

# The Ins and Outs of UK Unemployment

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- ▶ Do inflows or outflows drive unemployment dynamics?
- ▶ Spate of recent US work inspired by Hall (2005) and Shimer (2005, 2007)'s claim that job finding dominates and separations have no cyclical impact.
- ▶ Fujita and Ramey (2009), Davis, Faberman, Haltiwanger and Rucker (2008), Elsby, Michaels and Solon (2009): inflow rate not constant, indeed leads changes unemployment and accounts for just under half of unemployment variance.
- ▶ Should search/matching models have a constant separation rate?
  - ▶ Shimer's work inspired much theoretical development (Blanchard and Gali, 2008; Gertler and Trigari, 2006).

- ▶ BHPS present great opportunity to study UK.
  - ▶ Allow 3-state model including those not in employment  $E$  or unemployment  $U$ : "inactive"  $I$ .
- ▶ Two recent studies Petrongolo and Pissarides (2008) and Gomes (2009) rely on LFS: bigger, but shorter and quarterly. Elsby, Hobijn and Sahin (2008) use annual OECD-LFS data.
- ▶ Quarterly data miss a lot of transitions through 'time aggregation' (Shimer, 2007).
  - ▶ Measuring  $U_{Q1} \rightarrow E_{Q2}$  wrongly omits those who go  $U_{Q1} \rightarrow E \rightarrow (U_{Q2} \text{ or } I_{Q2})$  and wrongly adds those who go  $U_{Q1} \rightarrow I \rightarrow E_{Q2}$ .
- ▶ Missed transitions might well be cyclical, so cyclicalities will be wrongly measured.

- ▶ BHPS data are annual, but in principle capture all spells through recalled job history.
  - ▶ In addition to the 1990-2007 intra-panel spells (Waves A to Q) there are also the (largely) pre-panel labour market/job histories recorded in Waves B and C.

- ▶ Recall error.
  - ▶ Elias (1996), Paull (2002), Jürges (2007).
- ▶ Misclassification error.
  - ▶ Poterba and Summers (1986), Fujita and Ramey (2006).
- ▶ Margin error.
  - ▶ Abowd and Zellner (1985), Poterba and Summers (1986), Fujita and Ramey (2006).
- ▶ Dependent interviewing.
  - ▶ Jäckle and Lynn (2007), Nagypál (2007), Fallick and Fleischman (2004).

## Create monthly dataset.

- ▶ Use Paull (2002) method of reconciling data inconsistencies between Waves.
- ▶ Include all age 16 and above.
- ▶ 127,920 spells across 30,731 individuals are allocated to months (September 1912 to March 2008).
- ▶ 27.12 million month-individual cells.
- ▶ Status classified as E, U or I: 4.09 million individual-month observations.
  - ▶ Within the panel (Sep 90 - Aug 97): 2.99 million E, U or I individual-month observations, 1.74 million with non-zero weight.

$E$	63.9%
$U$	3.7%
$I$	32.4%
$U / (E + U)$	5.5%

*Status proportions (weighted)*

Transitions between months are summed (using weights) to give the various (weighted) flows.

- ▶ 1,469,945 total flows;
- ▶ 1,454,547 excluding missing status but including those where status stays the same;
- ▶ 20,612 flow 'transitions' involving a change of status between E, U or I.

	<b>BHPS</b>	<b>LFS<sup>q</sup></b>	<b>BD</b>
<i>EU</i>	0.31	0.4	0.9
<i>UE</i>	0.33	0.5	1.0
<i>EI</i>	0.34	0.5	1.7
<i>IE</i>	0.27	0.4	2.0
<i>UI</i>	0.09	0.3	0.9
<i>IU</i>	0.07	0.4	0.9
Total	1.40	2.5	7.4

- ▶ As is well known, flows are smaller in the UK than the US.
- ▶ The BHPS-LFS difference may reflect the different sample populations or time aggregation.

### *Monthly flows as proportion of population*

BHPS figures are gross flows divided by sample population, for all individuals aged 16 and over during September 1990 to August 2007.

LFS source: Gomes (2009); calculation based on time aggregation correction of quarterly data for working-age individuals, 1996-2008.

BD are calculated from Blanchard and Diamond (1990, Figure 1); gross flows divided by population, from CPS January 1968 to May 1986 (without Abowd-Zellner adjustment).



