Gross Worker Flows and the Great Recession in the United Kingdom: Examining the Theory and Evidence

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Abstract

This thesis provides a detailed analysis of the gross worker flows data in the United Kingdom between 1997 and 2010, with particular emphasis on the 2008-09 recession and its aftermath. Utilising flows data from the Labour Force Survey (LFS), the dominant macroeconomic factors driving unemployment in the United Kingdom before, during, and after the recessionary period are identified. The findings of the thesis are then reconciled with other theoretical and empirical literature in the field. Amongst the salient findings of this thesis is a striking decline in job-to-job movements throughout and beyond the recent recession. This discovery adds a new dimension to the existing literature in the field. Other contributions include the use of detrended Gross Domestic Product (GDP) as the cyclical indicator (as opposed to another labour market indicator) and a split-sample analysis, which flags some interesting trend changes in labour market flow movements and transition rates, even prior to the Great Recession.

Key Words: Worker Gross Flows; Hazard Rates; Job-Finding Rate; Job-Separation Rate.

JEL Classifications: E24, J60.

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Preface

This thesis is the culmination of the first 18 months' work of the research degree programme. No subsequent research was developed enough for inclusion before I took a leave of absence from the programme in December, 2012, in order to undertake a work placement at the Cabinet Office. I decided to extend my initial three-month stay after I was offered the opportunity to extend this to two years, before eventually deciding that I would prefer to remain in the Cabinet Office, rather than returning to complete for a PhD. This explains the length of time taken to complete the final MPhil thesis.

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Declaration

I certify that the thesis I have presented for examination for the MPhil degree in Economics at the University of York is solely my own work. Funding for the work was provided by the Economic and Social Research Council (ESRC).

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I warrant that this authorisation does not, to the best of my belief, infringe the rights of any third party.

Any views expressed in the thesis are those of the author and do not necessarily reflect the views held by the Cabinet Office or the Office for Budget Responsibility.

Introduction

The creation of a robust theoretical model of aggregate unemployment is an issue of foremost importance in macroeconomics. In modelling aggregate unemployment, there is an obvious place to start: matching theory. The Nobel Prize in economics was awarded to three pioneering figures of search theory (Diamond, Mortensen, and Pissarides) in 2010. This was recognition of the value of models of the labour market with search frictions in accounting for the observed fluctuations in unemployment.

The seminal work on matching theory, which forms the basis of modern macro-models of the labour market, is attributable to Pissarides (1985) and Mortensen and Pissarides (1994). (A summary of the theory and work in the field is provided by Pissarides, 2000.) The behaviour of aggregate unemployment is most commonly viewed through the lens of search-and-matching theory, as it can account for employment and wage determination, the simultaneous existence of vacancies and unemployment, and job creation and job destruction, within an intertemporal optimising framework. The idea is that the matching process between firms and workers is a costly process (a type of search friction): it is costly for an individual to search and it is costly for a firm to find a suitable person to fill the job. The matching rate (M) between workers and firms at time t is, then, a function of the number of people who are unemployed (U) and the number of vacancies (V):[1]

$$M_t = f(U_t, V_t).$$

[1] Indeed, the key variable in the matching approach to modelling unemployment dynamics is labour market 'tightness', which is defined as the ratio of the number of vacancies to the number of the unemployed (V/U).

Positive shocks create vacancies and cause firms to search for workers to fill them, while adverse shocks increase unemployment and cause workers to look for new jobs, as firms lay workers off. Matching theory is the most commonly applied model of unemployment, and there is certainly empirical merit in the model: phenomena such as the Beveridge curve can be explained through this medium. In spite of this, the model can be criticised for not providing a wholly adequate explanation of the type of unemployment that prevails in the real world. For example, Rogerson and Shimer (2011) argue that they, "[D]o not see much evidence that search behavior per se is of first order importance in understanding aggregate outcomes", (p. 693). Moreover, there is no role for involuntary unemployment in the model. Nevertheless, models with search, they argue, seem promising as a framework for understanding how aggregate labour market outcomes are affected by different wage-setting mechanisms.

The main alternative to matching theory is the theory of efficiency wages. The seminal work in this field is attributable to Shapiro and Stiglitz (1984). The basic idea is that firms are willing to pay a wage in excess of the general wage if a worker's productivity exceeds that of the average worker. Firms wish to avoid workers leaving, since they lose their investment if the worker is trained, and because they wish to avoid incurring the cost of finding a suitable replacement, as is the case in matching theory. The wage premium reduces the labour demand and may also increase labour supply, thus generating involuntary unemployment (particularly if we assume a fixed labour supply). In the Shapiro-Stiglitz model, the prevailing wage premium is supposed to detract workers from shirking, as they face a probabilistic loss if caught shirking. Moreover, firms pay higher wage premiums at times when unemployment is low, as it is easier for a worker to find a new job, and the risk to a worker of being caught shirking is small. This extra incentive not to shirk is required when unemployment is low, but, when unemployment is high, firms pay a lower wage premium, as the potential cost to a worker of being caught shirking is high, and less of an incentive not to shirk is needed.

There are certainly criticisms that can be levied at theories of efficiency wages, though. The main criticisms include reliance on some strong assumptions and the implication that high-skill workers are more likely to experience periods of unemployment than the general worker, since more skilled workers are willing to supply labour than are demanded at the prevailing premium wage. Specifically, in terms of the Shapiro-Stiglitz model (Shapiro and Stiglitz, 1984), the assumption of homogeneous workers is a particularly strong assumption. In actual fact, if employers have a record of a worker's previous employment history, as one would expect, then reputation can feasibly act as an additional discipline device. The fact that future employers will, in all probability, know a worker's previous employment history, is, in effect, a self-enforcing discipline device, insofar as it acts as a screening device for job applicants.

Empirical work such as this thesis clearly has theoretical implications: empirical observations can indicate whether the predictions of a certain theoretical model are borne out in reality, and can suggest key trends in the data that any robust theoretical model should account for. In particular, one may wish to examine the data to see if they are consistent with the search-and-matching approach of Pissarides (2000), or if this approach requires refinement, in line with the rigid wages hypothesis of Shimer (2004, 2010), for example. Moreover, one may ask whether the cyclical behaviour of unemployment is dictated by hires or separations. This is a contentious issue in the field of modern macro-labour economics, which was debated in the path-breaking work of Hall (2006) and Shimer (2012): the 'conventional wisdom' that recessions are primarily driven by high job destruction rates was brought into question.

Certain recent work in the field has even started to accept the Shimer (2010, 2012) finding that job-separation rate is almost acyclical, and attempted to integrate this (along with a dominant role for unemployment duration — the job-finding rate — in determining unemployment fluctuations) into models of the labour market and the economy, more generally (Gertler and Trigari, 2009, for example). Some have provided evidence against the claims of Hall and Shimer (Davis et al., 2006, for instance), emphasising the importance of job separations in driving unemployment, while other papers have found significant roles for both separations and the job-finding rate (Fujita and Ramey, 2007, and Elsby et al., 2009). The analysis of the gross worker flow data at a time such as this (after a deep recession) is therefore clearly a worthwhile activity that can give empirical support to the proponents of particular models.

This thesis analyses the latest job market figures to obtain stylised facts about gross worker flows in the UK, in light of the latest recession: that is, gross worker flows between the three labour market states (employment, unemployment, and inactivity). Job-to-job flows are also examined. The study examines the magnitude and cyclical properties of such flows, and results are compared to those presented in earlier studies of the UK labour market by Bell and Smith (2002) and Gomes (2009, 2012). The study utilises the two-quarter longitudinal data set for the period 1997 Q2 — 2010 Q3, sourced from the Labour Force

Survey, as well as the derived job-to-job flows data used by Gomes (2012). There is also a gender comparison of the rates of employment, unemployment, and inactivity.

This work seeks to incorporate data from the latest recession (beginning in 2008 Q2) into the analysis, and to resultantly shed light on the dominant macroeconomic factors driving unemployment in the UK throughout and beyond the 2008-09 recession. This thesis looks far more explicitly at the recent recession than does Gomes (2012), who looks at the broader picture, over the last 13 years. It is certainly true to say that a close examination of gross worker flows during and beyond the recession is valuable: what happens in recessions ultimately allows us to determine the cyclical nature of flows and hazards for moving between labour market states. These findings give valuable insight to theorists who attempt to create robust macroeconomic models of the labour market. Other contributions include the use of detrended Gross Domestic Product (GDP) as the cyclical indicator (as opposed to another labour market indicator) and a split-sample analysis, which flags some interesting trend changes in labour market flow movements and transition rates, even prior to the Great Recession.

One of the salient findings of this thesis is the striking decline in job-to-job movements during and beyond the recent recession. This striking decline came after a period of almost a decade where such movements had already been on a general downward trend. This has undoubtedly indirectly contributed to the observed rise in UK unemployment. Other key trends found include the substantial fall in the job-finding rate, the notable rise in the job-separation rate, and the fact that men seem to have suffered more than women as a result of the recession.

The thesis is organised as follows: chapter 1 reviews the related theory; chapter 2 reviews the empirical literature; chapter 3 analyses UK gross worker flows over the period investigated, including an examination of changes in the rates of employment, unemployment, and inactivity (overall and by gender), an analysis of gross flows between states, and an investigation of the probability of flowing between states; and the conclusion — which includes consideration of avenues of potential future work in this area, in light of the findings laid out in the thesis — wraps the thesis up.

Chapter 1: Theoretical Perspectives on Gross Worker Flows

1.1 Early Thinking on Gross Worker Flows

Before addressing the numbers, some of the theory on gross worker flows is discussed below. This section provides a useful point of reference later in the analysis, as it can be checked whether the data bears out the predictions of the theoretical models. A non-exhaustive overview of some key, elementary models is provided.

Blanchard and Diamond (1992) present a partial equilibrium model of the flow approach to the labour market, which serves as useful starting point. The flow approach, it is asserted, is built on three building blocks: 1) a specification of labour demand in terms of gross flows of job destruction, x, and job creation, y; 2) a specification of the hiring process through a matching function, m; and 3) a specification of the determination of the wage, w. Their labour demand relation is given by:

$$x = x(w, \theta_x), \qquad x_w \geq 0; \tag{1.1.1}$$

$$y = y(w, \theta_y), \qquad y_w \leq 0, \tag{1.1.2}$$

where w is the wage and θ_x and θ_y represent a vector of factors that shift job destruction and creation respectively. This specification implies a perfectly elastic long-run labour demand, at the wage which is such that $x = y$. Stocks are not incorporated in either the creation or the destruction equations. All flows in this model come from the process of job creation and destruction. Hiring is determined by the constant-returns matching function, given by:

$$h = m(U, V), \qquad m_U > 0; m_V > 0, \tag{1.1.3}$$

where h denotes total hires, U denotes unemployment, and V is vacancies. This implicitly assumes that only the unemployed are engaged in job-search. The final element of the Blanchard and Diamond model is how wages are determined. There are numerous potential approaches, but the paper chooses the efficiency wage approach (with wages set so as to discourage shirking).[2] The wage will depend on the probability of finding a job when unemployed, which, under constant returns in the matching technology, is dependent only on V/U. Therefore:

$$w = w(V/U), \qquad w' > 0. \tag{1.1.4}$$

Utilising equations (1.1.1) to (1.1.4), along with the two accumulation identities for unemployment and vacancies, yields the following two dynamic equations:

$$\frac{dU}{dt} = x[w(V/U), \theta_x] - m(U, V); \tag{1.1.5}$$

$$\frac{dV}{dt} = y[w(V/U), \theta_y] - m(U, V). \tag{1.1.6}$$

The key predictions of their model are summarised below. General movements in aggregate activity are likely to lead to opposite shifts in job creation and job destruction. Such movements usually mean U and V

[2] In fact, the Nash bargaining approach to wage-setting is probably the most prevalent in contemporaneous research. Gertler and Trigari (2009) show that staggered multi-period Nash wage bargaining can help to explain the volatility of unemployment over the business cycle, within the standard Mortensen and Pissarides (1994) matching framework.

move in opposite directions, since increased unemployment is associated with decreases in vacancies, and, thus, with decreases in wages. Times of reallocation, contrarily, are likely to lead to shifts of the same sign in job creation and destruction, meaning U and V generally move in the same direction. In short, the model predicts the number of workers moving from employment to non-employment (unemployment and inactivity) to be countercyclical as jobs are destroyed, while the numbers moving from unemployment to employment should be procyclical as job creation falls.[3]

Blanchard and Diamond (1990) present a model which considers two types of workers, who differ in their attachments to the labour market: 'primary' workers and 'secondary' workers. The former infrequently move into and out of the labour force, indicative of their strong labour force attachment, and have brief spells of unemployment; the latter are more likely to drop out of the labour force, demonstrating weak labour force attachment, and are more likely to spend long periods in both unemployment and inactivity. In summary, secondary workers drop out of the labour force more often, while, typically, a primary worker who leaves employment will move into unemployment.[4]

In an economy with continual job creation and destruction, it is assumed that primary workers only leave employment (E) when laid off; at this point they move into unemployment (U). Put equivalently, they do not quit. Secondary workers leave employment through both layoffs and quits; at this time they move into inactivity (I). Firms are willing to accept both primary and secondary workers, but prefer hiring a primary worker when given the choice. In equations, when subscript 1

[3]Non-employment is not a single labour market state: this was established as long ago as Flinn and Heckman (1983).

[4]The other fundamental aspects of the model are that search behaviour between the two groups and how workers are perceived by firms may both differ, with the latter leading to firms preferring to hire primary workers and preferring to fire secondary workers first.

denotes primary workers and subscript 2 denotes secondary workers:

$$L_1 = E_1 + U; \tag{1.1.7}$$

$$L_2 = E_2 + I, \tag{1.1.8}$$

where L_1 and L_2 are given. Jobs can take three forms: filled (F), unfilled with a vacancy posted (V), or unfilled with no vacancy posted (N). Each job requires a single worker and the total number of jobs is given by K. Therefore:

$$K = F + V + N, \qquad K \text{ given}; \tag{1.1.9}$$

$$F = E = E_1 + E_2. \tag{1.1.10}$$

Filled jobs produce a gross (of wages) revenue of either 1 or 0, with the 0—1 productivity for each job following a Markov process in continuous time. Productive jobs become unproductive with flow probability π_0, while π_1 is the flow probability that an unproductive job becomes productive. A productive job may become unproductive and vice versa at any point in time. This is the "black box" mechanism deployed in order to capture the large gross flows of job creation and job destruction that prevail in the economy. There is also the possibility of movement between states due to quits; primary workers are assumed not to quit, while secondary workers quit at the constant rate, q. Not dissimilarly to the 1992 paper by the same authors, there is an aggregate matching function, in which hires, h, are a function of the pool of non-employed workers and of vacancies:

$$h = m[(U + I), V], \qquad m_U \geq 0; m_V \geq 0. \tag{1.1.11}$$

Since, as aforementioned, it is assumed that employers rank primary workers above secondary workers, a matching function for the primary workers is, implicitly:

$$h_1 = m_1(U, V), \qquad m_{1,U} \geq 0; m_{1,V} \geq 0, \tag{1.1.12}$$

in which I no longer appears. Taking vacancies as given, a larger number of inactive secondary workers does not affect the employment prospects of unemployed primary workers. Finally, the hiring function of secondary workers is:

$$h_2 = h - h_1. \tag{1.1.13}$$

Taken together, the above equations and assumptions lead to the following three equations of motion:

$$\frac{dV}{dt} = -h - \pi_0 + \pi_1 N + qE_2; \tag{1.1.14}$$

$$\frac{dE_1}{dt} = -\pi_0 E_1 + h_1; \tag{1.1.15}$$

$$\frac{dE_2}{dt} = -(\pi_0 + q)E_2 + h_2. \tag{1.1.16}$$

If the economy is subject to an adverse cyclical shock, which leads to an increase in the rate of job destruction, π_0, and a decrease in the rate of job creation, π_1, the model generates a number of predictions:

1. Unemployment has a negative effect on the hires of secondary workers. Because secondary workers are often inactive, flows from inactivity to employment (IE) are likely to be greater when unemployment is low. As such, the flows are predicted to be procyclical, in line with the later work of Pissarides (2000).

2. As layoffs increase, the flows of both types of workers out of the

labour force increase; however, as the pool of employed secondary workers decreases, the number of quits falls, even at a constant quit rate. Hence, while the flow from employment to unemployment (EU) unambiguously increases, it is unclear whether the flow from employment to inactivity (EI) will increase or decrease.

3. On the hiring side, decreases in job creation and quits lead to a decline in job vacancies. Taken together with ranking and the increase in the pool of unemployed primary workers, this sharply decreases the chances of secondary workers finding work. Thus, the flow from inactivity to employment (IE) decreases.

4. What happens to the flow from unemployment to employment (UE) is ambiguous, since the larger pool of unemployed may offset the effect of fewer vacancies, and lead to an increase in the number of hires from unemployment (an increase in the UE flow).

Movements between unemployment and inactivity (UI and IU) are not considered in the Blanchard and Diamond (1990) model; nevertheless, the model has the potential to explain four of the six gross labour market flows between distinct states.

Further, as alluded to by Bell and Smith (2002), any analysis of the labour market is not complete without an examination of job-to-job flows. Pissarides (1994), in his model with on-the-job search, demonstrates that, at least in the beginning of the cycle, job-to-job flows should be procyclical. In the model there are both 'good' and 'bad' jobs, with unemployed workers willing to accept either, while employed workers will only accept good jobs. Employed workers only search if they are in bad jobs. Separations other than quits are assumed to be exogenous. If a job-seeker finds a good job, (s)he accepts it and stays in it until an exogenous separation process moves him (her) to unemployment. On-the-job search predominantly occurs at short job tenures since the accumulation of job-specific human capital ensures that at some point, denoted by τ, the wage growth in the bad job will offset the benefits of switching to a good job with zero tenure. As aggregate activity increases, τ rises because there are more vacancies and the expected search cost is reduced; however, this implies that there are fewer workers in bad jobs at all tenures, since more workers in bad jobs successfully find good jobs. Resultantly, employment in bad jobs declines, although workers in them search for longer. The implication of this is that a rise in aggregate activity will have an ambiguous effect on the steady-state number of employed job-seekers. Nevertheless, in the adjustment from one state to the other, the number of employed job-seekers first rises, before later falling, implying that job-to-job movements should be procyclical, at least in the beginning of the cycle.

1.2 Recent Thinking: Inside the Black Box

Contemporaneous analysis of gross worker flows has most commonly been viewed through the lens of aggregate matching models, stemming from the seminal work of Pissarides (1985) and, at a later date, Mortensen and Pissarides (1994). Pissarides (2000) applies the search-and-matching approach to analyse the interaction between unemployment transitions and macroeconomic equilibrium.

