ETLA ELINKEINOELÄMÄN TUTKIMUSLAITOS
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
Lönnrotinkatu 4 B 00120 Helsinki Finland Tel. 609900 Telefax 601753

Keskusteluaiheita - Discussion papers

No. 374

Juha Kettunen*

A SEARCH THEORETICAL ANALYSIS OF THE FINNISH UNEMPLOYMENT INSURANCE SYSTEM

* I am grateful to Simon Burgess, Andrew Chesher and Heikki Loikkanen for valuable comments and Yrjö Jahnsson Foundation for financial support.

ISSN 0781-6847 28.08.1991

KETTUNEN, Juha, **A SEARCH THEORETICAL ANALYSIS OF THE FINNISH UNEMPLOYMENT INSURANCE SYSTEM.** Helsinki : ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 1991. 25 p. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; no. 374).

ABSTRACT: 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 witing period has only a slight positive effect on the hazard function, but the effects of the mobility rules and reduction of benefits substantially increase the re-employment probability.

KEY WORDS: Search theory, unemployment insurance.

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 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.

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 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 set 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 unemployed 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 the 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) $u_C > 0,\ u_L > 0,\ u_{CC} \leq 0,\ u_{LL} \leq 0$ 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 $a_{ij}(0) = 0$, $\delta a_{ij}/\delta s > 0$ and $\delta^2 a_{ij}/\delta s\delta s \leq 0$. 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

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

The first term of the value function V(t+dt) on its 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 a 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 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 to zero gives the differential equation of expected utility stream with respect to the time

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

It is assumed that the remainder term o(dt) approaches to zero with dt. It can be seen that V(t) is constant over time, i.e. $\dot{V}(t) = 0$ in a model with an infinite horizon. The value function can now be written

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

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

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

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 the 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 comparative static properties of the model are studied, i.e. the effects of exogenous variables on the optimal reservation utility relative to a given optimal search intensity. These effects are solved by differentiation in the appendix.

Summarizing the comparative static properties of the reservation utility the following results are obvious. The reservation utility is

a) a decreasing function of the searching cost c, visiting cost c_i and subjective rate of time preference r,

b) 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.

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

$$(6) \qquad V_s(t) = \{- \Sigma\Sigma \frac{\delta u_0}{\delta C} \frac{\delta a_{ij}}{\delta s} c_i - \frac{\delta u_0}{\delta L}$$

$$+ \Sigma\Sigma \frac{\delta a_{ij}}{\delta s} \int_{u_{ij}(t)}^{\bar{u}} [(u - c_j)/r - c_i^m - V(t)]dF(u)\}/r = 0.$$

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

Derivation of comparative static results is complicated by the fact that 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 solved by implicit differentiation in the appendix. The following results are obvious. The search intensity is

a) 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,

b) an increasing function of searching cost c, arrival rate of job offers a_{ij}, visiting cost c_i and improvement of offer distribution and uncertainty of job offers.

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

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

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

$$(8) \qquad f(t) = h(t)\exp\left(- \int_0^t h(\tau)d\tau \right),$$

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

$$(9) \qquad E(T) = \int_0^\infty \exp\left(- \int_0^t h(\tau)d\tau \right)dt.$$

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 cost c and visiting cost c_i 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.

Summarizing the effects of exogenous variables on the hazard function, the following results are obvious. The hazard function is

a) a decreasing function of the UI benefits b, permanent cost of re-employment c_j and moving cost c_i^m,

b) an increasing function of the searching cost c and visiting cost c_i. The effects of the arrival rate of job offers a_{ij}, 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 has not left unemployment, 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

$$(10)\qquad V^*(t+dt) = u_0(bD(t) - c - \Sigma\Sigma a_{ij}c_i,\ 1 - s^*(t))B(dt)$$

$$+ \Sigma\Sigma a_{ij}dt \int_{u_{ij}^*(t)}^{\bar{u}} [(u - c_j)/r - c_i^m - V^*(t)]dF(u)D(dt)$$

