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THE EFFECTS OF EDUCATION ON THE DURATION OF UNEMPLOYMENT

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ABSTRACT: This paper studies the relationship between the level of education and re-employment probability. Using a search theoretical model it is shown that at first the education increases the re-employment probability, but later on the relationship turns negative. Using Finnish microeconomic data it is shown that the unemployed persons who have about 13-14 years of education have the highest re-employment probability.

KEY WORDS: Search theory, education, unemployment duration, unobserved heterogeneity.

1. Introduction

The role of education over the life cycle has been seen as an investment in human capital. In the theories of human capital it is usually assumed that the optimum amount of education is chosen to maximize life-time earnings or utility [e.g. Blinder and Weiss (1976)]. Empirical applications have been presented e.g. by Wolff and van Slijpe (1973), Willis and Rosen (1973), Garen (1984) and a replication of these studies by Oosterbeek (1990). Recently a paper by Groot and Oosterbeek (1990) studies the optimum amount of education and introduces a probability of becoming unemployed after school. There are other theories which support the argument that overeducation can be a long-lasting problem with negative effects on productivity [e.g. Spence (1973), Hartog (1981, 1986), Ducan and Hoffman (1981), Tsang and Levin (1985), Rumberger (1987) and Hartog and Oosterbeek (1988)].

The purpose of this study is to analyse the effects of education on the life-time utility and re-employment in the light of search theories. The optimal behaviour of an unemployed person is examined assuming a given level of education. It is shown that the effect of education on the value of life-time utility and the re-employment probability is not straightforward. Empirical evidence is presented using Finnish microeconomic data.

Assuming a finite search horizon it is evident that the time-path of the reservation utility is decreasing, which leads to an increasing hazard function. However, during the last few years the reservation utility is increasing and the hazard function is decreasing due to the lump-sum type of cost of re-employment. These theoretical findings are in accordance with the empirical evidence that the hazard function of an unemployed person is increasing and that elderly persons are apt to have serious problems in finding acceptable offers.

A higher level of education leads to a higher reservation utility, but the effect of education on the re-employment probability is analytically ambiguous. Numerical examples show that to some extent the probability of leaving unemployment increases when the level of education increases. The function subsequently becomes decreasing, however, since the possibility to get an acceptable offer decreases. Empirical evidence is in accordance with these theoretical results.

The remainder of this study is set out as follows. In section 2 the search theoretical model is presented, and in section 3 the numerical examples are presented. Section 4 includes the empirical evidence. A model of unemployment duration is estimated assuming that the effect of omitted variables can be taken into account using a discrete mass point distribution.

2. The effects of education in a search model

In this section a search theoretical model is developed to analyze the effects of education on the time-path of the value function, reservation utility and hazard function during the unemployment period are studied. Recent surveys in search theories can be found in Mortensen (1986) and Kiefer and Neumann (1989). It is assumed that the unemployed person evaluates job opportunities in terms of utility, which may include money and other characteristics. For simplicity the utility of an individual is assumed to be additively separable.
It is assumed that the individual's remaining time horizon is limited. It may be interpreted as an unemployed person's remaining time in the labour force from the beginning of his unemployment period. The search is assumed to take place during a unit of time dt after which the remaining search horizon is denoted as t.

While an unemployed person is searching for a job, he is assumed to get instantaneous utility b. Often b is taken to be identical to the received amount of unemployment benefits with other income net of searching costs.

The arrival rate of job offers a(s)dt are assumed to be relative to the length of search interval and depend on the level of education s. It is assumed that the arrival rate of offers is increasing and a concave function of education. Job opportunities rise with the length of schooling, as one can accept a job below the educational level but can not elicit a job offer above the educational level.

If an individual is unable to find a job within the local labour market area, an acceptable job may be found elsewhere. However, moving from an area of declining industries and high unemployment to a region with growing employment or changing occupation will also involve costs. It is assumed in the model that there are two kind of costs of re-employment which depend on the level of education. Some of the costs of re-employment are permanent. The permanent cost of re-employment c(s) are of a flow type. When an offer is accepted, the individual pays these costs daily. These costs may include travelling costs between home and work. Some of the costs of re-employment, e.g. the moving cost $c_m(s)$, may be of a lump-sum type. The costs are probabilistic and they are measured in terms of utility. It is assumed that c(s) and $c_m(s)$ are increasing and convex functions of the level of education.

Workers maximize the expected present value of the utility. The job search is undertaken during the interval dt. The value of the search can be written as follows

$$V(t+dt) = bB(dt) + a(s)dt \int_{u^*(t)}^{\bar{u}} [(u - c(s))B(t) - c_m(s)]dF(u,s)D(dt)$$

$$+ \{1 - a(s)dt[1 - F(u^*(t))]\}V(t)D(dt), \qquad (1)$$

where F is the distribution function of offers in terms of utility. It is assumed that the level of education shifts F to the right such that the new distribution function first-order stochastically dominates it. The first term of the value function V(t+dt) on the right hand side of (1) is the instantaneous utility during dt.

$B(dt) = [1 - \exp(-idt)]/i$ is the discount factor, where i is the subjective rate of time preference. The second term is the expected discounted utility related to an acceptable offer. The parameter $\bar{u}$ is the maximum attainable utility and $u^*(t)$ is the reservation utility at time t. Utility $u^*(t)$ is the endogenous variable of this model. Offers which are at least $u^*(t)$ are acceptable. B(t) discounts the expected utility related to an acceptable offer during the remaining search period [t,0). The third term is the expected discounted utility related to an unsuccessful search. $D(dt) = \exp(-idt)$ discounts the expected value of search apart from the instantaneous utility from t to t+dt.