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<i>UE</i>	0.33	0.5	1.0		
<i>EI</i>	0.34	0.5	1.7	<i>EE</i>	59.57
<i>IE</i>	0.27	0.4	2.0	<i>UU</i>	3.19
<i>UI</i>	0.09	0.3	0.9	<i>II</i>	34.79
<i>IU</i>	0.07	0.4	0.9	Total	97.55
Total	1.40	2.5	7.4		

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	<b>BHPS</b>	<b>LFS<sup>q</sup></b>	<b>BD</b>		<b>BHPS</b>		
<i>EU</i>	0.31	0.4	0.9		<i>EM</i>	0.42	
<i>UE</i>	0.33	0.5	1.0	<b>BHPS</b>	<i>ME</i>	0.16	
<i>EI</i>	0.34	0.5	1.7	<i>EE</i>	59.57	<i>UM</i>	0.05
<i>IE</i>	0.27	0.4	2.0	<i>UU</i>	3.19	<i>MU</i>	0.05
<i>UI</i>	0.09	0.3	0.9	<i>II</i>	34.79	<i>IM</i>	0.32
<i>IU</i>	0.07	0.4	0.9	Total	97.55	<i>MI</i>	0.05
Total	1.40	2.5	7.4			Total	1.05

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Monthly flow rates are calculated; e.g.  $UE_t / U_{t-1}$  - where  $U_{t-1} \equiv UE_t + UI_t + UU_t + UM_t$ .

- ▶ If a *discrete time* model is correct, these flow rates represent transition probabilities  $\Lambda_t^{UE}$  since then  $UE_t = \Lambda_t^{UE} U_{t-1}$ .
- ▶ Flow rates are individually seasonally adjusted using the Census Bureau's X12 program.

Assuming transition probabilities follow a Poisson distribution, transition probability and transition rate are related as follows:

$$\Lambda_t^{UE} \equiv 1 - \exp^{-\lambda_t^{UE}}$$

- ▶ so the transition rate for job finding is

$$\lambda_t^{UE} \equiv -\ln \left( 1 - \Lambda_t^{UE} \right).$$

I assume that transition rates are constant within months.

Contributions of the various flows to the dynamics of the unemployment rate are calculated:

- ▶ first assuming that actual unemployment is very close to its steady state level.
- ▶ then allowing past flow rates to affect current unemployment.

The dynamics of unemployment are such that:

$$\begin{aligned}
 U_t &= U_{t-1} + EU_t - UE_t + IU_t - UI_t & (1) \\
 U_t &= U_{t-1} + \Lambda_t^{EU} E_{t-1} - \Lambda_t^{UE} U_{t-1} + \Lambda_t^{IU} I_{t-1} - \Lambda_t^{UI} U_{t-1}
 \end{aligned}$$

where (if the discrete-time model is correct)  $\Lambda_t^{EU}$  is the separation probability,  $\Lambda_t^{UE}$  is the job finding probability, and  $\Lambda_t^{IU}$  and  $\Lambda_t^{UI}$  denote the probabilities of moves between inactivity and unemployment and in the reverse direction.

- ▶ *If it is not possible to make more than one transition per month*, transition rates can be read directly from the flows data since then  $UE_t = \left(1 - \exp^{-\lambda_t^{UE}}\right) U_{t-1}$ .

But if individuals can both find and lose a job within a month: in a 3-state model, the measured  $UE$  flow over  $t$

$$UE_t = \underbrace{\left(1 - \exp^{-\lambda_t^{UE}}\right) U_{t-1}}_{\text{effect of time aggregation}}$$

$$+ \underbrace{\int_0^1 \left(1 - \exp^{-\lambda_t^{IE}(1-\tau)}\right) UI_{t+\tau} d\tau}_{\text{effect of time aggregation}}$$

$$- \int_0^1 \left(1 - \exp^{-(\lambda_t^{EU} + \lambda_t^{EI})(1-\tau)}\right) UE_{t+\tau} d\tau$$

▶ will include - wrongly in terms of obtaining the continuous-time transition rate  $\lambda_t^{UE}$  - those who went  $U \rightarrow I \rightarrow E$ .

