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# ABSTRACT

## Unemployment Equilibrium and On-the-Job Search*

This paper uses the search and matching framework to explore the impact of employed job search on the labour market. The specific features of our model are endogenous employed job search, flows in and out of the labour force, endogenous job destruction and heterogenous job creation. Also, job flows and workers flows do not coincide as we allow for job-to-job flows and labour force entries and exits. Employed job search is shown to have a substantial impact on unemployment dynamics but a negligible one on the level of unemployment. More on-the-job search leads to lower unemployment inflow and outflow, i.e. a more stagnant unemployment pool. With employed job search, the stock of vacancies is more cyclically sensitive, the unemployment outflow less cyclically sensitive and the unemployment inflow more cyclically sensitive than without employed job search. With our model, the impact of a change in unemployment benefit does not only occur through the conventional decrease in the unemployment outflow rate, but also through an increase in the unemployment inflow rate. The calibrated version of our model replicates well the cyclical behaviour of job and worker flows observed in the data.

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Keywords: unemployment, on-the-job search, job destruction, business cycle, matching

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# 1 Introduction

There is much evidence that a large fraction of new hires comes from the ranks of the employed. On-the-job search has been identified (Burgess, 1993, Pissarides, 1994) as having an impact on unemployment equilibrium as well as on the dynamics of the labour market. Job flows and worker flows have been documented to be large, even in an economy in a steady-state, and exhibit different behaviour over the business cycle (Burda and Wyplosz, 1994, Davis and Haltiwanger, 1992). Importantly, these flows are not identical. Job creation and job destruction do not coincide with unemployment inflows and outflows. This is because workers move from job to job, in and out of the labour force, and firms churn workers. These churning flows and labour force flows have been shown to be large and sensitive to the business cycle (Burgess, Lane and Stevens, 2000, Burda and Wyplosz, 1994). Hence it seems useful to incorporate these features into a model of unemployment to understand the impact of on-the-job search flows and labour force flows on unemployment flows, job creation and job destruction.

In this paper, we use the Mortensen-Pissarides framework and extend it to include the above features[1]. On-the-job search, job creation and job destruction are all endogenous. Workers are allowed to flow into and out of the labour force at an exogenously determined rate, and we are able to look at the impact of the size of these flows on unemployment equilibrium. These flows are thought to be mainly 'demographic' flows of individuals either retiring or joining the labour force when leaving education. These new entrants then have to be 'processed' by the labour market in that they have to find a match with a vacant job and that they create congestion on the workers' side of the labour market while they search. Importantly, jobs quit by individuals retiring or moving to another job are not necessarily destroyed. Firms are heterogenous and the value of their output is decomposed in terms of a common aggregate component and an idiosyncratic component. The idiosyncratic component is subject to unanticipated shocks. Vacancies themselves are heterogenous[2] and all but the marginal vacancy are profitable. They offer heterogeneous wages, which justifies on-the-job search for some workers. Wages are continuously determined by Nash bargaining. In steady state, job destruction occurs after idiosyncratic shocks.

The main results of the paper are as follows: the presence of on-the-job search has a substantial impact on labour market equilibrium. More on-the-job search leads to lower matching probability for workers, i.e. a lower unemploy-

[1] Pissarides (1994) introduced on-the-job search into his model, but kept job desctruction exogenous. Mortensen and Pissarides (1994) made job destruction endogenous, but did not consider on-the-job search. Mortensen (1994) allowed for endogenous job destruction and on-the-job search, but assumed that all jobs quit were destroyed, hence job flows and worker flows coincide.

[2] As opposed to vacancies in the standard model which are all posted at the maximum productivity and all make zero profit. As a result, in the standard model, there is a unique potential wage rate at the match for all job seekers, i.e. no wage distribution at the time of the match.

ment outflow rate and also to a lower layoff rate, i.e. a lower unemployment inflow rate. The net effect on the unemployment stock is negligible. Only the dynamics of unemployment are affected as the unemployment pool has become more stagnant. As predicted by Burgess (1993), on-the-job search renders unemployment inflow rate more sensitive to the cycle and unemployment outflow rate less sensitive to the cycle. In all cases, the inflow rate is found to be more cyclically sensitive than the outflow rate, suggesting that most unemployment dynamics occur through this channel. This confirms empirical results for Great Britain by Burgess and Turon (2000). The number of employed job seekers is very sensitive to the cycle and positively correlated with it. Also, the presence of on-the-job search decreases the impact of changes in unemployment benefit on unemployment duration. Such changes are shown to have a considerable impact on the job destruction rate.

The calibrated version of our model matches empirical facts well: unemployment flows are countercyclical, job flows are countercyclical and worker flows are procyclical. It hence reconciles the different behaviours over the business cycle of job flows and worker flows.

We derive the model in the next section and present the calibration and the results in section 3. Section 4 concludes.

# 2 Model

Our model builds on the Mortensen-Pissarides framework and incorporates on-the-job search[3]. We also introduce flows in and out of the labour force. We do not model the out-of-the-labour-force state and keep these flows exogenous. Garibaldi and Wasmer (2001) analyse these flows in more depth, but without considering on-the-job search[4]. In our model, the flows in and out of the labour force are exogenous and assumed to be both equal to $s$ times the stock of the employed, $stE$. The stock of the labour force is constant and normalised to 1. The labour force inflow represents new entrants coming from education and re-entrants coming back after a career break. All labour force entries flow into unemployment. The labour market, through the matching mechanism, has to 'process' these workers before they find a match. The labour force outflow represents retirements and individuals going onto career breaks. For simplicity, all labour force exits occur from the state of employment. As documented by Burda and Wyplosz (1994) both these labour force flows occur in fact to and from both states of employment and unemployment, in cyclically sensitive proportions. Their evidence, however, supports that total labour force flows are roughly constant over the cycle.

[3] See Pissarides (2000) or Mortensen and Pissarides (1999) for the derivation of the original model.

[4] An interesting extension of both models would include endogenous on-the-job search and labour force entries and exits as both features are shown to affect unemployment dynamics.

