THE INTERACTION OF FIRING COSTS AND ON-THE-JOB SEARCH: AN APPLICATION OF A SEARCH THEORETIC MODEL TO THE SPANISH LABOUR MARKET

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ABSTRACT

Spain has had a serious structural unemployment problem for the last 20 years. This paper argues that the interaction of firing costs and job-to-job flows added to changes in unemployment benefits, could provide an explanation for equilibrium unemployment increasing, since 1984. First, we construct a new series of job-to-job flows and show it is significantly trended upwards and positively related to the stock of fixed term contracts. Second, we develop a search theoretic model, with firing permissions and on-the-job search, and simulate it for Spain. We show that the model can provide an explanation for the evolution of structural unemployment in Spain. Finally, we argue that an increase in the *level* of equilibrium unemployment can occur at the same time that the economy becomes less *dynamically sclerotic*. Though in the case of Spain, since 1992, the equilibrium unemployment rate has probably fallen whilst the economy has continued becoming less dynamically sclerotic.

1 Introduction

Spain has been one of the best performing economies in Europe, over the last six or seven years. It has had one of the highest growth rates and the unemployment rate has fallen nearly 10%, from a high of 24.6% in the first quarter of 1994, to less than 15% currently. For most countries, a 10% fall in the unemployment rate would be cause for celebration, yet Spain still has the highest unemployment rate in the EEC. This one fact highlights the severe structural unemployment problem Spain has had since Franco's death, when the unemployment rate was around 5%. In this paper we attempt to understand the unusual nature of the Spanish Labour Market, using a search model as our theoretical underpinning.

We argue that changes in the labour market, to employment protection and unemployment benefits, though they may have increased the natural rate of unemployment, have probably made the labour made less *dynamically sclerotic.* In other words, they have facilitated more labour market state transitions. We focus, in particular, on the change of regime brought about by the introduction of fixed term contracts in 1984. We argue that they have led not just to lower firing costs, but a higher level of on-the-job search, due to the fall in job tenure.

Much research has focussed on the fact that the introduction of fixed term contracts may have only reduced firing costs, and thus increased flexibility, at *the margin,* without affecting the core of the permanent employees (see for example Bentolila and Dolado 1994). Few, though, have looked at the link between the introduction of fixed term contracts and job-to-job flows. Yet this could be equally if not more important, in the case of Spain. As the figure below shows, temporary contracts, as a % of total contracts, have increased dramatically in Spain, to above 30% of the total number of employment contracts.

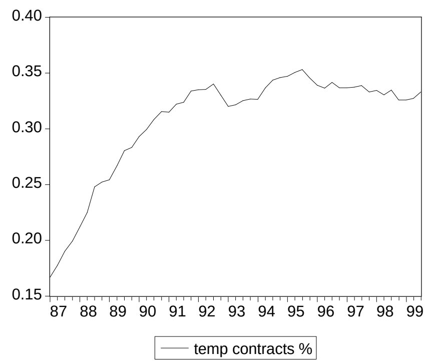

Figure 1: % of employment contracts in Spain which are fixed term. Source: EPA.

In Section 3, we construct a new measure of job-to-job flows and show how it has increased in line with the increase in the prevalence of temporary contracts. Job-to-job flows can undoubtedly have a very important effect on labour market dynamics. Mortensen (1994) showed they were necessary to make the positive correlation of unemployment inflows and outflows, consistent with the negative correlation of job creation and job destruction, in the US. Burgess (1994) shows, in a simple search model, that if the proportion of the employed engaging in search is sensitive to the chance of receiving an offer, then the effect of the cycle on the unemployment outflow rate is damped. This is due to the competition for jobs that employed job searchers provide the unemployed. Further, he shows that the effect of the cycle on the inflow rate is increased. As Burgess notes, the introduction of on the job search can lead to some very interesting and complicated dynamics of unemployment. For the above reasons, we take account of job-to-job flows when we analyse the Spanish Labour Market.

One natural way to try and explain Spain's unemployment dynamics is to simulate a model which allows for the changes in labour market institutions that have marked recent Spanish economic history. This paper carries out such an exercise. We calibrate a search theoretic model, allowing for a structural break in 1984, when temporary contracts were introduced, and simulate it for Spain. Section 2 details the recent changes in Spanish economic institutions. Basically, the structural break allows for: firing costs to fall; on-the-job search to increase and unemployment benefits to increase.

The novel feature of the model, is that it pulls together various innovations to the basic Mortensen and Pissarides (1994) search theoretic model. First, we include on-the-job search as first introduced by Mortensen (1994). Second, we include *firing permissions* as introduced by Garibaldi (1998), as well as lump sum firing costs. Firing permissions allow for the uncertainty in the firing procedure in a way that a lump sum cost cannot capture. Garibaldi argues persuasively that this is an important consideration when considering the economies of Continental Europe. Spain, ranked by the OECD as having one of the highest degrees of employment protection, definitely falls into this category. We differ from Garibaldi in that we use a Nash bargaining framework to model wage setting. He uses a simpler approach, namely that employers capture all the rents associated with a job-worker match, by paying workers the common alternative value of their time. However, one of the main routes by which institutions affect labour market dynamics are through wages. The kind of assumption used by Garibaldi, and first introduced by Jovanovic (1979, 1984), does not allow for these kind of effects. Given that this paper is attempting to document the effect of institutions on the labour market performance of Spain, this would be a serious omission. Thus, we revert to Nash bargaining solution, which, while complicating the model, allows for a much richer set of potential interactions.

The paper is structured as follows. First, we briefly summarise the recent labour market reforms to the Spanish economy. Second, we overview some of the main facets of the Spanish labour market. In this section, we also construct a new measure of job-job flows, based on the EPA gross flow data, and show that it has had an increasing trend since the introduction of temporary contracts. Third, we formulate a search model, with on-the-job search and firing permissions. Fourth, we do some comparative statics analysis. In particular, we focus on two elements: a change in the degree of on-the-job search; and a change in the speed at which firing permissions arrive. We do these experiments for a calibrated US economy, to allow an easier comparison with the prevailing literature. We discuss the effects of these changes on the dynamic correlations of the labour market. Fifth, we calibrate and simulate the model for Spain, allowing for a structural break in 1984 - when temporary contracts were introduced. Finally, we conclude with a discussion of how much the model can explain of recent Spanish history and we draw out predictions of future labour market performance.

2 A summary of the changing institutions in the Spanish Labour Market

There have been many structural reforms to the Spanish Labour Market since the death of Franco (see Bover et al (2000) for a comprehensive survey). We discuss a few of the important ones here: to employment protection and unemployment benefits.

Firing costs have been, effectively, very high in Spain. The OECD has consistently ranked Spain as having one of the highest degrees of employment protection. There have been significant legislative attempts to try and change this. At the end of 1984, fixed term contracts, with lower firing costs than permanent contracts, were introduced, for all activities, whether temporary or not. Further legislation was introduced in June 1997. This extended the causes that may give rise to an individual dismissal and created a new permanent employment-promoting contract whose main feature was lower unfair-dismissal costs, with respect to regular permanent contracts. Spanish unemployment remained stubbornly high even after the introduction of temporary contracts. As mentioned earlier, the unemployment rate reached an all time high of 24.6% in 1994.

The level and changes of unemployment benefits have also been substantial in Spain. As noted by Bover et al (2000), from the mid 80s to early 90s, the replacement rate was up to 80% for certain categories of the unemployed. Coverage also reached around 70% in 1993. Changes in legislation occurred in 1984 and 1989, to increase the generosity of benefits and in 1992 to reduce them. Unemployment benefits are considered important in determining equilibrium unemployment (see for example the work of Layard, Nickell and Jackman (1991, 1998)). Spain has unquestionably a generous benefits system when compared to international norms. But the changes are equally important as the level in explaining Spain's recent history. Benefits probably became more generous in the period after 1984, if you take all the changes of legislation and the dynamics of the coverage documented above. This has probably been important in explaining why unemployment continued to rise after 1984, when temporary contracts were introduced, peaking in 1994.

3 Overview of recent labour market dynamics in Spain

In the last ten years, there has been a change in focus in the economic literature. Labour market flow data such as: job creation, job destruction and unemployment flows are routinely discussed, as well as simple stock measures such as the unemployment and vacancy rate. There are two reasons for this: the pioneering work of Davis and Haltiwanger (1990, 1992 and 1996) in developing measures of job creation and job destruction, and the development of search theoretic models (see Pissarides (1990) and Blanchard and Diamond (1990, 1992)) which suggested that looking at flow data is necessary for explaining certain labour market phenomena. For example, the degree of job-to-job flows is not something that can be discerned from the stock of employment. Also as shown by Mortensen and Pissarides (1994), the movement of unemployment and vacancies are not sufficient to identify whether a shock is reallocative or aggregate - we need to look at job creation and job destruction.

In this section, we look at: job; employment and unemployment flow data, to get a more detailed picture of the Spanish Labour Market. Our main source is the gross flow transition data collated by EPA, but we also construct a new measure of job-to-job flows. All data are seasonally adjusted using the US Census X-11 method and are elevated by the appropriate factors to make them representative of the total population. We provide a more complete discussion of the data definitions and sources in the appendix.

Measuring job-to-job flows is notoriously difficult (see Blanchard and Diamond (1990) for a detailed discussion of some of the measurement error issues). In the US, a new question in the CPS, introduced in 1994, allows one to measure the number of transitions from one job to another. Mainly due to formidable problems of: spurious individual transitions and aggregating these individual responses into a time consistent series, the BLS has refrained from using this new question to form a new job-to-job flow measure. Hoyt Bleakley, in some unpublished work at the Federal Reserve Bank of Boston, has tried to collate the individual transitions, and has come up with a job-to-job flow of 2.5% of the initial employment rate, for the period 1994:1 to 1996:12. This is much higher than the upper bound estimated in Blanchard and Diamond (1990) of 1.6%, and is probably due to measurement error problems. The Blanchard and Diamond estimates, imply that about 20% of the employment inflow is due to job-to-job flows, for the period 1968-1986.

