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A SEARCH THEORETICAL ANALYSIS OF THE FINNISH UNEMPLOYMENT INSURANCE SYSTEM*

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This paper studies the effects of the Finnish unemployment insurance on the re-employment of unemployed workers using a search theoretical framework. It is well known that the unemployment benefits have a negative effect on the re-employment. In this paper it is shown that the re-employment probability can be increased by lowering the costs of re-employment. Furthermore, it is shown that the qualifying waiting period has only a slight positive effect on the hazard function, but removing of the mobility rules and reduction of benefits after a fixed period of unemployment substantially increase the re-employment probability. (JEL J65)

1. Introduction

In the search theoretical literature [e.g. Lippman and McCall (1976a, b, 1979), Mortensen (1986) and Kiefer and Neumann (1989)] it has been generally considered that unemployment insurance (UI) has a disincentive effect on employment. Mortensen (1977) pointed out that the search behaviour of new entrants who are not currently eligible for UI benefits but who will be eligible after being employed is different. An increase in UI benefits or extension of the maximum benefit period will increase their re-employment probability, since unemployed workers must have been employed before they qualify for UI benefits. This feature of the UI system has been well referenced and studied [e.g. Topel and Welch (1980) and Usategui (1988)]. However, there are many other features of the UI systems which need more attention. This study analyses three features of the Finnish UI system using search models. Applications concerning the nonstationary effects of the waiting period, mobility rules and reductions of benefits are presented. Their effects on the reservation utility, search intensity and re-employment probability are studied. The nonstationary features of search models in the context of housing demand have been studied by Loikkanen (1982).

Unemployed persons are not eligible for UI benefits at the beginning of their unemployment period. The insurance aspects of the waiting period have been earlier interpreted by Stafford (1977) using the economics of risk and insurance. In this paper it is shown using a search model that during the qualifying waiting period the reservation utility is increasing and the search intensity is decreasing. Hence the re-employment probability is

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decreasing due to a fact that the unemployed persons are not yet eligible for benefits. However the effect is rather small.

Reluctant movers may lose their UI benefits after the first three months of unemployment. It is shown that the threat of removal of benefits decreases the reservation utility and increases the search intensity and re-employment probability. Furthermore, it is shown that the reservation utility is slightly decreasing and the search intensity and re-employment probability are slightly increasing during the first three months.

Unemployed workers who are eligible for earnings-related unemployment allowances face a reduction of their benefits after the 100*th* day of unemployment. It is shown that the reductions decrease the reservation utility and increase search intensity and re-employment probability. Hence the reservation utility is decreasing and search intensity and re-employment probability are increasing before the reductions.

The remainder of this study is carried out as follows. In section 2 the basic search theoretical model is presented and its properties are analyzed. In section 3 the main features of the UI system are analyzed: the qualifying waiting period, threat to remove benefits from reluctant movers and reduction of benefits. Their nonstationary effects on the reservation utility, search intensity and hazard function are analyzed. Section 4 concludes the study.

2. *The basic model*

In this section the basic search model of unemployment is presented and its comparative static properties are analyzed. Assume that an unemployment person gets utility from consumption C and leisure L, and that there is no saving. The utility function is assumed to be a time separable function of these arguments. Leisure is the time not spent in job search during unemployment. The utility of an unemployed person is $u_0(C, L)$, where C consists of UI benefits b minus costs of search. $L = 1 - s(t)$, where $s(t)$ is the search intensity, i.e. a fraction of time spent on search at time t. It is assumed that

$$(1) \quad u_C > 0,\ u_L > 0,\ u_{CC} \leq 0,\ u_{LL} \leq 0 \text{ and } u_{CL} = u_{LC} > 0,$$

where the subscripts denote derivatives.

If an individual is unable to find a job within the local labour market area, a suitable job may be found elsewhere, or if he is unable to find a job within his occupation, he may change it. The arrival rate of job offers from area i and occupation j is assumed to follow a Poisson process with intensity $a_{ij}(s(t))$, which is a function of time spent on search. It is assumed that $a_{ij}(0) = 0$, $\partial a_{ij}/\partial s > 0$ and $\partial^2 a_{ij}/\partial s \partial s \leq 0$. The arrival rate of all the job offers $\Sigma\Sigma a_{ij} = \Sigma_i \Sigma_j a_{ij}(s(t))$ is convex as a sum of convex functions.

