Unemployment Dynamics in the United Kingdom: heterogeneity, duration dependence and business cycle effects.

INCOMPLETE AND PRELIMINARY VERSION, NOT TO BE QUOTED

Adriaan S. Kalwij

Department of Economics
University of Oxford
Manor Road Building
Oxford OX1 3UQ
United Kingdom

adriaan.kalwij@economics.ox.ac.uk

+44-1865-281168 (Tel.)
+44-1865-271094 (Fax)

January 2001
Abstract

This paper provides a complete picture of UK unemployment dynamics over the last two decades. For this purpose administrative data on individual unemployment related benefit claims is used covering about 368,000 claims of 116,000 men over the period 1982-1999. This unusually large dataset makes it possible to contribute significantly to the existing literature on unemployment dynamics by addressing the effects on the risk of leaving unemployment of individual heterogeneity, elapsed duration (i.e. duration dependence) and the macroeconomic situation (e.g. business cycle effects) in one single empirical framework. In doing so, no assumptions are made about the shape of the duration dependence and the distribution of unobserved heterogeneity. Furthermore, the empirical framework takes into account that the composition of the newly unemployed may vary over the business cycle, i.e. initial conditions are taken into account. Note that most of these issues have been addressed only separately in the micro-and macroeconomic studies and therefore this paper can be considered a bridge between the existing micro-and macroeconomic studies on unemployment dynamics.

Only incomplete and preliminary results are available at the moment. These preliminary results point in the following directions: Genuine duration dependence is found. Heterogeneity is of major empirical importance and so is controlling for the macroeconomic situation. Failing to control (un) observed heterogeneity and for the macroeconomic situation will seriously affect the duration dependence pattern of the risk of leaving unemployment. I will quantify these effects and will make policy recommendations once the final results are available. Also simulations have to be carried out to get a better understanding of the empirical results.
1. Introduction

For over two decades one of the major issues in the econometric analysis of unemployment durations is the distinction between genuine duration dependence and individual heterogeneity (see, e.g., the influential articles by Lancaster, 1979, and Nickel, 1979). The commonly observed decrease in the risk of leaving unemployment with the duration of unemployment can be caused by heterogeneity in the distribution of the unemployment duration or the presence of genuine duration dependence caused by, for instance, a stigma effect (see e.g. Vishwanath, 1989). From a policy perspective this distinction is of crucial importance. If heterogeneity is of importance, policy schemes such as training programs targeting specific disadvantaged groups of unemployed may be effective. If there is genuine duration dependence transitory shocks in unemployment due to either labour demand or supply shocks will have long-term effects. In this case policy should be directed towards preventing individuals from becoming (long-termed) unemployed and short-run policies such as job creation schemes will yield long-term benefits. Furthermore, genuine duration dependence may explain partially the observed slow adjustment of the labour market after a negative shock in aggregate unemployment (see, e.g., Henry and Nixon, 2000). Apart from heterogeneity and genuine duration dependence, the macroeconomic situation may affect individuals’ risks of leaving unemployment (see e.g. Layard et al., 1991, Chapt. 5). One may expect the risk of leaving unemployment to be higher in a period of high economic growth than in an economic recession. Furthermore, over the last two decades the labour market has becomes more flexible. Job security has decreased and for an average individual this implies that there is a higher risk of becoming unemployed. Whether or not due to the presence of genuine duration dependence this has severe long-term consequences on the individual level, hence also on the aggregate level, depends on the way elapsed duration affects the risk of leaving unemployment. In this context the issue of the composition of the newly unemployed over the business cycle is of importance. Relatively to a situation of high economic growth, in a situation of an economic recession one might expect a larger share of individuals who have been laid of among the newly unemployed and face less favourable reemployment opportunities.
In econometric analyses of unemployment dynamics the issue of the distinction between heterogeneity and duration dependence and the issue of business cycle effects have been investigated mostly separately in the micro- and macroeconomic literature. Empirical studies on individuals’ unemployment durations are mainly concerned with the distinction between heterogeneity and duration dependence and the empirical results seem to suggest that both individual heterogeneity and elapsed duration affect unemployment duration (for surveys, see, e.g., Lancaster, 1990, and Layard et al., 1991). Studies exploiting individual-level data are usually characterised by a short calendar time span (see, e.g., a recent UK study of Arulampalam et al., 2000). This does not allow addressing the issue of business cycle effects properly and may for this reason yield biased results concerning duration dependence. For instance, using aggregate data van den Berg and van Ours (1994) show that UK unemployment dynamics is characterized by a cyclical relationship between elapsed duration and the unemployment rate. Furthermore, they show that, under certain assumptions, individual heterogeneity plays no role in UK unemployment durations and that the negative duration dependence of unemployment duration is genuine. While this may be true, in general issues related to individual heterogeneity and duration dependence cannot properly be addressed using aggregate data.

