that include a move, the hypothesis of owners being more likely to be unemployed has little support. Havet and Penot (2010) critically review the related empirical literature in depth. Flatau et al. (2003) find that Australian homeowners with mortgages have a lower probability of being unemployed than outright owners who are less exposed than renters to unemployment risk. Munch et al. (2006), in a study of the unemployed in Denmark, divide their job transitions into those involving transition to local jobs and those involving transition to outside jobs, and find that unemployed homeowners tend to transition to outside jobs less often. However, their unemployment duration is shorter on average since their hazard rate for local jobs is considerably higher. Van Leuvensteijn and Koning (2004), using data on Netherlands, ask the question in reverse, and find that owners have longer durations of employment than renters.

Finally, Taskin and Yaman (2016) study the same question for the US, and using a competing risks hazard model that accounts for the unobserved heterogeneity and endogeneity of being a homeowner, they show that owners' job finding likelihood is no different than that of renters. This finding also holds up for the period that covers 2008 recession where housing is argued to have played an important role. This result is consistent with our theoretical model that implies little quantitative relevance of the job finding hazard difference between owners and renters. However, based on the model, we argue that it is still possible to find significant unemployment hazard difference between owners and renters for different locations. In the empirical part we rely on the framework of Taskin and Yaman (2016) and show that there is a positive relationship between homeownership and unemployment in areas where the local labor market is not strong.

The rest of the paper proceeds as follows. Section 2 constructs a simple model to underline the mechanism behind the empirical findings. Section 3 solves the model numerically, and reports the findings of the paper. Section 4 provides empirical findings suggested by the simple model. Lastly Section 5 concludes the paper.

2 A Simple Model

The economy has L symmetric locations, and each location is populated by a unit measure of a continuum of *ex-ante* identical infinitely-lived risk-neutral households.³ Time is con-

³Risk-neutral preferences can be justified by assuming complete markets. We acknowledge that there are certain other dimensions of the reality which might be important for the quantitative significance of housing illiquidity on unemployment hazard rates such as wealth as studied in Danforth (1979), staying rent-free using

tinuous, and there is no aggregate uncertainty. Households must reside in only one of the locations at any point in time. However, they can move between the locations. There are two types of housing in each location: rental and owner-occupied housing. So, at any time a household is either a renter or an owner. Both renters and owners pay the instantaneous cost, p , for housing.⁴ We assume that households have a strict preference for ownership over renting, that is, ownership brings a differential flow utility, $\gamma > 0$, for a household.⁵ There is search friction in the housing market, and renters can only search for owner-occupied units in their current location. They can find vacant houses at the poisson rate λ which represents the search frictions in the housing market to find an owner-occupied unit. Owners receive selling shock at the poisson rate φ which forces them to sell their houses and become renters. If an owner decides to move to another location, then she has to sell her house, and purchase a new one in the other location.^{6,7} However, such a move is entitled to some transactions costs κ to the mover.⁸ Renters are not subject to any moving costs.⁹

The labor market is in the spirit of the McCall model (McCall, 1970), extended for multiple locations as in Guler et al (2012) and Head and Llyod-Ellis (2012). The labor market prospects of the households do not depend on the housing tenure; that is, renters and owners face the same labor market opportunities. All households participate in the labor force: they are either employed or unemployed. An unemployed worker is entitled to an instantaneous benefit, b . Each location produces offers at the rate α . Since the total measure of individuals in each location is the same, each individual receives offers from the local location at the rate $\alpha(1 - \eta)$, and from outside locations at the rate $\alpha\eta$, where $\eta = \frac{L-1}{L}$. Since we assume all locations are symmetric, η captures the labor market size of each location. A decrease in η corresponds to an increase in the local labor market size. Wage offers w are generated from an exogenous wage offer distribution $F(w)$ with support $[0, \infty)$.¹⁰ There is

delinquency as in Herkenhoff and Ohanian (2015), substitutability of non-durable consumption and housing, etc. We abstract from these issues since the goal is to show qualitatively that market size can also have an additional effect as we find in the empirical part.

⁴Suppose that all housing units are owned by a third-party landlord, and households have access to an infinite-horizon mortgage. Assuming households and landlords have access to the same lending technology, the cost of renting and mortgage payments should be the same.

⁵This utility differential can be attributed to the benefits of ownership, which are not modeled here, like the tax-deductibility of mortgage interest rate, the social benefits of owning, and the different attributes of rental versus owner-occupied units, net of the cost of owning, such as the depreciation and maintenance costs.

⁶We assume that owners moving to the other location also stay as owners.

⁷We also solve the model by assuming that movers have to become renters in their new location. The results are very similar with this assumption.

⁸Selling the current house and buying a new house require certain transactions costs to be paid. Assuming that the landlord can convert an owner-occupied unit to a rental unit guarantees that this has no effect on the price of rental versus owner-occupied units.

⁹We abstract from the moving costs of the renters, like transportation, since they are common for owners also.

¹⁰It is worth to mention that the change in the frictions in the housing market will have effects on wages offered by firms. Although this could be another interesting channel to analyze, we leave it for future research

no on the-job-search, but an employed household receives an exogenous separation shock at the rate δ , which forces her to become unemployed.¹¹

Given this environment, at any time, a household can be in one of these four states: unemployed renter, employed renter, unemployed owner and employed owner. We start with writing the flow value of an employed owner working at the wage w , $W_H(w)$:

$$rW_H(w) = w - p + \gamma + \delta[U_H - W_H(w)] + \varphi[W_R(w) - W_H(w)], \quad (1)$$

where r is the subjective time discount factor for the households, and U_H is the value of being an unemployed owner. This value is equal to the sum of the instantaneous benefit of being employed at wage w , the instantaneous benefit of owning net of the cost of owning, $\gamma - p$, the change in value upon receiving an employment separation shock, $U_H - W_H(w)$, and the change in value upon receiving a selling shock, $W_R(w) - W_H(w)$. Similarly, the flow value of an employed renter working at wage w , $W_R(w)$ is the following:

$$rW_R(w) = w - p + \delta[U_R - W_R(w)] + \lambda[\max\{W_H(w) - W_R(w), 0\}] \quad (2)$$

where U_R is the value of an unemployed renter. Here, the difference is the change in the flow value upon finding an owner-occupied unit. Note that, in principle, it is possible for the renter to stay as a renter even if she finds an owner-occupied unit.

The flow value of an unemployed owner, U_H , is the following:

$$rU_H = b - p + \gamma + \alpha(1 - \eta) \int \max\{W_H(w) - U_H, 0\} dF(w) + \quad (3)$$

$$\alpha\eta \int \max\{W_H(w) - U_H - \kappa, 0\} dF(w) + \varphi[U_R - U_H]. \quad (4)$$

Unemployed owner gets the benefit b , pays the cost of owning, p , enjoys the benefit of owning, γ , and receives the wage offer w from each location at the rate $\alpha(1 - \eta)$, upon which the value changes to $W_H(w)$ if the offer w is accepted.¹² Notice also that if an unemployed owner accepts an outside offer that requires her to move, she becomes an employed owner, but has to incur a one-time cost κ .

Lastly, the flow value of an unemployed renter, U_R , is the following:

$$rU_R = b - p + \alpha \int \max\{W_R(w) - U_R, 0\} dF(w) + \lambda[\max\{U_H - U_R, 0\}], \quad (5)$$

and assume that offered wage distribution is exogenous.

¹¹In Section 3, we present an extension of the model with on-the-job search.

¹²Notice that due to the continuous time assumption, the probability of receiving offers from multiple locations is 0.

which simply states that the flow value of an unemployed renter is the sum of the unemployment benefit net of the rental payment, with the additional benefit of receiving a wage offer, which happens at rate $\alpha(1 - \eta)$ from each location, and the additional benefit of finding an owner-occupied unit, which occurs at the rate λ .

Before characterizing the stationary equilibrium for this economy, it is useful to characterize the value functions. It is clear that both value functions $W_R(w)$ and $W_H(w)$ are strictly increasing functions of w . As a result, the decision problem of an unemployed household upon receiving a wage offer, as usual, obeys a cut-off rule: above a certain reservation wage, the offer is accepted, and below that value it is rejected. Notice that, since all locations are symmetric, the unemployed renter has a unique reservation wage for offers from different locations. We denote w_R as the reservation wage for an unemployed renter. w_H^l denotes the reservation wage of an unemployed owner for local offers. Similarly, w_H^n is the reservation wage of the unemployed owner for outside offers. Since at the reservation wage the unemployed has to be indifferent between accepting the wage offer and rejecting it, the following equations characterize these reservation wages:

$$U_R = W_R(w_R), \quad (6)$$

$$U_H = W_H(w_H^l), \quad (7)$$

$$U_H = W_H(w_H^n) - \kappa \quad (8)$$

Notice that for an unemployed owner, the equation characterizing the reservation wage depends upon whether the offer is a local or an outside offer. In the case of a local offer, the unemployed owner does not incur any cost, whereas in the case of an outside offer, she has to incur the cost of moving κ .

In this economy, it is not clear whether being an unemployed owner always brings a higher utility than being an unemployed renter. As we take the difference between the value of an unemployed owner and an unemployed renter, we get

$$(r + \varphi)[U_H - U_R] + \lambda[\max\{U_H - U_R, 0\}] = \gamma - \kappa(\kappa),$$

where $\kappa = \alpha \int \max\{W_R(w) - U_R, 0\} dF(w) - \alpha(1 - \eta) \int \max\{W_H(w) - U_H, 0\} dF(w) - \alpha\eta \int \max\{W_H(w) - U_H - \kappa, 0\}$. This equation shows the two opposing forces of being an owner in this economy. Owners enjoy the instantaneous benefit of γ , but, conditional on κ and the composition of offers, they incur a cost in terms of their labor market prospects. In the extreme case where all the offers come from outside locations, $\eta = 1$ (or $L = \infty$), and $\kappa = \infty$, it is clear that owners will reject all offers and stay unemployed forever; however, renters are not affected by this. So, depending on the parameter values, it is possible to have $U_H < U_R$. However, such a parameter restriction generates measure zero employed owners in equilibrium. To avoid this,

we make the following assumption to ensure that it is always better to become an owner whenever the renter finds an owner-occupied unit:

Assumption 1 *An unemployed owner is better off than an unemployed renter: $U_H > U_R$.*

This assumption is clearly satisfied under some parametric restrictions, especially for sufficiently small κ compared to γ , and sufficiently many local offers. Given Assumption 1, it is always optimal for an employed renter to become an owner whenever she finds an owner-occupied unit. The following lemma states this fact:

Lemma 1 *Given Assumption 1, homeowners are always better off than renters at any wage level: $W_H(w) > W_R(w)$ for any w .*

Proof. See Appendix B for all the proofs. ■

Although being an owner gives a higher utility in this economy, this is purely due to the income effect coming through the instantaneous benefit of ownership, γ . On the other hand, in terms of labor market prospects, owners are worse-off compared to renters since owners, upon accepting an outside offer, have to incur the cost of relocation κ , which makes them less likely to accept outside offers compared to renters. In other words, regarding the outside offers, the reservation wage for an unemployed owner is higher than the reservation wage for an unemployed renter. This decreases the marginal benefit of staying unemployed for owners. As a result, the owner decreases the reservation wage for local offers. Thus, the reservation wage for local offers is strictly lower than the reservation wage for outside offers for the homeowners. The following proposition states this finding, and ranks the reservation wages of owners and renters.

Proposition 1 *The reservation wages are characterized by the following three equations:*

$$w_R \left(\frac{r + \lambda + \delta}{r + \delta} \right) = b + \frac{\alpha}{r + \delta} \int_{w_R} (1 - F(w)) dw + \lambda \frac{w_H^l}{r + \delta} \quad (9)$$

$$w_H^l \left(\frac{r + \varphi + \delta}{r + \delta} \right) = b + \frac{\alpha(1 - \eta)}{r + \delta} \int_{w_H^l} (1 - F(w)) dw + \frac{\alpha\eta}{r + \delta} \int_{w_H^n} (1 - F(w)) dw + \varphi \frac{w_R}{r + \delta} \quad (10)$$

$$w_H^n = w_H^l + \kappa(r + \delta) \quad (11)$$

The reservation wage for local offers for an owner is smaller than that for a renter: $w_H^l \leq w_R$. The reservation wage for outside offers for an owner is higher than that for a renter: $w_H^n > w_R$.

Here it is important to emphasize that it is not only κ that determines the additional friction owners face in this economy. The discount factor r and separation shock δ also affect the magnitude of these frictions. As the discount factor decreases (higher r) or the

separation shock increases higher δ), the value of employment gets smaller, and this causes the unit value of the one-time moving cost to increase.

The frequency of this friction, which is determined by the fraction of outside offers, η , is also important for the magnitude of this friction. The following lemma shows that in the extreme case where all the offers are local, there is no difference between the decisions of the owners and those of the renters.

