Housing Tenure and Labor Market Impacts:
The Search Goes On

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ABSTRACT: We develop two search-theoretic models of the Oswald hypothesis, the idea that homeownership is linked to inferior labor market outcomes, and compare their predictions to three extant theories. The five models have surprisingly different predictions about the labor market at both the aggregate and micro levels. We estimate micro and US state-level regression models of wages and unemployment and compare the estimates to those predictions.

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1. Introduction

Homeownership is supposed to be a stabilizing force in neighborhoods and in the economy. Because of the high search and transactions costs involved in both choosing and selling homes, owner-occupiers tend to spend longer spells in their residence than do renters, in order to spread those costs over a longer period of time. Rohe and Stewart (1996) provide ample evidence that owners are more likely to have long residence spells than renters. Most commentators regard this as a good thing for neighborhoods, as owners are more likely to invest in the social capital that makes for a better neighborhood. Rossi and Weber (1996) and DiPasquale and Glaeser (1999), among others, find that contributions to neighborhood social capital are indeed greater for owners than renters, and the latter paper finds that this investment seems to be due to their longer residence spells. A preponderance of owners in a neighborhood therefore has external benefits, which can be observed in the higher property values in such neighborhoods (Coulson, Hwang and Imai, 2002).

Some commentators view longer residence spells not as stability, but as immobility, and therefore as a cost rather than a benefit. This immobility has negative consequences for the economy to the extent that owners are not able to respond to local labor demand shocks. If demand for labor falls in a region, homeowners do not respond by migrating to those regions with positive shocks to labor demand, because the expected benefits from such a move do not necessarily outweigh the high transactions cost of moving from one owner-occupied house to another. There is a kind of coordination failure that creates inefficiency. Prominent among those who make this claim is Oswald (1997a), to the extent that such a linkage has been sometimes dubbed the Oswald Hypothesis.

Implicit in this claim is the hypothesis that individual homeownership is associated with inferior labor market outcomes. That is, even in the absence of regional shocks, homeowners will fare less well than renters. However, theory and evidence on this point are mixed. In this paper, we present new models of search and matching in labor markets and exploit cross-sectional differences in individual tenure choices and city-level homeownership rates to investigate how variation in tenure impacts equilibrium wages and unemployment. We specifically care about the link between homeownership, immobility and labor because of the important implications for housing policy.

Therefore, in Section 2 of this paper we review the literature on theoretical models that link immobility, as manifested in the choice of housing tenure, and labor market outcomes. The models, those of. Oswald (1997b), Dohmen (2005) and Munch, Rosholm and Svarer (2006) are somewhat different in flavor, and have varying predictions of the differential effects of homeownership. The model of Oswald (1997b) is a Walrasian setup, where homeowners are potentially faced with long commutes which creates an upward-sloping supply curve for labor. The latter two are models in which workers receive random wage offers from firms, but in which homeowners are more constrained in their ability to accept some offers because of relocation costs.

These models all have the fault that firms play no role in the labor market except as passive wage-offer generators; they are all partial equilibrium models. We attempt to fill this gap with the construction of two search-theoretic models. The first is in the search-and-bargaining framework of Pissarides (1985). We construct a model in which attachments and detachments take place randomly in a labor market, firms and workers meet, and arrive at a wage determined by Nash bargaining; firms know the tenure status of the worker and this has an impact on the bargain that is struck. The second model is inspired by Diamond (1971) wherein firms post wages which are then accepted or rejected by (anonymous) workers. Search and matching take place much as in the bargaining model. These two models deliver three items of interest: (1) they provide predictions on the impact of homeownership that are distinct from each other and from those in the above three models, in particular generating predictions at the aggregate level that are different from those at the individual level; (2) they produce a role for the *aggregate* homeownership rate in determining *individual* labor market outcome, thus demonstrating that previous attempts to model the interaction between labor and housing markets may be misspecified; and (3) they show that the most common method of dealing with the endogeneity of homeownership in tests of that interaction is invalid.

In Section 3 we then review the existing empirical evidence concerning the link between housing mobility and labor market outcomes. Because the predictions of our models contain distinct predictions at various levels of aggregation we review evidence at both the aggregate and individual level. We then provide new empirical evidence on labor market outcomes– unemployment and wages– as it relates to homeownership using data from the US Census. We first run regressions using city-level data in an attempt to discriminate across the various models at the aggregate level. But the primary focus of our empirical work is on models of unemployment and income at the individual level. As hinted above, we pay particular attention to the potential endogeneity of homeownership, and use instrumental variables techniques that are appropriate to the problem. In the concluding section 4, we summarize our findings, and provide some policy implications and suggestions for further research..

2. Theoretical Models of the Link Between Housing Tenure and the Labor Market

In this section we review five models of the link between housing tenure and the labor market. The descriptions of the first three are verbal and readers are referred to the original papers for complete descriptions of the models themselves. We then present our versions of the link between housing tenure and labor market outcomes.

Oswald (1997)

Oswald (1997) describes an economy with two locations that are linked by a roadway. Population is evenly split between these two locations, and the residents must choose *a priori* whether they wish to be owners or renters. Ownership has a benefit and a cost: the benefit is the extra utility that arises with pride of ownership. The cost is in the labor market. The two regions suffer asymmetrical demand shocks, which are revealed only after the tenure choice has been made. Indeed, one region has zero, and the other a positive, demand for labor. Those who live in the good region become employed, and renters in the other region can move to the good region and become employed at zero cost. Owners in the bad region either accept unemployment benefits (and leisure), commute at a cost to the good region, or move at a cost to the good region. The commuting cost rises with the number of commuters, and at some number of commuters, becomes equal to the moving cost[1]. The supply curve of labor to the good region is therefore (1) flat at low levels of wages (up to the number of owners in the good region and renters from both); (2) then upward sloping, as bad region owners are induced to commute; (3) then flat again when commuting and moving

[1]Thus aside from any external cost that homeowners impose on the labor market, the lengthier commutes of homeowners create an environmental externality.

expenses are equalized. At the wage that covers both the value of leisure and moving costs, everybody is willing to work at the prevailing wage in the good region. The size of the demand shock then determines the equilibrium quantities.

Thus, considering the labor market as a whole, *individual homeowners* are more likely to be unemployed, whereas renters are fully employed. Wage offers to homeowners and renters are identical, given the market-clearing, competitive nature of the labor market. At the aggregate level a rise in the incremental utility attached to pride of ownership will raise the homeownership rate and shift the upward sloping part of the supply curve to the left. Thus, holding the demand shock constant, higher *aggregate* homeownership rates are correlated with higher unemployment rates, *but also with higher wages* if the intersection of labor supply and demand occurs in this upward sloping region.

Dohmen (2005)

The model of Dohmen (2005) likewise posits a market with two locations. Jobs end each period and in each period each worker receives a job offer, which with probability q comes from region 1 and (1-q) from region 2. Renters can move without cost, but owners are required to pay a moving cost if they accept a job in the other region. The decision rule for accepting the distant job or not is simply whether he wage in the other market, net of unemployment benefits (or the value of leisure) is greater than the costs of changing locations. The implication of course is that individual homeowners are more likely to be unemployed, and that regions with greater homeownership will have greater unemployment rates. At this level, the model says nothing about the relationship between ownership and wages since wage offers are constant and exogenous. Conditional on employment, renter and owner wages are identical[2].

Munch, Rosholm and Svarer (2006)

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[2] Dohmen focuses much of his attention on the differential behavior of high and low skill workers. One purpose of this seems to be to reconcile *unconditional* positive correlations of aggregate unemployment rates and homeownership rates as demonstrated in Oswald (1997a). With proper controls at the aggregate level this should not be an issue. Dohmen extends his model to (separately) include on-the-job search and non-degenerate distributions of wage offers. When jobs last more than one period, the decision by job holders to search depends on the expected return to search effort. When moving costs are high, as they are for owners, the existence of high search costs causes owners to search less. While this analysis is not coupled with Dohmen's extension to wage offer distributions, it seems likely that this will lower the relative wages of owners.

Munch, Rosholm and Svarer (2006) also use the standard setup: there are two regions (a home market and a "national" market) and two types (again mobile renters and immobile owners). In their baseline model an unemployed person, regardless of tenure status, can receive job offers from both labor markets and the probability distribution of offers is the same across locations. As in Dohmen (2005), accepting a job outside the home market entails moving costs if the applicant is an owner. Such costs are again zero to a renter. For a renter, therefore, the utility-maximizing reservation wage is the same whether one receives the offer from the home region or elsewhere. However the reservation wage for homeowners must be lower for local jobs and higher when it entails moving costs. MRS show that these two reservation wages are below and above, respectively, the reservation wage for renters.