Search-and-matching models are the prevailing school of thought for understanding unemployment dynamics. Their core features are presented below. Given the nature of the paper, the focus is on partial equilibrium theories of the aggregate matching function, as opposed to the larger-scale general equilibrium search-and-matching models, which compute labour market equilibrium by combining the relevant optimising behaviour by firms posting a vacancy and workers negotiating a wage. The origins of such thinking can be traced back to Pissarides (1985). At the most rudimentary level, there exists a matching function at any given time, t, that can be defined as:

$$m_t L_t = m_t(u_t L_t, v_t L_t), \tag{1.2.1}$$

where L is the labour force or labour supply (employed and unemployed workers), u is the unemployment rate (so that uL equals the total number of unemployed workers), v is the vacancy rate per worker in the labour force (so that vL equals the total number of vacancies), and m is the matching rate (so that mL is the total number of matches between unemployed workers and firms posting a vacancy in any given time period). The function is increasing in both arguments, so that:

$$m_u(uL, vL) > 0 \text{ and } m_v(uL, vL) > 0, \tag{1.2.2}$$

with the time subscript having been dropped. (This matching function obviously disregards matches from employment — job-to-job flows — but the model can be extended so as to allow for this possibility.)

Workers and vacant jobs can be viewed as productive inputs which produce a match, leading to a productive job. Creation of employment requires the presence of both unemployed workers and vacant jobs: $m(0,0) = m(0,vL) = m(uL,0) = 0$. In the case of the function exhibiting constant returns to scale (CRS), we can write:

$$m = \frac{m(uL, vL)}{L} = m(u, v). \tag{1.2.3}$$

The matching function, $m(.)$, determines the flow of workers who find a job and who exit unemployment within each time interval. Under CRS, the probability that an unemployed worker finds a job is a function only of the vacancy-unemployment ratio:

$$\frac{m(u,v)}{u} = m(1, \frac{v}{u}) \equiv p(\theta), \tag{1.2.4}$$

where $\theta = v/u$, and is referred to as labour market 'tightness'. The instantaneous probability, p, that a worker finds a job is positively related to θ: an increase in θ reflects a relative abundance of vacant jobs compared to unemployed workers, and leads to an increase in p.

The average length of an unemployment spell is given by $1/p(\theta)$, and is thus inversely related to θ. The rate at which a vacant job is matched to a worker is given by:

$$\frac{m(u,v)}{v} = m(1, \frac{v}{u})\frac{u}{v} = \frac{p(\theta)}{\theta} \equiv q(\theta), \tag{1.2.5}$$

which is a decreasing function of θ: an increase in θ reduces the probability that a vacancy is filled. $1/q(\theta)$ measures the average time that elapses before a vacancy is filled. The dependence of p and q on θ captures the dual externality between agents in the labour market: an increase in the number of vacancies relative to unemployed workers increases the probability that a worker finds a job ($dp(.)/dv > 0$), but at the same time it reduces the probability that a vacancy is filled ($dq(.)/dv < 0$).

It is often assumed, for simplicity, that matches and separations arrive according to a Poisson process in continuous time — this is due to the process' features, which make it relatively straightforward to analyse. Therefore, in terms of the equations above, $p(\theta)$ is the Poisson arrival rate of a match for a vacancy, and $q(\theta)$ is the Poisson arrival rate of a match for an unemployed worker.

In the simplest form of the model, the separation rate — the flow into unemployment from employment — is exogenously determined. Changes in unemployment result from a difference between the flow of workers who lose their job and become unemployed, and the flow of workers who find a job. At each moment in time, a fraction, s, of jobs (corresponding to a fraction, $1-u$, of the labour force) is hit by a shock that reduces the productivity of the match to zero: in this case, the worker loses their job and returns to the pool of unemployed, while the firm is free to open up a vacancy in order to bring employment back to its original level. Given the match destruction rate, s, jobs remain productive for an average period of $1/s$. There has been no shortage of papers that have endogenised the job separation rate, with the most notable work being Mortensen and Pissarides (1994).

Given the assumptions above, it is now possible to describe the dynamics of unemployment. Since L is constant, $d(uL)/dt = \dot{u}L$ and hence:

$$\dot{u}L = s(1-u)L - p(\theta)uL. \tag{1.2.6}$$

Therefore:

$$\dot{u} = s(1-u) - p(\theta)u. \tag{1.2.7}$$

The dynamics of the unemployment rate depend on the 'tightness' of the labour market, θ: at a high value of θ workers easily find a job, leading to a large flow out of unemployment. Steady state unemployment is hence given as:

$$\bar{u} = \frac{s}{s+p(\theta)}. \tag{1.2.8}$$

Since $p'(.) > 0$, the properties of the matching function determine a negative relation between θ and u. Job creation and destruction rates are obtained by dividing the flows into and out of employment by the total number of employed workers, $(1-u)L$. The rate of destruction is simply equal to s, while the rate of job creation is given by $p(\theta)[u/(1-u)]$.

Each value of θ corresponds a unique value for the unemployment rate, u. The properties of $m(.)$ ensure that it is convex. Moreover, given u and θ, the number of vacancies is uniquely determined by $v = \theta u$, where v denotes the number of vacancies as a proportion of the labour force, L. The graphical relationship between the unemployment and vacancy rates, which is downward-sloping and convex in the u-v space, is known as the Beveridge curve — the locus identifies the level of vacancies v_i that corresponds to the pair (θ_i, u_i). It is important to note that variations in the labour market 'tightness', θ, are associated with a movement *along* the u-v curve, while changes in the separation rate, s, or the efficiency of the matching process (captured by the properties of the matching function) correspond to movements of the u-v curve *itself*.

The theory presented above constitutes the basic building blocks of matching theory. The function can be estimated itself, or the building blocks of this partial equilibrium set-up can also be extended to larger-scale models that encompass search behaviour by workers seeking a job and employers seeking to fill a vacancy. General equilibrium in search-and-matching models is computed by incorporating optimising behaviour by firms and workers; these search-and-matching models seek to examine the relationship between unemployment transitions and macroeconomic equilibrium. Obvious potential extensions that have been undertaken include allowing for on-the-job search (Pissarides, 1994) and endogenising the job separation rate (Mortensen and Pissarides, 1994), amongst many others.

An abundance of literature has been produced that aims to empirically estimate the matching function. Diamond (1982) finds that increasing returns to scale in the matching function lead to multiple equilibria; however, the overwhelming majority of empirical studies in the field find the matching function exhibits CRS, which is theoretically convenient (Petrongolo and Pissarides, 2001). Estimates of the matching function often take — but are certainly not restricted to — a Cobb-Douglas form — for example:

$$m_t = M(u_t, v_t) = \mu u_t^{\alpha} v_t^{\beta}, \tag{1.2.9}$$

where μ is a scale parameter capturing changes in the efficiency of the matching process that would impact on all searchers equally. CRS implies that $\alpha + \beta \approx 1$. This function is estimated by the application of a linear or log-linear (not purely logarithmic due to the inclusion of additional linear regressors) econometric specification.

The Cobb-Douglas functional form was previously assumed without there being any micro-foundations to justify this choice; however, Stevens (2007) creates a micro-founded, aggregate matching function that can be directly integrated into standard theoretical search models. A constant elasticity of substitution (CES) matching function, which is approximately Cobb-Douglas when search costs are approximately linear, is generated, with empirical estimates of matching function parameters interpretable as the costs and benefits of search. Petrongolo and Pissarides (2001) provide a comprehensive survey of the aggregate matching function, and the findings of a wide range of different associated studies which make use of different matching function specifications, finding most support for CRS specifications.

The main predictions of matching models in the context of labour market flows are that: job destruction rates drive unemployment in recessions; and that flows from inactivity into both employment and unemployment are procyclical (in line with the Blanchard and Diamond, 1990, model). In terms of the latter, the intuition is as follows: participation is higher when wages are higher, when the labour market is tighter (labour market 'tightness' is defined as the V/U ratio), and when the rates of job loss and interest are lower. Resultantly, one may expect flows from inactivity into both employment and unemployment to be procyclical, as the labour market becomes tighter as the employment rate increases.[5]

1.3 A New Paradigm?

The assertion that recessions are predominantly driven by high job loss rates had, perennially, been accepted as a stylised 'fact' in macroeconomics (Pissarides, 1985; Darby et al., 1986; Blanchard and Diamond, 1990; Pissarides, 2000). Recent papers by Hall (2006) and Shimer (2012), however, challenged the generally accepted view that increased separations drive recessions, with the three salient findings of the latter being: 1) the job-separation rate is almost acyclical; 2) separation rates contribute little to the variability of unemployment; and 3) unemployment dynamics are, in large part, driven by a job-finding rate that fluctuates at business cycle frequencies. Indeed, Shimer (2012) argues that increased unemployment during recessions arises from an increase in unemployment duration, as opposed to an increase in the number of unemployed workers.

[5] This reasoning follows the intuition of Bell and Smith (2002).

Shimer (2010) lays out the analytical argument and quantitative evidence in detail. The book focuses on the importance of the 'labour wedge' in determining unemployment dynamics over the business cycle. The 'labour wedge' is the ratio of the marginal rate of substitution of consumption for leisure (MRS) and the marginal product of labour (MPL). Under unrealistic theoretical assumptions (the most obviously contentious being the absence of taxes on consumption and labour), the two would equate; however, the existence of taxes drives a 'wedge' between the MRS and the MPL. This 'wedge' is shown to be strongly countercyclical over the business cycle: during recessions, it is shown that workers are dissuaded from working and firms dissuaded from hiring, due to a perceived increase in the effective labour income tax rate. In the absence of such taxes, modifications to the basic model that are empirically consistent with such tax increases are considered. Examples of this include an assumption that the representative household's disutility of labour fluctuates at business cycle frequencies (that is, households prefer not to work in recessions), and the observationally-equivalent hypothesis that workers' wage-setting power fluctuates at business cycle frequencies (that is, recessions are periods when households reduce their labour supply, in order to drive up wages). These are, however, not seen as adequate nor accurate explanations of movements in the 'labour wedge'. Search frictions are also shown to exacerbate inconsistencies between the competitive search-and-matching model and the data. It is argued, though, that real wage rigidities (the rigid wages hypothesis, discussed above), coupled with search frictions, can help help to reconcile the model and the data, as they create an endogenous cyclical 'wedge' between the MRS and the MPL.

In corroboration, Hall (2006) and Shimer (2012) have brought the question of whether hires or separations drive unemployment in recessions to the forefront of the research agenda. Shimer postulates that the Mortensen and Pissarides (1994) approach does not explain the observed cyclical volatility of its key variable, the V/U ratio (that is, labour market 'tightness'). With according alterations being made to the methodology, the putative, sustained increase in layoffs at the start of a downturn is shown not to be borne out by the evidence; in actual fact, recessions are shown to be characterised by a short-lived, sharp rise in employment to unemployment flows, and a large, prolonged decline in unemployment to employment flows, which is the predominant driver of unemployment dynamics over the course of the business cycle (Rogerson and Shimer, 2011). Work in this field has subsequently gone down two distinct and separate roads: models that incorporate the ideas of Hall and Shimer, and those that provide evidence against their claims. It is generally agreed that extensions to the canonical model are required, however, in order to reconcile the model with observed labour market dynamics.

1.4 Extensions to the Canonical Model

Particularly as a result of the path-breaking work of Hall (2006) and Shimer (2012), there has been a plethora of papers produced that have extended the canonical matching model. Such papers include those that consider general interactions with the economy as a whole, in full-scale general equilibrium models of the economy. This section discusses some interesting extensions to the basic model that have been calibrated, in order to assess whether they provide a better understanding of the cyclical behaviour of aggregate unemployment.

A paper that takes approach of Shimer is Blanchard and Galí (2010). In a model with constant job destruction rates, rigid wages are shown to generate inefficient and volatile fluctuations in unemployment.[6] On a related note, Hall (2009) finds that the cyclicality of the 'labour wedge' is eliminated in a model where wages are rigid but hours are efficiently bargained over.

Rigid wages are also incorporated into the Blanchard and Galí (2007) model via the real wage being backward-looking, with the current wage being a weighted average of the previous period's wage and the MRS. This change, as opposed to wages being perfectly flexible, is shown to both amplify and propagate shocks to the economy.[7] Gertler and Trigari (2009) go one step further than Blanchard and Galí. They modify the Mortensen and Pissarides (1994) model of unemployment dynamics to allow for staggered, multi-period wage contracting. This approach appeals to the proponents of the Shimer (2004, 2010) model, since it suggests that wage stickiness helps to explain the relatively volatile behaviour of unemployment over the business cycle. They assume that workers and firms negotiate only periodically, bargaining so as to satisfy the Nash solution, and fixing the wage until the next opportunity to renegotiate arises. Critically, the negotiated wage applies not only to the firm's existing workers, but also to any new workers it might hire. As a result, firms that last negotiated their wage prior to an adverse productivity shock will have little incentive to recruit new workers following said shock. It is once more

[6] Whether job destruction should be endogenous or exogenous is also debated in the associated job-search literature, as an assumption of a constant, exogenous separation rate is tantamount to Shimer's finding that the job separation rate is close to being acyclical.

[7] Shimer (2010) calculates the current real wage as a weighted average of the previous wage and the current wage that would prevail if there were Nash bargaining. This, again, significantly propagates shocks, without impacting upon the comovement of wages and labour productivity.

shown that this amplifies the effect of shocks on the labour market, with little consequence for overall macroeconomic equilibrium.

Pissarides (2009) acknowledges that the search-and-matching model's inability to explain the observed volatility of unemployment over the business cycle is a shortcoming to be addressed, but he does not believe wage stickiness is necessarily the answer to the "unemployment volatility puzzle". Rather, in a model with endogenous job creation and destruction, Pissarides (2009) concludes that the solution to the puzzle must be one that preserves the wage elasticities implied by the canonical model, citing the introduction of fixed job creation and negotiating costs, asymmetric information about idiosyncratic shocks, on-the-job search, and non-uniform productivity shocks as potential explanations. Indeed, Krause and Lubik (2010) build on the on-the-job search model by Pissarides (1994), discussed above, and conclude that on-the-job search and job-to-job transitions greatly amplify shocks to the economy.

Given the disparate predictions of the models of Pissarides (2000) and Shimer (2010), the latest recession provides crucial data on the dynamics of unemployment, enabling the economist to address the issue of which model best fits the UK labour market.

Chapter 2: Previous Empirical Evidence on Gross Worker Flows

2.1 UK Evidence

2.1a Gross Worker Flows in the UK

This subsection briefly reviews the empirical literature on gross worker flows. The focus is mainly on literature that specifically examines the UK labour market. Having used LFS data for the period 1993 to 2001, Bell and Smith (2002) found that, for the UK:

1. Flows from employment to unemployment are countercyclical, while the reverse flow (from unemployment to employment) is also countercyclical.

2. Flows from employment to inactivity tend to be procyclical, while flows from unemployment to inactivity appear to be countercyclical.

3. Flows from inactivity are imprecisely measured, so one can have little confidence when making any statement on their cyclical characteristics.

4. Job-to-job flows are strongly procyclical.

In relation to the final point, those engaged in search are, intuitively, more likely to make a job-to-job transition than those who are not (Pissarides and Wadsworth, 1994; Bell and Smith, 2002; Gomes, 2012). Importantly, however, it has also been suggested that certain types of individuals are more likely to make such job-to-job transitions. More specifically, job characteristics are crucial determinants of the likelihood of an individual moving between jobs. Pissarides and Wadsworth (1994) show that workers with long job tenures are much less likely to move between jobs because these individuals have less to gain from search, due to the acquisition of firm-specific capital.[8] It is also shown that younger people are more likely to be engaged in search, and that search — and in particular employed search — is a more attractive option for skilled as opposed to unskilled workers.

In a more recent paper, Gomes (2012) finds broadly similar results to those in Bell and Smith (2002) when using an extended data set, running from 1996 to 2010. Most of the aggregate flows are found to be stable within the sample, meaning the Bell and Smith conclusions remain valid. Gomes demonstrates that flows from inactivity to unemployment are strongly countercyclical, supporting the findings of Bell and Smith, who however lacked conviction on this result. Nevertheless, certain results differ and a number of new findings are stated. For example, the cyclical behaviour of the flows between inactivity and employment are shown to have changed since 2001: Bell and Smith demonstrate that the flows were not related to the business cycle before 2001, but Gomes' analysis suggests that these flows have since become procyclical. Furthermore, Gomes suggests a potentially important extension to the analysis of gross worker flows: the analysis of flows within education groups. The share of the highly educated is increasing and, at the same time, the labour market opportunities of different education groups are diverging: less-educated individuals are shown to face unemployment and inactivity rates three times greater than for those with higher education. Furthermore, the less-educated face a job-separation rate double that of the highly-educated, and a

[8] This finding is consistent with the model presented in Pissarides (1994).

job-finding rate that is half of the value for the highly-educated. This is consistent with the Blanchard and Diamond (1990) model of 'primary' and 'secondary' workers, with the highly-educated representing the 'primary' workers.

In another contemporaneous examination of the UK economy, Gregg and Wadsworth (2010) examine data on gross worker flows and other key macroeconomic indicators, in light of the latest recession. The impact of the recession is shown to have been much less severe than was perhaps expected in terms of the impact on the UK labour market. Despite a fall in Gross Domestic Product (GDP) of over 6% — a drop, in fact, that was both longer and deeper than in the previous two recessions — the loss of employment was much smaller. The UK, it is noted, is in a small group of countries that have witnessed small drops in the employment rate, in spite of not having a deliberate government-funded strategy of short hours working. The substantial decline in UK GDP coupled with a relatively minor worsening of the labour market situation has been coined the "productivity puzzle". The puzzle has yet to be adequately explained, but some early evidence suggests that weak productivity figures in the years following the Great Recession are likely to be "persistent effects" from the financial crisis, rather than temporary, cyclical factors which will dissipate as the economy recovers (Bank of England, 2014).

Typically, one may expect hours of work to fall in a recession. This is shown to indeed be the case in the most recent recession, while the observed rise in part-time working is consistent with this finding; this decline in hours worked is not unique to this recession, though. In fact, hours worked fell by less in this recession, while the last two recessions show similar or sharper rises in the share of part-time work.

