AN ANATOMY OF UNEMPLOYMENT FLOWS IN GREAT BRITAIN
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Discussion Paper No. 100
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AN ANATOMY OF UNEMPLOYMENT FLOWS IN GREAT BRITAIN

by

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July 1984

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ISBN: 0-949293-01-6
ISSN: 0725-420X
# Table of Contents

Abstract  
1. Introduction  
2. The Model  
   (i) Inflows  
   (ii) Outflows  
3. Econometric Results  
   (a) Methodology  
   (b) Results  
4. Conclusions  

Footnotes  
References  
Appendix
Abstract

The aim of this paper is to model the flows of people who join and leave the unemployment stock. In this paper we analyse the unemployment flows in Great Britain of males and females (separately) for the period 1967(3) to 1980(2). With these estimates we predict the unemployment stocks and find our predictions (within the sample period) are surprisingly good. Our main findings are that the growth in unemployment in Britain is explained by structural change in the economy and due to a lack of aggregate demand. An increase in real wages, per unit of output (which leads to a fall in profitability of firms) is partly responsible for the increase in unemployment. We also find that an increase in unemployment benefits leads to a fall in unemployment. We suggest that this latter result should be treated with caution.

Our main result is that an appropriate way of modelling unemployment stocks is to begin by modelling unemployment flows.
1. **Introduction**

The aim of this paper is to study the behaviour of unemployment flows of males and females in the labour market. In an earlier paper, Jumankar and Price (1984), we argued that for a proper understanding of the dynamics of unemployment we should model unemployment flows. There we estimated equations for total inflows and total outflows and argued that the results justified our approach. In this paper we disaggregate the flows by sex/gender and argue that our earlier approach is justified as the model is robust even when estimated for males and females separately. (The model is estimated on quarterly data for Britain from 1967 (3) to 1980 (2).) This is especially interesting since it has often been argued that it is difficult to model female unemployment, partly due to the large movements in and out of the labour force. The main theme of this paper is that labour market flows are caused by changes in the economy. Structural and technological change lead to the 'birth' and 'death' of firms and consequently affect hires and fires. In addition, workers retire and quit and some leave the labour force. Thus, we believe that these continual changes in the labour market are better captured by an analysis of unemployment flows.

The paper is structured as follows: Section 2 outlines the model, Section 3 presents the empirical results and Section 4 concludes the paper. An appendix describes the data.

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*a* We are grateful to the ESRC for financial support for the earlier stages of this work under grant HR 7274. We thank various people who commented on this paper when it was presented at the Universities of Exeter, Hull and Warwick. The remaining errors are our responsibility.
2. The Model

One of the main themes underlying our model is that the economy consists of several different firms, some of which are hiring and some that are firing. Changes in technology (which includes changes in production methods as well as changes in products) and the structure of the economy lead to a change in the distribution of hiring and firing firms. Changes in aggregate demand, similarly, lead to a change in the distribution of hiring and firing firms. In addition, changes in profitability (either due to changes in costs or demand) lead to changes in hiring and firing. To simplify our analysis we assume that there are two types of firms: those firms that are contracting their employment and those firms that are not contracting. The latter group we loosely call 'growing' firms. The aggregate hires and fires in an economy depend on the behaviour of these two types of firms and on the number of contracting and growing firms.

We postulate that firms are cost-minimisers with static expectations (taking wages and output as exogenous) and individuals in the labour market follow search strategies à la Mortensen. In our approach we model the gross inflows and outflows from the unemployment stock. Inflows consist of hires, (voluntary) quits and new entrants and re-entrants. Outflows consist of hires, discouraged workers who leave the unemployment stock, and retirees from the labour force. The stock of unemployment at time $t$ is given by

$$U_t = U_{t-1} + (I_t - Q_t)$$

where unemployment ($U_t$) is defined as the stock at the end of the period, and inflows ($I_t$) and outflows ($Q_t$) are flows during the period. We now outline the determinants of the different components of the flows.
(1) Inflows

(a) Firms

The aggregate fires in an economy depend on the firing policy of an individual declining firm, the number of declining firms and the number of firms that go bankrupt (or go into voluntary liquidation). We postulate that the firing policy of an individual firm is determined by cost minimising behaviour subject to a quadratic costs of adjustment function.

Using the Nadiri and Rosen (1973) framework, we may summarise the adjustment process by

\[
\begin{bmatrix}
E_t - E_{t-1} \\
h_t - h_{t-1} \\
s_t - s_{t-1}
\end{bmatrix}
= \begin{bmatrix}
\lambda_{11} & \lambda_{12} & \lambda_{13} \\
\lambda_{21} & \lambda_{22} & \lambda_{23} \\
\lambda_{31} & \lambda_{32} & \lambda_{33}
\end{bmatrix}
\begin{bmatrix}
E_{t-1} - E_{t-2} \\
h_{t-1} - h_{t-2} \\
s_{t-1} - s_{t-2}
\end{bmatrix}
\]

(2)

where \( E, h \) and \( S \) are employment, average hours and stocks (inventories) respectively, \( \lambda \) is a matrix of adjustment coefficients and the asterisked variables are optimal values. Assuming that \( s_t^* \) and \( h_t^* \) are unchanging over time, we can obtain (after some manipulation):

\[
\Delta E_t = \lambda_{11} E_t^* + (1-\lambda_{11}) \Delta E_{t-1} - \lambda_{12} \Delta h_{t-1} - \lambda_{13} \Delta s_{t-1}
\]

