

Bijwaard, Govert E.

Working Paper

Modelling the time on unemployment insurance benefits

IZA Discussion Papers, No. 2936

Provided in Cooperation with:

IZA – Institute of Labor Economics

Suggested Citation: Bijwaard, Govert E. (2007) : Modelling the time on unemployment insurance benefits, IZA Discussion Papers, No. 2936, Institute for the Study of Labor (IZA), Bonn

This Version is available at:

<http://hdl.handle.net/10419/34548>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

IZA DP No. 2936

Modelling the Time on Unemployment Insurance Benefits

Govert E. Bijwaard

July 2007

Modelling the Time on Unemployment Insurance Benefits

Govert E. Bijwaard
*Erasmus University Rotterdam
and IZA*

Discussion Paper No. 2936
July 2007

IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

Any opinions expressed here are those of the author(s) and not those of the institute. Research disseminated by IZA may include views on policy, but the institute itself takes no institutional policy positions.

The Institute for the Study of Labor (IZA) in Bonn is a local and virtual international research center and a place of communication between science, politics and business. IZA is an independent nonprofit company supported by Deutsche Post World Net. The center is associated with the University of Bonn and offers a stimulating research environment through its research networks, research support, and visitors and doctoral programs. IZA engages in (i) original and internationally competitive research in all fields of labor economics, (ii) development of policy concepts, and (iii) dissemination of research results and concepts to the interested public.

IZA Discussion Papers often represent preliminary work and are circulated to encourage discussion. Citation of such a paper should account for its provisional character. A revised version may be available directly from the author.

ABSTRACT

Modelling the Time on Unemployment Insurance Benefits^{*}

A duration model based on the time on Unemployment Insurance (UI) benefits instead of a model based on the time till re-employment is more relevant from a cost-benefit perspective. The contribution of this paper is to extend the standard (mixed) Proportional Hazard model to account for an upper bound on the duration. We use a modified mover-stayer model to this end and discuss the interpretation of the parameters. In an empirical application we compare the method with the standard analysis of unemployment duration. We also derive the expected UI-benefit costs implied by the model for some typical unemployed individuals.

JEL Classification: C41, J64, J65

Keywords: UI-benefits, maximum duration, mixed proportional hazard, mover-stayer model

Corresponding author:

Govert E. Bijwaard
Econometric Institute
Erasmus University
P.O. Box 1738
3000 DR Rotterdam
Netherlands
E-mail: bijwaard@few.eur.nl

^{*} This research is financially supported by the Netherlands Organisation for Scientific Research (NWO) nr. 451-04-011

1 Introduction

Many empirical studies on unemployment duration use administrative data. Very often a limitation of these data is that the unemployed are only observed while receiving Unemployment Insurance (UI) benefits. The common solution to this problem is to take the observations that end with benefit exhaustion as censored observations. This implies that the duration of interest is the time to the next job. However, the duration of benefit receipt is of more interest for computing direct program costs. Then, the upper bound of the benefit duration should be taken into account.

The contribution of this paper is to extend the standard (mixed) Proportional Hazard model to account for an upper bound on the duration. We use a modified mover-stayer model to this end and discuss the interpretation of the parameters. In an empirical application we compare the method with the standard analysis of unemployment duration. We also derive the expected UI-benefit costs implied by the model for some typical unemployed individuals.

2 Maximum duration in a duration model

In duration analysis the hazard rate or intensity is usually modelled. A common way to accommodate the presence of observed characteristics is to specify a proportional intensity model, see a.o. Lancaster (1990)

$$\lambda(t|x) = \lambda_0(t)e^{\beta'x_i},$$

where $\lambda_0(t)$ represents the baseline hazard, that is, the duration dependence of the intensity common to all individuals. The covariates affect the intensity proportionally.