## 2.1 Firms

The value of the output produced by firms is decomposed into two components: the aggregate component, $p$ and the idiosyncratic component of price, $\epsilon$, which is distributed over the interval $(-\sigma;\sigma)$. When $\epsilon$ is above some threshold $jc$ it is worthwhile opening a vacancy. $\epsilon$ is subject to idiosyncratic shocks occurring at rate $\nu$. These shocks are not anticipated by either firms or workers. The wage is negotiated at the time of matching (see section 2.3) and are re-negotiated after either an idiosyncratic shock to $\epsilon$ or an aggregate shock to $p$. When the idiosyncratic component of price is below some threshold $ojs$ the worker will find it worthwhile to be searching on the job and the firm knows this. So the state value of a vacancy will have a different expression when $\epsilon$ is in the range $(jc;ojs)$, denoted $V_o$, from when $\epsilon$ is in the range $(ojs;\sigma)$, denoted $V_n$, because the state value of the filled job with a non-searching worker, $J_n$, is different from the state value of a filled job with an on-the-job searcher, $J_o$. Vacant jobs have a probability $\lambda$ of being matched with a job searcher, determined by the matching function (see section 2.3). We assume that $\epsilon$ is unobserved to the worker until the match actually takes place. Hence all vacant jobs have the same probability of being matched, irrespective of their idiosyncratic productivity $\epsilon$. We also assume that, while jobs are vacant, they are not subject to idiosyncratic shocks. The state values for vacant jobs are:

$$r \cdot V_o(\epsilon) = -k + \lambda \cdot (J_o(\epsilon) - V_o(\epsilon)) \quad (1)$$
$$r \cdot V_n(\epsilon) = -k + \lambda \cdot (J_n(\epsilon) - V_n(\epsilon)) \quad (2)$$

where $r$ is the discount rate and $k$ the per-period cost of opening a vacancy. As in the Pissarides model, vacant jobs are created until the exhaustion of rents. What is different here is that all vacancies but the marginal one will make a positive profit[5]. The job creation threshold is determined as:

$$V_o(jc) = 0 \quad (3)$$

As seen above, when the idiosyncratic price component $\epsilon$ is in the interval $(jc;ojs)$, the job will be filled by a worker who will carry on job-searching. The firm hence expects the job to become vacant again, with probability $\mu_e$ (the matching probability for employed workers). It also expects the worker to leave the labour force with probability $s$[6]. When the job becomes vacant it keeps its level of idiosyncratic productivity $\epsilon$. The state values of a job filled with a worker searching on the job, $J_o(\epsilon)$, and of a job filled by a non-searching worker,

[5] In Mortensen and Pissarides (1994), all new jobs were created at the same idiosyncratic productivity - for which the profits from a vacancy is zero. Here, jobs are created over a range of idiosyncratic productivities $(jc;\sigma)$ and the profits from a vacancy are zero at $jc$ and positive over the rest of the range. In den Haan et al. (2001, pp. 8-10), new matches are 'accepted' by worker and firm as long as the relationship-specific productivity is greater than some threshold for which the joint surplus of the match is zero. Blanchard and Diamond (1989, p.9) already suggested that, in the short run, the profits from a vacancy were not necessarily zero.

[6] Note that in case of retirement or quit to another job, the firm plans to re-advertise the job. So separations and job destruction are different.

$J_n(\epsilon)$, are:

$$r \cdot J_o(\epsilon) = p + \epsilon - w_o(\epsilon) + (s + \mu_e) \cdot (V_o(\epsilon) - J_o(\epsilon)) \quad (4)$$
$$r \cdot J_n(\epsilon) = p + \epsilon - w_n(\epsilon) + s \cdot (V_n(\epsilon) - J_n(\epsilon)) \quad (5)$$

The wage negotiated with a worker continuing job search, $w_o(\epsilon)$, will be different from the wage negotiated with a worker who stops searching, $w_n(\epsilon)$. Wage determination is detailed in section 2.3. Whether a worker searches on the job or not does not depend on the worker but on the idiosyncratic productivity of the job, $\epsilon$. All workers employed in jobs with $\epsilon$ less than $ojs$ will be looking for another job, whilst no worker employed in jobs with $\epsilon$ more than $ojs$ will be doing so.

Filled jobs with idiosyncratic productivities in the range $(jc; ojs)$ are quit at a rate $(s + \mu_e)$ whereas filled jobs with idiosyncratic productivities in the range $(ojs; \sigma)$ are quit at a rate $s$. So jobs with $\epsilon$ in the range $(jc; ojs)$ are re-advertised at a rate $(s + \mu_e)$ whereas jobs with $\epsilon$ in the range $(ojs; \sigma)$ are re-advertised at a rate $s$. On the other hand, vacant jobs are all matched at the same rate, $\lambda$. We assume that genuine job creation occurs at rate $g.\xi$ over the range $(jc; ojs)$ and at a rate $\xi$ over the range $(ojs; \sigma)$. The distribution of idiosyncratic productivity $\epsilon$ will hence be different between vacant jobs and filled jobs. The calculation of the two density functions is detailed in the Appendix.

When an idiosyncratic shock occurs, a new value of $\epsilon$ is drawn from a uniform distribution over $(-\sigma; \sigma)$. If the new value falls below some threshold $jd$, the firm will decide to destroy the job and a layoff will occur provided that the worker is not retiring or quitting at the same time. The threshold $jd$ is determined by the condition:

$$J_o(jd) = -f \quad (6)$$

where $f$ is the amount of firing costs that the firm has to pay when laying off a worker. The value of $jd$ is less than $jc$ because the value of a filled job is positive at $jc$ and the function $J_o(.)$ is increasing. Hence, in the interval $(jd; jc)$, jobs survive but would not be re-advertised if the worker came to quit or retire. In this interval, workers engage in on-the-job search.

Idiosyncratic shocks lead to a job destruction rate of:

$$JD = \nu \cdot \frac{\sigma + jd}{2\sigma} \quad (7)$$

Job destruction only leads to a layoff if the worker has not left the labour force or quit in the same period. So the layoff rate is:

$$La = \nu \cdot \frac{\sigma + jd}{2\sigma} \cdot \left[ \begin{array}{c} (1 - s - \mu_e(1 - s)) \cdot (f_{0E}(jc - jd) + f_{1E}(ojs - jc)) \\ +(1 - s) \cdot f_{2E}(\sigma - ojs) \end{array} \right] \quad (8)$$

where $f_{0E}$, $f_{1E}$ and $f_{2E}$ are the values taken by the density function of $\epsilon$ for filled jobs over the ranges $(jd; jc)$, $(jc; ojs)$ and $(ojs; \sigma)$ respectively (see the Appendix). We see from equations (7) and (8) that worker flows and job flows do not coincide because of job-to-job flows and labour force entries and exits.