Antolin (1999) made an attempt to measure job-to-job flows for Spain, using the individual records from several EPAs. He estimated that job-to-job flows averaged slightly higher than 50% of total employment inflows, for the period 1987-94, and were increasing over the period[1].

In this paper, we take a slightly different approach. We utilise two sources of data: the gross flow transitions collated by EPA, by matching individual

[1] The calculations were only possible for the second quarter of each year, due to more detailed questions in the EPA, for the second quarter.

records over time; and the EPA official measure of employment less than three months. Of course, the EPA gross flows are also subject to measurement error problems as well (see Artola and Bell (1999) for a more detailed discussion of this). In particular, there are problems of *sample attrition* and *misclassification errors*, which are discussed in more detail in the appendix. As Blanchard and Portugal (2000) note, these problems, which will lead to spurious transitions, are likely to be more serious with cumulated monthly transitions than with quarterly transitions[2]. In this paper we use quarterly EPA data.

We measure job-to-job flows, on a quarterly basis from 1988q4 to 1999q3, as the following[3]:

$$jj = n3 - un - ian \tag{1}$$

where jj represents job to job flows, $n3$ employment less than 3 months, un the unemployment to employment transition, and ian the inactivity to employment flow. We are assuming here that $n3$ is a good proxy for *the employment inflow* per quarter. It is used in the same way that unemployment less than a month is used as a proxy for the unemployment inflow. It suffers from the same problem, in that people who make the transition to employment and then out of employment, within the quarter, will not be captured. But as Boeri (1999) notes, given that the gross flow transitions do not capture exactly the same kind of transitions, the effect should be balanced out.

The job to job series we estimate has a mean of around 42%, in terms of the total employment inflow. Referring to figure 2, jj also shows an increasing trend over time. Given that our sample is longer (up to 99q3) than Antolin's, it suggests that our estimates are significantly less than Antolin's. This could be because his estimates capture more spurious transitions.

[2]Still, Artola and Bell (1999) estimate that 12.5% of the Spanish unemployed were misclassified into a different labour market state in the first quarter of 1994. They also argue though, that the standard Abowd and Zellner (1985) measurment error correction is not very effective for Spain. For this reason we continue to use the measured labour market flows in the following analysis.

[3]we start in 88q4 rather than 87q2 as there seems to be some problems with $n3$ variable in 87q3 and 88q3. In particular, it seems too small as we get a negative measure of job-to-job flows. We are currently looking at ways to resolve this problem.

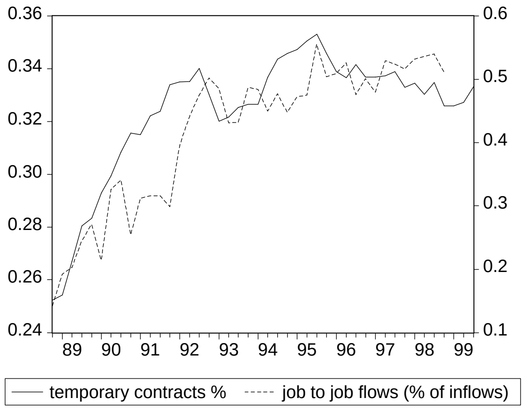

Figure 2: the left hand scale refers to the % of temporary contracts and the right hand scale, to the % of job-to-job flows.

As Pissarides (1994) notes, one of the most robust facts about job-to-job flows is their pro-cyclicality. This is documented for the US by Blanchard and Diamond (1990), the UK by Burgess (1994) and Burda and Wyplosz (1994) for several other European countries. In Spain, we find the correlation between job-to-job flows normalised by total employment, jjn and net employment growth changes ($netg$) to be 0.13, i.e. procyclical as expected. But, the increase in temporary contracts has probably been the main driver of job-to-job flows as illustrated strikingly in Figure 2. There are intuitive reasons for this link. Pissarides (1994) illustrates that in a search model, on-the-job search is much more likely at short job tenures. The mechanism behind the link, in his model, is the accumulation of firm-specific human capital. This insures that wages rise with tenure. Other mechanisms could simply be that shorter job tenure causes more disutility amongst workers by making them feel insecure, or that a fixed term contract is really a long period of notice. Thus fixed term contracts will give workers more encouragement to search on-the-job.

By assuming $n3$ is a measure of the employment inflow, nin, we can also recover employment outflows, $nout$, as:

$$nout = nin - net$$

where net is the net employment change.

The employment flows are shown in figure 3 below:

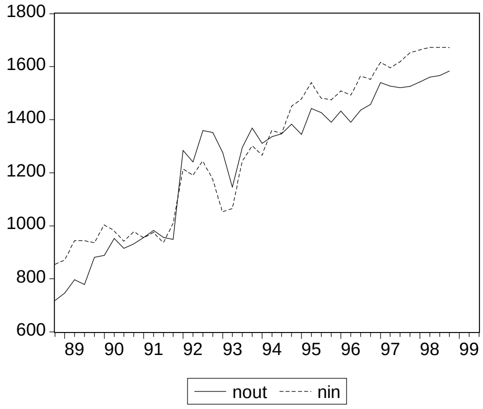

Figure 3: employment flows

It is clear that the employment flows are highly trended and positively correlated ($corr(nin, nout) = 0.95$). This positive correlation still shows up when we detrend the flows using a HP filter ($\lambda = 1600$) and look at the business cycle components (corr $= 0.58$). Further, the total employment inflow is highly procyclical ($corr(nin, net) = 0.31$) and the total employment outflow is basically acyclical ($corr(nout, net) = -0.01$).

We can rearrange equation (1) to express the employment inflow, nin, into its constituent parts:

$$nin = jj + un + ian$$

It may be interesting to look at the employment flow which only involves transitions in and out of unemployment and inactivity, i.e. omitting the job-to-job flow element. Let $nsemiin$ and $nsemiout$ be defined respectively as:

$$\begin{aligned} nsemiin &= un + ian \\ nsemiout &= nu + nai \end{aligned}$$

Where nu is the employment to unemployment flow, and nai is the employment to inactivity flow. Figure 4 illustrates the two flows. They are negatively correlated ($corr(nsemiin, nsemiout) = -0.24$), not particularly trended, with $nsemiin$ highly procyclical ($corr(nsemiin, net) = 0.74$) and $nsemiout$ highly counter cyclical ($corr(nsemiout, net) = -0.63$). This contrasts with the properties of total employment flows, with the only difference between the two being job-to-job flows.

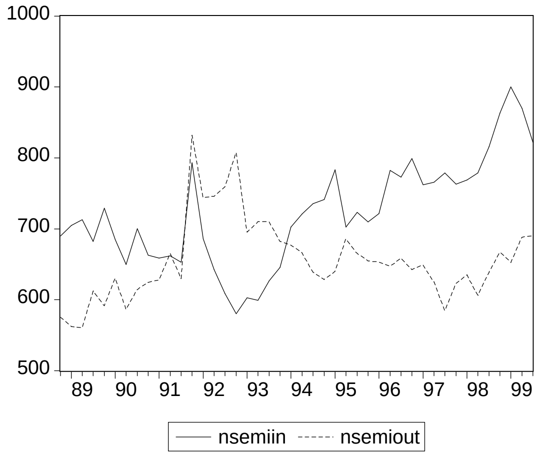

Figure 4: employment flows, to and from unemployment and inactivity.

Burgess (1994) found something similar for the UK, arguing that the positive correlation of employment flows, but the negative correlation of job creation, jc, and job destruction, jd, implied substantial and procyclical job-to-job flows. Or more particularly, substantial job-to-job flows that do not cause job creation or job destruction. A number of other studies show similar features: procyclical employment flows and asymmetrically cyclical jc and jd flows[4]. It is unlikely that for Spain procyclical job-to-job flows could explain negatively correlated employment flows, to and from unemployment and inactivity; and positively correlated total employment flows. As we noted above, jj is procyclical but more importantly, the increase in temporary contracts has caused a substantial trend in jj. It is this trend that explains the difference in the correlation of the two sets of employment flows, and causes total employment flows to be upwardly trended.

Finally, we look at unemployment inflows and outflows, *uin* and *uout* respectively, in Figure 5 below:

[4]These include Blanchard and Diamond (1990, 1991) and Davis and Haltiwanger for the US (1996), and Burda and Wyplosz (1994) for France and Germany.

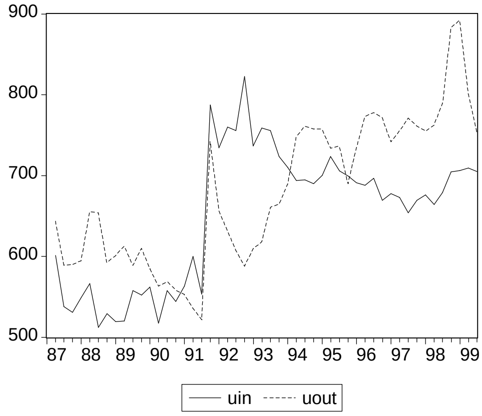

Figure 5: unemployment flows

They are negatively correlated, if we take into account a change of regime at the beginning of 1992, after which the levels of both sets of flows markedly increased on average. *uout* is procyclical ($corr(uout, net) = 0.46$) and *uin* countercyclical ($corr(uin, net) = -0.42$). The change of regime could be consistent with a change in the law, in 1992, which reduced the generosity of unemployment benefits and a change in the methodology of the EPA survey, in the first quarter of 1992. The correlation and the cyclicality of the flows is different to that found for other countries, for which the unemployment flows are positively correlated and *uout* is countercyclical[5]. The usual explanation for this, is that a big increase in unemployment, in a recession, outweighs the effect of a fall in the outflow rate, on the total level of outflows during a recession. This effect does not appear to be strong for Spain. The reason could be that high firing costs and a high degree of on-the-job search, reduce the increase of unemployment in a recession.

In the next section, we build a model to try and replicate some of the correlations noted above.

4 Model with on the job search and firing permissions

4.1 Set-up

We build on the search theoretic model of Mortensen and Pissarides (1994). We augment the model by adding variables to capture labour market institutions. First, we add *firing permissions* as in Garibaldi (1998). These take the form of a Poisson process: the longer the average wait time, the more binding the firing permission. Second, we add on-the-job search following Mortensen (1994).

