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Departamento de Economía
Universidad Carlos III de Madrid
Calle Madrid, 126
28903 Getafe (Spain)
Fax (34) 91-624-98-75

JOB FLOW DYNAMICS IN SEGMENTED LABOR MARKETS: THE EFFECTS OF A REDUCTION IN FIRING COSTS IN SPAIN *

Victoria Osuna

Abstract

This paper proposes a model of job creation and destruction of the search and matching type. The model is able to replicate the magnitude and cyclical behavior of job creation, destruction and reallocation rates in a segmented labor market like the one in Spain. The motivation is the similarity in the cyclical behavior of US and Spanish job reallocation (JR) rates despite the differences in job security regulations. This behavior contrasts to what is observed in the rest of continental Europe, where JR is acyclical. The model, by introducing a segmented labor market, makes is plausible to obtain a countercyclical JR rate in a high firing cost economy. In addition, we quantify the effects of a 40% reduction in the firing costs associated with permanent contracts. The main results are (i) negligible effects on permanent job destruction rates, (ii) significant effects on job creation and destruction (permanet/temporary) cyclical behavior, (iii) a 57% increase in the job conversion rate from temporary into permanet jobs and a 12% reduction in the temporary employment rate.

Keywords: Job Reallocation, Firing Costs, Bargaining, Matching, Search.

Osuna, Departamento de Economía, Universidad Carlos III de Madrid. E-mail: vosuna@est-econ.uc3m.es

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Contents

1 Introduction

The purpose in this paper is twofold. First, we build a search and matching model that is able to replicate the magnitude and cyclical behavior of job creation, destruction and reallocation[1] rates in a segmented labor market like the one in Spain. Second, we quantify the effects of a reduction in firing costs associated with permanent jobs for the *magnitude and cyclical behavior* of job creation, destruction and reallocation rates, the temporary employment rate and the job conversion rate from temporary into permanent contracts.

The motivation of the paper is the similarity in the cyclical behavior of US and Spanish job creation (JC), destruction (JD) and reallocation (JR) rates despite the differences in job security regulations (see Table 1). In particular, job reallocation rates are *countercyclical* in both labor markets.

Tabla 1: JC, JD and JR correlations with the cycle (NET)[2]

Country (period)	Corr(JC,NET)	Corr(JD,NET)	Corr(JR,NET)
US (1972-1986)	0.90	-0.958	-0.519
Spain (1990-1996)	0.602	-0.895	-0.531

This observation is inconsistent with one of the main conclusions drawn from the recent literature on job creation and job destruction in the OECD[3], i.e., countries with higher firing costs tend to have lower correlations of JR rate with the cycle. This regularity seems to be validated except for Spain (see this in Table 2, where some OECD countries have been ordered according to the stringency in job security provisions).

According to this literature, the countercyclical behavior of job reallocation rates in Anglo-xason countries is due to negligible firing costs. These economies are considered more efficient in the sense that they are able to reallocate when the opportunity cost (in terms of output losses) is lower, that is, in recessions. In contrast, job reallocation rates in continental Europe are

[1]Job reallocation is defined as the sum of job creation and job destruction.

[2]Notes: (1) Corr(JC, NET), Corr(JD,NET) and Corr(JR,NET) are the correlations of job creation, destruction and reallocation rates with net employment rate (NET), the indicator of the cycle. Source: USA, Davis et al.(1996); Spain, own designed using firm-level data from the survey "Encuesta de Coyuntura Laboral".

[3]See Garibaldi (1997), Garibaldi, Konings and Pissarides (1996), OECD Employment Outlook (1994), Millard y Mortensen (1997).

acyclical because high firing costs prevent the necessary reallocation from taking place in recessions. However, this does not seem to be the case in Spain.

Table 2: Mean reallocation rate and its correlation with the cycle[4].

Country	US	Canada	UK	Germany	Norway	Spain	Italy
Period	84-91	83-91	73-86	83-90	77-86	90-96	84-91
Mean	22.0	20.0	—	12.6	—	24.0	21.3
Corr	-0.52	-0.48	-0.95	0.04	-0.13	-0.53	0.11

In the light of what happens in the Spanish labor market, the obvious question is how to reconcile this observation with the results from previous studies, that is, what are the factors that make it possible to have a countercyclical JR rate in a high firing costs economy.