(3)

where \( \Delta \) is a first difference operator and \( E^* \) is determined by input prices and the level of output. Given the assumption of constant \( s_t^* \) and \( h_t^* \), inventories and hours act purely as buffers. For a declining firm, \( E^* \) is falling so the firm fires workers if \( |\Delta E_t| \) exceeds natural wastage (quits, retires and deaths) from the employed labour force. The net fires of a declining firm are:

\[
\psi_{it} = -\Delta E_{it} - (Q_{it} + R_{it})
\]

for \( \Delta E_{it} < 0 \) and \( \psi_{it} > 0 \)

\[
= 0 \text{ otherwise}
\]
where \( Q_{it} \) are voluntary quits and \( R_{it} \) are retiree plus deaths from the employed stock. We postulate that \( R_{it} \) is proportional to employment:

\[
R_{it} = \theta E_{it-1}
\]

\[
0 < \theta < 1
\]

The aggregate fires in an economy are given by

\[
\sum_{i=1}^{n} F_{it} = \sum_{i=1}^{n} (-\Delta E_{it} - (Q_{it} + R_{it} - \sum_{i=1}^{m} (-\Delta E_{st}) - \sum_{i=1}^{m} Q_{st} - \sum_{i=1}^{m} R_{st}) - m\Delta E_{st} - mQ_{st} - mE_{st-1}
\]

where we are summing over \( m \) declining firms. We postulate that \( m \) and the distribution of the \( \Delta E_{it} \), over firms depends positively on structural change variables \( (Z_p) \)

\[
m = m(Z_{st})
\]

Some of these \( m \) firms go bankrupt or into voluntary liquidation. This adds an element of discontinuity to our story.

We now turn to quits.

(b) Quits (Voluntary Separations)

Here we rely on the Mortensen (1970, 1977) search story where workers quit to search for a better job. Quits are determined by the worker’s current wage relative to some average of the wage distribution and by search costs. Hence an increase in unemployment benefits, \textit{ceteris paribus}, would tend to increase quits. We assume for simplicity that all quits join the unemployment stock. We assume that the sampling experiment facing the worker is a two stage experiment with \( q_1 \) being the probability of receiving an offer and \( q_2(W) \) being the probability distribution of wage offers conditional on receiving an offer. The joint probability \( q_1 q_2(W) \) would
increase with $r_1$. We postulate that an increase in vacancies increases $r_1$ and hence increases quits. We postulate

$$Q_{it} = Q_{it}(w_{it}/\bar{w}, b_t, v_t)$$

where $w_{it}/\bar{w}$ is the current wage relative to an average wage, $b$ are unemployment benefits and $v$ are vacancies. Aggregating over all firms

$$Q_t = \sum Q_{it}(w_{it}/\bar{w}, b_t, v_t)$$

$$= n Q_{it}(.)$$

where $n$ is the total number of firms in the economy which also depends on structural change, i.e. $n = n(Z_s)$. During a boom the number of firms increases while, in a recession, the number falls.

(c) New Entrants/Re-entrants

We postulate that this category of inflows depends on demographic and socio-economic factors. As the youth population increases, new entrants increase. The participation rate (especially of women) increases with the probability of employment. However, new entrants and re-entrants have less incentive to register as unemployed.

$$NE = NE(Pop_s)$$

where Pop is the population of the relevant age group.

Aggregate inflows are given by (6), (9) and (10) and, using (1) for $E_{it}$ we derive

$$I_t = -mE_{it}(.) - nE_{it}(.) - mE_{it-1} + nE_{it-1} + NE(.)$$

where $m = m(Z_s)$. This is a highly non-linear equation which we shall approximate by a log-linear functional form. In general functional form

$$I_t = I(\Delta w_t, \Delta r_t, mE_{t-1}, \Delta b_{t-1}, \Delta s_{t-1}, w_{it}/\bar{w}, b_t, v_t, \bar{w}_{t-1}, Pop_t, Z_s)$$

where $\Delta w$ is the change in the wage rate, $\Delta Y$ the change in output (coming from the employment adjustment equation (3)) and the other variables are as previously defined.
(11) Outliers

(a) Hires

We postulate that hires are determined by cost minimising firms subject to a convex adjustment costs function. The analysis is similar to that discussed in subsection (1)(a) above. However, there is a basic asymmetry in the analysis. In the firing decision firms can determine the firings while, in the hiring decision, firms make offers and the actual change in employment depends on acceptance by workers searching in the labour market. These hiring firms are assumed to be cost minimising subject to an additional constraint that determines their flow supply of labour, \( \hat{\lambda} \) in Mortensen (1970).

Following Mortensen (1970, 1977) we postulate that workers searching in the labour market accept offers if the wage offer exceeds their reservation wage. An increase in unemployment benefits has an ambiguous effect on the reservation wage: firstly, it increases the reservation wage because it lowers search costs but, secondly, it lowers the reservation wage for workers not "entitled" to the higher benefits who may then accept offers. The probability of an outflow from the unemployed stock is the joint probability of receiving an offer and the probability of accepting an offer \( \pi_u \). The flow supply constraint can be written as

\[
\Delta s_{lt} = \gamma (u_{lt}, u_{lt-1}) \frac{E_{lt}}{u_{lt}} \cdot u_{lt-1}
\]

(13)

where the variables are as previously defined and \( Z \) is a vector of characteristics of the unemployed. Hires must also satisfy the constraint

\[
H_{lt} = \Delta s_{lt} + (u_{lt} + R_{lt})
\]

for \( \Delta s_{lt} > 0 \)

\[
= \pi_u (u_{lt} + R_{lt})
\]

for \( \Delta s_{lt} \leq 0 \),

\( 0 \leq \pi_u \leq 1 \)

(14)
where natural wastage implies some hires even for contracting firms. The firm chooses a net change in employment by choosing the optimal $\rho$ in

$$\Delta E_{it} = \rho(.) \Delta E_{it}$$

where $\rho$ may be interpreted as the probability of an offer being made to a willing applicant. Clearly,

$$0 \leq \rho(.) \leq 1$$

and is a function of input prices and the output level of the firm. If we allow for heterogeneous labour, the firm could alter its hiring standards in terms of the quality of labour: when they wish to expand rapidly, they lower their hiring standards which is another reason for increasing marginal costs of adjustment. Similarly, the higher the inflows due to voluntary quits, the greater the proportion of workers in the unemployed stock with a higher exit probability and hence the greater $\gamma_a(.)$.\(^3\)