Moving from an area of declining industries and high unemployment to a region with growing employment, or changing occupation will also involve costs. They are measured in utility terms. It is assumed that in the model there are the searching costs c, the visiting costs c_i, the permanent cost of becoming employed c_j and moving costs c_i^m. The cost c is deterministic whereas c_i, c_j and c_i^m are probabilistic. The costs are of flow-type apart from c_i^m, which is of lump-sum type. The effects of c_i^m have been studied e.g. by Hey and McKenna (1979), Loikkanen (1982) and Burgess (1988), but the definition of c_j is new. It is a permanent loss in utility of a person who changes his occupation. For example white collar workers may feel that they lose something if they accept any other occupation even at the same wage rate. Alternatively c_j could be assumed to depend on the area or both the occupation and area. For example, daily travelling costs between home and work are permanent costs of becoming employed.

Workers maximize the expected present value of the utility. During a short interval dt active search is undertaken and the unemployed person's utility evaluated at t + dt is

$$\begin{aligned} (2) \quad V(t+dt) = {} & u_0[b - c - \Sigma\Sigma a_{ij} c_i, \\ & 1 - s(t)]\, B(dt) \\ & + \Sigma\Sigma a_{ij} dt \int_{u_{ij}(t)}^{\bar{u}} [(u - c_j)\, B(t) \\ & - c_i^m]\, dF(u)\, D(dt) \\ & + \{1 - \Sigma\Sigma a_{ij} dt\, [1 - F(u_{ij}(t))]\}\, V(t)\, D(dt) \\ & + o(dt). \end{aligned}$$

The first term of the value function V(t + dt) on the right-hand side describes the discounted instantaneous utility during the search period dt. The second term is the expected discounted utility related to an acceptable offer. The third term is the expected discounted utility related to an unsuccessful search and o(dt) is the remainder term. The expectation is taken with respect to the distribution function of utility F(u). $\bar{u}$ is the maximum attainable utility and $u_{ij}(t)$ is the reservation utility of an occupation j in an area i at time t. The offers that are at least $u_{ij}(t)$ are acceptable. The person may search for a job in one or more occupations in one or more areas. Also, it may not be optimal to search at all. This feature of search models has been studied by Loikkanen (1982).

B(dt), B(t) and D(dt) are discount factors for dt, t>0. $B(dt) = \int_0^{dt} e^{-r\tau}d\tau = [1 - \exp(-rdt)]/r$, where r is the subjective rate of time preference. By expansion it can be written as $B(dt) = dt + o(dt)$. The instantaneous utility of being unemployed is proportional to the length of the interval dt. In an infinite horizon case $B(t) = 1/r$, which discounts the utility of an acceptable offer. The discount factor $D(dt) = \exp(-rdt)$ discounts the expected value of search apart from the instantaneous utility from t to t+dt. By expansion $D(dt) = 1 - rdt + o(dt)$.

Substituting the discount factors, rearranging terms, forming the difference quotient $[V(t+dt) - V(t)]/dt$ and taking the limits as dt approaches zero gives the differential equation of expected utility stream with respect to the time

$$\text{(3)} \quad \dot{V}(t) = u_0[b - c - \Sigma\Sigma a_{ij}c_i,\ 1 - s(t)] - rV(t) + \Sigma\Sigma a_{ij} \int_{u_{ij}(t)}^{\bar{u}} [(u - c_j)/r - c_i^m - V(t)]\,dF(u).$$

It is assumed that the remainder term o(dt) approaches zero when dt → 0. It can be seen that V(t) is constant over time in a model with an infinite horizon. The value function can now be written

$$\text{(4)} \quad V(t) = \{u_0[b - c - \Sigma\Sigma a_{ij}c_i,\ 1 - s(t)] + \Sigma\Sigma a_{ij} \int_{u_{ij}(t)}^{\bar{u}} [(u - c_j)/r - c_i^m - V(t)]\,dF(u)\}/r.$$

The necessary condition for the optimal $u_{ij}(t)$ can then be solved by setting $\partial V/\partial u_{ij} = 0$, which gives

$$\text{(5)} \quad u_{ij}(t) = c_j + r[c_i^m + V(t)].$$

The value function can be written $V(t) = [u_{ij}(t) - c_j]/r - c_i^m$. It means that the expected value of continuing search, the value function, is equal to the utility of an acceptable offer minus the permanent cost discounted over the search horizon net of the moving cost. The reservation utility is chosen to equate the value of the worst acceptable offer with the expected value of unemployment.

Next the effects of exogenous variables on the optimal reservation utility relative to a given optimal search intensity are studied. These effects are derived in the appendix. The comparative static properties of the reservation utility are following.

