Homeownership and Unemployment: 
The Effect of Market Size 

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Abstract

This paper explores the effect 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 demand is low. We also show that the additional frictions homeowners face due to housing make them less mobile, and they become less likely to accept outside job offers, and more likely to accept local offers. Then, using data from the Survey of Income and Program Participation (SIPP), we find empirical evidence that as local labor market opportunities deteriorate, homeowners become more likely than renters to remain unemployed, as suggested by our theoretical model.

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 correlations 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, it is difficult based on macro level analysis, 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 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 to look for jobs in multiple locations, local vs national as in Guler et al (2012). Being an owner is strictly preferred by the individuals since there is a utility premium for housing. It takes time for renters to find an owner-occupied unit. At the same time, incumbent homeowners are forced to sell their units with some exogenous probability and become renters. Moreover, owners face an additional cost having to do with job offers from outside locations. For owners, accepting an outside offer requires paying an additional moving cost.

We prove that since owners face an additional cost for moving, they have a higher reservation wage for outside offers. For these offers, this implies lower unemployment hazard rates for homeowners as compared to renters, as suggested by Munch, Rosholm and Svarer (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 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. More specifically, we show that owners’ unemployment duration is higher in regions where the local labor demand is weak, thin markets, compared to thick markets, where local labor demand is strong. However, given reasonable parameters that reflects the US housing and labor markets, we find the positive effect of homeownership on the unemployment rate to be small.

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\(^2\)Dohmen (2005), van Vuuren and van Leuvensteijn (2007), Coulson and Fisher (2009), Morescalchi (2011), and Head and Ellis (2012) reach similar conclusions.
We use Survey of Income and Program Participation (SIPP) data from 1996 to 2003 to test the quantitative prediction of the housing and labor market 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.

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. Head and 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 that the aggregate effect of ownership on unemployment under plausible parametrization of the US economy is not quantitatively important. They argue that for this effect to achieve quantitative importance, one needs higher average unemployment rates and higher mobility. 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 (2012) study the mobility and unemployment implications of liquidity constraints and find that the housing bust marginally contributed to the sharp increase in the unemployment rate during the great recession. Our labor market is very similar to that described by Munch et al. (2006), with the inclusion of ownership choice, which is a simplification of Head and Ellis’s (2012) housing market.

One strand of the literature investigates whether owners are more likely to stay unemployed than renters using micro data. Although it has been widely reported that owners move less often, and that they thus 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 (2013) 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 are less likely to find jobs. Longer unemployment durations for homeowners are particularly strong for outright owners, and they argue that this is due to relative leverage on the house: Mortgage holders with a small share of outstanding housing debt have similarly long unemployment durations compared to outright owners. We mostly rely on the empirical framework of Taskin and Yaman (2013) and show that much of the positive relationship between homeownership and unemployment comes from regions where the local 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 households. Time is continuous, and there is no aggregate uncertainty. Housing tenure is explicitly modeled. 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\(^3\). We assume that households have a strict preference for ownership over renting, because ownership brings a differential flow utility, \( \gamma > 0 \), for a household\(^4\). 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 rate \( \lambda \).

Owners are hit with a selling shock at the rate \( \varphi \) which forces them to sell their houses. If an owner decides to move to another location, then she has to sell her house and purchase

\(^3\)Suppose that all housing units are owned by a third-party landlord, and households have access to an infinite-horizon mortgage. Given that households and landlords have access to the same lending technology, the cost of renting and mortgage payments should be the same.

\(^4\)This 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.
a new one in the other location\textsuperscript{5}. This total transaction costs $\kappa$ to the mover\textsuperscript{6}. Renters are not subject to any moving costs\textsuperscript{7}.

The labor market is in the spirit of the McCall model (McCall, 1970), extended for multiple locations as in Guler et al (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 $\alpha$. Since the total measure of individuals in each location is 1, this will have the result that each individual receives offers from the local location at the rate $\alpha \eta$, and from the outside locations at the rate $\alpha (1 - \eta)$, where $\eta = \frac{1}{L}$. Wage offers $w$ are generated from an exogenous wage offer distribution $F(w)$ with support $[0, \infty)$. There is no on-the-job-search, but an employed household receives an exogenous separation shock at the rate $\delta$, which makes her unemployed.

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 $w$, $W_H(w)$:

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

(1)

where $r$ is the subjective time preference of 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\textsuperscript{8}, $\gamma - p$, 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:

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

(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, here it is possible for the renter not to become an owner even if she finds an owner-occupied unit. Next, the flow value

\textsuperscript{5}We assume that owners moving to the other location also stay as owners. One can interpret $\lambda$ as the process of accumulating down payments for the house purchase. It takes time to build the wealth to purchase the house. Similarly, we can think of $\varphi$ as an adverse wealth shock to the individual, forcing her to sell the house. With this interpretation, clearly, an owner who is moving already has sufficient wealth to purchase a house, and she can do so immediately at the new location.

\textsuperscript{6}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.

\textsuperscript{7}We abstract from the moving costs of the renters, like transportation, since they are common for owners also.