[5]These include the US (see Blanchard and Diamond (1990, 1991)), the UK (see Burgess 1994) and France and Germany (see Burda and Wyplosz (1994)).

Third, we add other policy variables, such as: lump sum firing costs, unemployment benefits and training costs, to fully capture the richness of effects of institutions on the labour market.

The Mortensen-Pissarides model (MP for short) has two main foundations: a matching function that characterizes the search and recruiting process by which new job-worker matches are created, and an idiosyncratic productivity shock that captures the reason for resource reallocation across alternative activities. In the labor market, there are firms and there are workers. We assume they are both risk-neutral and maximize expected returns in output units, discounted at rate $r > 0$. Each firm has one job that can be in one of two states, filled and producing or vacant and searching. Whilst filled, jobs can be actively producing and profitable, or unprofitable and *idle*. Jobs are idle while waiting for a firing permission, whose arrival rate is a Poisson process with average waiting time of $\frac{1}{s}$. Once a firing permission arrives, the job is destroyed, unless it receives a positive productivity shock in the meantime. To destroy the job, the firm must pay a fixed firing cost, T, as well.. Workers can be either unemployed, or employed and producing. Both can search. Also let δ be the exogenous turnover rate.

Each job is characterized by a fixed irreversible technology and produces a quantity of goods equal to $p + x$. p is common to all jobs. x is job specific and represents an idiosyncratic component of productivity. p is an aggregate component of productivity that does not affect the dispersion of productivity. A change in p affects in a similar way the profitability of *all* jobs and it is thus called an *aggregate shock*. The process that changes the idiosyncratic component of productivity is assumed to be a Poisson process with rate of arrival λ. When there is change, the new value of x is a drawing from the fixed distribution $F(\cdot)$ which has finite upper support $\overline{x}$, and no mass points.

As in Mortensen and Pissarides (1994), firms create jobs that have productivity equal to the upper support of the distribution of productivities $p+\overline{x}$. Once a job is created, however, the firm has no choice over its productivity. Thus job productivity is a stochastic process, with initial state the upper support of the distribution and terminal state $x \leq R_0$ and the arrival of a firing permission. R_0 is the reservation productivity, below which the job is unprofitable[6]. Only the *combination* of $x \leq R_0$ and the arrival of a firing permission leads to job destruction. This is an important difference to the standard MP model, in which $x \leq R_0$ leads to immediate job destruction.

As workers are heterogeneous and firms are posting vacancies to operate specific jobs, matching a worker with a vacancy is costly and requires time. Because of this, the model is usually closed through a useful tool: the matching function[7], that is a stable, concave, homogenous-of-degree-one aggregate rela-

[6] Obviously, R_0 depends on P.

[7] See Jackman, Layard and Pissarides (1986), Pissarides (1986), Blanchard and Diamond (1989,1990) and Burda and Wyplosz (1994) for empirical evidence on the existence of stable aggregate matching functions. Caballero and Hammour (1990, 1996) show how a matching function is not required to close the model, as a search theoretic framework just asks for some mechanism that makes it progressively less profitable to post vacancies at a given level of

tion, $H = m(S, V)$, linking the pool of searchers (unemployed plus the effective number engaged in on the job search[8]), S, and the stock of vacancies, V, with the number of new hirings H. The matching function allows one to represent two key characteristics of the labour market: the fact that workers and firms are heterogeneous so that search is costly and time consuming; and the fact that different firms might compete for the same workers. The transition rate for vacancies is $q(\theta) = \frac{m(S,V)}{V} = m(\frac{S}{V}, 1) = m(\frac{1}{\theta}, 1)$, where $\theta = \frac{V}{S}$, while the rate at which job seekers meet vacancies is $\alpha(\theta) = \frac{m(S,V)}{S} = m(1, \theta)$. Once the matching has taken place, and the firm and worker have agreed an initial wage, w_0, the firm must pay a set up cost, k, which includes the cost of hiring, training and other forms of match specific investment.

Whilst unemployed, workers receive unemployment benefit. We assume that these depend on the replacement rate, σ, and on the general level of productivity, p. As Pissarides (1999) notes, this is a convenient modelling simplification, instead of having benefits as a function of real wages, as it does not sacrifice important generality.

To introduce aggregate shocks, we model p as a jump process characterized by η, a Poisson arrival rate, and $H : R \longrightarrow [0, 1]$, a conditional distribution function. Although simple, this approach captures the main features of cyclical shocks - there is a positive probability, less than one, that a boom or a recession will end within a finite period of time.

4.2 Formalities

The assumption that vacancies cost c_1 per unit of time, and that jobs are created at the upper support of the distribution of the productivity distribution, imply that

$$rV(p) = -c_1 + q(\theta(p))\{J_0(p) - k - V(p)\}$$

where $V(p)$ and $J_0(p)$ are respectively the asset values of a vacancy and of a job just filled. Notice how all the variables to be determined are indexed by aggregate productivity, as it can vary. As in Pissarides (1990) and Burda and Wyplosz (1994) jobs are created until the exhaustion of all rents. This implies the value of posting a vacancy must reach zero, so that the following *free entry condition* holds:

$$c_1 = q(\theta(p))\{J_0(p) - k\} \tag{FE}$$

In other words θ, a measure of *market tightness*, changes to equate the expected return and cost of filling a vacancy. Creation costs just reduce the value of forming a vacancy by k. θ changes via adjustments in vacancies, which

unemployment. In their set up, creation costs provide this.

[8]The workers are measured in effective terms, as the search efficiency of employees may be different to that of unemployed searchers. See later discussion.

is a jump variable. Equation (FE) defines θ as an increasing function of p. Because the rate at which searching workers find jobs, $\alpha(\theta(p))$, is an increasing function of market tightness, unemployment duration decreases in response to a positive aggregate shock, as one would expect.

The reservation productivity, R_0, is the value of x at which the job becomes unprofitable, i.e.

$$J(R_0(p), p) = -T \tag{JD}$$

In other words, jobs become idle when $x \leq R_0$, or when the asset value of the job, $J(x,p)$, is less than the cost of firing the worker. Since $J(x,p)$ is generally increasing in both arguments, R_0 is decreasing in p. Thus the flow into idle jobs increases as the economy experiences a negative aggregate productivity shock (p falls).

To complete the characterization of job creation and job destruction, implicit in equations (FE) and (JD), we need to determine $J(x,p)$. To do this we first need to specify the wage bargaining process. Following the search literature, for example Pissarides (1999), we assume wages are chosen via Nash bargaining. In this class of wage rules, threat points are equal to the option of looking for an alternative match partner. The important implication of this type of wage rule, is that the surplus from a job match is split in a fixed proportion between the worker and the employer. Let $W(x,p)$ denote the asset value of a job match, with idiosyncratic productivity, x, to an employee and $W_0(p)$ the initial value, before an idiosyncratic shock has hit the job. Further, let $U(p)$ denote the asset value of being unemployed. From here on, I focus only on the perfect foresight steady state, where the asset value of posting a vacancy is zero, $V = 0$. The initial and continuing surplus in equilibrium are:

$$\begin{aligned} S_0(p) &= J_0 - k + W_0(p) - U(p) \\ S(x,p) &= J(x,p) + T + W(x,p) - U(p) \end{aligned} \tag{2}$$

The difference between the initial wage bargain and subsequent renegotiations arises for two reasons. First, creation costs are 'sunk' in the latter case, but 'on the table' in the former. Second, termination costs are not incurred if no match is formed initially but must be paid if an existing match is destroyed. The standard Nash bargaining solution is the following:

$$\beta\{J_0(p) - k\} = (1-\beta)\{W_0(p) - U(p)\} \tag{3}$$

$$\beta\{J(x,p) + T\} = (1-\beta)\{W(x,p) - U(p)\} \tag{4}$$

where β, the worker's bargaining power is the resulting worker's share of match surplus.

Given the condition for setting of the reservation productivity $R_0(p)$, equation (JD), and the nash bargaining solutions above, $R_0(p)$ is set such that the joint net surplus, $S(R_0(p),p)=0$. For idle jobs, where $x<R_0(p)$, $S(x,p)<0$. Given the fixed sharing rule implied by nash bargaining, this would imply $W(x,p)<U(p)$. But this would not be feasible, as the worker would leave the job, given that the asset value of being unemployed would be higher than that of working. To make workers participate in idle jobs, we assume that in this state wages are set such that $W(x,p)=U(p)$. We cannot justify this endogenously, but it seems intuitive as it implies firms are making losses whilst the job is idle, while workers participate. It is equivalent to setting a wage floor at the value of being unemployed and a mechanism to prevent employers' driving down workers wages, such that they quit voluntarily idle jobs into unemployment.

As in Mortensen (1994) workers search on the job only if the expected gain from searching exceeds the cost. Assume that on the job search has search efficiency ζ and cost c_2. On-the-job search takes place if:

$$\zeta\alpha(\theta(p))[W_0(p)-\{W(x,p)+J(x,p)\}]>c_2 \tag{5}$$

The cost has two components: the value for the worker of having the current job and also the value to the firm of the job. The second component appears as it can be seen, from the Nash bargaining wage solutions, that:

$$W(x,p)=\beta S(x,p)+U(p)$$

Hence, the decision to search or not on-the-job, in order to maximise expected present value of future earnings, $W(x,y)$, must maximise the joint surplus, $S(x,p)$. In effect, the worker takes into account the cost he imposes on his current employer by searching on-the-job: it reduces the expected duration of a match[9]. Given the asset value of the worker and firm depend positively on the idiosyncratic part of productivity, x, there exists a second reservation productivity, $R_1(p)$, below which workers search on the job. Notice that provided c_2 is low enough, $R_1(p)>R_0(p)$, and some workers in actively producing jobs will engage in on the job search. Further all workers in idle jobs will search on the job. This should be expected, as we can think of idle jobs as equivalent to workers in a period of notice - they will be actively searching for alternatives.

Under the simplifying assumptions made in this paper, quits also induce job destruction[10]. This follows from the free entry condition, equation (FE) and the fact that newly created jobs are assumed to be the most productive.