Lemma 2 *If all offers are local, $\eta = 0$, then $w_H^l = w_R$, and $\theta_H = \theta_R$.*

Remember that exit rates from employment to unemployment in this economy are assumed to be constant over time across individuals, regardless of their housing tenure. What determines the difference between the unemployment rates of owners and renters is their job finding probability; that is, their unemployment hazard rate. The unemployment hazard rate for renters is

$$\theta_R = \alpha(1 - F(w_R)), \quad (12)$$

and for owners it is

$$\begin{aligned} \theta_H &= \theta_H^l + \theta_H^n \\ &= \alpha(1 - \eta)(1 - F(w_H^l)) + \alpha\eta(1 - F(w_H^n)) \end{aligned} \quad (13)$$

$$= \alpha(1 - \eta)(F(w_H^n) - F(w_H^l)) + \alpha(1 - F(w_H^n)). \quad (14)$$

Since the local reservation wage for owners is smaller than that of renters, which in turn is smaller than the outside reservation wage for owners, owners' unemployment hazard rate for local offers is higher than that of renters, whereas for outside offers the unemployment hazard rate for owners is smaller than that of renters. Although a comparison of the total unemployment hazard rate between owners and renters might seem to present ambiguities, if we assume that the wage offer distribution is log-concave, we can show that the total hazard rate for owners is smaller than that of renters.

Assumption 2 *The wage offer distribution is log-concave; that is, $\frac{f(x)}{F(x)}$ is decreasing in x , where f is the density function corresponding to the cumulative distribution function F .*

Proposition 2 *Given Assumptions 1 and 2, if $\eta > 0$, the total unemployment hazard rate is smaller for homeowners than for renters: $\theta_H < \theta_R$.*

The main focus of the paper is to show the asymmetric behavior of the difference between the unemployment hazard rates of renters and owners, $\theta_R - \theta_H$, to the composition of offers, η . As it is shown in Lemma 2, if $\eta = 0$, meaning that all offers are coming from the local location, then owners face no additional friction due to the moving cost, κ . Hence, in

the labor market both owners and renters behave in exactly the same way: their reservation wages are the same and the unemployment hazard rates become identical. As η increases, the fraction of outside offers increases, and this decreases the total acceptable offers for owners since outside offers are more likely to be rejected due to the moving cost. As a result, owners decrease the reservation wage for local and outside offers to compensate for the decrease in the total acceptable offers. This also has an indirect effect on the reservation wage of the renters. It is clear from equation (9) that as the reservation wage for local offers to the owner decreases, the reservation wage of the renters also decreases since a higher fraction of outside offers decreases the relative continuation value of being an employed owner as opposed to being an unemployed owner. The following proposition reflects these facts:

Proposition 3 *As η increases, all reservation wages decrease with the following relation: $\frac{dw_H^l}{d\eta} = \frac{dw_H^n}{d\eta} < \frac{dw_R}{d\eta} < 0$.*

Once we establish the response of the reservation wages to the composition of offers, we can discuss the effect of η on the unemployment hazard rates. The response for the renters is trivial. Remember that the hazard rate for renters is $\theta_R = \alpha(1 - F(w_R))$. So, we have

$$\frac{d\theta_R}{d\eta} = -\alpha f(w_R) \frac{dw_R}{d\eta}. \quad (15)$$

η has no direct effect on this hazard rate, but it indirectly affects the hazard rate through its effect on the reservation wage of renters. From Proposition 3, we know that as η increases the reservation wage of renters decreases, $\frac{dw_R}{d\eta} < 0$, so the unemployment hazard rate of renters increases: $\frac{d\theta_R}{d\eta} > 0$.

The effect of η on the unemployment hazard rate of owners is not trivial. It has both direct and indirect effects. The hazard rate for owners is $\theta_H = \alpha\eta(F(w_H^l) - F(w_H^n)) + \alpha(1 - F(w_H^l))$. So, we have

$$\frac{d\theta_H}{d\eta} = \alpha(F(w_H^l) - F(w_H^n)) - \alpha(1 - \eta)f(w_H^l) \frac{dw_H^l}{d\eta} - \alpha\eta f(w_H^n) \frac{dw_H^n}{d\eta} \quad (16)$$

η can affect this hazard rate in three ways. First, there is the direct effect. As η increases, the fraction of local offers decreases, and these offers are more acceptable than the outside offers. So, the unemployment hazard rate for owners decreases. This is captured in the first term of equation (16). Secondly, η has two indirect effects. Proposition 3 reveals that as η increases the reservation wage for both local and outside offers decreases. The second term in equation (16) shows that such a decrease in the reservation wage for local offers increases the hazard rate. The decrease in the reservation wage for outside offers also has a positive effect on the hazard rate captured by the third term in equation (16). Overall, the net effect

of η on the unemployment hazard rate of owners is also ambiguous, due to these opposing effects. The following proposition states these facts:

Proposition 4 *As η increases, the unemployment hazard rate for renters increases, but the effect on the unemployment hazard rate for owners is ambiguous.*

Having two opposing forces in place restricts us to make a definitive conclusion about the overall effect of η on the unemployment hazard rate of owners. Nevertheless, this theoretical model shows us the potential asymmetric behavior of the unemployment hazard rate as a response to the composition of offers.

2.1 Equilibrium Measures

Given the reservation wages and hazard rates, we can compute the equilibrium measures of each type of household. We have four types of households in the economy: unemployed renter, unemployed owner, employed renter, and employed owner. At the steady-state, in each location, inflows should be equal to outflows for each type of household. We denote u_R as the measure of unemployed renters, u_H as the measure of unemployed owners, e_R as the measure of employed renters, and e_H as the measure of employed owners. Normalizing the total measure in each location to 1, we can solve for the measure of each type of household:

$$\begin{aligned} u_R &= \frac{\varphi}{\lambda + \varphi} \frac{\delta}{\theta_R + \delta + \lambda \frac{\theta_H - \theta_R}{\theta_H + \delta + \lambda + \varphi}} \\ u_H &= \frac{\lambda}{\lambda + \varphi} \frac{\delta}{\theta_H + \delta + \varphi \frac{\theta_R - \theta_H}{\theta_R + \delta + \lambda + \varphi}} \\ e_R &= \frac{\varphi}{\lambda + \varphi} \frac{\theta_R + \lambda \frac{\theta_H - \theta_R}{\theta_H + \delta + \lambda + \varphi}}{\theta_R + \delta + \lambda \frac{\theta_H - \theta_R}{\theta_H + \delta + \lambda + \varphi}} \\ e_H &= \frac{\lambda}{\lambda + \varphi} \frac{\theta_H + \varphi \frac{\theta_R - \theta_H}{\theta_R + \delta + \lambda + \varphi}}{\theta_H + \delta + \varphi \frac{\theta_R - \theta_H}{\theta_R + \delta + \lambda + \varphi}} \end{aligned}$$

Notice that when $\theta_R = \theta_H = \theta$, which happens when $\eta = 0$, the measure of unemployed renters among renters and the measure of unemployed owners among owners are equal to each other: $u_H = u_R = \frac{\delta}{\theta + \delta}$. As stated in Proposition 4, an increase in η increases the unemployment hazard rate for renters, but for owners the effect is ambiguous. It is possible that as η increases, the hazard rate for owners might decrease and dominate the increase in the hazard rate for renters, and result in an increase in the overall unemployment rate. The quantitative significance of these differences is a matter that we analyze in the next section through a numerical exercise.

Table 1: Externally Calibrated Parameters

Parameter	Explanation	Value
r	discount factor	0.001
λ	house arrival rate	0.002
φ	house selling shock	0.001
p	mortgage payment	0.0
γ	ownership benefit	1.0
δ	separation rate	0.0054
b	unemployment benefit	40%
μ	mean of log-wage dist	1.0
σ	std of log-wage dist	0.05

Notes: The Table shows the externally calibrated parameters of the model following the literature. See the main text for a discussion of how they are set.

3 Quantitative Results

The goal of this section is to analyze the quantitative significance of frictions due to home-ownership on the unemployment hazard rates, and to depict the asymmetric response of the unemployment hazard rate differences between homeowners and renters across labor markets with different sizes. Although the model is fairly stylized, we calibrate certain important parameters by targeting related moments in the data.

The model is continuous, but for numerical purposes, we assume the time period as being a week to be as close as possible to continuous time assumption. We, then, choose a set of parameters exogenously following the literature. Risk-free interest rate, r is set to 0.001, which implies annual risk-free interest rate around 5.4% and corresponds to an annual discount factor of 0.95 with complete market assumption. The owner-occupied unit arrival rate λ is equal to 0.002, which corresponds to an average renter experience of 10 years.¹³ Selling shock, φ , is calibrated such that the ownership rate is 67%. Since the ownership rate in our model is $\frac{\lambda}{\lambda+\varphi}$, this gives us $\varphi = \frac{\lambda}{2} = 0.001$.

The unemployment benefit, b , is set to 0.4, which corresponds to 40% replacement rate. We assume log-normal distribution for the wage-offer distribution, and we set the standard deviation of the log-wage to $\sigma = 0.05$ and the mean to $\mu = -\frac{\sigma^2}{2}$, so that the average wage offer is normalized to 1. Following Shimer (2005), we set the exogenous job separation rate $\delta = 0.0054$, which corresponds to an average job life of 3.5 years. Housing related parameters, p and γ play no role in the quantitative results as long as γ is sufficiently large to make sure that the value of unemployment for a homeowner is higher than the value

¹³We interpret λ as the time an individual needs to accumulate enough assets for a down payment on an owner-occupied unit.

Table 2: Internally Calibrated Parameters

Parameter	Explanation	Value	Target	Model	Data
α	job-offer arrival rate	0.296	unemployment rate	6%	6%
η	fraction of outside offers	0.508	moving rate-renter	12.6%	12.6%
κ	moving cost	12.427	moving rate-owners	3.3%	3.3%

Notes: The Table shows the internally calibrated parameters of the model. See the main text for a discussion of the explanation of these parameters, and how they are identified in the model.

of a renter. So, we set $p = 0$ and $\gamma = 1.0$.¹⁴ Table 1 shows the summary of the externally calibrated parameters with their corresponding values.

This leaves us three parameters to be calibrated: job offer arrival rate for unemployed, α , fraction of offers coming from outside location, η , and the cost of moving for homeowners, κ . Given all the other parameters, job offer arrival rate directly affects flow from unemployment to employment, so α is crucial to match the unemployment rate. Fraction of offers from outside location affects the moving rate of renters, and cost of moving for homeowners affects the moving rate of homeowners. So, we target an unemployment rate of 6%, moving rate of 12.6% for renters and 3.3% for owners as in Head and Lloyd-Ellis (2012). Table 2 summarizes the set of the parameters calibrated internally within the model, their values, and the targets used to identify these parameters. Job offer arrival rate turns out to be 0.29, which is in the range of empirical estimates. The fraction of outside offers turns out to be around 50%, and the moving cost is calibrated as 12.427.¹⁵

The goal of the paper is to show the significance of market size on the frictions generated by less mobility of homeowners and the unemployment hazard rate difference of owners and renters. Our variables of interest are the unemployment hazard rates and the unemployment rates of owners and renters. To achieve this goal, we conduct three counterfactuals using the model. In the first counterfactual, we change the size of the local labor market by changing the fraction of outside offers captured by the parameter η . This allows us to see the direct effect of market size on the labor market related variables. In the second and third counterfactuals, we change the job arrival rate, α , and exogenous job separation rate, δ , to generate an increase in the unemployment rate as observed during the Great Recession. While the first counterfactual allows us to see the direct effects of market size on the hazard rates and unemployment rates, the second and third counterfactuals allow us

¹⁴We checked the results by increasing γ . It does not change any of the results.

¹⁵This cost corresponds to around 12 times the average weekly wage of the individual. In the data, this corresponds to around 14 thousand dollars given the average annual household income is around 60 thousand dollars. In the US, average house price is around 250 thousand dollars, which means our estimate of moving cost corresponds to around 6% of the house price, which is the typical real estate agency payment homeowners make when they sell their houses.

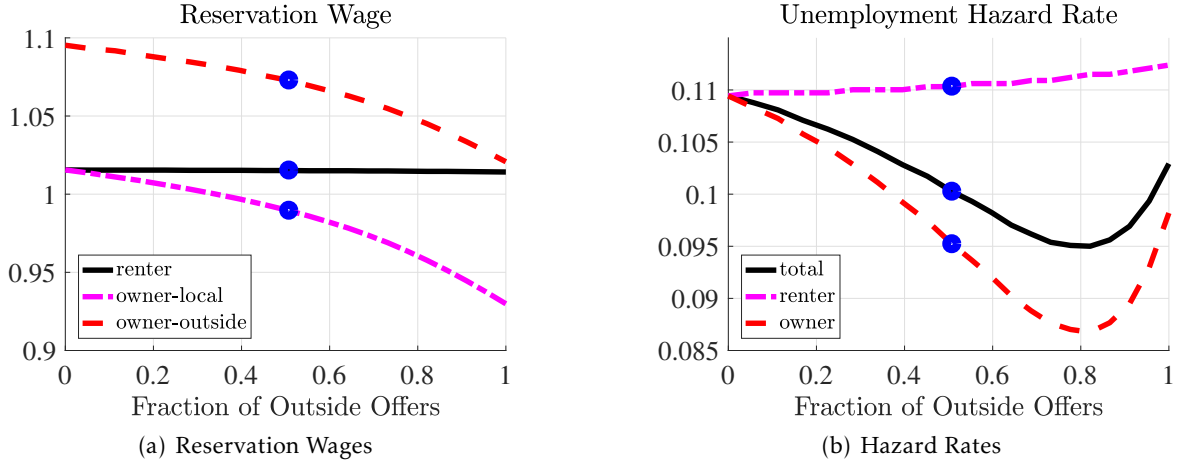


Figure 1: Reservation Wages and Unemployment Hazard Rates: The figure on the left plots the reservation wages and the figure on the right plots the unemployment hazard rates as a function of fraction of outside offers for renters and homeowners. The larger circles on each figure shows the corresponding value in the benchmark calibrated economy.

to analyze the amplification generated by housing market frictions on the hazard rates and unemployment rates. In the empirical section, we provide evidence for the predictions of these counterfactuals.

