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REGIONAL MOBILITY OF UNEMPLOYMENT WORKERS

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ABSTRACT: This paper presents mover-stayer models of regional mobility in the labour market using microeconomic data. Duration models are used to analyze the probability of regional mobility since they contain more information than the discrete choice models. The models are based on a Gompertz distribution which takes into account the fact that some of the unemployed persons will not move to get a job. Using Finnish data it was estimated that about 90 % of the persons who become unemployed will not move to get a job.

KEY WORDS: Regional mobility, unemployment duration, mover-stayer models.

1. Introduction

This paper is concerned with the estimation of regional mobility of unemployed persons in the labour market using Finnish microeconomic data. The models of leaving unemployment have been widely studied in search theoretical and microeconometric literature. However, the important feature of leaving unemployment by moving to an other area of residence has not received notable attention. In this paper models of mobility are presented and estimated using statistical methods for survival data.

There are many empirical studies on the probability of regional mobility. Discrete choice models are more often used to analyze the determinants of mobility [e.g. Holmlund (1984), Borjas (1987), Falaris (1987), Hughes and McCormick (1987), Molho (1987), Boots and Kanaroglou (1988) and Pissarides and Wadsworth (1989)]. Our paper extends the previous studies by analyzing the regional mobility of unemployed persons. Regional mobility is a rather rare phenomenon in the labour market. Therefore the number of persons who move may be low. Duration models are used because they are more efficient than the discrete choice models. Exact duration times contain more information than the 0-1-valued variables.

The probability of leaving unemployment by moving to an other area of residence may be so low for some of the persons that they will not move. The proportions of these people are estimated from the data, where the completed spells of unemployment are not observed for all the observations. If some persons will not move, there is a special requirement for the survivor function. It should be defective, i.e. the survivor function should allow a possibility of asymptotically decreasing to a positive value instead of zero. A Gompertz distribution allows for the defectiveness and gives estimates for the proportion of persons who will not leave their area of residence. A Gompertz model of regional mobility is estimated using the microeconomic data.

In an econometric analysis relevant variables will often be omitted, either because they are unmeasurable or because their importance is unsuspected. It is well known that neglected heterogeneity biases the parameter estimates [Lancaster (1979), Nickell (1979)]. The purpose of this paper is to take the heterogeneity into account in estimation. A Gompertz model allowing for neglected heterogeneity is derived and estimated assuming that the effect of omitted variables has a gamma distribution across individuals.

2. Parametric duration models of unemployment

A general form of the duration model

A general form for the likelihood function of parametric duration models with censored data is presented before the parametrization of the distribution. The interest is on the duration of time from the date of entry into unemployment till the date of exit to employment by moving. Let us consider independent pairs of independent random variables T and Z, where T is the duration variable of primary interest and Z is a censoring variable. A censoring time or a duration time are observed as, $t = \min(T, Z)$, with the censoring indicator, $\bar{c} = 1$ if $T \geq Z$ and $c = 0$ otherwise. An indicator of a completed spell of unemployment is defined as $c = 1 - \bar{c}$.

Duration models are specified in terms of the hazard function $h(t)$, which is the conditional probability that the person moves at t given that he still is unemployed. The survivor function of T is the probability of being still unemployed to the duration t. It can be written as

$$S(t) = e^{-I(t)}, \qquad (1)$$

where $I(t)$ is the integrated hazard

$$I(t) = \int_0^t h(\tau)d\tau. \qquad (2)$$

The unconditional probability (density function) that an individual leaves unemployment by moving at t is a product of the hazard and survivor functions

$$f(t) = h(t)e^{-I(t)} \qquad (3)$$

for $t \geq 0$. The likelihood contribution of an individual can then be written in view of the above definitions as

$$L = h(t)^{c}e^{-I(t)}, \qquad (4)$$

which is a general form for the duration models with right censored data. The distribution of unemployment duration has to be specified, and to estimate the unknown parameters the hazard function and integrated hazard are substituted into the likelihood function (4).

A very seldom studied feature of unemployment spells is that unemployed persons leave the ranks of the unemployed in different ways. This study is interested in persons leaving unemployment by moving from their area of residence. These kinds of observations are complete observations. The time between the date of becoming unemployed and the date of leaving unemployment by moving is the duration variable of interest. Some of the persons leave unemployment by staying in their area of residence and some of them are lost in the follow-up. Furthermore, some of them will not return back to work. They may leave the labour force before the re-employment. The reasons for that may be retirement, unemployment pension or even death. These kinds of observations are censored observations, i.e. the complete spells of the duration variable of interest is not observed.