$$+ V^*(t)D(dt) + o(dt),$$

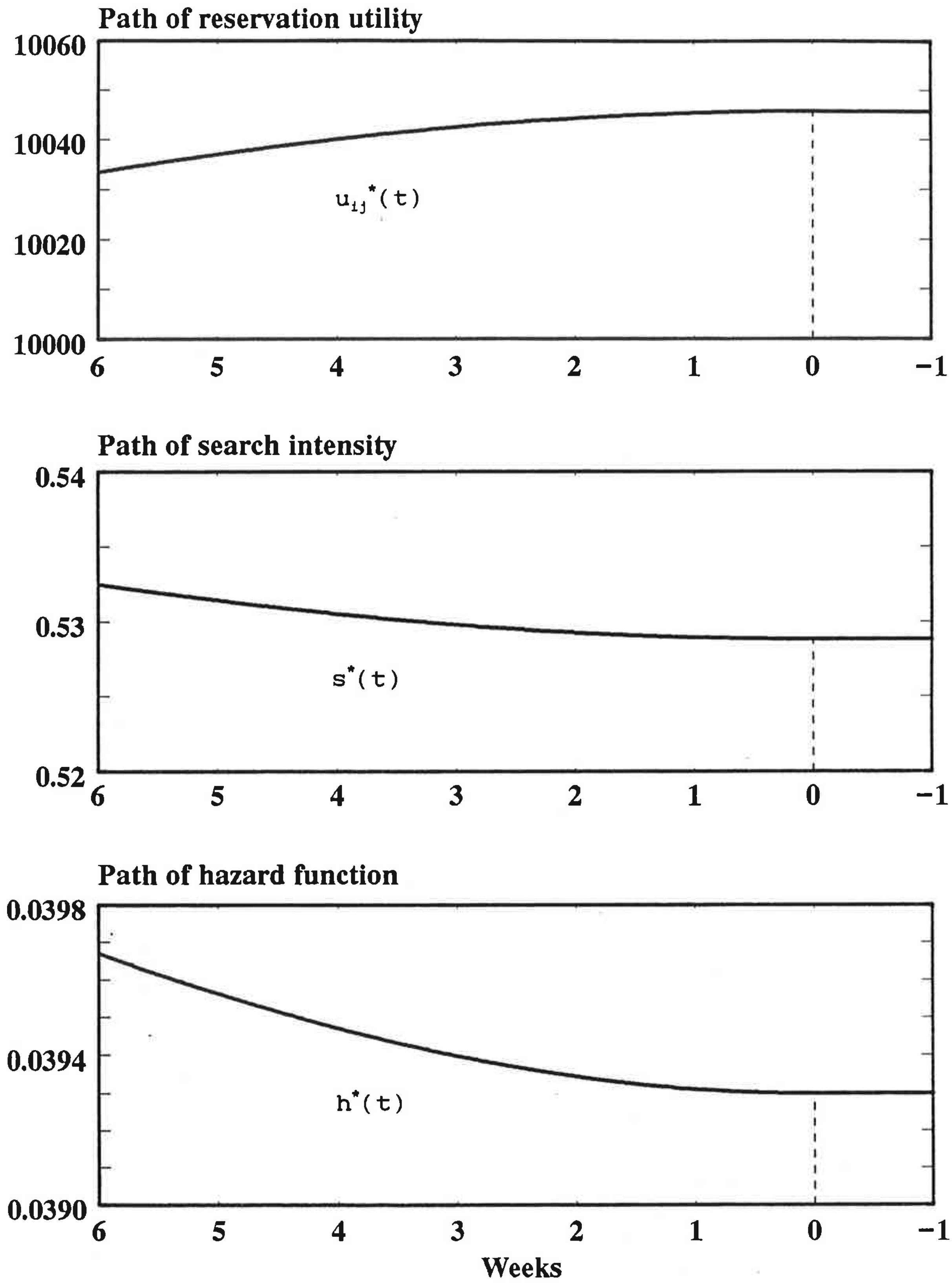
It is obvious that $\lim_{t\to\infty} V^*(t) = V(t; b=0)$ and $\lim_{t\to 0} V^*(t) = V(t)$, i.e. $\dot{V}^*(t) < 0$, since $D(t) = \exp(-rt)$. If $t \leq 0$ then $V^*(t) = V(t)$. The reservation utility does not have a stationary solution during the waiting period, since the value function depends on how long the worker has been unemployed.