Aggregate hires in an economy are given by

$$H_t = \frac{1}{\mu} \Delta E_{it} + (Q_{it} + R_{it}) + \frac{d}{1} \gamma_t (Q_{it} + R_{it})$$

$$= \mu [\Delta E_{it} + (Q_{it} + R_{it})] + d \gamma_t (Q_{it} + R_{it})$$

Again $\Delta E_{it}$, $Q_{it}$, $R_{it}$ are treated as averages, where there are $\mu$ expanding firms and $d$ declining firms that are hiring workers to partially replace workers lost through natural wastage.\(^9\) As argued earlier, $\mu$, $d$ and the distribution of the $\Delta E_{it}$ over firms are functions of structural change in an economy.

(b) Retires and Deaths

We postulate that this category is proportional to the unemployment stock, assuming a constant age composition. The decision to retire may be affected by legislation (as in 1981 when some long run unemployed were allowed to transfer to retirement status) or by the probability of
re-employment. For simplicity, we assume proportionality to the unemployed stock

\[ R_t = \delta U_{t-1}, \quad 0 < \delta < 1 \]  

(17)

(c) Discouraged Workers

A decrease in the probability of employment is likely to lead to the unemployed leaving the labour force. We may therefore observe a "perverse" relation between aggregate demand and outflows. The proportion of long term unemployed may affect the outflows in either direction. The greater the proportion of long term unemployed, the greater the number of unemployed workers who are hence increasing the outflows. However, the greater the proportion of long term unemployed, the fewer the hires because the employers treat duration as an index of labour quality. Finally, eligibility for unemployment benefits ceases after twelve months (eligibility for earnings related supplements ceases after, at most, six months) lowering the reservation wage with unemployment duration. Thus,

\[ DN_t = D(DL_t, V_t) \]  

(18)

where DN are the discouraged workers and DL the proportion of long term unemployed.

Aggregate outflows are given by summing over all hires, retires and discouraged workers. Combining equations (3), (14), (16), (17) and (18) we get

\[ 0_t = H(\cdot) + \delta U_{t-1} + D(\cdot) \]  

(19)

noting that the \( H(\cdot) \) function contains quits which are an important component of the inflows. Writing equation (21) in general functional form:

\[ 0_t = 0_t(DW_t, \Delta Y_t, \Delta E_{t-1}, \Delta H_{t-1}, \Delta E_{t-1}, W_{it}/G, B_t, \lambda_t, H_{t-1}^{LD}, Z_{st}) \]  

(20)

To conclude this section, we note that ideally we would estimate a model with separate equations for each component of the flows. However, data exist only for aggregate flows, forcing us to simplify and approximate
for estimation purposes. Inconveniently, many influences may be expected to have ambiguous effects overall: for example, a rise in demand for labour may reduce fires but encourage quits. Furthermore, while quits are an important element of the inflows in themselves, they also affect the level of hires (an outflow) and fires. In the next section, we discuss the empirical specification of our model and results.

3. Econometric Results
   (a) Methodology

   The model was estimated by instrumental variables using quarterly data for Great Britain from 1967(3) to 1980(2). In our earlier paper, Junankar and Price (1984) we estimated this model using the above data on total inflows and outflows. The procedure we followed was to estimate a log-linear model with a general lag distribution and then to obtain a parsimonious representation by imposing various restrictions on the lag distribution. The final specification was then used to generate dynamic within sample forecasts of unemployment stocks. The strategy we followed in this paper was to take precisely the same dynamic specification of the model and estimate it using data on male and female unemployment flows respectively. In addition, we did not experiment by adding or deleting variables from the set of variables used for the totals equations. The only changes we made were to use different values for particular variables (e.g. wage rates would be different for males and females, etc.).

   As mentioned earlier, ideally we should estimate equations for each of the different components of the inflows and outflows. However, as data do not exist by this level of disaggregation we have to proceed to estimate equations for inflows and outflows. We estimated log-linear equations as approximations to a highly non-linear system. We estimated equations of the general form
\[ \ln I_t = \alpha_1 \ln I_{t-1} + \sum_{t=2}^{n} \gamma_{i} \ln X_{it} + e_{1t} \]  
(21)

\[ \ln O_t = \beta_1 \ln O_{t-1} + \sum_{t=2}^{n} \phi_{i} \ln Z_{it} + e_{2t} \]  
(22)

where \( X_{it} \) and \( Z_{it} \) are explanatory variables. Unlike Nickell (1982) we do not estimate the equations with the dependent variable being defined as a flow deflated by the appropriate stock. Instead, we estimate it freely with the stocks on the right hand side and test the restrictions that \( \alpha_1 = 1 \) and \( \beta_1 = 1 \). This is also preferable from an econometric point of view since \( \ln O_t \) is almost a stationary series.

In terms of our model we have broadly six categories of independent variables.\(^{10}\)

(i) Structural Change Variables

We used the ratio of industrial to services employment as an index of structural change. In addition we also used bankruptcies and company liquidations as an index of a discrete change in employment by firms. We expect that as the ratio of industrial to service employment falls it leads to an increase of inflows (as industry declines) of especially males and an increase in outflows (as the services sector expands) of primarily females. However, as increased employment in services may be as a result of new entrants (or re-entrants) of females this may not show up in our estimates.