▶ will exclude - again wrongly in terms of obtaining  $\lambda_t^{UE}$  - those who went  $U \rightarrow E \rightarrow U$  or  $U \rightarrow E \rightarrow I$ .

where  $\mathcal{T} = [0,1)$  is the time elapsed since the last data observation at discrete intervals  $t = \{0,1,2,\dots\}$ .

The above is one equation from the total of three two-equation systems each involving all 6 transition rates.

There is no analytical solution but the system can be solved numerically.

## Does time aggregation matter?

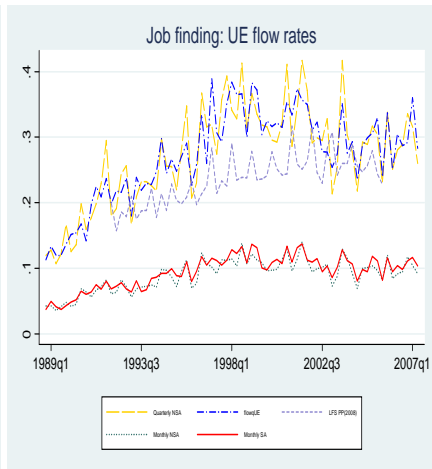
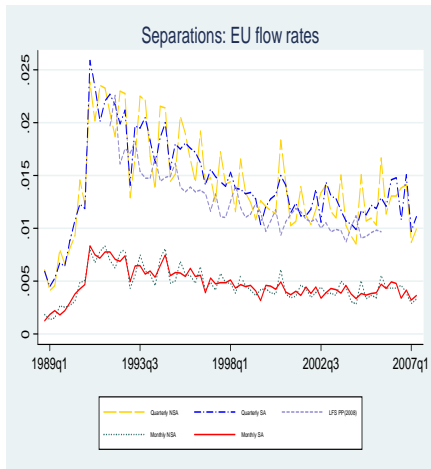
- ▶ BHPS data show that, in the UK, *intra-month* transitions are rare: weighted total 370.09 (unweighted 533) (during panel Sep 90 to Apr 08).
  - ▶ This is 1.8% of the 20,612 weighted total E-U-I transitions during the period.
- ▶ Petrongolo and Pissarides (2008) report little difference in results even with (two-state) *quarterly* UK LFS
  - ▶ but this presumably refers to contributions to unemployment dynamics rather than transition rate estimates.

Can calculate whether intra-quarter flows are important using BHPS data.

The following charts show flow rates:

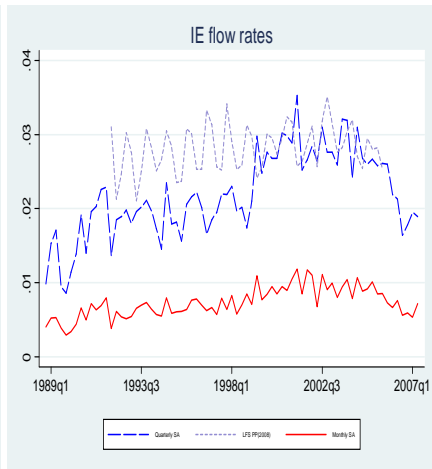
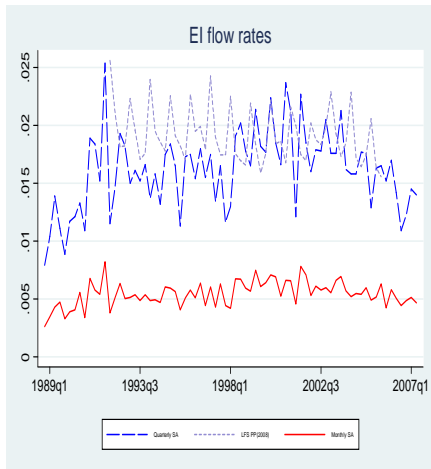
- ▶ Quarterly average of monthly flow rates (SA) forms the basis for later analysis.  $\frac{1}{3} \sum_{m=1}^3 (UE_m / U_{m-1}) = \frac{1}{3} \sum_{m=1}^3 ((\Pr[E_m | U_{m-1}] \times U_{m-1}) / U_{m-1})$ .
- ▶ Quarterly flow rates sum monthly flows over the quarter and divide by the 'base status' at the start of the quarter.  $(\sum_{m=1}^3 UE_m) / U_0 = (\sum_{m=1}^3 \Pr[E_m | U_{m-1}] \times U_{m-1}) / U_0$ .
- ▶ LFS quarterly flow rates just capture the difference in status between start and end of quarter.
  - ▶ omitting relevant transitions that are not maintained until the end of the quarter;
  - ▶ and mistakenly adding status changes that actually result from two other transitions.  $(\Pr(E_3 | U_0) \times U_0) / U_0$ .

