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Abstract

The notion of contiguous duration dependence is defined and illustrated with a simple nonstationary job search model where unemployment spell and accepted job spell durations are stochastically related through reemployment earnings. The distribution of both reemployment earnings and accepted job durations are analyzed jointly with completed unemployment duration using parametric and semi-parametric techniques.

Keywords: Unemployment Duration, Job Duration, Job Search, Reemployment Earnings.

1 Introduction

The estimation of nonstationary economic models explaining the behavior of unemployed individuals seeking reemployment opportunities has raised an enormous interest in recent years.[1] In particular, the time variation in unemployment benefit has been widely studies both theoretically and empirically. It is well known that when individuals claim UI benefit for a limited period only, their reservation wage decline until benefit termination and individuals escape unemployment at an increasing rate. Mortensen (1990) shows that, in a short period before exhaustion, the reservation wage may fall sharply.[2] Meyer (1990) and Hausman (1990) have found a clear presence of spikes in the escape rate out of unemployment when benefit lapse. However, given that these studies make use of duration data solely, it is virtually impossible to infer whether spikes are explained by variations in search efforts as opposed to changes in reservation wages. The primary objective of this paper is to remove this oversight.

Thsi paper proposes an analysis of the consequence of nonstationarity from an angle which has, so far, been ignored in the literature. The empirical analysis is based on the idea that nonstationarity in reservation wages creates a detectable dependence between the completed duration of unemployment and reemployment earnings. The nonstationarity retained in this paper is induced by finite UI benefit entitlement period. By allowing for the possibility of search activities upon reemployment, nonstationarity in reservation wages creates a statistical relationship between completed unemployment duration and accepted job duration which I call "contiguous duration dependence". It has similarities with the notion of "lagged duration dependence" commonly used in the literature on event histories analysis although the notion of contiguous duration dependence focuses on the dependence between two distinct, but consecutive, labor market states occupied by a given individual.

The main contribution of the paper is the analysis of the consequence of nonstationarity on reemployment outcomes (reemployment earnings and accepted job duration). A special attention is paid to the sensitivity of reemployment earnings and accepted job duration for those individual who escape

[1]See devine and Kiefer (1991) for a survey.

[2]Nonstationarity may also be introduced through unemployment duration "stigms". Examples of stigma include a decline in the arrival rate with elapsed unemployment duration or duration dependence in offered wages .

unemployment close to benefit termination to see if spikes in the hazard rate out of unemployment are explained by acceptance of lower wages or acceptance of jobs likely to be terminated very early. The analysis is applied to a sample of young Canadian males who experienced an involuntary separation (layoff) during a two-year period (1976-1977) and accepted a new job (recalls are omitted from the sample).

The paper is organized as follows. In the next section (section 2), the notion of contiguous duration dependence is illustrated with a simple nonstationary job search model. The empirical specification is discussed in section 3. Setion 4 is devoted to the presentation of the data while the results are in section 5.

2 Theoretical Framework

In this section, I use a simple nonstationary search model in order to illustrate the notion of contiguous duration dependence. It is used as a guideline for the empirical specification of the reduced-form analysis. The underlying framework is as follows. Initially, workers are laid off and are forced to search while unemployed. The value of unemployed search, $V_u(\tau_u)$, is assumed to be a decreasing function of unemployment duration τ_u because individuals are entitled to UI benefit for only a finite period. It is assumed that $V_u(.)$ represents the value of searching while unemployed taking into account the possibility of searching upon reemployment. Once reemployed, workers receive offers randomly (at no cost) and accept the first offer above their reemployment wage. We denote the value of occupying employment (at re-employment wage w) by $V_e(w)$[3]. It is understood that $V_e(w)$ represents the value of remaining employed at a given wage rate plus the discounted value of following the best strategy next period; that is accepting any offer above w. The escape rate out of unemployment, $\theta_u(.)$, is given by

$$\theta_u(\tau_u) = \lambda_u \{1 - F(w^*(\tau_u))\} \quad (1)$$

where τ_u denotes unemployment duration, $\lambda_u(.)$ denotes the arrival rate while unemployed, F(.) represents the distribution (exogenous) of wage offers