A usually applied specification is the proportional hazard model, where the hazard function $h(t) = h_0(t)h(x)$ factors into the product of a function of duration time t and a function of the regressors x. Function $h_0(t)$ is called the base-line hazard. The feature of unemployment spells that some of the persons will not move to get a job is allowed for using defective distributions. Such distributions are by no means worse than others, but it means that there is always mass in the survivor function regardless of how large the duration time is. A two state mover-stayer model is appropriate, since the interest is in the decision to move to another region and defective distributions allow for evaluating this phenomenon. Therefore it is reasonable to assume a Gompertz distribution, which is an extension of the exponential distribution.

The hazard function of the two parametric Gompertz distributions may be written as $h(t) = \phi\exp(t\theta)$. The base-line hazard is $h_0(t) = \exp(t\theta)$. The explanatory variables x are introduced into the model in a log-linear form $\phi = \exp(x\beta)$. The hazard function varies as an exponential function of time starting from ϕ. Analogically to biological studies the Weibull model has been used for modeling total mortality [e.g. Burch, Jackson, Fairpo and

Murray (1973)] and the Gompertz model for cause-specific mortality [e.g. Dix, Cohen and Flannery (1980)]. The integrated hazard can then be written as

$$I(t) = \int_0^t e^{x\beta + \tau\theta} d\tau + C. \tag{5}$$

The constant C is chosen such that I(0) = 0, then the integrated hazard of the Gompertz distribution can be written as

$$I(t) = e^{x\beta}(e^{t\theta} - 1)/\theta. \tag{6}$$

The survivor, density and hazard functions of the Gompertz distribution can be written as

$$S(t) = e^{-e^{x\beta}(e^{t\theta} - 1)/\theta} \tag{7}$$

$$f(t) = e^{x\beta + t\theta - e^{x\beta}(e^{t\theta} - 1)/\theta} \tag{8}$$

$$h(t) = e^{x\beta + t\theta}. \tag{9}$$

To write the likelihood functions and estimate the unknown parameters, the hazard function and integrated hazard are substituted into the likelihood function (4). For completeness the log likelihood functions which are maximized are presented. The likelihood function of the Gompertz model can be written as

$$L(\beta,\theta) = \sum_{i=1}^{n} c(x\beta + t\theta) - e^{x\beta}(e^{t\theta} - 1)/\theta. \qquad (10)$$

To see the shape of the survivor function of the Gompertz model, consider their limits as $t \to \infty$. If $\theta < 0$, then $\lim S(t) = \exp(\exp(x\beta)/\theta)$, and if $\theta > 0$, then $\lim S(t) = 0$. The limit of the survivor function gives an estimate for the proportion of individuals who will not move to get a job.

The elasticity of an explanatory variable x_j with respect to the hazard function can be written in logarithmic form as $\delta\log h(t)/\delta\log(x_{ij}) = x_{ij}\beta_j$, $i=1,...,n$, where n is the size of the sample. It can be seen that the elasticity depends both on the values of the parameter β_j and corresponding explanatory variable x_{ij}.

A Gompertz model allowing for gamma heterogeneity

It is inevitable that in an econometric analysis relevant variables will be omitted, either because they are unmeasurable or because their importance is unsuspected. Unobserved heterogeneity is widely discussed in the econometric literature. Lancaster (1979) assumed a parametric functional form for the pattern of heterogeneity. The gamma mixing distribution was chosen because it is analytically simple to use and it provides quite a flexible model for the distribution of the heterogeneity component. Lancaster found that the estimated parameters were biased if the unobserved heterogeneity was not controlled for. Even if the omitted variables are uncorrelated with those which are included in the model, the parameter estimates will be biased towards zero [Lancaster and Nickell (1980)]. The method of correcting for gamma heterogeneity has been widely used with exponential and Weibull duration distributions [e.g. Kooreman and Ridder (1983), Newman and McCulloch (1984), Narendranathan, Nickell and Stern (1985) and Engström and Löfgren (1987)]. In this paper the gamma heterogeneity assumption has been extended to the Gompertz distribution.