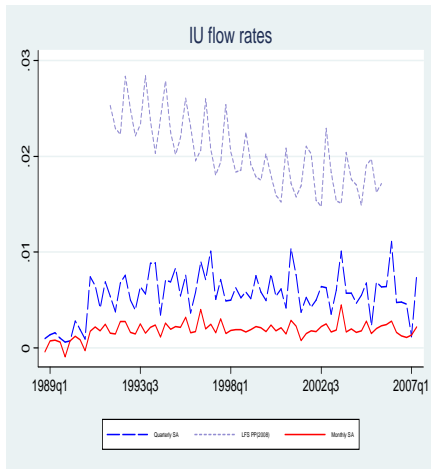
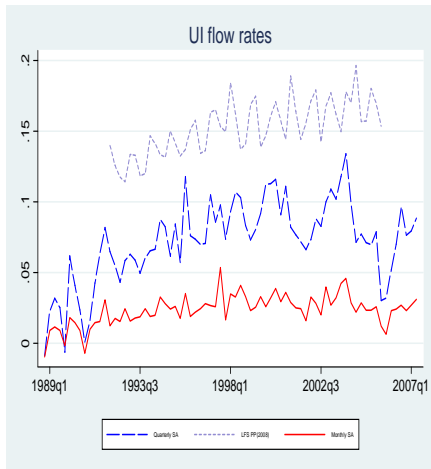




Comparing BHPS and LFS quarterly flow rates gives an indication of the proportion of transitions missed in LFS data through their 'time aggregation' over quarters (meaning that intra-quarter flows that are not maintained for the full quarter are missed, and intra-quarter flows via another state are erroneously included).

Quarterly flow rate	Mean 1992q1-2005q3	
	EU	UE
BHPS	1.47%	29.3%
LFS (PP 2008)	1.26%	23.6%
Implied necessary time aggregation correction	13.8%	17.9%





Simple measures of the relative importance of inflows and outflows in driving unemployment can be derived if we (can) assume that unemployment is well approximated by its steady state value.

- ▶ In continuous time, and in a 2-state world, the unemployment rate evolves according to

$$\dot{u} = \lambda^{EU} e - \lambda^{UE} u \equiv \lambda^{EU} (1 - u) - \lambda^{UE} u. \quad (2)$$

- ▶ Steady state  $\bar{u}$  implies inflows=outflows:  $\lambda^{EU} (1 - \bar{u}) = \lambda^{UE} \bar{u}$ .

- ▶  $\bar{u} = \frac{\lambda^{EU}}{\lambda^{EU} + \lambda^{UE}} \equiv \frac{s}{s+f}$ .

In a 3-state world:

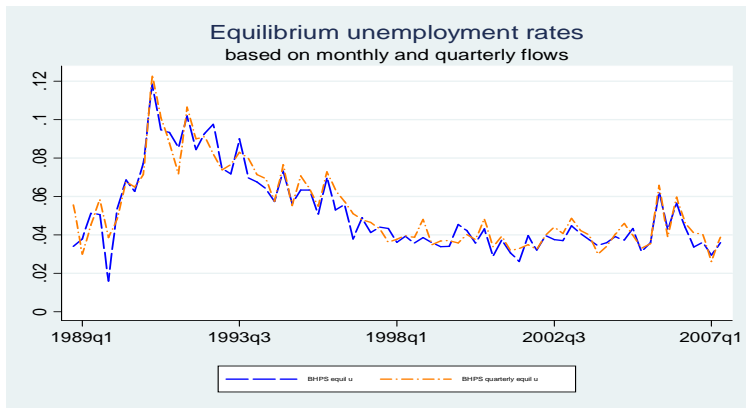
▶ ( $U$  inflows=outflows)  $\lambda^{EU}\bar{e} + \lambda^{IU}\bar{i} = \lambda^{UE}\bar{u} + \lambda^{UI}\bar{u}$