This paper bridges the micro-and macroeconomic literature on UK unemployment dynamics. Unemployment dynamics in the UK over the past two decades is investigated using individual level data. In particular this paper disentangles the effects of individual heterogeneity, elapsed duration and the macroeconomic situation on individual unemployment duration. In doing so this paper takes explicitly into account that characteristics of the newly unemployed may vary over the business cycle, i.e. initial conditions are taken into account. For this purpose administrative data on individual unemployment related benefit claims is used covering about 368,000 claims of 116,000 men over the period 1982-1999. This unusually large data set makes it possible to contribute significantly to the existing literature on unemployment dynamics by addressing all the issues of heterogeneity, duration dependence and business cycle effects in one single empirical framework. Hence, this paper provides a more complete picture of UK unemployment dynamics.
2. Descriptive statistics: the JUVOS data.

The JUVOS\textsuperscript{1} is a five percent sample of all computerized claims for unemployment related benefits in the UK. The observation period starts in the first week of October 1982 and ends the last week of December 1999. In principle all individuals who make a claim for unemployment benefits, income support or National Insurance credits, and have a National Insurance number that ends in a specific pair of digits are included in the sample. Thus the JUVOS is a random and representative stock-sample of the unemployed population. A JUVOS record consists of the start-data and the end-data of the claim. Furthermore, information is gathered on gender, data of birth, marital status and region of residence. Monthly, the Office of National Statistics (ONS) publishes unemployment rates based on the same JUVOS data.

The UK Welfare system has undergone quite some changes over the past two decades (see Employment Gazette, 1995, 1996). In order to keep a consistent definition of an unemployment claim over the observation period, some sample selections are made accordingly. The 1983 Budget provisions enabled men aged 60 and over and who mostly considered themselves to be retired, to receive national insurance credits or supplementary benefit without attending an Unemployment Benefit office. For this reason, men over 60 are excluded from the sample. In September 1988, the 1988 Social Security Act changed the benefit entitlement of the under 18-year-olds. This group no longer needs to sign on as unemployed in order to receive benefits. In line with the official unemployment figures published by ONS, individuals under 18 are removed from the sample. Furthermore, some benefit schemes have changed resulting in a change in the number of claims. For example, in April 1995 Incapacity Benefit (IB) has replaced Sickness Benefit (SB) and Invalidity Benefit (IVB). Under IB more people are passed fit for work, hence may claim Unemployment benefits. Also, unemployed may have entered government-supported training, such as the New Deal program. This has to be taken into account when interpreting the empirical results in this paper. An entirely different issue is the unemployment spells of women. After exhausting the unemployment benefits, women with a partner who is working or receiving unemployment related benefits are themselves in general no longer entitled

\textsuperscript{1} Joint Unemployment and Vacancy Operating System.
to receiving unemployment related benefits. In this case women stop claiming benefits without having found employment. In order to address the unemployment duration of women, one needs to have details information concerning their household situation. No information on the situation of individual after leaving unemployment is available. For these reasons, the sample used in the investigation is restricted to men.

To summarize, the sample consists of men between 18 and 60 years of age throughout the period of claim. In total 116,000 men over the period 1982IV-1999IV, 368,000 claims.