What, then, has led to the better-than-expected performance of the UK employment rate? Gregg and Wadsworth (2010) convincingly argue that this may be attributable to labour hoarding. Where possible, firms may seek to keep hold of their workforce through a recession, instead taking a short-term hit on profitability, as the loss of staff knowledge, particularly if it will be needed again in the near future, is costly. The gap between consumer wage growth and that faced by producers, induced by the substantial increase in real consumer wages and the decline in real wage growth to firms, is cited as a factor that is likely to have enabled firms to hoard labour during the recession. Higher profitability pre-recession and good profitability performance since may have helped, too. Firms cannot continue to hoard labour, however, without economic growth.

Gregg and Wadsworth (2010) also show that the rise in the unemployment rate in this recession has been small relative to the fall in GDP. Unemployment rate dynamics in the latest recession were characterised by a sharp rise, which preceded an early — even before the recession's end — stabilisation. Employment outflows are shown to be lower than in past recessions, while the outflow from unemployment into employment remained higher in this instance than in past downturns. Flows into inactivity, meanwhile, have been falling or stable in recent years, while outflows from inactivity into unemployment have risen. On the other hand, outflows from inactivity into employment are as low in this recession as in previous ones. From this, it is deduced that, "Unemployment in this recession has been driven by a combination of lower rates of job loss and slightly higher return rates to work than in past recessions", (Gregg and Wadsworth, 2010, p. 12).

Other related issues noted include: long-term unemployment is on the rise, although it is still much lower than the levels seen in past recessions; unemployment levels amongst less-educated young people in this recession were well above those of previous recessions; and the situation for older workers is much better than in previous contractions. The youth unemployment rate, in this recession, is found to be nearer three times that of prime-age adults, rather than double as in the past. Gregg and Wadsworth therefore suggest a further dimension to the Gomes (2012) assertion that less-educated workers face adversarial labour market conditions: it is ostensibly the less-educated young that suffer most.

Furthermore, a rise in the inactivity rate, albeit modest, is reported by Gregg and Wadsworth (2010). On the basis of past experience this rate may be expected to increase later in the cycle, though, since inactivity usually rises in a UK recession, although it typically lags behind movement in the unemployment rate by around one year. In a further observation, the authors note the increase in the number of young people staying on in both further and higher education. Such rates have risen in past recessions and the latest downturn has also seen a considerable rise. Indeed, inactivity rates discarding full-time students have been on a gradual decline since the 1990s recession. Using this logic, the authors show that the small rise in inactivity observed in this recession has, so far, been mainly down to increased participation in education.

Finally, it has previously been found that job-to-job changes account for most of labour turnover in the UK (Pissarides and Wadsworth, 1994). On a related note, Mumford and Smith (1999) show that flows between jobs is the largest of the three potential flows into employment (from unemployment, inactivity, and job-to-job), when using Australian labour market data. This is supported by Nagypál (2008), who shows that not only are job-to-job flows a pervasive feature of the US labour market, but that they are also essential to understanding worker turnover over the business cycle. Clearly, it would be remiss of any author to exclude job-to-job flows from their analysis.

2.1b Hazard Rates: Intuition and UK Evidence

It is imperative to note the distinction between gross flows and hazard rates. The simplest interpretation of a hazard rate is that it represents the probability of moving from one state to another (conditional on having been in the previous state between t_0 and t). In contrast, the flow simply gives the number of people moving between states. Crucially, for the same flow movement, the gross flows and hazard rates may diverge in terms of cyclicality. For example, one may expect the hazard rate for moving between unemployment and employment (UE) to fall in a recession (procyclical), although the incidence of such flows may increase due to an increase in the stock of unemployed (countercyclical). Intuitively, one may expect the hazard for the reverse move, from employment to unemployment (EU), to be countercyclical, although whether or not there is a wave of separations at the start of a recession is clearly a source of much contention, as demonstrated above. The evidence presented in Bell and Smith (2002) and Gomes (2012) suggests that the EU hazard is countercyclical in the UK.

Initially, it is unclear whether the unemployment-to-inactivity (UI) hazard or the inactivity-to-unemployment (IU) hazard will follow a particular pattern. There are likely to be countervailing forces pushing the UI hazard up and down simultaneously. More unemployed workers may become 'discouraged' during a recession and move into inactivity, increasing the hazard rate and hence making it countercyclical, though this effect may be offset if the pool of unemployed has increased. Both Bell and Smith (2002) and Gomes (2012) find a significantly procyclical hazard rate, implying that the probability of making a UI transition decreases in a recession. The cyclical pattern of the IU hazard is also theoretically and intuitively ambiguous. Nevertheless, both papers find a strongly countercyclical hazard.[9] The implications of the four results presented above are well summarised by Gomes (2012): [R]ecessions are periods when it is harder for an unemployed individual to find a job, an employed person is more likely to lose their job and an inactive person is more likely to start looking for one", (p. 10).

Why inactive people are more likely to begin job-search in a recession is unclear, given the facts and intuition imply it is more difficult to find a job in such times. This, too, seems counterintuitive since the opportunity cost of leisure is lower during a recession.[10] Although it is harder to find work, the fact that the labour market becomes looser (a rise in the number of flows between the three labour market states) in a recession may encourage individuals to start looking for work.

There are three more transition probabilities to consider: namely, employment-to-inactivity (EI), inactivity-to-employment (IE), and job-to-job (JJ). Once more, intuition struggles to predict the cyclical behaviour of the first two hazards. Bell and Smith (2002) find the EI hazard to be weakly countercyclical. Contrarily, Gomes (2012) finds the hazard to be weakly procyclical over the whole sample, not related to

[9]Again, Bell and Smith (2002) suggest readers err on the side of caution when interpreting their hazard rates out of inactivity — just as readers are encouraged to be cautious when interpreting flows out of inactivity — due to imprecise measurement and a lack of confidence on any statement of their cyclical characteristics.

[10]As explained by the Intertemporal Substitution Hypothesis.

the business cycle in the first sub-sample, and significantly procyclical in the second sub-sample. Of the *IE* hazard: Bell and Smith find it to be insignificantly procyclical, whereas Gomes finds the hazard to be insignificantly (and more weakly) procyclical over the full sample, unrelated to the business cycle in the first sub-sample, and significantly (albeit relatively weakly) procyclical in the second sub-sample. To complete the analysis, it is reasonable to conjecture that the *JJ* hazard will be procyclical, which is indeed evidenced by both papers.

2.2 International Evidence

Much of the literature in the field has focused on the US labour market. Although UK and US labour markets differ in terms of structure and frictions, it is important to still summarise some of the associated literature and their key findings. There is also some discussion of findings for other European and OECD labour markets in the survey below. Hall (2006) and Shimer (2012) are the main empirical studies that promote the rigid wages hypothesis, with subsequent work that accepted their findings attempting to build theoretical models of the labour market that went further towards reconciling the canonical model (with search frictions and rigid wages) and the claims of Hall and Shimer; most of the subsequent empirical literature provides evidence against their claims, though.

Davis et al. (2006) use new US micro-data sources to demonstrate that whether the job-loss or job-finding rate plays a dominant role in changes in unemployment depends heavily upon the severity of the employment downturn: the job-loss rate is shown to dominate in severe downturns. Elsby et al. (2009), meanwhile, find that there is a significant role for both hires and separations in explaining US unemployment dynamics, by merely applying a slight refinement to the theoretical approach of Shimer (2012), even when using the same data. This paper improves on the data correction methods of Shimer, whose methodology accounts for the effects of survey redesign and time-aggregation in the US Current Population Survey (CPS). Firstly, the authors generate a more stable corrected series for the problematic short-term unemployment series in the CPS. Secondly, they correct for time-aggregation bias by imputing weekly discrete-time hazard rates for the unemployment inflow. This improves on Shimer's continuous-time methodology, as it is consistent with the discrete weekly nature of the CPS labour force definitions. Similarly, Fujita and Ramey (2007) find that neither the job-finding rate nor the job-separation rate can, per se, account for all of the aggregate fluctuations in US unemployment; again, a role for both factors is found.

Haefke et al. (2013) show that the wage of newly-hired workers, unlike the aggregate wage, is volatile, responding to one-to-one to changes in labour productivity: that is, wages in new matches are flexible, but wages in existing matches are not. This form of wage rigidity is shown to not affect job creation, and so it cannot explain the "unemployment volatility puzzle". Pissarides (2009) finds the same when testing, via microeconometric methods, a model with fixed matching costs that allows wage flexibility in new matches. Rogerson and Shimer (2011) argue that this finding is not inconsistent with the rigid wages hypothesis, though, as the observation that wages are as volatile as labour productivity is shown to be uninformative about whether wages are rigid.

Elsby et al. (2013) use publicly-available data on unemployment by duration spell to estimate the job-finding and separation rates for

OECD countries. Building on the methodology of Shimer (2012), the authors use data on unemployment by duration of spell. For the US (and indeed the UK), they find that the calculated job-finding rate is quite different depending on which unemployment length was used, which can be interpreted as evidence of duration dependence (a well-known empirical fact of course being that the probability of moving from unemployment to employment depends on the duration of the unemployment spell). This demonstrates the importance of the job-finding rate in recessions: as the stock of unemployed increases, average duration is likely to increase, which will impact on the unemployment rate in the medium-term as those experiencing longer unemployment spells struggle to find employment.

Blanchard and Portugal (2001) also found an analogous result, but with job flows in a comparison of US and Portuguese labour markets. They find that, at a quarterly frequency, job creation and job destruction in Portugal are substantially lower than in the US, although the unemployment rate is roughly the same in the two nations. The two labour markets differ considerably in terms of frictions, in that there is more employment protection in Portugal. This reduces the job-separation rate, but, on the other hand, unemployment duration is longer, which impacts unemployment dynamics through a lower job-finding rate. The two forces push against once another, thus having an ambiguous impact on the unemployment rate.

Petrongolo and Pissarides (2008) assess the relative importance of unemployment inflows and outflows in the France and Spain (as well as the UK). In a similar finding to that of Blanchard and Portugal (2001), labour market frictions are shown to impact on unemployment inflows and outflows (and thus which dominates and drives unemployment dynamics in that particular country). In France, the dynamics of unemployment are driven almost entirely by the outflow rate — this is consistent with a regime that has strong labour market institutions and strict employment protection legislation (this is similar to the case of Portugal, discussed in the previous paragraph). Both rates are shown to contribute significantly to aggregate unemployment dynamics in Spain, and this is attributed to the high incidence of fixed-term contracts since the late 1980s. In the UK, the inflow rate became a bigger contributor after the labour market reforms of the mid-1980s, although its significance was shown to have subsided again in the late 1990s and 2000s.

Finally, the finding in subsection 2.1a that, in the UK, more inactive people beginning to search for a job during a recession is also found in the US labour market (Şahin et al., 2010). These authors suggest that this finding may be attributable to the failure of men — who perhaps had been prompted to rejoin the labour force by a decline in household liquidity — to find a job upon re-entry. Alternatively, this may be explained by the Pissarides (1994) model of on-the-job search, which implies that hires from unemployment are, in effect, 'crowded out' by hires from employment (job-to-job transitions) during expansions.

The usefulness of Labour Force Survey (LFS) data for the purpose of analysing how UK data fits with the models discussed in chapter 1 was previously hindered considerably because the sample did not include relevant data for a significant economic downturn; now it does, rendering this a most appropriate time to analyse gross flows and unemployment dynamics in the UK labour market.

Chapter 3: An Empirical Application: The UK Case

3.1 Modelling Labour Market Dynamics

Before discussing the findings, it is first important to outline some notation used and discuss some of the fundamental equations describing labour market dynamics and the movement between states. There are three labour market states: employment (E), unemployment (U), and inactivity (I). These sum to give the working-age population, W:

$$W \equiv E + U + I. \tag{3.1.1}$$

The labour force, L, is a subset of the working-age population, made up of the economically active (those either in employment or those actively seeking it):

$$L \equiv E + U. \tag{3.1.2}$$

The unemployment rate, u, is defined as the number of unemployed as a proportion of the labour force:

$$u \equiv \frac{U}{L}. \tag{3.1.3}$$

Furthermore, the participation rate, p, is defined as the labour force as a proportion of the working-age population:

$$p \equiv \frac{L}{W}. \tag{3.1.4}$$

Total employment evolves according to the following equation:

$$E_{t+1} = E_t + H_t^{UE} + H_t^{IE} - S_t^{EU} - S_t^{EI}, \tag{3.1.5}$$

where H represents the gross hiring flow (from U or I), S the gross separations flow (from E), and the superscript indicates the flow movement from state A (A=E, U, I) to state B (B=E, U, I), with $A \neq B$: for example, UE represents the flow from unemployment to employment. In words, total employment at the end of period t equals the number in employment at the start of period t, plus those entering E from either U or I, minus those exiting E to either U or I.[11]

During period t, one can denote In_t^A as the number of people who flow into state A (A=E, U, I) and Out_t^A as the outflow out of state A. This allows us to define a simple intertemporal constraint for each labour market state, similar to those presented by Bell and Smith (2002):

$$E_{t+1} = E_t + \mathrm{In}_t^E - \mathrm{Out}_t^E; \tag{3.1.6}$$

$$U_{t+1} = U_t + \mathrm{In}_t^U - \mathrm{Out}_t^U; \tag{3.1.7}$$

$$I_{t+1} = I_t + \mathrm{In}_t^I - \mathrm{Out}_t^I. \tag{3.1.8}$$

Equation (3.1.6) is a simplification of (3.1.5) and, similarly, (3.1.7) and (3.1.8) are simplifications of equations (3.1.12) and (3.1.16), respectively. This constitutes the gross flow approach to the analysis of labour markets, focused on by, for example, Blanchard and Diamond (1990). It is possible to focus on the total gross flows as the determinant of changes in the employment rate. Deducting E_t from both sides of equation (3.1.5) and

[11] This equation implicitly assumes a steady state population: that is, $L_{t+1} = L_t = L$.

normalising by the total working-age population gives:

$$\frac{E_{t+1}-E_t}{W_t}=\frac{H_t^{UE}}{W_t}+\frac{H_t^{IE}}{W_t}-\frac{S_t^{EU}}{W_t}-\frac{S_t^{EI}}{W_t}. \tag{3.1.9}$$

Alternatively, one may wish to think of the flows in terms of hazard rates, as advocated by Shimer (2010, 2012). If this is the case, (3.1.9) may be written in terms of hiring rates, h, and separation rates, s, by again deducting E_t from both sides of (3.1.5), before this time normalising by E_t:

$$\frac{E_{t+1}-E_t}{E_t}=h_t^{UE}+h_t^{IE}-s_t^{EU}-s_t^{EI}. \tag{3.1.10}$$

Equivalently, (3.1.9) can be written in terms of transition probabilities, with λ^{CE} denoting the hiring probability from pool C (C=U, I), and γ^{EC} similarly denoting the separation probability to pool C:

$$\frac{E_{t+1}-E_t}{E_t}=\lambda_t^{UE}\frac{u_t}{1-u_t}+\lambda_t^{IE}\frac{1-p_t}{p_t(1-u_t)}-\gamma_t^{EU}-\gamma_t^{EI}. \tag{3.1.11}$$

Similar decompositions are available for the changes in unemployment and inactivity. Unemployment evolves according to the following equation:

$$U_{t+1}=U_t+S_t^{EU}+Y_t^{IU}-H_t^{UE}-Y_t^{UI}, \tag{3.1.12}$$

where Y represents movements between U and I. Again, it is possible to focus on either gross flows or hazard rates. In gross flow terms, we have:

$$\frac{U_{t+1}-U_t}{W_t}=\frac{S_t^{EU}}{W_t}+\frac{Y_t^{IU}}{W_t}-\frac{H_t^{UE}}{W_t}-\frac{Y_t^{UI}}{W_t}. \tag{3.1.13}$$

Meanwhile, in hazard rate terms, one can write:

$$\frac{U_{t+1}-U_t}{U_t}=s_t^{EU}\frac{E_t}{L_t}\frac{L_t}{U_t}-f_t^{UE}+\frac{Y_t^{IU}-Y_t^{UI}}{L_t}\frac{L_t}{U_t}, \tag{3.1.14}$$

where f is the job-finding rate. Equivalently:

$$\frac{U_{t+1} - U_t}{U_t} = \gamma_t^{EU} \frac{1 - u_t}{u_t} + \psi_t^{IU} \frac{1 - p_t}{p_t u_t} - \lambda_t^{UE} - \psi_t^{UI}, \tag{3.1.15}$$

where ψ denotes the probability of making the transition between U and I indicated by the superscript. Lastly, inactivity evolves according to:

$$I_{t+1} = I_t + S_t^{EI} + Y_t^{UI} - H_t^{IE} - Y_t^{IU}. \tag{3.1.16}$$

Once more, the economist can focus on gross flows, as in equation (3.1.17), or hazard rates, as in equations (3.1.18) and (3.1.19):

$$\frac{I_{t+1} - I_t}{W_t} = \frac{S_t^{EI}}{W_t} + \frac{Y_t^{UI}}{W_t} - \frac{H_t^{IE}}{W_t} - \frac{Y_t^{IU}}{W_t}; \tag{3.1.17}$$

$$\frac{I_{t+1} - I_t}{I_t} = s_t^{EI} \frac{E_t}{L_t} \frac{L_t}{I_t} - f_t^{IE} + \frac{Y_t^{UI} - Y_t^{IU}}{L_t} \frac{L_t}{I_t}; \tag{3.1.18}$$

$$\frac{I_{t+1} - I_t}{I_t} = \gamma_t^{EI} \frac{(1 - u_t) p_t}{1 - p_t} + \psi_t^{UI} \frac{u_t p_t}{1 - p_t} - \lambda_t^{IE} - \psi_t^{IU}. \tag{3.1.19}$$

Transition rates from state A (A=E, U, I) to B (B=E, U, I) can then be calculated as:

$$\lambda_{t+1}^{AB} = -\ln(1 - \frac{AB_t}{A_t}), \tag{3.1.20}$$

where, again, $A \neq B$.

Referring back to the canonical model, discussed above, it was shown that in a two-state world, where there is no labour force growth, continuous time steady state unemployment is given by:

$$\overline{u}_t = \frac{s_t}{s_t + f_t}, \tag{3.1.21}$$

where, once more, s_t and f_t are the (instantaneous) unemployment inflow and outflow rates, respectively. In a three-state world, the continuous time stocks (pools) of the three labour market states evolve as follows:

$$\dot{E}_t = \lambda_t^{UE} U_t + \lambda_t^{IE} I_t - (\lambda_t^{EU} + \lambda_t^{EI}) E_t; \tag{3.1.22}$$

$$\dot{U}_t = \lambda_t^{EU} E_t + \lambda_t^{IU} I_t - (\lambda_t^{UE} + \lambda_t^{UI}) U_t; \tag{3.1.23}$$

$$\dot{I}_t = \lambda_t^{UI} U_t + \lambda_t^{EI} E_t - (\lambda_t^{IU} + \lambda_t^{IE}) I_t, \tag{3.1.24}$$

where λ_t denotes the (instantaneous) transition rate at time t and the superscripts denote the relevant movement between states.