The answer lies on the segmentation that characterizes the Spanish labor market. By looking at job creation, destruction and reallocation rates dissagregated by permanent (JC^p, JD^p, JR^p) and temporary employment (JC^t, JD^t, JR^t), it is easy to see that the magnitude and cyclical behavior of Spanish aggregate rates are mainly due to the behavior of temporary employment (see table 3).

Table 3: Job creation, destruction and reallocation rates in Spain[5]

	JC	JD	JR	JC^p	JD^p	JR^p	JC^t	JD^t	JR^t
Mean	2.7	3.2	5.9	2.7	3.0	5.8	11.9	13.1	25.0
Corr.	0.6	-0.89	-0.53	0.24	-0.48	-0.18	0.43	-0.7	-0.36

Temporary contracts were liberalized in Spain in 1984 and since then, firms have made widespread use of them[6]. There are two reasons for that

[4]Notes: (1) Mean stands for the annual job reallocation rate (average). (2) Corr. is the correlation of the job reallocation rate and net employment rate (NET). (3) The unit of study is the plant, except for Canada and Italy, where the unit of study is the firm. (4) The employment sector is manufactures, except for Spain, where services are also included. (5) Sources: OECD Employment Outlook and own designed

[5]Notes: (1) Source: own designed with quaterly firm-level data from the survey Encuesta de Coyuntura Laboral (ECL) covering the period 1990-96. The unit of study in the ECL is the plant. The sectoral coverage is manufacturing and services (excluding Public Administration). (2) The first row shows aggregate and disaggregate (temporary/permanent) job creation, destruction and reallocation rates (averages). The second row shows the correlations of these rates with net employment rate.

[6]In Spain, one out of three contracts is temporary, while in the rest of Europe the

behavior. First, they allow employment adjustments at a low cost, since the associated legal firing costs to temporary jobs are very low[7]. Second, until 1994, firms could freely use temporary contracts without having to justify the temporary nature of the activity, using the so called "contrato de fomento de empleo"[8].

The introduction of these cheap contracts, joint with the high firing costs associated to permanent jobs, has generated a segmented labor market, where workers in permanent jobs have a very low probability of being fired while temporary workers suffer the main adjustments. The usual practice has been hiring workers on a temporary basis, usually for 3 years (the maximun duration allowed), firing them upon contract expiration and, at the same time, hiring new temporary workers to fill the same positions.

In sum, the Spanish labor market may appear quite dynamic just by looking at the cyclical behavior of aggregate job creation, destruction and reallocation rates, but this might be misleading. On the one hand, firms fire permanent workers less than it would be efficient (labor hoarding) and, on the other hand, there is segment of the labor market suffering from excessive turnover.

Trying to rationalize the consequences of these specific features of the Spanish labor market is one of the objectives in this paper. For that purpose, we build a model, similar in spirit to the job creation and destruction model proposed by Mortensen and Pissarides (1994), and introduce some new elements to capture those specific features. The first one is the existence of a *Segmented Labor Market* with two types of jobs: permanent and temporary, differing in the maximum duration of the contract and in the associated firing costs[9] and held by homogeneous workers. Second, in contrast to pre-

temporary rate is around 8%.

[7]In the period under study (1990-96), firing costs are 12 days salary per year worked in some temporary contracts and zero in others. Unfair dismissals of workers in permanent contracts entail a cost of 45 days salary per year worked with a maximum of 42 monthly salaries, while in case of fair dismissals the costs are 20 days salary per year worked with a maximum of 12 monthly salaries.

[8]The possibility of hiring workers using this type of contract was eliminated in 1994, but they have been in place until 1997.

[9]We will assume that temporary contracts do not entitle to firing costs, since in most cases they are very low or even zero.

vious models in this literature, the model is set in discrete time[10]. In this labor market firms will be heterogeneous agents and will use these two types of contracts to adjust their employment levels when facing aggregate and idiosyncratic persistent shocks. We follow Mortensen and Pissarides (1994) by assuming one-job firms.

Before going into the details of the model, it is convenient to explain the timing and agent's decisions. At the beginning of the period, both aggregate and idiosyncratic shocks affecting firms are revealed. Then, firms and workers renegotiate wages. Given new wages, each firm decides whether to fire or not its actual worker, taking into account that firing costs depend on worker's previous wage. Firms with temporary workers take a similar decision. However, firms, whose temporary contracts expired last period, decide, in fact, whether to convert or not the temporary contract into a permanent job, knowing the consequences regarding future firing costs. Once all these decisions have been made, production starts both, in firms where workers have not been fired this period and in those that were matched with unemployed workers at the end of last period. Finally, search decisions are made: firms post vacancies and unemployed workers apply for jobs. This search process will generate new matches that will be productive next period. We will also assume that every job is created as a temporary job.