Proposition 1: The reservation utility is a decreasing function of the searching cost c and visiting cost c_i and an increasing function of the UI benefits b, arrival rate of job offers a_{ij}, permanent cost of re-employment c_j and moving cost c_i^m, improvement of offer distribution and uncertainty of job offers. The effect of the subjective rate of time preference r is generally ambiguous, but nearly always the reservation utility is a degreasing function of r.

Another decision variable of the model is the search intensity. An unemployed person's objective is to maximize the expected discounted utility by choosing search intensity relative to the acceptance rule of job offers. The necessary condition for the optimal search intensity is got by differentiating V(t) with respect to the search intensity s

$$\text{(6)} \quad V_s(t) = \{-\Sigma\Sigma \frac{\partial u_0}{\partial C}\frac{\partial a_{ij}}{\partial s}c_i - \frac{\partial u_0}{\partial L} + \Sigma\Sigma \frac{\partial a_{ij}}{\partial s} \int_{u_{ij}(t)}^{\bar{u}} [(u - c_j)/r - c_i^m - V(t)]\,dF(u)\}/r = 0.$$

It can be seen that the marginal utility of leisure and visiting costs is equated to the expected marginal utility gain from the search.

The derivation of the comparative static results is complicated because the necessary conditions involve not only endogenous and exogenous variables but also the value function. The endogenous variables are affected by exogenous variables directly and indirectly via the change in the value function. The results are again derived in the appendix. The comparative static properties of the search intensity are following.

Proposition 2: The search intensity is a decreasing function of the UI benefits b, permanent cost of re-employment c_j, moving cost c_i^m and the subjective rate of time preference r and an increasing function of searching cost c, arrival rate of job offers a_{ij}, improvement of offer distribution and uncertainty of job offers. The effect of the visiting cost c_i is generally ambiguous.

The hazard function is a product of the arrival rate and probability that an offer is acceptable

$$h(t) = \Sigma\Sigma a_{ij}[s(t)]\{1 - F[u_{ij}(t)]\}. \quad (7)$$

The connection of search models and econometric models of unemployment duration is obtained by the well-known density function of duration models

$$f(t) = h(t)\exp[-\int_0^t h(\tau)d\tau]. \quad (8)$$

The connection with the expected value of an unemployment spell can be written as

$$E(T) = \int_0^\infty \exp[-\int_0^t h(\tau)d\tau]\,dt. \quad (9)$$

The hazard function is affected by two endogenous variables; the reservation utility and search intensity. Both of them have to be taken into account when examining the effects of exogenous variables on the hazard function. The UI benefits b and costs c_j and c_i^m increase the reservation utility and decrease the search intensity. Hence their effect on the hazard function is negative. The searching costs c decrease the reservation utility and increase the search intensity. Hence their effect on the hazard function is positive. The effect of arrival rate of job offers on the hazard function has an ambiguous sign, since the direct effect is positive, but the indirect effect via the reservation utility is negative. The improvement of the offer distribution and uncertainty of job offers increase the reservation utility and search intensity. Hence their effects on the hazard function are ambiguous. The effect of the subjective rate of time preference on the hazard function is ambiguous, since it decreases the reservation utility and search intensity. The effects of exogenous variables on the hazard function are following.

Proposition 3: The hazard function is a decreasing function of the UI benefits b, permanent cost of re-employment c_j and moving cost c_i^m and an increasing function of the searching cost c. The effects of the arrival rate of job offers a_{ij}, visiting cost c_j, subjective rate of time preference r and improvement and uncertainty of job offers on the hazard function are ambiguous.

3. *The effects of the UI system*

3.1. *The waiting period*

According to the Finnish Unemployment Insurance Act benefits can be paid after a qualifying waiting period. It is normally one week or alternatively six weeks if the person has just entered the labor force or if he has quit his previous job. However, the waiting period of six weeks is not applied to a worker who has just finished school or who has been self-employed. In this section it is shown that the waiting period has a rather small effect on the re-employment and during the waiting period the hazard function is decreasing due to a fact that benefits are not yet paid.

The time concept in the applications to the UI system is such that at the outset of an unemployment period $t > 0$ and at the end of the waiting period $t = 0$. During the waiting period the instantaneous utility is $u_0(bD(t) - c - \Sigma\Sigma a_{ij}c_i,\ 1 - s^*(t))$, where $D(t) = \exp(-rt)$ and the asterisk is used refer to the functions affected by the feature of the UI system that is considered. If the person is still unemployed, his instantaneous utility will be $u_0(b - c - \Sigma\Sigma a_{ij}c_i,\ 1 - s(t))$ after the waiting period once he has got his benefits.

