DISCUSSION PAPER SERIES

IZA DP No. 210

Housing, Mobility and Unemployment

Thomas J. Dohmen

November 2000

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

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Thomas J. Dohmen
University of Maastricht,
Business Investment Research Center and IZA, Bonn

Discussion Paper No. 210
November 2000

IZA

P.O. Box 7240
D-53072 Bonn
Germany

Tel.: +49-228-3894-0
Fax: +49-228-3894-210
Email: iza@iza.org

IZA Discussion Paper No. 210
November 2000

ABSTRACT

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This paper develops a model that shows why high-skilled workers move more and are therefore unemployed less than low-skilled workers. The model can explain the paradoxical empirical regularity that higher owner-occupation rates are associated with higher levels of unemployment although home-owners tend to be unemployed less. The choice of housing tenure affects moving costs and thereby regional mobility and unemployment. The paper analyzes the impact of symmetric and asymmetric shocks on mobility and unemployment, and discusses effects of government intervention in the housing market. In addition, it is shown that moving costs reduce job search effort and search effectiveness.

JEL Classification: J6

Keywords: Housing, mobility, unemployment

Thomas J. Dohmen
Business Investment Research Center
University of Maastricht
P.O. Box 616
6200 MD MAASTRICHT
The Netherlands
Tel.: +31-43-388 3832
Fax: +31-43-388 4856
Email: t.dohmen@mw.unimaas.nl

* I thank Andrew Oswald, Gerard Pfann and Ben Kriechel for fruitful discussions and very useful comments.

1 Introduction

Despite the remarkable progress that has been made over in the past decade in developing theories to explain unemployment, the puzzle of high European unemployment remains largely unsolved. Blanchard and Katz (1997) assert: "The magnitude of the increase [in unemployment], the diversity of labor market institutions and of policies should have helped identify culprits. Yet while many suspects have been identified, none has been convicted." Consistent with this statement is the result of a recent paper by Nickell (1997) which does not find a satisfactory empirical explanation when estimating how labor market rigidities, the treatment of he unemployed,taxes, union coverage, union and employer co-ordination in wage bargaining – all key factors in prominent models – impact on unemployment. Nickell (1997) remarks that both geographical and occupational mobility of workers seem to be higher in the United States than in Europe where unemployment is higher. But he does not explore its causes any further, nor does he discuss the dimension of the role mobility could play as an explanatory variable in unemployment equations.

At the same time, empirical work suggests that housing plays an important role in the determination of unemployment.[1] When Nickell (1998) adds the proportion of home-ownership as an explanatory variable of unemployment rates, the fit of his regression improves considerably. However, compared to empirical work, little effort has been devoted to develop models that explain regional mobility and to enlarge existing models of unemployment, although the idea that mobility adversely affects labor market outcomes is at least as old as the idea of the natural rate of unemployment.[2]

This paper tries to fill this gap. It develops a model which studies the link between skills, the choice of housing tenure and mobility. It explains why high-skilled workers are more mobile than low-skilled workers given fixed moving costs. Moreover it shows how fixed moving costs impede geographical mobility and therefore affect labor market outcomes by reducing search intensity, diminishing the attractiveness of job offers, hence lowering wage pressure and increasing long-term unemployment. The model generates pre-

[1] See Hughes and McCormick (1981), (1985a), (1987), Oswald (1996) , (1997b), Owen and Green (1997) and Henley (1998).

[2] Friedman himself explained: "The natural rate of unemployment is the level which would be ground out by the Walrasian system of general equilibrium equations, provided that there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the cost of mobility, and so on."

dictions consistent with empirical results and stylized facts, and yields important implications for policy. The paper does not attempt to develop a new theory of unemployment but rather to arrange some simple ideas in a logical way that can readily be integrated into existing models.

The paper is organized as follows. The following section discusses links between housing and labor markets and reports some stylized facts that motivate the construction of a simple model of housing, mobility and unemployment in section 3. Section 4 discusses how shocks affect mobility and unemployment, while section 5 introduces some refinements of the simple model. Sections 6 and 7 extend the model to analyze the interaction between search and moving costs as well as the consequences of stigmatization and insider forces. Section 8 focuses on policy implication. Section 9 proposes possible extensions of the model for future work. Finally, section 10 concludes.

2 Links between Housing and Labor Markets – Stylized Facts and Empirical Evidence

There is a growing body of evidence which suggest a positive correlation between rates of home-ownership and unemployment. Oswald (1996), for example, finds that the gradient of unemployment to owner-occupation is roughly 0.2 in different data sets including cross-sections of OECD countries, UK regions, U.S. states, regions of France, Sweden and Italy and a panel data set of UK regions. This empirical regularity is buttressed by the fact that nations with fastest growth rates had fastest growth in unemployment. Again, a 10 percentage point increase in the rate of owner-occupation is associated with an increase in the unemployment rate of approximately 2 percentage points. Higher rates of owner-occupation seem to impede mobility and hence raise unemployment. The rate of owner-occupation might therefore be an important factor omitted in empirical studies of unemployment. In fact, the fit of Nickell's (1997) regression to explain equilibrium unemployment improves considerably – the R^2rises from .76 to .82 – when he adds the proportion of home- ownership as a proxy for mobility to the list of explanatory variables. The estimated coefficient of this variable implies that a 10 percentage point rise in the owner-occupation rate is associated with an additional 1.3 percentage points of the unemployment rate.[3]

[3]It should be noted that the equation is overfitted – there are only 28 degrees of freedom as 12 coefficients are estimated on 40 observations – such that not too much weight should be given to the point estimate of the coefficient on owner-occupation. It is clearly possible

The idea that housing and labor markets are linked is not new, however. Research by Hughes and McCormick (1981, 1985a, 1987) focuses on the private and public renting sector and concludes that council houses restrict labor mobility and hence raise unemployment. Bover et al. (1989) argue that regional house price/earnings differentials are an important element in wage and unemployment, vacancy equations. More recent papers have studied differences in mobility of owners and renters. According to Owen and Green (1997), private renters move relatively more than owners. Oswald (1997b) cites statistics from the 1995 General Household survey which indicates that renters have lived for shorter periods at the current address. Only 5% of all owners have lived at their current address for less than a year, while 27% of renters in the private unfurnished sector and 49% in the furnished sector moved in during the last 12 months. Henley (1998) reports findings suggesting that home ownership reduces mobility.

In spite of the empirical evidence there seems to be a lack of effort to develop theoretical models that are capable of explaining the process generating the evidence in the data. An exception is Oswald (1997a) who develops a model which predicts that higher rates of home-ownership are associated with more unemployment and that unemployment is concentrated among home-owners. However, unemployment data does not suggest that renters are unemployed less. Problems arise also when the model is extended in sensible ways; for example, when one assumes that skilled workers who have higher incomes than unskilled are more likely to own a house. According to the model unskilled are expected to move more and to be unemployed less frequently since they are more likely to be renters and therefore more mobile. Again, this is not what the data suggests.

The model developed in this paper explains how higher rates of home ownership can lead to higher levels of unemployment while unemployment is concentrated among low-skilled workers and possibly among renters as high-skilled workers are more mobile than low-skilled workers given fixed moving costs. The model generates predictions consistent with a number of empirical results and stylized facts concerning labor market outcomes which also motivate the building of the model.

First, flows in the labor markets are immense. Workers quit their job to search for better ones or to leave the labor force, others are fired, releasing a new wave of replacements. Yet another group enters the labor market. The magnitude of those gross flows is much higher than net flows might suggest and strikingly similar in magnitude across OECD countries (for evidence

that the gradient of unemployment to owner-occupation is larger and closer to 0.2 in a more parsimonious specification.

see Davis et. al, 1996; Contini and Revelli,1997 ; OECD,1996, chapter 5). Second, most of the rise in European unemployment can be attributed to an increase in duration hence a rise of the proportion of long-term unemployment (see Nickell, 1997) rather than to a higher inflow rate. Furthermore, most of the differences in unemployment rates across countries can be ascribed to variations in long-term unemployment. Short-term unemployment seems to be quite similar across countries, indicating that the amount of frictional unemployment – which does exist in equilibrium due to the reallocation of workers – is quite similar. Together with the third empirical regularity, that rates of home-ownership are positively correlated with unemployment, this suggests that mobility or better impediments to mobility play a crucial role in the determination of unemployment. It becomes harder to match workers and firms if workers are less prepared to move regions and spend less effort on search across regions. The consequent fall in search effectiveness is consistent with the fourth stylized fact: the outward shift of the Beveridge curve. In most countries, the number of unemployed has risen relative to the number of vacancies indicating that vacancies are filled less efficiently.