\textsuperscript{8}e.g., mortgage payments.
of an unemployed owner, $U_H$, becomes the following:

$$rU_H = b - p + \gamma + \alpha \eta \int \max \{W_H (w) - U_H, 0\} dF (w) + \alpha (1 - \eta) \int \max \{W_H (w) - U_H - \kappa, 0\} dF (w) + \varphi [U_R - U_H].$$

Unemployed owner gets the benefit $b$, pays the cost of owning, $p$, enjoys the benefit of owning, $\gamma$, and receives the wage offer $w$ from each location at the rate $\alpha \eta$, upon which the value changes to $W_H (w)$ if the offer $w$ is accepted. 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 $\kappa$. Lastly, the flow value of an unemployed renter, $U_R$, is the following:

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

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 $\alpha \eta$ from each location, and the additional benefit of finding an owner-occupied unit, which occurs at the rate $\lambda$.

Before characterizing the stationary equilibrium for this economy, it is useful to characterize the value functions. It is clear that both value functions $W_H (w)$ 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. $w^l_H$ denotes the reservation wage of an unemployed owner for local offers. Similarly, $w^n_H$ 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:

$$U_R = W_R (w_R),$$
$$U_H = W_H (w^l_H),$$
$$U_H = W_H (w^n_H) - \kappa.$$

Notice that for an unemployed owner, the equation characterizing the reservation wage de-

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9Notice that due to the continuous time assumption, the probability of receiving offers from multiple locations is 0.
pends 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 $\kappa$.

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

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

where $\kappa = \alpha \int \max \{W_R(w) - U_R, 0\} dF(w) - \alpha \eta \int \max \{W_H(w) - U_H, 0\} dF(w) - \alpha (1 - \eta) \int \max \{W_H(w) - U_H - \kappa, 0\}$.

This equation shows the two opposing forces of being an owner in this economy. Owners enjoy the instantaneous benefit of $\gamma$, but, conditional on $\kappa$ 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, $\eta = 0$ (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, this results from having no unemployed 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 parameter restrictions, especially for sufficiently small $\kappa$ compared to $\gamma$, 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 is beneficial in this economy, this is purely due to the income effect coming through the instantaneous benefit of ownership, $\gamma$. 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 $\kappa$, this makes them less likely to accept outside offers than 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 searching for owners. As a result, the owner decreases the reservation wage for inside offers. Thus, the reservation wage for inside 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:

\[
\begin{align*}
    w_R \left( \frac{r + \lambda + \delta}{r + \delta} \right) &= b + \frac{\alpha}{r + \delta} \int_{w_R} \left( 1 - F(w) \right) dw + \lambda \frac{w_H^l}{r + \delta}, \\
    w_H^l \left( \frac{r + \varphi + \delta}{r + \delta} \right) &= b + \frac{\alpha \eta}{r + \delta} \int_{w_H^l} \left( 1 - F(w) \right) dw + \frac{\alpha (1 - \eta)}{r + \delta} \int_{w_H^n} \left( 1 - F(w) \right) dw + \varphi \frac{w_R}{r + \delta}, \\
    w_H^n &= w_H^l + \kappa (r + \delta)
\end{align*}
\]

(9) (10) (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 \( \kappa \) that determines the additional friction owners face in this economy. The frequency of this friction, which is determined by the fraction of outside offers, \( 1 - \eta \), is also important in determining the magnitude of this friction. The following lemma shows that in this 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, \( \eta = 1 \), 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 differences 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

\[
\theta_R = \alpha (1 - F(w_R)),
\]

(12)

and for owners it is

\[
\begin{align*}
    \theta_H &= \theta_H^l + \theta_H^n \\
    &= \alpha \eta \left( 1 - F \left( w_H^l \right) \right) + \alpha (1 - \eta) \left( 1 - F \left( w_H^n \right) \right) \\
    &= \alpha \eta \left( F(w_H^n) - F \left( w_H^l \right) \right) + \alpha \left( 1 - F \left( w_H^l \right) \right).
\end{align*}
\]

(13) (14)

Since the local reservation wage for owners is smaller than that for renters, which in turn is smaller than the outside reservation wage for owners, owners’ unemployment hazard rate for local offers is higher than that for renters, whereas for outside offers the unemployment hazard rate for owners is smaller than that for 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 for 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 \( \eta < 1 \), the total unemployment hazard rate is smaller for homeowners than for renters: \( \theta_H < \theta_R \).

It is important to emphasize the mechanism behind this result. The total unemployment hazard rate of owners is smaller than that for renters because of the differential moving cost, \( \kappa \), that the owners have to pay. As \( \kappa \) goes to 0, owners become more like renters, and at the limit they have the same decision variables, that is, the same reservation wages, although owners still enjoy the extra benefit of ownership. Remember that in this framework, the only two decisions individuals make are the accept/reject decisions in the labor and housing markets. By Assumption 1, we already rule out the reject decision in the housing market. So, effectively, the only decision individuals make in this economy is the accept/reject decision upon receiving a wage offer. This decision depends purely on the benefits and costs of the search. The additional instantaneous benefit of accepting the offer does not depend on \( \gamma \), since both unemployed and employed enjoy the same benefit. Similarly, the additional benefit of searching does not directly depend on \( \gamma \). Thus, the presence of \( \gamma \) is not the main driving force behind these results.