The value of search evaluated at $t + dt$ can be written

$$\begin{aligned} V^*(t + dt) = {} & u_0[bD(t) - c - \Sigma\Sigma a_{ij}c_i, \\ & 1 - s^*(t)]B(dt) \\ & + \Sigma\Sigma a_{ij}dt \int_{u_{ij}^*(t)}^{\bar{u}} [(u - c_j)/r - c_i^m \end{aligned} \quad (10)$$

$-V^*(t)]dF(u)D(dt)+V^*(t)D(dt)$
$+o(dt),$

It is obvious that $\lim_{t\to\infty} V^*(t)=V(t;\ b=0)$ and $\lim_{t\to 0}V^*(t)=V(t)$, i.e. $\dot{V}^*(t)<0$, since $D(t)=\exp(-rt)$. If $t\leq 0$ then $V^*(t)=V(t)$. The reservation utility does not have a stationary solution during the waiting period, since the value function depends on how long the worker has been unemployed. The optimal reservation utility during the waiting period is $u_{ij}^*(t)=c_j+r[c_i^m+V^*(t)]$. These findings clearly imply the following consequences.

Proposition 4: It is obvious that during the waiting period $u_{ij}^*(t)<u_{ij}(t)$, $s^*(t)>s(t)$ and $h^*(t)>h(t)$. Clearly $\partial u_{ij}^*(t)/\partial t<0$, $\partial s^*(t)/\partial t>0$ and $\partial h^*(t)/\partial t>0$ during the waiting period, i.e. when the eligibility for UI benefits comes closer the reservation utility is increasing, and the search intensity and hazard function are decreasing.

A series of numerical examples are presented in this and following sections to illustrate the nonstationary functions. It is assumed that the UI benefits $b=5000$ if $t\leq 0$ and $b=0$ during the waiting period. Furthermore it is assumed that the offers are uniformly distributed between 5000 and 15 000 units of utility in a month. The distribution is used e.g. by Loikkanen and Pursiheimo (1979) and van den Berg (1987). The value of time spent on search is assumed to be specified as $\delta s(t)^2$, where $\delta=10\,000$ is a scaling factor and s is the search intensity. The arrival rate of job offers is specified as $\Sigma\Sigma a_{ij}(s)=0.15s$. The remaining parameter values used in the numerical example are as follows: $r=0.15/12$, $c=4000$, $c_i=1000$, $c_j=2000$ and $c_i^m=20\,000$.

The effects of the qualifying waiting period are illustrated in Figure 1, where the nonstationary time paths of the endogenous functions and hazard function are plotted against the weeks of remaining waiting time. It can be seen that the changes of the reservation utility, search intensity and hazard function are small during the waiting period even though

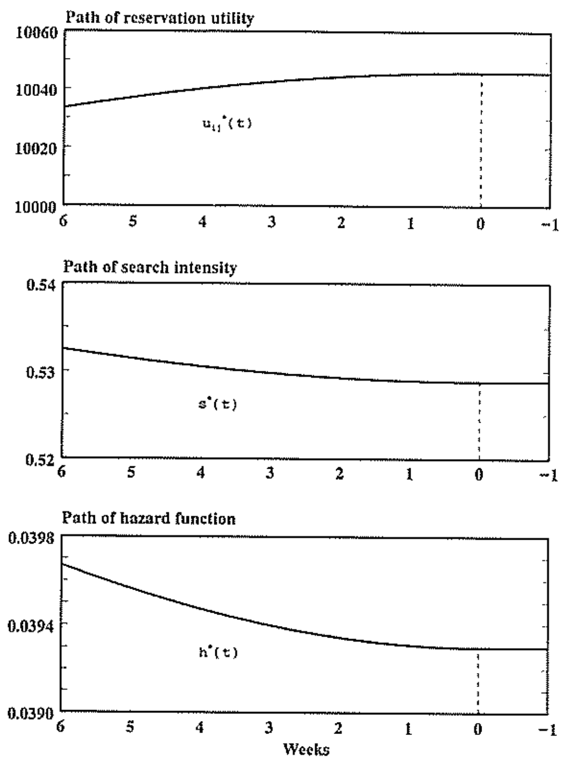

Figure 1. The effects of the waiting period.

the subjective rate of time preference is rather high. During the last week the functions are nearly flat. If r were lower the changes in the functions would be smaller. The conclusion is that the effects of the waiting period are very low. This finding leads to a conclusion that one way of improving the welfare of an unemployed person is to remove the waiting period, since it does not have much effect on the re-employment probability.