By expansion $B(dt) = dt + o(dt)$, where o(dt) is the remainder term. The instantaneous utility of being unemployed is proportional to the length of the time interval dt. Correspondingly the discount factor of expected utilities $D(dt) = 1 - idt + o(dt)$. Substituting the discount factors in V(t+dt), forming the difference quotient $[V(t+dt)-V(t)]/dt$, taking the limits as dt approaches zero and rearranging the terms gives the differential equation of expected utility stream with respect to the time

$$v(t) = b - iV(t) + a(s) \int_{u^*(t)}^{\bar{u}} [(u - c(s))B(t) - c_m(s) - V(t)]dF(u,s). \tag{2}$$

After the active search period the search does not produce any expected utility. Solving from (1) the value function $V(t) = b/i$ during the passive search, which implies $v(t) = b - iV(t) = 0$.

The optimal reservation utility is a solution to a dynamic optimal control problem. Differentiating v(t) with respect the reservation utility $u^*(t)$ gives the necessary condition for the optimal reservation utility

$$u^*(t) = c(s) + [c_m(s) + V(t)]/B(t). \qquad (3)$$

Rewriting (3) the value function $V(t)=[u^*(t)-c(s)]B(t)-c_m(s)$, which means that the expected value of continuing a search, the value function, is equal to the utility of an acceptable offer minus the permanent loss of utility due to leaving unemployment discounted over the life-time net of the lump-sum type of moving cost.

Next the comparative dynamics are studied. The focus is on the effects of education with respect to the reservation utility and hazard function. The hazard function is defined as

$$h(t) = a(s)[1 - F(u^*(t),s)]. \qquad (4)$$

It is a product of the arrival rate of job offers and the probability that an offer is acceptable.

Derivation of comparative static results is complicated by the fact that the necessary conditions involve not only the endogenous and exogenous variables but also the value function. The reservation utility may be affected by education directly and indirectly via the change in the value function. The effects of education on the arrival rate of job offers, offer distribution and re-employment costs are assumed to be positive. Then the effects of education can be considered via the arrival rate, offer distribution and costs. The details of the calculations are presented in Appendix 1.

The effect of education via the arrival rate of job offers has an ambiguous effect on the hazard function. The direct effect is positive, since the number of occasions on which one is able to leave unemployment increases. The indirect effect via the reservation utility is negative because of the increased selectivity of the searchers. Recently, a number of papers have been written in which sufficient conditions are derived for the hazard function to be non-negative. A short survey is given by van den Berg (1990). However, this issue is beyond the scope of this paper.

To solve the effects of education via the offer distribution a translation of the distribution function F to the right is made so that $F(u,s) = G[u + \mu(s)]$, for all u and $\mu > 0$. The translation is said to first order stochastically dominate $F(u,s)$. The method has been used e.g. by Mortensen (1986). The result is that the increase in offer distribution increases both the reservation utility and hazard function.

The effects of education via the re-employment costs $c(s)$ and $c_m(s)$ are straightforward. The costs increase the reservation utility and decrease the re-employment probability.

Summarizing the effects of education on the reservation utility the following results are obvious. The reservation utility $u^*(t)$ is an increasing function of education via the arrival rate of job offers $a(s)$, offer distribution $F(u,s)$, permanent cost $c(s)$ and lump-sum type of cost of re-employment $c_m(s)$. The hazard function is an increasing function of education via the offer distribution and a decreasing function via the costs of re-employment. The effect via the arrival rate is analytically ambiguous.

The connection between search models and unemployment duration models is defined by the hazard function. The density function of unemployment durations can be written as follows

$$f(t) = h(t)\exp[- \int_0^t h(\tau)d\tau], \qquad (5)$$

which is the product of the hazard and survivor functions of unemployment durations.

3. Numerical examples

In order to illustrate the time-path of the value function, numerical examples of the reservation utility and hazard function are given for the model with a limited search horizon. Furthermore, the effect of education on these functions is studied. The search horizon is assumed to be 40 years, but of course the person can enter or exit unemployment at any time during this period. For simplicity the offer distribution is assumed to have a uniform distribution between $[\underline{u}, \bar{u}] = [5, 15]$. The assumption is used earlier e.g. in the studies of Loikkanen and Pursiheimo (1979) and van den Berg (1987).

The time-paths have been calculated in reverse order using a fact that at the end of search horizon $V(t) = b/i$. The arrival rate of job offers, offer distribution and re-employment costs are defined as follows

$$a(s) = as \tag{6a}$$

$$\underline{u}(s) = 0.5s + \underline{u}, \quad \bar{u}(s) = 0.5s + \bar{u} \tag{6b}$$

$$c(s) = cs \tag{6c}$$

$$c_m(s) = c_m s. \tag{6d}$$

The remaining parameter values used in the numerical example are as follows: $b = 2$, $a = 0.15$, $a = 0.05/12$, $c = 1$ and $c_m = 150$. In order to illustrate the time-paths of the value function, reservation utility and hazard function the level of education was set as e = 4.

Figure 1 includes the time-paths. The value of search is a decreasing function over time. When there are 8.5 years left in the labour force, the active search period is over and the passive search with the constant value function starts. The reservation utility is a decreasing function, but during the last years it is increasing because of the lump-sum type of moving cost. A high wage is needed to offset the moving cost. A decreasing function of reservation utility implies an increasing hazard. During the last years the reservation utility is higher than the highest attainable utility, and the hazard function is zero, since there are no acceptable offers.