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, \( \eta \). We claim that as the fraction of outside offers increases the difference between the unemployment hazard rates between homeowners and renters widens. The empirical finding on Section 4 is supports this claim, and now we want to show this in our framework. As it is shown in Lemma 2, if \( \eta = 1 \), meaning that all offers are coming from the inside location, then owners face no additional friction due to the moving cost, \( \kappa \). 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 \( \eta \) decreases, that is, as the fraction of offers coming from the outside location increases, the analysis becomes more involved. First there is potentially the direct effect of the composition of offers on the hazard rates. As \( \eta \) decreases, 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. However, there is also the potential indirect effect of \( \eta \) on the hazard rate through a change in the reservation wages. As \( \eta \) decreases, 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 $\eta$ increases, all reservation wages increase with the following relation:

$$0 < \frac{dw_R}{d\eta} < \frac{dw_l}{d\eta} = \frac{dw_n}{d\eta}.$$  

Once we establish the response of the reservation wages to the composition of offers, we can discuss the effect of $\eta$ on the unemployment hazard rates. The response for the renters is trivial. Remember that the hazard rate for renters is $\alpha (1 - F (w_R))$. $\eta$ has no direct effect on this hazard rate, but it indirectly affects the hazard rate through its effect on the reservation rate of renters. From Proposition 3, we know that as $\eta$ increases the reservation wage of renters increases, so the unemployment hazard rate of renters decreases. However, the effect of $\eta$ on the unemployment hazard rate of owners is not trivial. It has both direct and indirect effects. The hazard rate for owners is $\alpha \eta (F (w^n_H) - F (w^l_H)) + \alpha (1 - F (w^n_H))$. $\eta$ can affect this hazard rate in three ways. First, there is the direct effect. As $\eta$ increases, the fraction of local offers increases, and these offers are more acceptable than the non-local offers. So, the unemployment hazard rate for owners increases. This is captured in the first term of the hazard rate equation: $\alpha \eta (F (w^n_H) - F (w^l_H))$. Secondly, $\eta$ has two indirect effects. Proposition 3 reveals that as $\eta$ increases the reservation wage for both local and non-local offers increases. The second equation in the hazard rate equation, $(\alpha (1 - F (w^n_H)))$, shows that such an increase in the reservation wage decreases the hazard rate. The increase in the reservation wage also has a second effect through the first term in the hazard rate equation: $\alpha \eta (F (w^n_H) - F (w^l_H))$. But the direction of this effect depends on the shape of the distribution of the wage offers; hence it is ambiguous. Overall, the net effect of $\eta$ on the unemployment hazard rate of owners is also ambiguous, due to these opposing effects. The following proposition states these facts:

**Proposition 4** As $\eta$ increases, the unemployment hazard rate for renters decreases, but the effect on the unemployment hazard rate for owners is ambiguous.

Having two opposing forces in effect restricts us to making a conclusion about the overall effect of $\eta$ 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. Since, the total measure in each location is 1, we have

$$u_R + u_H + e_R + e_H = 1.$$  \hfill (15)

The total inflow to the unemployed renter pool is $\varphi u_H + \delta e_R$, which is the sum of unemployed owners who experience a house selling shock and employed renters who experience unemployment shock. The total outflow from this pool, $u_R \theta_R + u_R \lambda$, is the sum of unemployed renters who find a job, which happens at the rate $\theta_R$, and unemployed renters who find an owner-occupied unit, which happens at rate $\lambda$. At steady-state, inflow should be equal to outflow:

$$\varphi u_H + \delta e_R = u_R \theta_R + u_R \lambda.$$  \hfill (16)

Similarly, we can write the inflow-outflow equation for unemployed owners:

$$\delta e_H + u_R \lambda = u_H \theta_H + u_H \varphi.$$  \hfill (17)

The inflow, LHS, is the sum of employed owners who lose their jobs and unemployed renters who find owner-occupied units. The outflow, RHS, is the sum of unemployed owners who find either a local or non-local job and unemployed owners who lose their owner-occupied units due to exogenous selling shock. Lastly, we can write the same equation for employed renters:

$$u_R \theta_R + e_H \varphi = \delta e_R + e_R \lambda,$$  \hfill (18)

where the LHS is the inflow coming from unemployed renters who find a job and employed owners who have to sell their owner-occupied units, and the RHS is the outflow as the sum of employed renters who lose their jobs and employed renters who find owner-occupied units to purchase. Combining equations (16),(17), and (18) results in

$$u_H \theta_H + e_R \lambda = \delta e_H + e_H \varphi,$$

which is basically the inflow-outflow equation for employed owners.

The computation of the measure of the total ownership in the economy is trivial. In each location, this measure is $u_H + e_H$. Notice that combining equations (16) and (18) results in

$$\varphi (e_H + u_H) = \lambda (u_R + e_R).$$
Defining the ownership rate as $h$, we have $h = u_H + e_H$ and $1 - h = u_R + e_R$. Substituting these into the above equation, we get

$$h = \frac{\lambda}{\lambda + \varphi}.$$ 

The ownership rate depends only on the rate of finding owner-occupied unit and selling shock. This feature of the model gives us a clear picture of the effect of the fraction of local offers, $\eta$, on the unemployment measures. Clearly, $\eta$ does not affect the homeownership rate. So, it will not have any indirect effect on the unemployment measures through changing the composition of owners and renters.