and

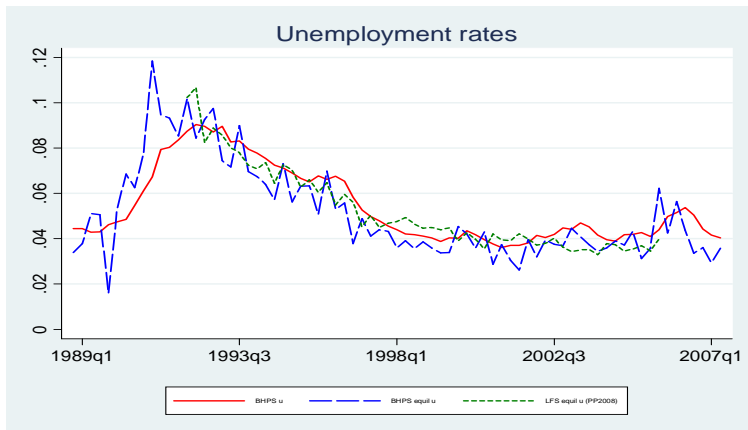
▶ ( $E$  inflows=outflows)  $\lambda^{UE}\bar{u} + \lambda^{IE}\bar{i} = \lambda^{EU}\bar{e} + \lambda^{EI}\bar{e}$ .

Then

$$\bar{u} = \frac{\lambda^{EI}\lambda^{IU} + \lambda^{IE}\lambda^{EU} + \lambda^{IU}\lambda^{EU}}{\lambda^{EI}\lambda^{IU} + \lambda^{IE}\lambda^{EU} + \lambda^{IU}\lambda^{EU} + \lambda^{UI}\lambda^{IE} + \lambda^{IU}\lambda^{UE} + \lambda^{IE}\lambda^{UE}} \cdot \quad (3)$$

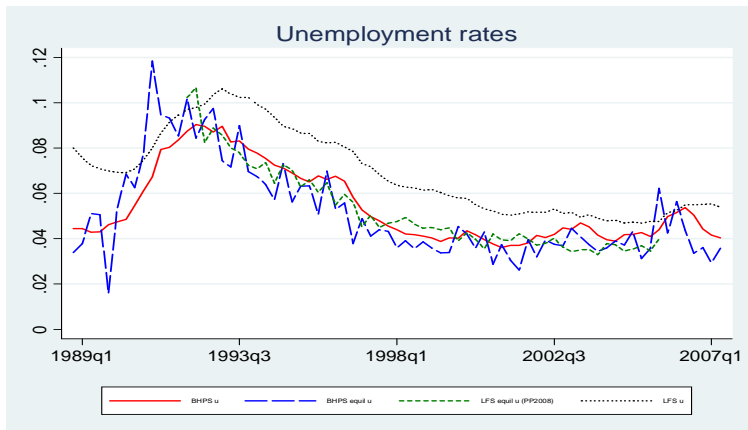


- ▶ Despite the importance of time aggregation for flow rates, steady state unemployment rates calculated on the basis of the relevant (3-state) quarterly and monthly transition rates are almost identical.



- ▶ Actual unemployment based on BHPS stocks moves quite closely with equilibrium unemployment, except when actual unemployment is changing fast.





- ▶ Actual unemployment based on BHPS stocks moves quite closely with equilibrium unemployment, except when actual unemployment is changing fast.

The importance of the speed at which unemployment is changing is clear from rearranging (2):

$$u = \frac{s}{s+f} + \frac{\dot{u}}{s+f}.$$

$\frac{\dot{u}}{s+f}$  will be less important the larger is  $\frac{s}{s+f}$ , i.e. the faster is labour turnover.

- ▶ In the US, the approximation  $u = \frac{s}{s+f}$  holds well (Shimer, 2007; Fujita and Ramey, 2008).

I investigate decompositions allowing for past separation and job finding rates to impact current unemployment.

I will show that deviations from steady state in the UK are common, large, and affect the measured relative importance of job finding and separation.

Shimer (2005), Hall (2005), Shimer (2007): empirical work using CPS showing that separation rate acyclical and job finding rate procyclical.