In Figure 2 the effects of education have been studied at t = 480 months (40 years). The time paths have been calculated for the different levels of education and the values of V(t), $u^*(t)$ and h(t) have been drawn. It can be seen that there is an optimal level of investment in education for an unemployed person. The reservation utility is increasing over the level of education, as expected. The effect of education on the hazard function is interesting. First the hazard function is increasing, but later on it turns into a decreasing function. Using the uniform distribution it is straightforward to show that $\delta^2 h(t)/\delta s \delta s < 0$, i.e. the hazard function is concave. Since the reservation utility increases with the education, there are less acceptable offers for the highly educated unemployed persons.

Fig. 1. Time−paths of various functions

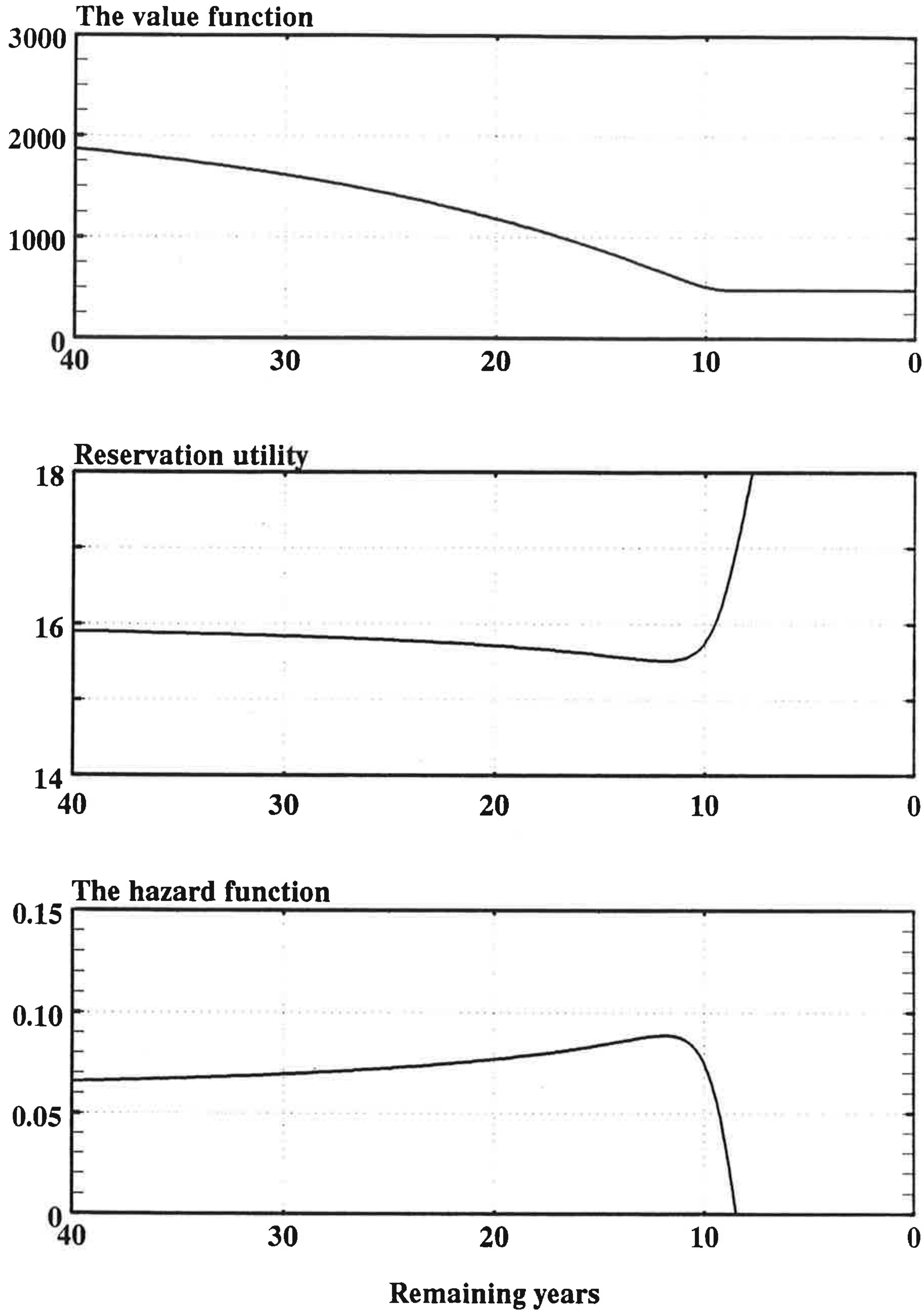
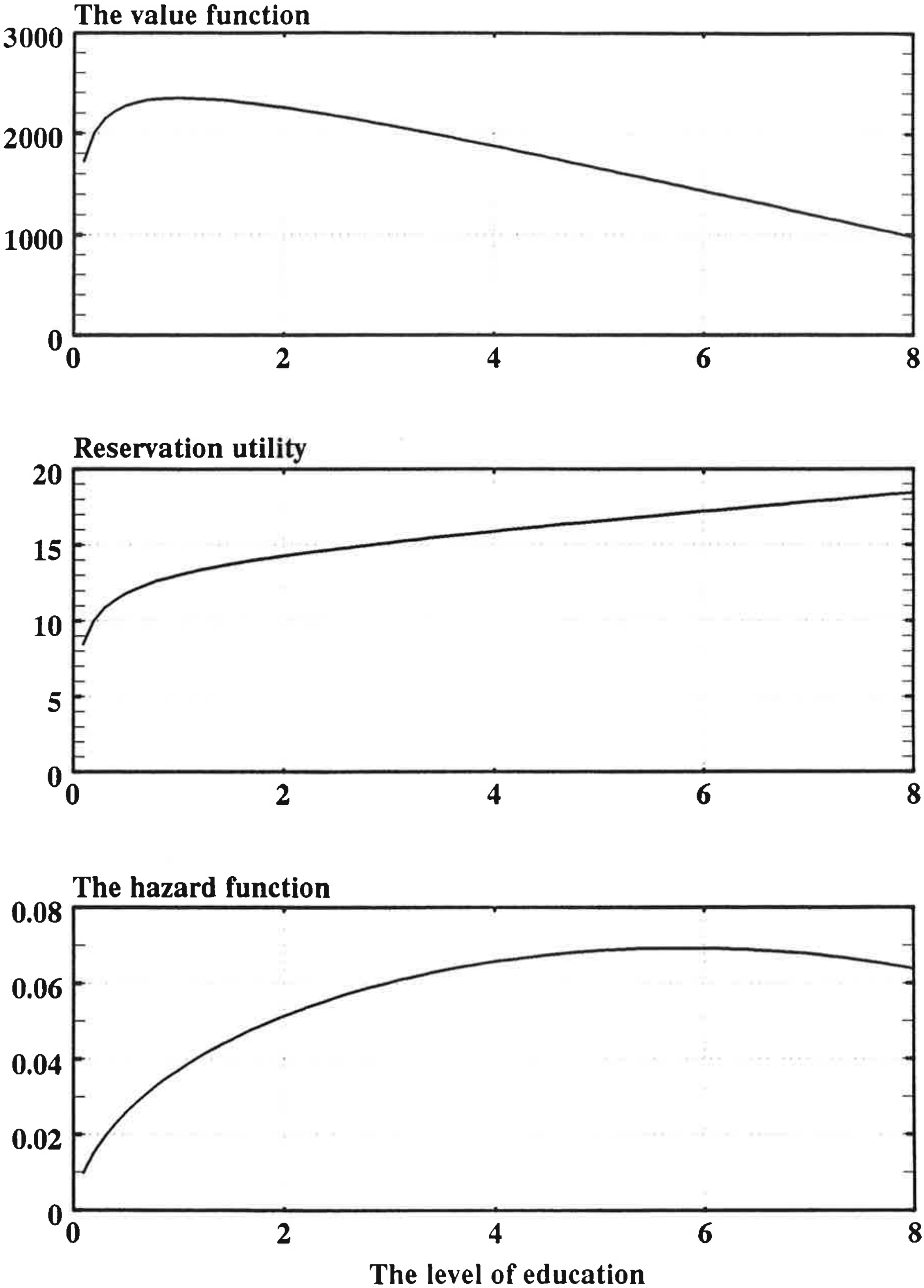