Suppose the individuals of the sample differ to some degree with respect to some unobservable variable, say, motivation v. Each individual has his own v_i and hence his own hazard function $h_i(t)$. Lancaster using data on a stock of unemployed persons assumed that these hazards have a gamma distribution. The conditional hazard in a Gompertz model allowing for gamma heterogeneity is

$$h(t|v) = v\, h(t), \tag{11}$$

where v has a gamma density

$$g(v) = \frac{\epsilon^{\mu}}{\Gamma(\mu)} v^{\mu-1} e^{-\epsilon v} \quad \text{with} \quad \Gamma(\mu) = \int_0^{\infty} w^{\mu-1} e^{-w} dw. \tag{12}$$

The expected value of the heterogeneity component $E(v) = \mu/\epsilon$ is normalized to one by setting $\epsilon=\mu$ and its variance, i.e. $\sigma^2 = 1/\mu$, is estimated.

The marginal survivor function, not conditional on v, is obtained by integrating over the assumed mixing distribution. The density function is obtained from the survivor function by differentiating $f(t) = -\delta S(t)/\delta t$ and the hazard function is obtained as a ratio $h(t) = f(t)/S(t)$. The Gompertz distribution allowing for unobserved gamma heterogeneity across individuals gives the following survivor, density and hazard functions

$$S_g(t) = [1 + \sigma^2 I(t)]^{-1/\sigma^2} \qquad (13)$$

$$f_g(t) = h(t)[1 + \sigma^2 I(t)]^{-1/\sigma^2-1} \qquad (14)$$

$$h_g(t) = h(t)[1 + \sigma^2 I(t)]^{-1}, \qquad (15)$$

where $I(t)$ is the integrated hazard of the original Gompertz distribution (6). The integrated hazard with gamma heterogeneity can be written as $I_g(t) = -\log[S_g(t)]$, which can be rewritten in an other form as follows

$$I_g(t) = 1/\sigma^2 \log[1 + \sigma^2 I(t)]. \qquad (16)$$

The integrated hazards $I(t)$ and $I_g(t)$ are the generalized residuals of these models in the sense of Cox and Snell (1968).

To write the likelihood functions and estimate the unknown parameters, the hazard function and the integrated hazard are substituted into the likelihood function (4). Then the log likelihood function of the Gompertz model with gamma heterogeneity can be written as

$$L(\beta,\theta)= \sum_{i=1}^{n} c(x\beta + t\theta) - (c + 1/\sigma^2)\log[1 + \sigma^2 e^{x\beta}(e^{t\theta} - 1)/\theta]. \tag{17}$$

Consider the limits of survivor functions after allowing for gamma heterogeneity as $t \to \infty$. If $\theta < 0$, then $\lim S_g(t) = [1 - \sigma^2 e^{x\beta}/\theta]^{-1/\sigma^2}$, and if $\theta > 0$, then $\lim S_g(t) = 0$.

3. Empirical findings

Retrospective data can be misleading because people forget and make mistakes. Therefore the data on 2077 Finnish unemployed persons used in this study has been taken from the register of the Ministry of Labour. It is more reliable than the data from surveys. In order to guarantee that the sample would be randomly generated, every hundredth individual was picked from the flow into unemployment during 1985. The individuals were then followed until the end of their unemployment spells but at most until the end of 1986. The re-employment by moving is a rather rare phenomenon. About 97 % of the observations are censored. In censored cases it is not known whether the persons have moved or not. A discrete choice model would in this case be clearly be inappropriate. A duration model is more reasonable since the exact durations contain more information than the 0-1-valued variables. However, the data enables to estimate only rather parsimonious models. The data set includes individual and market specific information. The description of the variables with their means are presented in the Appendix and reference for further details regarding the data should be made to Kettunen (1989, 1990). Regions consist of one or more communes and they are whatever the Finnish Ministry of Labour uses.

The results of estimations are presented in Table 1. The parameter estimate of duration dependence θ is negative indicating that the hazard function is falling and that the survivor function is asymptotically decreasing to a positive value. Hence some of the persons will not move to get a job. When gamma heterogeneity is introduced into the model the negative duration dependence decreases as expected. Another implication of the negativeness of θ is that the expected value of the duration for the sample is not defined, because some persons do not move. This fact has been noted by Broadbent (1958) and Lee (1980). The constant of the model, where the effect of omitted variables is captured, decreases and the absolute values of the statistically significant parameter estimates increase when gamma heterogeneity is introduced into the model as was expected.