One can easily solve for equilibrium measures explicitly using equations (15), (16), (17), and (18):

\[
\begin{align*}
    u_R &= \frac{\varphi}{\lambda + \varphi \theta_R + \lambda + \delta + \varphi \theta_H - \theta_R} \\
    u_H &= \frac{\lambda}{\lambda + \varphi \theta_R + \lambda + \delta + \varphi \theta_H - \theta_R} \\
    e_R &= \frac{\varphi}{\lambda + \varphi \theta_R + \lambda + \delta + \varphi \theta_H - \theta_R} \\
    e_H &= \frac{\lambda}{\lambda + \varphi \theta_R + \lambda + \delta + \varphi \theta_H - \theta_R}
\end{align*}
\]

Notice that when $\theta_R = \theta_H = \theta$, which happens when $\eta = 1$, the measures of unemployed renters among renters and the measure of unemployed owners among owners are equal to each other: $u_H = u_R = \frac{\delta}{\delta + \lambda}$. As $\eta$ decreases, the unemployment hazard rate for owners and renters decreases initially as stated in Proposition 4. As a result, we observe an increase in the unemployment measure for both renters and owners. Moreover, since $\theta_H < \theta_R$, for $\eta < 1$, we expect to observe a higher unemployment measure for owners than renters. The quantitative importance of these differences is a matter that we analyze in the next section through a numerical exercise.

3 Numerical Results

The goal of this section is to analyze the quantitative importance of ownership on the unemployment hazard rates, and to depict the asymmetric response of the unemployment hazard to changes in housing tenure across labor markets of different sizes. The economy is characterized by the following set of parameters: $\{r, \alpha, \delta, \varphi, \lambda, F, b, \gamma, \kappa, \eta\}$. $\eta$ is the parameter of importance in the model. It shows the size of the market in the economy. A small $\eta$
corresponds to a low local job offer arrival rate, and a high non-local job offer arrival rate, whereas a high $\eta$ corresponds to a high local job offer arrival rate, and a small non-local job offer arrival rate. Since the locations are assumed to be symmetric, one can think of this exercise as a comparison of economies composed of small labor markets versus those involving large labor markets\textsuperscript{10}. We first solve the model for different values of $\eta$. Then we decrease $\varphi$ which corresponds to an increase in the ownership rate, and analyze the effect of the increase in the ownership rate on the unemployment rate for different values of $\eta$.

The time period in the model is set to one week of calendar time. The weekly interest rate, $r$, is set to 0.001, which corresponds to an annual interest rate of 5.3\%. Weekly total arrival rate, $\alpha$, is set to 0.2, so that on the average the unemployment rate is around 5.4\%. Wage offers are drawn from a lognormal distribution with standard deviation $\sigma = 0.1$, and mean $\mu = -\frac{\sigma^2}{2}$, so that the average wage offer is normalized to 1. The weekly exogenous separation shock, $\delta$, is set to 0.0054 corresponding to an average job life of 3.5 years. The owner-occupied unit arrival rate $\lambda$ is equal to 0.002, which corresponds to an average renter experience of 10 years\textsuperscript{11}. Selling shock, $\varphi$, 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 is 40\% of the average wage offer. The cost of moving for owners, $\kappa$, is set at 30, which corresponds to 15\% of the median house price\textsuperscript{12}. Lastly, the ownership benefit, $\gamma$, is set to 0.25 so that ownership is always preferable to renting\textsuperscript{13}.

We solve the model for different values of $\eta \in [0, 1]$. Remember that $\eta = 0$ means that all wage offers come from outside locations, whereas $\eta = 1$ means that all wage offers are local. Figure 2 shows the response of the reservation wages for renters and owners as a function of $\eta$. As it is stated in Proposition 1, the reservation wages satisfy $w_{nH}^R > w_R \geq w_{nH}^L$; that is, the outside reservation wage 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, $\kappa > 0$. Since accepting outside offers requires paying the additional cost of moving, owners become less likely to accept these offers, meaning that they set a higher reservation wage for outside offers. This, in turn, decreases the benefits of searching, since one is less likely to accept an outside offer. As a result, the local reservation wage for owners is smaller than that for renters. Moreover, as Proposition 3 states, all reservation wages increase as the fraction of inside offers, $\eta$, increases, and the increase in the

\textsuperscript{10}Remember that $\eta = \frac{1}{L}$, meaning that a large $L$ corresponds to a small $\eta$, and a small $L$ corresponds to a large $\eta$.

\textsuperscript{11}We interpret $\lambda$ as the time an individual needs to accumulate enough assets for a down payment on an owner-occupied unit.

\textsuperscript{12}In the U.S., the median house price is 4 times the median household annual income. So, 15\% of the median house price corresponds to 30 times the median household weekly income.