Fig. 2. The effects of education



4. Empirical evidence

In this section unemployment duration models are estimated using Finnish microeconomic data. It is shown that the persons with less than 9 years of education and, on the other hand, the persons with master's, licentiate or doctor's degrees have the lowest re-employment probabilities. A Weibull model of unemployment is estimated and a mass point approach to allowing for unobservable differences across persons is followed.

The data of 2077 Finnish unemployed persons has been taken from the register of the Ministry of Labour. The sample has been taken from the flow into unemployment during the year 1985 and the individuals have then been followed until the end of 1986. 40 % of the observations are right censored. A description of the variables of the models are presented in the Appendix of this paper.

Graphical methods are used to get an initial view on the effects of education on the duration of unemployment. Score plots are useful for detecting effects of omitted variables. One might hope that graphical analysis would aid in selecting an alternative specification of education variables. It is possible that the association between the scores and candidate-omitted variable in a scatter plot might indicate ways of remedying misspecification by alerting to the possibility of a non-linear effect for an omitted regressor. Furthermore, graphical procedures may be valuable in indicating whether departures are of operational significance. Sometimes it is possible to find evidence from misspecification not detected by formal test procedures.

Chesher and Irish (1987) have examined graphical methods for detecting omission of regressors for grouped or censored data in the context of normal linear models. Lancaster (1990) has derived the residuals of duration models using the scores of omitted variables. Graphical residual analysis can be informative about model misspecification, but some care is required in interpreting residual scatter plots derived from censored data. In this paper a graphical procedure allowing for censoring is based on the scores of candidate regressors.

The likelihood contribution can be written using the hazard h(t) and integrated hazard I(t) as follows

$$\ell = [h(t)u]^{c} e^{-I(t)u}, \tag{7}$$

where $u = \exp(z\phi)$ and c is the censoring indicator. The variable z is deliberately excluded from the model. A way of testing whether ϕ is not zero is to examine the variation in the log likelihood contribution $L = \log \ell$, when this parameter is allowed to depart from zero, in either direction. This suggests that a test for adding explanatory variables could be based on the scores $\delta L/\delta\phi$ at $\phi = 0$, which can be written