Under the assumptions that the arrival of wages is independent of tenure status, that such offers arrive with equal frequency from the two locations and the distribution of wage offers is the same, signing the comparative static predictions for the effect of homeownership is not possible. However, because the reservation wage for distant jobs remains higher for owners, they wait longer since such acceptable offers come at a lower frequency than acceptable local offers. Thus if a higher probability of unemployment for owners is observed, it must be because they (were impelled to) wait for higher wages (from distant locations). And to the contrary, if homeowners have less unemployment, then owners are accepting local, and lower-paying jobs. Thus the sign of the comparative impacts of homeownership on unemployment and wage outcomes are the same: higher unemployment and higher wages, or lower unemployment and lower wages prevail. Intuitively, it seems as if the latter result is more sensible. An economy where everyone moves to take distant jobs involves rather more cross-hauling in the labor market than would be efficient.

The Oswald hypothesis in a model with bargaining and entry

We now present a model of search and bargaining in the style of Pissarides (1985) in which some searching workers are constrained in their search by virtue of their tenure choice, although the model is applicable to other forms of immobility. A key feature is the role of firm entry, which, as will be seen, ameliorates the effect of that immobility.

Within a single labor market, there is a continuum of workers of measure one, of whom some are mobile renters and some are immobile owners. There are two locations $j = 1, 2$, which characterize the location of the owners, the location of the firms and so obviously the areas in which firms and workers search and attempt to match. There is measure b_j of owners in the two locations so that the aggregate homeownership rate is $b_1 + b_2$, and there are of course $1 - b_1 - b_2$ renters in the economy. Unemployed homeowners can only search in their own (jth) location and the rate at which searchers make successful matches in location j is given as μ_j. Renters are able to potentially match with firms in either location, therefore their matching rate is given as $\mu_1 + \mu_2$.[3] Renter-searchers are therefore not characterized by their location, although the renter-employed might be so indexed. Both owners and renters are randomly detached from their jobs at rate δ, and have common discount rate r, and these two parameters are also constant across locations. The mass of residents can be characterized by labor market status according to the following, where the subscript $i = o, r$ indexes owners and renters. Employment at each location is given by

$$E_j = E_{oj} + E_{rj} \tag{1}$$

while the number of searchers in each location is

$$S_j = U_{oj} + U_r \tag{2}$$

Hence the aggregate unemployment rate is (recalling that the total measure of workers is unity) $U_{o1} + U_{02} + U_r$. The rate of owner unemployment can be derived as $(U_{o1} + U_{02})/(b_1 + b_2)$ while the renter unemployment rate is $U_r/(1 - b_1 - b_2)$.

Firms can enter and create job vacancies in either location by paying the location-invariant setup cost v. Vacancies in each location are similarly given as V_j so that the employment vacancy rate is defined as $V_j/(V_j + E_j)$. If the firm is matched with the worker in the current period, an output of location-invariant flow value y is produced.

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[3]In a discrete time framework, the μ_j's would be interpretable as the probability that a searcher in j makes a match. The renter's probability of making a match would therefore be $1-(1-\mu_1)(1-\mu_2) = \mu_1+\mu_2-\mu_1\mu_2$. Informally, in the continuous time framework, the time interval runs from t to t+h, and we let h go to zero. The $\mu_1\mu_2$ term vanishes at a faster rate, and so we are left with the simple sum of matching rates as the appropriate approximation. This approximation simplifies the analysis tremendously.

When firms and workers match, they decide on a wage through a Nash bargain, about which more below. For the time being, let this wage, w_{ij} vary by tenure and location. Let Π_f and Π_v be the continuous time evaluations of the value (or lifetime profit) functions of a filled and vacant job position so that

$$r\Pi_{fij} = (y - w_{ij}) + \delta(\Pi_{vj} - \Pi_{fij}) \quad (3)$$

$$r\Pi_{vj} = \eta(Q_j \Pi_{foj} + (1 - Q_j)\Pi_{rj} - \Pi_{vj}) \quad (4)$$

where $Q_j = U_{oj}/(U_{0j} + U_r)$, the proportion of searchers in location j that are owners.[4]

We notate the value functions for workers as J_{eij} and J_{uij} for employed and unemployed states.

$$rJ_{eoj} = w_{oj} + \delta(J_{uoj} - J_{eoj}) \quad (5)$$

$$rJ_{erj} = w_{rj} + \delta(J_{ur} - J_{erj}) \quad (6)$$

$$rJ_{uoj} = \mu_j(J_{eoj} - J_{uoj}) \quad (7)$$

$$rJ_{ur} = (\mu_1 + \mu_2)(J_{erj} - J_{ur}) \quad (8)$$

As noted, upon any given match the wage is determined by the symmetric Nash bargaining solution. That is, the firm and worker get equal surplus over and above their respective threat points.

Assumption 1 (Nash Bargain): For any given location and tenure type, the bargained wage solves

$$J_{eij} - J_{uij} = \Pi_{fij} - \Pi_{vj}. \quad (9)$$

Using the value functions (3) and (5) through (8) along with the Nash bargaining rule yields

$$w_{oj} = \frac{(y - r\Pi_{vj})(r + \delta + \mu_j)}{2(r + \delta) + \mu_j} \quad (10)$$

$$w_{rj} = \frac{(y - r\Pi_{vj})(r + \delta + \mu_1 + \mu_2)}{2(r + \delta) + \mu_1 + \mu_2} \quad (11)$$

We now assume a zero-profit condition:

Assumption 2 (Entry): Firms enter location j until lifetime profits are driven to zero. Therefore in equilibrium, $\Pi_{vj} = v$.

In the wage equation, we now replace the value function with the location-invariant setup costs to get

$$w_{oj} = w_o(\mu_j; \cdot) \quad (12)$$

[4]These value equations (and the ones that follow for renters) assume infinitely-lived agents and can be easily derived from the corresponding lifetime profit functions, assuming stationarity and constant discount rates, etc.

$$w_r = w_r(\mu_1, \mu_2; \cdot) \qquad (13)$$

with $\frac{\partial w_i}{\partial \mu_j} > 0$ for all possible cases.

Remark 1: Within each market, it is clear that renter wages are invariant across locations, because they are mobile across those locations; and renter wages are higher than owner wages, precisely because their search is wider.

We turn now the matching process itself. We assume a steady state matching process governed by a matching function:

Assumption 3 (Matching): The measure of matches taking place in location j is

$$\eta_j V_j = \mu_j S_j = M(S_j, V_j) \qquad (14)$$

where $M(\cdot)$ satisfies the usual regularity conditions, and has constant returns to scale. Under constant returns, Euler's theorem allows us to rewrite the relation between the two contact rates as

$$\eta_j = M(\frac{\eta_j}{\mu_j}, 1) \qquad (15)$$

so that steady-state matching suggests that the two contact rates must be functions of each other. Indeed they must be negatively related to each other, since increases in (say) the number of firms will lower the contact rate for firms and raise it for searching workers.

The steady state framework also suggests that flows into and out of employment for each tenure type (at each location) will be identical:

$$\delta E_r = (\mu_1 + \mu_2) U_r$$

$$\delta E_{oj} = \mu_j U_{oj}$$

For owners, since $E_{oj} + U_{oj} = b_j$ we have the measured of unemployed owners in each location as in each location as

$$U_{oj} = b_j \delta / (\delta + \mu_j) \qquad (16)$$

while for renters

$$U_r = (1 - b_1 - b_2)\delta / (\delta + \mu_1 + \mu_2) \qquad (17)$$

Through similar intuition we find the following:

Remark 2: (2a) Renter unemployment is invariant across locations 1 and 2; and (2b) Renter unemployment is less than owner unemployment.

We can now write Q as a function of exogenous parameters and the worker contact rates

$$Q = Q(\mu_1, \mu_2; \cdot) \tag{18}$$

and with both the wage and Q as functions of these two contact rates we can write the value function of the vacant firm as a function of just the worker contact rates and the firm contact rates and set that equal to the setup cost (as in Assumption 2). Using (3), (4), (12), (13) and (18) and Assumption 2, we have the following job creation condition

$$\Pi_{vj} = \frac{\eta_j(r+\delta)}{r(r+\delta+\eta_j)}(y - E(w_j)) = v \tag{19}$$

where $E(w_j) = Q_j w_{oj} + (1 - Q_j) w_r$ is the wage the firm expects to pay when creating a vacancy in location j. There are now four unknowns– the two firm contact rates and the two worker contact rates– in four equations– the matching functions in the two locations (15) and the two zero-profit conditions (19).

In order to facilitate discussion, we now limit ourselves to the case where $b_1=b_2=b/2$ (so that b is now the aggregate homeownership rate in the labor market). Thus the owner contact rates, wages, etc. are constant across the locations within each market. Of course it remains the case that regardless of b, the results described above remain intact: the labor market outcomes for renters are, within each market, superior to that of owners. This is the basic Oswald hypothesis. But now consider the impact of a rise in b. There are two effects. The first is the composition effect: a greater proportion of the population are homeowners, and as such, a greater proportion of the population will have the inferior labor market outcomes that we describe. This will serve to lower the average wage and raise the aggregate unemployment rate. The second effect we call the entry effect: from the definitions of $Q(\cdot)$ and the expected wage, that the expected wage will fall. In equation (19) the left hand side (expected profits) rises above the entry cost. Therefore entry must occur, which lowers the firm contact rate, η_j. This simultaneously increases the worker contact rate (15) and, with the resultant rise in wages for both renters and owners (from (12) and (13), and a fall in the steady-state unemployment rates (from (16) and (17)). If the entry effect is strong enough (particularly for the owners themselves) then it might outweigh the composition effect and lower the aggregate unemployment rate within the labor market.