- ▶ so rise in unemployment during recessions is driven (only) by a reduction in the job finding probability.
- ▶ Finding has influenced development of search-matching models (e.g. Blanchard and Gali, 2008).
- ▶ Recent empirical work, even using Shimer's own data, claims to reinstate a role for separations in driving unemployment.

- ▶ The relative importance of separations and job finding are sometimes measured by their cyclical correlations with unemployment, productivity, ...
- ▶ Alternatively their importance can be measured in terms of their relative contributions to unemployment dynamics.
- ▶ If actual and steady-state unemployment move closely together, simple decompositions can be used (Fujita and Ramey, 2008; Petrongolo and Pissarides, 2008; Elsby, Michaels and Solon, 2009)
- ▶ Rearrange (3):

$$\bar{u}_t = \frac{\lambda_t^{EU} + \frac{\lambda_t^{EI} \lambda_t^{IU}}{\lambda_t^{IU} + \lambda_t^{IE}}}{\lambda_t^{EU} + \frac{\lambda_t^{EI} \lambda_t^{IU}}{\lambda_t^{IU} + \lambda_t^{IE}} + \lambda_t^{UE} + \frac{\lambda_t^{UI} \lambda_t^{IE}}{\lambda_t^{IU} + \lambda_t^{IE}}} \equiv \frac{s_t}{s_t + f_t} \quad (4)$$

- ▶  $\frac{\lambda_t^{EI} \lambda_t^{IU}}{\lambda_t^{IU} + \lambda_t^{IE}}$  capture u inflows working via inactivity.

Then the dynamics of  $u$  can be decomposed into contributions arising from the various flows:

$$\begin{aligned} \Delta u_t &\approx \Delta \bar{u}_t = \frac{s_t}{s_t + f_t} - \frac{s_{t-1}}{s_{t-1} + f_{t-1}} & (5) \\ &= \underbrace{(1 - \bar{u}_t) \bar{u}_{t-1} \frac{\Delta s_t}{s_{t-1}}}_{\Delta u_t^s} - \underbrace{\bar{u}_t (1 - \bar{u}_{t-1}) \frac{\Delta f_t}{f_{t-1}}}_{\Delta u_t^f} \end{aligned}$$

Can use (4) to decompose  $s_t$  and  $f_t$  in (5), obtaining the contributions to steady state unemployment dynamics from separation and job finding rates and the contributions working through inactivity.

Can also obtain 'betas' from (5) (and (4)): the contributions to the variance of  $\Delta u_t$ :

$$\beta^s = \frac{\text{cov}(\Delta u_t, \Delta u_t^s)}{\text{var}(\Delta u_t)}, \quad \beta^f = \frac{\text{cov}(\Delta u_t, \Delta u_t^f)}{\text{var}(\Delta u_t)}$$

$$\beta^{EU} = \frac{\text{cov}(\Delta u_t, \Delta u_t^{EU})}{\text{var}(\Delta u_t)}, \quad \beta^{EIU} = \frac{\text{cov}(\Delta u_t, \Delta u_t^{EIU})}{\text{var}(\Delta u_t)}$$

$$\beta^{UE} = \frac{\text{cov}(\Delta u_t, \Delta u_t^{UE})}{\text{var}(\Delta u_t)}, \quad \beta^{UIE} = \frac{\text{cov}(\Delta u_t, \Delta u_t^{UIE})}{\text{var}(\Delta u_t)}$$

If  $\Delta u_t \approx \Delta \bar{u}_t$  then

$$\beta^s - \beta^f \equiv (\beta^{EU} + \beta^{EIU}) - (\beta^{UE} + \beta^{UIE}) \approx 1, \text{ since}$$

$$\Delta \bar{u}_t \equiv \Delta \bar{u}_t^s - \Delta \bar{u}_t^f.$$

Variance contribution	BHPS	LFS	CPS
$\beta^s$	0.601		
$\beta^f$	0.418		
$\beta^{EU}$	0.279	0.352	0.325
$\beta^{UE}$	0.354	0.133	0.053
$\beta^{EIU}$	0.322	0.364	0.588
$\beta^{UIE}$	0.065	0.151	0.035

*Covariance contributions to unemployment variance*

BHPS: 1988q4-2007q2; LFS (Petrongolo and Pissarides, 2008): Claimant count: 1992q1-2005q3; CPS (Petrongolo and Pissarides, 2008 using Shimer, 2007, CPS data for 1967-2006)

- ▶ Overall, job separations ( $EU$  and  $EI$ ) play the biggest role in unemployment fluctuations.
- ▶ But direct unemployment-employment transitions are more influential than employment-unemployment.