$$\delta L/\delta\phi = [c - I(t)]z. \tag{8}$$

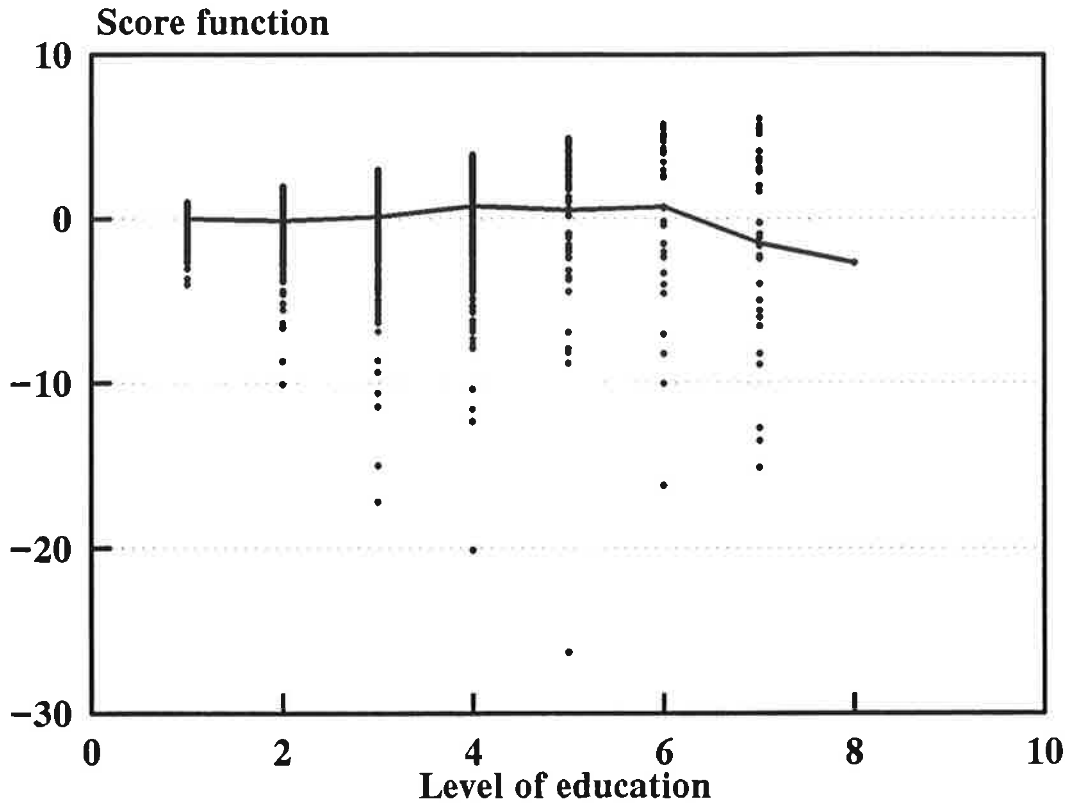
A graphical examination of the effect of the explanatory variable z can be obtained by plotting it against the scores.

The models of unemployment duration is presented in Table 1. The level of education, ranging from 1 to 8, has no statistically significant effect on the re-employment probability. Figure 1 plots the score function against education. Regressing the scores on the level of education yields a slope coefficient of 0.008 and intercept of -0.005, so that the regression is virtually a horizontal line. Joining up the average scores on each level of education gives the line drawn in Figure 1. The average scores suggests the possibility of a non-linear effect for this variable. Low levels of education seem to be associated with relatively low re-employment probabilities. High levels of education are also associated with relatively low re-employment probabilities and long unemployment durations.

Table 1. *Weibull models of unemployment duration*

	Std.errors in parentheses	
Shape parameter	0.861 (0.021)	0.861 (0.021)
Constant	-1.720 (0.132)	-1.695 (0.126)
Children	-0.009 (0.050)	-0.011 (0.050)
Married	0.153 (0.065)	0.154 (0.065)
Sex	-0.017 (0.056)	-0.015 (0.056)
Age	-0.040 (0.003)	-0.040 (0.003)
Level of education (1-8)	0.014 (0.022)	
Training for employment	0.174 (0.071)	0.170 (0.071)
Member of UI fund	0.199 (0.060)	0.198 (0.060)
Came from schooling	0.298 (0.080)	0.303 (0.080)
Came from house work	-0.717 (0.124)	-0.716 (0.125)
Regional demand	0.117 (0.236)	0.123 (0.235)
Occupational demand	0.752 (0.643)	0.943 (0.585)
Taxable assets	0.927 (1.078)	0.927 (1.076)
Replacement ratio	-1.240 (0.151)	-1.245 (0.151)
Log likelihood	-4967.8	-4968.0

Fig. 3. A score plot



The approach dispensing with the need to specify a parametric distribution for the heterogeneity component has its origins in the work of Kiefer and Wolfowitz (1956), who showed that a nonparametric characterization of the heterogeneity distribution ensures consistent estimation of simultaneously estimated structural parameters. Further work on the properties of mass point mixing distributions has been carried out by Simar (1976), Laird (1978), Lindsay (1983 a,b) and Heckman and Singer (1984 a,b). Applications of the mass point approach in the context of discrete choice models have been presented by Davies and Crouchley (1984), Dunn, Reader and Wrigley (1987), Davies (1987) and Card and Sullivan (1988). Applications to duration models have been presented by Brännäs (1986 a,b), Trussell and Richards (1987) and Ham and Rea (1987).

The idea of mass point models is that the constant parameter β_0 of the basic model is partitioned in m location parameters u_i and each of the location parameters is given a probability p_i. The vector of ones has been left out from the explanatory variables. In the case where m = 1, when there is one location parameter, the parameter u_1 is equal to the constant of the basic Weibull model β_0. Consequently, the likelihood function of mass point models reduces to the likelihood function of the basic Weibull model, and the model with one mass point and the basic Weibull model coincide.

Define the function $f_Q = \int_0^\infty f_u(t)dQ(u)$ to be the mixture density corresponding to a mixing distribution Q.

The densities f_u are atomic densities for each value of u. A convex combination of m elements of f_u can be written as $\Sigma\ p_i f_{u_i}$ with the restriction $\Sigma\ p_i = 1$. It is assumed that the density of heterogeneity has a particular functional form, namely the likelihood function has been specified so that there are m types of individuals in the sample not controlled by explanatory variables. The probabilities p_i are the shares of these groups, but it is not possible to distinguish between m types of individuals.

In the case of parametric duration models the mixing likelihood contribution can be written as

$$f_Q = \sum_{i=1}^{m} p_i h_i(t)^c e^{-I_i(t)}, \tag{9}$$

where $h_i(t) = \alpha t^{\alpha-1} e^{u_i+x\beta}$ and $I_i(t) = t^{\alpha} e^{u_i+x\beta}$ are the atomic hazard functions and integrated hazards and c indicates complete spells of unemployment. If c = 1 then t is a complete spell, otherwise c = 0. The objective is to estimate the discrete mixing distribution consistently with the atomic densities, a maximizer of the mixture likelihood function $\ell(Q) = \pi\ f_Q$. Maximizing the likelihood function $\ell(Q)$ over Q may be accomplished by maximizing the concave functional $L(f) = \Sigma \log f_Q$. The problem is equivalent to the maximization of a concave function subject to finitely many linear constraints.