In this set-up, there is no allowance for movements between jobs. It will later be shown that such movements are of considerable importance, and should, in future, be factored into simple equations that explain the evolution of labour market stocks — as well as in any robust theoretical model of labour market dynamics.

A final comment on notation is required. The '$\rightarrow$' symbol is used to denote total movements into or out of a particular labour market state. For example, $E\rightarrow$ denotes total employment outflows (to U and I), while $\rightarrow E$ is used for total employment inflows (from U and I). The '$\rightarrow$' is absent for flows between labour market states; for example, *EI* denotes flows from employment to inactivity, while the converse, *IE*, is used for the opposite flow (from inactivity to employment). *JJ* denotes job-to-job flows.

3.2 The Data

The study utilises the two-quarter longitudinal data set for the period 1997 Q2 — 2010 Q3, sourced from the LFS, and the job-to-job flows series of Gomes (2012), which was derived from the same source. Office for National Statistics (ONS) census population weights are applied to the constructed series, implying that non-response bias is compensated for, and estimates produced are interpretable for the population. Non-response occurs if an individual does not take part in the survey. This may take two forms: after taking part in the survey in earlier periods, individuals may not be contactable in later periods (non-contact), or an individual may refuse to participate (refusal). For the LFS, the rate of the former is around 5%, while the rate of the latter is between 10% and 15% (Gomes, 2012). The weighting procedure accounts for the fact that non-response is more likely to be associated with certain individual characteristics.

A further complication that is more difficult to deal with is that of response error bias. This occurs when respondents provide incorrect information (knowingly or unknowingly) about their current status. In longitudinal data this is certainly a more serious problem. Recent empirical evidence, as summarised in the Economic and Social Data Service (ESDS) user guide for two- and five-quarter longitudinal data sets, suggests that response error is likely to affect longitudinal data sets, most probably in the direction of an upward bias in estimates of gross flows between different broad economic activity categories.[12] This is consistent with theory, which suggests flows will be overestimated, as errors are cumulative. The guide also makes some (tentative) suggestions about particular transitions that are likely to be affected. Included in this list are *UI* flows. The fact that such flows will, in all likelihood, suffer from upward bias, is something we should particularly bear in mind. There is apparently no practical way to deal with response error bias, however. Nonetheless, Gomes (2012) argues there is no a priori reason to believe that response error bias will affect the

[12] Available at: http://www.esds.ac.uk/doc/6459/mrdoc/pdf/lfs_longitudinal.pdf. Retrieved on 2nd February, 2011.

cyclical properties of the gross flows.

Each series is seasonally adjusted. They are likely to exhibit distinct seasonal patterns (such as a large increase in the flow into employment at the end of the academic year) and the data need to be adjusted to account for these observed patterns. Therefore, the standard X12 seasonal adjustment is applied to each series. This is standard practice, although we are assuming that no prior adjustments to the data, before seasonally-adjusting, are required, so as to account for, say, trend breaks, seasonal breaks, or outliers. In order for a clearer pattern to emerge when the adjusted gross flows data are graphed, a four-quarter moving average is applied, which removes the rather pronounced, high frequency movements in the data. Doing this removes white noise seasonal components and allows for interactions between the business cycle and seasonality (Blanchard and Diamond, 1990).

No correction for potential time-aggregation bias has been applied to the data, given the focus of this thesis: as the thesis focuses on the cyclical nature of labour market flows and hazards, no adjustment has been made in this respect. Such adjustments are necessary for analyses that attempt to determine the relative importance of unemployment inflows and outflows in determining the dynamic behaviour of aggregate unemployment. As discussed below, though, such an analysis is not undertaken in this thesis, as the focus here is on the cyclical nature of flows and hazards over the entire sample, and two shorter sub-samples, in the mould of Bell and Smith (2002). This focus is as opposed to the thesis making an attempt to decompose unemployment rate dynamics in the UK, attaching relative weights to the importance of unemployment inflows and outflows respectively, as this has been done over a similar period by Gomes (2012). While slight downward bias with an appropriate cyclical indicator may be induced by the exclusion of some flows that actually occurred, there is no a priori reason to think that making a time-aggregation adjustment will affect the cyclical properties of labour market flows data: that is, there is no reason to believe, in the UK, that the size of these excluded flows is sufficiently large to impact the cyclical properties of the flow movement under which they are classified.

3.3 UK Gross Worker Flows: 1997 Q2 — 2010 Q3

3.3a Average Gross Flows

Figure 1 summarises the average quarterly worker flows from 1997 Q2 to 2010 Q3. Reported are the number of people, k, in thousands, who changed status, the average stocks and flows, p, as a percentage of the working-age population, and the hazard rate, h, for moving between states (that is, the probability of transitioning from one state to another, having been in the previous state during the previous time period). In this instance, as the Figure presents average stocks and flows since 1997 Q2, the used data are not seasonally-adjusted. It should also be noted that, in order to concentrate on worker flows between different labour market states, new entries and exits from the working-age population have been excluded from the analysis, consistent with Bell and Smith (2002) and Gomes (2012). The latter argues that this is reasonable since only a minority of young people enter the labour force directly when they come of age (16 years old), and, similarly, more than half of the people reaching retirement age (65 for men and 60 for women at the time this analysis was undertaken) are already inactive.

The data reveal that over the time period investigated there was, on average, a 73,000 net increase in employment, a 15,000 net decrease in unemployment, and a 58,000 net decrease in inactivity each quarter. The most important point to note here is that substantial quarterly gross flows lie behind the net values. While, for example, there was a 73,000 net quarterly increase in employment, this masks an average move of 870,000 people out of employment each quarter (with approximately 58% going into inactivity), while an average of 943,000 people move into employment (with an almost 50:50 split from unemployment and inactivity). Between the official start of the recession (in 2008 Q2) and 2010 Q1, there was a net decrease of 304,000 in the level of employment (a net decrease of 38,000 people per quarter). Meanwhile, net unemployment increased by 696,000 (a rise of 87,000 people per quarter) and net inactivity has fallen by 392,000 (a quarterly drop of 49,000 people). 2010 Q2 and 2010 Q3 figures show signs of recovery, though: the employment pool grew by 577,000, the unemployment pool fell by 11,000, and the inactivity pool fell by 566,000 (with around 46% of inactivity leavers entering employment).

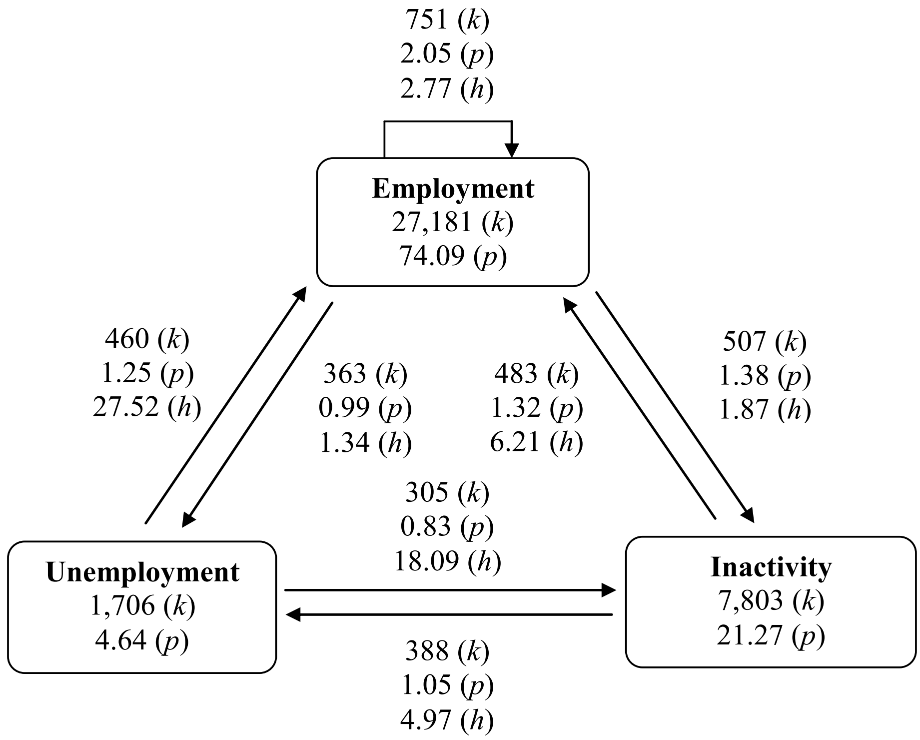

Figure 1. Average Quarterly Working-Age Population Worker Flows: UK, 1997 Q2 — 2010 Q3

Sources: LFS and author analysis

Notes: Working-age population is defined as men aged 16-64 and women aged 16-59. Worker flows are expressed as a total number of people in thousands (k), as a percentage of the working-age population (p), and as a hazard rate (h). Average quarterly job-to-job flows are indicated by the arrow out of and back into the employment pool.

Since the data set runs from 1997 Q2 to 2010 Q3, and the data used by Gomes (2012) for his comparable analysis runs over a similar period (1996 Q2 — 2010 Q4), the results presented here are similar to those presented by him. Resultantly, the discussion is kept brief, as the main focus of this work is the examination of gross flows since the 2008-09 recession. A noteworthy difference between Figure 1 and a similar analysis presented in Bell and Smith (2002) is the larger stock of unemployed found in their study. The strong growth of the UK economy from 2001 until the recession is likely to account for most of observed drop in the stock of the unemployed. The stock values in Figure 1 sum to a higher total than those presented by Bell and Smith, as expected, given the observed growth of the working-age population over time.

3.3b The Evolution of Labour Market Stocks, Flows, and Hazards

In this subsection the evolution of the employment, unemployment, and inactivity rates, the evolution of the outflows from each state (broken down into outflows into the other two remaining states, as a percentage of the working-age population), and the evolution of the hazard rate (transition probability) for exiting a particular state (again broken down into rates for moving into the two remaining states) are examined, over the investigated period. It is imperative to note that this sample includes data from the latest recession, and thus overcomes one major limitation of LFS data: the fact that many data were only available from 1996 onwards, and the period 1996 — 2008 constituted a long-lived expansion. Vertical lines are used to indicate the recessionary period (2008 Q2 — 2009 Q4), as per the Bank of England definition.

In terms of the employment rate, we have seen a pronounced and continual drop of around 2.40 percentage points (a proportional drop of around 3.20%) since the official start of the recession in 2008 Q2 (refer to Figure 2). The period before the recession was characterised by an increasing rate until around 2001, before the rate eventually stabilised, ostensibly around its steady-state value. It is also important to note that the drop was sudden, and the downward trend in the employment rate continued until 2010 Q2. There was no observed improvement in the performance of this indicator up until this date; and the increase at this date was indeed infinitesimal.

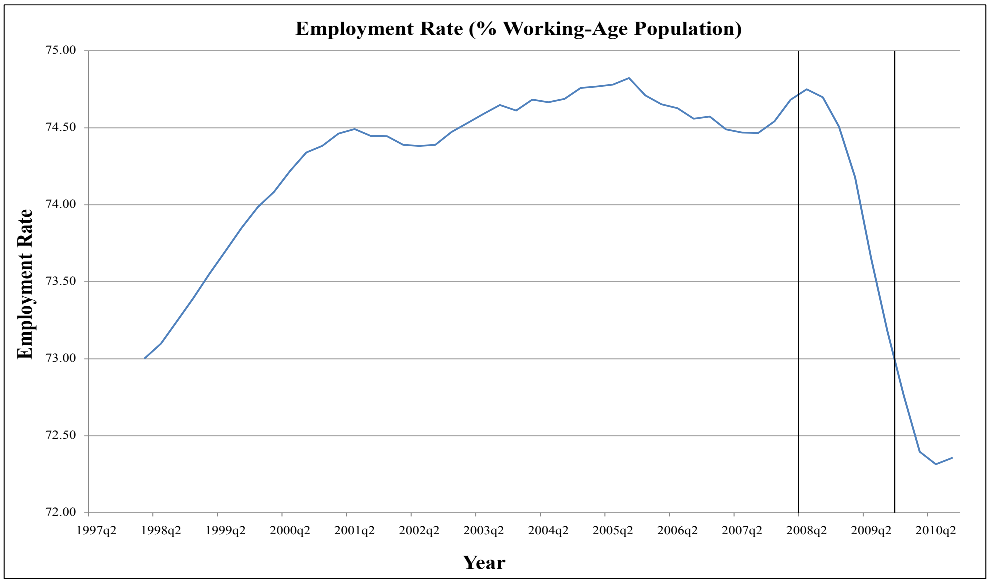

Figure 2. Evolution of the Employment Rate: UK, 1997 Q2 — 2010 Q3

Sources: LFS and author analysis

What has driven this decline in employment? Figure 3 shows how outflows from employment have evolved over time. *EI* flows appear to have fallen by 0.20 percentage points since the onset of recession (a proportional drop of around 15%); however, the drop in *E* outflows from this particular source has been more than offset by the increase in *EU* flows. From peak-to-trough, this flow movement increased by approximately 0.43 percentage points through the recession (a proportional rise of in excess of 30%). Although in recent quarters there appears to have been a drop in such flows, one can already state that employment outflows to unemployment appear to have played a significant role in driving UK unemployment through the recession. The evidence on employment outflow hazard rates (see Figure 4) further corroborates this argument. A negligible drop in the *EI* hazard and a considerable rise in the *EU* hazard are found — results that are not dissimilar to those found in Figure 3.

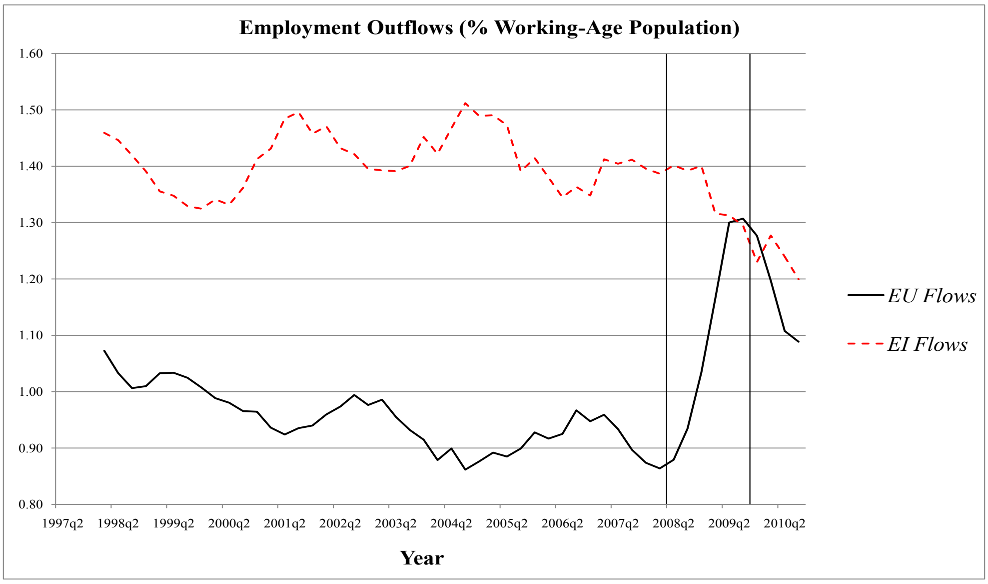

Figure 3. Evolution of Employment Outflows: UK, 1997 Q2 — 2010 Q3

Sources: LFS and author analysis

What about outflows from unemployment? Since the official start of the recession, the UK unemployment rate has increased by over 2.50 percentage points (see Figure 5). This constitutes a rise of almost 50%. The rate followed a path of gradual decline from the start of the sample, in 1997, again levelling off around 2001. The rate then remained relatively stable until the recession.

Figure 6 demonstrates how *UE* and *UI* flows gradually fell from the start of the sample up until around 2002, which, of course, is consistent with the observed fall in the unemployment rate. Both rates have risen since the recession began (by around 15% and 35%, respectively). The *UE* increase has been relatively small and was not instantaneous, while the *UI* increase has been more sizeable and immediate. A caveat is required here, though: as noted in section 3.2, the longitudinal nature of the data may bias this flow upwards.

The *UE* hazard rate, meanwhile, has fallen dramatically (refer to

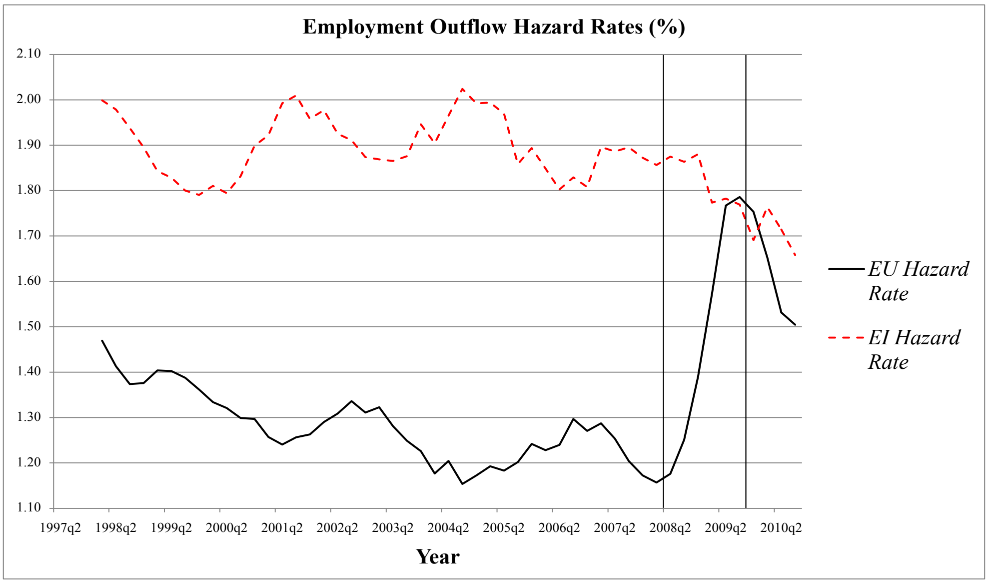

Figure 4. Evolution of Employment Outflow Hazard Rates: UK, 1997 Q2 — 2010 Q3

Sources: LFS and author analysis

Figure 7). The hazard was following a general pattern of increase until the mid-2000s when it took a considerable drop. This was followed by a brief recovery until the onset of recession, in 2008 Q2. Peak-to-trough, it fell by around 8.50 percentage points, a proportional fall of close to 30%. The *UI* hazard rate has fluctuated slightly over the sample, yet still broadly remained between 17% and 20%. The rate has fallen to below 17% since the recession started, though — falling by circa 2.50 percentage points (a 15% drop). The Figure seems to suggest the *UI* hazard has begun following a general upward trend, although it is too early to tell if this trend will continue.