## 2.2 Workers

We assume that employed job searchers have a matching probability $\mu_e$ equal to $a$ times the matching probability of unemployed job searchers:

$$\mu_e = a.\mu \tag{9}$$

The per-period search cost is denoted $c$. Following Jovanovic (1979), we assume that the job match is an experience good, so the idiosyncratic productivity of the job is unknown to the worker at the time of the match. Therefore employed job seekers sample *all* the available vacancies and their matching probability ($\mu_e$) as well as their expected value of employment in their next job ($EE$) do not depend on the $\epsilon$ in their current job. For employed workers in jobs with idiosyncratic productivity $\epsilon$ below $ojs$, the state value of being employed and searching on-the-job, $E_o(\epsilon)$, is therefore:

$$r \cdot E_o(\epsilon) = w_o(\epsilon) + s \cdot (U - E_o(\epsilon)) + \mu_e \cdot (EE - E_o(\epsilon)) - c \tag{10}$$

As we do not model the out-of-the-labour-force state, we assume that its state value equals $U$, the state value of being unemployed. $EE$ denotes the expected state value of being employed:

$$EE = f_{1V} \cdot \int_{jc}^{ojs} E_o(\epsilon)\ d\epsilon + f_{2V} \cdot \int_{ojs}^{\sigma} E_n(\epsilon)\ d\epsilon \tag{11}$$

where $f_{1V}$ (respectively $f_{2V}$) denotes the density of the distribution of $\epsilon$ over $(jc;ojs)$ (respectively $(ojs;\sigma)$) across vacant jobs.

The state value of being employed and not searching, $E_n(\epsilon)$, is:

$$r \cdot E_n(\epsilon) = w_n(\epsilon) + s \cdot (U - E_n(\epsilon)) \tag{12}$$

The idiosyncratic productivity at which workers are indifferent between continuing or stopping search is the on-the-job threshold mentioned above and satisfies:

$$E_n(ojs) = E_o(ojs) \tag{13}$$

if this gives a solution[7] greater than $jc$. Otherwise $ojs = jc$ and there are no employed job seekers.

The state value of being unemployed is:

$$r \cdot U = b + \mu \cdot (EE - U) \tag{14}$$

where $b$ is the per-period sum of the unemployment benefit and the value of leisure, net of job search costs.

[7] $E_n(\epsilon)$ and $E_o(\epsilon)$ are linear functions of $\epsilon$, usually with different slopes, so equation (13) will lead to a unique solution.

## 2.3 Wage bargaining and matching

The wage rate is determined by Nash bargaining between worker and firm, as in the Mortensen-Pissarides framework[8]. Here, the idiosyncratic productivity of the job, $\epsilon$, is unknown to the worker at the time of the match. It is only revealed to him when he starts in the job. As mentioned above, the wage level is constantly renegotiated between the worker and the firm, so that it always shares the match surplus between the two parties according to their bargaining power. So, before the match actually occurs, there is no actual wage offer apart from a knowledge of this renegotiation rule. The worker always finds it worthwhile to take up the job offer, either because he is unemployed and the lowest value of employment $E_o(jc)$ is greater than the value of unemployment $U$, or because he is an employed job seeker and has decided to search on-the-job because the expected value of alternative employment $EE$ is greater than the value of his current employment $E_o(\epsilon)$. It may be that the employed job searcher is unlucky when he finds a new job in that he experiences a wage drop, but his *expected* returns to search were still positive ex ante, which is why he decided to search in the first place.

From the equations above, we see that the surplus will have a different expression for jobs in which the worker carries on searching and in jobs where the worker stops searching. Because wage negotiation occurs once the worker is in the job, we assume that the worker's outside option is unemployment in both cases[9]. Similarly, if negotiation breaks down, the firm has to layoff the worker and to pay firing costs $f$, so the firm's outside option is $V_i(\epsilon) - f$. The two wage rates $w_o(\epsilon)$ and $w_n(\epsilon)$ resulting from the Nash bargaining will satisfy the following conditions:

$$\beta \cdot (J_o(\epsilon) - V_o(\epsilon) + f) = (1-\beta) \cdot (E_o(\epsilon) - U) \tag{15}$$

$$\beta \cdot (J_n(\epsilon) - V_n(\epsilon) + f) = (1-\beta) \cdot (E_n(\epsilon) - U) \tag{16}$$

where $\beta$ is the worker's share of the surplus.

Firm heterogeneity, embodied in the variance of $\epsilon$, and labour market frictions, embodied by the matching function, lead to some wage dispersion[10]. This dispersion in turn is an incentive for some workers paid at the lower end of the wage distribution to engage in on-the-job search.

Matches between searching workers and vacant jobs occur at a rate determined by the matching function, which we assume to exhibit constant returns to scale. The pool of job searchers comprises all the unemployed job seekers,

[8] There has been a growing literature on alternative models of wage determination over the past decade, particularly models with wage-posting games (see Mortensen and Pissarides, 1999 for a survey). Here, wage dispersion is obtained with Nash bargaining wage determination.

[9] Because the worker who has quit his previous job does not have the option to go back to it.

[10] Following Burdett and Mortensen (1998), there are a number of models of equilibrium wage dispersion with wage-posting firms. For example, Postel-Vinay and Robin (2002) present a search model where both workers and firms are heterogenous. They estimate that worker heterogeneity contributes 0 to 40% of the wage variance, firm heterogeneity 10 to 50% and labour market frictions about 50%.