Unfortunately the equilibrium solutions for the worker contact rates turn out to be quite complicated and we resort to numerical solutions in order to discuss that steady state. These calculations must be regarded as nothing more than suggestive, and as motivation for our empirical study below. We parameterize the matching function as a Cobb-Douglas function:

$$\eta V = \mu S = m S^{\alpha} V^{1-\alpha} \tag{20}$$

where m is a scaling factor, set equal to one in our case. Setting $\alpha = 0.5$ provides a particularly convenient form for equation (15) ($\eta = \mu^{-1}$). We furthermore set $y = 1$, so that other outcomes can be viewed as relative to firm output , as well as setting $\delta = .04$, $r = .03$, and $v = .3$.

As noted, we set $b_1 = b_2$, and we allow the aggregate $b_1 + b_2$ to vary. The solutions are calculated using the solving algorithm in Eviews. Figure 1 demonstrates that in the steady state characterized by the parameter values discussed above, owner unemployment probabilities are always greater than those of renters (as noted in Remark 2), but that each declines as the aggregate homeownership rate increases, as suggested by the entry effect. Note that the two lines converge to a small degree as b approaches one, thus exhibiting the possibility that the entry effect could outweigh the composition effect. Figure 2 demonstrates that this is indeed the case for this set of parameter values: at aggregate homeownership rates above approximately 42%, increases in that rate cause the aggregate unemployment rate to fall. Thus, even in the context of lower mobility of homeowners, and the Oswald hypothesis in place, the relationship between homeownership and the labor market is non-monotonic.

A similar phenomenon occurs as we plot the average wage. As Figure 3 demonstrates, with this set of parameters, the composition effect is dominant at low levels of homeownership, but as it rises, the entry effect becomes more powerful, and average wages rise with b. (Note that the maximum point on the unemployment graph is less that the minimum point of the wage graph.)

The Oswald model with wage-posting

From wage bargaining, we move to a wage-posting model. Unlike the previous models, now there is a single location, and we operationalize frictions from homeownership by assuming that workers living in different housing tenures differ in their utility from unemployment. In particular, owners are assumed to be disadvantaged as compared to renters because in times of unemployment it is more costly to adjust their housing consumption or to move to a better-suited location (within the metro area) for a new job.

There is a measure b of homeowners and $1-b$ renters. Let the utility from unemployment for renters be a_r. For homeowners, unemployment utility is lower $a_o < a_r$. Unemployed workers randomly arrive to vacant jobs, and they search sequentially, one vacant job at a time.

As before, jobs are either filled or vacant, and firms create vacant jobs by paying a set-up cost v. The equilibrium number of job vacancies is V. For vacant jobs, firms post a wage (that is, they pre-commit to a wage). Thus, unemployed workers who arrive to a vacant job observe the wage and decide whether or not to accept it (there is no bargaining). In this way, we modify *Assumption 1* of the previous section:

Assumption 1′ (Wage Posting): Firms creating a vacant job post a wage equal to either the renters' or the homeowners' reservation wage and unemployed workers arriving to a vacant job either accept its posted wage or reject this wage and continue search.

Following from the difference in unemployment utilities, renters have higher reservation wages than renters, as we establish below. Firms do not post a wage offer in between the reservation wage of each tenure type, because doing so simply gives away surplus to homeowners, without changing the likelihood of acceptance, since all renters will reject a wage below their reservation wage.[5] Let the equilibrium proportion of vacant jobs posting the low wage, w_l, be $0 \leq \beta \leq 1$.

The matching technology now represents the total flow of arrivals of unemployed workers to vacant jobs, but not necessarily ultimate matches. As before, we assume constant returns to scale in the matching technology, and now we add the assumption that the function is concave in its arguments. Let μ be the rate at which unemployed persons find a job. Homeowners and renters are perfect substitutes as workers; therefore, the offer arrival rate is independent of tenure status. Now, η is the rate at which vacant jobs have unemployed workers arrive to them, and analogous to *Assumption 3* we have $\eta V = \mu U = m(V, U)$, where U is the total number of unemployed workers. For simplicity, the matching rates are rewritten for this section as $\mu = m(\frac{V}{U}, 1) \equiv \mu(\theta)$, where $\theta = (V/U)$, and $\eta = m(1, \frac{U}{V}) \equiv \eta(\theta)$. We again assume that jobs are destroyed at an exogenous rate, δ.

5 In other models, when search is extended to all workers, not just those who are unemployed, wages may be posted in the interval precisely because doing so improves the firm's probability of a match.

To establish each tenure's reservation wage, we write the average flow value of employment J_{eik} (separately at the low and high wage for owners, $k = l, h$) and unemployment J_{ui} to workers of different tenures, $i = o, r$:

$$rJ_{eol} = w_l + \delta(J_{uo} - J_{eol})$$

$$rJ_{eoh} = w_h + \delta(J_{uo} - J_{eoh})$$

$$rJ_{er} = w_h + \delta(J_{ur} - J_{er})$$

$$rJ_{uo} = a_o + \mu(\theta)(\beta J_{eol} + (1-\beta)J_{eoh} - J_{uo})$$

$$rJ_{ur} = a_r + \mu(\theta)(1-\beta)(J_{er} - J_{ur}).$$

As noted, firms do not post a wage above the renters' reservation wage because doing so will not increase the likelihood of a match since all unemployed workers, both renters and homeowners, will be willing to work for this wage. Further, firms can extract all the surplus from a match with renters by making them indifferent between accepting a wage offer and remaining in unemployment. Therefore, firms set $w_h = a_r$.[6] Because homeowners may sometimes arrive to a job posting the high wage, w_h, the reservation wage of homeowners, referred to as the low wage w_l, is weakly greater than their unemployment utility, as we establish below.

Firms optimally set the low wage offer in order to make homeowners just indifferent, in expectation, between accepting and rejecting a low-wage offer:

$$rJ_{eol} = rJ_{uo} = w_l.$$

Rewriting $a_o = a_r - \varepsilon$, where $\varepsilon > 0$, and using the flow values above yields a reservation wage for homeowners,

$$w_l = a_r - \frac{\varepsilon(r+\delta)}{(r+\delta)+\theta\eta(\theta)(1-\beta)}.$$

Therefore, $a_o \leq w_l < a_r$. Notice that because firms do not observe the tenure of workers prior to posting the wage, homeowner expected wages are (weakly) greater than their reservation wage in equilibrium. On average, homeowners earn $a_o \leq \beta w_l + (1-\beta)a_r < a_r$.

[6] The paradox in Diamond's (1971) model exists in ours as well when workers are just indifferent between working and unemployment, since any positive costs of search will result in no search. We assume, however, that firms are willing to pay some amount higher than renter unemployment utility in order to increase their matching probability in our model, and that this amount is sufficient to induce search. We also note that the paradox is only likely to apply to renters, since homeowners receive more than their unemployment income in equilibrium.

Remark 3. In the wage posting model, as in the bargaining model, conditional on being employed, homeowners have lower wages than renters.

In equilibrium, the flows into and out of each tenure must be equal. Therefore, $\delta(b - U_o) = \mu(\theta)U_o$, and $\delta(1 - b - U_r) = (1 - \beta)\mu(\theta)U_r$, so that the tenure-specific unemployment, U_i is given by

$$U_o = \frac{b\delta}{d+\mu(\theta)}$$

and

$$U_r = \frac{(1-b)\delta}{d+\mu(\theta)(1-\beta)}.$$

Remark 4. Unlike the bargaining model, in the wage posting model homeowners are less likely to be unemployed than renters.