[3]The value functions are not derived explicitely since the objective is not to estimate a structural model. For an example of job search with unemployed and employed search, see van den Berg (1992) or Belzil (1996). the effect of human capital loss on reemployment earnings is analyzed structurally in Belzil (1995).

and $w^*(.)$ represents the reservation wage of the unemployed. The escape rate out of the accepted job, $\theta_e(.)$, is independent from accepted job duration (τ_e), that is

$$\theta_e = \lambda_e \{1 - F(w)\} \tag{2}$$

where λ_e is the arrival rate while employed and w is the accepted wage. Denoting the density of unemployment duration by $g(\tau_u)$, the mean reemployment wage may be expressed as

$$E(w) = int_0^\infty \left(\int_{w^*(\tau_u)}^\infty \left\{ \frac{f(w)}{1 - F(w^*(\tau_u))} \right\} wdw \right) g(\tau_u) d\tau_u \tag{3}$$

Because both $V_e(w)$ and the escape rate out of the accepted job are independent from job tenure and taking expectation with respect to w whose distribution depends on τ_u through $w^*(\tau_u)$, the accepted job conditional survivor function $S(\tau_e \mid \tau_u)$ is the expected survivor function, that is

$$S(\tau_e \mid \tau_u) = \int_{w^*(\tau_u)}^\infty \exp(-\tau_e.\theta_e(w)) \left\{ \frac{f(w)}{1 - F(w^*(\tau_u))} \right\} dw \tag{4}$$

where f(.) is the density of wage offers. This illustrates clearly how past unemployment (through reemployment wages) affects accepted job spells duration. Equation (2.3) establishes the negative relationships between unemployment duration and reemployment earnings while (2.4) suggests that nonstationarity in reservation wages creates a negative relationship between durations of contiguous spells of unemployment and reemployment (job). Using event history data, my objective is to investigate this dependence using a reduced-form model of the joint distribution of completed unemployment duration and reemployment outcome (reemployment earnings and accepted job duration).

3 Econometric Specification

The main purpose of the empirical analysis is to estimate the sensitivity of reemployment earnings (eq. 2.3) and accepted earnings (eq. 2.4) to completed unemployment duration. For this purpose, separate models for reemployment earnings and accepted job durations have to be introduced.

3.1 Simultaneous Model of Unemployment Duration and Reemployment Outcome

It is assumed that completed unemployment duration t_u, measured in weeks, depends on a vector of regressors X_i containing the initial benefit period (maximum benefit duration), benefit level and an intercept term. That is

$$\log t_{ui} = X_i'\beta + \varepsilon_{ui} \tag{5}$$

with

$$E(\varepsilon_{ui}) = 0 \text{ and Var } (\varepsilon_{ui}) = \sigma_u^2$$

The specification of the reemployment earnings equation must be consistent with the fact it depends on the value of the reservation wage upon acceptance of a new job which itself depends on the duration of unemployment up to benefit termination. Given the desire to impose a flexible form for the dependence of earnings on unemployment duration (benefit exhaustion) and to provide an estimation method as close as possible to a semi-parametric regression, I do the following. I define the potential entitlement period left upon reemployment (Δ_i) as the difference between the initial entitlement period (ϑ_i) and the completed duration of unemployment t_{ui} when the difference is positive and I set it to 0 when it is negative (that is when the individual accepted reemployment beyond exhaustion), that is

$$\begin{aligned} \Delta_i &= \vartheta_i - t_{ui} \text{ if } \vartheta_i - t_{ui} \geq 0 \\ \Delta_i &= 0 \text{ if } \vartheta_i - t_{ui} < 0 \end{aligned}$$

I then define a set of variable δ_i^j such that

$$\begin{aligned} \delta_i^j &= 1 \text{ if j} \leq \Delta_i \leq j+1 \\ \delta_i^j &= 0 \text{ if not} \end{aligned}$$

for j=1,3,5,...25. Those who have exhausted their benefit are identified with a variable δ_i^0 defined as

$$\delta_i^0 = 1 \text{ if } t_{ui} \geq \vartheta_i$$
$$\delta_i^0 = 0 \text{ if not}$$