The sample selected above is a stock sample. Using this stock sample would require the modelling of the backwards recurrence time (see Lancaster, 1991, section 3.1). For this reason a flow sample is used. The flow sample is restricted to those unemployment spells that started during the observation period. Effectively this means that all unemployment spells starting before 1982IV are removed from the stock sample. The stock sample is only used for descriptive purposes in the next section and the flow sample is used in the empirical analysis of section 3.

2.1 Descriptive Statistics

Fig.1 reports on the stock of unemployed individuals in the UK over the period 1982IV-1999IV. While unemployment remains fairly stable in the first half of the eighties, in the second half there has been a large decrease up to 1990 and hereafter unemployment has soared during the recession years of the early nineties up to 1993. After 1993 there has been a steady decline.

Fig.2 reports on the number of new claimants, i.e. the inflow, and the number of individuals that stop claiming, i.e. the outflow. Periods of high unemployment are preceded by periods in which the inflow exceeded the outflow and periods of low unemployment are preceded with periods in which the outflow exceeded the inflow. Fig.2 implies that both the inflow and outflow are cyclical but the cycles seem to be running parallel and crossing each other at the peak and troughs of the business cycle.
Figure 3 reports on the average elapsed duration. The pattern is not as clear as often reported in the literature (see, e.g., Layard et al., 1991). Low levels of unemployment seem to be characterised by relatively high elapsed durations.

2. The Econometric Model

One of the main objectives of this paper is to disentangle the effects on the hazard of leaving unemployment of elapsed unemployment duration and individual heterogeneity. To identify these two effects Cox’s proportional hazard model is chosen (Cox, 1972). Elbers and Ridder (1982) show that this model belong to a class of models in which both the shape of the duration dependence and the distribution of individual (un-) heterogeneity are non-parametrically identified. As mentioned in the introduction, this paper takes into account non-stationary macroeconomic environment. Controlling for the macroeconomic situation is not a trivial exercise; see e.g. Imbens (1994) for an excellent discussion on this issue. We follow the standard approach by using indicators for the economic cycle (see e.g. Baker, 1992).

Notation

\(i\) : Index for individual.

\(k\) : Index for the spell.

\(\tau_{i0}\) : Calendar time at which the individual turned 18.

\(\tau_{if}\) : Final period of observation of individual \(i\), the year in which the individual turned 60 or the time of censoring (31 December 1999).

\(K_i\) : Number of unemployment spells experienced by individual \(i\).

\(\tau_{ik}\) : Starting date of the \(k^{th}\) unemployment spell, in years.

\(q_{ik}\) : The quarter in which the \(k^{th}\) unemployment spell starts.

\(t_{ik}\) : Duration of the \(k^{th}\) unemployment spell.

\(c_{ik}\) : A dummy variable equal to 1 if the \(k^{th}\) unemployment spell is incomplete (right hand censored) and equal to 0 otherwise.

\(X_{ik}\) : Time constant explanatory variables but may vary across spells.
For every individual one spell ($K_i=1$) or a sequence of spells is observed ($K_i > 1$). The observations of individual $i$ can be summarized as follows:

$$\{\tau_{i0}, \tau_{ij}, (\tau_{ik}, q_{ik}, t_{ik}, c_{ik}, X_{ik} \mid k = 1, \ldots, K_i)\}$$

$\nu_i$ : Individual specific unobserved heterogeneity.

$g_i(.)$ : Density function.

$G_i(.)$ : The corresponding cumulative distribution.

$h_i(.)$ : Hazard rate.

### 3.1 Unemployment spell

Use a proportional hazard specification. The hazard rate of a transition from unemployment into employment is defined as follows:

$$h_i(t_{ik} \mid \tau_{ik}, X_{ik}, \nu_i; \beta) = \psi_i(t_{ik}; \beta_1) \psi_2(t_{ik}; \beta_2) \exp(X_{ik} \beta_0) \exp(\eta_i)$$

$$\beta = (\beta_0, \beta_1, \beta_2)$$

$\psi_i(.)$ : Duration dependence.

$\psi_2(.)$ : Calendar time effects on the transition into employment. This is approximated using macroeconomic indicators.