$stU$ plus the employed workers engaged in on-the-job search, $stOJS$:

$$\text{Number of matches} = eff \cdot (stU + a \cdot stOJS)^{(1-\alpha)} \cdot stV^{\alpha} \tag{17}$$

where $eff$ is the matching efficiency, $\alpha$ the matching elasticity with respect to vacant jobs and $stV$ the stock of vacancies. If we denote $\theta$ the labour market tightness:

$$\theta = \frac{stV}{stU + a \cdot stOJS} \tag{18}$$

we have the following expressions for the workers' ($\mu$) and vacancies' ($\lambda$) matching probabilities:

$$\mu = eff \cdot \theta^{\alpha} \tag{19}$$

$$\lambda = eff \cdot \theta^{\alpha-1} \tag{20}$$

## 2.4 Equilibrium

As mentioned earlier in this section, the labour force is assumed to be constant and normalised to 1, so we have the following identity between the stocks of employed $stE$ and unemployed $stU$:

$$stE + stU = 1 \tag{21}$$

The stock of vacancies $stV$ is determined by the level of $jc$, the $\epsilon$ threshold below which it is not profitable to open a vacancy (see equation (3)):

$$stV = \delta \cdot \frac{(\sigma - jc)}{2\sigma} \tag{22}$$

where $\delta$ is a scaling parameter. All the workers employed in jobs with $\epsilon$ less than $ojs$ are engaged in on-the-job search. So the stock of employed job seekers equals:

$$stOJS = stE_1 = f_{1E} \cdot (ojs - jc) \cdot stE \tag{23}$$

The inflow into unemployment comprises workers flowing in from employment following job destruction and individuals entering the labour force:

$$U\inf low = (La + s) \cdot stE \tag{24}$$

The outflow from unemployment equals the number of matches coming from the ranks of the unemployed as workers only leave the labour force from employment:

$$U\text{outflow} = \mu \cdot stU \tag{25}$$

The steady-state stock of unemployment is therefore, using (24), (25) and (21):

$$stU = \frac{La + s}{La + s + \mu} \tag{26}$$

With equation (18), the model is now closed.

# 3 Results

In this section we calibrate the model to obtain a solution that mirrors reality in terms of the sizes of the various stocks and flows. The literature gives us guidance on the range of values that the various parameters can take. There are fifteen parameters in the model: the per-period cost of opening a vacancy, $k$, the per-period cost of searching on-the-job, $c$, the parameter $b$ measuring the value of the unemployment benefit plus the value of leisure net of search cost for the unemployed, the discount rate $r$, the scaling parameter $\delta$, the worker's share of the surplus in the Nash wage bargaining $\beta$, the rate at which workers leave/enter the labour force $s$, the firing cost $f$, the aggregate price component $p$, the variance of the distribution of the idiosyncratic price component $\sigma$, the rate at which idiosyncratic shocks occur $\nu$, the matching efficiency $eff$, the matching elasticity with respect to vacant jobs $\alpha$, the relative matching efficiency of employed job seekers compared to unemployed job seekers $a$, and $g$ the ratio of genuine job creation rates between the ranges $(jc; ojs)$ and $(ojs; \sigma)$.

## 3.1 Calibration

In the calibration process we aim to reach a solution where the stock of unemployed is about 8% of the labour force. We assume that employed jobs seekers are 1.5 more efficient at finding jobs than the unemployed ($a = 1.5$). As there is evidence (Burgess, 1993) that half the new hires come from the ranks of the employed, we aim to find a stock of employed job seekers equal to two thirds the size of the unemployment stock.. We also aim for the matching probabilities to be about 0.40 for the job seekers and 0.90 for the vacant jobs, and for the unemployment inflow rate to be about 3.5% of the labour force[11]. We think of the unit time period to be a quarter and use a discount rate $r$ of 0.02. A summary of all parameter values for the base case is shown in Table 1.

Table 1: Parameter values

| $r$ | $\beta$ | $b$ | $s$ | $k$ | $f$ | $\nu$ | $eff$ |
|---|---|---|---|---|---|---|---|
| 0.02 | 0.5 | 0.9 | 0.015 | 0.2 | 1 | 0.04 | 0.6 |
| $\alpha$ | $\delta$ | $c$ | $p$ | $\sigma$ | $a$ | $g$ | |
| 0.5 | 0.146 | 0.15 | 1.5 | 2.4 | 1.5 | 0.5 | |

With these parameter values we obtain a labour market tightness $\theta$ of 0.46 and matching probabilities of 0.41 and 0.89 for workers and vacancies respectively. The resulting stocks of unemployed and employed job seekers are respectively 0.078 and 0.049, while the stock of vacant jobs is 0.070. The layoff rate is 0.02 and the unemployment inflow rate is 0.035. The average productivity is 2.78 and the wage at the average productivity is 1.74, which corresponds to a labour share of income of 63%

[11] These values were chosen to match data from Great Britain (NOMIS and Burgess and Turon, 2000).

## 3.2 Impact of on-the-job search

In order to assess the impact of the extent of employed job search, we allow the parameter $c$ to vary, which will have a direct impact on the number of employed job seekers. Results are reported in Table 2. We see that the stock of employed job seekers, $stOJS$, responds negatively to a change in $c$. Over these three cases, the elasticity of this stock to the search cost $c$ is -0.5.

Table 2: Impact of on-the-job search

| | Base | $c = 0.20$ | $c = 0.10$ |
|---|---|---|---|
| $\theta$ | 0.46 | 0.49 | 0.425 |
| $\mu$ | 0.407 | 0.420 | 0.391 |
| $\lambda$ | 0.885 | 0.857 | 0.920 |
| $stU$ | 0.078 | 0.077 | 0.080 |
| $stOJS$ | 0.049 | 0.040 | 0.059 |
| $stV$ | 0.070 | 0.068 | 0.072 |
| $La$ | 0.0195 | 0.0205 | 0.0189 |
| $avge$ | 2.78 | 2.81 | 2.75 |
| $w\,(avge)$ | 1.74 | 1.78 | 1.68 |
| $ls\,(avge)$ | 0.63 | 0.64 | 0.61 |

avge is the average productivity over filled jobs. ls(avge)=w(avge)/avge is the labour share at average productivity.

The increase in the number of employed job seekers has a negative impact on $\mu$. So the employed job seekers create congestion for the unemployed. There is a small positive impact on the stock of vacancies. The increase in the number of employed job seekers is accompanied by a decrease in the layoff rate, but the net effect of this decrease and of the decrease in $\mu$ is virtually no change in the stock of unemployment. So the stock of unemployment is unaffected by the change in the stock of employed job seekers, but it is more stagnant as both inflow and outflow are smaller. This agrees with the results of Boeri (1999) who observes that countries with a high fraction of employed job search exhibit lower unemployment turnover rates.