Fifth, there are important differences in unemployment rates between demographic and occupational groups. Skilled workers are unemployed less and have shorter expected unemployment durations. Sixth, skilled workers move more, search more and have a preference for employed search. Hughes and McCormick (1985b) find that education increases the probability of job search and Pissarides and Wadsworth (1994) provide evidence that skilled workers search more and prefer employed search. McCormick (1997) argues that unemployment rates are largely determined in the manual labor market and finds little evidence that manual labor moves to low unemployment markets. Instead, wide variations in regional unemployment rates exist among manual workers, whereas absolute net migration rates are much higher for non-manuals. Evans and McCormick (1994) distinguish in their empirical study between manual and non-manual workers and cite evidence that the market for non-manual labor is flexible and geographically integrated while the manual labor market is spatially rigid.

The model developed in this paper can be integrated into existing models in a rather straightforward fashion. Reduced mobility and search activity lead to a fall in search effectiveness and hence a reduction of wage pressure. If mobility and search behaviour are partly determined by conditions in the housing market, the wage pressure variable in models of the Layard and Nickell type (see Layard et al., 1991) or the search effectiveness parameter in matching models (see, for example, Pissarides, 1990) becomes a function of these conditions. Hence, interventions in the housing markets would affect labor market outcomes. This has important policy implications.

3 A Simple Model

This section introduces a simple model which is consistent with the empirical regularity that higher rates of home-ownership are associated with higher rates of unemployment. Moreover, it explains why high-skilled workers move more and are less often unemployed. A condition is derived under which high-skilled home-owners are more likely to move than low-skilled renters. The model is based on the following assumptions:

1. There are two identical regions, East and West. Hence, the size of the regions and the number of jobs in both regions are the same.
2. Workers must live where their job is (unemployed can live anywhere). Commuting is not feasible. If a worker accepts a job offer in the region where he does not live, he must move and incur the fixed moving costs k^m.
3. Workers are either home-owners or renters. The fixed moving costs are equal to k^o for owners, while renters incur a fixed cost of k^r when they change the region of residency. Moving is more expensive for owners, hence $k^o > k^r$.
4. There are two types of workers: High-skilled workers who earn a wage H and low-skilled workers who earn L, where $H > L$. Hence, a worker's wage, W, is defined as $W = H$ if the worker is high-skilled and $W = L$ if the worker is low-skilled.
5. For simplicity, it is assumed that high-skilled workers only receive job offers for skilled jobs and low-skilled workers only offers for unskilled jobs.[4]
6. Jobs last for one period. At the end of the period each worker receives one job offer. The offer comes from a firm in West with probability q and from a firm in East with probability $(1 - q)$. Workers can either accept and earn W or reject. If they reject they become unemployed for one period and get another job offer at the end of the next period.
7. In absence of asymmetric shocks, q is assumed to equal 0.5 such that a job offer comes from either region with equal probability.
8. Unemployed receive benefits B with $B < L$. Benefits are net of any costs of unemployment, C, like mental costs. Gross benefits include any payment or subsidy an unemployed worker receives as well as the monetary value of additional leisure time or self-employment he enjoys. Let M be the monetary value of gross benefits and C the monetary value of any cost associated with unemployment, then $B = M - C$.
9. The discount factor is equal to δ, $0 < \delta < 1$.
10. Worker's lives are infinite.

[4]Equivalently, we could assume that high-skilled workers receive a job offer for a skilled and an unskilled job, but that the condition that would make high-skilled workers prefer a low-skilled job to a high-skilled job is never satisfied, i.e. that $H > L + k^m$.

The last assumption is not crucial, since a finite horizon is generally sufficient to derive the important implications of the model. However, an infinite horizon sometimes facilitates the exposition. Assumption 6 is motivated by high rates of destruction.[5] Job destruction rates determine the expected length of an employment spell. To approximate this, it is assumed that employment lasts for a given period of time.[6] The assumption that employment lasts as long as the time between two job offers makes the mathematics much more transparent without affecting the main insights of the model. The predictions of the model continue to hold when employment is assumed to last longer than the interval between two job offers.

Proposition 1: Workers always accept job offers in their home region, i.e. employment is preferred to unemployment ceteris paribus.

Proof: $H > B$ and $L > B$ by assumptions 4 and 8.

Proposition 2: Given moving costs, high-skilled workers are more likely to move than low-skilled workers. There is a condition under which high-skilled workers always move if the offer comes from the other region while low-skilled workers never move. In that case, high-skilled workers never become unemployed, while low-skilled workers who do not receive a job offer where they live always become unemployed.

Proof: Suppose a worker receives a job offer in the other region. If he accepts and moves, his expected income, Y^a, is given by:

$$Y^a = W - k^m + \frac{0.5\delta}{1-\delta}(W + \max[W - k^m; B])$$

his expected income when rejecting, Y^r, and staying is given by:

$$Y^r = B + \frac{0.5\delta}{1-\delta}(W + \max[W - k^m; B]).$$

(Note that q equals 0.5 by assumption 7.) Hence, a worker moves if

$$W - B > k^m. \tag{1}$$

[5]See Davis et al. (1996), for example.

[6]This simplification is made despite being aware that there is great variation in employment spells. Farber (1999) summarizes some of the evidence. The assumption is not problematic, however, since it is shown in later sections, how mobility and unemployment are affected when expected lengths of employment spell differ across individuals.

Since $H - B > L - B$ by assumption 4, a high-skilled worker is more likely to satisfy (1) than a low-skilled worker, given moving costs. A high-skilled worker moves if

$$H - B > k^m, \tag{2}$$

a low-skilled worker prefers moving to unemployment if

$$L - B > k^m. \tag{3}$$

All workers move if (3) holds, whereas nobody moves if

$$H < B + k^m. \tag{4}$$

Only high-skilled workers move if (2) holds but (3) does not, i.e. if

$$H > B + k^m > L. \tag{5}$$

High-skilled workers are more mobile in this case and will not become unemployed while less-skilled do.

Proposition 3: A rise in net benefits, B, or an increase in moving costs make a worker of any type less likely to move and therefore more likely to become unemployed.

Proof: A rise in B reduces the excess value of employment and makes a worker less likely to satisfy (1). If moving costs, k^m, increase, a larger excess value of employment relative to unemployment, $W - B$, is required to make a worker move. Again, a worker is less likely to satisfy (1).[7]

Proposition 4: Renters are more likely to move than home-owners, ceteris paribus. Therefore, a rise in the rate of home-ownership results in rising average moving costs and a fall in the acceptance rate of job offers. Hence, unemployment rises.

Proof: By assumption 3, moving costs are higher for home-owners, i.e. $k^o > k^r$. Hence, ceteris paribus, home-owners are less likely to move than

[7]The result is the same if unemployment benefits are a proportion of the last wage as is common in numerous countries. M is then equal to $bW + S$, where b is the replacement rate and S are other benefits associated with unemployment. The moving condition can hence be written as $W > (S - C + k^m)/(1 - b)$, and a rise in b or an increase in moving costs increases mobility and hence reduces the expected duration of unemployment. The condition under which high-skilled always move while low-skilled rather go through a spell of unemployment is given by $H > (S - C + k^m)/(1 - b) > L$ (1.4a)

renters.

Proposition 5: High-skilled renters are most likely to move, whereas low-skilled owners are least likely to move. High-skilled owners are more mobile than less-skilled renters if the difference between high-skilled and low-skilled wages exceeds the difference between moving costs for renters and owners, i.e. if $H - L > k^o - k^r$.

Proof: It follows from propositions 2 and 4 that high-skilled renters are most likely to move and low-skilled owners least likely to move. High-skilled owners move if

$$H - B > k^o, \tag{6}$$

low-skilled renters move if

$$L - B > k^r. \tag{7}$$

High-skilled owners are more mobile than low-skilled renters if their net benefit from moving exceeds the net benefit that low-skilled renters enjoy, i.e. if

$$\begin{aligned} H - B - k^o &> L - B - k^r \\ \Leftrightarrow H - L &> k^o - k^r. \end{aligned} \tag{8}$$

This simple model predicts that regional mobility depends on wages relative to moving costs and unemployment benefits. A rise in benefits or moving costs reduces mobility. Workers with higher expected wages are more mobile and therefore less likely to become unemployed, for given moving costs and unemployment benefits. Higher education usually results in higher wages and therefore higher mobility. In addition, higher educated workers may incur lower fixed moving costs.[8] Home-owners incur higher moving costs and are therefore less likely to move. However, if workers with higher wages are more likely to be home-owners, we might observe that home-owners are on average more mobile if we do not correct for income. An increase in the proportion of less-skilled (high-skilled) owners unambiguously has an adverse effect on employment if moving is not optimal for less-skilled (high-skilled) owners but for less-skilled (high-skilled) renters.