3.1 The Effect of Market Size

To see the direct effects of the market size, we solve the model for different values of $\eta \in [0, 1]$. Notice that $\eta = 0$ means that all wage offers are local, whereas $\eta = 1$ means that all wage offers are from outside locations. Figure 1(a) shows the response of the reservation wages for renters and owners as a function of η . As it is stated in Proposition 1, the reservation wages satisfy $w_H^n > w_R \geq w_H^l$; that is, the reservation wage for outside offers is strictly greater than the renter's reservation wage, which in turn is greater than the local reservation wage. This happens due to the presence of a positive moving cost for owners, $\kappa > 0$.

As Proposition 3 states, all reservation wages decrease as the fraction of outside offers, η , increases, and the decrease in the local and outside reservation wages are equal, and they are greater than the decrease in the renter reservation wage: $\frac{dw_H^l}{d\eta} = \frac{dw_H^n}{d\eta} < \frac{dw_R}{d\eta} < 0$.

Proposition 2 shows that as long as there are some offers coming from outside locations ($\eta > 0$), the total unemployment hazard rate for owners will always be smaller than that of renters. As we see in Figure 1(b), for any $\eta > 0$, the unemployment hazard rate is smaller for owners than renters. And as Lemma 2 verifies, when $\eta = 0$, owners and renters are alike, and their unemployment rates are equal.

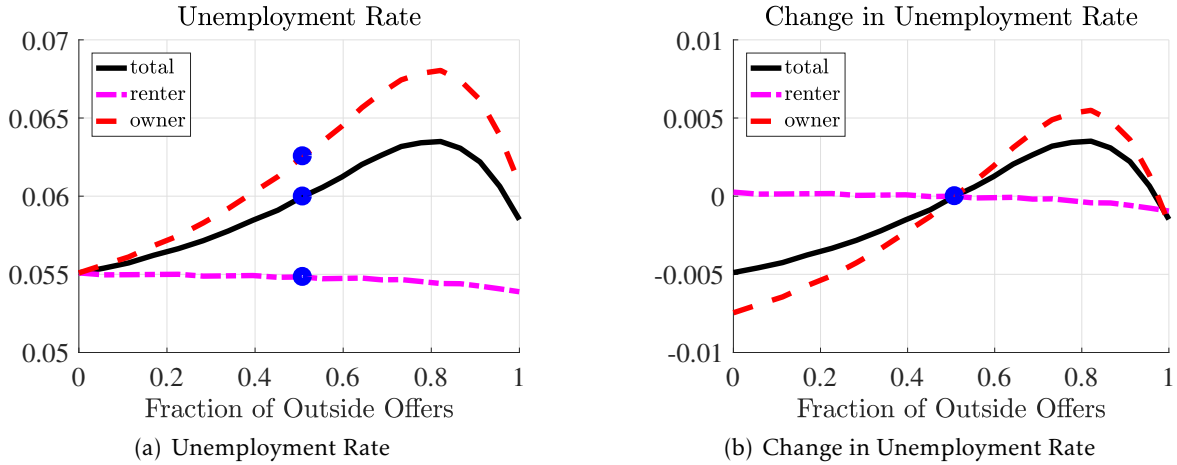


Figure 2: **Unemployment Rates:** The figure on the left plots the unemployment rate and the figure on the right plots the change in the unemployment rate with respect to the benchmark economy as a function of fraction of outside offers for renters, homeowners and the aggregate economy.

Another important result, which is the driving force of our results on the asymmetric response, is the U-shape of the unemployment hazard rate for owners as predicted by Proposition 4. The current parametrization results in a non-monotonic relation between η and the hazard rate for owners. As the fraction of outside offers increases, initially the hazard rate decreases, but after a certain level, around 0.8, meaning 80% of offers are from outside, the unemployment hazard rate starts to increase. For renters, the effect is unambiguous. Since the reservation wage for renters always decreases as η increases, the unemployment hazard rate for renters monotonically increases as η increases.

This behavior of the unemployment hazard rates clearly affects the unemployment rates of renters and owners. Figure 2(a) shows the unemployment rates for the owners, renters and total population in a given location as a function of the fraction of local offers. Here, the unemployment rates represent the rates among the similar types; that is, the owner's unemployment rate is the rate of unemployed owners among all owners. One quick observation is that owners have a higher unemployment rate than renters for every $\eta > 0$. When all offers are local, then unemployment rates become equal. The second observation is the non-monotonic relation between the unemployment rate for owners and the fraction of local offers. As η increases, the unemployment rate for the owners first increases, but then it starts to decrease. For renters, we have a monotonically decreasing unemployment rate. As one might expect, this graph, Figure 2(a), is the mirror image of the unemployment hazard rate graph, Figure 1(b). Since the total unemployment rate is a convex combination of unemployment rates for owners and renters, we still observe the non-monotonic behavior of the aggregate unemployment rate as a function of η .

As shown in Figure 2(b), the effects can be as large as 1% change in the unemployment rate when we compare an economy with 80% of job offers coming from outside location versus an economy with all offers are local. Compared to the benchmark economy where 50% of the offers are from outside locations, the change in the unemployment rate can be as large as 50 basis points if all the offers are local. These effects are in line with the estimates found in the literature. It should be noted that the comparison we actually do in this counterfactual experiment is to compare unemployment rates in economies with different sizes. Another interpretation of this experiment can be thought as considering the change in η as a local market shock, which decreases/increases the job arrival rate compared to the other locations. The results show that such a shock can increase/decrease the unemployment rate up to 50 basis points. Figure 2(b) also allows us to see the effects of eliminating homeownership completely. This economy corresponds to $\eta = 0$, i.e. all job offers are local. Such a change decreases the unemployment rate by 50 basis points compared to the benchmark economy, which is in line with the findings of Head and Lloyd-Ellis (2012).

In Section 4, we test our hypothesis by comparing the unemployment hazard rates of the owners and renters to check whether market size has any effect on this difference. As shown in Figure 1(b), our calibrated model predicts that the hazard rate of owners is around 15% lower than that of renters, and as the local market size shrinks with respect to the national market, we expect a decrease in the unemployment hazard rate of owners and an increase in the difference of unemployment hazard rates between owners and renters.

The bulk of the literature which estimates the role of illiquid housing market on the unemployment rate focuses on the amplification effect of illiquid housing market on the unemployment rate. To be more close to this literature, we conduct the following two counterfactuals: a decrease in job arrival rate and an increase in job separation rate. Both changes generate an increase in the unemployment rate. Our goal is to understand how market size plays a role in magnifying the effects of these shocks in the presence of housing market frictions.

3.2 The Effects of a Decrease in Job Arrival Rate

In this counterfactual, we decrease the job offer arrival rate to generate an increase in the unemployment rate similar in magnitude to the one the US economy experienced during the Great Recession. We decrease the offer arrival rate by 80%, which increases the unemployment rate in the benchmark economy from 6% to around 10% as observed at the peak of the Great Recession.

Figure 3(a) shows the changes in the conditional unemployment hazard rates for renters and owners. Conditional hazard rate is defined as the probability of accepting an offer conditional on receiving an offer. The figure shows that the change in job arrival rate increases

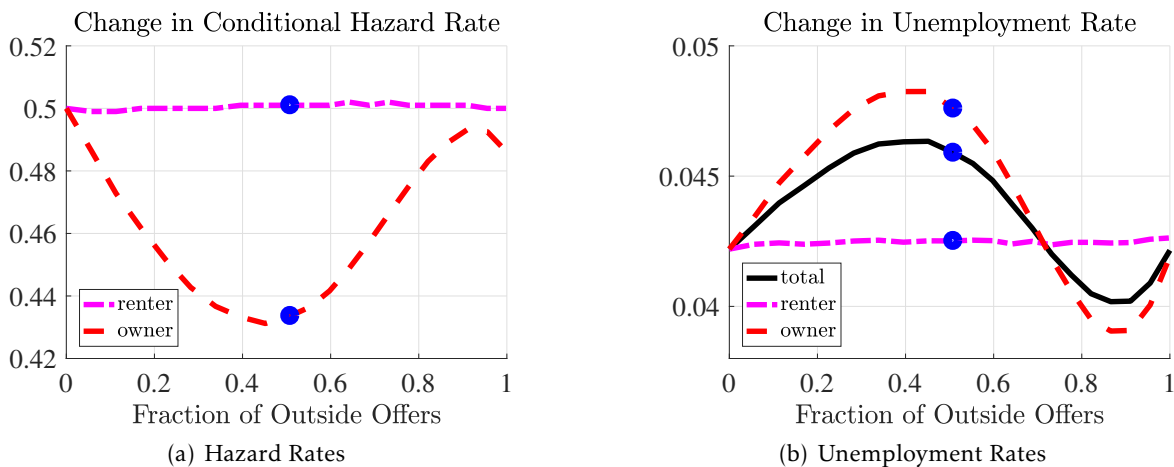


Figure 3: Change in Job Arrival Rate: The figures plot the changes in the unemployment hazard rates and unemployment rates for renters and homeowners in response to a 80% decrease in the job offer arrival rate. The figure on the left is for the conditional unemployment hazard rates and the figure on the right is for the unemployment rates. Conditional hazard rate is the probability of accepting a job offer conditional on receiving an offer. The magnitude of the change in the job arrival rate is chosen to generate an unemployment rate of around 10% in the new steady-state. The changes in both rates plotted are with respect to the levels in the benchmark economy.

the conditional hazard rate for both renters and homeowners. That is, given that there are less offers, individuals decrease their reservation wage, which increases their conditional hazard rates. Market size has insignificant effect on renter's conditional hazard rate. Regardless of the fraction of outside offers, renters' conditional hazard rate changes at the same magnitude. However, for homeowners, market size has significant effects on the hazard rate. Starting from frictionless economy ($\eta = 0$), the increase in the fraction of outside offers decreases the increase in the conditional hazard rate for owners.

As shown in Figure 3(b), the changes in the hazard rates result in changes in the unemployment rate. Since job arrival rate has decreased, regardless of the market size, unemployment rate for each group increases by around 4%. Although, for renters, the increase in the unemployment rate is the same across all market sizes, for homeowners, the increase in the unemployment can be amplified as much as 60 basis points. Overall, the aggregate unemployment rate can be amplified an additional 30 basis points in the benchmark economy due to the presence of housing market frictions. These estimates are consistent with the existing literature which finds small effects of housing market frictions on unemployment rate.

3.3 The Effects of an Increase in Job Separation Rate

There has been an extensive debate about whether the cyclical changes in the unemployment rate is driven by “hiring-driven” or “separation-driven” shocks. As advocated by Hall (2005a,b) and Shimer (2005a,b), “hiring-driven” theory assumes that the changes in hiring activity are the main drivers of the movements in the unemployment rate. However, “separation-driven” theory predicts that changes in the job separation rate is the main driver of the business cycle movements in the unemployment rate.¹⁶ So, as an alternative theory of changes in the unemployment rate, we also check the response of hazard rates and unemployment rates in response to a change in the job separation rate, δ . As in the previous counterfactual with job arrival rate, we increase the job separation rate to generate an unemployment rate in the neighborhood of 10% as experienced in the Great Recession. This results in increasing the job separation rate by 1.5 times its value in the benchmark economy.

Figure 4(a) and 4(b) show the changes in the conditional unemployment hazard rates and unemployment rates for different groups in response to the increase in the job separation rate. For renters, regardless of the market size, unemployment hazard rate and unemployment rate increase. The increase in the unemployment hazard rate is due to a decrease in the reservation wage to offset some of the negative effects of the increase in the job separation rate. As seen in both figures, market size has no amplification effect on renters’ hazard rate and unemployment rate. However, for owners, the changes are more drastic. First of all, unemployment hazard rate can even decrease for homeowners for certain market sizes. As can be seen in Figure 4(a), when the fraction of outside offers is around 80%, unemployment hazard rate for homeowners decreases in response to the increase in job separation rate.

These significant changes in the unemployment hazard rate for homeowners generate large movements in the unemployment rate as can be seen in Figure 4(b). While the increase in the unemployment rate is around 2.3% in the frictionless economy, in the benchmark economy, the unemployment rate for homeowners increases by 5%. For markets with around 80% of offers coming from outside location, the increase can be as high as 10%. Even the changes in the aggregate unemployment rate are quite substantial. In the benchmark economy, aggregate unemployment rate increases by 4% whereas in the frictionless economy, the increase is 2.3%. The presence of housing market frictions can result in doubling of the change in the aggregate unemployment rate. Compared to existing estimates in the literature, these changes are substantial.

It is interesting to note that when the source of the increase in the unemployment rate is

¹⁶Empirical support for “separation-driven” theory can be found in Davis (1987), Hall (1995), Davis, Haltiwanger, and Schuh (1996), and Fujita and Ramey (2006).