(ii) Aggregate Demand Variables

We used an index of capacity utilisation to proxy changes in aggregate demand for output. For labour supply the probability of employment is proxied by vacancies. There is an inherent ambiguity in the theory as to what signs to expect from these variables: while fires will fall; quits may rise in response to an increase in demand. An increase in demand may lead to an increase in outflows. However, it is possible that an increased perceived probability of finding a job may lead individuals to raise their reservation wage and hence decrease outflows.
(iii) Price Variables

To capture the firm's response in the labour market we used the real wage cost per unit of output. For firms employing women there were no data for female real wage costs per unit of output and so we had to approximate this series crudely.\textsuperscript{11} For workers' responses to price variables we used real earnings and real benefits. For men, benefits were a weighted average of a flat rate (for a married man with two children) plus an earnings related supplement. For women we used a single person's flat rate of benefits. We expect increases in wage costs to increase inflows (either because of a decrease in profitability or due to substitution) and decrease outflows. Increased benefits may encourage inflows but the impact on outflows is ambiguous. It may decrease outflows as is usually expected but it may increase outflows if there is an 'entitlements effect' à la Mortensen (1977).

(iv) Compositional Variables

We expect that an increase in the proportion of long term unemployed would decrease outflows either due to discouragement of workers or due to employers using long duration as a signal of undesirable characteristics. An important compositional effect on outflows is via the level of past and current inflows. An increase in inflows increases the proportion of the unemployed with high exit probabilities, while on the demand side employers are hiring to replace workers.

(v) Dynamic Adjustment Variables

We used lagged dependent variables as well as the level of inventories (stocks) and average hours. Given constant long-run equilibrium values for the latter two variables, an increase in inventories leads to a fall in hires (outflows) and a rise in fires (inflows). A similar argument (with reversed signs) applies to hours.
(vi) Dummy Variables

As we used seasonally adjusted data we introduced seasonal dummies. In addition we included dummies for extraordinary events like the 'three-day week', the crisis leading up to the 1976 IMF loan and for observations that had to be interpolated due to civil service industrial disputes in 1974 and 1976. Finally, to allow for the effects of employment legislation, we introduced a variable measuring the number of unfair dismissal cases heard which is zero up to 1972(2). This is a proxy for the difficulty that employers face in firing workers due to the legislation introduced in 1972.

(b) Results

In estimating equations (21) and (22) we assumed that the errors satisfied the usual properties. As mentioned earlier, in estimating the equations for males and females we used precisely the same specification (of variables included as well as dynamic specification): we did not carry out a specification search. Having estimated the equations we tested for structural stability by bisecting the sample at 1973(4) and doing a Chow test. We also used a post-sample parameter stability test with three observations at the end of our sample period. For purposes of comparison we reproduce the results for total inflows and outflows as Tables 1 and 2. Tables 1a and 2a are the estimates for Females and Tables 1b and 2b for males.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(inflows)_{t-1}</td>
<td>0.401</td>
<td>5.94</td>
</tr>
<tr>
<td>ln(deviation from trend GDP)_{t}</td>
<td>-0.067</td>
<td>2.25</td>
</tr>
<tr>
<td>ln(real wages and salaries per unit of output)_{t-3}</td>
<td>1.296</td>
<td>8.63</td>
</tr>
<tr>
<td>Δln(employment in production/employment in services)_{t-3}</td>
<td>1.572</td>
<td>2.43</td>
</tr>
<tr>
<td>ln(bankruptcies)_{t}</td>
<td>0.180</td>
<td>4.05</td>
</tr>
<tr>
<td>Δln(hours)_{t}</td>
<td>-0.729</td>
<td>1.70</td>
</tr>
<tr>
<td>ln(real benefits)<em>{t-1} - ln(real earnings)</em>{t-2}</td>
<td>0.315</td>
<td>2.76</td>
</tr>
<tr>
<td>Δln(stocks/GDP)_{t-1}</td>
<td>1.034</td>
<td>4.58</td>
</tr>
<tr>
<td>Δln(stocks/GDP)_{t-2}</td>
<td>0.690</td>
<td>5.26</td>
</tr>
<tr>
<td>no. of unfair dismissal cases_{t}</td>
<td>-0.089</td>
<td>2.40</td>
</tr>
<tr>
<td>Constant</td>
<td>3.663</td>
<td>8.32</td>
</tr>
<tr>
<td>seasonal: Q2</td>
<td>-1.258</td>
<td>4.38</td>
</tr>
<tr>
<td>interpolated observation dummy (1974(IV))</td>
<td>0.135</td>
<td>3.70</td>
</tr>
<tr>
<td>interpolated observation dummy (1976(IV))</td>
<td>0.117</td>
<td>2.94</td>
</tr>
</tbody>
</table>

* indicates variable was instrumented

$R^2 = .92$

Q(8) = 7.265 (Box-Pierce)

Z(4) = 3.094 (Lagrange Multiplier)