## 3.3 Impact of the business cycle

We now look at the impact of a change in the aggregate price component $p$. Results are shown in columns 2, 3 and 4 of Table 3. As observed in real data, the labour market tightness $\theta$, the workers' matching probability $\mu$, the stock of employed job seekers $stOJS$ and the stock of vacancies $stV$ are procyclical while the vacancies' matching probability $\lambda$, the stock of unemployment $stU$ and the layoff rate $La$ are countercyclical.

The stock of employed job searchers is very sensitive to the business cycle: its elasticity with respect to $p$ is 0.55 when $p$ increases from 1.5 to 2, and 0.85 when $p$ decreases from 1.5 to 1. This also suggests a concave relationship between $p$

Table 3: Impact of business cycle and on-the-job search

| | $p=1$ | Base | $p=2$ | $p=1$ no OJS | $p=1.5$ no OJS | $p=2$ no OJS |
|---|---|---|---|---|---|---|
| $\theta$ | 0.385 | 0.46 | 0.545 | 0.535 | 0.72 | 0.92 |
| $\mu$ | 0.372 | 0.407 | 0.443 | 0.439 | 0.509 | 0.575 |
| $\lambda$ | 0.967 | 0.885 | 0.813 | 0.820 | 0.707 | 0.626 |
| $stU$ | 0.093 | 0.078 | 0.065 | 0.087 | 0.073 | 0.063 |
| $stOJS$ | 0.035 | 0.049 | 0.058 | 0 | 0 | 0 |
| $stV$ | 0.056 | 0.070 | 0.083 | 0.046 | 0.053 | 0.058 |
| $La$ | 0.0234 | 0.0195 | 0.0158 | 0.0267 | 0.0250 | 0.0236 |
| $avge$ | 2.50 | 2.78 | 3.06 | 2.63 | 3.03 | 3.45 |
| $w\,(avge)$ | 1.63 | 1.74 | 1.84 | 1.90 | 2.20 | 2.54 |
| $ls\,(avge)$ | 0.66 | 0.63 | 0.60 | 0.72 | 0.73 | 0.74 |

avge is the average productivity over filled jobs. ls(avge)=w(avge)/avge is the labour share at average productivity.

and $stOJS$, whereby, when job opportunities become plentiful, more employed workers engage into job search but the rate of increase in their number decreases if the economy is already buoyant. As the matching probability $\mu$ for workers is procyclical too, the quit rate will be super-procyclical, as observed in real data.

Layoffs are countercyclical and exhibit an elasticity of -0.58 with respect to $p$. The elasticity of the worker's matching probability $\mu$, which is also the unemployment outflow rate exhibits an elasticity with respect to $p$ of 0.26. As layoffs account for over half the unemployment inflow (the remaining part of the inflow, coming from out of the labour force, is constant and equal to 0.015) the unemployment inflow is more sensitive to the cycle than the unemployment outflow. Columns 5 to 7 in Table 3 show model results when there is no employed job search. Comparing these with results with employed job search shows how employed job search affects the cyclical sensitivity of unemployment flow rates. With no employed job search the elasticity of layoffs with respect to $p$ is -0.18 (instead of -0.58 with employed job search) and the elasticity of the workers' matching probability $\mu$ with respect to $p$ is 0.40 (instead of 0.26 with employed job search). So we see that the presence of employed job search renders the unemployment inflow rate more sensitive to the cycle and the unemployment outflow rate less sensitive to the cycle, as predicted by Burgess (1993).

The stock of vacancies $stV$ is procyclical and exhibits an elasticity of 0.58 with respect to $p$ when there is employed job search (0.34 without employed job search) while the stock of unemployment $stU$ is countercyclical and exhibits an elasticity of -0.54 with respect to $p$ (-0.50 without employed job search). This corresponds to the often observed negative correlation between unemployment and vacancies over the business cycle -the Beveridge curve. The fact that the stock of vacancies is more sensitive to the cycle when there is employed job search agrees with Pissarides's (1994) findings. He also finds that employed job search renders unemployment less cyclically sensitive, which we do not as elasticities are about equal.

With employed job search, we also observe that the stock of vacancies is more cyclically sensitive than the unemployment outflow rate $\mu$ (the respective elasticities are 0.58 and 0.26). This is explained by the fact that, when there are more vacancies around, more employed workers engage into job search attracted by these increased opportunities and they 'crowd out' unemployed workers. The increase in matching probability for the workers is hence less than it would have been without employed job search. This smoothing effect is not present when there are no employed job searchers: the respective elasticities of the vacancies stock and workers' matching probability are 0.34 and 0.40.

The last three lines of Table 3 show that both the average productivity and the average wage are procyclical and that wages are less sensitive to the cycle than productivity. The labour share of income is hence countercyclical in our model, which replicates the behaviour of labour share in real data. It should be noted from the last three columns that, without employed job search, the model looses the feature of a countercyclical labour share (it is about acyclical).

### 3.4 Impact of unemployment benefit, worker's bargaining power and idiosyncratic productivity variance

We now turn to the impact of model parameters relevant for policy purposes: the unemployment benefit $b$, the worker's bargaining power $\beta$, the variance of $\epsilon$, the idiosyncratic productivity, the rate at which individuals flow in and out of the labour force $s$ and the firing costs $f$. Results are shown in Tables 4 and 5.

Table 4: Impact of unemployment benefit, worker's share and variance of idiosyncratic productivity

| | Base | $b = 0.4$ | $b = 1.4$ | $\beta = 0.4$ | $\beta = 0.6$ | $\sigma = 1.8$ | $\sigma = 3.0$ |
|---|---|---|---|---|---|---|---|
| $\theta$ | 0.46 | 0.545 | 0.385 | 0.625 | 0.34 | 0.525 | 0.42 |
| $\mu$ | 0.407 | 0.443 | 0.372 | 0.474 | 0.350 | 0.435 | 0.389 |
| $\lambda$ | 0.885 | 0.813 | 0.967 | 0.759 | 1.029 | 0.828 | 0.926 |
| $stU$ | 0.078 | 0.065 | 0.093 | 0.067 | 0.092 | 0.076 | 0.080 |
| $stOJS$ | 0.049 | 0.058 | 0.035 | 0.032 | 0.067 | 0.033 | 0.060 |
| $stV$ | 0.070 | 0.083 | 0.056 | 0.072 | 0.066 | 0.066 | 0.071 |
| $La$ | 0.0195 | 0.0158 | 0.0234 | 0.0191 | 0.0203 | 0.0205 | 0.0190 |
| $avge$ | 2.78 | 2.56 | 3.00 | 2.74 | 2.84 | 2.50 | 3.06 |
| $w\,(avge)$ | 1.74 | 1.34 | 2.13 | 1.63 | 1.88 | 1.75 | 1.74 |
| $ls\,(avge)$ | 0.63 | 0.53 | 0.71 | 0.60 | 0.66 | 0.70 | 0.57 |

avge=(1+jc)/2 is the average productivity. ls(avge)=w(avge)/avge is the labour share at average productivity.