Since the proportion of ownership is, in equilibrium, determined by the condition that the utility from owning is equal to the utility of renting, a

[8]It is likely that higher educated workers have lower psychic moving costs. First, those with university degree are somewhat used to move regions. Second, endogenous selection might be present as those who have strong aversions towards moving are likely not to opt for higher education. Third, information about job vacancies in other regions might be easier to obtain for high-skilled. Fourth, firms that offer jobs to higher educated workers sometimes pay physical moving costs.

change in the proportion can only be brought about by changes in relatives costs and benefits of owning which can be induced by changes in tastes (preferences) or government intervention.[9] If owning is a luxury good, such that an increase in the proportion of home-owners is brought about by an exogenous increase in wages, for example due to a productivity increase, then the effect on average mobility is ambiguous. Although average moving costs rise, incomes relative to moving costs may rise or fall.

It seems rather unrealistic that, for example, low-skilled renters either always or never move, or that lower moving costs have no impact on mobility over some range but cause discrete jumps in mobility rates when making a moving constraint non-binding. These discrete outcomes of the model obviously follow from the assumptions. This should not bother the reader. The discreteness disappear if we either assume a continuum of possible wage offers for different workers (in reality there is a continuum of skills and worker productivities) or a continuum of mobility costs. A continuous distribution of individual moving costs is realistic as a number of factors contribute to moving costs, for example, marital status, number of children, age of children, individual costs of moving (importance of friends, neighborhood, etc.). Changing the model to allow for a continuum of moving costs is a straightforward exercise. The model explains the composition of unemployment. The level of unemployment is only partly determined endogenously, namely to the extent that unemployment is caused by lack of mobility. However, other factors that are exogenous to the model might influence the level of unemployment. For example, a lower job offer arrival rate results in a higher level of unemployment as the expected duration of an unemployment spell increases. The next section will, inter alia, extend the model in that direction. The focus of the next section is also on the impact of shocks which affect the two regions differently.

4 The Effects of Shocks

This section analyzes the impact of shocks on mobility. It is shown how symmetric and asymmetric shocks impact on unemployment and how they affect different types of workers. An adverse symmetric shock is modeled as a fall of the job offer arrival rate. In particular, it is assumed that workers receive a job offer every second period rather than every period. Analogously, a positive symmetric shock is modeled as an increase in the job offer arrival

[9]The utility derived from owning might differ across countries mostly because of cultural reasons. For an extensive treatment of changes in preferences see for example Oswald (1996).

rate.

4.1 Asymmetric Shocks

Proposition 6: A temporary random asymmetric shock which reduces employment opportunities in one region (say East) and increases job offers and employment opportunities in the other region (West) only affects workers who satisfy the moving constraint (1) since the shock does not alter moving costs. It tends to increase the number of workers moving to West and lower the number of workers moving to East. An asymmetric shock which raises employment in West and lowers employment in East and is expected to persist in the future makes workers in East more likely to move and workers in West, the booming region, more likely to stay. The effect is bigger, the longer the shock is expected to persist. Therefore, serially correlated shocks have a bigger impact on mobility than random shocks.

Proof:
I) *Random, serially uncorrelated temporary shocks*
An asymmetric shock which increases job offers in West raises the probability q of a job offer in West. If the shock is temporary, say lasts one period, q exceeds one half only in the current period. The moving constraint is still given by (1) since the expected income when moving, for those who get a job offer in the other region, is given by:

$$W - k^m + \frac{0.5\delta}{1-\delta}(W + \max[W - k^m; B])$$

whereas the expected income when rejecting and staying is given by:

$$B + \frac{0.5\delta}{1-\delta}(W + \max[W - k^m; B]).$$

In absence of the shock, half of the workers who do not satisfy (1) receive a job offer in the other region and become unemployed because they do not move. Because of the shock, more workers in East are offered a job in West while less workers in West are offered a job in East. Those who do not satisfy (1) become unemployed. Thus, unemployment rises in East and falls in West. Unemployment is concentrated among the immobile workers.

II) *Persistent Shocks*
a) First consider a worker in East, the slump region, who receives an offer from West. For simplicity, assume that the difference in the rate of job offers persists only in the next future period. His expected discounted future

income when moving is given by:

$$W - k^m + \delta(qW + (1-q) * \max[W - k^m; B]) \\ + \frac{0.5\delta^2}{1-\delta}(W + \max[W - k^m; B]),$$

the present value of staying is given by

$$B + \delta((1-q)W + q * max[W - k^m; B]) \\ + \frac{0.5\delta^2}{1-\delta}(W + max[W - k^m; B]).$$

Hence, moving is profitable if

$$W - B > k^m - \delta((2q-1)W - (2q-1) * \max[W - k^m; B]). \tag{9}$$

For workers satisfying (1) this can be written as

$$W - B > k^m - \delta(2q-1)k^m \tag{10}$$

For workers not satisfying (1) the new moving constraint (9) is given by

$$\begin{aligned} W - B &> k^m - \delta(2q-1)(W-B) \\ &\Leftrightarrow \; W - B > \frac{k^m}{1 + \delta(2q-1)} \end{aligned} \tag{11}$$

The term in brackets on the right-hand side of (9) is always positive since by assumption $W > B, k^m > 0$ and q, the probability of receiving a job offer from in West, exceeds 0.5. Comparing (9) to (1) and (4), it is obvious that workers in East are more likely to accept a job offer in West and move, as long as the job offer arrival rate remains higher in West at least throughout the next period.

b) Next, consider a worker in West, the booming region, who receives an offer from East. For simplicity, assume that the difference in job offers persists only in the next future period: His expected discounted future income when moving is given by

$$W - k^m + \delta((1-q)W + q * \max[W - k^m; B]) \\ + \frac{0.5\delta^2}{1-\delta}(W + \max[W - k^m; B]),$$

the present value of staying is given by

$$B + \delta(qW + (1-q) * max[W - k^m; B]) \\ + \frac{0.5\delta^2}{1-\delta}(W + max[W - k^m; B]),$$

Hence, moving is profitable if

$$W - B > k^m + \delta \{(2q-1)W - (2q-1) * \max[W - k^m; B]\} \tag{12}$$

This can be written, for workers satisfying (1), as

$$W - B > k^m + \delta(2q-1)k^m \tag{13}$$

and for workers not satisfying (1) as

$$W - B > k^m + \delta(2q-1)(W-B). \tag{14}$$

Since $2q - 1 > 0$, the difference between the wage and the unemployment benefits must be higher to make moving worthwhile than in conditions (1).

If the shock is serially correlated, the moving condition is given by

$$W - B > k^m - 2\delta\rho\sigma k^m, \tag{15}$$

where ρ is defined as the correlation coefficient and σ is a measure of the shock with $0 < \sigma < 0.5$ and $0 < \rho < 1$. This is derived as follows: A worker in the depressed region who accepts a job offer in the booming region and who will always move, has an expected income of

$$W - k^m + \delta(W - 0.5k^m + \rho\sigma k^m) + \delta^2(W - 0.5k^m + \rho^3\sigma^3 k^m) + ...$$

Somebody who rejects, but would move in the second period receives

$$B + \delta(W - 0.5k^m - \rho\sigma k^m) + \delta^2(W - 0.5k^m + \rho^3\sigma^3 k^m) + ... \tag{16}$$

Notice that expected income from the second period onwards is the same as the probability of being in the booming region is the same.
Hence, moving is profitable if

$$W - B > k^m - 2\delta\rho\sigma k^m.$$

The bigger (is, i.e. the more workers value the future, and the bigger q is, i.e. the more intense the shock is, and the longer its persistence (for a proof see the appendix), the more attractive moving becomes for workers in East and staying for workers in West, the booming region. Equation (9) shows that the moving constraint is eased more the higher the wage is.[10] Those who are least likely to move in absence of a shock are therefore

[10]It should be noted that moving costs to the booming region may increase for owners if they find it harder to sell their home in the depressed region; on the other hand, costs are also likely to rise for renters in a perfect market as rents in the booming region are expected to increase.