To ensure that the probabilities $p_i \in (0,1)$ and sum to one the probabilities associated with each location have been defined using a multinomial logit type of formula

$$p_i = \frac{e^{g_i}}{1 + \sum_{k=1}^{m-1} e^{g_k}}, \quad i = 1,\ldots,m-1, \qquad (10)$$

where g_k, $k = 1,\ldots,m-1$ are parameters to be estimated. The probability of the last mass point is $p_m = 1-p_1-p_2-\ldots-p_{m-1}$. By definition $p_1 = 1$ when $m = 1$. The parameters g_k work only as a device, and they do not have an interesting economic interpretation in this context.

Following Lindsay (1983a) it can be seen that the log likelihood function $L(f) = \Sigma \log f_Q$ is differentiable with the directional derivative of L at L_{Q_0} towards L_{Q_1} being

$$D(u;Q) = \lim_{p\to 0} \{L[(1-p)f_{Q_0} + pf_{Q_1}] - L(f_{Q_0})\}/p$$

$$= \Sigma\ [(f_{Q_1} - f_{Q_0})/f_{Q_0}]$$

$$= \Sigma\ f_{Q_1}/f_{Q_0} - n, \qquad (11)$$

where it will be understood that the summing is over n observations. The main idea of the procedure is to increase the number of mass points until $D(u;Q) \leq 0$. Then the procedure is stopped and the semiparametric ML estimator is obtained. This procedure is suggested also by Brännäs and Rosenqvist (1988). Maximizing algorithms, e.g. the Berndt, Hall, Hall and Hausman (1974) algorithm, are directly applicable to the constrained problem of maximization over discrete mixtures Q with a fixed number of support points. A simple first order check for a global maximum is to verify that $D''(u^*; Q) \leq 0$ at the support points of measure Q. The values of function D of the models with 2,3,4 and 5 mass points are 2.04, 6.71, 3.88 and -3.84 respectively, showing that five mass points are enough to rectify the effect of omitted variables with this data set.

The results of estimations of mass point models are in Table 2. Models with two or more mass points produce increasing hazard functions. An increasing hazard function is in accordance with the search model with limited search horizon. The absolute values of statistically significant parameter estimates increase in most cases when more mass points are introduced into the model, as is to be expected.

The effects of education have been estimated using the lowest level of education, defined as less than 9 years of schooling, as the base for comparison. A higher level of education implies a higher hazard for the levels of education up to 13-14 years education. The result is statistically significant. On the other hand the re-employment probability turns decreasing for the persons with the lowest university degree. The persons with a master's, licentiate or doctor's degree have the lowest re-employment probability. The levels 6-8 do not statistically differ from the first level.

Many of the explanatory variables have significant effects on the re-employment probability. Age has a strong negative effect on the re-employment probability during the last years in the labour force as is expected by the search model. Training for further employment has a significant and positive effect on the re-employment probability. Members of the UI funds, i.e. members of the labour unions in the

Finnish system, are often skilled workers and therefore they become employed earlier than the non-members. The persons leaving school or the army usually have no great problems. They leave unemployment clearly earlier than the others. The persons who have come from house work find it very difficult to find a job. Regional demand increases the re-employment probability. The effects of unemployment benefits are measured using the benefit replacement ratio. The benefits decrease significantly the re-employment probability as is expected by the search theoretical models. The number of children, marriage, gender, occupational demand and taxable assets do not have statistically significant effects.