Columns 3 and 4 show the impact of a change in the unemployment benefit $b$. An increase in $b$ leads to an increase in $stU$ and a decrease in $\mu$ as predicted by unemployed job search theory. Here, the model also predicts that an increase

Table 5: Impact of labour force flows and firing costs

| | Base | $s = 0.01$ | $s = 0.02$ | $f = 0.5$ | $f = 1.5$ |
|---|---|---|---|---|---|
| $\theta$ | 0.46 | 0.505 | 0.42 | 0.495 | 0.425 |
| $\mu$ | 0.407 | 0.426 | 0.389 | 0.422 | 0.391 |
| $\lambda$ | 0.885 | 0.844 | 0.926 | 0.853 | 0.920 |
| $stU$ | 0.078 | 0.065 | 0.092 | 0.072 | 0.084 |
| $stOJS$ | 0.049 | 0.047 | 0.050 | 0.053 | 0.044 |
| $stV$ | 0.070 | 0.069 | 0.070 | 0.076 | 0.064 |
| $La$ | 0.0195 | 0.0198 | 0.0192 | 0.0180 | 0.0209 |
| $avge$ | 2.78 | 2.79 | 2.76 | 2.68 | 2.87 |
| $w\,(avge)$ | 1.74 | 1.76 | 1.71 | 1.55 | 1.90 |
| $ls\,(avge)$ | 0.63 | 0.63 | 0.62 | 0.58 | 0.66 |

avge=(1+jc)/2 is the average productivity. ls(avge)=w(avge)/avge is the labour share at average productivity.

in $b$ has a large impact on the job destruction and layoff rates. In the wage bargaining, the workers' outside option, $U$, is worth more when $b$ is higher, so the negotiated wage rate will be higher. The consequence is that some jobs with low idiosyncratic productivity $\epsilon$ will now not be profitable anymore. In other words, the job creation threshold $jc$ will be higher and less vacancies will be advertised. For the same reason, the job destruction thresholds $jd$ will be higher, so the probability that the idiosyncratic productivity falls below that threshold after a shock will be higher, hence the higher job destruction and layoff rates. A consequence of this is that the average productivity is positively correlated with unemployment benefit, as in den Haan et al. (2001, p.21). If we compare the impact of an increase in unemployment benefit on workers' matching probability and layoff rate by comparing their elasticities with respect to $b$, we obtain -0.16 and 0.35 respectively. So the impact on the layoff rate is much larger than the impact on $\mu$, which means that most of the impact of $b$ on $stU$ occurs through its impact on the unemployment inflow rate rather than on the outflow rate. As the matching probability is lower and the variance of job opportunities is lower, employed job search is much less attractive: the elasticity of $stOJS$ with respect to $b$ is -0.42. This means that the congestion on the workers's side of the labour market eases and $\mu$ increases, although not enough as to completely offset its initial decrease. The impact of unemployment benefit on unemployment exit rate is hence smaller in the presence of employed job search. There is a large literature on the impact of unemployment benefit on unemployment duration. Narendranathan, Nickell and Stern (1985) estimated the elasticity of unemployment duration for men with respect to unemployment benefit to be in the range 0.28 to 0.36. Our model predicts this elasticity to be 0.16.

In columns 5 and 6, a rise in the worker's share of the surplus in the Nash bargaining $\beta$ by 20% is shown to lead to a substantial (37%) rise in employed job search and a decrease (by 14%) of the workers' matching probability $\mu$. Layoffs also increase by 4% so the stock of unemployment itself increases by

18%. The stock of vacancies remains fairly constant, which suggests that most of the impact of the change in $\beta$ on unemployment occurs through its impact on employed job search.

In columns 7 and 8, we look at the impact of a change in the variance of the distribution of idiosyncratic productivity, $\sigma$. The elasticity of the stock of employed job seekers with respect to $\sigma$ is 1.10. Both stocks of unemployment and vacancies increase after an increase in $\sigma$ (the respective elasticities are 0.10 and 0.15). The unemployment outflow rate and the layoff rate both respond negatively to an increase in $\sigma$. Again, most of the final impact on unemployment occurs through the response of employed job search to this shock.

In columns 3 and 4 of Table 5, we see that an increase in $s$ does not have a great impact on either the stock of employed job search, the stock of vacancies or the layoff rate. A higher $s$ means a higher inflow into unemployment, which leads to more congestion on the workers' side of the labour market, so a decrease in the workers' matching probability $\mu$. These two effects combined lead to a substantial increase in the stock of unemployment, $stU$.

Results shown in columns 5 and 6 of Table 5 show that an increase in firing costs decreases the amount of employed job search in the economy. The workers' matching probability decreases too, but this decrease is attenuated by the lower number of employed job seekers easing the congestion on the workers' side of the labour market. The layoff rate increases after an increase in firing costs, which is a bit surprising intuitively. This increase results from the fact that, with high firing costs, less jobs are viable (i.e. the job creation threshold $jc$ is higher) which in turns increases the probability of job destruction. The aggregate effect on the unemployment stock is a 15% increase when firing costs are increased by 50%. In the literature (e.g. Bertola (1990), Millard (1994), Garibaldi (1998)), firing costs have usually been found to reduce job reallocation but not to affect greatly the level of unemployment itself (except in Millard (1994) where firing costs increase unemployment).