3.2. *The rule of labour mobility*

The main rule in the Finnish Unemployment Insurance Act concerning labour mobility is that an unemployed person does not have to move outside his working area or change his occupation within the first three months of unemployment. After that period he may no longer be eligible for UI benefits if he does not accept a job offered by the employment office. In this section it is shown that the threat of removal of benefits from a reluctant mover leads to a lower reservation utility and higher search intensity and hazard function. Furthermore, it is shown that the reservation utility is slightly decreasing, and the search intensity and hazard function are slightly increasing during the unemployment of the first three months.

The value of search can be written

$$(11)\quad V^*(t+dt)=u_0\{[1-\Sigma\Sigma a_{ij}F(u_{ij}^*(t_0))D(t)]b - c-\Sigma\Sigma a_{ij}c_i,\ 1-s^*(t)\}B(dt) + \Sigma\Sigma a_{ij}dt\int_{u_{ij}^*(t)}^{\bar{u}}[(u-c_j)/r-c_i^m - V^*(t)]\,dF(u)\,D(dt)+V^*(t)\,D(dt) + o(dt),$$

where $t_0 \leq 0$. The risk of losing UI benefits decreases the value of search. With probability $\Sigma\Sigma a_{ij}F(u_{ij}^*(t_0))$ an unemployed person gets an offer which is less than the reservation utility and loses his benefits. If an offer is accepted during the first three months, the per-

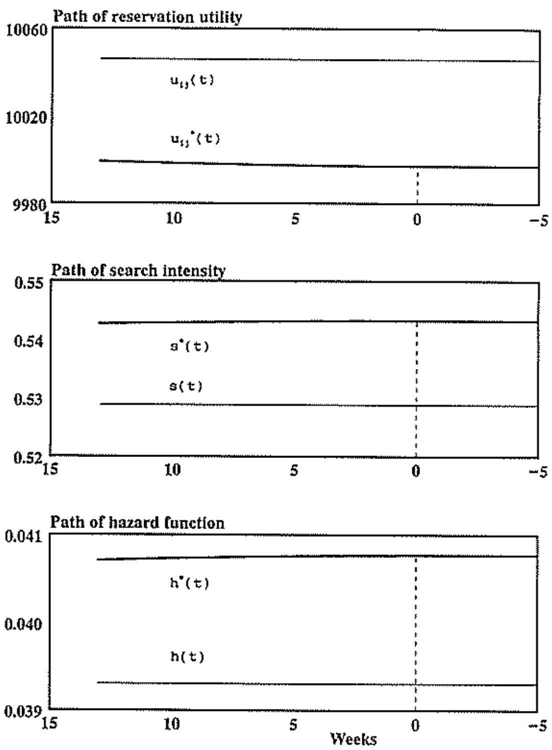

Figure 2. The effects of mobility rules.

son does not have any risk. If he is unemployed and searching for a job, the associated instantaneous utility may change starting at $t=0$. It is obvious that $V^*(t)>0$ before the risky period and $\lim_{t\to\infty} V^*(t)=V(t)$, since $D(t)=\exp(-rt)$. If the threat of removal of benefits is postponed, the threat of losing benefits matters less. If $\Sigma\Sigma a_{ij}=0$ or the offers are at least $u_{ij}^*(t)$, then $V^*(t)=V(t)$ and the rule of labour mobility has no effects. The optimal reservation utility during the first three months is $u_{ij}^*(t)=c_j+r[c_j^m+V^*(t)]$. The following facts hold.

Proposition 5: It is obvious that $u_{ij}^*(t)<u_{ij}(t)$, $s^*(t)>s(t)$ and $h^*(t)>h(t)$. The risk of losing benefits after the first three months decreases the reservation utility and increases the search intensity and hazard function. Clearly $\partial u_{ij}^*(t)/\partial t>0$, $\partial s^*(t)/\partial t<0$ and $\partial h^*(t)/\partial t<0$ during the first months, i.e. the path of reservation utility is decreasing, and the paths of the search intensity and hazard function are increasing.

Furthermore, it can be shown that the effects of UI benefits are decreasing over the spell of unemployment. The decreasing effect of UI benefits has been studied by Usategui (1988) in the case of a benefit period of finite duration.