\textsuperscript{13}This parameter has no quantitative importance in our model. It only matters in making owning more appealing compared to renting. So, its importance is relative to the cost of moving, $\kappa$. Increasing or decreasing $\gamma$ does not effect the results as long as owning is better than renting.
local and outside reservation wages are equal, and they are greater than the increase in the renter reservation wage: $\frac{dw^l_H}{d\eta} = \frac{dw^n_H}{d\eta} > \frac{dw^R}{d\eta} > 0$. Remember that for an owner the benefit of searching is given by $\frac{\alpha_r}{\tau + \delta} \int w^l_H (1 - F(w)) \, dw + \frac{\alpha(1-\eta)}{\tau + \delta} \int w^n_H (1 - F(w)) \, dw + \varphi \frac{w^L_H}{\tau + \delta}$, which increases as $\eta$ increases since $w^l_H < w^n_H$. As the fraction of local offers increases, this increases the benefit of searching. Thus, both local and outside reservation wages increase. We also observe a slight increase in the renter reservation wage, because the benefit of searching for a renter is $\frac{\alpha_r}{\tau + \delta} \int w^R_H (1 - F(w)) \, dw + \varphi \frac{w^L_H}{\tau + \delta}$. The first term is not affected from $\eta$, but since $w^l_H$ increases, we observe an increase in the benefit of searching, and this, in turn, increases the renter’s reservation wage. Since the effect is a second-order effect the increase in the renter’s reservation wage is very small.

An immediate corollary of these results is the comparison of unemployment hazard rates across renters and owners. Figure 2 shows the unemployment hazard rates for both groups. Since the local reservation wage for owners is the smallest, the owner’s unemployment hazard rate for local offers is higher than that for renters. Similarly, the owner’s unemployment hazard rate for outside offers is smaller than that for renters. Another result that we see in Figure 2 is that as the fraction of local wage offers increases, the local unemployment hazard rate for both owners and renters increases, and the outside unemployment hazard rate for both owners and renters decreases.

Since the unemployment hazard rate for local offers is higher for owners than for renters whereas for outside offers the opposite is true, it is not obvious which has has the bigger hazard rate. Proposition 2 shows that as long as there are some offers coming from outside locations ($\eta < 1$), the total unemployment hazard rate for owners will always be smaller than that for renters. As we see in Figure 3, for any $\eta < 1$, the unemployment hazard
rate is smaller for owners than renters. And as Lemma 2 verifies, when $\eta = 1$, owners and renters are alike, and their unemployment rates are equal. 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 the fraction of inside offers increases, initially the unemployment hazard rate decreases, but then it rebounds and starts to increase. This actually comes from the two opposing forces that affect the owner’s unemployment hazard rate. As $\eta$ increases, the composition of offers changes, the fraction of inside offers increases, and the fraction of outside offers decreases. Since the local reservation wage is smaller than the outside reservation wage for owners, this means that as $\eta$ increases the proportion of acceptable offers increases. This puts an upward pressure on the total unemployment hazard rate for owners. However, there is also another channel. The increase in the fraction of inside offers increases both local and outside reservation wages for owners. This puts a downward pressure on the total unemployment hazard rate for owners. As a result, the net effect depends on which force dominates. The current parametrization results in a non-monotonic relation between $\eta$ and the hazard rate for owners. Initially the hazard rate decreases, but after a certain level, around 0.3, meaning 30% of offers are local, the unemployment hazard rate starts to increase. This asymmetric response will be the driving force behind the results that we will show next to explain the empirical asymmetric response of the unemployment hazard rate difference between owners and renters to changes in the composition of job offers. For renters, the effect is unambiguous. Since the reservation wage for renters always increases as $\eta$ increases, the unemployment hazard rate for renters monotonically decreases as $\eta$ increases.

This behavior of the unemployment hazard rates clearly affects the unemployment rates of renters and owners. Figure 4 shows the unemployment rates for the owners, renters
Fraction of Local Offers: $\eta$

Unemployment Hazard Rate

Unemployment Hazard Rate: Renter vs Owner

Figure 3: Unemployment Hazard Rates: Renters vs Owners

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 $\eta < 1$. 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 $\eta$ increases, the unemployment rate for the owners first increases, but then it starts to decrease. For renters, we have a monotonically increasing unemployment rate. As one might expect, this graph, Figure 4, is the mirror image of the unemployment hazard rate graph, Figure 3. 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 unemployment rate as a function of $\eta$.

As we show in Section 4, the unemployment hazard rate difference between owners and renters has an asymmetric response to market size. In thick markets, representing large $\eta$, we observe an insignificant response of the unemployment hazard rate to the housing tenure, whereas in thin markets, representing small $\eta$, the unemployment hazard rate of renters is significantly higher than that of owners. When all the offers are local, $\eta = 1$, the unemployment hazard rate of renters and owners is the same. However, with the current calibration, as $\eta$ decreases to 0.3, the unemployment hazard rate of owners becomes 5% smaller than that for renters. This, in turn, means a 0.25 percentage point difference between the owners and the renters.

We also conduct the following experiment to analyze the effect of a change in the homeownership rate on the unemployment rate. We decrease the value of selling shock, $\varphi$, so
Figure 4: Unemployment Rates: Renters, Owners and Total

Figure 5: Change in Total Unemployment Rate
that the homeownership rate in the economy increases 10 percentage points. Remember that the homeownership rate in our model is \( \frac{1}{1 + \varphi} \), so setting \( \varphi = \frac{7}{23} \) results in a 10 percentage increase in the ownership rate. Figure 5 shows the change in the total unemployment rate corresponding to an increase in the homeownership rate. For low levels of \( \eta \), around 0.3, the unemployment rate increases by 0.02%, whereas for high levels of \( \eta \), the unemployment rate does not change significantly. When \( \eta = 1 \), there is no change in the unemployment rate. As we see in Figure 5, the asymmetric response of the unemployment rate in Figure 5 is preserved here. In markets with a low level of \( \eta \), that is, thin markets, owners face the largest friction compared to renters. Thus, as the homeownership rate increases, the change in the unemployment rate in these thin markets becomes relatively substantial.