Solving the optimal reservation utility during the waiting period gives $u_{ij}^*(t) = c_j + r[c_i^m + V^*(t)]$. It is obvious that during the waiting period $u_{ij}^*(t) < u_{ij}(t)$, $s^*(t) > s(t)$ and $h^*(t) > h(t)$. Clearly $\delta u_{ij}^*(t)/\delta t < 0$, $\delta s^*(t)/\delta t > 0$ and $\delta h^*(t)/\delta t > 0$ 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 15000 units of utility in a month. The distribution is used e.g. by Loikkanen and Pursiheimo (1979) and van den Berg (1987). Monthly figures are chosen since these things are usually thought in this way in Finland. The value of time spent on search is assumed to be specified as $xs(t)^2$, where $x = 10000$ 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 $c_i^m = 20000$.

The effects of the qualifying waiting period have been illustrated in Figure 1. It can be seen that the changes of the reservation utility, search intensity and hazard function are small during the waiting period even though the subjective rate of time preference is rather high, and during the last week the functions are near the constant values. If r would be 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.

Fig 1. The effects of the waiting period



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 unemployment of the first three months. After that period he may no longer be eligible for UI benefits if he does not accept an offer obtained from the Employment Service. 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)

$$V^*(t+dt) = u_0([1 - \Sigma\Sigma a_{ij}F(u_{ij}^*(t_0))D(t)]b - c - \Sigma\Sigma a_{ij}c_i,\ 1-s^*(t))B(dt)$$

$$+ \Sigma\Sigma a_{ij}dt \int_{u_{ij}^*(t)}^{\bar{u}} [(u - c_j)/r - c_i^m - V^*(t)]dF(u)D(dt)$$