The economic inactivity rate has tended to gradually fall (with some fluctuation) over the sample. Figure 8 shows that the recessionary period has seen the first noteworthy rise of about 0.45 percentage points in the rate of inactivity since the early 2000s (a proportional rise of about 2%). This rise was, however, not immediate.

We can see from Figure 9 that *IE* flows were, on average, trending

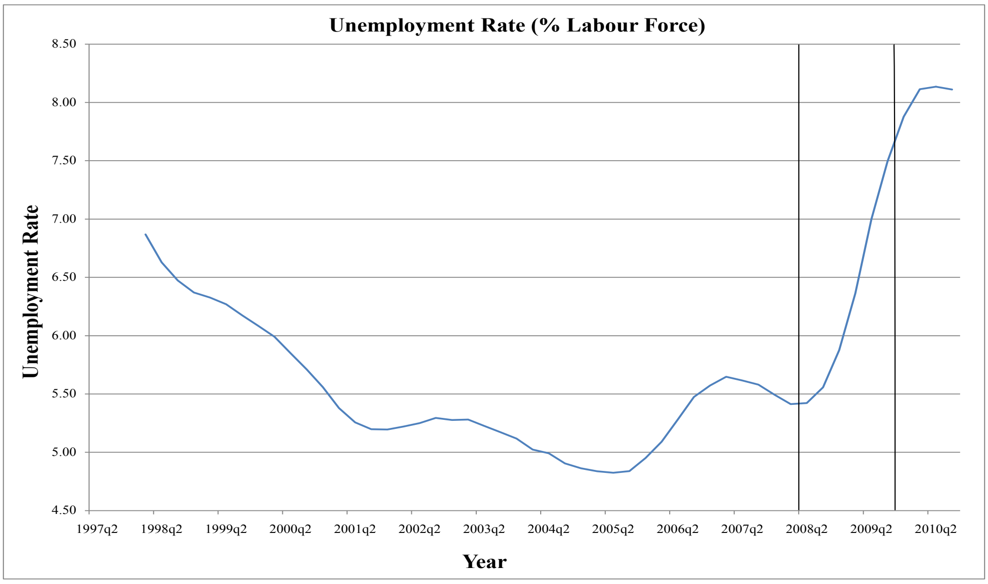

Figure 5. Evolution of the Unemployment Rate: UK, 1997 Q2 — 2010 Q3

Sources: LFS and author analysis

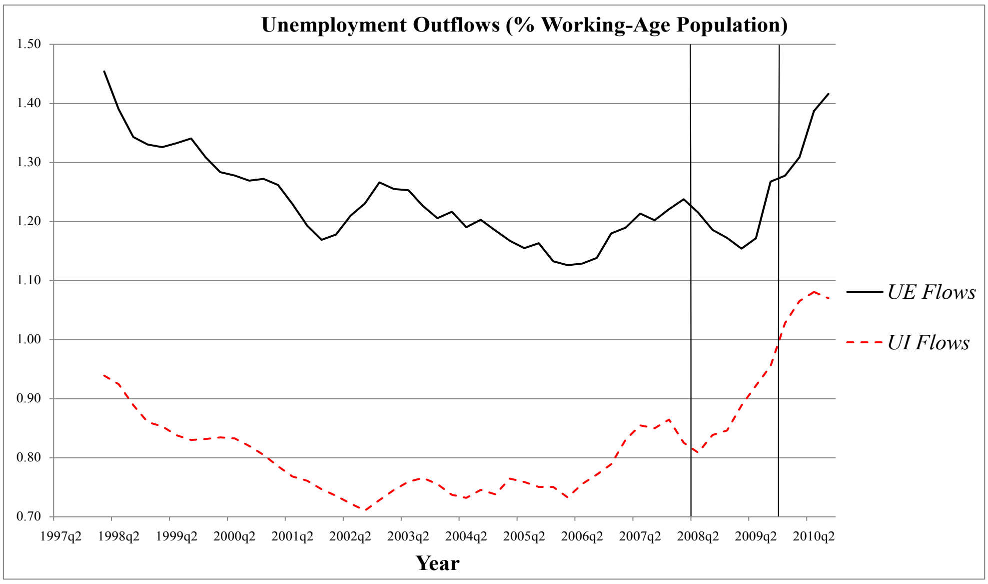

Figure 6. Evolution of Unemployment Outflows: UK, 1997 Q2 — 2010 Q3

Sources: LFS and author analysis

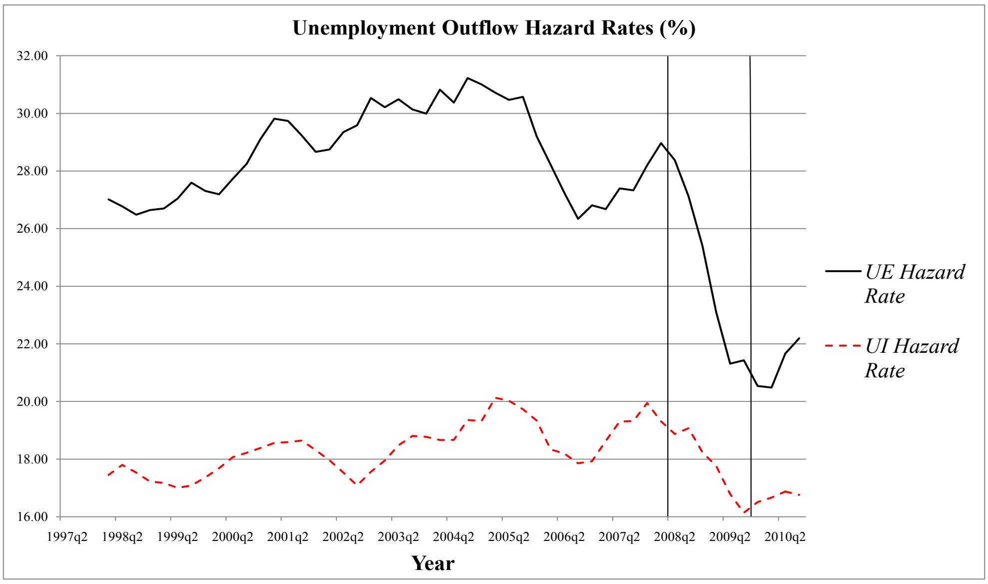

Figure 7. Evolution of Unemployment Outflow Hazard Rates: UK, 1997 Q2 — 2010 Q3

Sources: LFS and author analysis

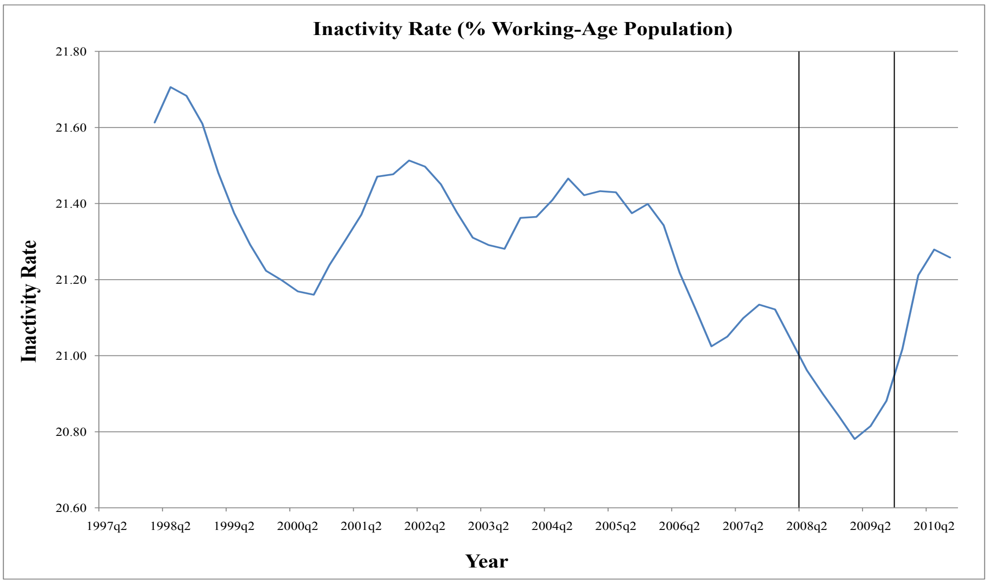

Figure 8. Evolution of the Inactivity Rate: UK, 1997 Q2 — 2010 Q3

Sources: LFS and author analysis

upwards in spite of certain downward fluctuations; again, until recession struck, when such flows markedly decreased. These flows, in fact, fell by 0.35 percentage points (around a quarter of the pre-recession level) from peak-to-trough after the recession, although they have started trending upwards again in recent quarters; this, perhaps, when coupled with the recent decline in *EU* flows, could be seen as being indicative of some sort of recovery. On the other hand, *IU* flows have been on the rise since 2002. Before that date, this flow had been trending downwards. The rise in *IU* flows became more pronounced around 2006, and has remained pronounced since the official beginning of the recession, rising by roughly 0.25 percentage points (a rise of almost a quarter). In the meantime, the respective hazard rates have, too, followed divergent patterns (see Figure 10). Since the recession, the *IE* hazard has fallen by around one fifth of its pre-recession level (again, despite a slight recovery in recent quarters), while the *IU* hazard, which has risen consistently since 2002, has increased by around one fifth. These patterns are, once more, almost identical to those seen in Figure 9.

To sum up, since the onset of recession (in 2008 Q2): the employment rate has fallen, the unemployment rate has risen, and the inactivity rate has (belatedly) also risen. The results further show that *EU* flows and hazards have increased markedly, implying they are strongly countercyclical. *EI* flows have fallen by a small amount and the hazard has fallen negligibly, so there is no clear cyclical pattern implied as yet. *UE* flows are on the rise (countercyclical), although the hazard rate is falling rapidly (procyclical). Similarly, *UI* flows have risen (countercyclical), with the hazard rate going in the opposite direction (procyclical). Finally, *IE* flows and hazards have fallen markedly (both procyclical), while *IU* flows and hazards have increased

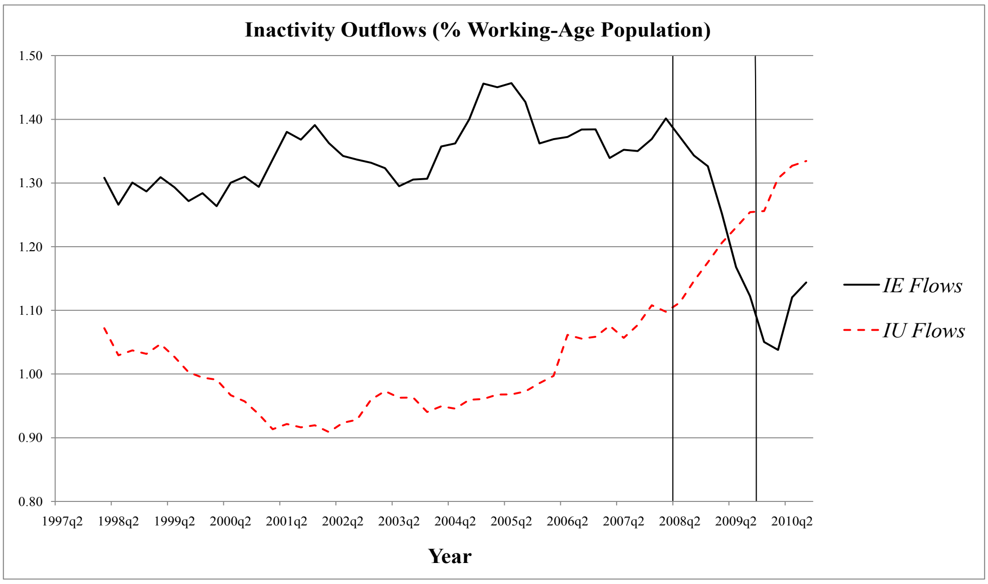

Figure 9. Evolution of Inactivity Outflows: UK, 1997 Q2 — 2010 Q3

Sources: LFS and author analysis

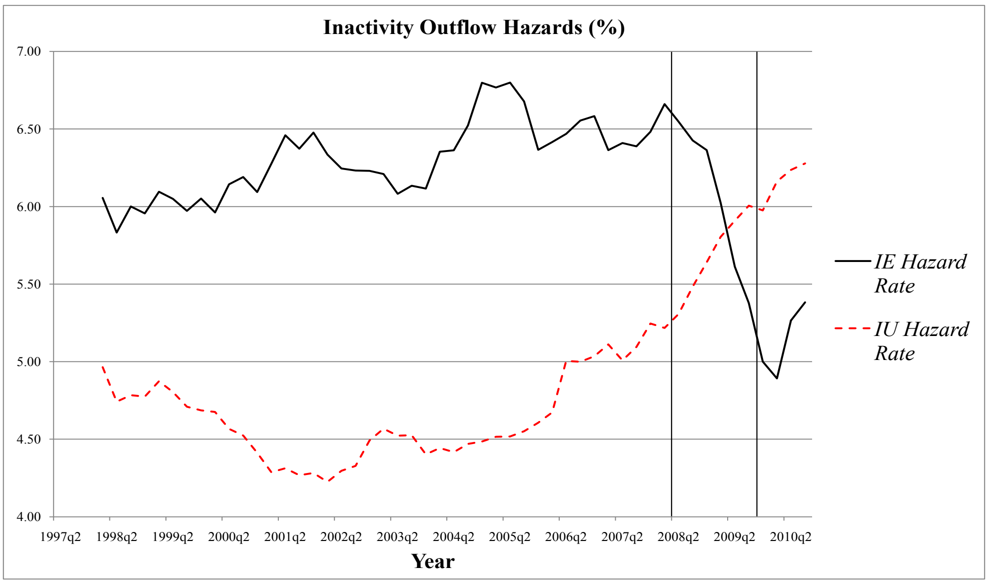

Figure 10. Evolution of Inactivity Outflow Hazard Rates: UK, 1997 Q2 — 2010 Q3

Sources: LFS and author analysis

rapidly (both countercyclical), although this upward trend began before the recession. These findings are reconciled with the theory and previous empirical evidence in section 3.6.

3.3c Employment, Unemployment, and Inactivity Rates by Gender

A further important question is whether there have been differential effects of the recession on the labour market outcomes of men and women. Given the increasing participation rates of women in the UK labour market (and the increasingly prominent role they have to play), it is interesting to ask whether or not the 2008-09 recession has curbed this. It is also interesting to see the effects on the male participation rate — which has been moving in the opposite direction to that of women — as a result of the recent recession. Further, examination of the male unemployment rate is also of interest, since it would not be unreasonable to conjecture that young, uneducated males are likely to be disproportionately affected by the recession, given their comparatively poor labour market outcomes in periods of economic growth.

Figures 11, 12, and 13 show the rates of employment, unemployment, and inactivity for both men and women.[13]. It is immediately apparent that, given the pre-recession levels of employment and unemployment, men have fared markedly worse than women during the recession: the male employment rate fell by around 3.5 percentage points (a proportional fall of around 4.5%), while that for women fell by just over 1 percentage point (a proportional fall of roughly 1.5%); and the male unemployment rate increased by 3.3

[13]Data, in this instance, are sourced from the ONS

percentage points (an approximate 60% rise), compared to an increase of 2 percentage points for women (an approximate 40% rise).

Why might this be the case? Şahin et al. (2010) observe a similar pattern in the US, and conjecture that this is because certain male-dominated industries (manufacturing, for example) were affected disproportionately by the recession. One may tentatively suggest that an analogous argument holds for the UK. It may also be argued that women are more likely to have their hours of work varied over the business cycle. A far higher proportion of women work part-time than do males (indeed, the OECD rate of female part-time working is high — far higher than that for males). It is possible that the effect on women has not been as severe as that for males, as women are more likely to accept a reduction in working hours from full-time to part-time, or to fewer part-time hours. It is in the firm's interests to cut costs by cutting working hours, rather than getting rid of workers (labour hoarding), especially if the worker is trained, as it means the firm does not lose its training investment. This also means the firm can avoid future hiring and training costs for new workers, when the economic environment improves. Many women work to supplement the income primary earner, who is typically male. As males tend to be the primary earners, they are less likely, and usually less able, to accept a reduction in working hours, if offered. Women, meanwhile, are more likely to work in industries where a reduction in working hours is more feasible; this may not always be a possibility in certain male-dominated industries.