the last to satisfy (9). So, the model predicts that higher skilled workers are the first to leave a depressed region. This effect is magnified if there is uncertainty about the length of the shock. To appreciate this argument, assume that shocks either persist 3 periods or 1 period. Furthermore, workers cannot observe the type of shock initially. If both shocks are equally likely to occur, the expected length of a shock is 2 periods. Suppose that there is a group for which moving is optimal only if the shock lasts at least for 3 periods. Given an expected duration of 2 periods, it is ex ante never optimal for them to move, although in half of the cases moving is optimal ex post. When workers learn about the true type of the shock (after 1 period say), the remaining duration of the shock is too short to make a move profitable. The moving constraint (9) might remain binding for some workers while unemployment in the depressed region is increasing[11]. This would be consistent with Evans and McCormick's (1994) finding that relative demand shocks do not stimulate out-migration from the depressed region unless local wages fall.[12] We would then conclude that migration rates for a given group of workers do not respond to higher unemployment rates. Yet, higher unemployment has an (indirect) effect on regional mobility if wages are flexible. If higher unemployment creates downward pressure on wages, relative wages will rise in the booming region, West. Moving away from the depressed region, East, becomes more attractive. To illustrate, consider again a worker in East, the depressed region, who gets a job offer in the booming region, West, which pays W^W. Assume that a job in East pays W^E, where $W^W > W > W^E$, and that the shock lasts for one future period, after which wages are equal again in both regions. His expected discounted future income when moving to West is given by

$$W^W - k^m + \delta\{qW^W + (1-q)\max[W^E - k^m; B]\} + \frac{0.5\delta^2}{1-\delta}\{W + \max[W - k^m; B]\},$$

the present value of staying is given by

$$B + \delta\{(1-q)W^E + q\max[W^W - k^m; B]\} + \frac{0.5\delta^2}{1-\delta}\{W + \max[W - k^m; B]\}.$$

[11]Note that the unemployment rate rises in the depressed region among immobile workers since fewer of them receive a job offer in their home region.

[12]Moreover, they find that relative regional unemployment rates in 1975 are highly correlated with relative regional unemployment rates in 1987 in the UK, Japan and Italy and moderately in Germany and Sweden. Interestingly, owner-occupation rates are smaller in the latter two countries.

Moving is optimal if

$$\begin{aligned} W^W - B \;\; > \;\; & k^m - \delta(qW^W - q * \max[W^W - k^m, B]) \\ & +\delta((1-q)W^E - (1-q) * \max[W^E - k^m, B]) \end{aligned} \tag{17}$$

Three cases have to be distinguished:
1) For workers satisfying $W^E - B > k^m$, (17) can be written as

$$W^W - B > k^m - \delta(2q-1)k^m, \tag{18}$$

2) for workers not satisfying $W^E - B < k^m < W^W - B$, (17) simplifies to

$$W^W - B > k^m - \delta q k^m + \delta(1-q)(W^E - B), \tag{19}$$

3) for workers satisfying $W^E - B < k^m$, (17) can be written as

$$W^W - B > \frac{k^m + \delta(1-q)(W^E - B)]}{1+\delta q}. \tag{20}$$

In all cases, the moving constraint is eased more the higher the wage in the booming region W^W and the larger the shock q is. For workers with a sufficiently low moving barrier (case 1), moving becomes even more attractive than without wage adjustments (compare to equation (10) because of the higher wage paid in West.

4.2 Symmetric Shocks

Proposition 7: An adverse symmetric shock that reduces the job offer arrival rate results in a higher level of unemployment. A positive symmetric shock that increase the length of an employment spell results in an increase in mobility and a reduction in the level of unemployment. More workers move during booms, and the effect is stronger the stronger the boom.
Proof:
I) *Recession*
Assume that workers receive a job offer every second period while a job last for one period such that all workers whose job ends become unemployed for at least one period. Note that Proposition 1.1 still holds, i.e. that workers always accept a job offer in the region where they live. Thus, we only have

to consider workers whose first job offer comes from the other city. Moreover, as all workers receive benefits in the period immediately following their employment spell, we only need to compare the expected incomes from rejecting and accepting the job offer in the other region at the time the moving decision has to be made, i.e. in the second period. Since job offers come from either region with equal probability, i.e. $q = 0.5$, the expected income from accepting a job offer in the other region at the time the moving decision is made equals

$$W - k^m + \frac{\delta}{1-\delta^2}B + \frac{0.5\delta^2}{1-\delta^2}(W + \max[W - k^m; B])$$

The expected income from rejecting the offer equals

$$B + \frac{\delta}{1-\delta^2}B + \frac{0.5\delta^2}{1-\delta^2}(W + \max[W - k^m; B])$$

Therefore a worker accepts the job offer and moves iff

$$W - B > k^m. \tag{21}$$

The length of the recession does not alter the moving decision as long as both regions are affected by the recession in the same way, because an adverse symmetric shock does not alter the moving constraint (1) given that wages remain unchanged. The shock does, however, raise the level of unemployment, because everybody enters the unemployment pool after an employment spell. The expected unemployment duration exactly one period for mobile workers (satisfying (1)) but exceeds 1 period for immobile workers. Consequently, the unemployment rate is higher among immobile workers. If wages fall during recessions, mobility is reduced as the moving constraint (1) is less likely to be satisfied.

II) *Booms*

Next, consider what happens if jobs last longer than the period between two job offers, i.e. if rate at which job offers arrive increases. In particular, assume that employment lasts for 2 periods. Workers receive a job offer when their job ends or after each period when being unemployed. It is implicitly assumed that workers must fulfill their contract.[13]

[13]Alternatively, we could assume that everybody receives a job offer each period even during employment. But this complicate the analysis as it alters the ex ante probability of not having to move once a job is accepted and would lead to more job changes within a region.After the first period of employment the worker receives a job offer where he

1. Permanent shocks

a) Consider first the effect of a permanent shock on workers who would move in absence of the shock, i.e. those for whom $W - k^m > B$. Accepting a job offer from the other region yields an expected income of

$$W - k^m + \frac{\delta}{1-\delta^2}W + \frac{\delta^2}{1-\delta^2}(W - 0.5k^m),$$

expected income when rejecting is equal to

$$B + \frac{\delta}{1-\delta^2}(W - 0.5k^m) + \frac{\delta^2}{1-\delta^2}W$$

Thus, moving is profitable iff

$$W - B > k^m - \frac{0.5\delta}{1+\delta}k^m \tag{22}$$

The term in square brackets on the right-hand side of equation (22) is positive as $\delta > 0$. Comparing (22) to (1) it is clear, that the expected net benefit from moving rising after a positive permanent shock as mobile workers profit from lower expected moving costs having to move less frequently in order to avoid unemployment.

b) Workers who do not satisfy (1) but fulfill (22) become mobile and will therefore not become unemployed.

c) Workers who do not satisfy (22) become unemployment when their job ends. Yet, they are still better off after the shock being employed more often in their home region as jobs lasts twice as long.

If employment lasts t periods, the moving constraint is given by

$$W - B > k^m - \frac{0.5(\delta - \delta^t)}{1-\delta^t}k^m. \tag{23}$$

The coefficient $\frac{(\delta-\delta^t)}{1-\delta^t}$ is increasing in t.[14] Thus, the stronger the boom, the more mobile workers become.

lives with probability 0.5. It is optimal to accept this offer and quit the current job to be employed for at least two more periods in the same region. The worker rationally rejects an offer from the other region to satisfy the current contract as it keeps the possibility alive that he receives an offer where he lives when the current contract terminates. This happens with probability 0.5. So the ex ante probability of not having to move for the next job is 0.75.

[14]9 The first derivative with respect to t is given by $\frac{-\delta^t}{1-\delta^t}\ln\delta$ which is positive since $0 < \delta < 1$.

2. Temporary shocks
If the shock is temporary, say lasts for one period such that only jobs accepted in the first period last for two periods, a worker who accepts a job offer and moves has an expected income equal to

$$W - k^m + \delta W + \frac{0.5\delta^2}{1-\delta}(W + \max[W - k^m; B]),$$

not moving yields

$$B + 0.5\delta(W + \max[W - k^m; B]) + \frac{0.5\delta^2}{1-\delta}(W + \max[W - k^m; B]).$$

Moving is profitable if

$$W - B > k^m - 0.5\delta(W - \max[W - k^m; B]). \tag{24}$$

For workers who would move in absence of the shock, the moving constraint becomes

$$W - B > k^m - \delta 0.5 k^m. \tag{25}$$

For workers with $W - k^m < B$, the moving constraint becomes

$$W - B > k^m - \delta 0.5(W - B). \tag{26}$$

Immobile workers experience a larger reduction in mobility costs during temporary booms, the larger the difference between their wages and the benefit level (see equation (26)). In addition, the moving barrier is reduced more during a temporary boom than during a permanent boom for all workers (compare (24) and (25) and note that $\delta > \frac{\delta}{1+\delta}$. Opportunity costs of not moving are higher during a temporary boom.