The model is calibrated to the Spanish economy and we test its validity to replicate the behavior of job creation and job destruction in that economy. In addition, we quantify the effects of a 40% reduction in firing costs for the magnitude and cyclical behavior of the variables of interest. Such a reduction (i) has negligible effects on the magnitude of permanent job destruction rates, (ii) significant effects on job creation and destruction (permanent/temporary) cyclical behavior, (iii) increases the job conversion rate by 57% and (iii) reduces the temporary employment rate by 12%. Moreover, this simulation exercise shows that the aggregate job creation and job destruction statistics

[10]This is necessary for two reasons. First, firms need to know worker's previous wage when considering whether to fire or not a worker, since firing costs are computed using this information. That is, worker's previous wage is a state variable. Second, tenure in a temporary contract is also a state variable, since temporary contracts have a fixed-term duration.

can be very similar in a rigid (high firing costs) and in a flexible economy (low firing costs).

The outline of the paper is as follows. In Section 2, we briefly review previous literature. In Section 3, we present the model. In Section 4, we discuss its calibration. In Section 5, we show simulation results. In Section 6, we comment the results obtained from the reduction in firing costs. Finally, Section 7 draws some conclusions.

2 Related literature

The pioneer empirical studies in this literature are due to Davis and Haltiwanger (1990,1992). Using firm-level data, they document the magnitude and cyclical behavior of job creation and destruction rates in the US economy. Among their findings, one of the most interesting is the countercyclical behavior of the JR rates. Following Davis and Haltinwanger (DH), a number of empirical studies have applied the same methodology to some European countries: Boeri y Cramer (1993) for Germany, Contini and Revelli (1987) for Italy, Konings (1995) for the United Kingdom (UK), Dolado and Gómez (1995) and García-Serrano and Jimeno (1997) for Spain. The most relevant result from this research program is the acyclical behavior of the JR rates in the European economies, except for the UK.

These differences in the cyclical behavior of JR rates across labor markets are frequently attributed to differences in employment protection regulations[11]. While the job creation technology is slow and costly in both types of economy, the job destruction technology is instantaneous in the Anglo-xason countries due to lower firing costs.

At the same time, a number of theoretical studies have been developed trying to rationalize the observed facts. The most important contribution is the stochastic endogenous job creation and destruction model by Mortensen and Pissarides (1994). In this model, the exogenous job destruction rate in

[11]Bentolila y Bertola (1990) y Bertola (1990) conclude that differences in firing costs explain differences in the dynamic behavior of employment, but they do not necessarily imply a higher unemployment rate

the classic search and matching model by Pissarides (1990) is endogenized. Subsequently, Pissarides (1994) and Mortensen (1994) introduce on the job search. These models are able to reproduce the "stylized facts" observed in the US economy: (i) job creation and destruction flows coexisting in all phases of the cycle, (ii) a lot of heterogeneity among plants and (iii) a very volatile job destruction process.

However, these models cannot account for the cyclical behavior documented in the European countries. Garibaldi (1998), in a modified version of the Mortensen-Pissarides (1994) model, has reproduced the acyclical reallocation rate observed in most European economies by introducing elements of employment protection. In his model, job destruction is also endogenous, but firms cannot get rid of their labor force instantaneously. The process of firing a worker is slow and costly since firms must wait for an administrative authorization before firing a worker.

Garibaldi's model, while able to explain the behavior of job creation and job destruction in most European economies, does not look appropriate to account for the Spanish facts. Thus, the first goal in this paper is to build a model that is able to account for that behaviour. For that purpose, we introduce two specific features of the Spanish labor market: (i) the existence of two types of contracts (permanent and temporary), differing in their maximun duration and in firing costs, and (ii) the possibility of converting a temporary contract into a permanent one. Modelling the process of job creation and job destruction in that way, it is possible to study separately the cyclical properties of job creation and destruction by type of contract and analyze the effects of a reduction in firing costs associated to permanent contracts for permanent job creation and destruction rates.