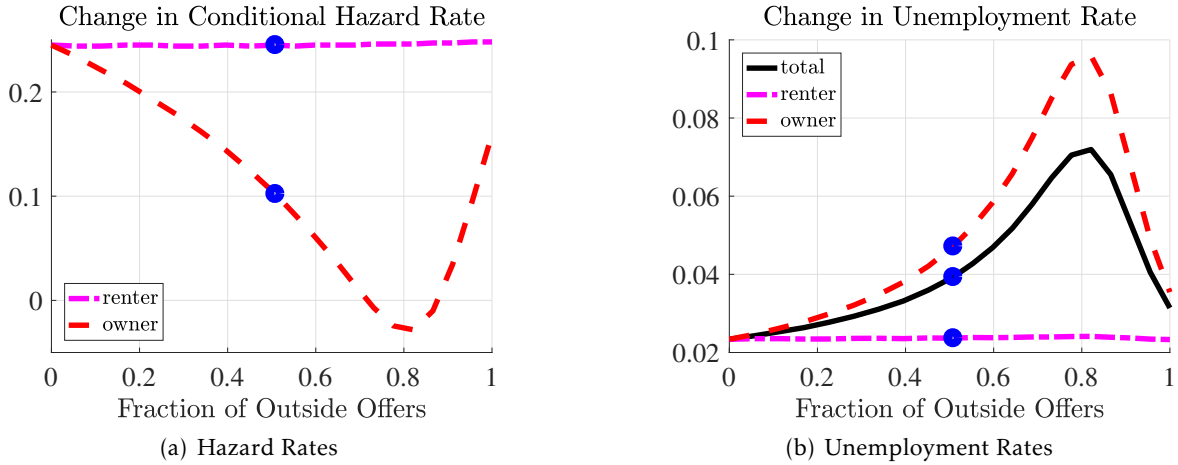


Figure 4: Change in Job Separation Rate: The figures plot the changes in the unemployment hazard rates and unemployment rates for renters and homeowners in response to a 1.5 times increase in the job offer arrival rate. The figure on the left is for the conditional unemployment hazard rates and the figure on the right is for the unemployment rates. Conditional hazard rate is the probability of accepting a job offer conditional on receiving an offer. The magnitude of the change in the job separation rate is chosen to generate an unemployment rate of around 10% in the new steady-state. The changes in both rates plotted are with respect to the levels in the benchmark economy.

the drop in job arrival rate, the model generates small amplification due to housing frictions. However, when the source of the increase in the unemployment rate is the increase in the job separation rate, it generates quite significant amplification. What is the intuition behind these differences? Notice that the only margin individuals in the model can respond to the changes in the environment is through reservation wage. Changes in the job arrival rate directly effects the reservation wage since it decreases the frequency of the offers. As a result, individuals become less picky for offers, and reservation wage decreases. However, these changes are in similar magnitudes for all reservation wages: renter's, owner's local and owner's outside reservation wages. So, changes in job arrival rate does not create differential effects on reservation wages. Hence, market size does not play much role on the changes of the unemployment rate.

However, changes in job separation rate have differential effects on the local and outside reservation wages for homeowners. As can be seen in equation 11, job separation rate δ directly effects the difference between local and outside reservation wages. The logic for this result is simple. Job separation rate governs the duration of a job. For outside offers, the individual has to incur the moving cost κ , and this is a one time cost. The flow rate of this cost depends on the duration of the job. As the duration is shortened through an increase in δ , the flow rate of the moving cost increases, and that results in an increase in the outside reservation wage. Obviously, this channel depends on the magnitude of the moving cost κ ,

and how often the individual faces this cost, governed by the fraction of outside offers, η . On the other hand, the increase in the job separation rate has a direct effect on all reservation wages as standard in job search models. As the job separation rate increases, all reservation wages decrease. However, the additional effect on outside reservation wage dominates in a certain region of the market size, and may result in a decrease of the unemployment hazard rate.

These results show that the source of the changes in the unemployment rate can have different implications for the housing market frictions. Obviously, there are other mechanisms for individuals to offset the negative effects of labor market shocks that we abstract from in this paper such as wealth, spousal insurance, delinquency, etc.¹⁷ The presence of such insurance channels might dampen the quantitative effects we find in this paper. Quantifying these effects needs a much serious structural model with all these features built into the model, and it is beyond the scope of the paper. However, our findings suggest that when building these models, the source of the shock can matter to understand the effects of housing market frictions.

3.4 Wage Dynamics

One of the advantage of the model we use in the paper is that we can also check the response of the observed wage dynamics to the changes in the housing frictions. This is one of the main differences of our paper compared to the closest papers Head and Lloyd-Ellis (2012) and Rupert and Wasmer (2012). Although the wage-offer distribution is exogenous in the model, the observed wage distribution is endogenous since individuals do not accept every wage offer. Moreover, in our model with housing tenure, each type of individual has different reservation wages, and this creates another dimension of wage inequality in the model.

Figure 5(a) shows the observed wages for different housing tenure in the model. In general, renters have higher wages than homeowners. This is due to lower reservation wage for local job offers for homeowners. However, once the fraction of outside offers is sufficiently large, the differences between renters and owners diminish as local offers are few, and reservation wages for outside offers look similar to the ones for renters. In the benchmark calibration, the model generates around 1% difference between renters' and homeowners' wages.

The model also allows us to see the effects of market size on wages and wage inequality. There has been an increasing debate about the sources of income inequality in the US. Baum-Snow and Pavan (2012) finds that at least one-quarter of the increase in earnings inequality after 1980s can be explained by the increase in the earnings inequality in large

¹⁷See Danforth (1979) for the effects of wealth, Guler et al (2012) for the effects of spousal insurance and Herkenhoff and Ohanian (2015) for the effects of delayed foreclosure on unemployment duration.

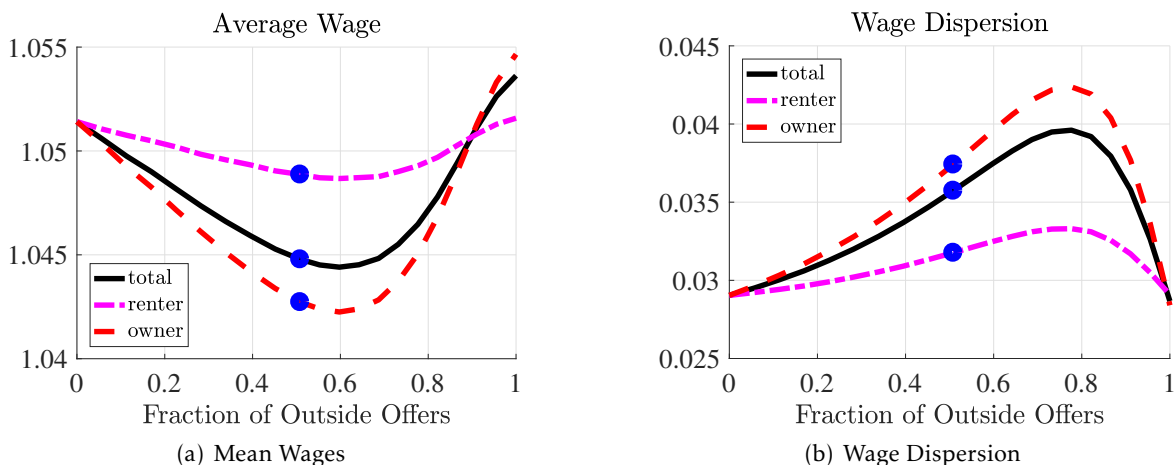


Figure 5: **Wages:** The figures plot observed wages in the model for different groups. The left panel plots the average wage for renters, homeowners and overall. The right panel plots the dispersion of observed wages computed as the standard deviation of observed wages.

urban areas.¹⁸ The leading explanation for the increase in urban inequality is the increased city composition with urbanization.¹⁹

Do housing frictions have any effects on wage inequality? Our model can provide an answer for this question. A decrease in the fraction of outside offers can be considered as an increase in urbanization by shifting the composition of offers from outside towards local ones. Figure 5(b) shows the wage dispersion as a function of fraction of outside offers. The benchmark calibration generates a wage dispersion which is one-fifth higher than the wage dispersion observed in the frictionless economy, where $\eta = 0$ (0.037 vs 0.029). Housing frictions amplify the wage dispersion in the economy. However, if we interpret the decrease in the fraction of outside offers as greater urbanization, the model implies a decrease in the wage dispersion contrary to what we observe in the data.²⁰

¹⁸Handbury and Weinstein (2015) notes that real urban inequality has increased much less than the nominal urban inequality once living standards are adjusted.

¹⁹See Rosen (1981), Glaeser (2008), Eeckhout et al (2014) for several explanations for increased urban inequality related to changing city composition.

²⁰A better way to think about the effects of urbanization on wage inequality is to consider an asymmetric location model. In such a model, urbanization will have differential effects on rural and urban cities. While urbanization will have the similar effects mentioned above, there will be further effects coming through the changes in rural cities. With urbanization rural cities will observe a decrease in the share of local offers and an increase in outside offers. Such a change in composition of offers might increase the share of homeowners in the rural cities and increase the migration rate of young individuals from rural cities to urban cities. Since young individuals are less experienced and have lower wages, this might increase the wage inequality in urban cities.

3.5 Extension: Model with on-the-job Search

A natural extension of the model is to include on-the-job search. A common message throughout the paper, similar to the findings of Head and Lloyd-Ellis (2012) and Rupert and Wasmer (2012) is that the magnitude and frequency of housing frictions matter a lot for the significance of housing frictions on the unemployment rate. In the model without on-the-job search, only unemployed individuals are subject to these frictions. However, in the data majority of transitions to employment is job-to-job transitions. So, including on-the-job search can increase the frequency of these frictions in the aggregate economy. However, such a model also requires re-calibration, which, in turn can effect the magnitude and frequency of these frictions.

To better quantitatively assess how our results are sensitive to incorporating on-the-job search, we extend the model by assuming employed individuals receive job offers at the rate α_e from the same distribution as the unemployed individuals, and we keep the other features of the model as in the benchmark economy. To re-calibrate the model, we include monthly job-to-job transition rate of 2.2% as an additional target estimated by Krusell et al (2017). This moment helps us to identify job arrival rate for the employed. The re-calibration results in the following estimates for the parameters: $\alpha = 0.099$, $\eta = 0.235$, $\kappa = 7.82$, and $\alpha_e = 0.028$. Compared to the benchmark economy, the re-calibration results in lower job arrival rate for the unemployed, lower fraction of outside job offers, and lower cost of moving for homeowners.

We, then, solve the model for different values of η , fraction of outside offers. Figures 6(a) and 6(b) show the unemployment hazard rate and unemployment rate corresponding to different values of η . Compared to the benchmark economy, the presence of on-the-job search slightly amplifies the effects of housing frictions. Compared to a frictionless economy ($\eta = 0$), the calibrated economy results in around 60 basis points higher unemployment rate. For markets with 50% offers coming from outside locations, this effect can be as large as 100 basis points. The reason for these larger effects is due to the increase in the frequency of housing frictions in the model. With on-the-job search, not only unemployed individuals, but also employed individuals are subject to these frictions. However, the decrease in the recalibrated parameter values which govern housing illiquidity partially mitigate the increase in the effects of these frictions. Overall, the model with on-the-job search mildly increases the effects of the housing illiquidity on the unemployment rate.

4 Empirical Evidence

In this section we test key predictions of the housing and unemployment model using micro data. The theoretical model predicts that homeowners have lower hazard rate than renters

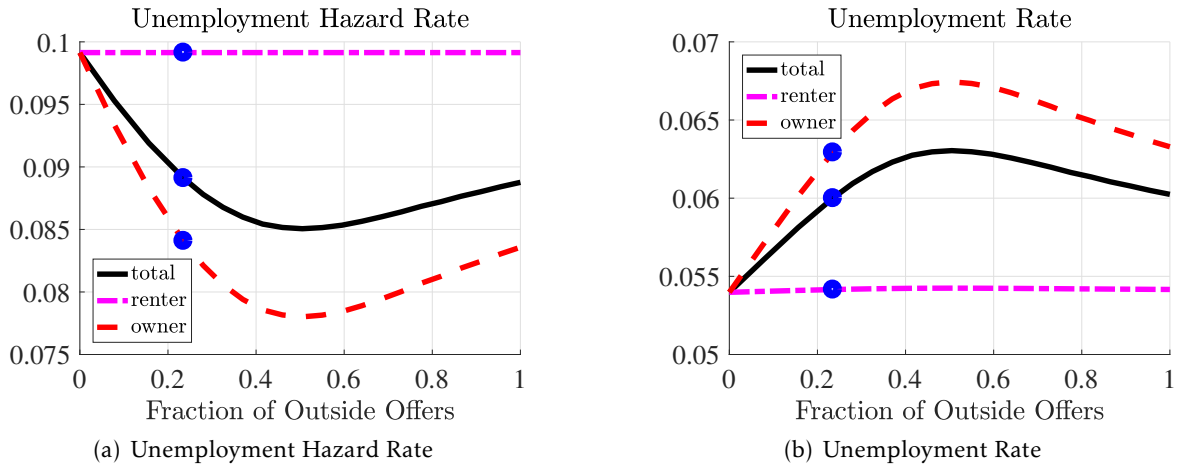


Figure 6: **The Effects of On-the Job Search:**

since they are less mobile, and this induces them to have lower reservation wage for local job offers. We first estimate the effect of homeownership on unemployment duration. Later, we briefly discuss the relationship between homeownership and post-unemployment wages as shown in Proposition 1.

Using micro data, Taskin and Yaman (2016) inquire whether homeowners have longer unemployment spells. Here we investigate whether in weak labor markets -where local job offers are more scarce- homeowners have relatively longer unemployment durations compared to renters. Proposition 2 establishes longer unemployment durations for homeowners than for renters, however, the size of the difference depends on the fraction of outside offers. As shown in Figure 1(b) the calibrated model predicts that the unemployment hazard of owners could be up to 25 percent lower than that of renters. In the following sections, we estimate the response of the homeowners' unemployment hazard rate compared to that of renters' via local economic conditions.