Structural change 1973(IV)/1974(IV) : F(14, 24) = 2.13

P(3) = 0.686 (Parameter Stability)
Table 2

Instrumental Variables Estimates of the Outflows Equation

Dependent variable: ln(outflows)$_t$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(inflows)$_t$</td>
<td>0.374</td>
<td>5.54</td>
</tr>
<tr>
<td>ln(inflows)$_{t-2}$</td>
<td>0.113</td>
<td>1.76</td>
</tr>
<tr>
<td>ln(outflows)$_{t-1}$</td>
<td>0.281</td>
<td>3.86</td>
</tr>
<tr>
<td>ln(unemployment stock)$_{t-1}$</td>
<td>0.033</td>
<td>1.87</td>
</tr>
<tr>
<td>$\Delta_t$ ln(real wages and salaries per unit of output)$_t$</td>
<td>-0.571</td>
<td>1.99</td>
</tr>
<tr>
<td>$\Delta_t$ ln(real wages and salaries per unit of output)$_{t-2}$</td>
<td>-0.444</td>
<td>1.85</td>
</tr>
<tr>
<td>ln(deviations from trend GDP)$_{t-3}$</td>
<td>0.092</td>
<td>3.66</td>
</tr>
<tr>
<td>$\Delta_t$ ln(employment in production/employment in services)$_t$</td>
<td>1.856</td>
<td>3.67</td>
</tr>
<tr>
<td>$\Delta_t$ ln(vacancies)$_{t-1}$</td>
<td>0.150</td>
<td>2.90</td>
</tr>
<tr>
<td>ln(proportion of unemployed with duration $\geq$ six months)$_{t-1}$</td>
<td>-0.227</td>
<td>4.65</td>
</tr>
<tr>
<td>$\Delta_t$ ln(real weighted benefits)$_{t-1}$</td>
<td>0.703</td>
<td>5.92</td>
</tr>
<tr>
<td>ln(real weighted benefits)$_{t-3}$</td>
<td>0.456</td>
<td>5.16</td>
</tr>
</tbody>
</table>

Three day week dummy                                        | -0.120      | 3.61        |
1975 crisis dummy                                            | -0.183      | 6.04        |
Interpolated observation dummy                               | 0.093       | 2.72        |
Constant                                                    | 2.914       | 6.14        |
seasonal: Q1                                                 | 0.090       | 5.66        |
seasonal: Q2                                                 | 0.127       | 9.17        |
seasonal: Q3                                                 | 0.040       | 2.54        |

* indicates variable was instrumented

$R^2 = .95$

Q(8) = 6.460 (Box-Pierce)
Z(4) = 7.082 (Lagrange Multiplier)
Structural change 1973(IV)/1974(I): $F(19, 14) = 1.29$
$P(3) = 17.587$ (Parameter Stability)
<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Absolute t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>** ln(inflows)(_t-1) **</td>
<td>0.395</td>
<td>3.895</td>
</tr>
<tr>
<td>ln(deviation from trend GDP)(_t)</td>
<td>-0.147</td>
<td>2.829</td>
</tr>
<tr>
<td>** ln(real wages and salaries per unit of output)(_t-3) **</td>
<td>1.293</td>
<td>5.718</td>
</tr>
<tr>
<td>( \Delta_1 \ln(employment in production/employment in services)(_t-3) )</td>
<td>1.356</td>
<td>1.134</td>
</tr>
<tr>
<td>ln(bankruptcies)(_t)</td>
<td>0.184</td>
<td>2.456</td>
</tr>
<tr>
<td>** ( \Delta_1 \ln(hours) (_t) ) ( ^{a} ) **</td>
<td>-1.227</td>
<td>0.756</td>
</tr>
<tr>
<td>** ln(real benefits)(_t-1) - ln(real earnings)(_t-2) **</td>
<td>0.252</td>
<td>1.340</td>
</tr>
<tr>
<td>( \Delta_1 \ln(stocks/GDP)(_t-1) )</td>
<td>1.028</td>
<td>2.343</td>
</tr>
<tr>
<td>( \Delta_1 \ln(stocks/GDP)(_t-2) )</td>
<td>0.505</td>
<td>1.192</td>
</tr>
<tr>
<td>no. of unfair dismissal cases(_t)</td>
<td>0.139</td>
<td>1.960</td>
</tr>
<tr>
<td>constant</td>
<td>3.200</td>
<td>4.971</td>
</tr>
<tr>
<td>seasonal : Q1</td>
<td>0.027</td>
<td>0.868</td>
</tr>
<tr>
<td>seasonal : Q2</td>
<td>-0.134</td>
<td>2.609</td>
</tr>
<tr>
<td>seasonal : Q3</td>
<td>0.779</td>
<td>1.516</td>
</tr>
<tr>
<td>interpolated observation dummy ((1974(IV)))</td>
<td>0.175</td>
<td>2.254</td>
</tr>
<tr>
<td>interpolated observation dummy ((1976(IV)))</td>
<td>0.235</td>
<td>3.201</td>
</tr>
</tbody>
</table>

* indicates variable was instrumented

** indicates defined for women

\( R^2 = 0.90 \)

\( Q(8) = 5.29 \) (Box-Pierce)

\( LM(8) = 11.20 \)

\( LM(12) = 20.29 \)

\( F_{total}(10,38) = 13.96 \)

\( F_{male}(10,38) = 690.13 \)

Structural Change 1973(IV)/1974(1):

\( F(16,20) = 0.896 \)
Table 2a

Instrumental Variable Estimates of the Female Outflows Equation 1967(3)-1980(2)

Dependent Variable ln(Female outflow)\_t

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Absolute t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(inflows)_t</td>
<td>0.399</td>
<td>5.513</td>
</tr>
<tr>
<td>ln(inflows)_t-2</td>
<td>-0.026</td>
<td>0.3350</td>
</tr>
<tr>
<td>ln(outflows)_t-1</td>
<td>0.408</td>
<td>4.685</td>
</tr>
<tr>
<td>ln(unemployment stock)_t-1</td>
<td>0.074</td>
<td>3.281</td>
</tr>
<tr>
<td>Δ_1 ln(real wages and salaries per unit of output)_t</td>
<td>-1.238</td>
<td>2.920</td>
</tr>
<tr>
<td>Δ_1 ln(real wages and salaries per unit of output)_t-2</td>
<td>-0.033</td>
<td>0.104</td>
</tr>
<tr>
<td>ln(deviations from trend GDP)_t-3</td>
<td>0.098</td>
<td>2.744</td>
</tr>
<tr>
<td>Δ_1 ln(employment in production/employment in services)_t</td>
<td>1.317</td>
<td>1.752</td>
</tr>
<tr>
<td>Δ_1 ln(vacancies)_t-1</td>
<td>0.106</td>
<td>1.646</td>
</tr>
<tr>
<td>ln(proportion of unemployment with duration ≥ six months)_t-1</td>
<td>-0.199</td>
<td>3.468</td>
</tr>
<tr>
<td>Δ_1 ln(real weighted benefits)_t-1</td>
<td>0.611</td>
<td>3.731</td>
</tr>
<tr>
<td>ln(real weighted benefits)_t-3</td>
<td>0.364</td>
<td>2.438</td>
</tr>
<tr>
<td>Three day week dummy</td>
<td>-0.125</td>
<td>2.616</td>
</tr>
<tr>
<td>1975 crisis dummy</td>
<td>-0.229</td>
<td>4.948</td>
</tr>
<tr>
<td>Interpolated observation dummy</td>
<td>0.032</td>
<td>0.649</td>
</tr>
<tr>
<td>constant</td>
<td>1.759</td>
<td>3.379</td>
</tr>
<tr>
<td>seasonal : Q1</td>
<td>0.030</td>
<td>1.408</td>
</tr>
<tr>
<td>seasonal : Q2</td>
<td>0.080</td>
<td>3.724</td>
</tr>
<tr>
<td>seasonal : Q3</td>
<td>0.051</td>
<td>2.165</td>
</tr>
</tbody>
</table>