Throughout this section, we have seen that variations in employed job search following a change in one of the model parameters play a very important role in the overall impact of this shock on the steady-state level of unemployment. The presence and sensitivity to various labour market parameters of employed job search is hence a crucial aspect of the labour market's response to shocks to institutions or to the economy.

## 3.5 Job flows and worker flows

In our model, job flows and worker flows do not coincide. Not all the job destroyed incur layoffs because some workers either leave the labour force or take another job. Unemployment inflows include not only layoffs but also entries into the labour force. Job creation and unemployment outflows do not coincide either as some new jobs (about half of them) are taken by employed job searchers and because job-to-job moves give rise to new vacancies without job creation when the firm decides to replace those workers who quit. We present in Table 6 some measures of job flows and worker flows in the base case, in a recession

($p = 1$) and in a boom ($p = 2$).

Table 6: Job flows and worker flows

| | $p = 1$ | $p = 1.5$ | $p = 2$ |
|---|---|---|---|
| Job flows | 0.022 | 0.019 | 0.016 |
| Layoffs | 0.021 | 0.018 | 0.015 |
| Separations | 0.054 | 0.062 | 0.067 |
| U flows | 0.035 | 0.032 | 0.029 |
| L flows | 0.014 | 0.014 | 0.014 |
| JJ flows | 0.020 | 0.030 | 0.039 |
| Worker flows | 0.068 | 0.076 | 0.081 |
| JF / WF | 0.32 | 0.25 | 0.19 |
| UF / JF | 1.59 | 1.68 | 1.84 |
| JD/separations | 0.40 | 0.31 | 0.23 |

U flows: Unemployment inflow and outflow in steady state. L flows: Flows in and out of the labour force.

JJ flows: Job-to-job flows. WF: worker flows. JF: job flows.

Row 5 of Table 6 shows that our model produces countercyclical unemployment flows, consistent with the data presented by Burda and Wyplosz (1994) for four European countries. Job flows (row 2) are also countercyclical, whereas worker flows (row 8) are procyclical. The ratios in rows 9 and 10 show that unemployment flows, worker flows and job flows have very different cyclical behaviour. As mentioned in section 3.3, job-to-job flows, i.e. quits, are very procyclical. In our model, job destruction does not coincide with job separations, as is often assumed in the literature. Indeed, the ratio between the two (row 11) not only is much smaller than 1, but is very sensitive to the business cycle, varying from 0.40 in a recession to 0.23 in a boom. So models assuming that all jobs quit are destroyed ignore a significant aspect of labour market dynamics.

# 4 Conclusion

This paper uses the search and matching framework to explore the role of employed job search on the labour market. With our model, we can analyse its impact in terms of unemployment level and dynamics, job creation and job destruction. The specific features of the model are endogenous employed job search, flows in and out of the labour force, endogenous job destruction and heterogenous job creation. In our model, job flows and workers flows do not coincide as we allow for job-to-job flows, firms' churning of workers and labour force entries and exits.

Employed job search is shown to have a substantial impact on unemployment dynamics but a negligible one on the level of unemployment. More on-the-job search leads to lower unemployment inflow and outflow, i.e. a more stagnant unemployment pool. The sensitivity of the labour market to the business cycle is affected too: with employed job search, the stock of vacancies is more cyclically sensitive, the unemployment outflow less cyclically sensitive and the unemployment inflow more cyclically sensitive than without employed job search. One consequence is that most unemployment dynamics arise through the inflow response to cyclical shocks.

With our model, the impact of a change in unemployment benefit does not only occur through the behaviour of unemployed job seekers. A higher unemployment benefit leads to less job creation, more job destruction and less on-the-job search. So we obtain a rise in equilibrium unemployment coming not only from the conventional decrease in the unemployment outflow rate, but also from an increase in the unemployment inflow rate. The latter effect is in fact stronger than the former. Also, changes in the worker's bargaining power and in the variance of the idiosyncratic productivity affect unemployment mainly through their impact on employed job search.

The calibrated version of our model matches empirically observed facts well. The unemployment level and layoffs are countercyclical, the unemployment outflow rate, the stock of vacancies and the number of employed job seekers are procyclical. Also, wages are less sensitive to the cycle than prices so that the labour's share of total income is countercyclical.

Our model also does well at replicating the cyclical behaviour of job and worker flows. Unemployment flows are countercyclical, job-to-job flows (very) procyclical, job flows countercyclical and worker flows procyclical. Two features of our model are crucial for these results: we allow for employed job search and jobs that have been quit are not necessarily destroyed.

Given the important role we find for employed job search in the determination and cyclical behaviour of labour market equilibrium, it would be interesting to assess empirically the size of and the main influences on employed job search. For example, recent labour market developments such as decreasing job security and increased use of fixed-term contracts may well have an impact on the number of employed job seekers, which in turn will affect unemployment dynamics.

# Appendix

The density function of the distribution of $\epsilon$ for vacant jobs equals $f_{1V}$ and $f_{2V}$ over the ranges $(jc; ojs)$ and $(ojs; \sigma)$ respectively. As it integrates to 1 over the whole range, we have:

$$f_{1V} \cdot (ojs - jc) + f_{2V} \cdot (\sigma - ojs) = 1 \tag{A.1}$$

The stocks of vacancies in both ranges are respectively denoted $stV_1$ and $stV_2$ and take the following expressions in terms of the total stock of vacancies, $stV$:

$$stV_1 = f_{1V} \cdot (ojs - jc) \cdot stV \tag{A.2}$$
$$stV_2 = f_{2V} \cdot (\sigma - ojs) \cdot stV \tag{A.3}$$

The density function of the distribution of $\epsilon$ for filled jobs equals $f_{0E}$, $f_{1E}$ and $f_{2E}$ over the ranges $(jd; jc)$, $(jc; ojs)$ and $(ojs; \sigma)$ respectively. As it integrates to 1 over the whole range, we have:

$$f_{0E} \cdot (jc - jd) + f_{1E} \cdot (ojs - jc) + f_{2E} \cdot (\sigma - ojs) = 1 \tag{A.4}$$

The stocks of filled jobs (or employment) in the three ranges, as a function of the total stock of employment $stE$, are:

$$stE_0 = f_{0E} \cdot (jc - jd) \cdot stE \tag{A.5}$$
$$stE_1 = f_{1E} \cdot (ojs - jc) \cdot stE \tag{A.6}$$
$$stE_2 = f_{2E} \cdot (\sigma - ojs) \cdot stE \tag{A.7}$$