The effects of the rules of labour mobility have been illustrated in Figure 2, where the nonstationary time paths of the endogenous functions and hazard function are plotted against the remaining weeks until the risky period starts. The reservation utility is decreasing, and the search intensity and hazard function are increasing during the first three months, and after the unemployment of three months the functions are constant. If there were no rules of mobility, the reservation utility would be higher and the search intensity and hazard function would be lower, which have been denoted by the straight horizontal lines. Compared to the waiting period it can be concluded that the rule of labour mobility has substantially larger effects.

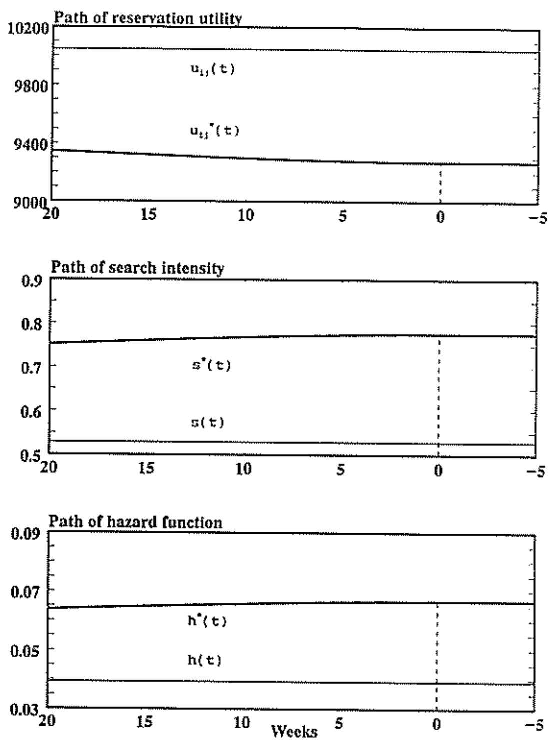

Figure 3. The effects of reductions of UI benefits.

3.3. Reduction of UI benefits

In this section a case where an unemployed person faces a relative reduction of UI benefits is studied. The earnings-related unemployment allowances decreased by 20 % after 100 days of unemployment in 1985 – 1987. It is shown that the path of the reservation utility is decreasing, and the paths of the search intensity and hazard function are increasing before the reduction. At the beginning of the search the instantaneous utility is $u_0((1-kD(t))b-c-\Sigma\Sigma a_{ij}c_i,\ 1-s^*(t))$. If the person has not left unemployment, his instantaneous utility is lower $u_0((1-k)b-c\ -\Sigma\Sigma a_{ij}c_i,\ 1-s^*(t))$ once the reduction of $k \cdot 100$ % has happened.

The value function can now be written as

$$
\begin{aligned}
(12)\quad V^*(t+dt) = {} & u_0\{[1-kD(t)]b-c-\Sigma\Sigma a_{ij}c_i,\\
& 1-s^*(t)\}B(dt)\\
& +\Sigma\Sigma a_{ij}dt \int_{u_{ij}^*(t)}^{\bar{u}} [(u-c_j)/r-c_i^m\\
& -V^*(t)]dF(u)D(dt)+V^*(t)D(dt)\\
& +o(dt).
\end{aligned}
$$

The reductions of UI benefits decrease the expected value of utility. It is obvious that $\lim_{t\to\infty} V^*(t)=V(t)$. $V(t)$ was the value function with no reduction of UI benefits. If the reduction of benefits is postponed far into the future, the reduction does not matter. Clearly the value function is decreasing i.e. $\dot{V}^*(t)>0$. The optimality condition for the reservation utility during the waiting period is found to be $u_{ij}^*(t)=c_j+r[c_i^m+V^*(t)]$. The reader can now verify for himself the final results.

Proposition 6: It is obvious that $u_{ij}(t) > u_{ij}^*(t)$, $s^*(t)<s(t)$ and $h(t)<h^*(t)$. Clearly $\partial u_{ij}^*(t)/\partial t>0$, $\partial s^*(t)/\partial t<0$ and $\partial h^*(t)/\partial t<0$ before the reduction of benefits, i.e. when the reduction comes closer the reservation utility decreases and the search intensity and hazard function increase.

The effects of the reduction of benefits have been illustrated in Figure 3. In the numerical example it has been assumed that the UI benefits have been reduced from 5000 to 1000 units of utility. The reservation utility is decreasing before the reduction, and the search intensity and hazard function are increasing. After the reduction the functions are constant. If there were no reductions the reservation utility would be higher, and the search intensity and hazard function would be lower. These stationary functions have been described by the horizontal lines. It can be concluded that the reduction of benefits provides a substantial incentive to leave the pool of unemployed workers.