4.1 Data and Sample Selection

Our empirical analysis is based on micro data from the Survey of Income and Program Participation (SIPP). We use the 1996 and 2001 panels, which covers the period between 1996 and 2003; this is an ideal period for our analysis since it predates the housing bust and it covers an expansionary and a recessionary period, roughly completing a business cycle.²¹ We use unemployment rates to characterize the local labor market conditions. Here, the idea is that labor markets that have weak labor demand, or few local job offers -which

²¹The advantages of the SIPP for the purpose of this exercise are discussed in detail by Taskin and Yaman (2016). We refer readers to that study for further investigation.

correspond to higher η in the model- also have higher unemployment rates. Unemployment rates at the state level come from the Bureau of Labor Statistics (BLS) and we use the Census for Metropolitan Statistical Areas (MSA) unemployment rates.

Sample Selection We follow a similar restriction methodology applied in Taskin and Yaman (2016). We compile unemployment spells of working age civilian males who are either homeowners or renters living in states excluding Alaska, Hawaii, Washington DC, Maine, North Dakota, South Dakota, Vermont and Wyoming.²² We restrict our attention to the main family in the household with reference persons and their spouses and partners, thus dropping any other relatives (child, father, etc.) and non-relatives (roommate etc.). Moreover, we match our unemployment spell data with asset and liabilities information provided in the SIPP topical modules. For those individuals who do not appear in those modules or have inconsistent mortgage information with the original housing tenure status are subsequently dropped. This leaves us with 9,115 unemployment spells across 43 states and 96 MSAs; 7,258 of them terminate with a return to employment. Among those spells 5,160 are homeowners.

Panel A in Table 3 describe sample statistics of a subset of the covariates we use in our analysis, for homeowners and renters. As expected, unemployed owners and renters have considerably different characteristics. Renters are more likely to be black or hispanic, are somewhat less educated, younger, less likely to be married and less likely to have kids. Living in a metropolitan area is more common for renters. Owners and renters have drastic differences in terms of income: renters have considerably lower paying jobs before unemployment and have lower family income. Furthermore owners are more likely to receive unemployment benefits.

Renters and owners are also quite different with respect to assets and liabilities: 77 percent of the owners has a mortgage in the house accruing a sizable amount of mortgage debt (more than annual average household income). On the other hand liquid wealth - defined as total wealth minus home, real estate, business and vehicle equity- of homeowners are much higher than that of renters. Finally, owners have relatively higher unsecured debt, though this is within the scale of their earnings. All in all, these statistics suggest that although homeowners have higher amount of liquid wealth -and equity on the house they own-, they are also more indebted.

We aim to test whether in distressed labor markets unemployed homeowners have worse employment outcomes than renters. We use unemployment rate as a proxy; if the average unemployment rate is higher in a state, this implies weak labor demand or distressed eco-

²²The first 2 states are excluded because the housing and unemployment relationship is not applicable to those states since cost of moving in those states might be also high for renters as well. The latter 6 are not separately identified in our panels.

Table 3: Summary statistics of covariates at the beginning of spell; renters vs owners, distressed states vs control states

	Panel A		Panel B	
	Renters	Owners	Distressed States	Control States
Black (percent)	11.63	6.76	7.94	9.36
Hispanic (percent)	19.57	9.46	23.89	8.64
Married (percent)	50.14	79.21	64.60	67.63
Kids (percent)	41.26	53.84	49.94	47.58
Less than high school (percent)	24.35	14.46	23.18	16.45
High school (percent)	61.01	64.73	58.66	65.43
Age (mean)	36.55	44.84	40.64	41.56
Pre-spell earnings (mean)	1554	2540	2142	2097
Pre-spell family income (mean)	2125	4034	3220	3198
Unemployment benefits (percent)	16.36	26.39	22.60	21.75
Metro area (percent)	80.54	73.53	79.97	74.83
Homeowner (percent)	--	--	46.85	61.67
Has mortgage* (percent)	--	76.76	78.04	76.26
Mortgage debt* (mean)	--	56753	68982	51941
Unsecured debt (mean)	5463	6854	5782	6494
Liquid wealth (mean)	7706	50982	23448	36740
Observations	3955	5160	3110	6005

Source: SIPP 1996-2001. In Panel A (between renters and owners) each descriptive variable is significantly different from each other at 5 the percent level. In Panel B (between distressed states and control states) each descriptive variable excluding pre-spell earnings, pre-spell family income, unemployment benefits and mortgage is significantly different from each other at 5 percent level.

* Conditional on being a homeowner

Table 4: Unemployment Duration by Household Type: States

	Full Sample	Owner	Renter
Full Sample	8.85 (N=9115)	8.89 (N=5160)	8.79 (N=3955)
Distressed States	9.13 (N=3110)	9.58 (N=1457)	8.74 (N=1653)
Control States	8.70 (N=6005)	8.62 (N=3703)	8.83 (N=2302)

nomic conditions for that state. Table 11 describes the annual unemployment rate of the states in our sample prior to the panel year (1995 for the 1996 SIPP, and 2000 for the 2001 SIPP). As a first step for both time periods, we pick the ten states with the highest unemployment rates and label them as distressed labor markets.²³ Although there is strong persistence in unemployment rates across time, we see three states switching from the distressed sample.

Next we look at the unemployment durations of homeowners and renters via local economic conditions. Table 4 shows that although observable characteristics of homeowners and renters are quite different from each other, conditional being unemployed, the unemployment durations are comparable. The unemployment durations of homeowners are only slightly longer, but the differences in unemployment durations are more apparent for states with weak labor markets. In those states, unemployment durations of homeowners are 0.84 weeks longer than those of renters, whereas for the rest of the sample homeowners have slightly shorter unemployment durations. Overall, being in distressed state increases unemployment duration of homeowners about 1 week more than it does for renters.

Panel B in Table 3 sheds light on the possible differences between what we classify as distressed states and the rest of the sample. Here, one notable observation is the low share of homeowners in distressed states. However, this mostly stems from the state level homeownership rates. Although the share of households with mortgage are similar in both subsamples, the mortgage debt is considerably higher for distressed states. This difference is not reflected in the pre-spell family income. Moreover, liquid wealth is substantially lower in states with distressed economic conditions.

²³This roughly corresponds to a quarter of states with the highest unemployment rates. We may, for instance, define distressed states for those whose unemployment rates above the national average in that year. The qualitative conclusions do not depend on this specification.

4.2 Findings

We now turn to a formal econometric model that captures nonlinear job finding probability and controls for individual and local characteristics. In particular we estimate a proportional hazard model for job finding:

$$\theta_i(t|h_i, d_i, x_{it}) = \lambda(t) \exp(\alpha_1 h_i + \alpha_2 h_i * d_i + \beta x_{it}), \quad (17)$$

where h_i is a dummy for homeownership, d_i is a dummy for states with distressed economic conditions, x_{it} denotes the vector of covariates, and $\lambda(t)$ is the baseline hazard, which we specify as a non-parametric function. We control for major demographic and economic variables such as age, race, education, assets and liabilities etc. as well as fixed and variable factors at the state and MSA level.²⁴ Here we are particularly interested in the interaction of the homeownership variable and the weak labor market indicator, α_2 , since this interaction indicates the effect of market size on the job finding probability of owners as compared to renters.

The first column of Table 5 describes the coefficient estimates of the related variables. Here, ownership variable is negative but insignificant and small in magnitude, while for states with weak labor demand, we find that an unemployed homeowner's job finding hazard is 18 percent lower ($\exp(-0.198) - 1$) than that of renters. This difference is surprisingly close to the hazard rate difference presented in Figure 1(b) of the model. The coefficient of the labor market conditions indicator is negative but insignificant; this could be due to marginal variations in the distressed economic areas subgroup across the 1996 and 2001 panels.²⁵

One could argue that the effect of weak labor demand on the relative job finding hazard of homeowners is due to a lack of precision in our local economic conditions proxy. For that reason we also characterize the labor demand in terms of the unemployment rate prior to the panel year. In this case, we replace the labor market conditions dummy and the interaction term with annual unemployment rates for each state. We report the corresponding estimates in the second column of Table 5. Our main variable of interest, the interaction term, is still negative and statistically significant. Essentially, this means that as the unemployment rate goes up in a state, or the local labor market worsens, it takes longer time for homeowners to find jobs, compared to renters. In a state that has a 10 percent unemployment rate, the job finding hazard of a homeowner is roughly 25 percent lower than that of renters.

In order for our local economic conditions proxy to work, other aspects of locations need to be similar to each other. For that reason we control for various time varying state level

²⁴A complete list of the covariates is described in Appendix.

²⁵The estimates for other controls are in line with the unemployment duration literature. For space purposes we do not provide any discussion on those results. They are available upon request.

Table 5: Estimation Results with State Level Labor Markets

Statistic ^a	I	II	III	IV
owner	.005 (.044)	.106 (.098)	.006 (.054)	-.021 (.080)
distressed	-.006 (.072)		-.032 (.083)	.067 (.161)
owner x distressed	-.198*** (.050)		-.174*** (.058)	-.284*** (.109)
unemp. rate		-.026 (.041)		
owner x unemp. rate		-.034* (.018)		
Observations	9115	9115	6984	2131

^aThis Table shows the unemployment hazard regression specified in equation 17 at the state level. The first column shows the results with a dummy specification for the labor market conditions, and the second column shows the results with previous year unemployment rate as the labor market condition indicator. The third and columns restrict analysis for households who live in metropolitan areas and do not live in metropolitan areas respectively. A complete list of the other covariates is described in Appendix. The numbers in the parentheses are the robust standard errors. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

characteristics (population, per capita income etc.) to isolate the effect of local labor demand through unemployment rate. However, the symmetric nature of our theoretical model suggests that this effect should be more clear at smaller agglomerations which take the outside offers as given. Our data only allows us to identify metropolitan status of the households with additional identifiers for a list of MSAs.²⁶ Here we could split the sample based on the metropolitan status of household residence. The metropolitan sample arguably has a lot heterogeneity in terms of city characteristics which induce higher noise in unemployment rate for it to be able suitably reflect local labor demand. Individuals who do not have metropolitan residence, on the other hand, live in smaller neighborhoods which have similar labor market structures with respect to each other. Therefore we expect our state level distressed market measure to have stronger effect in those areas. The estimates of the interaction variable for metropolitan areas in column three and for non-metropolitan areas in column four speak to this argument: in non-metropolitan areas weak labor demand increases unemployment duration of homeowners even further. This effect is relatively smaller in metropolitan areas.

It is possible to question the exogeneity assumption on ownership variable since it could be related to job finding opportunities conditional on being unemployed. For instance, there may be a positive selection problem where more productive individuals -hence individuals

²⁶More detail about MSAs follows in the next section.

with better labor market outcomes- could afford being a homeowner since they have enough income and labor market opportunities. In this case, when unemployed, they will find jobs faster. On the other hand, individuals who prefer not to move from certain locations might also prefer to be homeowners, but then they are restricted with a smaller set of jobs which could make their unemployment durations longer. Therefore, in terms of the causal effect of ownership on unemployment duration these endogenous forces are working against each other.

In order to mitigate the effects of these concerns, we rely on a rich set of variables that characterize education, several types of income, several types of wealth and fixed and varying factors of location etc. These variables, though not perfectly, control for the main arguments with respect to selection problems. Moreover, the usage of instrumental variables and other econometric techniques introduce complications in other ways and do not seem to provide substantial information compared to the exogenous ownership assumption.²⁷ For that reason, we refrain from using any endogeneity correction method. However, we try to address endogeneity concerns further in the next section with different exercises.

4.3 MSAs as Labor Markets

One critique of using states as a proxy for local labor markets is that within a state there might be heterogeneity in terms of job opportunities. For instance, although California is listed as a distressed economic area, some labor markets within California might have strong labor demand. For the US as a whole, the suitable regional entities that are used to characterize the labor markets are the Metropolitan Statistical Areas (MSAs). Our data allows us to identify the 96 most populated MSAs.²⁸ Within these MSAs, there is considerable heterogeneity in terms of population; from New York-New Jersey-Long Island Consolidated Metropolitan Area (CMSA) having 20 million to Fort Pierce-Port St. Lucie Metropolitan Area having 250 thousand as of 1990. MSAs with sizable populations create agglomeration economies where job matching efficiency is argued to be higher. Moreover, population within a labor market also affects the combination of local vs outside offers. Therefore, in order for our labor market indicator, unemployment rate, to proxy for local labor demand one would also need to control for population over time. For the rest of the analysis, we rely on 1990 and 2000 MSA/CMSA population measures as an additional control. Moreover, motivated by the sizable heterogeneity within MSAs, we also create an identifier for MSAs whose population was more than 2 million as of 1990.²⁹

²⁷See Taskin and Yaman (2016) for a thorough discussion.

²⁸In this section, we exclude individuals who do not have MSA information, which leaves us 5,165 spells for analysis. Among those spells 4,057 end up finding a job and 2,862 are reported to be homeowners.

²⁹This corresponds to splitting the sample into a half where one side is considered small labor markets and the other side is considered big labor markets.