The group of individuals who have left unemployment with a potential entitlement period of 27 weeks or more are taken as the reference group. The unemployment duration (benefit exhaustion) outcomes are grouped by periods of two weeks so that the number of regressors (binary variables) remains manageable. The reemployment earnings equation can therefore be expressed as

$$\log w_i = Z_i'\alpha + \varepsilon_{wi} \tag{6}$$

where

$$E(\varepsilon_{wi}) = 0 \text{ and Var } (\varepsilon_{wi}) = \sigma_w^2$$

and where Z is a column vector which contains an intercept term, previous labor market experience (representing the effect of accumulated human capital) excluded from the unemployment duration equation and 14 binary variables δ^j for j=0,1,3,...25. The same principle may be applied to the analysis of accepted job duration, t_e, that is I can define the following equation

$$\log t_{ei} = Z_i'\Gamma + \varepsilon_{ei} \tag{7}$$

with

$$E(\varepsilon_{ei}) = 0 \text{ and Var } (\varepsilon_{ei}) = \sigma_e^2$$

Clearly, in the presence of unobserved heterogeneity correlated across states, 3.1/3.2/3.3 define a non-linear simultaneous system with limited dependent variable[4]. Furthermore, the composition of X and Z ensures identification. Therefore, equations 3.1 and 3.2 and, subsequently, 3.1. and 3.3. may be estimated by maximum likelihood techniques if I assume that the error terms are multivariate normal with covariance σ_{uw} and σ_{ue}. The joint estimation of (t_e, w, t_u) would have little interest since accepted job duration and accepted earnings are just alternative ways of looking at the reemployment outcome. It is also clear that t_e and w must depend logically on the same regressors. So a joint reduced-form model of (t_u, w, t_e) would run into serious identification problems.

[4]A similar model specification is used in Belzil (1995,a) in order to estimate the effect of UI entitlement on the incidence of unemployment.

3.2 Semi-parametric Analysis

Although the simultaneous system is quite promising (it tackles simultaneity caused by unobserved heterogeneity), it also has some weaknesses. First, log normality constitutes a strong restriction of the baseline hazard. A survey of the recent empirical literature concerned with economic duration data reveals the importance of using models where either the baseline hazard or the unobserved heterogeneity term are allowed to be estimated non parametrically. To evaluate the robustness of the results, equation 3.3 has been reestimated ignoring endogeneity.[5]To do so, I use the semi-parametric method proposed by Han and Hausman (1990). Their method of estimation, based on the regression specification implied by the proportional hazards specification, involves maximization of an ordered discrete choice model where the categories are the actual discrete failure times generated by a continuous duration random variable. Denoting continuous job duration by τ_e and letting Z denote the set of covariates defined earlier, the hazard function h(.) is assumed to be

$$h(\tau_e; Z, \eta) = h_0(\tau_e)\ .\exp(-Z'\eta) \tag{8}$$

where $h_0(.)$ denotes the baseline hazard and η denotes a vector of parameter to be estimated. The model admits a regression interpretation in terms of the log integrated hazard, that is

$$\log \int_0^t h(\tau_e) d\tau_e = \delta_t = Z'\eta + \varepsilon \tag{9}$$

for t=1,2,..T. T denotes the number of discrete time intervals considered. Note that given 3.5, a positive coefficient indicates that an increase in the covariate reduces the hazard rate and therefore increases duration. The probability that the accepted job will be terminated in month t, denoted P_{it}, is given by

$$P_{it} = \int_{\delta_{t-1} - Z_i'\eta}^{\delta_t - Z_i'\eta} f(\varepsilon) d\varepsilon$$

where f(.) is the extreme value density. For right censored observations, the probability that a failure takes place beyond period t for individual i, denoted $\bar{P}_{it}$, is given by

[5]Actually, the results (presented in section 5) have indicated weak evidence that the unobserved factors affecting unemployment duration are correlated with those unobserved factors affecting accepted job duration.

$$\bar{P}_{it} = \int_{\delta_t - Z_i'\beta}^{\infty} f(\varepsilon)d\varepsilon$$

The log likelihood is simply given by

$$l(\eta) = \sum_{i=1}^{N}\sum_{t} d_{it}\left[c_i \log P_{it} + (1 - c_i)\log \bar{P}_{it}\right] \tag{10}$$

where $d_{it} = 1$ if the observed job duration is in month t and 0 if not and $c_i = 1$ for completed observations and 0 for censored spells.