Over the range $(jc; ojs)$ (respectively $(ojs; \sigma)$), the number of new matches every period equals $\lambda \cdot stV_1$ (respectively $\lambda \cdot stV_2$) as all vacant jobs are matched at the same rate $\lambda$, irrespective of the value of their $\epsilon$. The number of jobs being re-advertised every period because of a quit or retirement equals $(s + \mu_e (1 - s)) \cdot stE_1$ over the range $(jc; ojs)$ and $s \cdot stE_2$ over the range $(ojs; \sigma)$ (because quits do not occur over this range). The number of new vacancies due to genuine job creation equals $\xi g \cdot \frac{ojs - jc}{2\sigma}$ over the range $(jc; ojs)$ and $\xi \cdot \frac{\sigma - ojs}{2\sigma}$ over the range $(ojs; \sigma)$. after an idiosyncratic shock, the new idiosyncratic productivity is drawn uniformly from $(-\sigma; \sigma)$. So the net flow of employment due to idiosyncratic shock over each range takes the form: $\nu \cdot \left(\frac{1}{2\sigma} - f_{iE}\right) \cdot stE_i$.

Finally, equating inflow and outflow of vacancies over the ranges $(jc; ojs)$ and $(ojs; \sigma)$, we obtain:

$$\xi g \cdot \frac{ojs - jc}{2\sigma} + (s + \mu_e (1 - s)) \cdot stE_1 = \lambda \cdot stV_1 \tag{A.8}$$

$$\xi \cdot \frac{\sigma - ojs}{2\sigma} + s \cdot stE_2 = \lambda \cdot stV_2 \tag{A.9}$$

Writing similar steady-state conditions for the stocks of employment over the ranges $(jd; jc)$, $(jc; ojs)$ and $(ojs; \sigma)$, we obtain:

$$\nu \cdot \left(\frac{1}{2\sigma} - f_{0E}\right) \cdot stE_0 = (s + \mu_e (1 - s)) \cdot stE_0 \tag{A.10}$$

$$\lambda \cdot stV_1 + \nu \cdot \left(\frac{1}{2\sigma} - f_{1E}\right) \cdot stE_1 = (s + \mu_e (1 - s)) \cdot stE_1 \tag{A.11}$$

$$\lambda \cdot stV_2 + \nu \cdot \left(\frac{1}{2\sigma} - f_{2E}\right) \cdot stE_2 = s \cdot stE_2 \tag{A.12}$$

From equations (A.1), (A.4) and (A.8) to (A.9), we can solve for the density values $f_{1V}$, $f_{2V}$, $f_{0E}$, $f_{1E}$ and $f_{2E}$ that we can then use in (11) and (8).

# References


[1] Bertola, G. (1990), 'Job security, employment and wages', European Economic Review, vol. 34, pp. 851-886.

[2] Blanchard, O. and Diamond, P. (1989), 'The Beveridge curve', Brookings Papers on Economic Activity, pp. 1-60.

[3] Boeri, T. (1999), 'Enforcement of employment security regulations, on-the-job search and unemployment duration', European Economic Review, vol. 43, pp. 65-89.

[4] Burda, M. and Wyplosz, C. (1994), 'Gross worker and job flows in Europe', European Economic Review, vol. 38, pp. 1287-1315.

[5] Burdett, K. and Mortensen, D. (1998), 'Wage differentials, employer size and unemployment', International Economic Review, vol. 39, pp. 257-273.

[6] Burgess, S. (1993), 'A model of competition between employed and unemployed job searchers: An application to the unemployment outflow rate in Britain', Economic Journal, pp. 1190-1204.

[7] Burgess, S. Lane, J. and Stevens, D. (2000) 'Job flows, worker flows and churning', Journal of Labor Economics, vol. 18, pp. 473-502.

[8] Burgess, S. and Turon, H. (2000), 'Unemployment dynamics, duration and equilibrium: Evidence from Britain', CEPR working paper.

[9] Davis, S. and Haltiwanger, J. (1992), 'Gross job creation, gross job destruction and employment reallocation', Quarterly Journal of Economics, pp. 819-863.

[10] Den Haan, W., Haefke, C. and Ramey, G. (2001), 'Shocks and institutions in a job matching model', NBER Working Paper No 8463.

[11] Garibaldi, P. (1998), 'Job flow dynamics and firing restrictions', European Economic Review, vol. 42, pp. 245-275.

[12] Garibaldi, P. and Wasmer, E. (2001) 'Labor market flows and equilibrium search unemployment', IZA discussion paper No 406.

[13] Jovanovic (1979), 'Job matching and the theory of turnover', Journal of Political Economy, vol. 87, pp. 972-990.

[14] Millard, S. (1994), 'The effect of employment protection legislation on labour market activity: a search approach', Northwestern University.

[15] Mortensen, D. (1994), 'The cyclical behaviour of job and worker flows', Journal of Economic Dynamics and Control, vol. 18, pp. 1121-1142.

[16] Mortensen, D. and Pissarides, C. (1994), 'Job creation and job destruction in the theory of unemployment', Review of Economic Studies, vol. 61, pp. 397-416.

[17] Mortensen, D. and Pissarides, C. (1999), 'Job reallocation, employment fluctuations and unemployment' in Handbook of macroeconomics by J. Taylor and M. Woodford (eds), vol. 1, pp. 1137-1170.

[18] Mortensen, D. and Pissarides, C. (1999), 'New developments in models of search in the labor market' in Handbook of Labor Economics by O. Ashenfelter and D. Card (eds), vol. 3, pp. 2567-2627.

[19] Narendranathan, W., Nickell, S., and Stern, J. (1985), 'Unemployment benefits revisited' Economic Journal, pp. 307-329.

[20] Pissarides, C. (1990), 'Equilibrium unemployment theory', Blackwell, Oxford.

[21] Pissarides, C. (1994), 'Search unemployment with on-the-job search', Review of Economic Studies, vol. 61, pp. 457-475.

[22] Postel-Vinay, F. and Robin, J.M. (2002), 'Equilibrium wage dispersion with worker and employer heterogeneity', Econometrica, vol. 70, pp. 2295-2350.

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