Firms choose which wage to post by maximizing the flow value of a vacant position. The tradeoff from posting a lower wage is that while this obviously lowers the cost of hiring a worker (for the same level of assumed productivity), it reduces the likelihood of offer acceptance since unemployed renters will reject it. (Recall that unemployed workers arrive randomly.) Therefore, flow value of a vacant job for which the posted wage is w_l is

$$r\Pi_{vl} = \eta(\theta)Q(\Pi_{fl} - \Pi_{vl})$$

where Q is the proportion of unemployed workers that are homeowners. The value of a vacant job when the posted wage is $w_h = a_r$ is likewise defined as

$$r\Pi_{vh} = \eta(\theta)(\Pi_{fh} - \Pi_{vh})$$

since all unemployed workers will be willing to accept the high wage. The flow values of a filled position at either wage, Π_{fk} are

$$r\Pi_{fl} = y - w_l - \delta\Pi_{fl}, \text{ and}$$

$$r\Pi_{fh} = y - a_r - \delta\Pi_{fh}.$$

We adopt the zero profit condition found in Assumption 2, and a steady-state equilibrium is defined by θ, the degree of market tightness, and β, the distribution of wage offers. Noticing that the flow value of a vacant position at the high wage is independent of β, we use the zero profit condition for firms posting a high wage to arrive at a job creation condition which determines θ,

$$\frac{(y-a_r)}{(r+\delta)} - v - \frac{vr}{\eta(\theta)} = 0.$$

Because the reservation wage of renters is independent of the matching rate, this condition is greatly simplified as compared to the prior model in (19). In equilibrium, the flow values from a vacant position posting either wage are equal, which yields a second equation, defined in terms of the rate at which homeowners are unemployed, Q:

$$Q = \frac{(y-a_r)r}{(y-w_l)(r+\eta(\theta))-(y-a_r)\eta(\theta)}.$$

Therefore using the definitions of Q, U_o, U_r, w_l, and θ as determined by the job creation condition, we can solve for β. Effectively, as the mix of low and high wage offers changes, so does the proportion of unemployed homeowners in the market (and thereby the matching rate at the low wage) until firms are indifferent between posting either wage.

A solution exists under general conditions for ε (the extent to which additional frictions exist for homeowners) large enough. An interior solution (that is, a mixed strategy for firms) exists for β if ε is neither too large, nor too small. The intuition is as follows. If the wedge between homeowner and renter reservation wages is very large, then the value to firms from offering the low wage will always outweigh the longer time that it will take to fill a vacant position, and $\beta = 1$. On the other hand, if the difference is too small, then the value of filling the job more quickly, as achieved by posting the high wage, will always outweigh the slightly greater costs of filling jobs at the high wage, and $\beta = 0$. When the difference in utility from unemployment is more moderate, vacant jobs at both wages are observed in equilibrium.

Summarizing the results of the wage posting model:

1. Conditional on employment, wages for homeowners are less than those of renters. This is because they accept lower wages because the cost of being without work is greater.

2. The probability of unemployment is lower for homeowners because they get more acceptable offers.

To this point, our results are similar to Munch et al. (2006) when their model is restricted to one location. However, and in addition, given the equilibrium defined by θ and β, we can show the following results with respect individual and aggregate unemployment and wages:

3. If the homeownership rate rises, the fraction of firms offering the low wage goes up, therefore homeowner wages will fall and average wages will fall.

4. If the homeownership rate rises, then renter unemployment will increase.

5. The impact of an increase in the homeownership rate on overall unemployment is positive. The households that switch to owning will lower their unemployment probability, while the remaining renters have higher probability of seeing an unacceptable wage. The latter effect dominates.

Summary of theoretical predictions and their economic content

The summary of model predictions is contained in Table 1. We differentiate between Oswald's predictions, search without firm entry, search with firm entry and wage bargaining, and finally search with firm entry and wage-posting.[7] Oswald and the wage bargaining model each conform to the basic idea of the Oswald hypothesis, that homeowners will be unemployed more frequently, although for slightly different reasons: Oswald because owners do not like longer commutes, and in our model because owners have inferior search ability. In the other two models, unemployment for owners is lower precisely because owners have lower standards for job acceptance. In a wage regression, Oswald (1997a) posits a Walrasian labor market, so the coefficient on homeownership will be zero. The search models, on the other hand, all predict that average wage offers to owners will be lower, for reasons just given. (All of this assumes the "localized" version of the MRS model.)

The search models with firm entry differ from the other models in the emphasis placed on the roles of firm entry and the aggregate homeownership. As can be seen from Figure 1, in the bargaining model the probability of unemployment may fall for both homeowners and renters as the aggregate homeownership rate rises. Thus, in the micro-level regressions we will include the homeownership rate in the labor market, and the bargaining model suggests that this should have a negative sign. In the income regression we do the same thing, with bargaining providing an expectation of a positive sign. The wage posting model, on the other hand predicts that if the homeownership rate rises, wages will fall (but only for homeowners) and unemployment will rise (but mostly for renters). The Oswald model (like the bargaining model) predicts that an increase in ownership in the aggregate shifts up the labor supply curve and increases individual wages.

[7] By search without entry, we refer to Dohmen and MRS. We only refer to Dohmen's result with respect to unemployment.

At the aggregate level, the models posit different relationships yet again. We have noted that because of its Walrasian flavor, a higher aggregate homeownership rate in the Oswald model is manifested by a leftward shift in the labor supply curve, and is thus associated with a lower employment rate and higher wages. With firm entry and bargaining, both positive and negative relationships are possible between the homeownership rate on the one hand, and average wages and the unemployment rate on the other, as displayed in Figures 2 and 3. This will depend on the importance of the composition effect and the entry effect in the determination of the two labor market variables. The job posting model suggests that increased homeowners will raise unemployment and lower wages. Neither Dohmen (2005) nor Munch, Rosholm and Svarer (2006) consider the implications of changes in the aggregate homeownership rate.

3. Empirical evidence

Previous work

The extant empirical evidence on the link between housing tenure and the labor market can, like the theoretical predictions, be divided into evidence on aggregate relationships and evidence using micro data[8]. The earliest work is almost entirely in the first category and entirely concentrates on the impact of tenure choice on the unemployment rate, rather than wages. Much of this early work is bivariate in nature and uses countries, or a set of regions within a country, as the unit of observation. In Oswald (1997a, 1999) a plot of unemployment and homeownership rates, or changes in these variables for OECD countries, US States, Swiss Cantons, and other samples reveal a positive correlation, congruent with his hypothesis[9]. Also using data on US states, Green and Hendershott (2001) find no relationship between these two variables once the aging of the US population is controlled for. However, stratifying the sample by age group, they do find a correlation for middle aged households, the group for which the correlation is presumably the strongest.

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[8]We limit the discussion here to the relationship between tenure choice and unemployment and wages. Other papers, including van Leuvenstijn and Konig (2004), Boeheim and Taylor (2002) etc. discuss the relative mobility, *per se*, of owners and renters, while others (including Coulson and Fisher (2002)) discusses the effect on unemployment duration. We eschew consideration of duration here, as a topic for further research.
[9]Casas-Arce and Saiz (2006) note that there is a correlation between poor legal protection for landlords which leads to lower aggregate rental tenure and more owner-occupation. If these "poor" legal protections are positively correlated with other legal institutions, then these countries my have poorer economic outcomes in general – hence the relationship between owner-occupation and unemployment.

Partridge and Rickman (1997) are evidently the first to consider the relationship between aggregate homeownership and aggregate unemployment in the context of a multivariate model (although this was not the relationship of interest in their paper). They find the relationship between ownership and unemployment to be positive, using a panel data set of US States. Pehkonen (1999) using a sample of Finnish regions, comes to a similar conclusion. On the other hand, Barrios Garcia and Rodriguez Hernandez (2004) find little evidence of the Oswald effect in their multivariate model of Spanish regions– rather, they find a negative relationship between the two rates. It would seem that the evidence concerning the relationship between aggregate homeownership and the unemployment rate is rather scattered.

The few studies that have used micro-data have found little evidence of a link between ownership and unemployment. Coulson and Fisher (2002) found that US homeowners had, contrary to the hypothesis, lower probability of unemployment, (and had higher wages, conditional on a number of demographic attributes). Using Australian data, Flatau et al (2003) extend the empirical scope of Coulson and Fisher (2002). Their main conclusion is that homeowners do not have higher probability of unemployment, but they find evidence that highly-leveraged owners re-enter the labor force as quickly as possible. If high leverage makes adjustments to housing consumption more costly, then this outcome is congruent with the predictions of the wage posting model. In Munch, Rosholm and Svarer (2006), the authors use data from the Danish labor market, and find that unemployment spells for owners are shorter than those for renters, which is congruent with their "local" model and our job postings model in which homeowners accept jobs more readily . However in Munch, Rosholm, and Svarer (2008) the authors find that owners earn *higher* wages than renters (of course using the appropriate controls), which is not congruent with their 2006 model. They speculate that homeowners are offered higher wages than renters, even locally, because their immobility causes them to invest more in the local jobs they have, increasing their firm-specific productivity.

We turn now to some new empirical evidence. Our strategy is motivated by three considerations. The first is that our discussion of extant theory, as summarized in Table 1, demonstrates that predictions are distinct at the aggregate and individual levels. Thus it will be helpful to follow both strands of the empirical literature on this topic and provide evidence at both levels. The second consideration is that at both levels, but at the individual level in particular, evidence from the US is lacking. Only Coulson and Fisher (2002) provide such evidence. The third consideration is that the vast majority of evidence-excepting Coulson and Fisher (2002) and Munch, Rosholm and Svarer —considers only unemployment (and its duration) while the Oswald hypothesis also makes predictions about income. In what follows we present aggregate and individual level evidence on the relationship between homeownership (and its attendant immobility) and unemployment status and wages using US census data.