4 The Data

The models are estimated from a panel of Canadian labor force participants which is extracted from the Longitudinal Labor Force File of Employment and Immigration Canada. The data are constructed as an event history data set and covers a period going from January 1972 until December 1984 and contains several pieces of information about employment and unemployment spells of a random sample of Canadian labor force participants. The data are actually based on a merge of several administrative files such as Records of Employment and the Unemployment Insurance administrative files and they enable the researcher to recreate the sequence of labor market states occupied by a given individual. The Records of Employment identify the reason for separation and provide information about job tenure, age, experience and industry .[6]The Unemployent Insurance file, along with some partial income tax records file, gives information about potential benefit duration for the unemployed, weekly earnings, unemployment duration, UI benefit level and the number of weeks of benefit entitlement left when a new job is accepted. The employer code available is used to identify individuals who have been laid off and returned with the same employer subsequently. The original data set contains an impressive number of observations but only a sub-sample, ensuring a reasonable level of homogeneity across individuals, has been used.

The first selection criteria was the occurrence of a layoff covered by Unemployment insurance between January 1976 and December 1977. The job

[6]The data set is actually described in Belzil (1995a, 1995b and 1996). Ham and Rea (1987) also use data extracted from the same source.

separation had to be followed by acceptance of a new job (in order to eliminate temporary layoffs). The sample contains 823 males (aged 24 or less at the time of the layoff) who remained in the labor force for the remaining of the period covered by the data. The sample contains actually 430 accepted job durations which were later terminated by a layoff and 294 job durations terminated by a quit.[7] As I look only at young males whom are well known to have a high turnover rate, only 12% of the reemployment job spells (99) had not been terminated by the end of the sample survey. Note that for these 99 observations, reemployment earnings are unknown. this explains the smaller sample size when reemployment earnings are analyzed (as opposed to accepted job durations). the data set is also particularly convenient since it also enables to capture exogenous variations in the individual benefit entitlement period (because of legislation changes taking place in 1977). Some sample summary statistics are found in table1.

Table 1

Variable	Mean	Standard Deviation
Experience (weeks)	127	61
Previous Earnings (current dollars)	240	120
Duration of unemployment (weeks)	12	18
Potential Benefit Period (weeks)	33	14
Unemployment Benefits (dollars)	122	30
Accepted Earnings (current dollars)	223	102
Duration of Accepted job (weeks)	35	65

[7]With administrative data, it is quite difficult to collect information on individuals who become non-participants. Among all individuals experiencing a layoff during this period, only 7% have actually left the accepted job to leave the labor force. However, as this information is actually estimated from the existence of subsequent employment records, this number can only be viewed as an estimate.

5 Empirical results

In this section, the main results are presented. The results obtained when unemployment duration and reemployment earnings are analyzed jointly are in section 5.1 Those concerned with the joint distribution of excepted job durations and unemployment durations are in section 5.2