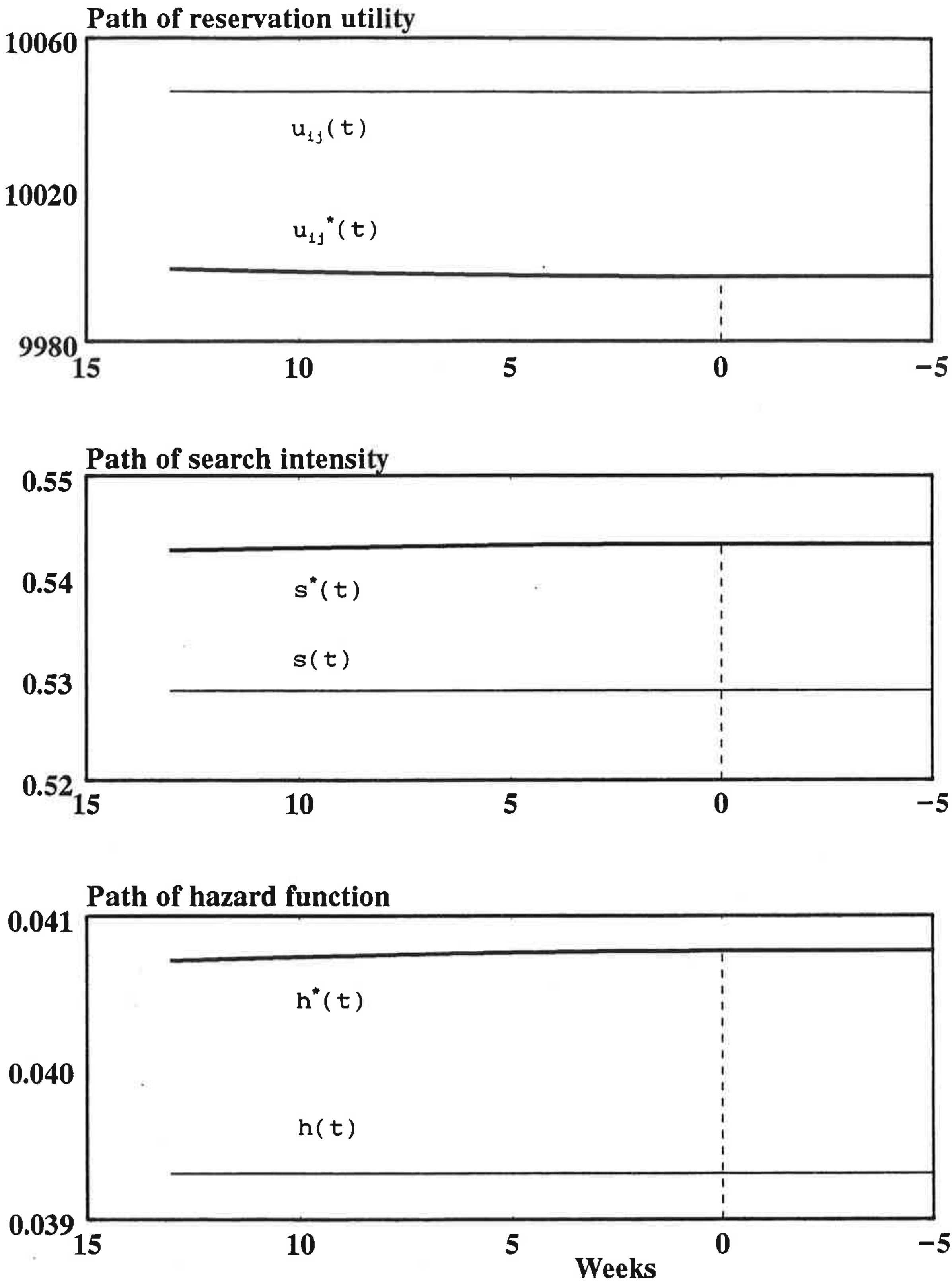
$$+ V^*(t)D(dt) + o(dt),$$

where $t_0 \leq 0$. The risk of losing UI benefits decreases the value of search. With a 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 person does not face a risk. If he is unemployed and searching for a job, the associated instantaneous utility may change starting at t=0. It is obvious that $\dot{V}^*(t) > 0$ before the risk 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 $u_{ij}^*(t) = c_j + r[c_i^m + V^*(t)]$. 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 $\delta u_{ij}^*(t)/\delta t \geq 0$, $\delta s^*(t)/\delta t \leq 0$ and $\delta h^*(t)/\delta t \leq 0$ 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. 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.

Fig 2. The effects of mobility rules



3.3. Reduction of UI benefits

In this section a case where an unemployed person faces a relative reduction of UI benefits is considered. The earnings-related unemployment allowances decrease by 20% after 100 days of unemployment. 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 be written

$$V^*(t+dt) = u_0((1-kD(t))b - c - \Sigma\Sigma a_{ij}c_i,\ 1-s^*(t))B(dt) \tag{12}$$

$$+ \Sigma\Sigma a_{ij}dt \int_{u_{ij}^*(t)}^{\bar{u}} [(u - c_j)/r - c_i^m - V^*(t)]dF(u)D(dt)$$