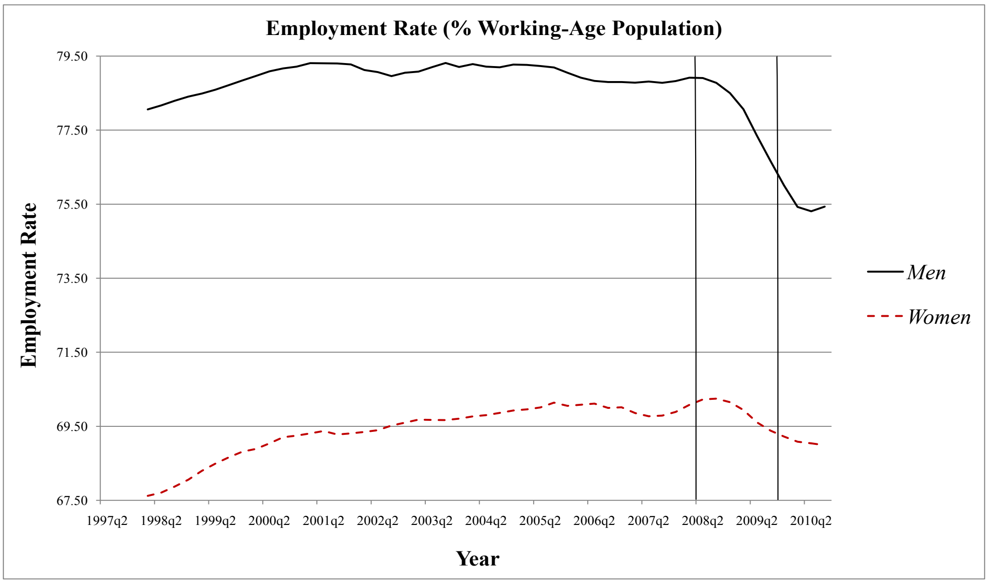

Figure 11. Evolution of the Employment Rate by Gender: UK, 1997 Q2 — 2010 Q3

Sources: ONS and author analysis

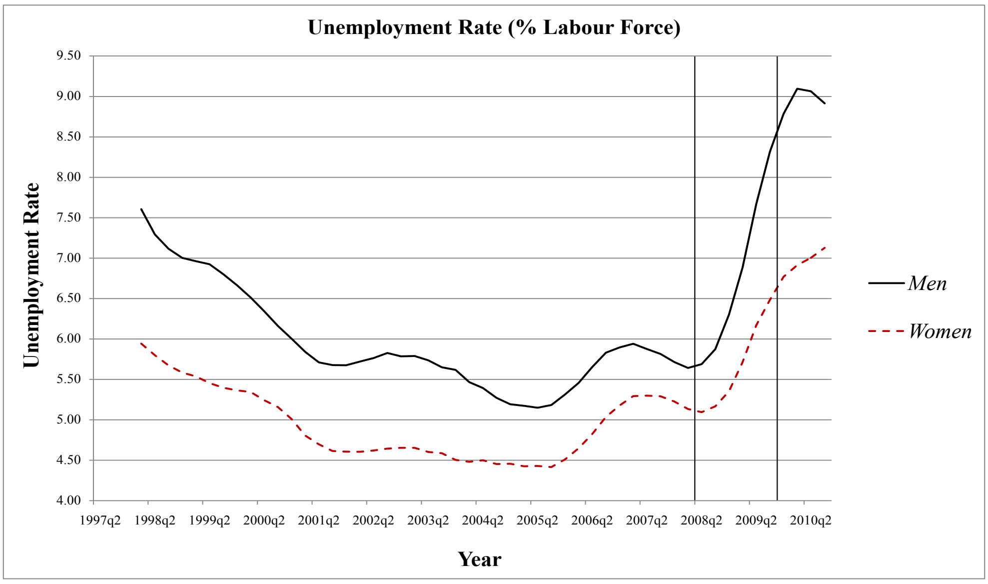

Figure 12. Evolution of the Unemployment Rate by Gender: UK, 1997 Q2 — 2010 Q3

Sources: ONS and author analysis

With regard to the inactivity rates, the rate for men has been following a gradual, general upward trend over the sample period, with an upward spike of around half a percentage point occurring in late 2009; while the rate for women has been on a downward trend over the sample. This confirms two patterns that are well-established in the existing literature: the increasing prevalence of economic inactivity amongst working-age males, and the increasing labour force participation rates of working-age women.

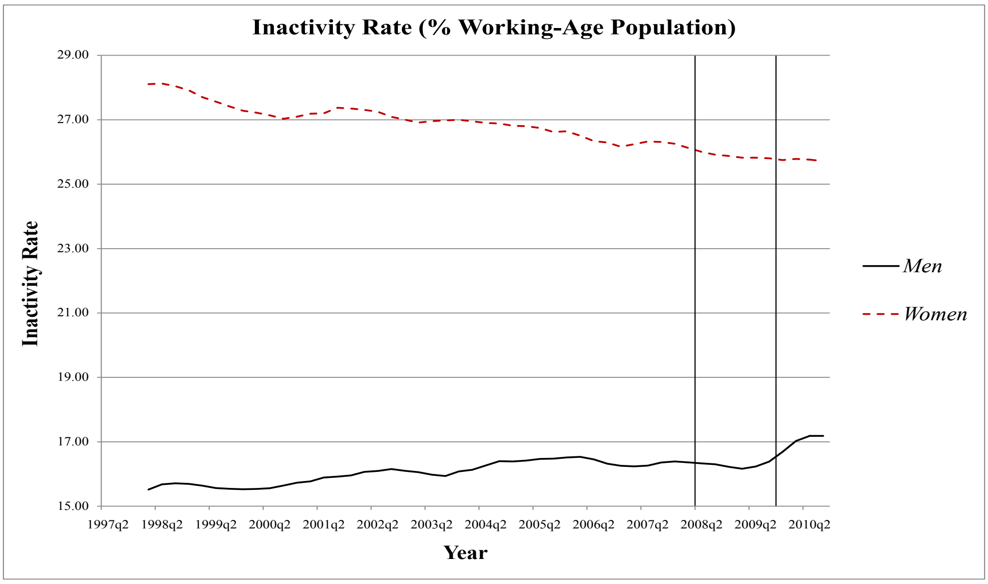

Figure 13. Evolution of the Inactivity Rate by Gender: UK, 1997 Q2 — 2010 Q3

Sources: ONS and author analysis

3.3d Job-to-Job Flows

As aforementioned, analysis of the labour market is incomplete without the examination of job-to-job flows. Figure 14 shows how such flows appear to have been on a downward trend roughly between 2001 and 2006. Job-to-job flows then began to increase again, before a sharp decline associated with the recession. Somewhat counterintuitively, the share of employed persons searching for a job, which was on a downward trend until 2006, appears to have risen since the recession (see Figure 15). The rate began to rise again in 2006, before falling back slightly, and eventually beginning to rise in early 2009 (and then onwards). This is in spite of the lower probability of being able to make a JJ transition.

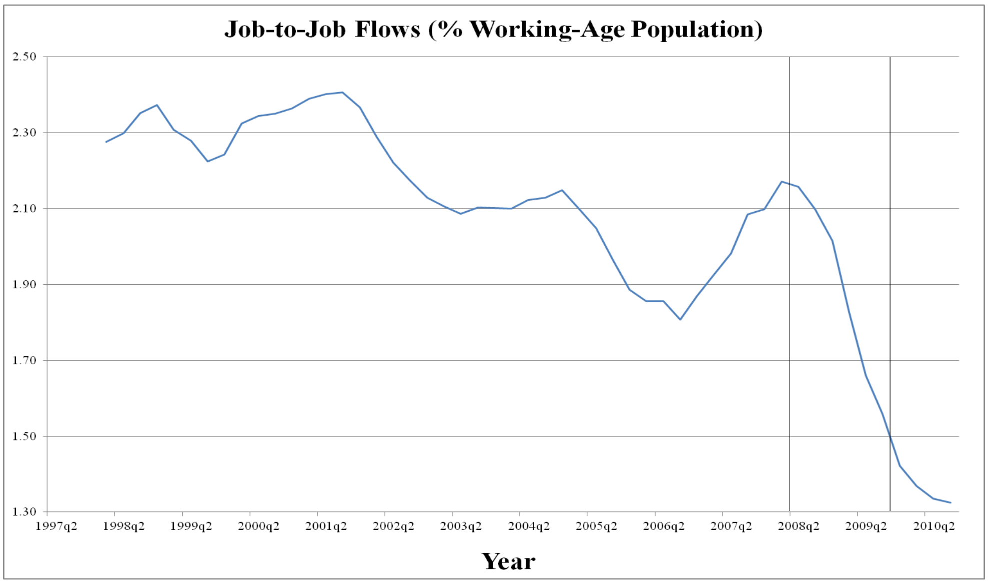

Figure 14. Job-to-Job Flows as a Share of the Working-Age Population: UK, 1997 Q2 — 2010 Q3

Sources: LFS, Gomes (2012) data set for job-to-job flows, and author analysis

One would expect persons who are actively searching for a job to be more likely to find one than those who are not engaged in job-search. This is indeed shown in Figures 16 and 17. These figures also show that the chance of making a JJ transition has fallen strikingly since the recession, both if an individual is actively searching and if they are not. Both have fallen by just short of 40% since the recession officially began (Figure 14).

The fall in JJ flows appears to have been a prominent factor in driving UK unemployment. Figure 18 graphs the breakdown of the hiring rate (accessions into E from U and I, plus JJ transitions). The graph shows how the hiring rate from U has risen by just over 0.20 percentage points since the beginning of the recession (a proportional change of around 17%), while the hiring rate from I has fallen by approximately 0.25 percentage points (a proportional change of just less than 20%); however, these changes have been modest when compared to the absolute fall in the hiring rate from E (JJ flows). The rate has fallen by around 0.80 percentage points, a proportional drop of approximately 37%. It may also be noted from Figures 14, 16, 17, and 18 that that there was a downturn in job-to-job movements between 2005 and 2007. The fact that there was a slowdown of the GDP growth rate in a number of quarters between these dates may go toward explaining this observation.

Figure 15. Share of Employed Searching for a Different Job: UK, 1997 Q2 — 2010 Q3

Sources: LFS, Gomes (2012) data set for job-to-job flows, and author analysis

Figure 16. Job-to-Job Hazard if Looking for a Different Job: UK, 1997 Q2 — 2010 Q3

Sources: LFS, Gomes (2012) data set for job-to-job flows, and author analysis

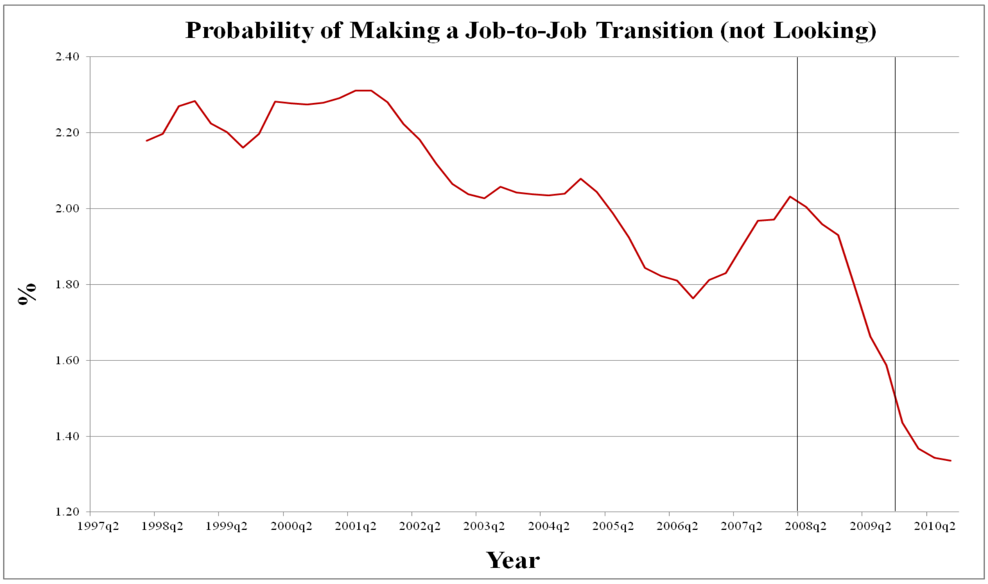

Figure 17. Job-to-Job Hazard if not Looking for a Different Job: UK, 1997 Q2 — 2010 Q3

Sources: LFS, Gomes (2012) data set for job-to-job flows, and author analysis

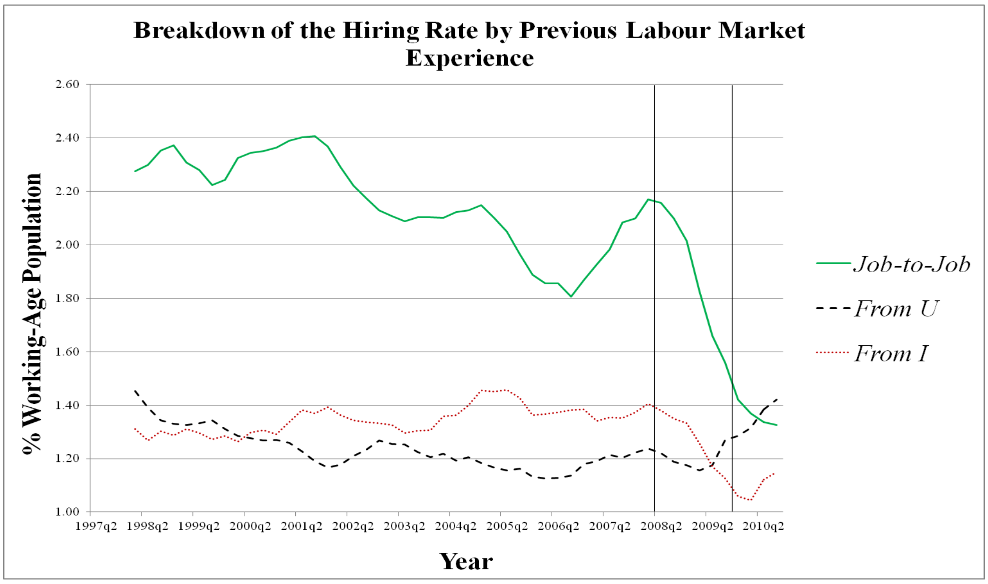

Figure 18. Breakdown of the Hiring Rate: UK, 1997 Q2 — 2010 Q3

Sources: LFS, Gomes (2012) data set for job-to-job flows, and author analysis

3.4 What has Driven UK Unemployment Through the Recession?

Figures 19 and 20 map the evolution of the hiring and job-separation rates, respectively. The aim is to investigate whether either factor has played a dominant role in driving unemployment dynamics throughout the recession. The hiring rate had trended downwards from the start of the sample up until around 2006, before making a substantial and speedy recovery. This recovery continued until the recession. Since then it has fallen by about 0.90 percentage points, a proportional drop of around 19%. In the meantime, the job-separation rate rose dramatically at the start of the recession, although recent quarters have seen the rate start to recover. From peak-to-trough, the rate increased by circa 0.35 percentage points, a proportional rise of around 16%.

In order to investigate whether the reduction in *JJ* transitions can account for most of the witnessed fall in the hiring rate, Figure 21

Figure 19. Evolution of the Job-Finding Rate: UK, 1997 Q2 — 2010 Q3

Sources: LFS, Gomes (2012) data set for job-to-job flows, and author analysis

Figure 20. Evolution of the Job-Separation Rate: UK, 1997 Q2 — 2010 Q3

Sources: LFS, Gomes (2012) data set for job-to-job flows, and author analysis

graphs the hiring rate, excluding JJ transitions (which is here defined as the job-finding rate). A drop over the recessionary period of in the region of 0.30 percentage points (a proportional fall of approximately 11%) implies that the observed reduction in the UE and IE flows also play a significant role in explaining the observed cyclical behaviour of UK unemployment, although the observed decline in JJ flows appears to have been the dominant factor in driving the decrease in the hiring rate.

The above analysis is somewhat intuitive, but the figures reveal that both the job-separation rate and the job-finding rate (and indeed the hiring rate) have had at least some role to play in the observed rise in UK unemployment since the recession: it is certainly reasonable to conjecture that the UK's job-separation rate is not acyclical. This is examined further below, although this thesis does not, by using the different decomposition methods proposed in the literature, attach relative weights to the importance of the job-finding and job-separation rates for UK unemployment fluctuations: this has already been done over a similar sample period for the UK by Gomes (2012), using the decompositions of Fujita and Ramey (2009) and Shimer (2012). Moreover, Smith (2011) proposes a new (non-log) decomposition of unemployment dynamics that does not require unemployment to be in steady state at all times, and uses this to analyse British Household Panel Survey (BHPS) data from 1988 to 2008; this is also discussed below.[14]

Gomes (2012) corrects the data for the possibility of multiple transitions between interview periods. An example of this would be a

[14]This is particularly useful for analysing UK data, since the unemployment rate is likely to deviate more noticeably from steady state when inflow and outflow transition rates are not particularly high. This is true of the UK, especially when compared to the US.

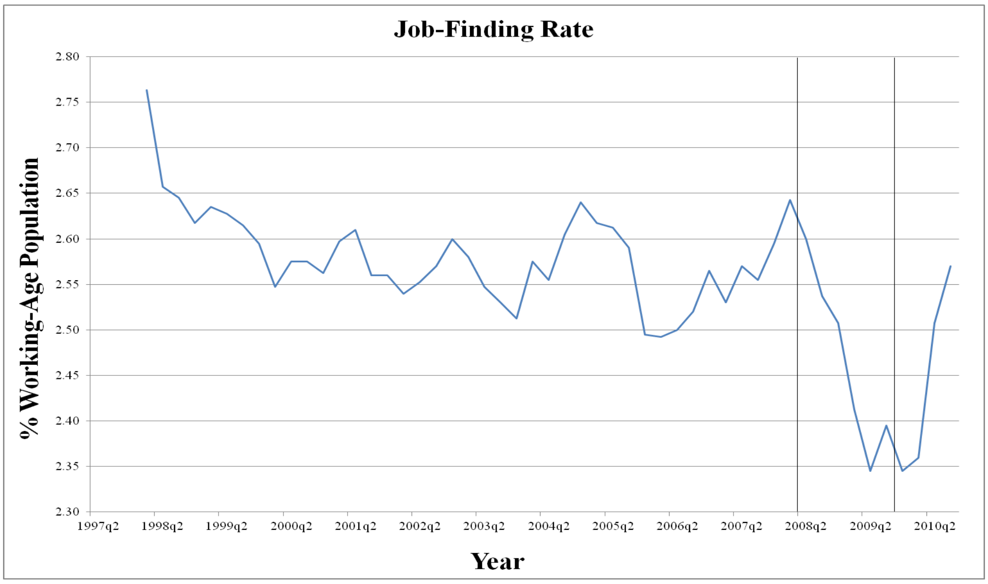

Figure 21. Evolution of the Job-Finding Rate (Hiring Rate Less Job-to-Job Transitions): UK, 1997 Q2 — 2010 Q3

Sources: LFS and author analysis

worker making an *EU* transition, followed by an *UE* transition, between interview periods — the worker would be recorded as having been continually employed, having been employed at the two interview points, and neither of the two transition would be recorded in the data. This is a problem referred to as time-aggregation bias, and is likely to induce downward bias in the correlation of the job-finding rate with an appropriate cyclical indicator. In theory, time-aggregation bias should be more of a problem in the UK than the US, as surveys are quarterly, rather than monthly. Still, such adjustments to the data are most relevant to the application of decomposition methods that attempt to attach relative weights to the unemployment inflow and outflow rates respectively, rather than in the examination of the cyclical nature of the flows (as is undertaken in this thesis). While slight downward biased may be induced, there is no a priori reason to believe the cyclical properties of flows will be affected by such a data adjustment. Therefore, adjustment in this respect is made to the data in this thesis.

Gomes (2012) uses the continuous-time correction method of Shimer (2012) to account for this. He finds that both the job-finding rate and the job-separation rate have an important role to play in explaining unemployment fluctuations in the UK, when applying both the unemployment decomposition methods of Fujita and Ramey (2009) and Shimer (2012). In a two-state decomposition (inactivity is ignored), the job-separation rate is shown to be a marginally more important determinant of fluctuations in unemployment than the job-finding rate. In a three-state decomposition (including inactivity), once flows into and out of inactivity have been discarded, the split is 60:40 in favour of the job-finding rate. The results hold for both decomposition methods, and imply that both the job-finding rate and job-separation rate are important in determining unemployment fluctuations over the business cycle in the UK. This is consistent with Petrongolo and Pissarides (2008).