3 Model

3.1 Population

The economy consists of a continuum of workers with unit mass[12] and a continuum of firms. Workers can either be employed or unemployed[13]. Unemployed workers look for employment opportunities; employed workers produce and do not search on the job. Each firm is a one-job firm. The job might be occupied and producing or vacant.

The source of heterogeneity is due to the existence of matchings with different quality levels, durations, and firing costs (that depend on previous wage). Therefore, the state space that describes the situation of a particular worker is $S = \{\{0,1\} \times \mathcal{E} \times D \times [0, \bar{w}]\}$, where $\mathcal{E} = \{\epsilon_1, ..., \epsilon_n\}$ is a discrete set, the quality levels, $D = \{d_1, ..., d_N\}$ is a discrete set denoting tenure on a particular job and wages take values in an interval $[0, \bar{w}]$. Therefore, each quadruple indicates whether the worker is unemployed (0) or employed (1) and, in that case, the quality of the match, worker's tenure and his previous wage. Note that the state space is continuos since the wage takes values in an interval.

3.2 Preferences

Workers have identical preferences, live infinitely and maximize their utility, which is taken to be linear in consumption. We assume that they supply work inelastically, that is, they will accept every opportunity that arises. Thus, each worker has preferences defined by

$$\sum_{t=1}^{\infty} \beta^t c_t$$

where β, $0 \leq \beta < 1$, is the discount factor and c_t is consumption. Firms are also risk neutral.

[12]We assume a zero population growth rate.

[13]We do not considered other labor market states out of the labor force

3.3 Technologies

We assume that there are two technologies in this economy: a production and a matching technology.

3.3.1 Production technology

Each job is characterized by an irreversible technology and produces one unit of a differentiated product per period, whose price is $y(z_t, \epsilon_t)$, where $\{z_t\}$ is an aggregate productivity component, common to every job, and $\{\epsilon_t\}$ is a specific component, i.e. the quality of the match. Each new matching (assumed to be temporary) starts with the same entry level ϵ_e, a relative low quality level. From this initial condition, the quality of the match will evolve stochastically due to shocks, $\{z_t, \epsilon_t\}$.

The aggregate shock, $\{z_t\}$, is modeled as a stationary and finite Markov chain, with transition probabilities $\Pi(z'|z) = Pr\{z_{t+1} = z'|z_t = z\}$ where z, $z' \in Z = \{1, 2, ..., n_z\}$. The idiosyncratic component, $\{\epsilon_t\}$, is also modeled as a stationary and finite Markov chain. This process is the same for every matching and, conditioning on z_{t+1}, the realizations ϵ_{t+1} are independent and identically distributed with conditional transition probabilities $\pi(\epsilon'|\epsilon, z') = Pr\{\epsilon_{t+1}|\epsilon_t, z_{t+1}\}$, where ϵ, $\epsilon' \in \mathcal{E} = \{1, 2, ..., n_\epsilon\}$. Therefore, the joint process $\{\epsilon, z\}$ is a Markov chain with $n_\epsilon \times n_z$ states with transition probabilities

$$\Gamma[(\epsilon', z')|(\epsilon, z)] = Pr\{\epsilon_{t+1}, z_{t+1}|\epsilon_t, z_t\}$$

In this paper, we assume that both stochastic processes are independent. This implies $\Gamma[(\epsilon', z')|(\epsilon, z)] = \Pi(z'|z) * \pi(\epsilon'|\epsilon)$. In addition, we assume that agents know the laws of motion of both processes and observe their realizations at the beginning of the period.

3.3.2 Matching technology

As before mentioned, every job is created as a temporary job. Temporary jobs are created by firms that post vacancies in the market. We assume free entry in the creation of vacancies. Thus, posting a vacancy is not job creation, unless it is filled. Finally, there is a cost associated to posting a vacancy, c.

In each period, vacancies and unemployed workers are stochastically matched. We assume the existence of an homogeneous of degree one matching function $m = m(u_t, v_t)$, increasing and concave in both arguments, where v_t is the number of vacancies and u_t the number of unemployed workers, both normalized by the fixed labor force. The application process is as follows. Workers can only apply to one job each period. Given this restriction and the assumption that workers supply curve is inelastic, their decision is trivial. They will accept a job whenever there is a contact.