* indicates variable was instrumented
** defined for women

LM(8) = 13.80
LM(12) = 33.63
F\_2 = 0.95
F\_total(12, 33) = 77.60 coeff.
Q(8) = 8.92 (Box Pierce)
F\_male (12, 33) = 88.21

Table 1b
Instrumental Variables Estimates of the Male Inflows Equation
Dependent Variable: ln(Male inflows)ₜ

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Absolute t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(inflows)ₜ₋₁</td>
<td>0.485</td>
<td>7.136</td>
</tr>
<tr>
<td>ln(deviation from trend GDP)ₜ</td>
<td>-0.066</td>
<td>2.402</td>
</tr>
<tr>
<td>ln(real wages and salaries per unit of output)ₜ₋₃</td>
<td>1.063</td>
<td>7.241</td>
</tr>
<tr>
<td>δₜ ln(employment in production/employment in services)ₜ₋₃</td>
<td>1.471</td>
<td>2.365</td>
</tr>
<tr>
<td>ln(bankruptcies)ₜ</td>
<td>0.154</td>
<td>3.602</td>
</tr>
<tr>
<td>δₜ ln(hours)</td>
<td>3.415</td>
<td>1.847</td>
</tr>
<tr>
<td>ln(real benefits)ₜ₋₁ - ln(real earnings)ₜ₋₂</td>
<td>0.136</td>
<td>1.056</td>
</tr>
<tr>
<td>δₜ ln(stocks/GDP)ₜ₋₁</td>
<td>0.813</td>
<td>3.800</td>
</tr>
<tr>
<td>δₜ ln(stocks/GDP)ₜ₋₂</td>
<td>0.461</td>
<td>4.003</td>
</tr>
<tr>
<td>no. of unfair dismissal casesₜ</td>
<td>-0.183</td>
<td>5.476</td>
</tr>
<tr>
<td>constant</td>
<td>2.575</td>
<td>6.903</td>
</tr>
<tr>
<td>seasonal : Q1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>seasonal : Q2</td>
<td>-0.123</td>
<td>4.671</td>
</tr>
<tr>
<td>seasonal : Q3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>interpolated observation dummy (1974(IV))</td>
<td>0.157</td>
<td>4.403</td>
</tr>
<tr>
<td>interpolated observation dummy (1976(IV))</td>
<td>0.070</td>
<td>1.859</td>
</tr>
</tbody>
</table>

* indicates variable was instrumented.

R² = 0.94
Q(8) = 9.21 (Box-Pierce)

Structural Change 1973(IV)/1974(1): F(14, 24) = 1.507
LM(8) = 11.80
LM(12) = 33.36
Table 2b
Instrumental Variable Estimates of the Male Outflows Equation 1967(3)-1980(2)
Dependent Variable ln(Male outflows)\textsubscript{t}

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Absolute ( t )-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(inflows)\textsubscript{t}\textsuperscript{a}</td>
<td>0.034</td>
<td>0.226</td>
</tr>
<tr>
<td>ln(inflows)\textsubscript{t-2}</td>
<td>0.360</td>
<td>2.617</td>
</tr>
<tr>
<td>ln(outflows)\textsubscript{t-1}</td>
<td>0.269</td>
<td>2.071</td>
</tr>
<tr>
<td>ln(unemployment stock)\textsubscript{t-1}</td>
<td>0.006</td>
<td>0.158</td>
</tr>
<tr>
<td>(\Delta)ln(real wages and salaries per unit of output)\textsubscript{t}\textsuperscript{a}</td>
<td>-0.031</td>
<td>0.069</td>
</tr>
<tr>
<td>(\Delta)ln(real wages and salaries per unit of output)\textsubscript{t-2}</td>
<td>-0.840</td>
<td>2.128</td>
</tr>
<tr>
<td>ln(deviations from trend GDP)\textsubscript{t-3}</td>
<td>0.122</td>
<td>3.094</td>
</tr>
<tr>
<td>(\Delta)ln(employment in production/employment in services)\textsubscript{t}</td>
<td>1.464</td>
<td>1.812</td>
</tr>
<tr>
<td>(\Delta)ln(vacancies)\textsubscript{t-1}</td>
<td>0.116</td>
<td>1.375</td>
</tr>
<tr>
<td>ln(proportion of unemployment with duration ( \geq ) six months)\textsubscript{t-1}</td>
<td>-0.194</td>
<td>2.394</td>
</tr>
<tr>
<td>(\Delta)ln(real weighted benefits)\textsubscript{t-1}</td>
<td>-0.237</td>
<td>1.365</td>
</tr>
<tr>
<td>ln(real weighted benefits)\textsubscript{t-3}</td>
<td>0.376</td>
<td>2.406</td>
</tr>
<tr>
<td>Three day week dummy</td>
<td>-0.122</td>
<td>2.348</td>
</tr>
<tr>
<td>1975 crisis dummy</td>
<td>-0.217</td>
<td>4.522</td>
</tr>
<tr>
<td>Interpolated observation dummy</td>
<td>0.117</td>
<td>2.099</td>
</tr>
<tr>
<td>constant</td>
<td>2.575</td>
<td>3.110</td>
</tr>
<tr>
<td>seasonal : Q1</td>
<td>0.148</td>
<td>3.976</td>
</tr>
<tr>
<td>seasonal : Q2</td>
<td>0.095</td>
<td>3.628</td>
</tr>
<tr>
<td>seasonal : Q3</td>
<td>0.030</td>
<td>1.191</td>
</tr>
</tbody>
</table>