5 Refinements of the Simple Model

So far the analysis has been fairly crude and assumed that high-skill and low-skill workers only differ with respect to wages. This view surely neglects many well established empirical facts of labor markets. There is ample evidence that high-skilled workers receive more wage offers and that employment spells for workers with firm-specific skills and workers in high-wage industries last longer than jobs for low-skilled workers. Two general propositions are derived from the results of the previous section concerning changes in job offer arrival rates and expected length of employment spells. Next, it is analyzed what happens when individual wage offer distributions differ.

5.1 Variation in Job Offer Arrival Rates

Proposition 8: Workers who are in low demand and therefore receive job offers at a lower rate face higher moving barriers. They therefore move less and are unemployed more often. Workers enjoying a higher rate of job offers become more mobile and less likely to become unemployed.

Proof: See the proof of Propositions 6 and 7.

Since high-skilled workers are more likely to receive job offers at a higher rate, high-skilled workers are more mobile, less frequently unemployed and more often observed to move in the data.

5.2 Variations in the Length of Employment Spells

Proposition 9: The longer is the expected length of an employment spell, the more mobile a worker becomes and the less likely he is to become unemployed. Since high-skilled workers, and in particular those with firm-specific skills, have longer expected employment spells with a given firm, they are more mobile and less likely to become unemployed than low-skilled workers.

Proof: See the proof of proposition 7, in particular the argument for positive symmetric shocks.

5.3 Implications when Individual Wage Offer Distributions Differ

It has been assumed so far that individual wages are deterministic (assumption 4). But it is more realistic to assume that an individual worker draws an offer from some distribution. Suppose that the cumulative distribution function of the wage distribution from which a high-skilled worker gets a draw, is given by $F(w)$, while the cumulative distribution function of the wage distribution for a low-skilled worker is defined as $G(w)$. The respective density functions are defined as $f(w)$ and $g(w)$. Assume that the expected wage is H for a high-skilled worker and L for a low-skilled worker. Notice that the model in section 3 is a special case in which F and G are degenerate (since $f(H) = g(L) = \infty$).

Next, define the wage that is required to satisfy the moving constraint as w^o for home-owners and w^r for renters, with $w^o > w^r$. Consider workers receiving their job offer from a firm in the other town. The probabilities that workers accept the offer and move are given by $1 - F(w^r)$ for high-skilled

renters, $1 - F(w^o)$ for high-skilled owners, $1 - G(w^r)$ for low-skilled renters, and $1 - G(w^o)$ for low-skilled owners.

Renters are more likely to move than owners, since $w^o > w^r$ and therefore $1 - F(w^r) > 1 - F(w^o)$ and $1 - G(w^r) > 1 - G(w^o)$ because $F(w^r) < F(w^o)$ and $G(w^r) < G(w^o)$. High-skilled renters are more mobile than low-skilled renters if

$$F(w^r) < G(w^r), \tag{27}$$

while high-skilled owners are more mobile than low-skilled owners if

$$F(w^o) < G(w^o). \tag{28}$$

The condition that makes high-skilled owners more mobile than low-skilled renters is given by

$$1 - F(w^o) > 1 - G(w^r)(F(w^o) < G(w^r). \tag{29}$$

Conditions (27) and (28) are always satisfied if the wage distributions for high-skilled and low-skilled differ only in the mean (which is larger for high-skilled) such that $F(w) < G(w)$ for any w in the range of all job offers. Notice that this corresponds to the assumption in previous sections. But other characteristics of the density function can play an important role as well.

Proposition 10: Everything else equal, a rise in the mean of the wage distribution increases the probability of receiving a wage offer that makes moving optimal.

Proof: See the argument above.

Proposition 11: Given that the wage wm that is required to make moving optimal is larger than the expected wage, an increase in the variance of the wage offer distribution tends to increase the probability of receiving an offer exceeding wm, and hence tends to raise mobility.

Proof: If $f(w)$ and $\tilde{f}(w)$ are the same in every respect but the variance, which is bigger for $\tilde{f}(w)$ say, then for values exceeding the mean $\bar{w}$,

$$\tilde{F}(w) < F(w),$$

where $\tilde{F}$ and F are the cumulative distribution functions of $\tilde{f}$ and f respectively. Since by assumption $w^m > \bar{w}$,

$$\tilde{F}(w^m) < F(w^m),$$

and job offers that make moving optimal arrive more often.

It is likely that the variance of an individual's wage offer distribution is positively related to his skills, since higher skilled workers have a broader range of jobs to choose from. In addition, if there are inter-industry wage differentials[15] such that some industry x pays wages z percent higher than industry y, then the wage distribution for those earning higher incomes is likely to have a bigger variance. To appreciate this, assume that factor requirements are the same in both industries, then the wage offer distribution for high-skilled have a larger variance than that for less-skilled.[16]

A straightforward way to integrate this idea into the simple model is to assume that workers of each skill type can either have a job paying above average wages for the respective skill level – such jobs are called "good" jobs in the analysis that follows – or a job paying below average wages, which are named "bad" jobs.[17] High-skilled workers with a "good" job earn $(1+h)H$ while those having a "bad" job are paid $(1-h)H$. Similarly, low-skilled can either earn $(1+l)L$ or $(1-l)L$. If there are as many "good" as "bad" jobs, h^2H^2 and l^2L^2 are the variance of the job offer distribution for high-skilled and low-skilled workers respectively. If $l = h$, i.e. if remuneration of "good" jobs is $2h$ percent higher than that of "bad" jobs for both types of workers, the wage offer distribution for workers with a higher mean income also has a larger variance. Assume that workers get a job-offer for either job with equal probability such that expected income is given by H for high-skilled and L for low-skilled. The moving constraint for a high-skilled worker being offered a "good" job is then given by

$$H - B + hH > k^m, \tag{30}$$

for those being offered a "bad" job, it is

$$H - B - hH > k^m, \tag{31}$$

and similarly for low-skilled workers offered a good job the moving constraint is

$$L - B + lL > k^m, \tag{32}$$

[15]See Krueger and Summers (1988) for evidence on inter-industry wage differentials.

[16]The skewed aggregate wage distribution observed in reality provides support for the hypothesis that the variance of the offer distribution is positively related to income (and hence skills).

[17]Jobs in the high-wage industry are hence "good" jobs; equivalently jobs requiring a higher productivity but the same formal qualifications can be interpreted as "good" jobs.

for those being offered a "bad" job, it is

$$L - B - lL > k^m. \tag{33}$$

Suppose for simplicity that l and h are the same. In that case, high-skilled workers who are offered a "good" job are most likely to move. In particular, it is possible that they are the only type of workers who move in absence of any shocks. The condition is

$$(1+h)H - B > k^m > (1-h)H \tag{34}$$

assuming that $(1-h)H > (1+l)L$.

Note also that in this simple setting the searching constraint derived above is not affected since the one period ahead forecast of income is still given by H for high-skilled and L for low-skilled workers.

6 Interactions between Search and Moving Costs

6.1 A Model with Costly Search

The simple model of section 3 reveals that moving costs reduce workers' willingness to accept jobs – which is reflected in prominent labor market models as a fall in search effectiveness.[18] This section explains how fixed moving costs interact with search. The model predicts, consistent with empirical findings in the literature, that high-skilled search more and prefer on-the-job search.[19]

So far it has been assumed implicitly that search is costless, since workers automatically receive a job offer at given intervals. Moreover, the simple model does not distinguish between on-the-job search and search from unemployment. It is reasonable to assume that on-the-job search is more expensive than search from unemployment.[20]

The simple model of section 3 is altered in two ways. First, a worker becomes unemployed for one period after his job contract expires. In each of the following periods, he receives a job offer free of charge. Second, a worker can search for a job while employed to generate one job offer at a fixed cost,

[18] See Pissarides (1990), for example.

[19] See Pissarides and Wadsworth (1994).

[20] Unemployed often receive free support from employment agencies; furthermore, employed workers have to take time off to search and, unlike unemployed, incur a loss of income.

s.[21] The other assumptions of the simple model still hold.