These assumptions allow us to define the transition rates for vacancies and unemployed workers. The vacancy transition rate, q, is defined as the probability of filling a vacancy and is given by

$$q(\nu) = \frac{m(v,u)}{v} = m\left(1, \frac{u}{v}\right)$$

The transition rate for unemployed workers, α, is defined as the probability of finding a job and is given by

$$\alpha(\nu) = \frac{m(v,u)}{u} = m\left(\frac{v}{u}, 1\right)$$

Given that the homogeneity of degree one in the matching function, these transition rates depend only on $\nu = v/u$, a measure of tightness in the labor market.

On the other hand, permanent jobs are created when firms decide to convert a temporary job into a permanent one. This can be motivated by a good realization of the joint process $\{\epsilon, z\}$. In particular, conversion will take place for realizations above a specific threshold that firms determine.

3.4 Equilibrium

The concept of equilibrium used is the recursive equilibrium. In each period, the aggregate state of the economy is described by the pair (μ, z), where μ represents the matching distribution by quality levels, tenure and previous wages. In the following I will describe firms and workers problems.

3.4.1 Problem of a firm with permanent job

The vector of states for this firm is $(\epsilon, w_{-1}, \mu, z)$, where ϵ is the quality of the match, w_{-1} the previous wage and the pair (μ, z) represents the aggregate state in this economy[14].

The problem of this firm is

$$\begin{aligned} J^p(\epsilon, w_{-1}, \mu, z) &= max\{y(z,\epsilon) - w(\epsilon, w_{-1}, \mu, z) + \beta \sum_{\epsilon', z'} \Gamma[(\epsilon', z')|(\epsilon, z)] J^p(\epsilon', w, \mu', z'), \\ & -cf(w_{-1}) - c + \beta q(\mu, z) \sum_{z'} \Pi(z'|z) J^t(\epsilon_e, d_1, \mu', z') + \beta(1 - q(\mu, z)) J^0\} \end{aligned}$$

s.t.

$$\mu' = G(\mu, z, z')$$

where $J^p(\epsilon, w_{-1}, \mu, z)$ is the firm value function, $w(\epsilon, w_{-1}, \mu, z)$ is the wage, previously determined in a bilateral negotiation between the firm and the worker, $cf(w_{-1})$ is the firing cost, that depends on the previous wage, $J^t(\epsilon_e, d_1, \mu', z')$ is the value function of a firm with a first period temporary job, $J^0(\mu, z)$ is the value of a vacancy and the function $G(\mu, z, z')$ describes the distribution law of motion.

The decision rule for this firm is denoted by $g^p(\epsilon, w_{-1}, \mu, z)$. The firm must decide whether to continue with the actual match, $g^p(\epsilon, w_{-1}, \mu, z) = 1$, or whether to fire the worker and look for a new one, $g^p(\epsilon, w_{-1}, \mu, z) = 0$.

Note that the problem is different for a firm whose temporary contract expired in the previous period. Let us denote n the maximum number of periods for a temporary contract. In this case, the vector of states is $(\epsilon, d_{n+1}, \mu, z)$,

[14] Since the state variable w_{-1} takes values in an interval, the state space, $S = \{\{0,1\} \times \mathcal{E} \times D \times [0, \bar{w}]\}$, is continuum and, the value functions are infinite-dimensional objects. There are two approaches to deal with this problem. The first one is to discretize the state space, that is, to partition the wage support considering only a finite number of wages. The drawback is that the wage is not an exogenous variable, but an endogenous one, determined in the bargaining process. Therefore, this approach will be unreliable and restrictive, unless the partition is very fine. But then, the problem is that the state space increases too much. The other approach consists in partitioning the wage support to evaluate the value functions using linear interpolation when the argument w_{-1} falls outside the grid. This is the approach followed here, so that the value functions are still infinite-dimensional objects and wages are not restricted to take values in a discrete set.

where d_{n+1} indicates that if the worker is not fired at the beginning of this period, this worker will start the subsequent period as a permanent worker. His previous wage is not part of the state vector because the firing cost at the beginning of the period would be zero. The problem of this firm can be written as

$$\begin{aligned} J^p(\epsilon, d_{n+1}, \mu, z) &= max\{y(z,\epsilon) - w(\epsilon, d_{n+1}, \mu, z) + \beta \sum_{\epsilon', z'} \Gamma[(\epsilon', z')|(\epsilon, z)] J^p(\epsilon', w, \mu', z'), \\ & -c + \beta q(\mu, z) \sum_{z'} \Pi(z'|z) J^t(\epsilon_e, d_1, \mu', z') + \beta(1 - q(\mu, z)) J^0\} \end{aligned}$$

s.t.

$$\mu' = G(\mu, z, z')$$

The decision rule is $g^p(\epsilon, d_{n+1}, \mu, z) = 1$ if the firm converts the temporary contract into a permanent one and $g^p(\epsilon, d_{n+1}, \mu, z) = 0$ if the firm decides to fire the worker and start looking for another one.