[9]This condition for on-the-job search requires a high degree of rationality on behalf of the worker - he is taking into account the effect that his search has on the surplus of the job and therefore his wages. A simpler rule would be the following $\zeta\alpha(\theta(p))[W_o(p)-W(x,p)]>c_2$. In other words the worker doesn´t take into account the effect his on-the-job search has on the duration of a match and thus the value of the surplus and his wages. It should be noted though, given the way the model is calibrated, using this rule instead would not lead to different results. This simpler rule, *ceteris paribus*, would imply more quits. Since we calibrate the model on the number of quits, all that would happen is that c_2 would increase under the simple rule to calibrate the same number of quits. The dynamics of the simulations would not be affected and thus the results would not qualititatively differ.

[10]we will discuss the implications of this later, when we simulate the model for a US baseline economy and try to match the correlations the model produces, with those inherent in the data.

This implies the value of a job just quit, will be less than the cost of posting a vacancy, c_1.

Job destruction also occurs when idle jobs receive firing permissions and there is exogenous turnover. The level of job destruction is thus:

$$jd(p) = sI + \delta N + Q \tag{6}$$

where I is the stock of idle jobs, N is the stock of employed workers and Q is the number of job-to-job quits. Similarly, job creation is simply the job finding rate multiplied by the stock of searchers:

$$jc(p) = \alpha(\theta(p))S = \alpha(\theta(p))U + Q \tag{7}$$

4.2.1 The equilibrium surplus value of a match

We now have all the tools to write down the asset flows equations. The value of a match, facing idiosyncratic and aggregate components of productivity x and p respectively, to an employer, $J(x,p)$, is defined by:

$$\begin{aligned} rJ(x,p) &= p + x - w(x,p) - \phi(R_1(p) > x)\zeta\alpha(\theta(p))J(x,p) \\ &+ \lambda \int \{J(y,p) - J(x,p)\}dF(y) + \eta \int \{J(x,z) - J(x,p)\}dH(z/p) \\ &+ s\{\max(-T, J(x,p)) - J(x,p)\} - \delta J(x,p) \end{aligned} \tag{assetj}$$

The first line, equals the current profit less an allowance for the expected loss attributable to the possibility that the worker in the match quits. $w(x,p)$ is current state contingent wage received. ϕ is an indicator function that takes a value of one for $R_1 > x$ and zero otherwise. In other words, it represents when employees decide to search on-the-job. The second line represents the expected changes in the value of the employer's state, associated with the possible arrival of a new job-specific, or aggregate shock respectively. The final line takes into account the possible and necessary arrival of a firing permission, along with exogenous quits. In this model, firing has two elements: the wait for a permission and then the payment of a lump sum tax. An important difference to the standard MP model is that the expected changes in the value of the employer's state, due to the arrival of a shock, are calculated across the entire distribution of idiosyncratic and aggregate productivity, respectively. This is because job destruction does not happen immediately when a shock, idiosyncratic or aggregate, hits a job such that $x < R_0(p)$ and $J(x,p) < 0$. This is due to the need for firing permissions. In the MP model $J(x,p)$ is bounded above zero, as job destruction can happen immediately when a shock hits that makes $x < R_0(p)$.

Similarly, the value of the same match to an employed worker, $W(x,p)$, is defined by:

$$\begin{aligned} rW(x,p) &= w(x,p) + \phi(R_1(p) > x)[\zeta\alpha(\theta(p))\{W_0(p) - W(x,p)\} - c_2] \\ &+ \lambda \int \{W(y,p) - W(x,p)\}dF(y) + \eta \int \{W(x,z) - W(x,p)\}dH(z/p) \\ &+ s\phi(R_0(p) > x)\{U(p) - W(x,p)\} + \delta\{U(p) - W(x,p)\} \end{aligned} \tag{assetw}$$

The first line is the sum of the current state contingent wage and the expected capital gain associated with on the job search. The second line represents the expected changes in the value of the employed worker's state associated with the possible arrival of a new job-specific, or aggregate, shock respectively, and is analogous to the expected changes for an employer. Notice again how the expected changes in the value of the employed worker's state, due to the arrival of a shock, are calculated across the entire distribution of idiosyncratic and aggregate productivity, respectively. The third line, has exactly same interpretation as that given for the employer's asset equation.

Finally the value of being unemployed is given by:

$$rU(p) = b + \sigma p + \alpha(\theta(p))\{W_0(p) - U(p)\} + \eta \int \{U(z) - U(p)\} dH(z/p) \tag{assetu}$$

The first term is the utility of leisure and the second captures unemployment benefits. The third represents the expected gain of finding a job and the fourth the expected change in value due to an aggregate productivity shock.

Summing up asset equations (assetj) (assetw) and (assetu) and making use of the nash bargaining equations (3) and (4), we can show that the surplus value function $S(x,p)$ satisfies:

$$\begin{aligned} \{r + \lambda + \delta + \eta + s\phi(R_0(p) > x)\}S(x,p) &= x + y \\ &+ \phi(R_1(p) > x)[\zeta\alpha(\theta(p))\{\beta S_0(p) - S(x,p) + T\} - c_2] + (r+\delta)T \\ &- b - \alpha(\theta(p))S_0(p) + \lambda \int S(y,p)dF(y) + \int S(x,z)dH(z/p) \end{aligned} \tag{assets}$$

$$S_0(p) = S(\overline{x}, p) - T - k \tag{11}$$

where $S_0(p)$ is the surplus of a just filled job, i.e. one that has not been hit by an idiosyncratic shock. The equilibrium surplus value, of a match for given (x, y), is the solution to equation (assets).

4.3 Solving the model

Given the solutions to the wage bargaining problem, the free-entry and reservation productivity conditions can be respectively re-written as:

$$\frac{\alpha(\theta(p))}{\theta(p)}\{(1-\beta)S_0(p)\} = c_1 \tag{12}$$

$$S(R_0(p), R_1(p), p) = 0 \tag{13}$$

$$\zeta\alpha(\theta(p))[\beta S_0(p) - S(R_0(p), R_1(p), p) + T] - c_2 = 0 \tag{14}$$

The first condition is the free-entry condition and determines the number of vacancies a firm would like to advertise. The next two conditions determine the level of idiosyncratic productivity below which the firm would like to destroy jobs, $R_0(p)$, and workers would like to search on the job, $R_1(p)$. An equilibrium is a solution to the above three conditions, equations (12) (13) and (14); along with a solution to the surplus value function, equations (assets) and (11), for all values of p. Mortensen(1994) develops a method for solving such a non linear system, once the model has been calibrated and if we approximate the aggregate shock process by a finite Markov chain. This is the method used to solve the model in this paper, and interested readers are referred to the aforementioned paper for more detail. Once the model has been solved, it is then straightforward to simulate the model and recover the dynamics of employment, unemployment, job and worker flows.

4.4 The dynamics of job and worker flows

Given a generated series of aggregate productivity states, we can simulate the above model and derive the dynamics of the labour market. Both the idiosyncratic productivity component, x, and market tightness, θ, are forward-looking jump variables. On the other hand, due to the time it takes to match workers with jobs, unemployment and employment are sticky variables. Thus to implement the model, we need to specify its dynamic behaviour at a discrete time $t = 0, 1, ..., \tau$. For this purpose, it is necessary to keep track of the entire distribution of employment over x. Consider the distribution of x split into $2z$ intervals $x \epsilon [a_i, a_{i-1})$, $i = 1, 2, ...2z + 1$, and $a_{i-1} > a_i$. z is the number of possible aggregate productivity states in the Markov chain[11]. Following Mortensen (1994), we assume that the aggregate shock is completely revealed at the beginning of each period. In the time interval between t and $t+1$, $R_0(p_t)$, $R_1(p_t)$ and $\theta(p_t)$ are state variables determined at the beginning of time t and stay constant throughout. If N_t measures employment at the end of period t, then $N_t = I_t + O_t$, where I_t indicates idle jobs waiting for a firing permission and O_t are operational jobs that will ignore the arrival of a firing permission. Let n_{it} be the measure of workers employed in jobs within interval $[a_i, a_{i-1})$ at the end of period t. The distribution's law of motion, is given by the following:

$$n_{it} = \left\{ \begin{array}{c} (1-\delta-\lambda)n_{it-1} + \lambda[F(a_{i-1}) - F(a_i)]N_{t-1} \\ \text{if } \overline{x} > a_i \geq R_1(p_{t-1}) \\ (1-\delta-\lambda)n_{it-1} + \lambda[F(a_{i-1}) - F(a_i)]N_{t-1} - \zeta\alpha(\theta(p_{t-1}))n_{it-1} \\ \text{if } R_1(p_{t-1}) > a_i \geq R_0(p_{t-1}) \\ (1-\delta-\lambda)n_{it-1} + \lambda[F(a_{i-1}) - F(a_i)]N_{t-1} - \zeta\alpha(\theta(p_{t-1}))n_{it-1} \\ -sn_{it-1} \quad \text{if } R_0(p_{t-1}) > a_i \end{array} \right| \tag{15}$$

[11] $2z$ intervals are chosen over x because as Mortensen(1994) shows, the Surplus value function, $S(x, y)$, is a contraction that maps a set of piecewise linear functions, in x, with $2z$ kinks at the values of x equal to the elements of R_0 and R_1, into itself. The intervals, are simply the distribution over x split by the kink points.

The laws of motion are self explanatory. The flow out of n_{it} consists of: exogenous turnover; the possibility of an idiosyncratic shock; if $a_i < R_1(p_{t-1})$, job to job quits; and if $a_i < R_0(p_{t-1})$, job destruction when a firing permission arrives. The flow into n_{it} is simply the chance that a job is hit by an idiosyncratic shock within the interval $[a_i, a_{i-1})$.

To evaluate the laws for job creation and job destruction, equations (7) (6) respectively, we need to keep track of the switch in the composition of employment between operational and idle jobs, and the number of endogenous quits.