Proposition 12: High-skilled workers are more likely to search while employed than less-skilled and hence are less likely to become unemployed. The smaller is δ (i.e. the less a worker values the future), the lower is search intensity and the higher is unemployment. The more expensive moving becomes, the less likely are mobile workers to search.

Proof: Note first that the moving constraint in absence of search differs slightly from (1); a non-searching worker becomes unemployed every second period which lowers the net benefit from moving. The discounted stream of income for somebody who is offered a job in the other region and moves is given by

$$W - k^m + \frac{\delta}{1-\delta^2}B + \frac{0.5\delta^2}{1-\delta^2}(W + \max[W - k^m; B]),$$

while expected income when rejecting the offer equals

$$B + \frac{0.5\delta}{1-\delta^2}(W + \max[W - k^m; B]) + \frac{\delta^2}{1-\delta^2}B, \tag{35}$$

and therefore it is optimal to move if

$$W - B > k^m + \frac{0.5\delta}{1+\delta}(W + \max[W - k^m, B]) - \frac{\delta}{1+\delta}B. \tag{36}$$

Notice that the term $\frac{0.5\delta}{1+\delta}(W + \max[W - k^m; B]) - \frac{\delta}{1+\delta}B$ is always positive, confirming that moving in this setting is generally less attractive than in the simple model

I) Consider now the search decision of workers satisfying (36) who find it always optimal to move when offered a job in the other region. Their expected income when searching only in the first period is given by

$$W - s + \frac{\delta}{1-\delta^2}W - \frac{0.5\delta}{1-\delta^2}k^m + \frac{\delta^2}{1-\delta^2}B,$$

while not searching yields an expected income of

$$W + \frac{\delta}{1-\delta^2}B + \frac{\delta^2}{1-\delta^2}W - \frac{0.5\delta^2}{1-\delta^2}k^m,$$

[21] The assumption that search from unemployment is free of charge is not crucial, that is important is that employed search is more expensive. Hence, we scale such that search from unemployment costs nothing; therefore s can be interpreted as the excess cost of employed over unemployed search.

Hence, search is optimal if

$$W - B > \frac{1+\delta}{\delta} s + 0.5k^m. \tag{37}$$

Moreover, it can be shown that a worker satisfying (36) will always search. His expected income when he always searches is given by

$$W - s + \frac{\delta}{1-\delta} W - \frac{\delta}{1-\delta} s - \frac{0.5\delta}{1-\delta} k^m.$$

Always searching is hence preferred to never searching if

$$W - B > + \frac{1+\delta}{\delta} s + 0.5k^m \tag{38}$$

It is apparent that the higher W, the more likely (38) is to be satisfied. A fall in δ, a rise in search costs, s, and higher moving costs all increase the right-hand side of (38) and therefore reduce search activity of workers who are ready to move.

II) For workers who optimally reject a job in the other region the present value of future income when searching only in the first period is given by

$$\begin{aligned} &W - s + \delta(0.5W + 0.5B) + \delta^2(0.5B + 0.5(0.5W + 0.5B) \\ &+\delta^3(.25B + .75(0.5W + 0.5B)) + ... \end{aligned}$$

The present value of future income when not searching is given by:

$$W + \delta B + \delta^2(0.5W + 0.5B) + \delta^3(0.5B + 0.5(0.5W + 0.5B) + ...$$

Search is hence profitable if

$$W - B > \frac{\delta + 2}{\delta} s. \tag{39}$$

An increase in search costs and a higher discount rate, i.e. lower δ, make searching less attractive. Search costs are more important for immobile workers – the coefficient on search costs in (39) is bigger than the one in (**??**) – since workers not satisfying the moving constraint only accept half of the job offers they generate and hence their search effort is useless in half of the cases. However, the excess amount of income over benefits, W-B, that is required to make search attractive is lower for immobile workers if

$$k^m > \frac{2s}{\delta}. \tag{40}$$

Note that (40) is always satisfied if the moving constraint is binding but (39) is not, i.e. if

$$\frac{1+\delta}{\delta}s + 0.5k^m > W - B > \frac{\delta+2}{\delta}s,$$

since this implies that

$$k^m > \frac{2+\delta}{\delta - 0.5\delta^2}s, \tag{41}$$

and (40) is satisfied if (41) holds since $\frac{2+\delta}{\delta-0.5\delta^2} > \frac{2}{\delta}$.

Thus, higher moving costs, lower search costs or a lower discount rate δ make mobile workers less likely to search relative to immobile workers. However, the unemployment rate of non-searching mobile workers is lower than the unemployment rate of searching immobile workers as the expected duration of unemployment is longer for immobile workers. For mobile workers who do not search, the expected duration of unemployment is 1 period, while the expected duration for non-searchers is 2 periods. An increase in moving costs has two effects on search intensity. First, it reduces the net gain of search of mobile workers and hence tends to diminish their search activity. This has a negative impact on employment. Second, it increases the proportion of immobile workers. This tends to increase overall search activity but reduces search effectiveness since immobile workers accept only half of the offers. Although the inflow rate into unemployment might fall – it is possible that some mobile workers who did not search become immobile in response to higher moving costs but find it then attractive to search – outflow rates fall even more as unemployment duration increases. Thus, the unemployment rate rises. Both effects have a negative impact on matching and tend to reduce employment. Workers can be a member of one of the following four groups:

1. If they satisfy (36) and (37 or 38) they will search, accept any offer and will never become unemployed.

2. Workers might satisfy the search condition but do not find it optimal to move. Proportion q of them will become unemployed, where q is the probability of receiving a job offer in the other region.

3. Workers are mobile, but do not search. All of them will go through a spell of unem-ployment which lasts exactly for one period, after which they accept a job offer in any region.

4. Workers neither move nor search. These workers will become unemployed and the expected duration of unemployment is 2 periods.

6.2 Implications of Shocks

A random temporary shock impacts on search behaviour as workers decide to search before the shock is revealed. A negative (positive) symmetric shock increases (reduces) unemployment among immobile workers. An asymmetric shock increases (decreases) unemployment in the region that is negatively (positively) affected since it reduces (increases) job offers for immobile workers. Mobile workers in the adversely affected region face, on average, higher ex post moving costs, while workers in the booming region gain. The shock has no impact on the employment status of mobile workers. Things are different if workers expect the shock to persist in the future. If q, the probability of getting a job offer in West, is larger than 0.5 only in the next future period, then workers will take into account the higher employment prospects in West. The moving constraint after the first period remains unchanged since it does not matter where one lives 2 periods ahead. However, searching becomes less attractive for workers in the depressed region and more attractive in the booming region. For mobile workers in the depressed (booming) region, the expected benefit from searching falls (rises) by $\delta(q-0.5)k^m$, whereas the expected gain from searching falls (rises) by $\delta(q-0.5)(W-B)$ for immobile workers. The analysis of the previous section revealed that worker in the depressed region become more likely to move if the shock persists for longer. In addition, the value of search increases for workers living in the depressed region because working in the booming region is more attractive and searching increases the chances of finding employment there early. The main insight of the above analysis is that employed search is likely to be optimal for high-skilled workers while it is less likely to be optimal for low-skilled workers. Since it is more profitable for high-skilled workers to engage in costly on-the-job search activity they are less likely to become unemployed. Moreover, moving costs, and therefore the type of housing a worker chooses, influences search behaviour. The result derived in section 3 that moving costs have a negative impact on employment continues to hold. It should be noted that the assumptions about the length of the periods of employment and unemployment are not crucial to derive these implications. In principle, the longer expected employment becomes relative to the period between two job offers, the more likely a worker becomes to search and move. The length of the periods chosen facilitates the illustration of the main implications of the model. The model predicts that higher search costs have a negative impact on employment, a fact that is rather obvious and has received considerable discussion in the literature. Factors that can reduce search costs are, for example, a well functioning personal network, or the access to information. Furthermore, opportunity costs influence employed search behaviour. Work-

ers whose wage largely reflects firm specific skills face higher opportunity costs than workers with more general skills from which they can profit in other firms or industries if they want to leave a firm because they expect their job to end. Since university graduates are likely to have more general skills they face lower opportunity costs of changing jobs and are hence more likely to search and move. The model also implies that immobile workers would concentrate their search activity locally, if this was possible. This limits their alternatives and is likely to lead to inefficient matching which has a negative impact on productive efficiency.