3.4.2 Problem of a firm with a temporary job

The vector of states for this firm is (ϵ, d, μ, z), where d represents tenure at the beginning of the period. Note that the previous wage is not part of the state vector, since firing costs are zero for this type of contracts. The problem of this firm is

$$\begin{aligned} J^t(\epsilon, d, \mu, z) &= max\{y(z,\epsilon) - w(\epsilon, d, \mu, z) + \beta \sum_{\epsilon', z'} \Gamma[(\epsilon', z')|(\epsilon, z)] J^t(\epsilon', d+1, \mu', z'), \\ & -c + \beta q(\mu, z) \sum_{z'} \Pi(z'|z) J^t(\epsilon_e, d_1, \mu', z') + \beta(1 - q(\mu, z)) J^0(\mu, z)\} \end{aligned}$$

s.t.

$$\mu' = G(\mu, z, z')$$

$$d = \{d_1, ..., d_{n-1}\}$$

where $J^t(\epsilon, d, \mu, z)$ is the value function for this firm and $w(\epsilon, d, \mu, z)$ is the wage, previously determined in a bilateral negotiation between the firm and the worker.

The firm must decide whether to continue with the match, $g^t(\epsilon, d, \mu, z) = 1$, or to fire the worker and look for another one, $g^t(\epsilon, d, \mu, z) = 0$.

Note that due to the limited duration of temporary contracts to n periods, the problem of a firm with a temporary contract in the last period is

$$\begin{aligned} J^t(\epsilon, d_n, \mu, z) &= max\{y(z,\epsilon) - w(\epsilon, d_n, \mu, z) + \beta \sum_{\epsilon', z'} \Gamma[(\epsilon', z')|(\epsilon, z)] J^p(\epsilon', d_{n+1}, \mu', z'), \\ &\quad -c + \beta q(\mu, z) \sum_{z'} \Pi(z'|z) J^t(\epsilon_e, d_1, \mu', z') + \beta(1 - q(\mu, z)) J^0(\mu, z)\} \end{aligned}$$

s.t.

$$\mu' = G(\mu, z, z')$$

3.4.3 Problem of a worker in a permanent job

The problem of this worker is trivial. In fact, his decision is indirect since he negotiates with the firm over the wage before the firm decides upon his continuation.

$$\begin{aligned} V^p(\epsilon, w_{-1}, \mu, z) &= \tilde{\Phi}(g^p = 1)[w(\epsilon, w_{-1}, \mu, z) + \beta \sum_{\epsilon', z'} \Gamma[(\epsilon', z')|(\epsilon, z)] V^p(\epsilon', w, \mu', z')] \\ &\quad + \tilde{\Phi}(g^p = 0)[V^0(\mu, z) + cf(w_{-1})] \end{aligned}$$

where $V^p(\epsilon, w_{-1}, \mu, z)$ is the value function for this worker, $\tilde{\Phi}(x)$ is an indicator function that takes the value 1 if the assessment is true and zero otherwise, and $V^0(\mu, z)$ is the value function for an unemployed worker.

3.4.4 Problem of a worker in a temporary job

His problem is also trivial.

$$
\begin{aligned}
V^t(\epsilon, d, \mu, z) &= \tilde{\Phi}(g^t = 1)[w(\epsilon, d, \mu, z) + \beta \sum_{\epsilon', z'} \Gamma[(\epsilon', z')|(\epsilon, z)] V^t(\epsilon', d+1, \mu', z')] \\
&\quad + \tilde{\Phi}(g^t = 0) V^0(\mu, z)
\end{aligned}
$$

where $V^t(\epsilon, d, \mu, z)$ is the value function of a worker in a temporary job.