Aggregate metropolitan data

While Oswald (1999) and Green and Hendershott (2001) examine US state data to test the implications of the various forms of the Oswald hypothesis at an aggregate level, this is somewhat unsatisfactory, since the aggregate unit of observation should correspond to a labor market. We therefore use MSA (or PMSA as appropriate) level observations in aggregate models of unemployment rates and median incomes. From the State of the Nation's Cities database we collect data on the following MSA variables:

oor = the percentage of households that are owner-occupiers

pcimm= percentage of the population that is immigrant (i.e. born outside the US)

pcba= percentage of the population over 25 which has a four year college degree

pcblack = percentage of the population identifying themselves as Black

pchisp = percentage of the population identifying themselves as Hispanic

pcman= percentage of the employed population employed in the manufacturing sector

pop= MSA population

ur = unemployment rate

medinc = medinc income of employed males

The last two are the dependent variables, and our parameter of interest is the coefficient of *oor,* the MSA ownership rate. For each of the dependent variables we estimate the model three ways. First, we estimate a bivariate regression, in the spirit of Oswald (1997a, 1999), second with all of the other covariates listed above, and third limiting the sample to cities with population greater than 500,000[10]. The latter specification is

[10]Following Green and Hendershott (2001), we also estimated a weighted regression using population of the MSA as the weight. The results were virtually the same

meant to test the idea that reduced mobility matters less, or not at all, in large cities, as would be suggested by search theory generally. The results are in Table 2.

The results for unemployment are easily summarized. The fit of the model is substantial, with over half of the variation in unemployment rates being explained by the variables in the fully specified model. The background variables have more or less expected signs on their coefficients. Cities with greater black and Hispanic populations generally have higher unemployment, as do cities with lower levels of education. Population and immigrant percentage are insignificant; possibly the only surprise is the lower unemployment rates in cities with relatively high levels of manufacturing employment. Our key variable, the ownership rate, carries a negative coefficient in the bivariate regression, which, it should be noted, is congruent only with our bargaining model of the aggregate relationship. When the sample is restricted to large cities the coefficient is smaller, suggesting that the lack of mobility (however that is manifested in the theory models) is less severe in larger economies. Because the simulations of our model indicated that the relationship between the ownership rate and the unemployment rate is possibly non-monotonic, we added the square of the ownership rate to the regression model, but this added nothing to the fit. Because the ownership rate is between zero and one, the correlation coefficient between it and its square is greater than 90%. Thus we do not have complete confirmation of the bargaining version of the Oswald hypothesis. (One might speculate that the majority of the data points are on the downward sloping side of Figure 2.) Nevertheless we reiterate that only the bargaining model predicts the negative relationship observed in Table 2.

Models of MSA median earnings have a somewhat different character. In the bivariate regression the coefficient on the ownership rate is negative, albeit with an insignificant coefficient. When the background regressors are included, the fit is rather better; roughly three-quarters of the variation is explained by the included variables, and the background variables, with the exception of population, have the expected signs and significance. However the impact of the ownership rate coefficient is positive and significant in these specifications, which is congruent with both the Walrasian model of Oswald (1997b) and our bargaining model. (Again, the quadratic term adds nothing to the fit.) The restriction of the sample to larger cities reduces the impact, which is intuitive if search is more efficient in large cities.

Evidence from micro-data

Our purpose now is to use micro-level data to once again test the various forms of the Oswald hypothesis. Since the structural forms of these four models differ considerably, we use the reduced form predictions of these models as a basis for comparison. We consider models of the following sort:

$$U_i = X_i\beta + H_i\gamma + \overline{H_i}\delta + \epsilon_i \qquad (21)$$

where U_i is a binary indicator with 1 indicating that the i^{th} individual is unemployed, X_i is a set of demographic and location characteristics of that individual, to be described below. H_i is an binary indicator where 1 indicates that the individual is an owner-occupier, so that the sample mean of H, $\overline{H}$ is the ownership in the labor market of the observation. β, γ, δ are parameters to be estimated. We then replace U_i with the natural log of earnings and estimate (21) again. We use probit regressions for the unemployment model and linear regression for the latter. For reasons discussed in detail below we use the 1990 Census supplement to the Current Population Survey to test the models' predictions on the conditional probability of unemployment and the conditional expectation of wages. The data consists of individuals aged 18 to 65 who are residents of a Metropolitan Statistical Area (MSA). The correlates we use are listed in Table 3 as are summary statistics for the sample. The Table indicates that the sample is fairly representative of the population, particularly with respect to the variables of primary interest. Discrepancies between this sample and the population as a whole are due to our sample screens, discussed in detail below. The sample homeownership rate is 69%, and the sample unemployment rate is 3%, which are slightly better than the official data for the time period. Average annual income is about $33,000. The ethnic distribution of the sample is also reasonable, although blacks are a bit underrepresented and Hispanics overly so (again this is due to our sample screens discussed below): 7% of the sample identify themselves as Black and 13% as Hispanic. The background variables also include measures of educational attainment (High School, College, and Postgraduate Degree– the omitted category in the regressions is non-High School graduate), marital status (Married; Separated, which includes Widowed and Divorced; and the omitted category is Single), and dummies for being in the Service or Professional categories of job description. We also include indicators for size of the MSA: large (population>2,500,000); medium (population between 500,000 and 2,500,000). The omitted category is MSAs with populations less than 500,000.

There exists the possibility that homeownership is endogenous. A few different reasons for this endogeneity may arise, none of which are particularly addressed by the theory models described above. Ownership involves a choice of financial leverage, and also a choice of structure type and size. Owner-occupied dwellings are typically single-family detached units, while rental units are smaller and part of multi-unit facilities. Even controlling for structure type, owned units are typically larger than rentals. All of this is to say that housing expenditure under ownership usually is greater than that for renters, and involves access to mortgage markets and down payments, and this might limit ownership to those who are steadily employed and have sufficiently high wages. Furthermore, the transaction costs of homeownership are greater, a factor which contributes to the stability of owner-households, but which also may be correlated with labor market outcomes.

We therefore attempted to follow Flatau et al (2003) and others by replacing the ownership binary variable in some of our specifications with a predicted probability of ownership derived from a probit equation with ownership as the dependent variable. While the nonlinearity of the probit prediction is perhaps sufficient for identification, it is helpful have exclusion restrictions as well– that is, some set of variables that predicts ownership but plays an insignificant role in labor market outcomes. Our search of the literature reveals some unsatisfactory choices. Flatau et al (2003) use binary variables that describe the age of the person. We speculate that age is not a particularly useful instrument, since excluding it from the second stage equation seems inappropriate. One prominent instrument, extensively used in the literature (Van Leuvensteijn & Koning (2004), Munch, Rosholm and Svarer (2006)) is the aggregate homeownership rate in the individual labor market. Importantly, our model suggests that this has a direct effect on labor market outcomes, and so cannot be excluded from the second stage regression. DiPasquale and Glaeser (1999) propose a modification of this, stratifying the local homeownership rate, by race and income quantile, but in our data this is so highly collinear with the included overall ownership rate as to make it almost useless as a separate identifier.

We have a number of plausible instruments, all of which are used in each instance of IV estimation below. As noted above, one of the most reliable facts in housing markets is that owner-occupied dwellings tend to be single-family detached units, and rentals are in multifamily dwellings (Coulson and Fisher, in progress). Thus the relative stock of each housing types is correlated with the propensity for homeownership in the community. At the individual level, the structure type will likely be endogenous, so we use the percentage of households in the MSA living in multifamily housing as our first instrument. Our second instrument is the (maximum) state tax rate, as applied to the deductibility of mortgage interest. That is, if the state tax code does not permit deductibility then the instrument takes a value of zero. If mortgage interest is deductible, then it takes a value of the maximum marginal tax rate in that state. The point of course is that homeownership is more prevalent in those states in which the price of borrowing is lower. We assume that variations in that deductibility are uncorrelated with labor markets in those states, which seems plausible.

While these two instruments both have the appropriate properties of good instruments, they remain somewhat unsatisfactory in that they are both measures of aggregate (state or MSA level) ownership and our regressions use individual level observations. From a practical standpoint the use of aggregate instruments poses a problem, in that the fitted values from a first stage regression using such instruments will be highly correlated with the aggregate ownership rate that is part of our second stage model. Because of this, it is desirable to include a household level covariate among the instruments. Such an instrument should be correlated with the propensity to become a homeowner and yet uncorrelated with unobservable labor market behavior.

In a different context, Angrist and Evans (1998) consider the relationship between fertility and labor supply. Their investigation seeks to resolve the issue of endogeneity between the presence of children and labor market outcomes by exploiting the preference of parents for siblings of different sexes to create a plausibly exogenous instrument for the number of children in a household. Angrist and Evans (1999) show that when they use the same-sex instrument for the presence of more children, the change in the number of children does not significantly influence male labor supply. Because the presence of children is well-known to be correlated with a propensity to become owners, we seek to replicate their approach by using the sex of children in the household as an instrument for homeownership.