Suppose that the duration of each individual has an, individual specific, upper bound of \bar{t}_i , say the maximum number of weeks an individual is eligible for UI-benefits. If a non-zero, albeit unknown, percentage p of the individuals reach their upper bound, the survival conditional on not have reached the maximum duration is (for $0 \leq t \leq \bar{t}_i$)

$$S(t|\bar{t}_i, x_i) = p + (1 - p) \frac{\exp(-\int_0^t \lambda_0(s)e^{\beta'x_i} ds) - \exp(-\int_0^{\bar{t}_i} \lambda_0(s)e^{\beta'x_i} ds)}{1 - \exp(-\int_0^{\bar{t}_i} \lambda_0(s)e^{\beta'x_i} ds)} \quad (1)$$

Thus a fraction of $1 - p$ the individuals will make a transition before their maximum duration is reached. This is an extension of a so-called mover-stayer or ‘split-population’ model that accounts for an upper bound in the duration. The mover-stayer approach was first applied in the social sciences to model the recidivism of criminals by Schmidt and Witte (1989). It assumes that a latent group of individuals have a zero probability to make a transition, the *stayers*. Here the stayers are those individuals that reach their upper bound on the duration.

If we do not account for possible missing variables, the parameter estimator may be biased. It may lead to spurious negative duration dependence. Therefore, it is important to allow for individual-specific unobserved heterogeneity in the model. The conventional way to capture this effect is to include a multiplicative random variable in the hazard to get a mixed proportional hazard model with hazard

$$\lambda(t|v_i, x_i) = v_i \lambda_0(t) \exp(\beta' x_i(t)), \quad (2)$$

where the $v_i > 0$ are i.i.d. random variables with (mixture) distribution function $G(v)$. The Gamma distribution with mean one and variance σ^2 is most often chosen to represent the unobserved heterogeneity.

The latent probability of reaching the maximum duration lays between zero and one and can be modelled in a logit form and it can depend on observed characteristics of the individuals, $p(x_i) = e^{\gamma' x_i} / (1 + e^{\gamma' x_i})$. The density of observed UI-benefit duration is now a mixture of a discrete distribution, the probability of reaching the upper bound, and a continuous distribution, the probability to leave the UI-system before benefit exhaustion, i.e.

$$f(t|\bar{t}_i, x_i) = \begin{cases} 1 & t = \bar{t}_i \\ \frac{e^{\beta' x_i} \lambda_0(t) \left[1 + \sigma^2 \Lambda(t|x_i)\right]^{-\left(\frac{1}{\sigma^2} + 1\right)}}{1 - \left[1 + \sigma^2 \Lambda(\bar{t}_i|x_i)\right]^{-1/\sigma^2}} & t < \bar{t}_i \end{cases} \quad (3)$$

where $\Lambda(t|x_i) = \int_0^t \lambda_0(s) e^{\beta' x_i} ds$. A very flexible assumption is to use a baseline hazard that is constant on M intervals. Let the intervals $I_m(t) = I(d_{m-1} \leq t < d_m)$ for $m = 1, \dots, M$ with $d_0 = 0$ and $d_M = \max_i \{\bar{t}_i\}$ be the intervals on which we define the baseline hazard. Then, the baseline hazard is $\lambda_0(t) = \sum_{m=1}^M e^{\alpha_m} I_m(t)$. The parameters of the model can be obtained

by standard maximum likelihood procedures. Note that the parameters of the probability of reaching the upper bound can be estimated solely based on a logit analysis of benefit exhaustion.

The interpretation of the parameters is not as clear as in the standard (M)PH model. Although conditional on being a mover, somebody who leaves the UI-system before benefit exhaustion, the hazard rate still exhibits the multiplicative structure, the unconditional hazard is non-linear in its components. However, in a cost-benefit analysis of the UI-system the expected costs per unemployment individual has a more relevance than the impact on the hazard rate out of UI-benefits. Given the estimated parameters the expected UI-duration is

$$\begin{aligned}
E[T|\bar{t}_i, x_i] &= p(x_i)\bar{t}_i + \frac{1 - p(x_i)}{1 - \left[1 + \sigma^2 e^{\beta' x_i} \sum_{m=1}^M e^{\alpha_m} (d_m - d_{m-1})\right]^{-1/\sigma^2}} \\
&\times \left\{ \sum_{m=1}^M \frac{e^{-\alpha_m - \beta' x}}{1 - \sigma^2} \left(\left[1 + \sigma^2 e^{\beta' x_i} \sum_{j=1}^{m-1} e^{\alpha_j} (d_j - d_{j-1})\right]^{-\frac{1}{\sigma^2} + 1} - \left[1 + \sigma^2 e^{\beta' x_i} \sum_{j=1}^m e^{\alpha_j} (d_j - d_{j-1})\right]^{-\frac{1}{\sigma^2} + 1} \right) \right. \\
&\quad \left. - \bar{t}_i \left[1 + \sigma^2 e^{\beta' x_i} \sum_{m=1}^M e^{\alpha_m} (d_m - d_{m-1})\right]^{-1/\sigma^2} \right\} \quad (4)
\end{aligned}$$