$$+ V^*(t)D(dt) + o(dt),$$

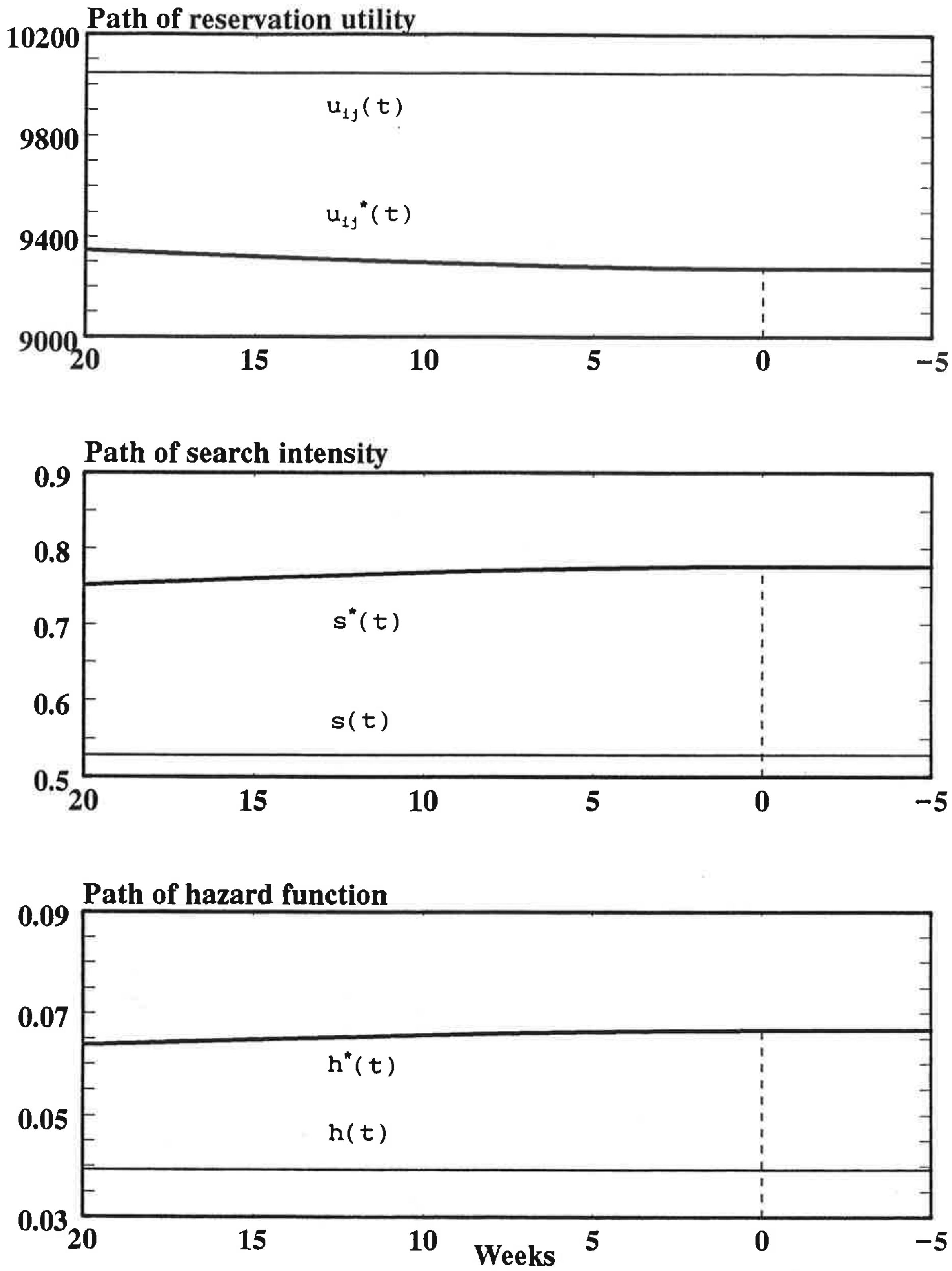
The reductions decrease the expected value of utility. It is obvious that $\lim_{t\to\infty} V^*(t) = V(t)$, which is the value function with no reduction of UI benefits. If the reduction of benefits is postponed far in the future, the reduction does not matter. Clearly the value function is decreasing, i.e. $\dot{V}^*(t) > 0$.

The optimality condition for the reservation utility during the waiting period is found to be $u_{ij}^*(t) = c_j + r[c_i^m + V^*(t)]$. It is obvious that $u_{ij}(t) > u_{ij}^*(t)$, $s^*(t) < s(t)$ and $h(t) < h^*(t)$. Clearly $\delta u_{ij}^*(t)/\delta t > 0$,

$\delta s^*(t)/\delta t < 0$ and $\delta h^*(t)/\delta t < 0$ 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 constant horizontal lines. It can be concluded that the reduction of benefits provides a substantial incentive to leave unemployment.

Fig 3. The effects of reductions



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 political 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.

References

Albrecht, J.W., Holmlund, B. and Lang, H. (1986), "Job Search and the Transition to Employment," The Industrial Institute for Economic and Social Research, Working Paper, No. 26.

Berg, G.J. van den (1987), "Nonstationarity in Job Search Theory," Tilburg University, Department of Economics, FEW 242.

Burgess, S.M. (1988), "Search, Job Changing Costs and Unemployment," University of Bristol, Mimeo, May.

Hey, J.D. and McKenna, C.J. (1979), "To Move or Not to Move?" *Economica* 46, 175-185.

Kiefer, N.M. and Neumann, G.R. (1989), *Search Models and Applied Labor Economics,* Cambridge University Press, Cambridge.