In particular, from 1990 Public Use Microdata 5% sample we draw a sample of moms between the age of 21 and 35 who were married and for whom their spouse was present, and who had 2 or more children in the household[11]. To do so, we utilize iPUMs (Ruggles et al. 2008) indicators linking moms, children and spouses. Due to evidence that fertility does not affect male labor outcomes, we in turn focus on the total income and unemployment experience of husbands associated with this sample of moms in the year before the census. Because of our focus on homeownership and housing, we screen for a few more data irregularities than Angrist and Evans (like the presence of multiple families in one residence and other ambiguous tenure arrangements like those living in group homes) to arrive at a final sample of over 185,000 married men. Table 3 also provides summary statistics of the instruments so derived. Households for whom the two first-born children are the same sex are 6% more likely to have a third child in this sample (as compared to 7% in Angrist and Evans (1998)).

Households with two children are 5% more likely to be homeowners than households with more than two children. However, when we examine the differences in homeownership by whether the first two children are the same sex, we do not find a discernable difference in homeownership rates – both groups with two or more than two children have a homeownership rate of 69%. An investigation of whether the same-sex first-borns are male or female offers some evidence about why this indicator is confounded – households where the first two children are male are about .3% more likely to be homeowners, while households with 2 female first-born children are about .4% less likely to be homeowners than all other households. In the two stage estimation below, we employ both indicators for male and female same-sex first-borns with an indicator for whether the first born is male to fully specify the sex composition of the two first-born children in each family in the first stage estimation of tenure choice (along with the two market-level instruments discussed above)[12].

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11 This explains the somewhat different sample, as displayed in Table 3. Hispanics for example have higher than average fertility levels.

12 Another issue, also raised by a number of the referenced papers, is the plausibility of strictly identifying homeownership with immobility, and renting with mobility. On the one hand, homeowners are not equally mobile. A prominent manifestation of this, as Chan (2001) notes, is that falling house prices can cause a spatial lock-in effect. On the other hand, it is also not the case that all renters are mobile. Following a line of research that begins with Hughes and McCormick (1981), and continues in Flatau et al (2003) and Battu et al (2008), one might speculate that households who are subsidized in their rental arrangements in some way, perhaps through public housing, also face high transactions costs when considering relocation. Although our prior belief is that US residents with rental assistance are not as constrained in the same way as those in European or Australian markets studied by the above authors, in previous versions of this paper we created indicators for leveraged households, those who had negative equity, and those who were in subsidized rental

Unemployment

In Table 4, we first present results for probit regressions on the probability of unemployment. Recall that the dependent variable equals one if the person in question is *unemployed*. In the first column the lone regressor is the binary variable which equals one if the individual is a homeowner. The negative (and highly significant) coefficient indicates that the unconditional probability of unemployment is higher for renters than owners, which, considered on its own, is contradictory to the standard Oswald hypothesis but congruent with the wage posting models. Column 2 adds the usual set of conditioning demographic variables, most of which have signs which are congruent with prior expectations and previous research. There is a statistically insignificant increase in the probability of unemployment as a person ages, however the marginal effect of a year of age is less than .1 percentage points. Blacks and Hispanics have a significantly higher unemployment probability, while the difference between Asian and White unemployment is small and not estimated precisely. The three education variables are all economically and statistically significant, and of the expected relative magnitudes: compared to the omitted category of less than 12th grade education, those who are high-school graduates have a 1.9 percentage points lower probability of unemployment; the corresponding numbers for college graduates and advanced degree holders are 2.3 and 2.4 percentage points[13]. Those with professional and service careers are also less likely to be jobless. In column 3 we find evidence that city size on its own has a significant effect on unemployment; those in medium size cities have probabilities of unemployment 0.5 percentage points higher than those in the omitted category of small cities. As suggested by our theory models, in column 4 we add the local homeownership rate to the model. One can observe that the coefficient on homeownership stays roughly the same, while the unemployment probability rises as more owners enter the market.

In the fifth column is our preferred specification in which we estimate the probit model using the instruments suggested above. As can be seen the coefficient on unemployment is still negative and of roughly the same magnitude. Its negative sign matches the predictions of the MRS model and the job posting

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arrangements. The number of such households in our data was too small to generate meaningful estimates, although there were indications that negative equity changes did have some effect on labor market outcomes.
[13]These marginal effects, like others below, are evaluated at the means of the regressors.

model. The positive coefficient of the homeownership rate matches the job posting model only. The impacts of these variables are sensible; at the mean values of the regressors, they imply that individual homeownership raises the probability of unemployment by about 3.5 percentage points, while a 10 percentage point increase in the homeownership rate will increase that probability by less than one percentage point.

Income

The results for income are contained in Table 5, where the estimation sequence is exactly the same as in the unemployment models of Table 4, merely switching from probit (without or with instruments) to probit (in the first stage) and instrumental variable estimation[14]. The dependent variable is the log of annual earnings of the householder for those individuals who did not report themselves as unemployed.

We begin by presenting the unconditional relationship – that is, the simple regression of homeownership on the natural log of income. The results are what might be expected from such an unconditional relationship: homeowners have incomes that are 52% higher than renters, which is contrary to the pure form of the Oswald hypothesis, but is presumably due to differences in homeowners and renters other than their relative mobility. Some of those differences are controlled for in column 2, which adds the same background characteristics used in Table 4. Most of these characteristics have coefficients with the expected signs and precision– indeed all of them have significant t-ratios. Older workers have higher wages: according to these OLS estimates, wages rise at about 1.2% per year. Nonwhites have lower wages than whites (the omitted category). High school, college and post-baccalaureate graduates have increasingly higher wages (compared to high school non-graduates). Professional workers have wages that are 22% higher and service industry workers have wages 3% higher than other industry categories. In the next column, we note that the coefficients of our city-size category variables are monotonically increasing in the size of the city. This may be due to increasing search efficiency, but may also reflect compensating differentials for the higher

14We use a probit in the first stage because in the linear second stage there would otherwise be a very high degree of collinearity between the fitted value and the included ownership rate. Wooldridge (2002) suggests that using the fitted value of the probit as the instrument for ownership in the second stage IV regression will produce correct inference.

cost-of-living in larger metropolitan areas. The key coefficient, that of homeownership, falls to about two-thirds of its size in the first column. Following the modeling sequence in Table 4, in the next column we add the local homeownership which has a negative coefficient. In the next column we present our IV estimates. In this, the most credible specification, the effect of ownership on wages is now negative, and the effect of the homeownership rate is positive, which only matches the prediction of the bargaining model.

As a final test of the models, we note from Table 1 that both of our models predict that there is a differential effect of the aggregate ownership rate on renters and owners. It was not possible to test this in the models presented in Tables 4 and 5; this requires a covariate that interacts (instrumented) ownership with the ownership rate. These estimates were wildly unstable. As a rough alternative, we split the sample into owner and renter subsamples and ran the regressions again using the covariates in Tables 4 and 5 and Heckman selection term. The results for the coefficients on ownership rates are contained in Table 6. We observe there that the effect of the aggregate ownership rate on renters' unemployment is stronger than that of owners. This is exactly as predicted by the wage posting model, and the opposite of what the bargaining model states. For wages the effects are reversed, the impact is positive for owners and negative (but very small) for renters. This is basically what is predicted by the bargaining model, although it conjectures that the effect is positive for both.

4. Conclusions

We have outlined five theory models that link tenure in the housing market to labor market outcomes and noted that their predictions differ not only with respect to each other, but within the models themselves at various levels of aggregation. We therefore model the relationship between labor market outcomes and tenure choice at both the individual and MSA level and compare the outcomes to these predictions.

Consider Table 7. This table compares the qualitative predictions of our two models to the evidence presented in the previous section. We only consider our two new theory models, because these are the only ones to take into full account the effects of aggregate ownership on individual outcomes, and this proved to be an important addition to the specification of individual-level models. The summary conclusion is clear but somewhat unsatisfactory: *the wage posting model explains the results on unemployment, and the bargaining model explains* *the results on wages*. The weakness of either model can be traced to its set-up. In the wage-posting model, workers do not share in the gains from matching, and thus wages are not responsive to market tightness. In the bargaining model, homeowner unemployment is restricted to be greater than that of renters due to the assumed differences in matching rates. A hybrid model, beyond the scope of this paper, is evidently needed to reconcile all of these empirical results, and this is the object of current research.