Given the at times graphically obvious deviation of unemployment from steady state, I investigate the impact of allowing for past changes in inflow and outflow rates to affect current unemployment.

A discrete-time version of (2), using  $s$  and  $f$  to represent transition rates in a 2-state model, is:

$$\frac{du_t}{dt} = s_t(1 - u_t) - f_t u_t$$

Solving this forward one month gives

$$u_t = \rho_t \bar{u}_t + (1 - \rho_t) u_{t-1}$$

where  $\rho_t$  is the monthly rate of convergence of  $u_t$  to the steady state  $\bar{u}_t$ :

$$\rho_t = 1 - \exp^{-(s_t + f_t)}$$

If  $\rho_t \neq 1$ , Elsby, Hobijn and Sahin (2008) show that

$$\Delta \ln u_t \approx \underbrace{\rho_{t-1}(1 - \bar{u}_t) [\Delta \ln s_t - \Delta \ln f_t]}_{\Delta u_t^s \text{ and } \Delta u_t^f \text{ as before}}$$

$$+ \underbrace{\rho_{t-1} \frac{1 - \rho_{t-2}}{\rho_{t-2}} \Delta \ln u_{t-1}}_{\text{due to devns from ss caused by past changes in } s \text{ and } f}$$

- ▶ If  $\rho_t = 1, \forall t$ , there are no deviations from steady state.
- ▶ If  $\rho_t = \rho, \forall t$ , changes in  $u_t$  are a distributed lag of current and past changes in  $s_t$  and  $f_t$ .

Contributions to unemployment variance are again expressed in terms of betas.

- ▶ Here  $\beta^s = \frac{\text{cov}(\Delta \ln u_t, C_t^s)}{\text{var}(\Delta \ln u_t)}$  and  $\beta^f$  (similarly defined) represent the contribution to changes in the (log) unemployment rate of the *cumulative* contribution of current and past changes in transition rates  $C_t^s$  and  $C_t^f$ .

$$C_t^s = \rho_{t-1} \left[ (1 - \bar{u}_{t-1}) \Delta \ln s_t + \frac{1 - \rho_{t-2}}{\rho_{t-2}} C_{t-1}^s \right]$$

$$C_t^f = \rho_{t-1} \left[ - (1 - \bar{u}_{t-1}) \Delta \ln f_t + \frac{1 - \rho_{t-2}}{\rho_{t-2}} C_{t-1}^f \right]$$

- ▶ where  $C_0^s \equiv C_0^f \equiv 0$ .

- ▶ There is also a contribution from the initial deviation from steady state at  $t = 0$ :

$$C_t^0 = \rho_{t-1} \frac{1 - \rho_{t-2}}{\rho_{t-2}} C_{t-1}^0$$

- ▶ where  $C_0^0 \equiv \Delta \ln u_0$ ;
- ▶ and a possible contribution from the residual, which captures everything not included in the second-order expansion: it should be zero if the lags used fully capture actual unemployment dynamics.

Variance contribution	BHPS	OECD-LFS
$\beta^s$	0.223	0.569
$\beta^f$	0.021	0.417
$\beta^0$	-0.024	0.008
$\beta^{residual}$	0.779	0.006

*Covariance contributions to unemployment variance*

BHPS: 1988q4-2007q2; OECD-LFS (Elsby, Hobijn and Sahin, 2008): 1983-2007

- ▶ Note that the large residual in the BHPS case results because monthly, rather than annual, unemployment dynamics are involved.

- ▶ Results suggest a role for separations in UK unemployment dynamics.
- ▶ UK unemployment dynamics are clearly more complex than previous models have allowed for.
- ▶ Aspects of flows involving inactivity deserve more attention.
- ▶ Reweighting pre-panel data may avoid some of the apparent recall error observed by Elias (1996) and enable investigation over a larger number of business cycles.

THE END