4 Empirical Evidence

In this section we test key predictions of the housing and unemployment model using micro data. More specifically, we would like to focus on the effect of homeownership on unemployment duration in the presence of local labor market conditions. Using micro data, Taskin and Yaman (2013) inquire whether homeowners have longer unemployment spells. Here we investigate whether in weak labor markets homeowners have relatively longer unemployment durations compared to renters. Note that although Proposition 2 establishes longer unemployment durations for homeowners than for renters, with reasonable calibration the difference is particularly small. However, from Figure 3, one could find more sizable unemployment hazard rate differences between owners and renters along the fraction of local offers line. In this section 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 2001; 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.\(^{14}\) We use unemployment rates to characterize the local labor market conditions. 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 (2013). Our sample essentially contains working age civilian males who are either home-

\(^{14}\)The advantages of the SIPP for the purpose of this exercise are discussed in detail by Taskin and Yaman (2013). We refer readers to that study for further investigation.
Table 1: Unemployment Duration by Household Type

<table>
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<td>Control States</td>
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<td>8.54</td>
</tr>
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</table>

owners or renters living in states excluding Alaska, Hawaii, Washington DC, Maine, North Dakota, South Dakota, Vermont and Wyoming.\(^{15}\) Moreover, we also drop individuals who are listed as relatives of the reference person (child, father, etc.\(^{16}\)) in the household since we do not have rich controls for this type of intra-household relationship. This leaves us with 10,328 unemployment spells across 43 states and 96 MSAs; 8,052 of them terminate with a return to employment. Among those spells 5,466 are homeowners.

4.2 Findings

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 economic conditions for that state. Table 4 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 economic areas. Although there is a 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 1 shows that the unemployment durations of homeowners are slightly higher, and the differences in unemployment durations are more apparent for states with weak labor markets. In those states, the unemployment durations of homeowners are 1.23 weeks higher than those of renters, whereas this number is reduced to 0.19 weeks for the rest of the sample. We conclude that the raw data marginally supports our hypothesis.

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

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

\(^{15}\)The first 3 states are excluded because the housing and unemployment relationship is not applicable to those states. The latter 5 are not separately identified in our panels.

\(^{16}\)Individuals who are listed as the spouse or unmarried partner of the reference person are included.
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 piecewise-constant function.\(^{17}\) We control for major demographic and economic variables such as age, race, education, etc.\(^{18}\) Here we are particularly interested in the interaction of the homeownership variable and the weak labor market indicator, $\alpha_2$, 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 2 describes the coefficient estimates of the related variables. Here, ownership itself has virtually no effect on unemployment duration, while for states with a weak labor demand, we find that an unemployed homeowner’s job finding hazard is 17 percent lower ($\exp(-0.188) - 1$) than that for renters. The coefficient of the labor market conditions indicator is negative but insignificant; this is due to marginal variations in the distressed economic areas subgroup across the 1996 and 2001 panels.

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 2. Our main variable of interest, the interaction term, is still negative and statistically significant at 10 percent. Essentially, this means that as the unemployment rate goes up in a state, or the local labor market worsens, it takes a longer and 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 20 percent lower than that of renters.

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 market are the Metropolitan Statistical Areas (MSAs). Our data allows us to identify the 96 most populated MSAs.\(^{19}\) Within these MSAs, 18 are identified as Consolidated Metropolitan Areas (CMSA); these make up more than half of the sample. For

\(^{17}\)In particular, the baseline hazard is constant for the intervals of 0 to 4 weeks, 5 to 10 weeks, 11 to 16 weeks, 17 to 18 weeks, 19 to 26 weeks, and longer than 26 weeks.

\(^{18}\)A complete list of the covariates is described in the Appendix.

\(^{19}\)In this section, we exclude individuals who do not have MSA information, which leaves us 5,913 spells for analysis. Among those spells 4,544 end up finding a job and 3,037 are reported to be homeowners.
Table 2: Estimation results

<table>
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<td>(.102)</td>
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<td>(.049)</td>
<td>(.067)</td>
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<td>owner x cmsa</td>
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<td></td>
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<tr>
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<td></td>
<td>(.066)</td>
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<td>(.063)</td>
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</table>

*The Table shows the unemployment hazard regression specified in equation 19 at the state and MSA level. The first two columns do the regression at the state level whereas the third and fourth columns repeat the same exercise at the 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 numbers in the parentheses are the standard errors.*
Table 3: Unemployment Duration by Household Type

<table>
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<th>Owner</th>
<th>Renter</th>
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<td>Full Sample</td>
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<td>Distressed MSAs</td>
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<td>Control MSAs</td>
<td>9.36</td>
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</table>

the estimations below, we separately control for these CMSAs since they create agglomeration economies.