7 Autocorrelation in the Quality of Sequential Job Offers

7.1 Stigmatisation and Insider Forces

In section 3 it has been assumed that workers get job offers for "good" and "bad" jobs with equal probability. This might not be a realistic assumption, however. If unexplained inter-industry wage differentials cause the differences in earnings, it is reasonable to believe that workers already working in the high-wage industry are more likely to remain there because of some insider power like their social network, for example. Likewise, if the wage differentials exist because workers with identical formal qualifications, differ in with respect to other qualities relevant for the job, it is not obvious why the market does not reward them accordingly. One reason could be that workers' qualities are not readily observed; rather firms learn about a worker's true quality over time. Suppose that firms rely on the employment history of a worker as a signal. Workers who had a "good" job before, receive a job offer for a "good" job with probability p, where $0.5 < p < 1$, and a "bad" job with probability $1 - p$ (p depends on the effectiveness of the screening process or the importance of other forces like insider power). The probability is not equal to one, since some workers' qualities might have been misjudged previously.[22] Similarly, workers who held a "bad" job previously receive a job offer for a "good" job with probability r and for a "bad" job with probability $1 - r$, where $0 < r < 0.5$. Moreover, assume that unemployment is the worse signal, such that unemployed only receive offers for "bad" jobs. Consider a high-skilled worker with a "good" wage offer in the other region.

[22]The probability p refers to the group of workers with a "good" job rather than to individual workers within the group. In fact, the probability of retaining a "good" job for somebody whose qualities were misjudged is lower than p since at least his old employer will not offer him the same job again.

His expected stream of income until the first two periods after accepting is given by

$$(1+h)H - k^m + 0.5\delta\{p(1+h)H + (1-p)(1-h)H\}$$
$$+0.5\delta\{p\max[(1+h)H - k^m; B] + (1-p)\max[(1-h)H - k^m; B]\}$$

If the worker does not accept, expected income in the next periods is given by

$$B + 0.5\delta(1-h)H - 0.5\delta p\max[(1-h)H - k^m; B].$$

Note that expected income from the third period onwards is higher if accepting the job offer because upon rejecting, the worker can at best get a "bad" job in the second period and therefore only get a "good" job offer in the third period with probability r. This probability is higher for someone who accepts initially. Hence rejecting is the worse strategy if

$$\begin{aligned} H - B \;>\; & k^m - hH - \delta phH - \delta 0.5p\max[(1+h)H - k^m; B] \\ & -0.5\delta p\max[(1-h)H - k^m; B] - \delta^2 v, \end{aligned} \tag{42}$$

where v is the discounted excess value of income from the third period onwards when having accepted initially. Comparing (42) with (30) it is obvious that the opportunity costs of not moving rise for the group of workers with a "good" job. Stigmatisation triggers autocorrelation in the quality level of the job offer sequence. Analogously, the moving condition for a low-skilled worker with a "good" job becomes

$$\begin{aligned} L - B \;>\; & k^m - lL - \delta plL - 0.5\delta p\max[(1+l)L - k^m; B] \\ & -0.5\delta p\max[(1-l)L - k^m; B] - \delta^2 v \end{aligned} \tag{43}$$

For a high-skilled worker being offered a "bad" job in the other region the stream of income in the next two periods is given by

$$(1-h)H - k^m + 0.5\delta\{r(1+h)H + (1-r)(1-h)H\}$$
$$+0.5\delta\{r\max[(1+h)H - k^m; B] + (1-r)\max[(1-h)H - k^m; B]\}.$$

If the worker does not accept, expected income in the next periods is given by:

$$B + 0.5\delta(1-h)H - 0.5\delta p\max[(1-h)H - k^m; B], \tag{44}$$

The moving constraint becomes

$$\begin{aligned} H - B \;>\; & k^m + hH - \delta rhH - 0.5\delta r\max[(1+h)H - k^m; B] \\ & -0.5\delta r\max[(1-h)H - k^m; B] - \delta^2 v, \end{aligned} \tag{45}$$

where v is again the excess value of accepting the job offer initially from the third period onwards.

Similarly, for low-skilled workers offered a "bad" job in the other region, the moving constraint becomes

$$\begin{aligned} L-B \;>\; & k^m + lL - \delta rlL - 0.5\delta r\max[(1+l)L - k^m; B] \\ & -0.5\delta r\max[(1-l)L - k^m; B] - \delta^2 v, \end{aligned} \tag{46}$$

Comparing (45) and (46) to (31) and (33) respectively, it is clear that stigmatisation raises the opportunity cost of not moving for workers with a "bad" job. If stigmatisation is relevant, a given fixed moving cost impedes mobility less. Once again, the effect is strongest for those with highest earnings, which makes this group even more mobile relative to other groups. In addition, a larger variance of the job offer distribution, i.e. a larger h or l, increase the net benefit from moving if job offers depend on the employment history. This potentially explains why young entrants into the labor market are willing to move in order to accept a good job offer. The job accepted today might open up future employment opportunities and thereby raise the mean and variance of the individual job offer distribution. This is especially true for university graduates.

7.2 Search and Stigmatisation

The analysis of this section can also be integrated into the framework analyzed in section 6 which explains why workers with higher earnings search more and prefer employed search. To ease the exposition, it is assumed that workers search only in the first 2 periods. It is clear, however, that searching always is optimal given search is profitable in the first two periods since the third period can be interpreted as the start of a new process.

A high-skilled worker with a "good" job searching in the first two periods has an expected stream of income in the first four periods of

$$\begin{aligned} & (1+h)H - s + \delta[H + 2phH - hH - qk^m - s] \\ & +\delta^2[H + 2p^2hH - 2rphH + 2rhH - hH - qk^m] + \delta^3 B \end{aligned}$$

The present value of expected future income when not searching is given by

$$(1+h)H + \delta B + \delta^2[(1-h)H - qk^m] + \delta^3 B \tag{47}$$

Hence, search is profitable if

$$H - B + (2p-1)hH + \delta[2p^2hH + 2(1-p)rhH] > \frac{1+\delta}{\delta}s + qk^m \tag{48}$$

Comparing this to the search condition derived in section 2.3, we see that workers with wages above average become even more likely to search since the two extra terms on the left-hand side are positive. Analogously, the search condition for low-skilled workers with a "good" job is derived. It is given by

$$L - B + (2p - 1)lL + \delta[2p^2lL + 2(1 - p)rlL] > \frac{1 + \delta}{\delta}s + qk^m. \quad (49)$$

Searching is profitable for a high-skilled worker with a "bad" job if

$$(1 - h)H - B + 2rhH + \delta[2rphH + 2(1 - r)rhH] > \frac{1 + \delta}{\delta}s + qk^m. \quad (50)$$

while a low-skilled worker with a "bad" wage offer optimally searches if

$$(1 - l)L - B + 2rlL + \delta[2rplL + 2(1 - r)rlL] > \frac{1 + \delta}{\delta}s + qk^m. \quad (51)$$

Earning less, $(1 - h)H$ instead of H or $(1 - l)L$ instead of L, reduces the likelihood of search, as one would predict given the results of section 6. But the effect of stigmatisation has a positive impact on search which is reflected in the two additional terms on the left-hand side of equations (50) which are both positive and hence increase the net benefit of search.

8 Policy Implications

The simple model implies that policies that raise moving costs, reduce mobility, and thereby increase unemployment. The analysis of asymmetric shocks indicates that higher moving costs slow the adjustment process as unemployment among immobile workers in the slump region remains high for a prolonged period. In addition, there are important interactions with search behavior, and increases in mobility costs tend to reinforce other imperfection that can lead to hysteresis effects. The extensions to the simple model generally show that adverse effects of moving costs on unemployment do not only work through the direct channel of fixed moving costs that impede regional mobility, but also through indirect channels as interaction with search behavior or job acceptance behavior (i.e. tend to increase the reservation wage). These effects are largely neglected in the theoretical and empirical literature, but potentially explain the surprising correlation between home ownership rates and the level of unemployment.

A tax deduction, tax benefit or subsidy to moving costs obviously increases mobility and thereby the equilibrium level of unemployment. However, when a policy is tailored to a particular form of housing tenure, substitution effects have to be considered. For example, a subsidy for owning or building a home tends to makes owning more attractive relative to renting. The subsequent rise in the home ownership rate increases moving costs for new owners which might more than offset the initial reduction. Moreover, if such a subsidy is only paid once, for example for the first home bought, future moving costs of owners are not affected by the increase which leads to higher average moving costs in the future as the rate of home owners rises over time due to those who become owners to collect the initial subsidy.