Table 2. *Mass point heterogeneity in a Weibull model*

Dependent variable: The length of the spell of unemployment	Number of mass points, std.errors in parentheses				
	m=1	m=2	m=3	m=4	m=5
Shape parameter	0.843	1.079	1.250	1.415	1.751
	(0.020)	(0.039)	(0.060)	(0.099)	(0.138)
Children	-0.036	-0.116	-0.101	-0.162	-0.145
	(0.051)	(0.069)	(0.082)	(0.097)	(0.118)
Married	0.005	-0.007	-0.116	-0.125	-0.126
	(0.065)	(0.091)	(0.101)	(0.119)	(0.144)
Sex	-0.086	-0.166	-0.116	-0.146	-0.163
	(0.057)	(0.080)	(0.092)	(0.108)	(0.132)
Age, 56-65 years	-2.051	-2.602	-2.931	-3.225	-3.921
	(0.244)	(0.255)	(0.280)	(0.342)	(0.441)
Education: Level 2	0.275	0.293	0.334	0.341	0.458
	(0.083)	(0.116)	(0.136)	(0.160)	(0.197)
Level 3	0.411	0.342	0.442	0.455	0.565
	(0.072)	(0.101)	(0.117)	(0.137)	(0.169)
Level 4	0.357	0.365	0.377	0.410	0.497
	(0.090)	(0.124)	(0.139)	(0.163)	(0.203)
Level 5	0.467	0.486	0.789	0.915	1.069
	(0.136)	(0.203)	(0.271)	(0.311)	(0.393)
Level 6	0.340	0.471	0.492	0.522	0.695
	(0.187)	(0.298)	(0.352)	(0.426)	(0.486)
Levels 7 and 8	-0.095	-0.379	-0.517	-0.638	-0.660
	(0.267)	(0.360)	(0.445)	(0.556)	(0.620)
Training for employment	0.184	0.288	0.340	0.422	0.479
	(0.072)	(0.103)	(0.122)	(0.143)	(0.176)
Member of UI funds	0.090	0.222	0.224	0.261	0.332
	(0.060)	(0.083)	(0.097)	(0.113)	(0.139)
Came from schooling	0.435	0.550	0.690	0.731	0.971
	(0.078)	(0.114)	(0.136)	(0.164)	(0.205)
Came from house work	-0.740	-0.807	-0.905	-1.067	-1.319
	(0.123)	(0.155)	(0.182)	(0.211)	(0.255)
Regional demand	0.140	0.339	0.514	0.674	1.030
	(0.235)	(0.303)	(0.360)	(0.416)	(0.510)
Occupational demand	0.159	-0.720	-0.693	-0.897	-0.774
	(0.653)	(0.921)	(1.048)	(1.256)	(1.546)
Taxable assets	-0.872	-1.834	0.595	-0.621	-2.414
	(1.009)	(1.209)	(1.564)	(1.719)	(2.083)
Replacement ratio	-1.281	-1.947	-2.457	-2.763	-3.667
	(0.149)	(0.212)	(0.266)	(0.346)	(0.453)
u_1	-2.620	-2.382	-1.993	-1.332	-0.471
	(0.128)	(0.171)	(0.214)	(0.319)	(0.358)
u_2		-4.500	-3.870	-3.081	-2.652
		(0.243)	(0.278)	(0.380)	(0.421)
u_3			-7.303	-4.746	-4.448
			(0.889)	(0.459)	(0.527)
u_4				-8.399	-6.310
				(1.101)	(0.628)
u_5					-10.245
					(1.175)
g_1		0.769	1.172	0.487	0.199
		(0.170)	(0.277)	(0.408)	(0.269)
g_2			1.597	1.346	-1.062
			(0.236)	(0.333)	(0.278)
g_3				1.318	-1.220
				(0.271)	(0.350)
g_4					-0.173
					(0.319)
p_1		0.683	0.352	0.159	0.080
p_2		0.317	0.539	0.376	0.227
p_3			0.109	0.366	0.330
p_4				0.098	0.270
p_5					0.093
Log likelihood	-4972.3	-4926.9	-4915.2	-4912.4	-4910.0

The survivor function of the model is obtained from the mixing likelihood contribution (9) by setting c = 0, which gives

$$S(t) = \sum_{i=1}^{m} p_i e^{-I_i(t)}. \quad (12)$$

Integrating the survivor function gives the expected value of unemployment spells $E(T;\theta)$, where $\theta = (\alpha, \beta, u_i, g_k)$, $i = 1...m$, $k = 1...m-1$. $E(T;\theta)$ can be written as a weighted average of the expected values of the m groups $E(T_i;\theta_i)$, $\theta_i = (\alpha, \beta, u_i)$, as follows

$$E(T;\theta) = \sum_{i=1}^{m} p_i E(T_i;\theta_i), \quad (13)$$

where

$$E(T_i;\theta_i) = (1/\alpha)e^{-(u_i+x\beta)/\alpha} \Gamma(1/\alpha). \quad (14)$$

Γ is the gamma function. The variance of $E(T;\theta)$ can be approximated by the delta method. The first order Taylor series expansion gives

$$E(T;\hat{\theta}) \approx E(T;\theta) + (\hat{\theta} - \theta)' \frac{\delta E(T;\theta)}{\delta\theta}, \quad (15)$$

The variance can then be written

$$\mathrm{Var}[E(T;\hat{\theta})] \approx \frac{\delta E(T;\theta)'}{\delta\theta}\mathrm{Var}(\hat{\theta})\frac{\delta E(T;\theta)}{\delta\theta}. \qquad (16)$$

A similar procedure gives the variances of $E(T_i;\theta_i)$, i=1...m. The expected duration of unemployment for the whole sample is 53.3 (2.7) weeks, where the standard error is in parentheses. The expected unemployment durations for the five groups are respectively 1.5 (16.1), 5.1 (15.8), 14.2 (14.7), 41.5 (12.1) and 388.5 (2.7) weeks. Long expected durations seem to have small standard errors. Table 3 includes the effects of education on the duration of unemployment calculated for an average person in the sample. It can be seen that the education has a strong effect on the duration of unemployment. The fifth level of education implies the shortest duration.

Table 3. *The effects of education on the unemployment duration*

Level of education	The effect of education in weeks*	Sdt.errors**
2	-14.8	6.6
3	-17.7	6.7
4	-15.9	6.6
5	-29.3	7.1
6	-21.0	9.1
7-8	+29.4	40.5

* The effects are compared to the first level of education

** $\sqrt{\mathrm{Var}\,E(T;\theta,\text{level }1) + \mathrm{Var}\,E(T;\theta,\text{each level})}$

5. Conclusions

In this study the effects of education on the re-employment probability were analyzed using a search model. It was shown that the effect of education on the re-employment probability is not straightforward. Using a model with a finite search horizon it was shown that the time-path of the reservation utility is decreasing, which leads to an increasing hazard function. However, during the latter years the reservation utility is increasing and the hazard function is decreasing due to the lump-sum type of cost of re-employment.

It was shown that there is an optimal level of education for a life-time income maximizing unemployed person. Furthermore, a higher level of education leads to a higher reservation utility. The re-employment probability increases over the lower levels of education. However, the possibility to get an acceptable offer decreases when the reservation utility increases with the education. With the highest levels of education the hazard function becomes decreasing.