Note that the original manifestation of the Oswald hypothesis carried with it the suggestion that homeownership had not only adverse consequences for the individual, but inefficiencies in the labor market as a whole (Dietz and Haurin (2003)) and if that were the case then an economy could be said to have "too much homeownership". Our empirical results suggest something of the opposite, at least from the point of view of society as a whole. Suppose the local labor market of 100,000 workers and households (i.e. a total population of something less than 500,000) shifts 1000 people from owners to renters. The results suggest that 35 of those 1000 people will now become employed (granting that that they become employed perhaps because their standards are lower). This raises society's output by 35*(y-a). It also raises the ownership rate by 1 percentage point but the impact on employment is less than one person, a comparatively trivial amount. This shift does change wages and in ways that are not a net benefit for workers, but from the point of view of our models, the wage changes have no impact on overall welfare since firms and workers were merely splitting rents that occur because of the match. The number of matches is what is important.

That workers evidently absorb a loss of wages as a result of becoming homeowners is presumably counterbalanced by the rewards of homeownership, which are not a part of any of the models discussed here, but might include psychic or financial (due to tax considerations) payoffs.

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Table 1: Model Predictions

Comparative Static Result	Response of individual labor market outcome to individual tenure status.		Response of individual labor market outcome to aggregate homeownership rate.		Response of aggregate labor market outcome to aggregate homeownership rate.	
Labor Market Outcome	Unemp.	Wage	Unemp.	Wage	Unemp.	Wage
Oswald	+	0	0	0	+	0/+
Search	+/-	same sign as unemp.	0	0	0	0
Search with firm entry and bargaining	+	-	- (stronger for owners)	+ (stronger for owners)	+/-	~opposite sign of unemp.
Search with firm entry and wage posting	-	-	+ (renters only)	- (owners only)	+	-

TABLE 2
Aggregate MSA Regressions

Dependent Variable	Unemp. Rate	Unemp. Rate	Unemp. Rate	Ln (Med. Income)	Ln (Med. Income)	Ln (Med. Income)
Sample	all MSAs	all MSAs	MSAs with Pop>500,000	all MSAs	all MSAs	MSAs with Pop>500,000
oor	-0.068	-0.068	-0.052	-0.204	0.619	0.528
	-4.710	-5.470	-3.230	-1.360	6.430	3.760
pcimm		0.015	0.025		1.156	0.791
		1.020	1.390		9.960	5.080
pcba		-0.120	-0.153		1.687	1.922
		-11.350	-8.640		20.590	12.470
pcblack		0.027	0.026		-0.118	-0.267
		4.180	2.400		-2.350	-2.820
pchisp		0.041	0.039		-0.511	-0.588
		5.350	3.840		-8.570	-6.630
pcman		-0.046	-0.019		0.638	0.370
		-4.130	-0.980		7.320	2.220
population		0.000	0.000		0.000	0.000
		-0.430	0.060		0.280	-0.140
_cons	0.102	0.130	0.121	10.937	9.866	9.999
	10.620	13.200	9.240	108.440	128.750	87.640
r2	0.061	0.533	0.708	0.005	0.728	0.803
N	344	344	109	344	344	109

Summary Statistics

Variable	Mean	Min	Max
Homeowner	0.69	0	1
Income (1989)	33424	0	398228
Unemployed (1989)	0.03	0	1
Same sex children	0.50	0	1
Same sex (female)	0.24	0	1
Same sex (male)	0.26	0	1
Sex of first child (1 = male)	0.51	0	1
Age	33.51	18	65
White	0.76	0	1
Black	0.07	0	1
Hispanic	0.13	0	1
Asian	0.03	0	1
Other	0.01	0	1
No High School	0.15	0	1
High School	0.54	0	1
College	0.23	0	1
Grad. Degree	0.08	0	1
Bluecollar	0.48	0	1
Admin and Services	0.28	0	1
Professional	0.24	0	1
Large city	0.26	0	1
Medium city	0.46	0	1
Small city	0.28	0	1
Ownership Rate (x100)	65.33	35.79	83.20
State Marg Tax Rate (x100)	4.83	0	9.5
% Multifamily Struct. (x100)	11.12	0	50.99

Table 3: Summary Statistics for the Individual-Level Regressions

Married Male Unemployment (1989)					
	(1)	(2)	(3)	(4)	(5)
					IV
Homeowner	-0.4617	-0.3218	-0.3264	-0.3412	-0.492
	[0.0114]**	[0.0124]**	[0.0124]**	[0.0126]**	[0.400]*
Ownership Rate				0.0058	0.0072
				[0.0008]**	[0.038]*
Age		0.0027	0.0033	0.0036	0.0059
		[0.0012]*	[0.0012]**	[0.0012]**	[0.0062]
Black		0.2715	0.2866	0.2947	0.259
		[0.0194]**	[0.0195]**	[0.0195]**	[0.100]*
Hispanic		0.0962	0.1174	0.1450	0.1226
		[0.0163]**	[0.0166]**	[0.0171]**	[0.0630]*
Asian		0.0241	0.0509	0.0822	0.066
		[0.0352]	[0.0353]	[0.0356]*	[0.056]
Other		0.2727	0.2722	0.2821	0.261
		[0.0612]**	[0.0614]**	[0.0614]**	[0.085]**
High School		-0.3214	-0.3224	-0.3222	-0.300
		[0.0144]**	[0.0145]**	[0.0145]**	[0.0275]**
College		-0.5250	-0.5230	-0.5207	-0.488
		[0.0215]**	[0.0215]**	[0.0216]**	[0.0937]**
Graduate Degree		-0.6167	-0.6128	-0.6108	-0.582
		[0.0379]**	[0.0379]**	[0.0379]**	[0.0894]**
Admin and Service		-0.2063	-0.2034	-0.2007	-0.196
		[0.0143]**	[0.0143]**	[0.0143]**	[0.0203]**
Professional		-0.2984	-0.2893	-0.2863	-0.275
		[0.0203]**	[0.0203]**	[0.0204]**	[0.0386]**
Large city			-0.1493	-0.1123	-0.109
			[0.0160]**	[0.0168]**	[0.019]**
Medium city			-0.1133	-0.1019	-0.100
			[0.0138]**	[0.0139]**	[0.0147]**
Constant	-1.5524	-1.3738	-1.3078	-1.7081	-1.7898
	[0.0084]**	[0.0402]**	[0.0408]**	[0.0703]**	[0.220]**
Observations	185380	185380	185380	185380	185380
Pseudo R-squared	0.03	0.07	0.07	0.07	0.06
Log Likelihood	-26517.51	-25434.61	-25383.71	-25359.01	-25720.17
Standard errors in brackets					
* significant at 5%; ** significant at 1%					

Table 4 Coefficients and standard errors from probit and IV probit regressions of unemployment indicator on indicated regressors. * significant at 10%, ** at 1%.

Married Male Income (Dependant variable: ln(income))					
	(1)	(2)	(3)	(4)	(5)
					IV
Homeowner	0.5151	0.3340	0.3395	0.3445	-0.3560
	[0.0034]**	[0.0034]**	[0.0033]**	[0.0034]**	[0.0433]**
Ownership Rate				-0.0018	0.0047
				[0.0002]**	[0.0005]**
Age		0.0128	0.0121	0.0120	0.0226
		[0.0003]**	[0.0003]**	[0.0003]**	[0.0007]**
Black		-0.2489	-0.2664	-0.2691	-0.4290
		[0.0059]**	[0.0058]**	[0.0058]**	[0.0118]**
Hispanic		-0.1968	-0.2324	-0.2411	-0.3430
		[0.0047]**	[0.0047]**	[0.0048]**	[0.0083]**
Asian		-0.1775	-0.2123	-0.2218	-0.2960
		[0.0082]**	[0.0082]**	[0.0082]**	[0.0102]**
Other		-0.1761	-0.1758	-0.1786	-0.2701
		[0.0197]**	[0.0196]**	[0.0196]**	[0.0225]**
High School		0.2599	0.2648	0.2649	0.3622
		[0.0045]**	[0.0045]**	[0.0045]**	[0.0078]**
College		0.4456	0.4472	0.4467	0.5904
		[0.0054]**	[0.0054]**	[0.0054]**	[0.0107]**
Graduate Degree		0.6568	0.6553	0.6546	0.7785
		[0.0073]**	[0.0072]**	[0.0072]**	[0.0111]**
Admin and Service		0.0303	0.0238	0.0230	0.0438
		[0.0035]**	[0.0035]**	[0.0035]**	[0.0041]**
Professional		0.2191	0.2079	0.2072	0.2577
		[0.0042]**	[0.0042]**	[0.0042]**	[0.0056]**
Large city			0.2195	0.2087	0.2235
			[0.0040]**	[0.0042]**	[0.0047]**
Medium city			0.0900	0.0866	0.0923
			[0.0035]**	[0.0035]**	[0.0039]**
Constant	9.8535	9.2421	9.1714	9.2972	8.9088
	[0.0029]**	[0.0110]**	[0.0111]**	[0.0176]**	[0.0309]**
Observations	179131	179131	179131	179131	179131
R-squared	0.11	0.25	0.26	0.26	0.08
Standard errors in brackets					
* significant at 5%; ** significant at 1%					

Table 5 Coefficients and standard errors from OLS and IV regressions of log income on indicated regressors. * significant at 5%, ** at 1%

	unemployment regression	income regression
owners	.28	.039
renters	.75	-.0005

Table 6: Coefficient of homeownership rate in regression of indicated column variable using sample from indicated row. All coefficients significant at 5% level.