As for the states 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. 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. Table 3 shows the MSA analogue of unemployment duration comparisons of homeowners and renters in terms of economic conditions. Again, we see a slight difference between the unemployment durations of renters and owners, with the duration for owners being marginally higher, and this difference in unemployment durations is more apparent for the MSAs with weak labor markets. However this result is somewhat weaker than that of the previous section.

We repeat the empirical exercise described in section 4.2. The third and fourth columns of Table 2 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 durations than otherwise identical renters. When we introduce the actual unemployment rate as a control for labor demand, the effect of market size, although still negative, becomes insignificant. In line with evidence from raw data, the coefficient in the interaction term, \( \alpha_2 \), is slightly smaller than in the previous section. We conclude that the MSA characterization of a labor market supports our hypothesis.

In addition to the previous section, we add two new interaction variables to control for the “big labor markets” characterized as CMSAs. These are additional controls for market size; 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 the CMSA dummy is positive, meaning that given a

---

20Although 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.

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particular unemployment rate, in “big” labor markets it is easier to find jobs. The rest of the coefficients, although positive, are not significant.

5 Conclusion

In this paper we have explored the effect 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, unemployed homeowners become less likely than renters to find jobs. However, the quantitative effect seems to be small, in the range of a 5% difference between the unemployment hazard rates and a 0.25% difference between the unemployment rates of owners and renters.

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 by 7 – 17%, depending on the local labor market definition, once we move from strong local labor markets to weak ones.

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. First, we do not have job-to-job transitions in the model. Such an extension of the model quantitatively increases the frictions homeowners face in the labor market, and can result in a higher difference between the unemployment hazard rates of homeowners and those of renters.

The theoretical model also abstracts from the housing price effects. Karahan and Ree (2013), Nenov (2012), 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.

Acknowledgments

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at South Bend. The views expressed here are those of the authors and do not reflect those of the Central Bank of the Republic of Turkey.
References


A Data Description

- indicator for holding a mortgage
- the last earned monthly income amount observed before the beginning of an unemployment spell,
- a dummy indicating no information on previous earnings (an unemployment spell 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>
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<th>state</th>
<th>unemp. 00</th>
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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:

\[(r + \delta + \varphi) (W_H (w) - W_R (w)) + \lambda \{ W_H (w) - W_R (w), 0 \} \] = \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:

\[W_H (w) - W_R (w) = \gamma + \delta [U_H - U_R].\]

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

\[(r + \delta) W_H (w_H) - (r + \delta) W_H (w_H) = (r + \delta) \kappa\]

\[w_H - w_H = (r + \delta) \kappa.\]

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

\[w_H = b + \frac{\alpha \eta}{r + \delta} \int_{w_H} (1 - F (w)) \, dw + \frac{\alpha (1 - \eta)}{r + \delta} \int_{w_H} (1 - F (w)) \, dw + \varphi \Delta, \quad (20)\]

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

\[w_R = b + \frac{\alpha}{r + \delta} \int_{w_R} (1 - F (w)) \, dw - \lambda \Delta. \quad (21)\]

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

\[\Delta (r + \delta + \lambda + \varphi) = - \left[ \frac{\alpha \eta}{r + \delta} \int_{w_H} (1 - F (w)) \, dw + \frac{\alpha (1 - \eta)}{r + \delta} \int_{w_H} (1 - F (w)) \, dw \right]. \quad (22)\]

Combining equations (20), (21), and (22), we can rewrite the equation for \( \Delta \) in terms of reservation wages:

\[\Delta = \frac{w_R - w_H}{r + \delta}\]

Substituting this expression for \( \Delta \) into equation (20) and (21), we get the equations for renter.
to see the ranking of the reservation wages, subtract equation (10) from equation (9):

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

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 \( \eta = 1 \), we arrive at

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

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

\[
\theta_R = \alpha \left( 1 - F(w_R) \right) = \alpha \left( 1 - F \left( w_H^l \right) \right) = \theta_H.
\]

Proof. [Proposition 2] Notice that unemployment hazard rate for owners strongly depend on the cost of moving for owners, \( \kappa \). 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 \( \kappa \) using equation (13):

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

Using equation (11), we know that

\[
\frac{dw_H^n}{d\kappa} = \frac{dw_H^l}{d\kappa} + r + \delta.
\]
Again, using equation (10), we can evaluate \( \frac{dw^l_H}{dk} \):

\[
\frac{dw^l_H}{dk} (r + \varphi + \delta) = - \frac{dw^l_H}{dk} \alpha \eta \left(1 - F \left( w^l_H \right) \right) - \frac{dw^H_H}{dk} \alpha \left(1 - \eta \right) \left(1 - F \left( w^H_H \right) \right) + \varphi \frac{dw_R}{dk}.
\]  

(25)

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

\[
\frac{dw_R}{dk} (r + \lambda + \delta) = - \frac{dw_R}{dk} \alpha \left(1 - F \left( w_R \right) \right) + \frac{\lambda}{\lambda + \delta + \theta_R} \frac{dw^l_H}{dk}.
\]  

(26)

Combining equations (24), (25) and (26), we get the following equation for \( \frac{dw^l_H}{dk} \):

\[
\frac{dw^l_H}{dk} = \frac{- \theta^n_H (r + \delta)}{r + \delta + \varphi + \theta_H - \frac{\varphi \lambda}{r + \delta + \lambda + \theta_R}}.
\]

Notice that \( r + \delta + \varphi + \theta_H - \frac{\varphi \lambda}{r + \delta + \lambda + \theta_R} > 0 \) and \( \theta^n_H > 0 \) as \( \eta < 1 \), which means \( \frac{dw^l_H}{dk} < 0 \).