For identification issues: Imbens (1994)

The conditional probability (conditional on being unemployed) depends on the time in unemployment and the calendar time. This model is identified. The density function of a spell of unemployment equal to $t_{ik}$ is given by:

$$g_i(t_{ik} \mid \tau_{ik}, X_{ik}, \eta_i; \beta) = h_i(t_{ik} \mid \tau_{ik}, X_{ik}, \eta_i; \beta) \exp\left\{-\int_0^{t_{ik}} h_i(s \mid \tau_{ik}, X_{ik}, \eta_i; \beta) ds\right\}$$

Survival function:

$$1 - G_i(t_{ik} \mid \tau_{ik}, X_{ik}, \eta_i; \beta) = \exp\left\{-\int_0^{t_{ik}} h_i(s \mid \tau_{ik}, X_{ik}, \eta_i; \beta) ds\right\}$$

This is all conditional on the time of inflow $\tau_{ik}$.
3.2 Initial condition: inflow in the first observed spell of unemployment.

In most empirical studies the characteristics of the individuals who become unemployed are assumed to be constant over time. This assumption is reasonable if one follows, for instance, a group of individuals who all became unemployed at the same moment in time. Duration dependence is intimately linked with unobserved characteristics (see eg Lancaster 1979) hence if one has observations on individuals who entered unemployment at different moments in time with a different distribution of unobservable characteristics a restrictive assumption on this distribution is constant over time will affect the estimates of the duration dependence and the time affects on the probability of leaving unemployment.

Define the density function of being unemployed in period \( \tau_{i1} \) is defined as follows:

\[
g_0(\tau_{i1} \mid \tau_{i0}, X_{i0}; \alpha) = \lambda_0(\tau_{i1} \mid \tau_{i0}, X_{i0}; \alpha) \exp \left\{ - \int_{\tau_{i0}}^{\tau_{i1}} \lambda_0(s \mid \tau_{i0}, X_{i0}; \alpha) \, ds \right\}
\]

Reduced form duration model. Not to be interpreted as survival until that time but rather as the probability of not being unemployed at the time of transition. This distinct difference is of major importance. The hazard rate of becoming unemployed at the age of \( \tau_{i1} \) is parameterized as follows:

\[
\lambda_0(\tau_{i1} \mid \tau_{i0}, X_{i0}; \alpha) = \exp \left\{ \sum_{j=1}^{9} \alpha_j I(\tau_{i1} = j) + \sum_{a=16}^{64} \alpha_{a} I((16 + \tau_{i1} - \tau_{i0}) = a) + X_{i0} \alpha_x \right\}
\]

\[
\alpha = (\alpha_{1,81}, \ldots, \alpha_{1,99}, \alpha_{2,16}, \ldots, \alpha_{2,64}, \alpha_x),
\]

Define the probability function of becoming unemployed in quarter \( q \) conditional on the year of becoming unemployed \( (\tau_{i1}) \) as follows:

\[
g_0(q \mid \tau_{i1}, \tau_{i0}, X_{i0}; \Theta) = \frac{I(q \mid \tau_{i1}, \tau_{i0}; \Theta)}{\sum_{q=1}^{4} I(q \mid \tau_{i1}, \tau_{i0}; \Theta)}
\]
with
\[ I(q | \tau_{i1}; \tau_{qj}; \Theta_q) = \exp \left\{ \sum_{j=1}^{99} \Theta_{ij} I(\tau_{ij} = j) + \sum_{a=16}^{64} \Theta_{2a} I((16 + \tau_{i1} - \tau_{0a}) = a) \right\} \]

\( \Theta_q = (\alpha_{q1}^0, \ldots, \alpha_{q99}^0, \alpha_{q16}^0, \ldots, \alpha_{q64}^0, \alpha_q^0) \) and \( \Theta = (\Theta_q, \Theta_2, \Theta_4) \)

Normalization is \( \Theta_q = 0 \). The density function of entering unemployment at year \( \tau_{i1} \) in quarter \( q_{i1} \) is given by
\[ g_0(\tau_{i1}, q_{i1} | \tau_{01}, X_{i1}; \alpha, \Theta) = g_0(q_{i1} | \tau_{i1}, \tau_{01}; \Theta) g_0(\tau_{i1} | \tau_{01}, X_{i1}; \alpha) \]

The parameters of the model above are not identified: the business cycle effects will be approximated using macroeconomic indicators. Change the above notation to make this clear.