Lippman, S.A. and McCall, J.J. (1976a,b), "The Economics of Job Search: A Survey," *Economic Inquiry* 14, 155-189 and 347-368.

Lippman, S.A. and McCall, J.J. (1979), *Studies in The Economics of Search,* North-Holland, Amsterdam.

Loikkanen, H.A. (1982), *Housing Demand and Intra-Urban Mobility Decision Search Approach,* Commentationes Scientiarum Socialium, 17, Fennica, Helsinki.

Loikkanen, H.A. and Pursiheimo, U. (1979), "On an Extended Model of Job Search, Department of Economics," University of Helsinki, Department of Economics, Discussion Papers No. 118.

Mortensen, D.T. (1986), Job Search and Labor Market Analysis, in: O. Ashenfelter and R. Layard (eds), *Handbook of Labor Economics, vol II,* North-Holland, Amsterdam, 849-919.

Rothschild, M. and Stiglitz, J. (1970), "Increasing Risk I: A Definition," *Journal of Economic Theory* 2, 225-243.

Stafford, F.P. (1977), "More on Unemployment Insurance as Insurance," *Industrial and Labor Relations Review* 30 521-526.

Topel, R. and Welch, F. (1980), "Unemployment Insurance: Survey and Extensions," *Economica* 47, 351-379.

Usategui, J.M. (1988), Finite Duration of Unemployment Insurance, Reservation Wages and Participation in the Job Market, Southern European Economics Discussion Series, No. 63.

Appendix. Comparative static results

Reservation utility

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

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

where the comparative static results can be solved:

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

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

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

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

$$(18) \qquad \frac{\delta u_{ij}}{\delta c_j} = 1 > 0$$

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

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

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). The translation is said to first order stochastically dominate F(u). Substituting the following useful transformation

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

and $F(u) = G(u + \mu)$ for (13) and noting that $E_G(u) = \mu + E_F(u)$ gives

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

where the effect of offer distribution on the reservation utility is solved

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

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

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

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

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

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

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

Search intensity

The technique of solving the effects on the search intensity is presented e.g. by Albrecht, Holmlund and Lang (1986). By the implicit function rule of differentiation the effect of the UI benefits is solved from (6)

$$(27) \qquad \frac{\delta s}{\delta b} = - \frac{\delta V_s}{\delta b} / \frac{\delta V_s}{\delta s},$$

where $\delta V_s/\delta s < 0$ by the second order condition of the optimal search intensity. Therefore it is needed to consider the sign of $\delta V_s/\delta b$, which is easily shown to be negative. The needed derivatives are

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

$$(29) \qquad \frac{\delta V_s}{\delta c} = - \frac{\delta V_s}{\delta b} > 0$$

$$(30) \qquad \frac{\delta V_s}{\delta c_i} = - \frac{\delta V_s}{\delta b} \Sigma a_{ij} > 0$$

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

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

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

Substituting the transformation (21) and $F(u) = G(u + \mu)$ for (6) and noting that $E_G(u) = \mu + E_F(u)$ gives

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

Differentiation gives

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

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

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

Differentiation gives

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

ELINKEINOELÄMÄN TUTKIMUSLAITOS (ETLA)
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
LÖNNROTINKATU 4 B, SF-00120 HELSINKI

Puh./Tel. (90) 609 900 Telefax (90) 601 753
Int. 358-0-609 900 Int. 358-0-601 753

KESKUSTELUAIHEITA - DISCUSSION PAPERS ISSN 0781-6847

No 348 VESA KANNIAINEN, Optimal Production of Innovations Under Uncertainty. 07.01.1991. 39 p.

No 349 KARI ALHO, Bilateral Transfers and Lending in International Environmental Cooperation. 16.01.1991. 24 p.

No 350 VESA KANNIAINEN, Yritysten rahoituspolitiikka: selvitys Suomen pörssiyhtiöistä 1983-87. 24.01.1991. 19 s.

No 351 MARI HARNI - JUKKA LASSILA - HEIKKI VAJANNE, Transformation and Graphics in ETLAs Economic Database System. 25.01.1991. 12 p.

No 352 JUHA KETTUNEN, Heterogeneity in Unemployment Duration Models. 31.01.1991. 22 p.