If we define $I_{\inf t}$ as the inflow into the idle state during period t, it follows that:

$$I_{\inf t} = \lambda F(R_0(p_{t-1}))\{N_{t-1} - I_{t-1}\} + \phi(R_0(p_{t-1}) \geq R_0(p_{t-2})) \int_{R_0(p_{t-2})}^{R_0(p_{t-1})} n_{it-1} di \tag{iinf}$$

where again, ϕ is an indicator function that takes value of one if the interior inequality is satisfied and zero otherwise. Jobs flows into the idle state for two reasons: either an idiosyncratic shock below the current reservation productivity hits the job or the aggregate state worsens and makes idle all those jobs whose productivity lies between the two states. Similarly, if we define I_{outt} to be the outflow from the idle state during period t:

$$\begin{aligned} I_{outt} &= [\lambda\{1 - F(R_0(p_{t-1}))\} + s]I_{t-1} \\ &+ \phi(R_0(p_{t-2}) > R_0(p_{t-1}) \int_{R_0(p_{t-1})}^{R_0(p_{t-2})} n_{it-1} di + \zeta\alpha(\theta(p_{t-1}))I_{t-1} + \delta I_{t-1} \end{aligned} \tag{iout}$$

Jobs leave the idle state for five reasons: a positive idiosyncratic shock makes jobs fully operational; firing permissions arrive; positive aggregate shock makes all jobs between the two reservation productivities fully operational; job to job quits and exogenous turnover. Given the flows in equations (iinf) and (iout) it is obvious that:

$$I_t = I_{\inf t} - I_{outt} + I_{t-1}$$

Q_t, the level of endogenous job to job flows during period t is given by:

$$Q_t = \sum_i \zeta\alpha(\theta(p_{t-1}))\phi(R_1(p_{t-1}) > a_i)n_{it-1}$$

This is simply the sum, over all intervals of x, of the job-to-job flows in each interval.

Thus job destruction in period t:

$$jd_t = sI_{t-1} + \delta N_{t-1} + Q_t$$

is now fully specified. As is job creation in period t:

$$jc_t = \alpha(\theta(p_{t-1}))\{1 - N_{t-1}\} + Q_t$$

Obviously, the end of the period employment is:

$$N_t = N_{t-1} + jc_t - jd_t$$

Notice that, since we have no inactive state in the model, unemployment inflows and outflows are simply given by $in_t = jd_t - Q_t$ and $out_t = jc_t - Q_t$ respectively. These are also equivalent to employment outflows and inflows, which do not involve job-to-job flows, respectively. To get measures comparable to those of Davis and Haltiwanger, we normalise in, out, jd and jc by $\frac{N_t+N_{t-1}}{2}$. We also measure the outflow rate as, $outr_t = \frac{out_t}{U_{t-1}}$. Finally, we use net employment changes: $net_t = N_t - N_{t-1}$ as a measure of the cycle.

5 Comparative Statics in a calibrated model

The theoretical consequences of either: more on-the-job search; or firing permissions arriving more quickly, are difficult to determine. More on-the-job search implies a smaller role for job destruction, through unemployment, in the reallocation of labour from less to more productive activity. However on-the-job search also reduces the expected duration of a match, and thus also affects the incentives to create and destroy jobs. A similar problem arises with firing permissions. For this reason, both Mortensen (1994) and Garibaldi (1998) use simulations to provide information about the effects of a change in these variables. We follow the same procedure here. Before simulating the model, we need to calibrate it. Many recent papers (Mortensen and Pissarides (1994), Mortensen (1994) and Cole and Rogerson (1998)) have argued that a variant of the search model exposed to aggregate shocks can perform well in matching business cycle facts for the US. For this reason and also for the ease of comparison with other studies, we do the comparative statics exercises for the model, calibrated on the US economy.

5.1 Calibration for a US economy

To model the evolution of aggregate productivity, we follow previous studies in this area (Mortensen (1994), Mortensen and Pissarides (1994) and Millard, Mortensen and Rosenblat (1996)) and suppose that the aggregate productivity follows the following first order autoregressive process:

$$p_t = \rho p_{t-1} + (1-\rho)\mu + \upsilon_t \qquad \text{with } E(\upsilon_t^2) = \sigma_\upsilon^2$$

We follow Millard, Mortensen and Rosenblat (1996) in setting ρ and σ_υ to equal 0.95 and 0.047 respectively[12]. Chari, Christiano and Kehoe (1991) show

[12]These values were chosen so that the autocorrelation and variance of aggregate consumption in the calibrated model, matched that in detrended data for the US, as reported by Merz (1994).

how a continuous Markov process can be approximated as a finite state Markov chain. Mortensen (1994) and Mortensen and Pissarides (1994) use a three state approximation. We use nine states, as Millard, Mortensen and Rosenblat (1996) show that simulated results for unemployment tend to be very jerky, when compared to the data, if the number of states is small.

A matching function of the Cobb-Douglas form is assumed with elasticity with respect to vacancies equal to ϑ, i.e. $q(\theta) = \theta^{-\vartheta}$. We set $\vartheta = 0.6$ following Blanchard and Diamond (1990). The distribution of idiosyncratic shocks is assumed to be uniform on the support $[\gamma, 1]$, i.e. $F(x) = \frac{x-\gamma}{1-\gamma}\ \forall\ x \epsilon [\gamma, 1]$. We set the worker's share of the Nash Bargain, equal to the average wage share, from 1960-98, $\beta = 0.7$[13]. The replacement ratio is set to equal the average gross replacement rate over the period, as calculated by the OECD, $\sigma = 0.1$. We set the lump sum firing cost to be zero, as in Mortensen and Pissarides (1998). We also set the arrival rate of firing permissions, $s = 1$. Thus on average one firing permission arrives per period and the economy performs in a similar way to if there was no need to wait for a firing permission. The parameters chosen for the firing procedure, reflect that firing is neither costly nor time consuming in the US. The arrival rate of an idiosyncratic shock, λ, the interest rate, r, the training cost, k, and the recruiting cost c_1, are the same as those justified in Mortensen and Millard (1997). The value of leisure, b, the lower bound of the idiosyncratic shock distribution, γ, and the efficiency of on the job search, ζ, are chosen so that the calibrated model, on average, matches certain features of the US economy. In particular, that it matches: an unemployment rate and duration of 6% and 3 months respectively, which are post WWII averages; and that job to job flows are about 50% of hires from unemployment (see Blanchard and Diamond 1990). The simulations are carried out over 100 quarters and repeated 100 times. The institutional values for this baseline economy are summarised below:

$$\begin{aligned}\lambda &= 0.107, \gamma = 0, r = 0.01, \delta = 0.14, \beta = 0.7 \\ \vartheta &= 0.6, \sigma = 0.1, T = 0, k = 0.275, c_1 = 0.33 \\ b &= 1.05, \zeta = 0.36, s = 1\end{aligned}$$

5.2 Results for a baseline economy

We present the simulated results for the baseline economy, and correlations found in US data, in Table 1. The results for comparative statics exercises on: changes in the on-the-job search efficiency; changes the arrival rate of firing permissions; and changes in the replacement ratio are documented in Tables 1-3.

The results in **Table 1**, replicate some of the results found in the data and Mortensen (1994), namely: the positive correlation between unemployment inflows and outflows; the negative correlation between unemployment and vacancies (the Beveridge curve); and the negative correlation between job creation

[13] We use ameco data, which is adjusted for self employment.

and job destruction. Unfortunately, as in Mortensen (1994), the standard errors associated with the correlation of the flows, are high relative to the actual estimates. The mean rates of job creation and job destruction, at around 8.7% are higher than the ranges estimated by Blanchard and Portugal (2000), which are 6-7.2% and 6.3-7.6% respectively. These ranges are based on the manufacturing numbers estimated by Davis and Haltiwanger (1992) for 1977q2 - 1988q4 and a correction to elevate the numbers to represent the whole economy. There is a range of values due to uncertainty about the elevation factor. One simple explanation of the differences, could simply be that our simple model does not differentiate between worker flows and job flows. All outflows lead to job destruction, as do all job-to-job quits. Yet as Blanchard and Portugal (2000) note, many separations are not due to desired changes in the level of employment of the firm, but due to match-specific problems. Thus, worker flows typically exceed job flows. Blanchard and Portugal estimate, for the US, that the ratio of worker to job flows is in the range 1.4-2.2. Thus if we make a downward adjustment to the flows generated by the model, to take account of the differences between worker and job flows, we would get numbers closer to those estimated by Blanchard and Portugal.

5.2.1 Changes in the degree of on-the-job search

Table 1 illustrates the correlations once we vary the efficiency of on the job search, ζ. The levels of unemployment inflows and outflows fall as ζ rises. This is unsurprising: job destruction leading to unemployment is less frequent, as many workers quit for another job before their current job is destroyed. Further, as Mortensen (1994) notes though, the 'crowding out' effect of an increase in employed worker search on the job finding probability of unemployed workers (see Burgess (1994) and Pissarides (1994)) is absent in this model. This is due to: 1) the complementarity between vacancy seeking workers and worker seeking vacancies, in the matching function; and 2) the free entry condition, equation (FE), which together imply that vacancies respond in proportion to offset such a congestion. Thus the level of unemployment falls as ζ rises, due to the above mentioned fall in the inflow rate, as illustrated in Tables 1-3. This itself will lead to lower outflows, as the outflow rate is not changing due to the lack of a congestion effect. The fact that the duration of unemployment hardly changes, as ζ varies, illustrates that the outflow rate is not changing[14].

The standard deviation of unemployment rises though. This is because the standard deviation of inflows increases. The intuition is the following: the higher is ζ, the bigger fall in job-to-job flows in a recession, due to its procyclical nature. This implies more jobs will become idle, before a worker quits. This, ceteris paribus, will increase the level of inflows in a recession. The opposite effect will happen in a boom, and given that inflows are counter-cyclical, this will increase its standard deviation. It will also increase its degree of counter-cyclicality, which is confirmed by looking at the changes in $corr(net, in)$. This

[14] the outflow rate is simply the inverse of the duration of unemployment.

also ties in with Burgess (1994), who argues that an increase in on-the-job search should increase the cyclicality of inflows. But, as argued above, the 'crowding out' effect that leads to the outflow rate becoming less cyclical in Burgess's analysis, is not present here. The simulations seem to suggest that the cyclical nature of the outflow rate has a non-linear response to an increase in ζ: at first $corr(net, outr)$ rises and then it falls.