On the other hand, subsidies to the renting sector have to be evaluated carefully. At first sight, rent control would probably judged beneficial for renters as it is designed to keep rents fairly cheap. However, rent control affects the investment decision in the private renting sector. In particular, rent control tends to reduce the return on investment and thus triggers a reduction of supply, either because property is sold off or simply due to attrition. As a result, renters are limited in making their optimal housing consumption choice and given the scarcity in the renting sector, private ownership becomes more attractive. Workers leaving the renting sector are worse off than without controlled rents because they preferred renting when their consumption opportunity were not limited. The loss in utility is reflected in lower mobility. Moving costs rise on average and aggregate unemployment tends to rise given the prediction of the model set out above. However, whether unemployment rises more among owners is ambiguous if the most mobile renters leave the private renting sector first, which is likely since the cost of additional immobility are smallest for them. Moreover, those with higher incomes are more mobile and more likely to be able to afford ownership. In addition, a shrinking private renting sectors has negative effects on mobility of those remaining in the renting sector if rate at which landlords reduce supply exceeds the exit rate from the renting sector. This limits choices of those remaining in the renting sector even further. Consequently, average mobility and therefore employment falls in the renting sector as well.[23]

It should always be kept in mind that an increase in the proportion of home owners tends to decrease average mobility in the renting sector as the

[23]In Britain, workers at lower incomes have opted to leave the private renting sector for council housing. Mobility of council tenants is lower than mobility of private renters (see Hughes and McCormick (1981)). Council tenants wishing to migrate have to obtain council housing in their destination region and that process does not seem to work well. Hughes and McCormick (1987) argue that council tenants are no less likely than owner-occupiers to wish to migrate, but merely less successful in fulfilling their intentions.

more mobile workers tend to leave the renting sector first. Those who are closer at the margin where home owning is preferred to renting are likely the ones who are affected by changes in policy. Therefore, it would not be surprising to see the level of unemployment increase more in the renting sector when the ownership rate rises.

9 Possible Extensions of the Model

The model developed in this paper can be extended in future work to take account of important features of reality. First, the model neglects the possibility that workers can commute. Commuting is an alternative to moving and hence increases opportunities for workers. Due to congestion costs, commuting costs are a positive function of the number of commuters. Those with lowest moving costs will eventually prefer moving to commuting. The number of commuters is likely to exceed the social optimum because of the externality caused by congestion costs. Moreover, distance is important in reality. To account for this, elements from gravity models might be integrated with the kind of modelling suggested in this paper.

Second, the consumption and investment characteristics of housing and the adjustment of housing prices deserve closer attention. The model establishes that mobility depends on moving costs, but neglects effects of expected capital gains and losses for home-owners. If house prices are expected to rise because the region is hit by a positive asymmetric shock which triggers inmigration and hence an increase in housing demand, owners in the booming region are reluctant to move and sell their house because they would not able to take advantage of the capital gain on their housing investment. Retired or inactive workers in the booming region become less likely to move and fewer housing slots are freed for potential migrants. This tends to slow the adjustment process. Renters (and maybe those owners who can afford to own more than one house) on the other hand can separate their investment and consumption decision. If the consumption and investment decision are separated, there is a freer flow of capital and house price differentials are reduced more quickly.

Changes in housing prices also impact strongly on costs of living, since a large proportion of income is spent on housing, and therefore influence the wedge of consumer and producer prices. This is likely to affect reservation wages and hence wage setting. In addition, consumption demand for other goods is likely to fall if the proportion of income spend on housing rises and hence aggregate demand is dampened. Moreover, fluctuations in housing prices affect different groups in varying degrees and lead to important income

distribution issues.

Third, more attention should be paid to the adjustment process of wages when there is an asymmetric shock as described in section 4.1. It was argued that relative wages fall in the depressed region and shown that this encourages out-migration. However, the determination of wages was not endogenised.Wage differentials are reduced during persistent shocks due to additional in-migration. In addition, lower wages attract more firms to the depressed region and demand is likely to rise in the depressed city and to fall in the booming city. These issues can be analyzed in a model that endogenizes job creation and job destruction. Differences in size, or better in population density, are also likely to impact on the adjustment process. The more densely populated or the bigger the city is, the higher is effective supply for each vacancy. Productivity is likely to be higher due to more efficient job matching. This tends to attract firms to the bigger city.

10 Conclusion

The model explains why high-skilled workers move more and are therefore unemployed less than low-skilled workers. It is consistent with the empirical regularity that higher owner-occupation rates are associated with higher rates of unemployment. Home-owners are less likely to move than renters, ceteris paribus, because their moving costs are higher. But this effect is offset if home-owners earn more since mobility increases with income.

Regional mobility depends on moving costs and on the difference between the value of employment and the value of unemployment. This difference is higher for workers with higher wages. Since wages are a positive function of skills, high-skilled workers are more likely to move regions to find employment, ceteris paribus. The more mobile a worker is, the less likely he is to become unemployed. If mobile workers become unemployed, the expected duration of their unemployment spell is shorter than for immobile workers.

A rise in the value of unemployment relative to the value of employment, e.g. an increase in unemployment benefits or a reduction in wages, reduces mobility and therefore causes unemployment to rise. Similarly, higher moving costs are associated with less mobility. Owners, who incur higher moving costs than renters, are therefore less mobile, ceteris paribus. However, workers with higher wages are more likely to become home-owners as owning is more affordable for them. If high-skilled are more likely to be home-owners, it is possible that the group of home-owners is more mobile than the group of renters.

If the private renting sector shrinks, e.g. because of government interven-

tion or a change in preferences, more mobile workers are likely to leave the renting sector first and hence average mobility of the renting sector and of the owner-occupied sector falls. A higher rate of owner-occupation is therefore associated with more unemployment.

Workers are more likely to move during economy-wide booms because expected moving costs fall. The reduction is larger the higher the wage. Hence, mobility of workers with lowest wages is affected least. Asymmetric shocks tend to increase the number of workers moving to the booming city and reduce the number of workers leaving the booming city. The impact on mobility depends positively on the intensity and persistence of the shock. Mobility is increased most for workers with higher wages. Thus, the model predicts that high-skilled workers are the first to leave a depressed region.

Workers who are willing to move search more effectively. Search effectiveness is an increasing function of mobility. If mobility is reduced, vacancies are filled less efficiently, which is reflected in an outward shift of the Beveridge curve as is observed in European countries.

If job offers follow an autocorrelated process, which could for instance be the result of stigmatisation and asymmetric information concerning individual productivity, workers with higher incomes also face higher opportunity costs of not moving. Moreover, it is suggested that young workers are more mobile if their future income depends on jobs taken presently. In addition, workers whose job offer distribution has a larger variance, ceteris paribus, are more likely to receive a job offer that makes moving profitable.

The choice of housing tenure has important implications for labor market outcomes. Moving costs are hence an important variable that should become part of prominent models of unemployment. Taking account of regional mobility is likely to prove an important step towards explaining the puzzle of European unemployment which, despite a considerable amount of empirical and theoretical work, remains largely unsolved.

A Appendix

Proof that moving to the booming city becomes more attractive the longer the boom is expected to persist:

Suppose it is optimal for the worker in East not to move to West, the booming city, if the asymmetric shock persists only in the next future period. The worker does not satisfy condition 11, i.e. $W - B < k^m - \delta(2q-1)(W-B)$ for him. If the shock persists one period longer, the worker will not move in

the second period if he had not moved in the first. Consider a worker who receives a job offer in the booming city and expects the shock to persist for the next 2 periods. Not accepting the offer gives an income of

$$B + \delta\{(1-q)W + qB\} + \delta^2\{(1-q)W + qB\} + \delta^3 V,$$

where V is the expected stream of income discounted to period 3 that is the same in expectation for movers and non-movers. The income when accepting can be calculated by backward induction and is given by

$$W - k^m + \delta\{qW + (1-q)B\} + \delta^2\{qW + (1-q)B\} + \delta^3 V$$

since $W - B < k^m - \delta(2q-1)(W-B)$ and $W > B$. A worker will hence move if

$$W - B > k^m - \delta(2q-1)(W-B) - \delta^2(2q-1)(W-B) \qquad \text{(A1)}$$

When the shock persists for just one more future period, the moving constraint was given by

$$W - B > k^m - \delta(2q-1)(W-B). \qquad (14)$$

Comparing (A.1) with (14) it is obvious that moving becomes more likely since the additional term, $\delta^2(2q-1)(W-B)$in (A.1) is positive.

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