5.1 Unemployment Durations and Reemployment Earnings

The first step of the analysis consists in the joint estimation of equations 3.1 and 3.2 using maximum likelihood techniques. The results are found in Table 2. The first two variables, log benefit level and log maximum benefit duration are part of the unemployment duration equation. The results indicate that higher level of benefit and longer benefit duration raise unemployment duration. The parameter estimates are .2114 and .2916 respectively and they admit an elasticity interpretation. These are standard results. The effect of benefit level is however not very precisely estimated. It is also found that experience raises reemployment earnings (the coefficient is .0346 with a t-ratio of 2.45). The set of binary variables representing the time until benefit termination attracts most interest. Because the reference group is composed of those who left unemployment early (with 27 weeks or more of benefit remaining), the parameter estimates are therefore expected to be negative around exhaustion (0 to 4 weeks) and closer to 0 as we move toward the last group (25-26). The results are consistent with what is expected; there is a clear evidence of a decrease in reemployment earnings as individuals approach exhaustion. The parameter estimates range from -1.43 around benefit termination to .03 (insignificant) for those leaving unemployment the period next to the reference group. Finally, the covariance between the error terms (σ_{uw}) is not very precisely estimated so the null hypothesis of independence between earnings and unemployment durations would actually fail to be rejected at any reasonable level (the asymptotic t-ratio is 1.79).

5.2 Accepted Job Duration and Unemployment Duration

The model presented in section 2 predicts that a decrease in reservation wages should be mirrored by acceptance of jobs likely to be terminated by the worker. To verify this, the simultaneous model (equations 3.1 and 3.3) has been estimated jointly. The likelihood is in 3.4 and the results in table 3. There is no notable change for the coefficient associated to benefit level, benefit duration and experience. Given the definition of the binary variables introduced earlier, it is now possible to apply the analysis made with reemployment earnings to accepted job durations. Furthermore, like in the case of reemployment earnings, negative coefficients are expected around exhaustion since unemployed individuals accepting job around benefit termination are more likely to quit these jobs. The parameter estimates show indeed that it is the case. Coefficients are negative around benefit termination (-.80) and are close to 0 (.02 for the group next to the reference group). Interestingly, the estimated covariance between both error terms (σ_{ue}) is positive but particularly insignificant.

It is now natural to reestimate 3.3 using the semi-parametric method proposed by Han and Hausman (1990) and ignoring endogeneity. To do so, 12 interval of one months have been chosen so that the number of parameter to be estimated remains reasonable (14 binary variables for exhaustion have also to be estimated). The results are in table 4. The resulting parameter estimates show a tendency similar to the one obtained with the simultaneous system (they range from -.62 to .01) although the parameters cannot be compared readily. Nevertheless, given the weak evidence of endogeneity between completed unemployment duration and reemployment job duration, this is not surprising.[8]

Finally, given that the search framework of Section 2 predicts that unemployment duration and accepted job duration are connected only through accepted earnings, this hypothesis can be tested by including both accepted earnings and unemployment duration in the accepted job duration model. The results, in Table 5, indicate that once accepted earnings are taken into account (they have a strong positive effect on job duration), unemployment duration (introduced using the flexible functional form discussed earlier) is practically

[8]The semi-parametric estimation of the hazard function revealed that job durations have high termination rates in the first 2 or 3 months and that the termination rate tend to decrease thereafter to remain relatively flat. This might be explained by the fact that individuals accepting low paying job may wait until they rebuild their qualification to unemployment benefit.

uninformative. This is verified by a likelihood ratio test for the null that all parameters associated to unemployment duration classes are equal to 0 (see footnote in table 5).

6 Conclusion

The sensitivity of the escape rate out of unemployment to benefit duration is usually documented by the presence of spikes around benefit termination. In this paper, I have analyzed the re-employment implications of nonstationarity in job search using two measures of reemployment outcome; reemployment earnings and the waiting time until the worker quits the accepted job. It has been found that accepted job tenure and reemployment earnings are negatively correlated with completed unemployment duration and that much of the negative relationship between reemployment outcomes and unemployment duration is explained by the fact that they are sensitive around benefit termination.

This is interesting since the sensitivity of reemployment outcomes is found at a point where, in general, spikes in the escape rate out of unemployment are also found. To a large extent, the empirical results found in this paper may indicate that spikes in the escape rate out of unemployment are mirrored at reemployment by a sharp decline in reemployment earnings and acceptance of jobs from which voluntary separation is likely. It has also been found that the connection between unemployment and accepted job durations comes from accepted earnings, not from unobserved heterogeneity.