4. Conclusions

According to the comparative static results the UI benefits have a negative effect on the re-employment probability. This is a well known result, but from the policy point of view it is interesting to know that the costs of re-employment have positive effects on the re-employment probability. Hence the conditional benefits can be used in order to reduce the re-employment costs and increase the probability of leaving unemployment.

Using search models it was shown that the hazard function is decreasing during the qualifying waiting period due to a fact that the benefits are not yet paid. Concerning the waiting period of UI benefits it can be concluded that it has only a slight effect on the re-employment probability. The improvement of the welfare of an unemployed person by removing the waiting period has a rather small negative effect on the re-employment probability.

Reluctant movers may lose their benefits if they do not accept an offer from other working areas or occupations after the first three months of unemployment. During the first three months of unemployment the hazard function is increasing for a person who gets benefits. The threat of removing benefits may increase substantially the re-employment probability if there are non-acceptable offers.

Persons who get earnings-related unemployment allowances face reductions of their benefits. The hazard function is increasing before the reduction. It was shown that the awareness of the reduction increases effectively the re-employment probability.

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Appendix. Comparative statics results

In the appendix the effects of exogenous variables on the reservation utility and search intensity are derived.

Reservation utility

The fundamental equation for the reservation utility is solved from the value function (4) by inserting $V=(u_{ij}-c_j)/r-c_i^m$, which gives

$$(13)\quad u_{ij}=u_0[b-c-\Sigma\Sigma a_{ij}c_i,\ 1-s(t)]+c_j+rc_i^m + \Sigma\Sigma a_{ij}\int_{u_{ij}}^{\bar{u}}(u-u_{ij})\,dF(u)/r,$$

where the comparative static results can be solved:

$$(14)\quad \frac{\partial u_{ij}}{\partial b}=\frac{\partial u_0}{\partial C}>0$$

$$(15)\quad \frac{\partial u_{ij}}{\partial c}=-\frac{\partial u_0}{\partial C}<0$$

$$(16)\quad \frac{\partial u_{ij}}{\partial a_{ij}}=-\frac{\partial u_0}{\partial C}c_i+\int_{u_{ij}}^{\bar{u}}(u-u_{ij})\,dF(u)/r>0$$

$$(17)\quad \frac{\partial u_{ij}}{\partial c_i}=-\frac{\partial u_0}{\partial C}\Sigma a_{ij}<0$$

$$(18)\quad \frac{\partial u_{ij}}{\partial c_j}=1>0$$

$$(19)\quad \frac{\partial u_{ij}}{\partial c_i^m}=r>0$$

$$(20)\quad \frac{\partial u_{ij}}{\partial r}=c_i^m-\Sigma\Sigma a_{ij}\int_{u_{ij}}^{\bar{u}}(u-u_{ij})\,dF(u)/r^2<0.$$

The subjective rate of time preference r increases the reservation utility via the lump sum type of moving cost, but on the other hand it decreases it via the expected utility. The total effect is negative only during the last weeks of unemployment. In the standard search model r has a negative effect on u_{ij}, since c_i^m does not exist.

To solve the effects of the offer distribution a translation of F to the right is made so that $F(u)=G(u+\mu)$, for all u and $\mu>0$. This method was used by Mortensen (1986). This translation is said to first order stochastically dominate F(u). Substituting the following useful transformation.

$$(21)\quad \int_{u_{ij}}^{\bar{u}}(u-u_{ij})\,dF(u)=E_F(u)-u_{ij}+\int_0^{u_{ij}}F(u)\,du$$

and $F(u)=G(u+\mu)$ into (13) and noting that $E_G(u)=\mu+E_F(u)$ we obtain

$$(22)\quad u_{ij}=u_0+c_j+rc_i^m+\Sigma\Sigma a_{ij}[\mu+E_F(u)-u_{ij} + \int_0^{u_{ij}}F(u-\mu)\,du]/r.$$

The effect of offer distribution on the reservation utility can now be solved

$$(23)\quad \frac{\partial u_{ij}}{\partial \mu}=\Sigma\Sigma a_{ij}[1-F(u_{ij}-\mu)]/r>0.$$

Next the effects of uncertainty of job offers are considered. Rothschild and Stiglitz (1970) introduced the 'mean preserving spread'. The distribution H is a mean preserving spread of F given that they have the same mean if and only if

$$(24)\quad \int_0^{u_1} H(u)\,du \geq \int_0^{u_1} F(u)\,du, \quad \text{for all } u_1 > 0.$$