Table 6: Unemployment Duration by Household Type: MSAs

	Full Sample	Owner	Renter
Full Sample	9.36 (N=5165)	9.58 (N=2862)	9.09 (N=2303)
Distressed MSAs	9.74 (N=2137)	10.19 (N=1076)	9.28 (N=1061)
Control MSAs	9.10 (N=3028)	9.22 (N=1786)	8.93 (N=1242)

As in previous section we use the annual MSA unemployment rate prior to the panel year to characterize labor market conditions. Our micro data identifies MSAs in terms of 1993 OMB standards, so we rely on historical data for unemployment rates.³⁰ As a first attempt to characterize MSAs with weak labor demand, we pick the 26 MSAs (out of 96) with the highest unemployment rates and label them as distressed economic areas.³¹ Table 12 lists the distressed MSAs based on this classification together with their respective unemployment rates in 1995 and 2000. Here we see that, as in the case of the states, there is a strong persistence; out of 26 MSAs listed as distressed labor market, 17 of them are present in both years. Moreover, among this subsample, 6 of them are Consolidated MSAs with integrated cities and considerably higher population.

Next, we show the MSA analogue of unemployment duration comparisons of homeowners and renters in Table 6. Again, we see a slight difference between the unemployment durations of renters and owners, with the duration for owners being slightly higher, and this difference in unemployment durations is more apparent for the MSAs with weak labor markets. Moreover, although we only classify a quarter of MSAs as distressed labor market, share of unemployment spells within these MSAs is about 40 percent of the overall sample.

We repeat the empirical exercise described in section 4.2. The first two columns of Table 7 show the main results for the interaction effects, with the two mentioned specifications. We see that owners in MSAs with weak labor demand experience longer unemployment

³⁰Although BLS reports unemployment rates for MSAs starting from 1990, they continuously update the definitions. For year 1995, we take MSA unemployment rates from the State and Metropolitan Area Data Book published by the Census Bureau. For the year 2000 we use the 3% summary file from the 2000 Decennial Census. Although unemployment rate levels are slightly different in these reports (one uses BLS, the other relies on the Decennial Census survey), it does not make much difference for the purpose of characterizing distressed labor markets.

³¹As in previous section this arbitrary cutoff corresponds to a quarter of MSAs with the highest unemployment rates. As in the previous section, we could identify distressed areas based on national unemployment rate. The results based on this qualification produce very similar results.

durations than otherwise identical renters. The coefficient in the interaction term, α_2 , is slightly smaller compared to the state level measure. When we introduce the actual unemployment rate as a control for labor demand, the effect of market size, although still negative, becomes insignificant. We conclude that the MSA characterization of a labor market supports our hypothesis.

In addition to the usual covariates we also add an indicator for MSAs with population above 2 million and interact this with ownership and local labor market conditions variables. This aims to capture the sheer size of the city and its interaction with the local labor demand. More specifically, we are controlling for the fact that in these big MSAs matching technology might be more efficient due to agglomeration, and by the same reasoning, unemployed owners who live in these big MSAs might have better job finding outcomes. The coefficient on the interaction between the unemployment rate and high population dummy is positive, meaning that given a particular unemployment rate, in “big” labor markets it is easier to find jobs. Homeowners in these “big” MSAs, on the other hand, do not seem to have any other difference in unemployment duration compared to renters.

Although in this section we control for MSA/CMSA population over time, our labor market proxy would work better in smaller cities. This is because it is easier to compare cities with similar population in terms of unemployment rate. Moreover, as shown in column 2, in “big” MSAs the effect of unemployment rate on job finding probability is mitigated. Therefore, owners are expected to have even longer durations of unemployment in distressed labor markets with lower population. In column three of Table 7 we restrict our analysis to those MSAs with population lower than 2 million people as of 1990. The coefficient on distressed market is considerably higher, further supporting a similar argument presented in the third and the fourth columns of Table 5.

The fact that mobility and ownership is strongly related to each other induces selection problems that would affect unemployment duration. For instance, it is possible for some immobile by nature individuals to buy houses in locations with relatively weak labor demand. This would produce a spurious negative relationship between owners in distressed areas and their job finding probabilities, thus compromising our results. In order to address this concern, we focus on individuals who still live in their state of birth. Arguably these people are the subject of this type of selection due to their preference to the state of birth. Column four in Table 7 shows, however, that the effect of ownership and its interaction with weak labor market, albeit negative, becomes insignificant. Therefore we do not see any strong results for this group due to a supposed selection.

We conclude that the evidence coming from state level and MSA level results suggests that homeowners experience longer unemployment durations than renters in distressed labor markets. This effect is stronger in non-metropolitan areas and metropolitan areas with smaller populations. Moreover, unreported estimates confirm that our main result is robust

Table 7: Estimation Results with MSA Level Labor Markets

Statistic ^a	I	II	III	IV
owner	-.033 (.073)	.041 (.113)	.080 (.098)	-.049 (.101)
distressed	-.013 (.117)		.067 (.135)	-.029 (.182)
owner x distressed	-.123* (.066)		-.225* (.116)	-.040 (.097)
owner x high population	-.011 (.067)	-.051 (.064)		.018 (.099)
high population x distressed	.120 (.163)			-.112 (.227)
unemp. rate		-.112*** (.036)		
owner x unemp. rate		-.018 (.016)		
high population x unemp. rate		.231*** (.076)		
Observations	5165	5165	2063	2611

^aThe Table shows the unemployment hazard regression specified in equation 17 at MSA level. The first column shows the results with a dummy specification for the labor market conditions, and the second column shows the results with previous year unemployment rate as the labor market condition indicator. The third column presents the results of households that live in MSAs smaller than population of 2 million. The fourth column presents the results for those households who live in their state of birth. A complete list of the other covariates is described in Appendix. The numbers in the parentheses are the standard errors. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

to different ways defining the distressed labor market and running separate regressions based on distressed labor market status.³² We agree that this does not necessarily rule out the full list of selection issues associated with being homeowner and unemployment duration in a distressed labor market. However, it is highly unlikely that this seemingly reaffirming relationship between these homeownership and unemployment hazard rate -after a long list of control variables, state and MSA level exercises, different subgroup regressions- is an artifact of an alternative story.

4.4 Homeownership and Wages

One potentially important aspect of the effects of homeownership on individuals' labor market performance is the wage followed by an unemployment period. Our theoretical model suggests that homeowners are less likely to accept outside job offers due to higher moving costs, and to compensate this imposed friction they have lower their reservation wages for the local jobs. One could test this hypothesis using post unemployment information. More specifically, we could compare pre and post unemployment wages of homeowners and renters for those households that find a local job. In this section we rely on two data sources to test our theoretical proposition.³³

First, we use the SIPP unemployment spell data compiled in the previous section for the purpose of job finding probability. However, we impose further restrictions for that sample to identify the effect of homeownership on post unemployment wages. We focus on individuals who were working prior to the unemployment spell and have found a job after the unemployment. Moreover, we drop spells that have zero wage in either before or after unemployment periods or wages that deviate more than 2 times in between.³⁴ Since we are looking at local jobs, we drop individuals who move between MSAs within the course of that unemployment spell. In order to avoid short term movements out of and into the same job, we restrict our attention to unemployment spells longer than 1 week and we reduce any

³²For instance, we defined distressed labor market as those places that have higher unemployment rates than the national average. We also tried a time invariant distressed labor market for those places who were labeled as distressed in both time periods. The estimates are quite similar both for state level and MSA level exercises. In order to control for structural differences across distressed vs other labor markets we ran our benchmark regressions separately for distressed labor markets and other areas which yield strong and significant effects for distressed labor markets. The results are available upon request.

³³Unlike the literature on housing and unemployment, there are not many studies that investigate this question. Munch, Rosholm and Svarer (2008) jointly estimate job duration with wages and find that homeownership has a negative impact on job separation and positive impact on wages. More recently Yang (2015) compares households with mortgage and renters, and find that ownership has a negative effect on post unemployment wages.

³⁴Pre and post periods are defined based on the wave preceding and following the unemployment spell respectively. We take the weekly average wage of the first job (the main job) in these periods for those individuals who remained employed on all 4 months in that wave. Average wage is defined as the total wage in a wave divided by number of weeks worked in that wave.

Table 8: Pre and Post Unemployment Weekly Wages: Homeowners and Renters

	Panel A: SIPP		Panel B: DWS	
	Renters	Owners	Renters	Owners
Pre Unemployment Wage	453	724	514	843
Post Unemployment Wage	448	687	494	755
Log Wage Difference	-.01	-.04	.02	-.12
Unemployment Duration	10.93	10.47	8.69*	10.82*
Observations	560	781	292	535

Source: SIPP 1996-2001. CPS DWS 1994-2004

Pre and Post Unemployment wages are inflation adjusted weekly average wages preceding and following an unemployment spell. Log wage difference is the difference of log post unemployment wage and log pre unemployment wage.

* Conditional on having unemployment duration information greater than 1 week

multiple spells within 4 months into one spell. This leaves us with 1,341 unemployment spells of whom 781 are homeowners.

Table 8 panel A describes relevant statistics for the subsample used in this analysis. As we observed in the original sample, wages of homeowners and renters are considerably different from each other. In terms of pre and post unemployment outcomes, renters do not experience much of a change after an unemployment spell ending with local job whereas homeowners have a mild drop in wages. In this subsample average unemployment duration is slightly higher for renters. From the raw data there is only limited support for the post unemployment wage difference between homeowners and renters for jobs found in the local market.

We then perform a linear regression of wage difference between post and pre unemployment against the covariates introduced in previous section. As common in studies of wage comparison after an unemployment spell, we include log pre unemployment wage as a further control. Table 9 presents the coefficient of homeownership together with the additional controls. If we do not control the pre unemployment wage, being a homeowner reduces the post unemployment wage by almost 9 percent. However this effect is not significant. Once we add the aforementioned variable its effect becomes virtually zero. However, it should be noted that several factors make it difficult to isolate the effect of ownership on post-unemployment wages. First of all, as it is seen in Table 8, unlike their unemployment durations, average wage of owners and renters are quite different from each other and their wage levels are closely related to the cost of living in the city of their residence. Second, the factors that affect the likelihood of being unemployed could be related to both pre and post unemployment wages. Third, as shown in Guler et al (2012) joint-search problem of married households may have direct effects on post-unemployment wages and is not easy

Table 9: Homeownership and Post Unemployment Wages: Evidence from SIPP

Statistic ^a	I	II	III
owner	-.085 (.059)	-.011 (.050)	-.131* (.072)
pre-unemp. wage		-.525*** (.033)	-.528*** (.051)
Observations	1341	1341	647

^aThis Table shows the estimates of wage difference regression based on the SIPP data. The dependent variable is the difference of log post-unemployment wages and log pre-unemployment wages. First column shows the result for the reduced sample of wages excluding pre-unemployment wage as a regressor. Second column includes pre-unemployment wage as a regressor. Third column presents results based on a further reduced sample where married households with spouses in the labor force are excluded. A complete list of the other covariates is described in Appendix. The numbers in the parentheses are the robust standard errors. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

to control, which further complicates the second point. For a simple test of this, we remove any individual whose wife is part of the labor force and run the same regression with the newly restricted sample. In this case, ownership seems to reduce post-unemployment wage by 13 percent. We conclude that high frequency nature of the SIPP data makes it difficult to isolate these concerns altogether. For that reason we turn to Current Population Survey's Displaced Worker Supplement which we argue is more suitable for this exercise.

Displaced Worker Survey (DWS) is a supplement to the Current Population Survey. It conducts interviews every two years and asks retrospective questions regarding job loss due to involuntary reasons such as plant closing or relocation, slack work, abolition of shift or position etc. It is often used in wage comparison analysis since it has wage information for before and after unemployment.³⁵ The biggest advantage of the DWS is that it focuses on individuals with involuntary separation from previous jobs which makes it easier for us to interpret the reasons for wage change after a job loss. Moreover, it has more detailed information on location which allows us to control for city level wage dispersion over time. We provide more detail about DWS data, our sampling restrictions and control variables in Appendix.

For the purpose of this exercise we collect DWS data for years 1996, 1998, 2000, 2002 and 2004 which overlap with the SIPP unemployment spell data. We focus on civilian males who lost a job in recent years before the interview date and found another job later on. As argued in the theoretical model, we focus on individuals who did not move after the job loss. Panel B in Table 8 describes the summary statistics of wage and unemployment duration

³⁵See Addison and Blackburn (2000) for a general introduction of the survey. Farber (2012) rely on DWS to assess the contribution of housing to the unemployment increase in the Great Recession. Farber (2017) further discusses the experience of job losers during the Great Recession and compares it with earlier periods in terms of job finding and post unemployment wages.

Table 10: Homeownership and Post Unemployment Wages:Evidence from DWS

Statistic ^a	I	II	III	IV	V	VI
owner	-0.095** (0.044)	-0.135* (0.073)	-0.071** (0.030)	-0.056 (0.042)	-0.041 (0.025)	-0.043 (0.033)
pre-unemp. wage	-0.584*** (0.052)	-0.565*** (0.073)	-0.538*** (0.034)	-0.532*** (0.045)	-0.592*** (0.027)	-0.594*** (0.034)
Observations	827	516	1448	945	1939	1278

^aThis Table shows the estimates of wage difference regression based on the DWS data. The dependent variable is the difference of log post-unemployment wages and log pre-unemployment wages. First column presents results for individuals who lost their jobs due to involuntary reasons within 1 year before the interview date. Second column introduces further restriction of at least 2 weeks of unemployment before finding a job to the first column. Third and fifth columns present results for individuals who lost their jobs due to involuntary reasons within 2 years and 3 years respectively. Fourth and sixth columns introduce further restriction of at least 2 weeks of unemployment before finding a job to the third and fifth columns. A complete list of the other covariates is described in Appendix. The numbers in the parentheses are the robust standard errors. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

both for renters and owners using DWS data. For descriptive purposes we only consider individuals who lost their jobs up to one year before the interview date.³⁶ As in the case of the SIPP data, homeowners have higher pre and post unemployment wages. However the drop in homeowners' wage after an involuntary spell of unemployment is much higher than that of renters. Another interesting observation is that unemployment duration of homeowners is also higher. This in essence says that after an involuntary unemployment spell, not only it is harder for homeowners to find a new job but also they end up settling for lower paid jobs.