The results also hold when Gomes (2009) applies what the author argues to be an improvement on the Shimer (2012) time-aggregation correction method: the application of the Elsby et al. (2009) discrete-time correction method. This method is more aligned with the discrete nature of CPS (and LFS) definitions and ignores movements out of and back into a particular state, within one week. It would, for example, be nonsensical to count someone as being unemployed, if they left one job at the end of a particular working day, before starting a new job the next morning. On the contrary, the continuous-time method would class every point in time between leaving a job and starting a new one as a spell of unemployment. As such, Shimer's method is likely to over-correct for time-aggregation bias. Gomes' results when applying this methodology demonstrate that, although the job-finding rate has been more important than the job-separation rate over the last decade (despite both still being important), the job-separation rate has played a key role during significant downturns. The same can be said of this latest recession.

Finally, the examination of BHPS data carried out by Smith (2011) demonstrates that the job-separation rate drives UK unemployment through recessions, while it is driven by the job-finding rate through periods of moderation. It should however be noted that this paper cannot account for the fall-out effects of the latest UK recession, as the data set only runs up to 2008.

3.5 Cyclical Properties of UK Gross Worker Flows

The cyclicality of flows can be defined as their correlation with the level of economic activity. This subsection examines the cyclicality of gross worker flows to explore whether the findings are consistent with the theory and the previous evidence. Two approaches are applied: correlating the flows and hazards with the business cycle (GDP); and a simple, linear regression approach that aims to identify if flows and hazards have a statistically significant effect on the unemployment rate.

Firstly, correlation coefficients between each of the seasonally-adjusted series (flows and hazards) and the natural logarithm of detrended GDP (the cyclical indicator) are examined. The author favours the use of these correlation coefficients for the analysis of the cyclical properties of labour market flows and hazards for four reasons: GDP — as opposed to another labour market indicator — is used as the indicator of the business cycle; it is more robust to detrend GDP than it is to model the negative structural trend in the unemployment rate over the sample with a simple time trend (as is done in the regression approach, discussed below); the approach further simplifies an already basic regression approach to assessing the cyclical properties of labour market flows and hazards; and this approach is not undertaken in papers of a similar scope to this thesis, thus allowing for a unique contribution in this area. The GDP data are detrended using a Hodrick-Prescott (HP) filter, with a smoothing parameter, λ, of 1,000,000 (10^6). Although it is standard to use a λ of 1600 for quarterly data, a smaller smoothing parameter causes the filter to track the original data much more closely than a considerably larger smoothing parameter. Using such a large smoothing parameter is close to linear detrending. The application of a HP filter with a smoothing parameter that is too low will not allow the data to fluctuate around its trend enough (it tracks the original series too closely), and, resultantly, pronounced deviations from trend are more likely to exhibit high degrees of correlation.[15] This is why such a large smoothing parameter has been used here.

The data are split into a 27-quarter sub-sample and a 26-quarter sub-sample for robustness purposes and to allow for specific focus on the recessionary period: 1997:Q2 to 2003:Q4 and 2004:Q1 to 2010:Q2.[16] Table 1.a presents the results for the whole sample, Table 1.b for the first sub-sample results (1997:Q2 to 2003:Q4), and Table 1.c for those from the second sub-sample, which includes the recessionary period

[15] Given that a certain series, z_t, which in our case, here, is GDP, can be split into two components (trend, μ_t, and cycle, c_t), so that $z_t = \mu_t + c_t$, the HP filter solves $\min_{\mu_t} \sum_{t=1}^{T} \left[(z_t - \mu_t)^2 + \lambda(\Delta^2 \mu_{t+1})^2\right]$ where Δ^2 indicates the second-difference. A large smoothing parameter, λ, attaches a heavy weight (penalisation) to the second term in the equation and penalises the growth rate in the trend component much more heavily than the cyclical component.

[16] Note that one observation has been lost due to the filtering of the data.

(2004:Q1 to 2010:Q2).[17] As detrended GDP is used as an indicator of the business cycle, a positive coefficient implies that a particular flow or hazard is procyclical, while a negative coefficient means that it is countercyclical. Splitting the sample into two, when analysing the simple bivariate correlation coefficients between detrended GDP and the seasonally-adjusted flows and hazards, contributes to the existing literature on worker gross flows by allowing more explicit analysis of the cyclical nature of the series in recent quarters, including the recession period and beyond. The recession is important for revealing the cyclical properties of the series in the UK — especially since it has been such a long time since the last UK recession (a time when detailed data on gross worker flows were not available). This exercise, coupled with the above results, allows us to determine the cyclical properties of UK gross worker flows, and what drives UK unemployment in the aftermath of a severe recession; these were the very questions that motivated the thesis.

[17]The second sub-sample has been chosen deliberately to include a sustained period (of economic growth) before the recession. The cyclical nature of the flows and hazards at this time are likely to be influenced heavily by the recessionary period. The inclusion of a sustained period prior to the recession allows us to place the findings in the context of the past seven years, rather than merely looking at the cyclical properties of the flows during the recession and in the brief period beyond (the results of which will be entirely predictable). The results should also be relatively robust to any trend changes in particular flows or hazards, as the period examined when the sample split (27 and 26 quarters) is relatively short compared to the whole sample (53 quarters).

Transition	*Correlation Coefficient of Log Detrended GDP With:*		*Average Size of Quarterly Gross Worker Flow as a Percentage of Working-Age Population*
	Gross Flow	*Hazard Rate*	
$E \to U$	-0.52**	-0.57**	0.99
$E \to I$	0.44**	0.24*	1.38
$U \to E$	-0.49**	0.61**	1.25
$U \to I$	-0.58**	0.48**	0.83
$I \to E$	0.34*	0.53**	1.32
$I \to U$	-0.47**	-0.51**	1.05
Job-to-Job	0.48**	0.35*	2.77†
Job-to-Job (S)	0.42**	0.44**	0.86†
Job-to-Job (NS)	0.50**	0.38**	1.85†
$\to E$	-0.01	0.61**	2.57
$E \to$	-0.28*	-0.29*	2.37
$\to U$	-0.64**	-0.59**	2.04
$U \to$	-0.62**	0.58**	0.83
$\to I$	-0.26*	0.42**	2.21
$I \to$	-0.11	-0.17	2.37

Table 1.a. Cyclical Properties of Labour Market Flows and Hazards — Correlation Coefficients Between Labour Market Flows and Hazards and Log Detrended GDP: UK, 1997 Q2 — 2010 Q2

Transition	*Correlation Coefficient of Log Detrended GDP With:*		*Average Size of Quarterly Gross Worker Flow as a Percentage of Working-Age Population*
	Gross Flow	*Hazard Rate*	
$E \rightarrow U$	-0.43**	-0.62**	0.98
$E \rightarrow I$	0.19	0.04	1.42
$U \rightarrow E$	-0.56**	0.54**	1.29
$U \rightarrow I$	-0.60**	0.33*	0.81
$I \rightarrow E$	0.15	0.19	1.33
$I \rightarrow U$	-0.45**	-0.47**	0.98
Job-to-Job	-0.11	-0.15	$3.06^{\dagger}$
Job-to-Job (S)	-0.21	-0.02	$0.96^{\dagger}$
Job-to-Job (NS)	0.02	0.09	$2.06^{\dagger}$
$\rightarrow E$	-0.22	0.53**	2.62
$E \rightarrow$	-0.16	-0.39*	2.39
$\rightarrow U$	-0.61**	-0.58**	1.96
$U \rightarrow$	-0.67**	0.52**	0.81
$\rightarrow I$	-0.21	0.32*	2.22
$I \rightarrow$	-0.13	-0.19	2.31

Table 1.b. Cyclical Properties of Labour Market Flows and Hazards — Correlation Coefficients Between Labour Market Flows and Hazards and Log Detrended GDP: UK, 1997 Q2 — 2003 Q4

Transition	*Correlation Coefficient of Log Detrended GDP With:*		*Average Size of Quarterly Gross Worker Flow as a Percentage of Working-Age Population*
	Gross Flow	*Hazard Rate*	
$E \to U$	-0.55**	-0.60**	1.00
$E \to I$	0.46**	0.33*	1.35
$U \to E$	-0.47**	0.62**	1.22
$U \to I$	-0.66**	0.50**	0.86
$I \to E$	0.52**	0.61**	1.31
$I \to U$	-0.62**	-0.64**	1.12
Job-to-Job	0.62**	0.59**	$2.49^{\dagger}$
Job-to-Job (S)	0.57**	0.61**	$0.76^{\dagger}$
Job-to-Job (NS)	0.69**	0.67**	$1.66^{\dagger}$
$\to E$	-0.08	0.62**	2.52
$E \to$	-0.19	-0.22	2.35
$\to U$	-0.67**	-0.71**	2.12
$U \to$	-0.65**	0.67**	0.86
$\to I$	-0.31*	0.52**	2.21
$I \to$	-0.14	0.01	2.43

Table 1.c. Cyclical Properties of Labour Market Flows and Hazards — Correlation Coefficients Between Labour Market Flows and Hazards and Log Detrended GDP: UK, 2004 Q1 — 2010 Q2

Sources: LFS, Gomes (2012) data set for job-to-job flows, and author analysis

Notes: The average sizes of the gross flows are calculated from the raw (seasonally-unadjusted) data. One observation has been lost due to the filtering of the data.

† Job-to-Job flows are expressed as a percentage of total employment

S = Searching; NS = Not Searching

** = Statistically significant from zero at the 1% level; * = Statistically significant from zero at the 5% level

The findings shown by Tables 1.a, 1.b, and 1.c are, in the main, consistent with those found in Bell and Smith (2002) and Gomes (2009, 2012). Inflows to and outflows from all pools are countercyclical in the main (although acyclical in some cases), with U inflows and outflows being particularly strongly countercyclical. There are more movements between the three pools during a recession, as the labour market becomes looser. The findings confirm the conclusion of Gomes (2012), which states that most of the action occurs in the unemployment pool: more inactive people start searching for jobs (indicated by a countercyclical *IU* flow), and more workers lose their jobs (countercyclical *EU* flow). At the same time, more unemployed people stop searching (countercyclical *UI* flow) and more unemployed workers find jobs (countercyclical *UE* flow) by virtue of the fact that the pool of unemployed is larger, and more people are out of work and are searching for work (although, statistically, it is more difficult to find work, as indicated by a procyclical *UE* hazard rate). Also, *EI* and *IE* flows are procyclical (particularly so over the whole sample and the second sub-sample). The correlation coefficients tend to be stronger when the sample is split (particularly in the second sub-sample).

In terms of hazard rates, over the whole sample period, the *EU* hazard is strongly countercyclical, and the *EI* hazard is (less strongly) procyclical. The *UE*, *UI*, and *IE* hazards are all fairly strongly procyclical, while the *IU* hazard is countercyclical. Therefore, the recent recession appears to have been a time when a worker was more likely to become unemployed and was less likely to become inactive. It was also a time when an unemployed person was less likely to find work or become inactive. Inactive people are less likely to become employed and are more likely to start looking for work. Most coefficients on the respective hazards are stronger when the sample is split into the two sub-samples (particularly in the second sub-sample): that is, the cyclical pattern is more pronounced.

The correlation coefficients for the flows and hazards in the second sub-sample — as shown in Table 1.c — are clearly larger in terms of absolute magnitude, and hence generally exhibit a higher degree of cyclicality. This could perhaps be attributable to the 2008-09 recession. Comparable analysis by Bell and Smith (2002) does not incorporate data from any significant downturn, while Gomes (2012) focuses on the broader picture, rather than more narrowly on the recession, as is done here. One could speculate that the onset of recession has shown up strong underlying cyclical patterns that gross flows actually exhibit; perhaps the true extent of such patterns do not show up in expansions. For example, the three sets of JJ flows and hazards appear procyclical over the whole sample, while the flows and hazards are either countercyclical or exhibit little or no cyclical component in the first sub-sample, but are strongly procyclical in the second. While this may be surprising, the findings are consistent with those presented in Figures 14, 16, 17, and 18, which imply that JJ flows had been falling throughout the 2000s (pre-recession). This implies that job-to-job flows have started to develop a greater degree of cyclicality in recent years, and this pattern has been emphasised by the recession. This finding expands on the comparable results those of Gomes (2009, 2012): job-to-job flows and hazards are procyclical over the whole sample (as Gomes finds), but the flows and hazards pertaining to job-to-job flows depict a much higher degree of (pro)cyclicality during the second sub-sample (that is, 2004 Q1 — 2010 Q2).

Also, the EI hazard rate appears acyclical in the first sub-sample, yet procyclical in the second, while the IE flow appears far more strongly procyclical in the second sub-sample than the first. The above results remain broadly unchanged when the (seasonally-adjusted) unemployment rate is used as the cyclical indicator (see the appendix), although, when this measure is used, the absolute magnitude of the correlation coefficients tend to be larger, and there are also more statistically significant correlation coefficients (most likely due to the endogeneity of the indicator).

Secondly, the logarithm of each series is regressed on a constant term, seasonal quarter dummies, a linear time trend, and the seasonally-unadjusted percentage unemployment rate, using Ordinary Least Squares (OLS). This is the same approach used by Baker (1992) to assess the cyclical properties of unemployment duration. The cyclical component is defined by the coefficient on the seasonally-unadjusted unemployment rate. The results of this approach are shown in Table 2. As the unemployment rate is used as an indicator of the business cycle in both cases, a positive coefficient implies that a particular flow or hazard is countercyclical, while a negative coefficient means that it is procyclical.

Table 2 shows the findings of running a similar OLS regression to that of Baker (1992), in order to examine the cyclical properties of the respective flows and hazards. The findings largely support those in Tables 1.a, 1.b, and 1.c. There are two notable differences, though: here, there is shown to be a cyclical component to transition probabilities between employment and inactivity, and the job-finding rate appears to be a more important contributor to fluctuations in the unemployment rate than does the job-separation rate. With inspection of 1.c, one can see that the *EI* and the *IE* transition probabilities became fairly strongly procyclical (particularly the *IE* hazard) during the second sub-sample. This meant that these hazards were procyclical over the whole sample (see Table 1.a), and is likely to explain why significant coefficients on the hazards are found in Table 2, as well.

With regard to the relative importance of the job-finding rate and the job-separation rate, while both hazards are statistically significant, the absolute coefficient on the finding rate is three times that of the separation rate in Table 2. Judging by the findings, it would appear that the job-finding rate is somewhat more important in determining unemployment dynamics in the UK (by a ratio of 75:25), although a more careful analysis would be required, in order to fully justify this statement.

Transition	*Gross Flow*	*Hazard Rate*	*Average Size of Quarterly Gross Worker Flow as a Percentage of Working-Age Population*
$E \to U$	0.093** (8.32)	0.103** (9.39)	0.99
$E \to I$	-0.038** (-4.22)	-0.027** (-2.96)	1.38
$U \to E$	0.063** (7.21)	-0.096** (-10.3)	1.25
$U \to I$	0.107** (13.4)	-0.052** (-6.72)	0.83
$I \to E$	-0.065** (-7.11)	-0.065** (-6.97)	1.32
$I \to U$	0.082** (10.70)	0.082** (10.3)	1.06
Job-to-Job	-0.083** (-7.70)	-0.072** (-6.79)	$2.77^{\dagger}$
Job-to-Job (S)	-0.069** (-5.30)	-0.074** (-6.65)	$0.86^{\dagger}$
Job-to-Job (NS)	-0.099** (-10.20)	-0.072**(-7.66)	$1.85^{\dagger}$
$\to E$	-0.001 (-0.15)	-0.090** (-10.8)	2.57
$E \to$	0.018* (2.47)	0.030** (3.94)	2.37
$\to U$	0.087** (14.5)	0.087** (13.6)	2.05
$U \to$	0.081** (12.8)	-0.078** (-11.6)	2.09
$\to I$	0.019** (2.98)	-0.050** (-6.95)	2.21
$I \to$	0.004 (0.55)	0.004 (0.60)	2.37

Table 2. Cyclical Properties of Labour Market Flows and Hazards — Baker-Type OLS Regression Coefficients and t-statistics: UK, 1997 Q2 — 2010 Q3

Sources: LFS, Gomes (2012) data set for job-to-job flows, and author analysis

Notes: The cyclicality of the series is defined as the coefficient on the unemployment rate, in an OLS regression of the logarithm of the series in question on a constant term, seasonal quarter dummies, a linear time trend, and the seasonally-unadjusted (%) unemployment rate (t-statistics are in parentheses). The average sizes of the gross flows are calculated from the raw (seasonally-unadjusted) data. The results are robust to the removal of the linear time trend. Also, it makes little-to-no difference if the seasonally-adjusted or seasonally-unadjusted (%) unemployment rate is used.

† Job-to-Job flows are expressed as a percentage of total employment

S= Searching; NS = Not Searching

** = Statistically significant from zero at the 1% level; * = Statistically significant from zero at the 5% level

3.6 Reconciling the Findings with the Theory and Previous Evidence

Are these findings consistent with the theory and (or) previous empirical evidence? In terms of explaining unemployment dynamics, the findings presented suggest that both the job-finding and the job-separation rate play a crucial role in determining the cyclical behaviour of UK unemployment. This finding is consistent with Bell and Smith (2002) and Gomes (2009, 2012), who find that both are important determinants of unemployment fluctuations in the UK. Gomes (2009, 2012) carries out a rigorous analysis of the relative importance attached to each factor, and finds both play important roles in the determination of UK unemployment movements, with the largest ratio in favour of the job-finding rate being 60:40. It also supports the findings of Elsby et al. (2009), who state that both the job-finding rate and the job-separation rate are important in explaining unemployment fluctuations in the US. Contrary to Blanchard and Diamond (1990), Davis and Haltiwanger (1992), and Pissarides (2000), there is no dominant role found for the job-separation rate in explaining UK unemployment dynamics. Similarly, in contrast to Hall (2006) and Shimer (2010, 2012), there is no dominant role found for the job-finding rate, either. Both flows appear to behave in a volatile manner. Davis et al. (2006) find that changes in the job-separation rate explain most of the variation in unemployment during sharp recessions, whereas fluctuations in the job-finding rate dominate during milder economic downturns — a reasonable argument, given the findings above, accompanied with those of Gomes (2009, 2012).