and it is straightforward to derive the marginal effect, $\partial E[T|\bar{t}_i, x]/\partial x$, at a given covariate vector. For a cost-benefit analysis one can either calculate the money value of the expected time on UI-benefits or calculate the marginal effect in money value.

3 Empirical Application

Between mid-1984 and mid-1985, the Illinois Department of Employment Security conducted a controlled social experiment.¹ In the experiment, newly unemployed claimants were randomly divided into three groups: a *Claimant Bonus Group*, a *Employer Bonus Group* and, a *control group*. For the purpose of the present analysis we focus on the members of the control group. The sample contains 3641 individuals who start a new unemployment spell during the period. We have information on a limited set of explanatory variables: age, pre-unemployment earnings, race, gender and weekly benefit level (and dependence allowance).

¹A complete description of the experiment and a summary of its results can be found in Woodbury and Spiegelman (1987).

The central data base is an administrative source that only observes the unemployed while they receive UI-benefits. If an individual exhausts UI-benefits, the labor market status of that individual is unknown. At that time the maximum duration of receiving UI-benefits in Illinois was 26 weeks. Thus, the duration on UI-benefits has an upper bound of 26 weeks. Table 1 presents the estimation results and Figure 1 the unconditional ‘baseline’ hazard, the hazard for the reference individual. Note that in the model for UI-benefit duration the baseline hazard conditional on being a mover(only in this case equal to $\lambda_0(t)$) implies a positive duration dependence while the unconditional hazard exhibits a negative duration dependence.

Table 1: Parameter estimates of MPH hazard model with and without maximum duration.

	Standard MPH	Maximum duration	
	hazard	hazard	Prob. exhaust benefits
	β	β	γ
age	-0.152** (0.031)	-0.042 (0.051)	0.225** (0.048)
age-squared	0.066* (0.029)	0.066 (0.049)	-0.100* (0.044)
Log Base Period Earnings	0.318** (0.063)	0.124 (0.106)	-0.477** (0.097)
black	-0.538** (0.057)	-0.201* (0.098)	0.735** (0.078)
male	0.116* (0.046)	-0.003 (0.078)	-0.191** (0.070)
Log Weekly benefits	-0.501** (0.106)	-0.288 (0.187)	0.747** (0.163)
constant			-0.198** (0.064)
<i>baseline hazard</i>			
α_1 (0 to 2 weeks)	-3.222** (0.070)	-3.002** (0.098)	
α_2 (2 to 10 weeks)	-3.376** (0.051)	-2.256** (0.091)	
α_3 (10 to 20 weeks)	-3.684** (0.056)	-1.692** (0.167)	
α_4 (20 to 22 weeks)	-3.470** (0.100)	-0.402 (0.264)	
α_5 (22 to 24 weeks)	-3.432** (0.101)	0.055 (0.315)	
α_6 (24 to 26 weeks) ^a	-3.336** (0.100)	1.700** (0.398)	
$\ln(\sigma^2)$	-15.426 446.563	-0.269 (0.230)	
Log-likelihood	4774.930	-8654.748	

^a In the standard MPH model the last interval is 24 weeks till ∞ .

Notes: Standard errors are shown in parentheses. * $p < 0.05$; ** $p < 0.01$

From the implied expected duration in UI-benefits it is straightforward to calculate the expected UI-costs for any individual. Table 2 shows the expected cost of UI-benefits payments for some typical unemployed individuals.

Table 2: Expected UI costs

	UI weekly benefit			
	\$126.50	\$51	\$161	\$209
base	\$2230	\$735	\$2974	\$4045
black	\$2621	\$903	\$3447	\$4616
male	\$2141	\$704	\$2861	\$3901
age = 20	\$1956	\$634	\$2627	\$3605
age = 40	\$2281	\$754	\$3038	\$4125
base Period Earnings = \$1533	\$2360	\$787	\$3135	\$4244
base Period Earnings = \$4267	\$2089	\$683	\$2796	\$3820

A base individual is a white female aged 33 with \$126.50 weekly benefit and base period earnings of \$2511.