Table 10 reports estimates of the relevant variables for the purpose of this exercise. We first regress post and pre unemployment wage difference against ownership (and other variables) for those individuals who lost their jobs up to a year before the interview date. This is more relevant for our analysis because our control variables (especially ownership) is coming from the current interview -not retrospective status as of job displacement-; that information is more likely be more accurate for the job losses that happened not long ago. The first column reports the regression results based on this sample. For those individuals who experience an involuntary unemployment up to a 1 year, being a homeowner decreases post unemployment wage by almost 10 percent. When we restrict our attention to individuals with at least 2 weeks of unemployment before finding a job in column two this effect becomes even stronger. Pre-unemployment wage, as observed before, have a strong negative effect on post unemployment wage difference.

³⁶We will relax this assumption in the regression analysis.

In columns three and four we include job loss experience until 2 years before the interview date. In this case the effect of ownership becomes about a half of the effect observed in previous columns. Finally, in column five and column six we include job loss information up to 3 years ago. The estimates drop further and also become insignificant. This is not surprising because as we include further unemployment spells, the likelihood of incorrect information regarding ownership status becomes higher, pushing estimates towards zero. Based on this analysis we conclude that the effect of ownership on post unemployment wages could be between -10 to -5 percent. However, one should take these results with caution since our sample is much smaller compared to the unemployment duration analysis hence deprives us from doing further robustness tests.

5 Conclusion

In this paper we have explored the effects of the local labor market size on unemployment hazard rates for homeowners and renters. In a simple search-theoretic framework we showed that as the local labor market weakens, homeowners become less likely to find jobs than renters. With a calibrated model, we show that although the quantitative effects of housing frictions are small, they might have stronger amplifications effects when unemployment rate increases during a recession.

To test our theoretical result we analyzed the Survey of Income and Participation Survey data for the years between 1996 and 2003. Using a proportional hazard model for job finding, we find that unemployed homeowners are less likely than renters to become employed in areas with a weak local labor market, confirming our theoretical prediction. The unemployment hazard rate difference between renters and owners may increase up to 18%, depending on the local labor market definition. Consistent with the model predictions, we also provide evidence that homeowners have lower post unemployment wages than renters for local jobs.

Our theoretical model omits some important dimensions regarding the labor market and the housing market which might be important in understanding the effect of housing tenure on the unemployment hazard rate. It abstracts from wealth and housing price effects. Karahan and Ree (2013), Nenov (2015), and Ohanian and Raffo (2012) show that housing price dynamics can create movements in the unemployment dynamics. Such an analysis can be done at the state or MSA level using the empirical specification we use in the model. Rather than focusing on the effect of the local labor market conditions on the unemployment dynamics, the effect of differential house price dynamics across different states or MSAs on the unemployment dynamics can be analyzed by using the supply restrictions index introduced by Saiz (2010) as an instrumental variable.

Although, in the empirical section we control for asset and liability aspects of the house-

holds there are further avenues of research in this dimension. Liquid wealth is often resorted as unemployment insurance which could prolong the unemployment duration. In the same manner, leveraged households have incentives to find jobs faster when unemployed. It is an open question whether liquid wealth and leverage interacts with homeownership. Moreover, as shown in Farber (2012) and others, homeownership did not have a strong impact on the rising unemployment rates during the Great Recession. One could test whether increased leverage of homeowners mitigate the effects of homeownership on unemployment duration.

Acknowledgments

We would like to thank Dean Corbae, Andy Glover, Kripa Freitas for their comments and suggestions. We also greatly appreciate the feedbacks received from seminar and conference participants at the University of Texas at Austin and 2012 Midwest Macroeconomics Meetings at South Bend.

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A Data Description

A.1 List of Covariates in Unemployment Duration Estimation

- indicator for holding a mortgage
- log of inflation adjusted mortgage debt
- share of mortgage debt against the home value
- log of inflation adjusted unsecured debt
- log of inflation adjusted secured debt (excluding mortgage)
- indicator for positive liquid wealth (defined as total wealth minus home, real estate, business and vehicle equity)
- log of inflation adjusted liquid wealth
- the last earned monthly income amount observed before the beginning of an unemployment spell,
- a dummy indicating no information on previous earnings (an unemployment spelling entering from non-participation and without prior job information in the SIPP),
- a dummy indicating positive property income for the family,
- a dummy indicating positive transfer income for the family,
- the income decile of the family as of first month of unemployment (for the unemployment spells that end within the same month we use the previous month's income),
- dummies for blacks, and hispanics,
- dummies for men without high school, and with high school but no college degrees,
- dummies for age categories 18 to 24, 25 to 29, 30 to 39, 40 to 49,
- a dummy for married men,
- a dummy indicating whether the spouse is working,
- a dummy indicating whether the spouse is not participating in the labor force,
- a dummy indicating the presence of children in the household,
- a dummy indicating the receipt of unemployment benefits,

- the amount of unemployment benefits received,
- state controls,
- MSA controls,
- year dummies,
- annual unemployment rate in the state of residence, source: BLS,
- annual homeownership rate in the state of residence, source: Census,
- log of annual population in the state of residence, source: Census,
- log of annual percapita income in the state of residence, source: BEA,
- log of annual home price in the state of residence, source: FHFA.

Table 11: State Unemployment Rates

state	unemp. 95	state	unemp. 00
California	7.9	Mississippi	5.7
West Virginia	7.8	West Virginia	5.5
New Mexico	6.8	Oregon	5.1
Louisiana	6.7	New Mexico	5.0
Mississippi	6.5	Washington	5.0
New Jersey	6.5	California	5.0
New York	6.3	Louisiana	4.9
Washington	6.3	Montana	4.8
Rhode Island	6.1	Idaho	4.7
Texas	6.1	New York	4.5
Pennsylvania	5.9	Illinois	4.5
Florida	5.7	Texas	4.4
Nevada	5.6	Kentucky	4.3
Kentucky	5.6	Rhode Island	4.2
Massachusetts	5.5	Pennsylvania	4.2
Montana	5.5	Arkansas	4.2
Arizona	5.4	Nevada	4.2
Tennessee	5.4	Arizona	4.1
Michigan	5.3	Ohio	4.0
Idaho	5.3	Alabama	4.0
Connecticut	5.2	Tennessee	4.0
Illinois	5.2	Florida	3.8
Alabama	5.1	Kansas	3.8
South Carolina	5.1	North Carolina	3.8
Maryland	5.0	Michigan	3.7
Oregon	4.9	New Jersey	3.7
Ohio	4.9	South Carolina	3.6
Arkansas	4.8	Maryland	3.6
Georgia	4.7	Georgia	3.5
Missouri	4.7	Utah	3.4
Oklahoma	4.6	Wisconsin	3.4
Virginia	4.4	Missouri	3.3
Kansas	4.4	Delaware	3.3
North Carolina	4.4	Oklahoma	3.1
Indiana	4.3	Minnesota	3.1
Delaware	4.3	Indiana	2.9
Colorado	4.0	Nebraska	2.8
New Hampshire	4.0	Iowa	2.8
Wisconsin	3.7	Colorado	2.8
Minnesota	3.7	Massachusetts	2.7
Iowa	3.6	New Hampshire	2.7
Utah	3.5	Virginia	2.3
Nebraska	2.6	Connecticut	2.3

Table 12: Selected MSA/CMSA Unemployment Rates

MSA/CMSA	unemp. 95	MSA/CMSA	unemp. 00
McAllen–Edinburg–Mission, TX MSA	19.8	McAllen–Edinburg–Mission, TX MSA	12
Modesto, CA MSA	15.3	Bakersfield, CA MSA	12
Fresno, CA MSA	14.3	Fresno, CA MSA	12
Bakersfield, CA MSA	13.8	Modesto, CA MSA	11.7
Stockton–Lodi, CA MSA	12.3	Stockton–Lodi, CA MSA	10.3
Fort Pierce–Port St. Lucie, FL MSA	10.7	El Paso, TX MSA	9.5
El Paso, TX MSA	10.5	Fayetteville, NC MSA	8.6
Beaumont–Port Arthur, TX MSA	9.8	Beaumont–Port Arthur, TX MSA	7.8
Corpus Christi, TX MSA	9.1	Corpus Christi, TX MSA	7.6
Scranton–Wilkes-Barre–Hazleton, PA MSA	7.7	Los Angeles–Riverside– Orange County, CA CMSA	7.4
Los Angeles–Riverside– Orange County, CA CMSA	7.5	Miami–Fort Lauderdale, FL CMSA	7.2
Lakeland–Winter Haven, FL MSA	7.2	Buffalo–Niagara Falls, NY MSA	7
West Palm Beach–Boca Raton, FL MSA	7.2	New Orleans, LA MSA	6.8
Mobile, AL MSA	6.8	Killeen–Temple, TX MSA	6.8
Santa Barbara–Santa Maria–Lompoc, CA MSA	6.7	Mobile, AL MSA	6.7
Miami–Fort Lauderdale, FL CMSA	6.7	New York–Northern New Jersey– Long Island, NY–NJ–CT–PA CMSA	6.7
Sacramento–Yolo, CA CMSA	6.7	Santa Barbara–Santa Maria–Lompoc, CA MSA	6.7
New York–Northern New Jersey– Long Island, NY–NJ–CT–PA CMSA	6.5	Las Vegas, NV–AZ MSA	6.6
Melbourne–Titusville–Palm Bay, FL MSA	6.5	Eugene–Springfield, OR MSA	6.4
New Orleans, LA MSA	6.4	Memphis, TN–AR–MS MSA	6.4
San Diego, CA MSA	6.4	Philadelphia–Wilmington– Atlantic City, PA–NJ–DE–MD CMSA	6.3
Baton Rouge, LA MSA	6.1	Chicago–Gary–Kenosha, IL–IN–WI CMSA	6.3
Philadelphia–Wilmington– Atlantic City, PA–NJ–DE–MD CMSA	6.1	Sacramento–Yolo, CA CMSA	6.2
Houston–Galveston–Brazoria, TX CMSA	5.9	Syracuse, NY MSA	6.2
Pittsburgh, PA MSA	5.9	Houston–Galveston–Brazoria, TX CMSA	6.2
Springfield, MA MSA	5.8	Pensacola, FL MSA	6.2

A.2 Displaced Worker Survey Data

Displaced Worker Survey is part of Current Population Survey and has been conducted every two years in months of February or January. Working age adults are asked whether they lost a job within the last 3 years due to involuntary reasons such as: plant closing or relocation, insufficient work, abolition of shift or position, completion of seasonal job, self-operated business failure. For those individuals that respond positively to this question it then asks a series of questions regarding previous job, details of displacement, unemployment period and subsequent job history that follows. More specifically it includes industry and occupation of the lost job and weekly earnings in that time. It has information on the year and the reason of job loss, together with the following mobility, unemployment benefits, unemployment duration history. It also has how many jobs the individual has worked ever since the original job loss and for the current job we have variety of information such as industry, occupation and weekly earnings. The nature of the CPS allows us to identify individuals at the MSA level for large part of the sample. Finally monthly CPS data has the usual demographic information (age, race, education, marital status etc.)

Data Construction and Sampling Restrictions We compile data from Displaced Worker Survey together with the original Current Population Survey of that month for years 1996, 1998, 2000, 2002 and 2004. Our main sample is civilian males of ages between 18-65 who lost a job due to involuntary reasons within the last 3 years of the interview date and subsequently found another job. As in the case of unemployment sample we focus on individuals who are listed either household head or spouse/partner of the household head. We drop individuals who are currently registered to a school. For the purpose of being close to proposed theory we only consider individuals who did not move after the job loss and have been working on the same job after the unemployment period.

We adjust weekly earnings by annual CPI (1996 level) and further drop any observation that has an earnings change more than 200 percent. For the sample where we have unemployment information we drop any duration less than 2 weeks. Finally we exclude states of Alaska and Hawaii and drop households that do not live in metropolitan areas. We combine this data with state level aggregates (unemployment rate, log population, log percapita income, house prices) and metropolitan level aggregates (unemployment rate and population). We further complement the data with labor market information on wives.