The finding that *IE* flows are procyclical, whereas *UE* flows are countercyclical, is consistent with the Blanchard and Diamond (1990) model of 'primary' and 'secondary' workers. Moreover, the countercyclical nature of *EU* flows and the procyclical nature of *EI* flows that are observed are consistent with those found in the comparable analysis of Gomes (2009, 2012), and are also consistent with figures reported in Blanchard and Diamond (1990). *IU* flows are found to be countercyclical, which supports the findings of Bell and Smith (2002), as well as Gomes (2009, 2012), but does not bear out the predictions of the Pissarides (2000) model. *JJ* flows and hazards are found to be procyclical over the sample. This is consistent with the equivalent results presented by Gomes (2009, 2012), although the degree of correlation found is considerably lower than those stated by Bell and Smith. This finding is consistent with the decline of *JJ* flows through the 2000s, discussed above. In recent times, however, it appears that job-to-job flows and hazards have started to exhibit a larger degree of (pro)cyclicality, as they did in the 1993 — 2000 period, as evidenced by Bell and Smith. The correlation coefficients on the three flows and hazards pertaining to job-to-job flows in Table 1.c are closer to those presented by Bell and Smith than those presented by Gomes (2009) and those in Tables 1.a and 1.b, above. In terms of absolute magnitude, the correlation coefficients on the flows in Table 1.c are close to matching the coefficient on job-to-job flows in the Bell and Smith paper, while the correlation coefficients on the hazards in Table 1.c exceed that on the job-to-job hazard in Bell and Smith.

Furthermore, the finding that *IU* flows have increased since the onset of recession, as has the share of those in employment who are searching for a new job (implying more people have started searching for a job in the recession, and job-search is thus countercyclical), seems counterintuitive. This may be attributable to the loosening of the labour market, which may encourage people to start looking for a new job.[18] This observation is also consistent with the Pissarides (1994) model of on-the-job search. The argument is that firms open relatively more jobs that are suitable for employed job-seekers, making it more difficult for unemployed job-seekers to get such jobs. Hires from unemployment are, in effect, 'crowded out' by hires from employment (job-to-job transitions) during expansions: "The changes in the composition of job vacancies and the congestion caused by employed job-seekers are especially acute immediately following an improvement in economic conditions", (Pissarides, 1994, p. 473). Alternatively, since IU flows appear to have been trending upwards before the recession, this may be indicative of a targeted government policy (Labour's New Deal) to get inactive people back into the labour force.

The fact that the share of those who are employed and searching is increasing may be down to the number of employed persons searching (E^S) remaining relatively stable, while the number of employed persons (E) fell. Alternatively, E may be falling at a faster rate than E^S. The share of employed persons searching is given by:

$$\text{Share of Employed Searching} = \tfrac{E^S}{E}.$$

If the denominator falls while the numerator remains fixed, or if the denominator falls at a faster rate than the numerator, then the left-hand side (the share of employed persons searching) will increase.

Meanwhile, inflows into inactivity appear to be on the rise, although no obvious pattern has yet appeared. This is consistent with the assertion by Gregg and Wadsworth (2010) that inactivity usually increases in a

[18]Even though it is statistically more difficult to find a job, individuals may be encouraged to start job-search by the perceived increase in gross labour market flows. Expansions are periods when, although jobs become easier to find, as the labour market is tighter, there are fewer movements between labour market states.

UK recession, although it tends to lag behind the unemployment rate by around a year. The rise in the male inactivity rate, for instance, rose by about half of a percentage point at the end of 2009, a year after the recession's official start.

In terms of gender, the observed gradual fall in the female inactivity rate, and the gradual rise in the male inactivity rate, over the sample, bear out already familiar patterns found in the literature on the labour force participation rates of men and women. The finding that the recent recession has had a more detrimental impact on men than women (with the male employment rate falling by more than the female rate, and the male unemployment rate rising by more than the female rate) is consistent with intuition and with results found in Gregg and Wadsworth (2010) and Şahin et al. (2010). Many women work part-time, and it may be expected that women are more likely to accept a reduction in working hours than men. Women are also more likely to work in industries where a reduction in working hours is more feasible: this may not always be a possibility in certain male-dominated industries. Gregg and Wadsworth observed an increase in part-time working during the 2008-09 recession. Most of the people taking up the offer of part-time work are likely to be women. It should also be noted, however, that the increase in part-time working was of a lesser order than in previous recessions (particularly the recession of the late 1980s, when short-time working was subsidised by the government). The authors state that firm profitability was greater prior to this recession than previous ones. This, coupled with the fact that there was, this time around, no government subsidy for short-time working, has probably meant the rise in the incidence of part-time work in this recession was not as high as in previous recessions. Nevertheless, the rise will have saved a considerable number of jobs; the majority of which are likely to have belonged to women.

Furthermore, Şahin et al. (2010) give a two-fold argument as to why male unemployment has increased more than women's in the US: 1) male-dominated industries have been hit hardest by the recession; and 2) previously inactive men, perhaps prompted by a decline in household liquidity, have rejoined the labour force, but failed to find work. A similar story may be unfolding in the UK.

What are the implications of these findings for the theory, discussed in chapter 1? The Pissarides (1994) model is consistent with labour market dynamics in the UK, over the period considered here, in that the recent recession is shown to be a time when more people started job-search. This model could be used as a basis for modelling the observed cyclical properties of job-search.

It is demonstrated that both the job-finding rate and job-separation rate are significant in explaining the dynamic behaviour of unemployment in the UK. Gomes (2009, 2012), along with Petrongolo and Pissarides (2008), shows that the two factors are close to being equally important determinants of unemployment dynamics in the UK.[19] A robust theoretical model of the UK labour market should therefore generate a procyclical job-finding rate and a countercyclical job-separation rate, that both behave in a volatile manner. Such a model may wish to consider how the relative importance of the job-finding and job-separation rate could differ with the severity of the downturn, as emphasised by Davis et al. (2006). A salient additional finding of this thesis is that the hiring rate decline appears to have been driven primarily by a fall in JJ flows, and this is something future theory may wish to acknowledge.

[19] Whether this holds for the US or other OECD economies is another matter, but it appears that there is a role for both factors in the UK.

Many theoretical and empirical questions remain unanswered (or not fully and satisfactorily answered), however. These include: the conundrum over whether the search-and-matching needs to be refined to account for, say, the rigid wages hypothesis of Shimer (2004, 2010); whether job destruction should be endogenous or exogenous; whether matching theory is the optimal lens through which to view aggregate unemployment, given its limitations; and how one is to overcome problems with the available data, such as time-aggregation bias. Although in some ways limited, and even though it is not necessarily intrinsically important in determining labour market outcomes (Rogerson and Shimer, 2011), it appears that matching theory has the sturdiest empirical support in explaining the dynamic behaviour of aggregate unemployment. Its main rival, the theory of efficiency wages, relies on some strong assumptions, and, intuitively, it cannot explain the type of unemployment one actually observes. Nor can it provide a credible explanation of involuntary unemployment, as, in the Shapiro-Stiglitz model (Shapiro and Stiglitz, 1984), more skilled workers are more likely to experience periods of unemployment than the general worker.

Conclusion

Underpinning the unemployment rate is a complex pattern of (sizeable) flows between the three labour market states. This thesis reveals that, between the official start of the recession (in 2008 Q2) and 2010 Q1, there was a net decrease of 304,000 in the level of employment (a net decrease of 38,000 people per quarter). Meanwhile, net unemployment increased by 696,000 (a rise of 87,000 people per quarter), and net inactivity has fallen by 392,000 (a quarterly drop of 49,000 people). Recent quarters, however, show a marked improvement in the functioning of the labour market.

In spite of potential measurement biases exhibited by gross flows data, some interesting patterns emerge. The contributions of this work have been to demonstrate that the prominent features exhibited by the recession, in terms of gross worker flows, have been:

1. a proportional decrease of around 3.20% (equivalent to roughly 2.40 percentage points) in the employment rate, and a proportional increase of almost 50% (equivalent to approximately 2.50 percentage points) in the unemployment rate;

2. an increased number of flows from employment to unemployment, and a higher probability of making such a transition;

3. increased flows out of unemployment into both employment and inactivity — the increase in the flow to inactivity has been more sizeable and immediate, although, as noted in section 3.2, the longitudinal nature of the data is likely to bias this flow upwards;

4. a lower probability of moving from unemployment to employment;

5. fewer flows and a lesser chance of transitioning from inactivity to employment;
6. increased flows and a greater chance of transitioning from inactivity to unemployment;
7. a considerable decline in job-to-job movements and the likelihood of moving between jobs (both for those who are looking for a new job and those who are not);
8. men faring decidedly worse than women, in terms of overall rates of employment and unemployment.

These results are broadly similar to those presented in Bell and Smith (2002) and Gomes (2009, 2012). Analysis of a data set incorporating a downturn, however, gives one salient additional finding: job-to-job flows are shown to have fallen strikingly since the start of the recession, and this appears to have been the major force driving the observed fall in the hiring rate. In turn, as both the job-finding rate and the job-separation rate are shown to have contributed substantially to the dynamic behaviour of UK unemployment, the fall in job-to-job flows has implicitly been one of the main factors associated with the rise in UK unemployment since the official start of the recession. The other main contributions are the use of detrended Gross Domestic Product (GDP) as the cyclical indicator (as opposed to another labour market indicator) and a split-sample analysis, which flags some interesting trend changes in labour market flow movements and transition rates, even prior to the Great Recession (for example, the general downward trend in job-to-job movements).

Since the onset of recession, both the job-finding rate and the job-separation rate have behaved in a volatile manner. This finding is consistent with Bell and Smith (2002) who find that employment inflow and outflow rates are equally volatile, and Gomes (2009, 2012), who finds that both the job-finding rate and job-separation rate are significant in explaining unemployment dynamics in the UK. It is also demonstrated the effect of the recession on labour market outcomes has been markedly worse for men than women. Şahin et al. (2010) found the same in a study of the US labour market. The finding is perhaps attributable to it being more likely for women to be offered, and to accept, a reduction in working hours; because male-dominated industries were hit harder by the recession; and, perhaps, due to inactive men re-entering the labour force due to household liquidity constraints, but failing to find work.

The recession has shed further light on the magnitude and cyclical properties of gross worker flows in the UK. These insights are of interest to macroeconomists, labour economists, and policy-makers alike. Aside from the intriguing empirical findings laid out above, the paper further demonstrates that a robust theoretical model of the UK labour market should generate a procyclical job-finding rate and a countercyclical job-separation rate, that both behave in a volatile manner.

This thesis supports the findings of Gomes (2009, 2012) that, in the UK, the job-finding rate and the job-separation rate both play an important role in determining unemployment fluctuations. While the Pissarides (2000) model seemingly fails to explain the observed cyclical volatility of its key variable, the V/U ratio (labour market 'tightness'), and perhaps too much weight is given to the job-separation rate in determining unemployment fluctuations (particularly in an economic downturn), it is clear to see that employment inflows are not acyclical (or, indeed, nearly acyclical), which discredits the Shimer (2012) hypothesis.

There is certainly weight, as evidenced in this thesis, for the Davis et al. (2006) suggestion that unemployment inflows drive unemployment dynamics during severe downturns, whereas unemployment outflows drive unemployment dynamics during milder downturns in the UK. Therefore, a promising route for future theory to take would be to use a model that considers how the relative importance of the job-finding and job-separation rates could differ with the severity of the downturn. Economists, in such a model, may also want to incorporate the result that job-search is seemingly countercyclical — a prediction that can be generated by a model similar to that presented by Pissarides (1994) — and may try to explain the observed decline in the hiring rate, which appears to have been driven primarily by a fall in JJ flows.

There are a few obvious directions of travel in light of this thesis. The first, and most obvious, would be to extend the data set to see if the patterns borne out over the period assessed also held into 2014. Basic intuition suggests that some strong cyclical patterns would continue to be found, in light of the continual and persistent fall in the claimant count measure of unemployment (changes in which tend to be a good predictor of the slightly less contemporaneous International Labour Organization — ILO — measure of unemployment). Second, potential further disaggregation of the flows data could usefully be undertaken: splitting flows by education levels, splitting inactive workers into marginally attached and distant from the labour market, and the contrast between the quit and layoff elements of the job-separation rate (the former of which we expect to be procyclical and the latter of which countercylical) could be useful distinctions to make. Third, a more sophisticated approach to decomposing unemployment inflows and outflow rates could have been used, in line with the methods applied by, amongst others, Fujita and Ramey (2009), Smith (2011), and Shimer (2012). It would also be appropriate to extend the transition rate analyses to incorporate other pertinent factors, such as net migration and population growth, as well as allowing, in the theoretical set-up, for job-to-job movements, which have been shown to be of considerable importance in this thesis. Finally, assessment of whether the rigid wages hypothesis could help to reconcile the competitive search-and-matching model with UK data may also be an interesting avenue for research in this area, given its importance in the US.

This having been said, UK unemployment has proved not to be particularly volatile over the business cycle, when compared to the impact on output: the impact of the Great Recession was markedly damper on the labour market than on GDP, and the recovery of the latter has been far more sluggish. Research as to why this has been the case is most pressing, with questions raised around whether it is an economic issue, or labour market statistics are masking what is, in actual fact, a worse economic situation than the aggregates might imply. It would be interesting to see if more contemporaneous analysis of labour market flows and wider labour market data are able to shed light on the troubling — and as not satisfactorily-explained — UK productivity puzzle. Analysis of further disaggregated flows data may well help to shed light on other pressing economic questions, such as why tax revenues have been under-predicted in 2014-15 (Office for Budget Responsibility, 2014). (One might reasonably conjecture that increased movements into low-paid industries and the increasing incidence of low-paid self-employment are explanations that allow economists to reconcile a high employment rate and weaker-than-expected tax receipts.) In this sense, labour market data can shed light on the most fundamental economic questions facing the UK: namely, how the government will meet its fiscal mandate and supplementary debt target in the face of increased spending over which it has little control (Annually Managed Expenditure) and weaker-than-anticipated receipts. Conclusive findings in this regard can also shape the direction of future policy, providing a clearer focus for future policy initiatives. Whether the finding above that the job-finding and job-separation rates are equally important determinants of UK unemployment dynamics still holds true when more contemporaneous data are analysed is an important question for the direction of UK labour market policy: should policy be geared towards job creation, preventing job destruction, or some mixture of both that reflects the relative importance of each factor?

Appendix

Transition	*Correlation Coefficient of Unemployment Rate Series With:*		*Average Size of Quarterly Gross Worker Flow as a Percentage of Working-Age Population*
	Gross Flow	*Hazard Rate*	
$E \rightarrow U$	0.77**	0.79**	0.99
$E \rightarrow I$	-0.51**	-0.44**	1.38
$U \rightarrow E$	0.71**	-0.83**	1.25
$U \rightarrow I$	0.89**	-0.66**	0.83
$I \rightarrow E$	-0.68**	-0.71**	1.32
$I \rightarrow U$	0.76**	0.79**	1.05
Job-to-Job	-0.65**	-0.55**	$2.77^{\dagger}$
Job-to-Job (S)	-0.52**	-0.64**	$0.86^{\dagger}$
Job-to-Job (NS)	-0.72**	-0.58**	$1.85^{\dagger}$
$\rightarrow E$	0.03	-0.84**	2.57
$E \rightarrow$	0.38**	0.45**	2.37
$\rightarrow U$	0.85**	0.85**	2.04
$U \rightarrow$	0.89**	-0.86**	0.83
$\rightarrow I$	0.46**	-0.68**	2.21
$I \rightarrow$	0.24*	0.21	2.37

Table A1.a. Cyclical Properties of Labour Market Flows and Hazards — Correlation Coefficients Between Labour Market Flows and Hazards and the Unemployment Rate: UK, 1997 Q2 — 2010 Q3

Transition	*Correlation Coefficient of Unemployment Rate Series With:*		*Average Size of Quarterly Gross Worker Flow as a Percentage of Working-Age Population*
	Gross Flow	*Hazard Rate*	
$E \to U$	0.73**	0.85**	0.98
$E \to I$	-0.35*	-0.02	1.42
$U \to E$	0.80**	-0.74**	1.29
$U \to I$	0.89**	-0.53**	0.81
$I \to E$	-0.38*	-0.24	1.33
$I \to U$	0.72**	0.77**	0.98
Job-to-Job	0.08	0.37*	3.06†
Job-to-Job (S)	0.35*	-0.08	0.96†
Job-to-Job (NS)	-0.16	0.22	2.06†
$\to E$	0.42*	-0.74**	2.62
$E \to$	0.21	0.59**	2.39
$\to U$	0.82**	0.84**	1.96
$U \to$	0.90**	-0.76**	0.81
$\to I$	0.39*	-0.52**	2.22
$I \to$	0.22	0.39*	2.31

Table A1.b. Cyclical Properties of Labour Market Flows and Hazards — Correlation Coefficients Between Labour Market Flows and Hazards and the Unemployment Rate: UK, 1997 Q2 — 2003 Q4

Transition	*Correlation Coefficient of Unemployment Rate Series With:*		*Average Size of Quarterly Gross Worker Flow as a Percentage of Working-Age Population*
	Gross Flow	*Hazard Rate*	
$E \rightarrow U$	0.78**	0.78**	1.00
$E \rightarrow I$	-0.59**	-0.56**	1.35
$U \rightarrow E$	0.69**	-0.86**	1.22
$U \rightarrow I$	0.92**	-0.73**	0.86
$I \rightarrow E$	-0.82**	-0.84**	1.31
$I \rightarrow U$	0.91**	0.89**	1.12
Job-to-Job	-0.87**	-0.88**	2.49†
Job-to-Job (S)	-0.82**	-0.84**	0.76†
Job-to-Job (NS)	-0.92**	-0.91**	1.66†
$\rightarrow E$	-0.13	-0.87**	2.52
$E \rightarrow$	0.41*	0.44*	2.35
$\rightarrow U$	0.92**	0.93**	2.12
$U \rightarrow$	0.89**	-0.88**	0.86
$\rightarrow I$	0.48**	-0.76**	2.21
$I \rightarrow$	0.21	0.06	2.43

Table A1.c. Cyclical Properties of Labour Market Flows and Hazards — Correlation Coefficients Between Labour Market Flows and Hazards and the Unemployment Rate: UK, 2004 Q1 — 2010 Q3

Sources: LFS, Gomes (2012) data set for job-to-job flows, and author analysis

Notes: The average sizes of the gross flows are calculated from the raw (seasonally-unadjusted) data.

† Job-to-Job flows are expressed as a percentage of total employment

S = Searching; NS = Not Searching

** = Statistically significant from zero at the 1% level; * = Statistically significant from zero at the 5% level

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