The models of unemployment duration allowing for a discrete pattern of heterogeneity across unemployed individuals were estimated. Weibull models with mass point heterogeneity were estimated using Finnish microeconomic data. In the basic Weibull model the estimated value of the shape parameter was less than one indicating negative duration dependence. However, the absolute values of the parameter estimates increased substantially after allowing for heterogeneity and the hazard function turned increasing. An increasing hazard function is in concordance with the search models. Five mass points were enough to rectify the effects of omitted variables. According to the model the re-employment probability is low for the persons who are near the age of retirement.

According to the duration models the education has a positive effect on the re-employment probability up to about 13-14 years of education, but the unemployed persons with a master's, licentiate or doctor's degree have problems in finding acceptable offers. This result is in concordance with the search model.

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Appendix 1. Comparative static results: The effects of education on the reservation utility and hazard function

For simplicity the comparative static results have been derived in an infinite horizon model where $v(t) = 0$ and $B(t) = 1/i$. Since $\delta a/\delta s$, $\delta \mu/\delta s$, $\delta c/\delta s$ and $\delta c_m/\delta s$ are positive, it is needed to consider the effects of a, μ, c and c_m on the reservation utility and hazard function.

The effects of arrival rate of job offers

Applying the chain and implicit-function rules of differentiation to (3) and (2) gives the effect on the reservation utility

$$\frac{\delta u^*}{\delta a} = \frac{\delta u^*}{\delta V} \frac{\delta V}{\delta a}$$

$$= - \frac{\delta u^*}{\delta V} \frac{\delta v}{\delta a} / \frac{\delta v}{\delta V} > 0.$$

Consequently, the effect on the hazard function (4) is

$$\delta h/\delta a = [1 - F(u^*,s)] - af(u^*,s) \frac{\delta u^*}{\delta a} ,$$

where $f(u^*,s)$ is the density function of offers. Clearly $\delta h/\delta a$ has an ambiguous sign.

The distribution of offers

Substituting the following useful transformation

$$\int_{u^*}^{\bar{u}} [(u - c)/i - c_m - V]dF(u) = [E_F(u) - c]/i - c_m - V + \int_0^{u^*} F(u)du/i$$

into (2) gives v(t), which can be written as

$$0 = b - iV + a\{[E_F(u) - c]/i - c_m - V + \int_0^{u^*} F(u)du/i\}.$$

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

$$0 = b - iV + a\{[\mu + E_F(u) - c]/i - c_m - V + \int_0^{u^*} F(u - \mu)du/i\},$$

from which the effect of the offer distribution on the reservation utility level is solved by implicit differentiation. Denoting the right-hand side of the last equation by R, the effect of offer improvement on the reservation utility level is

$$\frac{\delta u^*}{\delta \mu} = \frac{\delta u^*}{\delta V}\frac{\delta V}{\delta \mu}$$

$$= - \frac{\delta u^*}{\delta V}\frac{\delta R}{\delta \mu} / \frac{\delta R}{\delta V}$$

$$= a[1 - F(u^* - \mu)f(u^* - \mu)]/(i+a) > 0.$$

The effect of an increase of the offer distribution μ on the hazard function (4) is

$$\frac{\delta h}{\delta \mu} = af(u^* - \mu)(1 - \frac{\delta u^*}{\delta \mu}) > 0,$$

since $\delta u^*/\delta\mu < 1$.

The costs of re-employment

The effect of c on the reservation utility can be written as

$$\frac{\delta u^*}{\delta c} = 1 + i \frac{\delta V}{\delta c}$$

$$= 1 - i \frac{\delta v}{\delta c} / \frac{\delta v}{\delta V}$$

$$= 1 - a[1 - F(u^*)]/\{i + a[1 - F(u^*)]\} > 0.$$

Clearly $\delta u^*/\delta c_m > 0$. The effects of c and c_m on the hazard function are clearly negative.

Appendix 2. Variables of the data

Duration of unemployment is calculated in weeks and it is the difference between the date of entry and the date of leaving unemployment. Mean = 15.03.

Number of children is the number of unemployed person's children who are younger than 18 years. Mean = 0.23.

Married is a dummy variable, 1 = yes. Mean = 0.37.

Sex is a dummy variable, 1 = male. Mean = 0.54.

Age, 56-65 years is a dummy variable and it is measured in years, 1 = yes. Mean = 0.05.

Level of education is a dummy variable, 1 = yes:

Level 1 = less than 9 years education. Mean = 0.368.

Level 2 = 9 years education. Mean = 0.174.

Level 3 = 10 - 11 years education. Mean = 0.245.

Level 4 = 12 years education. Mean = 0.152.

Level 5 = 13 - 14 years education. Mean = 0.028.

Level 6 = 15 years education. Lowest university degree. Mean = 0.017.

Level 7 = 16 years education. Master's degree. Mean = 0.015.

Level 8 = licentiate or doctor's degree. Mean = 0.0005.

The level of education is based on the education code of the Central Statistical Office of Finland.

Training for employment is a dummy variable, 1 = The person has got training for further employment. Mean = 0.15.

Member of UI fund is a dummy variable, 1 = yes. Mean = 0.42.

Came from schooling is a dummy variable, 1 = The person has come from schooling or from the army. Mean = 0.13.

Came from house work is a dummy variable, 1 = The person has come from home or elsewhere outside the labour force. Mean = 0.07.

Regional demand describes the regional rate of jobs available. It is the number of vacancies divided by the number of job seekers in the area. Mean = 0.10.

Occupational demand describes the occupational rate of jobs available in the whole country. It is the number of vacancies divided by the number of job seekers in the occupation group. Mean = 0.12.

Taxable assets has been compiled from the tax register and it is measured in millions of Finnmark. Mean = 0.011.

Replacement ratio is unemployed persons average replacement ratio of unemployment benefits during the unemployment period after tax. Weekly unemployment benefits after tax have been divided by the weekly income after tax. Mean = 0.17.

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