### 3.3 Employment spells

Between unemployment spells I assume these people are employed. Hence I can exploit this duration to analyse duration dependence in inflow rates:

Density function:
\[ g_2(\tau_{ik+1} - \tau_k | \tau_{ik}, X_{ik}, \nu; \gamma) = h_2(\tau_{ik+1} - \tau_k | \tau_{ik}, X_{ik}, \nu; \gamma) \exp \left\{ -\int_0^{\tau_{ik+1} - \tau_k} h_2(s | \tau_{ik}, X_{ik}, \nu; \gamma) ds \right\} \]

Survival function:
\[ 1 - G_2(\tau_{ik+1} - \tau_k | \tau_k, X_{ik}, \nu; \gamma) = \exp \left\{ -\int_0^{\tau_{ik+1} - \tau_k} h_2(s | \tau_k, X_{ik}, \nu; \gamma) ds \right\} \]

\[ h_2(\tau_{ik+1} - \tau_k | \tau_k, X_{ik}, \nu; \beta) = \psi_4(\tau_{ik+1} - \tau_k; \gamma_1) \psi_4(\tau_{ik+1}; \gamma_2) \exp \{ X_{ik} \gamma_0 \nu \} \]

Also here, business cycle effects are approximated using macroeconomic indicators.
3.4 Likelihood function

I observe: \( H_i = \{\tau_{i0}, \tau_{i}, \tau_{ik}, \xi, c, X_i\} \), \( i = 1, \ldots, N \).

Unobserved heterogeneity is denoted by \( \nu_i \). I use the support point approach as described in Heckman and Singer (1984), Huh and Sickles (1994) have an excellent discussion on the empirical implementation of this method. Now I can formulate the likelihood function for a sequence of spells of individual \( i \):

\[
L_i(H_i \mid \alpha, \theta, \beta, \gamma) = \sum_{p=1}^{P} g_0(\tau_{i1} \mid \tau_{i0}, X_i, \nu_i, \alpha) \times g_0(q_{ii} \mid \tau_{i0}, \theta) \\
\times \left( \prod_{k=1}^{K} \left[ g_2(\tau_{ik} \mid \tau_{i}, X_i, \nu_i, \beta) \right]^{-c_k} \left[ 1 - G_1(t_{i} \mid \tau_{i}, X_i, \nu_i, \beta) \right]^{c_k} \right) \\
\times \left( \prod_{k=0}^{K} \left[ g_2(\tau_{ik+1} \mid \tau_{i}, X_i, \nu_i, \gamma) \right] \right) \\
\times \left[ 1 - G_2(\tau_{ik} \mid \tau_{i}, X_i, \nu_i, \gamma) \right]^{-c_k} \times \Pr(\nu_i).
\]

Sample log-likelihood function:

\[
\ln (L(H \mid \alpha, \theta, \beta, \gamma)) = \sum_{i=1}^{n} \ln (L_i(H_i \mid \alpha, \theta, \beta, \gamma))
\]

4. Empirical Results

No empirical results are reported at this stage.

---some notes---

Layard et al. (1991) show that changes in UK unemployment over the business cycle are caused largely by changes in the duration of unemployment while the incidence of becoming unemployed remains relatively constant over time. For the US they find more fluctuation in the incidence of unemployment over the business cycle and therefore conclude that in comparison with the US the UK labour market is less flexible. Whether or not a relatively inflexible labour market results in significant
welfare losses depends on the significance of duration dependence in explaining persistency in unemployment. Van den Berg and van Ours (1994) have addressed this issue using aggregate data. They show that, under certain assumptions, individual heterogeneity plays no role in UK unemployment durations and that the negative duration dependence of unemployment duration is genuine.

References


Employment Gazette’s