No 353 PENTTI VARTIA, Experiences from Growth and Transformation in the Post-war Period - The Country Study for Finland. 12.02.1991. 20 p.

No 354 VEIJO KAITALA - MATTI POHJOLA - OLLI TAHVONEN, An Analysis of SO_2 Negotiations between Finland and the Soviet Union. 18.02.1991. 17 p.

No 355 JUHA KETTUNEN, Transition Intensities from Unemployment. 27.02.1991. 24 p.

No 356 MARKKU KOTILAINEN, Exchange Rate Unions: A Comparison to Currency Basket and Floating Rate Regimes. 15.03.1991. 54 p.

No 357 SYNNÖVE VUORI, Returns to R&D in Nordic Manufacturing Industries, 1964 to 1983. 20.03.1991. 42 p.

No 358 VEIJO KAITALA - MATTI POHJOLA - OLLI TAHVONEN, A Finnish-Soviet Acid Rain Game: "Club Solutions", Noncooperative Equilibria and Cost Efficiency. 22.03.1991. 18 p.

No 359 JUHA KETTUNEN, Occupational Mobility of Unemployed Workers. 25.03.1991. 29 p.

No 360 JUSSI RAUMOLIN, Logistiikan näkymiä yhdentyvässä Euroopassa. 25.03.1991. 17 s.

No 361 MARKKU OLLIKAINEN, Kestävä kehitys - ongelmia ja tulkintoja. 08.04.1991. 24 s.

No 362 PEKKA ILMAKUNNAS, Working Time, Productivity and Labor Demand in Finnish Manufacturing. 22.04.1991. 40 p.

No 363 JUHA KETTUNEN, Time-Dependent Effects of Unemployment Benefits. 24.04.1991. 29 p.

No 364 GEORGE F. RAY, Long-Term Propsects for Industrial Materials. 30.04.1991. 45 p.

No 365 ROBERT HAGFORS - TOIVO KUUS, The Structure and Distribution of Income in Estonia and Finland. 07.05.1991. 30 p.

No 366 T.R.G. BINGHAM, The Foreign Exchange Market: Structure, Intervention and Liquidity. 10.05.1991. 29 p.

No 367 Elinkeinoelämän Tutkimuslaitoksen toiminta vuonna 1990. 24.05.1991. 30 s.

No 368 JUHA KETTUNEN, The Effects of Education on the Duration of Unemployment. 06.06.1991. 38 p.

No 369 ROBERT HAGFORS - ROLF MAURY, Suomalaisten kotitalouksien rakennekehityksen arviointia vuosille 1960-1985. 18.06.1991. 47 s.

No 370 VESA KANNIAINEN - JAN SÖDERSTEN, Undervaluation of Corporate Shares Revisited: A Note. 27.06.1991. 9 p.

No 371 MARKKU RAHIALA - TIMO TERÄSVIRTA, Forecasting the Output of Finnish Forest Industries Using Business Survey Data. 29.07.1991. 13 p.

No 372 MARKKU KOTILAINEN, Exchange Rate Unions: A Comparison to Currency Basket and Floating Rate Regimes - A Three-Country Model with Endogenous Prices. 29.07.1991. 47 p.

No 373 HEIKE HINDOV, On Population Development in Estonia and Finland. 20.08.1991. 47 p.

No 374 JUHA KETTUNEN, A Search Theoretical Analysis of the Finnish Unemployment Insurance System. 28.08.1991. 25 p.

No 375 JUHA KETTUNEN, Regional Mobility of Unemployment Workers. 28.08.1991. 19 p.

No 376 JUHA KETTUNEN, Työttömyysturvajärjestelmän vaikutukset työnetsintään: Tutkimusaineistokuvaus. 28.08.1991. 13 s.

Elinkeinoelämän Tutkimuslaitoksen julkaisemat "Keskusteluaiheet" ovat raportteja alustavista tutkimustuloksista ja väliraportteja tekeillä olevista tutkimuksista. Tässä sarjassa julkaistuja monisteita on rajoitetusti saatavissa ETLAn kirjastosta tai ao. tutkijalta.
Papers in this series are reports on preliminary research results and on studies in progress; they can be obtained, on request, by the author's permission.

E:\sekal\DPjulk.chp/28.08.1991