Substituting (21) and $F(u)=H(u, \sigma)$ for (13) gives

$$(25)\quad u_{ij} = u_0 + c_j + rc_i^m + \Sigma\Sigma a_{ij}[E_F(u) - u_{ij} + \int_0^{u_{ij}} H(u, \sigma)\,du]/r,$$

where σ is the parameter of relative dispersion. The effect of uncertainty on the reservation utility is then

$$(26)\quad \frac{\partial u_{ij}}{\partial \sigma} = \Sigma\Sigma a_{ij} H(u, \sigma)/r > 0.$$

Search intensity

The technique of solving the effects on the search intensity is presented e.g. by Albrecht, Holmlund and Lang (1986). Implicitly differentiating the effect of the UI benefits can be obtained from (6)

$$(27)\quad \frac{\partial s}{\partial b} = -\frac{\partial V_s}{\partial b} \Big/ \frac{\partial V_s}{\partial s},$$

where $\partial V_s/\partial s < 0$ by the second order condition of the optimal search intensity. Therefore the sign of $\partial V_s/\partial b$ must be studied. It is easily shown to be negative. The necessary derivatives are

$$(28)\quad \frac{\partial V_s}{\partial b} = (-\Sigma\Sigma \frac{\partial^2 u_0}{\partial C \partial C} \frac{\partial a_{ij}}{\partial s} c_i - \frac{\partial^2 u_0}{\partial L \partial C})/r < 0$$

$$(29)\quad \frac{\partial V_s}{\partial c} = -\frac{\partial V_s}{\partial b} > 0$$

$$(30)\quad \frac{\partial V_s}{\partial c_i} = [\Sigma \frac{\partial^2 u_o}{\partial C \partial C} \frac{\partial a_{ij}}{\partial s} c_i a_{ij} - \Sigma\Sigma \frac{\partial u_0 \partial a_{ij}}{\partial C \partial s} + \Sigma \frac{\partial^2 u_0}{\partial L \partial C} a_{ij}]/r$$

$$(31)\quad \frac{\partial V_s}{\partial c_j} = -\Sigma\Sigma \frac{\partial a_{ij}}{\partial s}[1 - F(u_{ij})]/r^2 < 0$$

$$(32)\quad \frac{\partial V_s}{\partial c_i^m} = -\Sigma\Sigma \frac{\partial a_{ij}}{\partial s}[1 - F(u_{ij})]/r < 0$$

$$(33)\quad \frac{\partial V_s}{\partial r} = -\Sigma\Sigma \frac{\partial a_{ij}}{\partial s} \int_{u_{ij}}^{\bar{u}} (u - c_j)\,dF(u)/r^2 - V_s/r < 0.$$

The sign of $\partial V_s/\partial c_i$ cannot generally be determined, since the utility function is not known. In the numerical example the sign is clearly negative. Substituting the transformation (21) and $F(u)=G(u+\mu)$ for (6) and noting that $E_G(u)=\mu+E_F(u)$ gives

$$(34)\quad V_s = \{-\Sigma\Sigma \frac{\partial u_0}{\partial C} \frac{\partial a_{ij}}{\partial s} c_i - \frac{\partial u_0}{\partial L} + \Sigma\Sigma \frac{\partial a_{ij}}{\partial s}[\mu + E_F(u) - u_{ij} + \int_0^{u_{ij}} F(u-\mu)\,du]/r\}/r.$$

Differentiation gives

$$(35)\quad \frac{\partial V_s}{\partial \mu} = \Sigma\Sigma \frac{\partial a_{ij}}{\partial s}[1 - F(u_{ij} - \mu)]/r^2 > 0.$$

Substituting (21) and $F(u)=H(u, \sigma)$ for (6) gives

$$(36)\quad V_s = \{-\Sigma\Sigma \frac{\partial u_0}{\partial C} \frac{\partial a_{ij}}{\partial s} c_i - \frac{\partial u_0}{\partial L} + \Sigma\Sigma \frac{\partial a_{ij}}{\partial s}[E_F(u) - u_{ij} + \int_0^{u_{ij}} H(u, \sigma)\,du]/r\}/r.$$

Differentiation gives

$$(37)\quad \frac{\partial V_s}{\partial \sigma} = \Sigma\Sigma \frac{\partial a_{ij}}{\partial s} H(u, \sigma)/r^2 > 0.$$