\(\textsuperscript{a}\) indicates variable was instrumented.

Structural Change 1973(IV)/1974(1) = F(19, 14) = 2.355
\(R^2 = 0.90\)
\(\ln(8) = 25.16\)  \(\ln(12) = 33.36\)
\(Q(8) = 9.56\) (Box-Pierce)
(1) Females

The female equations (Tables 1a and 2a) perform surprisingly well considering that there was no experimentation with dynamic specification or with alternative variables or alternative definitions of variables. Looking at the summary statistics first we find that the equations have high explanatory power but, perhaps, more importantly there is little evidence of serial correlation up to eight periods. There is some evidence of serial correlation in the female outflows equation using the Lagrange-Multiplier test when we go as far as twelve periods. However, this test may not be reliable as we lose 12 degrees of freedom in constructing this test. The equations also perform well in terms of the Chow test; we cannot reject the hypothesis that the parameters in the two sub-sets are equal. Finally, all the variables have appropriate signs (and are of reasonable magnitude) except for the unfair dismissals variable. As this variable is zero up to 1972 and then increasing, it may be picking up a trend in increased participation. This needs further investigation. All in all, these results suggest that our model is surprisingly robust. Let us now look at the results in more detail.

Looking at the female inflows equation (Table 1a) first, we find that the structural change variables (although of the same sign as the totals) have lower t-values with the employment in production to services industries losing significance, while bankruptcies are just significant. The former result may be due to collinearity with the wage cost variable (which was constructed using information on the industrial and services sector, see Appendix). It may also be due to the fact that fewer women register as unemployed. Finally, it may just be that this particular lag is inappropriate for females. As we had set out to use the same specification as for
totals we have no results for alternative dynamic specifications. Our aggregate demand variable is correctly signed: the greater the capacity utilisation the lower the inflows. The real wage costs variable comes out strongly with an expected positive sign. The replacement rate (benefit-earnings ratio) is not significant for females. The dynamic adjustment variables (inventories and hours) come out with mixed results: one of the lags on inventories is significant. Although the results are not reported here, the coefficient on lagged employment is very small and insignificant.

Turning to the female outflows equation (Table 2a) we find that because of compositional effects, an increase in inflows increases outflows in the same quarter. The structural change variable loses significance, perhaps due to changes in employment resulting from changes in participation. There are significant aggregate demand effects although vacancies are not significant. Perhaps this is not surprising since the vacancies variable measures total vacancies, not vacancies that are in the (gender-typed) 'female' occupations. The real wage costs variable is very significant and real benefits come with a positive sign. This implies that when benefits increase female outflows increase in order to be eligible to obtain the higher benefits in the future: the so-called entitlement effect. Again we find that the greater the proportion of long term unemployed the lower the outflow, either due to discouragement from searching or due to employers not hiring women with long duration unemployment. Finally, the lagged unemployment stock has a small coefficient and is significantly different from zero and one. Again we find normalising the flow variables by appropriate stocks is a mis-specification.

A final test we carried out was to compare the set of parameters on the total flows equations with those on the female flows equation - we
decisively reject the hypothesis. We also compared them with the
parameters on the male equations and rejected the hypothesis. Thus
although the results for the female equations are pretty good and broadly
similar to that for the totals there is a significant difference in the
magnitudes (elasticities).

Since we argue that a proper study of unemployment shocks should
begin with an analysis of flows we used the identity (1) to generate
within sample dynamic forecasts of unemployment stock using the estimated
inflow and outflow. As can be seen the tracking performance is surpris-
ingly good over a period when unemployment rose quite dramatically.12

(ii) Males

The male equations (Tables 1b and 2b) perform fairly well with the
male inflows equation performing better than the male outflows equation.
Again there was no experimentation with specification. In terms of
summary statistics, both equations have good fits, there is no evidence
of serial correlation in the inflows equation up to eight periods using
either the Box-Pierce statistic or the Lagrange Multiplier test. However,
for the outflows equation the Box-Pierce statistic and Lagrange Multiplier
test results conflict: the former suggesting no serial correlation while
the latter suggesting the presence of serial correlation up to eight periods.
In neither case is there evidence of structural change at the 5% level of
significance. The parameter estimates all have the expected signs and are
of reasonable magnitude.

Looking at the male inflows equation (Table 1b) we find that the
structural change variables come out fairly strongly, the aggregate demand
variables is of the right sign and is significant, and real benefits are
not significantly different from zero. The dynamic adjustment variables
are all significant and as expected. The unfair dismissals variable
suggests that firing of workers was negatively affected by employment protection legislation. When estimated with lagged employment the parameter was very small and not significantly different from zero.