It should also be noted, that the negative correlation between unemployment and vacancies becomes less strong as ζ increases. This is not surprising: as ζ increases, vacancies become more responsive to on-the-job searchers rather than unemployed searchers.

5.2.2 Changes in the arrival rate of firing permissions

Table 2 documents the results, once we change the arrival rate of firing permissions, s. A fall in s reduces both unemployment and its standard deviation. The effect on the standard deviation is not a surprise - we would expect it to fall as the process of firing becomes more uncertain, because firms cannot react as quickly to a shock. The fall in unemployment illustrates that the fall in the inflow rate is more important than the fall in the outflow rate. In fact the outflow rate hardly changes - the duration of unemployment is more or less constant. The number of job-to-job flows increases as s falls. This is because more people will be in idle jobs and all of the workers in this category will be searching on-the-job, as $R_1 > R_0$. This ties in with the evidence of Boeri (1999), that countries with stricter firing restrictions have higher job-to-job flows. Even though job-to-job flows increase as s falls, job creation and job destruction fall, as unemployment flows fall more than job-to-job flows rise. Thus the economy is becoming more sclerotic and less efficient as firing permissions take longer to get: it cannot reallocate labour as effectively in reaction to shocks. This ties in with the conclusions of Bentolila and Bertola (1990). As in Garibaldi (1998) the standard deviation of destruction falls. Also, the counter-cyclicality of the unemployment inflows falls. This is because it takes longer for firms to get rid of workers in a recession and firms anticipating this, realise firing permissions at higher levels of idiosyncratic productivity.

Finally, it is worth noting that as s falls, job creation and job destruction become increasingly positively correlated. This seems strange, as a major reason why Mortensen (1994) introduced on-to-job search, was to account for positively correlated unemployment flows and negatively correlated job creation and job destruction, in the US. The reason we now have both sets of flows being positively correlated is intriguing and is the following. The introduction of pro-cyclical job-to-job flows allows unemployment outflows to be counter-cyclical, but job creation to be pro-cyclical. Normally with a high arrival rate of firing permissions, unemployment inflows are highly counter-cyclical and thus job destruction remains counter-cyclical. However, we noted above, that when firing permissions arrive very infrequently, the counter-cyclicality of unemployment inflows is greatly reduced. Thus job destruction could now even be pro-cyclical if job-to-job flows, which induce job destruction, are sufficiently pro-cyclical.

Thus job flows could be positively correlated. To surmise, if firing permissions are sufficiently hard to get and on-the-job search very active, we can have positively correlated job creation and job destruction.

5.2.3 Changes in the replacement ratio

Table 3 shows the results of a change in the replacement ratio, which we briefly discuss below. An increase in σ increases unemployment significantly and its duration, as expected. The level of creation and destruction doesn´t change much, but the balance between inflows/outflows and job-to-job flows does. Job-to-job flows fall as σ increases, but inflows and outflows increase. The reason why job-to-job flows fall, is that as σ rises, unemployment becomes less uncomfortable and so workers are more willing to have a period of unemployment between jobs. Inflows and outflows increase, as though the outflow rate falls (duration increases), the increase in the level of unemployment more than compensates for this fall.

In the next section, we perform a full simulation for Spain and try to explain its recent history of high unemployment.

6 A simulated model for Spain

As documented in section 2, it seems that the introduction of temporary contracts has led to a marked increase in job-to-job flows, in Spain. As well as leading to a reduction in firing costs, they seem to have led to an increase in on-the-job search. In this section, we calibrate a search theoretic model, for the period 1977-1999, allowing for a structural break in 1984 when temporary contracts were introduced, and simulate it for Spain. Given the discussion in section 2, the structural break allows for: firing costs to fall; on-the-job search to become more active and unemployment benefits to increase.

We keep the same Markov chain process for aggregate productivity as assumed for the calibration of a US economy. We also assume the same λ, γ, r, ϑ, δ, k and c_1 as before. We take β to be the average of the wage share from 1977-1998, i.e. around 75%[15]. We use the gross replacement ratio, as estimated by the OECD, as our value for σ. For 1977-84 it is around 25% and from 1985-99, it is 35%. This fits in with the discussion in the introduction to this paper - overall for the second period, the various changes in benefit laws have increased the effective level of benefits whilst unemployed. We choose the rest of the parameters to fit: the level of the NAIRU; the duration of unemployment; and job-to-job flows, as a percentage of employment inflows.

Estrada, Hernando and Lopez-Salido (2000) have recently come up with some new estimates of the NAIRU. We use these in our calibrations. Thus we set the NAIRU for 1977-84 at around 15% and for 1985-99 at around 18%. The average duration of unemployment, for the period 1987-99, is 4.5 quarters,

[15] again using ameco data.

according to the EPA gross flow data. We use this estimate for the period 1985-99. Unfortunately, for the period 1977-1984, no available comparable EPA gross flow data exists, thus we have to make a reasoned estimate. An often quoted figure for duration in continental European countries is 3 quarters (see Mortensen and Pissarides (1998, 1999)). Given that, within a country, duration tends to increase with the unemployment rate, this seems a reasonable estimate for the period 1977-1984. We estimated, in section 2, that the mean percentage of job-to-job flows was around 42%, for the period 1988-1999. Given that this series shows an upward trend, a fair estimate for the period 1985-1999 may be that a third of the inflow into employment was caused by job-to-job flows. For the period 1977-84, there will have been some job-to-job flows, though not many. Given the upward trend of job-to-job flows commented on earlier, possibly around 10% of the employment inflow would have been made up of job-to-job flows.

For 1977-1984, we set ζ, T, b, and s to calibrate the estimated NAIRU, duration and job-to-job flows for that period. For 1985-1999, we keep b constant, but allow ζ, T and s to change and calibrate the changes in the NAIRU, duration and job-to-job flows. All the parameters are summarised below:

$$
\begin{aligned}
\lambda &= 0.107, \gamma = 0, r = 0.01, \delta = 0.14, \beta = 0.75 \\
\vartheta &= 0.6, k = 0.275, c = 0.33,\ b = 1.32, \\
\sigma &= 0.25(pre85)\ and\ 0.35(post85), \\
T &= 1(pre85)\ and\ 0.5(post85), \\
\zeta &= 0.09(pre85)\ and\ 0.7(post85), \\
s &= 0.25(pre85)\ and\ 0.75(post85)
\end{aligned}
$$

Notice how the calibrated changes fit in with our perception of the changes in the Spanish labour market. Namely, increased unemployment benefits, reduced firing costs (both lump sum and over time) and increased on the job search activity. Given the calibration procedure, it will make little difference that estimating some of the parameters has involved reasoned guesswork, provided the direction, and magnitude of the changes are credible.

6.1 Results for Spain

The results are presented in **Table 4**, along with a comparison with the correlations in the data. There are interesting differences between the two periods. The levels of inflows and outflows are more or less the same. This is due to the effects of the changes more or less cancelling each other out. The increase in the arrival rate of firing permissions will increase both outflows and inflows, as will the increase in the replacement rate. Whereas the increase in on-the-job search efficiency will reduce both of them, as shown in section 4. The level of the flows, at around 6% of employment, is consistent with the evidence documented in section 2. *nsemiout* and *nsemiin*, once normalised by the level of employment, are more or less equivalent to inflows and outflows in the model:

they measure employment flows that do not involve job-to-job flows. The mean value of these, from the EPA gross flow data, is respectively 5.8% and 5.2%.

Outflows are highly procyclical across both periods, but inflows become increasingly countercyclical. This is not surprising given the effects we noted of an increase in s and ζ in section 2. These cyclical properties for the second period are consistent with the properties of: *nsemiout*, *nsemiin*, *uout* and $u\,\mathrm{in}$. The unemployment flows have the same cyclical properties as the employment flows without job-to-job flows. One difference between the data and the simulation is that $corr(in, out) > 0$ in the simulations, but $corr(u\,\mathrm{in}, uout) < 0$ and $corr(nsemiin, nsemiout) < 0$ in the data. It should be noted though, that the standard deviation associated with the simulated statistic $corr(in, out)$ is actually greater than the observed value. Therefore it could be consistent to have a $corr(in, out) < 0$ in reality, given the simulation results.

The level of creation and destruction is higher in the second period than the first, due to higher job-to-job flows. Even though the average level of unemployment is higher, the lowering of firing costs and increasing on-the- job search activity may have made the economy less sclerotic - the economy reallocates labour in reaction to shocks more quickly. The level, in the second period, of job flows at around 9%, is much higher than the figure estimated by Dolado and Gómez (1995) on data, from the Central de Balances del Banco de Espana, for the period 1984-1992. They come up with a figure of around 3% for job creation and 4% for job destruction *annually.* However, Diaz-Moreno and Galdon-Sanchez (1998) argue that the values produced by Dolado and Gómez (1995) may be seriously biased downwards, as they refer to large manufacturing firms only. They use data from the Spanish Social Security Census and get much larger flows. Also there is the issue that we touched on when discussing the US results - not all job-to-job flows will cause job creation and job destruction. Thus the real level of job creation and job destruction will probably be less than predicted by the model. The cyclical properties of job creation and job destruction from the simulations are similar to the results of Dolado and Gomez (1995). Namely job creation is pro-cyclical and job destruction is counter-cyclical. The cyclicality of job destruction becomes more pronounced in the second period, as expected due to inflows becoming more countercyclical.

7 A sequence of events for Spain

In section 5, we have shown how a calibrated search model can deliver the high degree of unemployment experienced by Spain, since the late 1970s, and the explain some of the dynamic correlations in the data. Perhaps surprisingly, it is not difficult for a model with: a reduction in firing costs; an increase in on-the-job search and an increase in benefits, to calibrate a higher average level of unemployment, post 1984, than before. The introduction of temporary contracts reduced the level of firing costs and increased the level of on-the-job search. But the effect of these two changes on the level of unemployment is ambiguous. The comparative statics exercises in section 4, suggest that an increase in the arrival rate of firing permissions may increase average unemployment, whereas an increase in on-the-job search, may reduce unemployment. The comparative statics exercises also suggest that an increase in the effective level of benefits for the unemployed results in a large increase in the unemployment level. The combination of the three effects led to an increase in the average level of unemployment in the post 1984 period.