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Table 2

Simultaneous System
Maximum Likelihood Estimates*
Model : Unemployment Duration and Reemployment Earnings

Variables	Param (t-ratio)	Variables	Param (t-ratio)
Benefit Level (log)	.2114 (1.86)	19-20	-.08 (1.07)
Init. Benefit Period (log)	.2916 (2.20)	21-22	.04 (.44)
Experience	.0346 (2.45)	23-24	.07 (.36)
Weeks to Exhaustion		25-26	-.03 (.76)
0**	-1.24 (2.33)	σ_u	1.06 (5.06)
1-2	-1.43 (2.56)	σ_w	.96 (6.07)
3-4	-1.33 (2.41)	σ_{uw}	-.16 (1.79)
5-6	-.73 (1.61)	Sample Size	724
7-8	-.75 (1.60)	Log Likelihood	-925.6
9-10	-.82 (1.70)		
11-12	-.51 (1.36)		
13-14	-.47 (.99)		
15-16	-.39 (.50)		
17-18	-.07 (1.46)		

* Asymptotic t-ratios are in bracket.

Table 3

Simultaneous System
Maximum Likelihood Estimates*
Model : Unemployment Duration and Accepted Job Duration

Variables	Param (t-ratio)	Variables	Param (t-ratio)
Benefit Level (log)	.1916 (1.76)	19-20	.05 (1.20)
Init. Benefit Period (log)	.3004 (2.32)	21-22	-.03 (.74)
Experience	.0304 (2.04)	23-24	-.02 (.41)
Weeks to Exhaustion		25-26	.02 (.54)
0**	-.80 (2.24)	σ_u	1.05 (5.36)
1-2	-.84 (3.01)	σ_e	.91 (6.12)
3-4	-.70 (2.24)	σ_{ue}	.21 (1.49)
5-6	-.27 (1.09)	Sample Size	823
7-8	-.25 (1.27)	Log Likelihood	-1034.4
9-10	-.14 (1.09)		
11-12	-.09 (1.04)		
13-14	.02 (.89)		
15-16	-.04 (.76)		
17-18	.06 (1.20)		

* Asymptotic t-ratios are in bracket.

Table 4

Semi-Parametric Method (Han and Hausman)
Maximum Likelihood Estimates
Model : Accepted Job Duration

Variables	Param (t-ratio)
Benefit Level (log)	-
Init. Benefit Period	-
Experience	.0286 (2.12)
Weeks to Exhaustion	
0**	-.62 (2.86)
1-2	-.64 (2.75)
3-4	-.49 (2.37)
5-6	-.21 (2.01)
7-8	-.09 (1.31)
9-10	-.12 (1.09)
11-12	-.08 (1.02)
13-14	.05 (.80)
15-16	-.04 (.60)
17-18	.02 (1.30)
19-20	.03 (1.70)
21-22	-.07 (.80)
23-24	-.03 (.49)
25-26	.01 (.61)
Sample Size	823
Log Likelihood	-1046.2

* Asymptotic t-ratios are in bracket.

Table 5

Semi-Parametric Method (Han and Hausman)
Maximum Likelihood Estimates
Model : Accepted Job Duration (Accepted Earnings Included)

Variables	Param (t-ratio)	Variables	Param (t-ratio)
Benefit Level (log)	-	19-20	-.02 (1.17)
Init. Benefit Period	-	21-22	.05 (.65)
Experience	.0234 (2.04)	23-24	.02 (.36)
Weeks to Exhaustion		25-26	-.01 (.56)
0**	-.12 (1.83)	Accept. Earnings (log w)	.1816 (2.65)
1-2	-.14 (1.79)	Sample Size	823
3-4	-.07 (1.18)	Log Likelihood	-1047.7
5-6	-.04 (1.72)		
7-8	-.01 (.99)		
9-10	.04 (1.01)		
11-12	-.02 (.96)		
13-14	.07 (.90)		
15-16	-.02 (1.04)		
17-18	.09 (.59)		

* Asymptotic t-ratios are in bracket.
** A reestimation of Table 5 without unemployment duration variables gives a log likelihood of -1037.3, so the likelihood ratio test for the null that all parameters are 0 fail to be rejected (the critical value is 23.7 at α=.05).

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