4 Further Research

Another application of the described model is the (cost-benefit) analysis of disability benefits. In most Western countries disability benefits cease after retirement. In fact, everybody leaves the potential workforce when reaching the retirement age. An issue hardly ever mentioned in the analysis of labour market transitions is that for some individuals labour market transitions occur at a very low rate. Therefore, these individuals may stay on disability benefits till they reach the retirement age of 65. This implies that the duration on disability has a upper bound of the time till retirement. Bijwaard and Veenman (2007) apply this argument to model the duration on disability benefits for different ethnic groups in The Netherlands.

References

- Bijwaard, G. E. and J. Veenman (2007). Unequal chances on the transitional labour market, The case of the Netherlands. Discussion Paper No. 2908, IZA.
- Lancaster, T. (1990). *The Econometric Analysis of Transition Data*. Cambridge University Press.

Schmidt, P. and A. D. Witte (1989). Predicting criminal recidivism using ‘split population’ survival time models. *Journal of Econometrics* 40, 141–159.

Woodbury, S. A. and R. G. Spiegelman (1987). Bonuses to workers and employers to reduce unemployment: Randomized trials in Illinois. *American Economic Review* 77, 513–530.

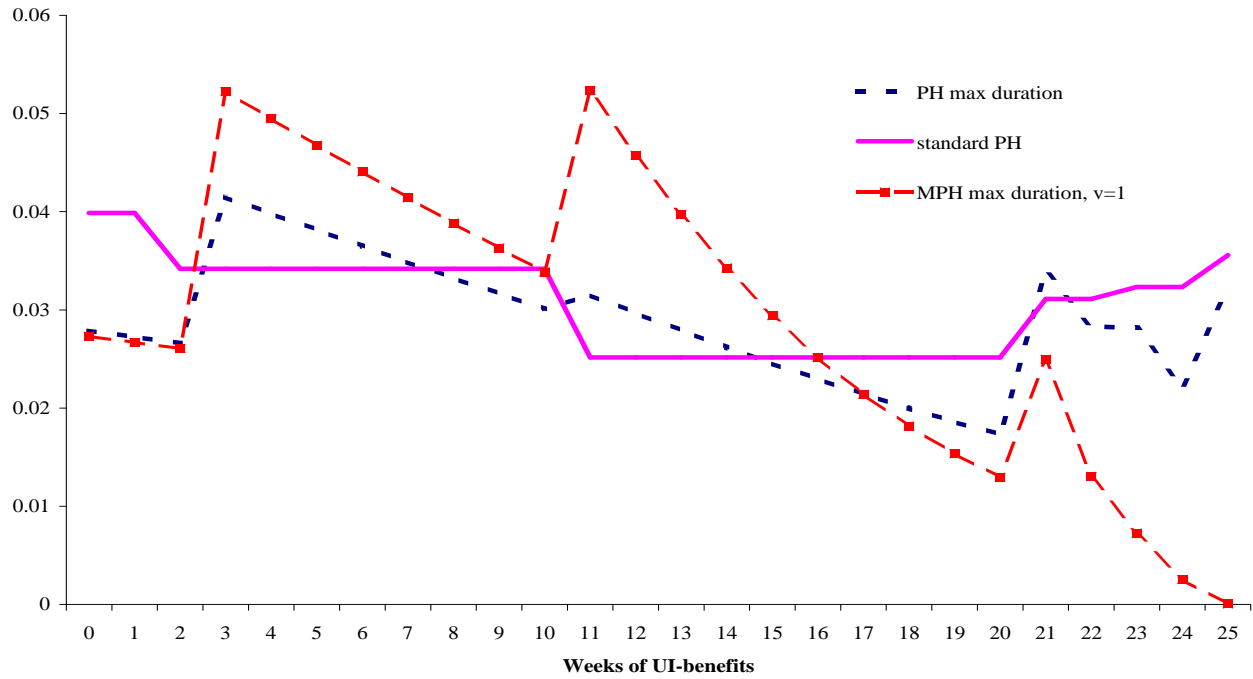


Figure 1: Estimated baseline hazard.