Table 1. Gompertz models of regional mobility

(A) A Gompertz model
(B) A Gompertz model with gamma heterogeneity

	(A)	(B)
	Std.errors in parentheses	
Duration dependence, θ	-0.024	-0.010
	(0.013)	(0.018)
Variance of the heterogeneity, σ^2		37.655
		(29.180)
Constant	-3.540	-3.353
	(0.537)	(0.698)
Age	-0.053	-0.059
	(0.022)	(0.026)
Member of labour union	-1.378	-1.515
	(0.461)	(0.494)
Regional demand	-1.941	-2.387
	(1.446)	(1.637)
Occupational demand	2.761	-3.692
	(3.111)	(3.449)
Replacement ratio	-5.185	-5.731
	(0.959)	(1.025)
Mean $x\beta$	-6.489	-6.583
Log likelihood	-333.3	-332.9

Some of the explanatory variables have significant effects on the probability of moving. Age is a statistically significant factor. Old people are less flexible in leaving their area of residence. With substantial amounts of human capital older workers will have a narrow choice set of alternative jobs available. The incentives for moving may consequently be quite restricted. Young workers, on the other hand, have a broad choice set of jobs available. The incentives for job search are therefore likely to be stronger for young workers. Members of the labour unions are often skilled workers and therefore they are less prone than the non-members to accept an offer outside their area of residence.

The demand for labour in the area of residence of unemployed persons seems to decrease the probability of moving, and the occupational demand in the whole country seems to increase the probability of moving. However, the demand effects are not statistically significant.

It could be hypothesized that by increasing the reservation wage, UI benefits therefore reduce the search intensity and probability of moving. The effects of unemployment benefits are measured using the benefit replacement ratio. The parameter estimate of the replacement ratio took a negative sign, as expected, and the effect is rather strong and statistically very significant. From a policy viewpoint it may be of interest to see whether an increase in unemployment benefits has any influence on the probability of moving. The increase of the replacement ratio of an average person for example by 1 % will decrease the probability by 0.88 and 0.97 % in these two models.

It is well known that uncontrolled unobservables bias the estimated hazards towards negative duration dependence [e.g. Heckman and Singer (1984, 1986)]. Consequently it could be expected that after allowing for gamma heterogeneity the estimates of survivor functions would be lower. The estimate of the proportion of persons who do not move is 0.94, and after allowing for gamma heterogeneity the corresponding proportion is 0.90.

4. Concluding remarks

A Gompertz model of regional mobility of unemployed persons was estimated using Finnish microeconomic data. Completed spells are not observed for all the observations in the data. The model takes into account the censored observations and the feature of unemployment spells that for some of the persons the probability of leaving unemployment by moving is so low that they will not move. The model gives an estimate of the proportion persons who will not move. The proportion of these persons given by a Gompertz model is 0.94.

Even though the data is more reliable than data from surveys, there is reason to assume that relevant variables have been omitted from the model. Neglected heterogeneity across individuals was taken into account in estimation. A Gompertz model allowing for gamma heterogeneity was derived and estimated assuming that the effect of omitted variables has a gamma distribution across individuals.

Comparing the results of the two models shows that the model without correcting for heterogeneity gives lower estimates of parameters. The absolute values of parameter estimates increase when heterogeneity is introduced into the model. Furthermore, the Gompertz model gives estimates for the hazard function that are too low. Consequently, the survivor function of the model with gamma heterogeneity is lower. As a final estimate based on the correction for omitted variables it can be said that 90 % of the persons who become unemployed will not move to get a job.

Some of the explanatory variables have statistically significant effects on the probability of leaving unemployment by moving. Younger people and non-members of the labour unions are more apt to move. The demand for labour in the area of residence of unemployed persons seems to decrease, and the occupational demand in the whole country seem to increase the probability of moving. The replacement ratio of unemployment benefits has a strong negative effect. The final estimate of the elasticity of the replacement ratio with respect to the probability of moving is -0.97.

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Data appendix

Duration of unemployment is calculated in weeks and it is the difference between the date of entry into unemployment and the date of returning back to work. Mean = 15.03.

Age is measured in years. Mean = 31.2.

Member of labour union is a dummy variable, 1 = yes. Mean = 0.42.

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.

Replacement ratio is unemployed persons average replacement ratio of unemployment benefits during the unemployment period after tax. Average weekly unemployment benefits after tax have been divided by the average weekly income after tax in 1985. Mean = 0.17.

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