Moreover, since \( \frac{dw_R}{dk} = \frac{\lambda}{\lambda + \delta + \theta_R} \frac{dw^l_H}{dk} \) and \( \frac{\lambda}{\lambda + \delta + \theta_R} < 1 \), we have \( \frac{dw^l_H}{dk} < \frac{dw_R}{dk} < 0 \). Using equation (24), we get

\[
\frac{dw^n_H}{dk} = \frac{(r + \delta) \left( r + \delta + \theta^l_H + \varphi - \frac{\varphi \lambda}{r + \delta + \lambda + \theta_R} \right)}{r + \delta + \varphi + \theta_H - \frac{\varphi \lambda}{r + \delta + \lambda + \theta_R}} > 0,
\]

since \( \varphi - \frac{\varphi \lambda}{r + \delta + \lambda + \theta_R} > 0 \). Using these expression for \( \frac{dw^l_H}{dk} \) and \( \frac{dw^n_H}{dk} \) in (23) yields us

\[
d\theta^H_H = \alpha \eta \frac{f \left( w^l_H \right) \theta^n_H (r + \delta)}{r + \delta + \varphi + \theta_H - \frac{\varphi \lambda}{r + \delta + \lambda + \theta_R}} - \alpha \left(1 - \eta \right) \frac{f \left( w^n_H \right)}{\frac{r + \delta + \varphi + \theta_H - \frac{\varphi \lambda}{r + \delta + \lambda + \theta_R}}{r + \delta + \varphi + \theta_H - \frac{\varphi \lambda}{r + \delta + \lambda + \theta_R}}}.
\]

\[
= \alpha^2 \eta \left( 1 - \eta \right) \frac{f \left( w^l_H \right) \left(1 - F \left( w^l_H \right) \right)}{r + \delta + \varphi + \theta_H - \frac{\varphi \lambda}{r + \delta + \lambda + \theta_R}} - \alpha \left(1 - \eta \right) f \left( w^n_H \right) \left( r + \delta + \varphi - \frac{\varphi \lambda}{r + \delta + \lambda + \theta_R} \right)\frac{f \left( w^l_H \right) \left(1 - F \left( w^l_H \right) \right)}{r + \delta + \varphi + \theta_H - \frac{\varphi \lambda}{r + \delta + \lambda + \theta_R}}.
\]

Since the second part in the last equation is negative, showing \( f \left( w^l_H \right) \left(1 - F \left( w^l_H \right) \right) - f \left( w^n_H \right) \left(1 - F \left( w^n_H \right) \right) < 0 \) is sufficient to prove that \( \frac{d\theta_H}{dk} < 0 \). 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 \( w^l_H < w^n_H \), then we have \( \frac{f \left( w^n_H \right) \left(1 - F \left( w^n_H \right) \right)}{1-F \left( w^n_H \right)} < \frac{f \left( w^l_H \right) \left(1 - F \left( w^l_H \right) \right)}{1-F \left( w^l_H \right)} \), which immediately results \( f \left( w^l_H \right) \left(1 - F \left( w^l_H \right) \right) - f \left( w^n_H \right) \left(1 - F \left( w^n_H \right) \right) < 0 \).
Next, we need to show that \( \frac{d\theta}{d\kappa} > 0 \). Using equation (2), we have \( \frac{d\theta}{d\kappa} = -\alpha f(w_R) \frac{dw_R}{d\kappa} \).

Note that \( \frac{dw_R}{d\kappa} < 0 \), which implies \( \frac{d\theta}{d\kappa} > 0 \).

**Proof.** [Proposition 3] First we compute \( \frac{dw_H^l}{d\eta} \) and \( \frac{dw_H^n}{d\eta} \). Using equation (11), we have

\[
\frac{dw_H^l}{d\eta} = \frac{dw_H^{\alpha}(1 - F(w_H^l))}{d\eta} - \frac{dw_H^n}{d\eta} \alpha (1 - \eta) (1 - F(w_H^n)) + \varphi \frac{dw_R}{d\eta}.
\]

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

\[
\frac{dw_R}{d\eta} (r + \lambda + \delta) = -\frac{dw_R}{d\eta} \alpha (1 - F(w_R)) + \lambda \frac{dw_H^l}{d\eta}.
\]

Combining equations (27) and (28), we get

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

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

\[
\frac{\lambda}{r + \lambda + \delta + \theta_R} < 1, \quad 0 < \frac{dw_R}{d\eta} < \frac{dw_H^l}{d\eta} = \frac{dw_H^n}{d\eta}.
\]

**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 \( \eta \) as

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

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

\[
-\alpha \eta f(w_H^l) \frac{dw_H^l}{d\eta} - \alpha (1 - \eta) f(w_H^n) \frac{dw_H^n}{d\eta} = -\frac{dw_H^l}{d\eta} \left(\alpha \eta f(w_H^l) + \alpha (1 - \eta) f(w_H^n)\right) < 0.
\]

So, overall effect is ambiguous. ■