Though the average level of unemployment has been higher in the post 1984 period, there has been a large fall in unemployment since 1994. What can explain this? The *sequencing* of the reforms is obviously important. The laws in 1984 and 1989, to increase the generosity of unemployment benefits, along with the reduction in firing costs and cyclical factors, can probably help explain the build up of unemployment to a peak of 24% in the first quarter of 1994. In 1992 though benefit laws were tightened, as a consequence of a crisis in the funding of Social Security. This tightening, combined with increase in on-the-job search and cyclical factors, probably interacted to help reduce the unemployment rate, from a peak of 24% to just under 15% in the second quarter of 2000.

It is very important to differentiate between effects on the *level* of unemployment and the *efficiency* of the labour market (see Bentolila and Bertola (1990)). The reduction in firing costs and increase in job-to-job flows have probably increased the level of efficiency in the labour market - levels of job creation and job destruction in the model increase.

One final point to mention, is the value of leisure, b, is estimated to be higher in Spain than in the US, in the simulation exercises performed earlier. For Spain, $b = 1.32$ and for the US, $b = 1.05$. One hypothesis could be that measured household production is higher in Spain. Campbell and Ludvigson (2000) argue that it is natural to think of home production as a part of measured leisure, instead of an alternative. In Spain there has been a lot of debate about the black economy, or *la economia sumergida.* Many have argued that in areas such as Andalucia, where the unemployment in parts reaches 30%, this kind of activity is large. Given that people working in the underground economy, will still be claiming unemployment benefit, we can think of the activity as measured home production, i.e. as part of measured leisure. This may have had the unforeseen effect of increasing the measured utility of being unemployed and therefore increasing the level of measured unemployment.

8 Conclusions

For many economists, the degree of the structural unemployment problem, in Spain, has been a puzzle. This is especially apparent when comparing Spain with Portugal - a country with a similar historical legacy and with seemingly similar labour market institutions (see Blanchard and Jimeno (1995)). In this paper, we have considered the effects of: first, the interaction of the introduction of fixed term contracts and on-the-job search ; and second, the changes in the generosity of benefits. We have simulated a search theoretic model, with on-the-job search and firing permissions, to illustrate that these effects can easily calibrate an increase in the structural level of unemployment in Spain, since 1984. At the same time, they may have increased the *efficiency* of the labour market - post 1984 Spain may be an economy more capable of reallocating labour in response to shocks. It should be noted though, that since 1992, when unemployment benefit laws were tightened, the equilibrium level of unemployment has probably fallen whilst the economy has continued to become less dynamically sclerotic. Further, other factors have probably been important in explaining the evolution of the Spanish labour market, for example: the system of collective bargaining and employment taxes. In this paper, we have simply shown that a combination of changes in: firing costs, unemployment benefits and on-the-job search may make the Spanish jigsaw that is unemployment, a bit less of a puzzle.

References

[1] Artola, C. and Bell, U-L. (1999) 'Identifying Labour Market Dynamics using Labour Force Survey Data', *Banco de Espana wp9922.*

[2] Antolin, P. (1999) 'Gross Worker Flows: How Does the Spanish Evidence fit the stylized facts', *Labour* 13(2), 549-585.

[3] Bentolila, S. and Bertola, G., (1990), "Firing Costs and Labour Demand: How Bad is Eurosclerosis?", *Review of Economic Studies*, 57, 381-402.

[4] Bentolila, S and Dolado, J.J. (1994) 'Labour Flexibility and Wages: lessons from Spain', *Economic Policy*, April, pp. 55-99.

[5] Bertola, G. and Rogerson R. (1997), "Institutions and Labor Reallocation", *European Economic Review,* 41-6 June, 1147-1172.

[6] Blanchard, O.J. and Diamond P. (1989), "The Beveridge Curve", *Brookings Papers on Economic Activity 1989, 1*, 1-60.

[7] Blanchard, O.J. and Diamond P. (1990), "The Cyclical Behaviour of Gross Flows of Workers in the United States", *Brookings Papers on Economic Activity*, 1, 1-76.

[8] Blanchard, O.J. and Diamond P. (1992), "The Flow Approach to Labor Markets", *American Economic Review*, 82, May, 354-359.

[9] Blanchard, O.J. and Jimeno, J.J. (1995), "Structural Unemployment: Spain versus Portugal", *American Economic Review Papers and Proceedings,* vol. 85 no2, May, pp.212-218.

[10] Blanchard, O.J. and Portugal P. (2000), "What hides behind an Unemployment Rate: Comparing Portuguese and U.S Unemployment", *American Economic Review,* forthcoming.

[11] Bover, O., Garcia-Perea, P. and Portugal, P. (2000) 'A comparative study of the Portuguese and Spanish Labour Markets' *Banco de Espana* wp 9807.

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

[13] Burgess, S.M. (1994) 'Matching models and labour market flows', *European Economic Review*, 38, 809-816.

[14] Burda, M. and Wyplosz C. (1994), "Gross Worker and Job Flows in Europe", *European Economic Review*, 38(6), June, 1287-1315.

[15] Caballero, R. and M. Hammour, (1996), "On the Timing and Efficiency of Creative Destruction", *Quarterly Journal of Economics,* 805-851.

[16] Caballero, R. and M. Hammour, (1994b), "The Cleansing Effect of Recessions", *American Economic Review* Vol. 84 NO.5, December, 1350-1368.

[17] Campbell, J.Y. and S. Ludvigson (2000) ', "Elasticities of Substitution in Real Business Cycle Models with Home Production", *Journal of Money, Credit and Banking* (forthcoming).

[18] Chari V., Christiano L.J. and Kehoe P.J. (1991) 'Analysis of a Business Cycle Model with Distorting Taxes', Northwestern University Mimeo.

[19] Clark, K. and Summers, L. (1979), "Labor Market Dynamics and Unemployment: a Reconsideration", *Brookings Papers on Economic Activity 1990, 1*, 13-60.

[20] Cole, H.L. and Rogerson, R. (1996) 'Can the Mortensen-Pissarides matching model match the business cycle facts?', *Federal Reserve Bank of Minneapolis,* Research Department, Staff Report 224.

[21] Davis, S. and J. Haltiwanger, (1990), "Gross Job Creation and Destruction: Microeconomic Evidence and Macroeconomics Implications", *NBER Macroeconomics Annual* , 5, 99-113.

[22] Davis, S. and J. Haltiwanger, (1992), "Gross Job Creation, Gross Job Destruction and Employment Reallocation", *Quarterly Journal of Economics* 107, 819-63.

[23] Davis, S., Haltiwanger, J. and Schuh, S. (1996) '*Job Creation and Destruction',* MIT Press.

[24] Diaz-Moreno, C. and Galdon-Sanchez, J.E., (1998) 'Job Creation, Job Destruction and the Dynamics of Spanish Firms' (mimeo), University of Minnesota.

[25] Dolado, J.J. and Gomez, R. (1995) 'Creacion y destruccion de empleo en el sector manufacturero espanol: un analisis descriptivo', *Investigaciones Economicas*, September, 371-394.

[26] Dolado,J.J. and Jimeno J. F. (1997), " The Causes of Spanish Unemployment: A Structural VAR Approach", *European Economic Review,* 41-7, July, 1281-1308.

[27] Estrada, A., Hernando, I. and Lopez-Salido, J.D. (2000) 'Measuring the NAIRU in the Spanish Economy', *Banco de Espana mimeo*, May.

[28] Garibaldi, P. (1998) 'Job Flow Dynamics and firing restrictions', *European Economic Review,* 42, pp. 245-275

[29] Garibaldi P., Konings, J. and Pissarides C. (1996), "Gross Job Reallocation and Labour Market Policy" in *Unemployment Policy: Government Options for the Labour Market,* edited by Snower, D. and De la Dehesa G., C.E.P.R., London.

[30] Jackman, R., Layard,R. and Pissarides, C. (1989), "On Vacancies", *Oxford Bulletin of Economics and Statistics*, 51, November, 377-95.

[31] Jovanovic, B. (1979), "Job Matching and the Theory of Turnover", *Journal of Political Economy,* 87, 972-990.

[32] Jovanovic, B. (1984), "Matching, Turnover and Unemployment", *Journal of Political Economy,* 92, 108-122.

[33] Layard R., Nickell S. and Jackman R. (1991), *Unemployment: Macroeconomic Performance and the Labour Market,* Oxford University Press.

[34] Layard R. and S. Nickell (1997) 'Labour Market Institutions and Economic Performance', *Handbook of Labour Economics* (forthcoming)

[35] Marimon, R. and Zilibotti, F. (1996), "Actual versus Virtual employment in Europe: is Spain different?", *European-Economic-Review*, 42-1, January, 123-53.

[36] Millard, S. and Mortensen, D.T. (1997) 'The unemployment and welfare effects of labour market policy: A comparison of the US and UK', in D.Snower and G. de la Dehesa (eds.), *Unemployment Policy: Government Options for the Labour Market,* Cambridge: Cambridge University Press.

[37] Millard S., Mortensen D.T. and Rosenblat T.S. (1996) 'A Computational Approach to labour market Flows and Policy', Northwestern University working paper.

[38] Mortensen, D.T., (1994), "The Cyclical Behaviour of Job and Worker Flows", *Journal of Economic Dynamics and Control*, 18, July, 1121-1142.

[39] Mortensen, D.T. and C. Pissarides,. (1994), "Job Creation and Job Destruction in the Theory of Unemployment" *Review of Economic Studies*, 61, July, 397-415.

[40] Mortensen, D.T. and C. Pissarides,(1998), "Technological Progress, Job Creation and Job Destruction", *Review of Economic Dynamics*, 1-4, October, 733-753.

[41] Mortensen, D.T. and C. Pissarides,(1999a), 'Job Reallocation, Employment Fluctuations and Unemployment.' *Centre for Economic Performance dp.* 421.