List of Covariates -ownership status

-log of previous wage

-age categories, education categories, race indicators, indicator of having children in the house, marriage and partnership indicators, labor force indicators of the partner (labor force

status, employment status, full time status)

-previous occupation and industry categories, full time status in previous job, reason for job displacement, indicator for unemployment benefits, job loss year

-current occupation and industry categories, indicators for industry and occupation mobility, current full time status, family income categories with a year trend

-state fixed effects, MSA fixed effects, year fixed effects

-state level unemployment rate, homeownership rate, house prices, log percapita income, log population; MSA level unemployment rate, triple interaction of MSA level population categories with central city residence and year trend

B Proofs

Proof. [Lemma 1] By taking the differences of the value functions between the employed owner and employed renter, we can see that this difference depends on the difference between the values of being an unemployed owner and unemployed renter:

$$(r + \delta + \varphi)(W_H(w) - W_R(w)) + \lambda [\max\{W_H(w) - W_R(w), 0\}] = \gamma + \delta [U_H - U_R].$$

Since, by Assumption 1, we know that $U_H > U_R$, we get $W_H(w) > W_R(w)$ for any w . ■

Proof. [Proposition 1] First, notice that the difference between employed owner and employed renter at a given wage w is constant, i.e. independent of the wage w . We can see this taking the difference between equations (1) and (2), together with the fact $W_H(w) > W_R(w)$ due to Lemma 1:

$$W_H(w) - W_R(w) = \frac{\gamma + \delta [U_H - U_R]}{r + \delta + \varphi + \lambda}.$$

Using equations (8) and (7), we get

$$\begin{aligned} (r + \delta) W_H(w_H^n) - (r + \delta) W_H(w_H^l) &= (r + \delta) \kappa \\ w_H^n - w_H^l &= (r + \delta) \kappa. \end{aligned}$$

w_H^l is characterized by equation (7). Substituting equations (1) and (3) into equation (7), and using integration by parts, we get

$$w_H^l = b + \frac{\alpha(1-\eta)}{r+\delta} \int_{w_H^l} (1-F(w)) dw + \frac{\alpha\eta}{r+\delta} \int_{w_H^n} (1-F(w)) dw + \varphi\Delta, \quad (18)$$

where $\Delta = [W_H(w) - W_R(w)] - [U_H - U_R]$, which is constant and independent of w . Similarly, w_R is characterized by

$$w_R = b + \frac{\alpha}{r+\delta} \int_{w_R} (1-F(w)) dw - \lambda\Delta. \quad (19)$$

Using equations (1),(3),(2), and (5), Δ can be expressed as

$$\Delta(r + \delta + \lambda + \varphi) = - \left[\frac{\alpha(1-\eta)}{r + \delta} \int_{w_H^l}^{w_R} (1 - F(w)) dw + \frac{\alpha\eta}{r + \delta} \int_{w_H^n}^{w_R} (1 - F(w)) dw \right] \quad (20)$$

Combining equations (18),(19), and (20), we can rewrite the equation for Δ in terms of reservation wages:

$$\Delta = \frac{w_R - w_H^l}{r + \delta}$$

Substituting this expression for Δ into equation (18) and (19), we get the equations for renter reservation wage, w_R , and local reservation wage of an owner, w_H^l :

$$\begin{aligned} w_R \left(\frac{r + \lambda + \delta}{r + \delta} \right) &= b + \frac{\alpha}{r + \delta} \int_{w_R} (1 - F(w)) dw + \lambda \frac{w_H^l}{r + \delta} \\ w_H^l \left(\frac{r + \varphi + \delta}{r + \delta} \right) &= b + \frac{\alpha(1-\eta)}{r + \delta} \int_{w_H^l} (1 - F(w)) dw + \frac{\alpha\eta}{r + \delta} \int_{w_H^n} (1 - F(w)) dw + \varphi \frac{w_R}{r + \delta} \end{aligned}$$

To see the ranking of the reservation wages, subtract equation (10) from equation (9):

$$(r + \delta + \lambda + \varphi)(w_R - w_H^l) = - \left[\alpha(1-\eta) \int_{w_H^l}^{w_R} (1 - F(w)) dw + \alpha\eta \int_{w_H^n}^{w_R} (1 - F(w)) dw \right].$$

Notice that $w_H^l < w_H^n$. Then, if $w_R < w_H^l < w_H^n$, the RHS of the above equation becomes positive whereas the LHS becomes negative. Similarly, if $w_H^l < w_H^n \leq w_R$, then RHS becomes negative and LHS becomes positive. Both cases result in a contradiction. As a result, we have $w_H^l < w_R < w_H^n$. ■

Proof. [Lemma 2] Subtract equation (9) from (11), and set $\eta = 0$, we arrive at

$$(r + \delta + \lambda + \varphi)(w_R - w_H^l) = -\alpha \int_{w_H^l}^{w_R} (1 - F(w)) dw.$$

Here it is immediate to see $w_R = w_H^l$. This will also imply that

$$\theta_R = \alpha(1 - F(w_R)) = \alpha(1 - F(w_H^l)) = \theta_H.$$

■

Proof. [Proposition 2] Notice that unemployment hazard rate for owners strongly depend on the cost of moving for owners, κ . If $\kappa = 0$, then from equation (11), we get $w_H^n = w_H^l$, which immediately implies that $w_R = w_H^l = w_H^n$. So, when $\kappa = 0$, we have $\theta_H = \theta_R$. Then, if we can show that $\frac{d\theta_H}{d\kappa} < 0$ and $\frac{d\theta_R}{d\kappa} > 0$, this will suffice to prove our proposition. We first start with expressing the derivative of the total owner unemployment hazard rate with

respect to κ using equation (13):

$$\frac{d\theta_H}{d\kappa} = -\alpha(1-\eta)f(w_H^l)\frac{dw_H^l}{d\kappa} - \alpha\eta f(w_H^n)\frac{dw_H^n}{d\kappa}. \quad (21)$$

Using equation (11), we know that

$$\frac{dw_H^n}{d\kappa} = \frac{dw_H^l}{d\kappa} + r + \delta. \quad (22)$$

Again, using equation (10), we can evaluate $\frac{dw_H^l}{d\kappa}$:

$$\frac{dw_H^l}{d\kappa}(r + \varphi + \delta) = -\frac{dw_H^l}{d\kappa}\alpha(1-\eta)(1-F(w_H^l)) - \frac{dw_H^n}{d\kappa}\alpha\eta(1-F(w_H^n)) + \varphi\frac{dw_R}{d\kappa}. \quad (23)$$

Lastly, using equation (9), we can express $\frac{dw_R}{d\kappa}$ as

$$\begin{aligned} \frac{dw_R}{d\kappa}(r + \lambda + \delta) &= -\frac{dw_R}{d\kappa}\alpha(1-F(w_R)) + \lambda\frac{dw_H^l}{d\kappa} \\ \frac{dw_R}{d\kappa} &= \frac{\lambda}{r + \lambda + \delta + \theta_R}\frac{dw_H^l}{d\kappa} \end{aligned} \quad (24)$$

Combining equations (22), (23) and (24), we get the following equation for $\frac{dw_H^l}{d\kappa}$:

$$\frac{dw_H^l}{d\kappa} = -\frac{\theta_H^n(r + \delta)}{r + \delta + \varphi + \theta_H - \frac{\varphi\lambda}{r + \delta + \lambda + \theta_R}}.$$

Notice that $r + \delta + \varphi + \theta_H - \frac{\varphi\lambda}{r + \lambda + \delta + \theta_R} > 0$ and $\theta_H^n > 0$ as $\eta > 0$, which means $\frac{dw_H^l}{d\kappa} < 0$. Moreover, since $\frac{dw_R}{d\kappa} = \frac{\lambda}{r + \lambda + \delta + \theta_R}\frac{dw_H^l}{d\kappa}$ and $\frac{\lambda}{r + \lambda + \delta + \theta_R} < 1$, we have $\frac{dw_H^l}{d\kappa} < \frac{dw_R}{d\kappa} < 0$. Using equation (22), we get

$$\frac{dw_H^n}{d\kappa} = \frac{(r + \delta)\left(r + \delta + \theta_H^l + \varphi - \frac{\varphi\lambda}{r + \delta + \lambda + \theta_R}\right)}{r + \delta + \varphi + \theta_H - \frac{\varphi\lambda}{r + \delta + \lambda + \theta_R}} > 0,$$

since $\varphi - \frac{\varphi\lambda}{r+\delta+\lambda+\theta_R} > 0$. Using these expressions for $\frac{dw_H^l}{d\kappa}$ and $\frac{dw_H^n}{d\kappa}$ in (21) yields us

$$\begin{aligned} \frac{d\theta_H}{d\kappa} &= \alpha(1-\eta) \frac{f(w_H^l)\theta_H^n(r+\delta)}{r+\delta+\varphi+\theta_H - \frac{\varphi\lambda}{r+\delta+\lambda+\theta_R}} - \alpha\eta f(w_H^n) \frac{(r+\delta)(r+\delta+\theta_H^l + \varphi - \frac{\varphi\lambda}{r+\delta+\lambda+\theta_R})}{r+\delta+\varphi+\theta_H - \frac{\varphi\lambda}{r+\delta+\lambda+\theta_R}} \\ &= \alpha^2(1-\eta)\eta(r+\delta) \frac{f(w_H^l)(1-F(w_H^n)) - f(w_H^n)(1-F(w_H^l))}{r+\delta+\varphi+\theta_H - \frac{\varphi\lambda}{r+\delta+\lambda+\theta_R}} \\ &\quad - \frac{\alpha\eta f(w_H^n)(r+\delta)(r+\delta+\varphi - \frac{\varphi\lambda}{r+\delta+\lambda+\theta_R})}{r+\delta+\varphi+\theta_H - \frac{\varphi\lambda}{r+\delta+\lambda+\theta_R}} \end{aligned}$$

Since the second part in the last equation is negative, showing $f(w_H^l)(1-F(w_H^n)) - f(w_H^n)(1-F(w_H^l)) < 0$ is sufficient to prove that $\frac{d\theta_H}{d\kappa} < 0$. Since F is log-concave we know that $1-F$ should be also log-concave, that is $\frac{f(x)}{1-F(x)}$ is increasing in x . Notice that $w_H^l < w_H^n$, then we have $\frac{f(w_H^l)}{1-F(w_H^l)} < \frac{f(w_H^n)}{1-F(w_H^n)}$, which immediately results $f(w_H^l)(1-F(w_H^n)) - f(w_H^n)(1-F(w_H^l)) < 0$.

Next, we need to show that $\frac{d\theta_R}{d\kappa} > 0$. Using equation (2), we have $\frac{d\theta_R}{d\kappa} = -\alpha f(w_R) \frac{dw_R}{d\kappa}$. Note that $\frac{dw_R}{d\kappa} < 0$, which implies $\frac{d\theta_R}{d\kappa} > 0$. ■

Proof. [Proposition 3] First we compute $\frac{dw_H^l}{d\eta}$ and $\frac{dw_H^n}{d\eta}$. Using equation (11), we have $\frac{dw_H^n}{d\eta} = \frac{dw_H^l}{d\eta}$. Again, using equation (10), we get

$$\begin{aligned} \frac{dw_H^l}{d\eta}(r+\varphi+\delta) &= -\frac{dw_H^l}{d\eta}\alpha(1-\eta)(1-F(w_H^l)) - \frac{dw_H^n}{d\eta}\alpha\eta(1-F(w_H^n)) + \varphi\frac{dw_R}{d\eta} \quad (25) \\ &\quad - \alpha \int_{w_H^l}^{w_H^n} (1-F(w))dw. \end{aligned}$$

Similarly, we can compute $\frac{dw_R}{d\eta}$ using equation (9):

$$\begin{aligned} \frac{dw_R}{d\eta}(r+\lambda+\delta) &= -\frac{dw_R}{d\eta}\alpha(1-F(w_R)) + \lambda\frac{dw_H^l}{d\eta} \\ \frac{dw_R}{d\eta} &= \frac{\lambda}{r+\lambda+\delta+\theta_R} \frac{dw_H^l}{d\eta} \quad (26) \end{aligned}$$

Combining equations (25) and (26), we get

$$\frac{dw_H^n}{d\eta} = \frac{dw_H^l}{d\eta} = -\frac{\alpha \int_{w_H^l}^{w_H^n} (1-F(w))dw}{r+\delta+\varphi+\theta_H - \frac{\varphi\lambda}{r+\delta+\lambda+\theta_R}} < 0,$$

since $w_H^n > w_H^l$. Thus, we also have $\frac{dw_R}{d\eta} = \frac{\lambda}{r+\lambda+\delta+\theta_R} \frac{dw_H^l}{d\eta} < 0$. But notice that since $\frac{\lambda}{r+\lambda+\delta+\theta_R} < 1$, $\frac{dw_H^l}{d\eta} = \frac{dw_H^n}{d\eta} < \frac{dw_R}{d\eta} < 0$. ■

Proof. [Proposition 4] From Proposition 3 we have $\frac{dw_R}{d\eta} < 0$. This implies, $\frac{d\theta_R}{d\eta} = -f(w_R) \frac{dw_R}{d\eta} > 0$. Using the equations (13) and (2), we can express the derivative of the unemployment hazard rate for owners with respect to η as

$$\frac{d\theta_H}{d\eta} = -\alpha \left(F(w_H^n) - F(w_H^l) \right) - \alpha \eta f(w_H^n) \frac{dw_H^n}{d\eta} - \alpha (1 - \eta) f(w_H^l) \frac{dw_H^l}{d\eta}.$$

Since $w_H^n > w_H^l$, we have $-\alpha \left(F(w_H^n) - F(w_H^l) \right) < 0$. However, the other term is positive:

$$-\alpha (1 - \eta) f(w_H^n) \frac{dw_H^n}{d\eta} - \alpha \eta f(w_H^l) \frac{dw_H^l}{d\eta} = -\frac{dw_H^l}{d\eta} \left(\alpha \eta f(w_H^n) + \alpha (1 - \eta) f(w_H^l) \right) > 0,$$

since $\frac{dw_H^l}{d\eta} = \frac{dw_H^n}{d\eta} < 0$. So, overall effect is ambiguous. ■