Comparative Static Result	Response of individual labor market outcome to individual homeownership.		Response of individual labor market outcome to aggregate homeownership rate.		Response of aggregate labor market outcome to aggregate homeownership rate.	
Labor Market Outcome	Unemp.	Wage	Unemp.	Wage	Unemp.	Wage
Search with bargaining	+	-	- (stronger for owners)	+ (stronger for owners)	+/-	~opposite of unemp.
Search with wage posting	-	-	+(renters mostly)	-(owners only)	+	-
Empirical	-	-	+ (stronger for renters	+ (stronger for owners	-	+

Table 7: Empirical results and theoretical predictions

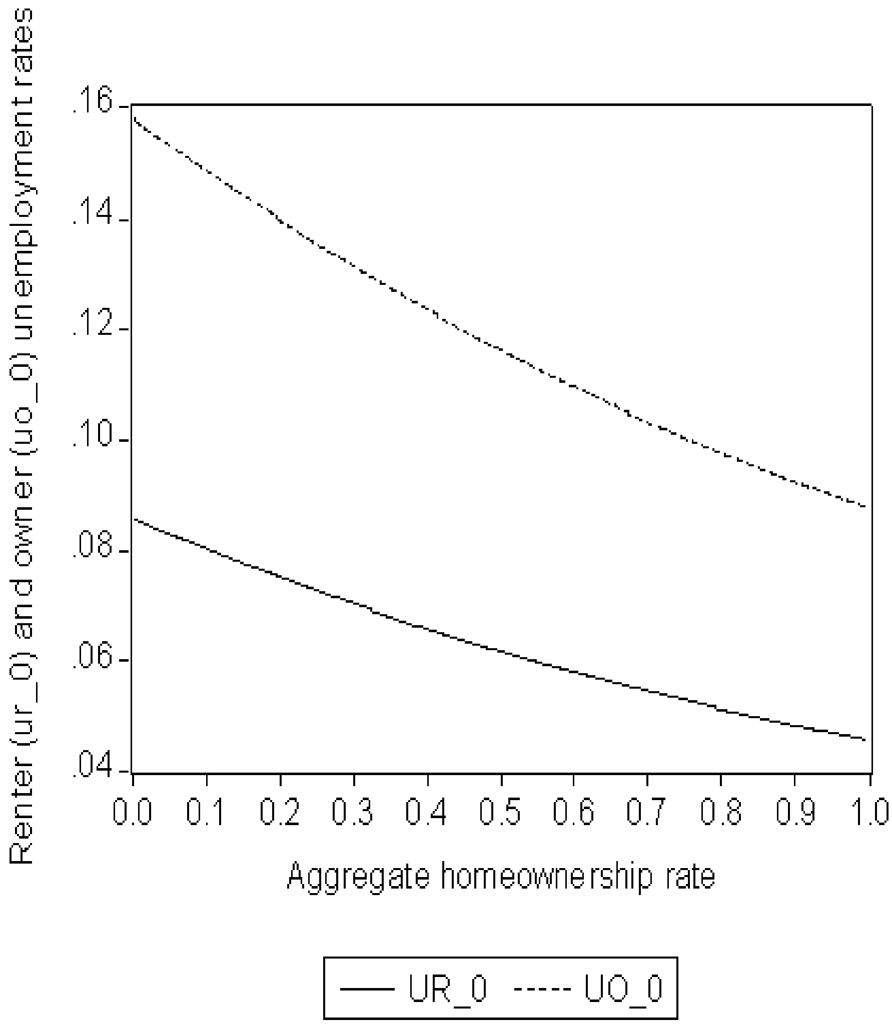
Renter (ur_0) and owner (uo_0) unemployment rates
.16
.14
.12
.10
.08
.06
.04
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Aggregate homeownership rate
UR_0
UO_0

Figure 1

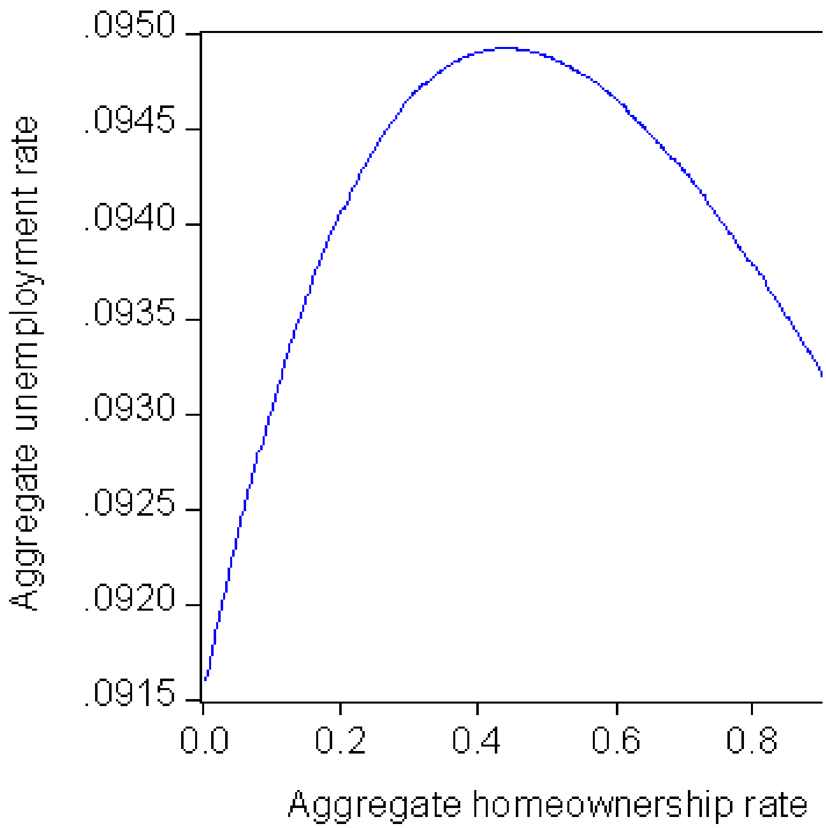
.0950
.0945
.0940
.0935
.0930
.0925
.0920
.0915
Aggregate unemployment rate
0.0
0.2
0.4
0.6
0.8
Aggregate homeownership rate

Figure 2

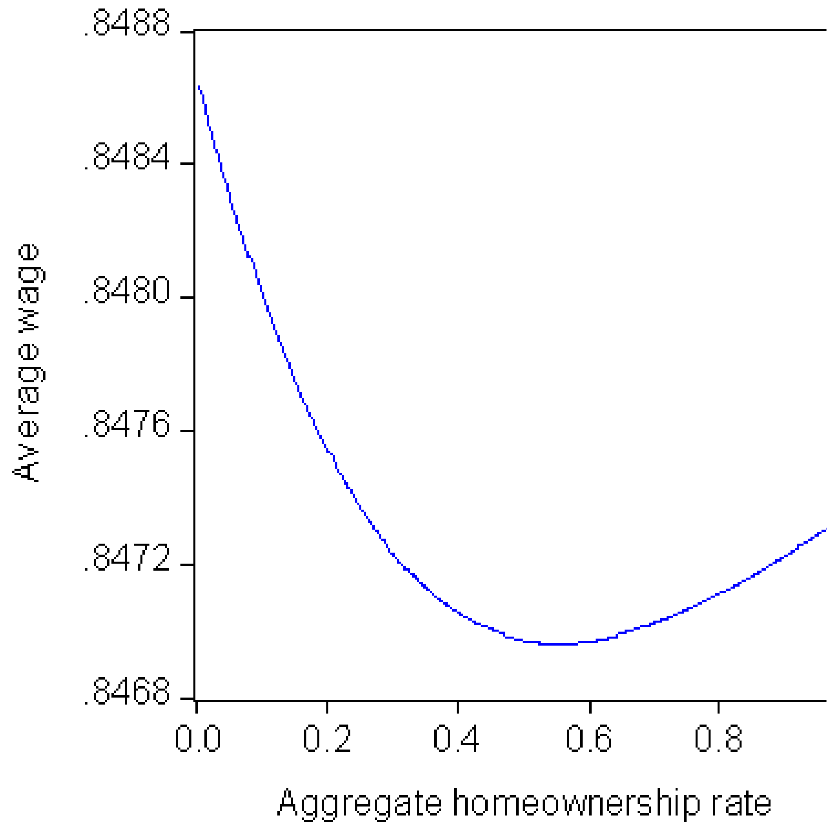
.8488
.8484
.8480
.8476
.8472
.8468
Average wage
0.0
0.2
0.4
0.6
0.8
Aggregate homeownership rate

Figure 3