In the male outflows equation (Table 1b), the compositional variable current inflows is no longer significant although lagged inflows is significant. The structural change variable although correctly signed has a low t-value. Real benefits still come up with a positive sign supporting an 'entitlement' effect. Aggregate demand in the output market is significant although the labour market indicator (vacancies) has a low t-value. It is worth noting that the coefficient on the lagged unemployment stock is very small and not significantly different from zero. As mentioned earlier there is some possibility of serial correlation and if we were to experiment with the specification by imposing zero restrictions on some variables we may be able to improve the results. However, we have deliberately eschewed this approach.

As for females we generated within sample dynamic forecasts of male unemployment stock using the estimated inflow and outflow equations. The results are presented in Diagram 2. Again the tracking performance is surprisingly good.

4. Conclusions

We find that an analysis of unemployment flows provides us with a good explanation of unemployment stocks. We are encouraged by our results in this paper which substantiate our earlier work, Junankar and Price (1984). It is especially interesting that when we look at female and male unemployment flows without changing the specification of our model for total flows that we have fairly good results. In particular the results for female unemployment flows suggests that our model is fairly robust. Many previous writers have claimed that it is difficult to model female unemployment:
our results contradict this view. Our general findings are that aggregate demand and structural change are important determinants of unemployment flows and stocks. An increase in real wage costs per unit of output (which decreases profitability of firms) leads to a small increase in unemployment. An increase in unemployment benefits apparently leads to a decrease in unemployment. This may be due to the 'entitlement effect': unemployed workers accepting jobs quickly in order to be eligible for higher benefits in the future. We feel that this result should be treated with caution since the variable measuring unemployment benefits may be inadequate. In general, our results for males and females were similar, although the elasticities with respect to the variables were significantly different.

To conclude, we believe that we should attempt to model flows and if data were available we should model individual components. In our study we had to make several approximations to move from the model to the empirical specification. We believe that this is a useful first step but much more work needs to be done.
Footnotes

1 For example, see Nickell (1982) where he states: 'Furthermore, the data refer only to males since the relationship between registered unemployment and the true level of female unemployment is not known over the whole sample period and where information is available it reveals that this relationship is not stable'. (p.566)

2 This section leans heavily on our discussion paper, Junankar and Price (1983).

3 Our data exclude school leavers but include youths.

4 See Greenhalgh (1980).

5 The adjustment costs are assumed to be internal to the firm due to recruitment and training costs which disrupt production.

6 In Britain, entitlement to unemployment benefits requires a worker to have worked for at least twelve months in the year previous to becoming unemployed.

7 In Mortensen (1970) increasing marginal costs are due to firms choosing to pay higher wages to expand the labour force rapidly. In our model wages are given exogenously and we rely on internal adjustment costs.

8 There is some evidence to suggest that the young are over-represented in voluntary quits and that their exit probability is higher.

9 The total number of firms in an economy is \( n = (m + \mu + d) \).

10 There is a more complete discussion in our paper Junankar and Price (1983).

11 See Appendix for details.

12 The root-mean-square-error is 16.67 thousand where the minimum unemployment stock over the period is 67.2 thousand and the maximum is 562.8 thousand.

13 Note that the coefficient on lagged male unemployment is smaller than that on lagged female unemployment. This is probably because more women leave the labour force from unemployment.
References


Appendix

Data: Sources and Definitions

All variables are in natural logs and are seasonally unadjusted except where otherwise stated. All data are available from the authors.

Inflows

Inflows to G.B. unemployment per quarter, 000s.
Source: Department of Employment. (DE)

Outflows

Outflows from G.B. unemployment per quarter, 000s.
Source: DE

Unemployment Stock

The stock is generated from the identity (1) in the text.

Vacancies

Vacancies excluding youths, 000s, end quarter, G.B.
Source: British Labour Statistics (B.L.S.) and Employment Gazette (EG)

Capacity Utilisation

Defined as the deviation from a log linear trend of real GDP, fitted over the period 1955(I) to 1979(I), where GDP is the expenditure measure at constant (1975) prices.

Earnings

Weekly earnings (old series) G.B. seasonally adjusted, Jan. 1970 = 100 deflated by retail price index.
Source: Economic Trends Annual Supplement (RTAS).

Retail Prices

Retail Price index, quarterly averages, Jan. 1974 = 100.
Source: DHSS Abstract of Statistics for ... (A.S. ...) 1981.
Wages and Salaries for Males

Wages and salaries per unit of output, whole economy, seasonally adjusted, 1975 = 100. Deflated by wholesale price index.
Source: ETAS. 1981.

Wages and Salaries for Females

This was derived as a proxy for wages and salaries per unit of output in services.

\[
\left( \frac{\text{Wages and salaries per unit of output (whole economy)}}{\text{Index of GDP}} \times \frac{\text{Index of Services}}{\text{Index of GDP}} \right) \times \left( \frac{\text{Wages and salaries per unit of output on manufacturing}}{0.283 \text{ Index of Manufacturing Output}} \right) \div \text{whole sale price index.}
\]

Wholesale Prices

Wholesale Price index, 1975 = 100
Source: ETAS.

Benefits for Females

Flat rate benefit deflated by retail prices for single person.
Quarterly averages.
Source: A.S. ... 1981.

Benefits (weighted average) for Males

Weighted average of deflated flat rate and flat rate plus earnings related benefits. Weights from proportions in receipt of benefits.
Sources: A.S. ... 1981, DHSS Social Security Statistics.

Long Duration

Percentage of G.B. unemployed with duration exceeding 6 months.
Start of quarter.
Source: E.G. various.
Bankruptcies

Bankruptcies and Company liquidations in England and Wales.
Seasonally adjusted.
Source: British Business.

Industrial/Services Mix

Ratio of industrial production employment (including agriculture and transport) to non-industrial production employment.
Source: E.C.

Inventories

Ratio of cumulated stock changes with end 1980 benchmark to GDP at 1975 prices.
Source: ETAS.

Hours Worked

Average hours worked in U.K. manufacturing, July 1972 - 100.
Source: ETAS.