[42] Mortensen, D.T. and C. Pissarides,(1999b), 'Unemployment Responses to Skill-Biased Technology Shocks: The Role of Labour Market Policy', *Economic Journal, 109 (*April*), pp. 242-265.*

[43] Pissarides, C. A., (1986), "Unemployment and Vacancies in Britain", *Economic Policy*, 3, 499-559.

[44] Pissarides, C. A., (1999), *Equilibrium Unemployment Theory*, MIT press.

[45] Pissarides, C. A., (1994), "Search Unemployment with On-the-job Search", *Review of Economic Studies*, 61, July, 457-475.

9 Appendix

9.1 Construction of flow data

The data come from the Spanish Labour Force Survey (EPA: Encuesta de la Población Activa). The EPA is a survey on all members of around 60,000 households (approximately 200,000 persons each quarter). Consecutive waves of EPA are matched to obtain flow data. To make the data representative of the total population, we elevate by the appropriate factors.

Two large problems with surveys like the EPA are *sample attrition* and *miss-classification error*. Sample attrition occurs when a household unit, which in principle should be covered by the survey, does not respond to the survey. Available Spanish evidence (INE (1996)) suggest that between 6-8% of the sample cannot be matched across consecutive periods. To the extent that the attrition is not random, it can cause unadjusted labour market flows to be biased. Miss-classification errors arise as a result of respondent errors miss-coding or interview errors. As Blanchard and Portugal (2000) note, these problems, which will lead to spurious transitions, are likely to be more serious with cumulated monthly transitions than with quarterly transitions. Artola and Bell (1999) analyse this issue in detail for Spain.

9.2 Employment flow data

We use two sources of data: the gross flow transitions collated by EPA, by matching individual records over time; and the EPA official measure of employment less than three months. The official measure of employment less than 3 months is used as a proxy for the total employment inflow. The gross flow transitions give us an individual breakdown of the transitions in and out of employment, to and from unemployment or inactivity. They can be summed up to give us the net employment flow, excluding job-to-job flows.

9.3 Unemployment flow data

Again the gross flow transitions are the source. There are two main flows into unemployment: from employment and from inactivity. These flows are summed to give us the total unemployment inflow. The unemployment outflow is constructed in exactly the same manner: we sum the flows from unemployment into inactivity and employment.

simulation stats	- varying ζ			
	baseline	$\zeta = 0.6$	$\zeta = 0.05$	data
$mean(out)$	5.78 (0.33)	4.16 (0.39)	8.73 (0.13)	3.07-4.27[a]
$mean(in)$	5.78 (0.33)	4.16 (0.39)	8.73 (0.13)	3.37-4.76[a]
$mean(quits)$	2.93 (0.23)	5.07 (0.34)	0.39 (0.05)	2.93[b]
$sd(out)$	0.76 (0.20)	1.21 (0.86)	0.47 (0.06)	
$sd(in)$	0.68 (0.14)	1.09 (0.57)	0.30 (0.04)	
$corr(net, outr)$	0.75 (0.10)	0.63 (0.43)	0.59 (0.11)	
$corr(net, in)$	-0.57 (0.11)	-0.69 (0.14)	-0.41 (0.06)	
$corr(jc, jd)$	-0.23 (0.19)	-0.49 (0.22)	0.09 (0.07)	-0.36[c]
$corr(net, quits)$	0.18 (0.07)	0.28 (0.15)	0.03 (0.05)	
$corr(in, out)$	0.23 (0.28)	0.01 (0.40)	0.20 (0.09)	0.16[d]
$corr(u, v)$	-0.71 (0.31)	-0.37 (0.57)	-0.94 (0.03)	-0.88[e]
$mean(u)$	5.95 (0.79)	4.34 (0.74)	8.74 (0.79)	6.00[f]
$sd(u)$	1.14 (0.32)	1.42 (0.60)	1.04 (0.33)	1.49[f]
$mean(duration)$	1.09 (0.09)	1.07 (0.09)	1.10 (0.09)	1.00[d]

Table 1: results (mean values with s.ds in brackets) for a US economy, varying the efficiency of on-the-job search, simulated 100 times over 100 quarters . Data Sources: [a]Blanchard and Portugal (2000) once quits have been taken away; [b]Blanchard and Diamond (1990); [c]Davis and Haltiwanger (1992); [d]Mortensen (1994); [e]Mertz (1992); [f]Computed from U.S unemployment 1960:1 - 1999:3.

simulation stats	- varying s			
	baseline	$s = 0.5$	$s = 0.1$	data
$mean(out)$	5.78 (0.33)	4.75 (0.28)	2.56 (0.12)	3.07-4.27[a]
$mean(in)$	5.78 (0.33)	4.75 (0.28)	2.56 (0.12)	3.37-4.76[a]
$mean(quits)$	2.93 (0.23)	3.08 (0.20)	3.37 (0.11)	2.93[b]
$sd(out)$	0.76 (0.20)	0.51 (0.10)	0.21 (0.04)	
$sd(in)$	0.68 (0.14)	0.39 (0.09)	0.16 (0.05)	
$corr(net, outr)$	0.75 (0.10)	0.66 (0.12)	0.60 (0.12)	
$corr(net, in)$	-0.57 (0.11)	-0.25 (0.11)	0.01 (0.11)	
$corr(jc, jd)$	-0.23 (0.19)	0.38 (0.18)	0.93 (0.05)	-0.36[c]
$corr(net, quits)$	0.18 (0.07)	0.21 (0.07)	0.55 (0.12)	
$corr(in, out)$	0.23 (0.28)	0.65 (0.16)	0.77 (0.09)	0.16[d]
$corr(u, v)$	-0.71 (0.31)	-0.87 (0.15)	-0.89 (0.08)	-0.88[e]
$mean(u)$	5.95 (0.79)	4.94 (0.67)	2.71 (0.34)	6.00[f]
$sd(u)$	1.14 (0.32)	0.88 (0.30)	0.42 (0.16)	1.49[f]
$mean(duration)$	1.09 (0.09)	1.08 (0.09)	1.08 (0.09)	1.00[d]

Table 2: results (mean values with s.ds in brackets) for a US economy, varying the arrival rate of firing permissions, simulated 100 times over 100 quarters . Data Sources: [a]Blanchard and Portugal (2000) once quits have been taken away; [b]Blanchard and Diamond (1990); [c]Davis and Haltiwanger (1992); [d]Mortensen (1994); [e]Mertz (1992); [f]Computed from U.S unemployment 1960:1 - 1999:3.

simulation stats	- varying σ			
	baseline	$\sigma = 0.3$	$\sigma = 0.5$	data
$mean(out)$	5.78 (0.33)	6.58 (0.30)	7.49 (0.26)	3.07-4.27[a]
$mean(in)$	5.78 (0.33)	6.58 (0.30)	7.49 (0.26)	3.37-4.76[a]
$mean(quits)$	2.93 (0.23)	2.12 (0.19)	1.34 (0.14)	2.93[b]
$sd(out)$	0.76 (0.20)	0.62 (0.09)	0.56 (0.10)	
$sd(in)$	0.68 (0.14)	0.57 (0.09)	0.47 (0.07)	
$corr(net, outr)$	0.75 (0.10)	0.66 (0.12)	0.55 (0.11)	
$corr(net, in)$	-0.57 (0.11)	-0.55 (0.11)	-0.51 (0.09)	
$corr(jc, jd)$	-0.23 (0.19)	-0.13 (0.16)	-0.06 (0.09)	-0.36[c]
$corr(net, quits)$	0.18 (0.07)	0.18 (0.07)	0.19 (0.08)	
$corr(in, out)$	0.23 (0.28)	0.29 (0.21)	0.26 (0.15)	0.16[d]
$corr(u, v)$	-0.71 (0.31)	-0.85 (0.14)	-0.91 (0.05)	-0.88[e]
$mean(u)$	5.95 (0.79)	8.00 (0.99)	11.5 (1.32)	6.00[f]
$sd(u)$	1.14 (0.32)	1.30 (0.42)	1.66 (0.59)	1.49[f]
$mean(duration)$	1.09 (0.09)	1.32 (0.12)	1.74 (0.17)	1.00[d]

Table 3: results (mean values with s.ds in brackets) for a US economy, varying the replacement ratio, simulated 100 times over 100 quarters . Data Sources: [a]Blanchard and Portugal (2000) once quits have been taken away; [b]Blanchard and Diamond (1990); [c]Davis and Haltiwanger (1992); [d]Mortensen (1994); [e]Mertz (1992); [f]Computed from U.S unemployment 1960:1 - 1999:3.

simulation stats	- for Spain		
	pre-1985	post-1985	data
$mean(out)$	6.10 (0.43)	6.08 (0.94)	5.2[a]
$mean(in)$	6.10 (0.34)	6.08 (0.89)	5.8[a]
$mean(quits)$	0.65 (0.17)	2.78 (0.69)	2.78[b]
$corr(net, out)$	0.92 (0.05)	0.72 (0.14)	0.74[a]
$corr(net, in)$	-0.25 (0.21)	-0.54 (0.17)	-0.63[a]
$corr(net, jc)$	0.96 (0.03)	0.89 (0.07)	0.95[c]
$corr(net, jd)$	-0.11 (0.26)	-0.50 (0.12)	-0.94[c]
$corr(jc, jd)$	0.16 (0.26)	-0.07 (0.21)	
$corr(net, quits)$	0.48 (0.23)	0.48 (0.23)	
$corr(in, out)$	0.11 (0.25)	0.15 (0.28)	-0.24[a]
$corr(u, v)$	-0.84 (0.10)	-0.79 (0.08)	
$mean(u)$	14.9 (4.62)	18.2 (7.72)	15.0, 18.0[d]
$sd(u)$	3.05 (2.38)	6.28 (4.34)	5.01, 2.61[e]
$mean(duration)$	3.06 (1.31)	4.70 (1.40)	4.5[a]

Table 4: results (mean values with s.ds in brackets) for a Spanish economy, simulated 100 times over 100 quarters . Data Sources: [a]EPA gross flows for period 1988:4-1999:3 - see section 3; [b]job-to-job flow measure for period 1988:4-1999:3 - see section 3; [c]Dolado and Gmez (1995); [d]Estrada, Hernando and Lpez-Salido (2000) - for respective periods; [e]EPA official data - for respective periods.