3.4.5 Problem of an unemployed worker

Unemployed workers look for employment and accept a job whenever an opportunity arises. The value function for an unemployed worker is

$$
\begin{aligned}
V^0(\mu, z) &= b + \beta q(\mu, z) \sum_{z'} \Pi(z'|z) V^t(\epsilon_e, d_1, \mu', z') + \\
&\quad \beta(1 - \alpha(\mu, z)) \sum_{z'} \Pi(z'|z) V^0(\mu', z')
\end{aligned}
$$

where $V^t(\epsilon_e, d_1, \mu', z')$ is the value function of a temporary worker in his first period. The parameter b can be interpreted in two ways. It could be some kind of unemployment subsidy. Under this assumption, we would need a public sector to raise taxes. The other interpretation is that b is the return to home production, assuming that every household have access to the same production technology. This technology allows them to produce b units of the period consumption good every period.

3.4.6 Wage determination

Wages are the result of a bilateral bargaining between the worker and the firm. Bargaining is dynamic, that is, wages are revised every period upon occurrence of new shocks. This assumption is reasonable due to existence of sunk costs (search costs) once the match is produced. This creates local monopoly power and generates a surplus to be split among the participants in the match. This surplus, in the case of a permanent contract, is defined as

$$
S^p(\epsilon, w_{-1}, \mu, z) = J^p(\epsilon, w_{-1}, \mu, z) - (J^0(\mu, z) - cf(w_{-1})) + V^p(\epsilon, w_{-1}, \mu, z) - (V^0(\mu, z) + cf(w_{-1}))
$$

$$
\begin{aligned}
S^p(\epsilon, w_{-1}, \mu, z) &= J^p(\epsilon, w_{-1}, \mu, z) - (J^0(\mu, z) - cf(w_{-1})) + \\
& \quad V^p(\epsilon, w_{-1}, \mu, z) - (V^0(\mu, z) + cf(w_{-1}))
\end{aligned}
$$

Wages are obtained by maximizing the following Nash product with respect to the wage

$$
[J^p(\epsilon, w_{-1}, \mu, z) - (J^0(\mu, z) - cf(w_{-1}))]^{1-\theta}[V^p(\epsilon, w_{-1}, \mu, z) - (V^0(\mu, z) + cf(w_{-1}))]^{\theta}
$$

Wages are set so that the surplus of the match, $S^p(\epsilon, w_{-1}, \mu, z)$, is split in fixed proportions. In equilibrium

$$
(1-\theta)S^p(\epsilon, w_{-1}, \mu, z) = J^p(\epsilon, w_{-1}, \mu, z) + cf(w_{-1})
$$

$$
\theta S^p(\epsilon, w_{-1}, \mu, z) = V^p(\epsilon, w_{-1}, \mu, z) - (V^0(\mu, z) + cf(w_{-1}))
$$

where θ indicates workers bargaining power.

In general, the determination of wages using dynamic bargaining implies having to solve a fix point problem, since the value functions that define the surplus to be maximized depend on the wage. However, in this case, it is possible to avoid this computational problem. The assumption of free entry in the creation of vacancies allow us to obtain an expression for the wage from the first order condition that only depends on the transition rates for a vacancy and a worker and on parameters. That expression is independent of the value functions and is given by

$$
w(\epsilon, w_{-1}, z) = (1-\theta)b + \theta \left[y(\epsilon, z) + \frac{c\alpha(z)}{q(z)} \right] + (1-\beta)cf(w_{-1})
$$

Wages associated to temporary contracts are obtained by maximizing a similar expression, where $cf(w_{-1})$=0.

3.4.7 Definition of Equilibrium

A recursive equilibrium is a list of value functions $J^p(\epsilon, w_{-1}, \mu, z)$, $J^p(\epsilon, d_{n+1}, \mu, z)$, $J^t(\epsilon, d, \mu, z)$, $V^p(\epsilon, w_{-1}, \mu, z)$, $V^p(\epsilon, d_{n+1}, \mu, z)$, $V^t(\epsilon, d, \mu, z)$, $J^0(\mu, z)$, $V^0(\mu, z)$, transition rates $q(\mu, z)$, $\alpha(\mu, z)$, prices $w(\epsilon, w_{-1}, \mu, z)$, $w(\epsilon, d, \mu, z)$, decision rules $g^p(\epsilon, w_{-1}, \mu, z)$, $g^p(\epsilon, d_{n+1}, \mu, z)$ and $g^t(\epsilon, d, \mu, z)$ and a law of motion for the aggregate state $G(\mu, z, z')$ such that

1. *Optimality*: Given the functions $q(\mu, z)$, $\alpha(\mu, z)$, $w(\epsilon, w_{-1}, \mu, z)$ and $w(\epsilon, d, \mu, z)$, the value functions $J^p(\epsilon, w_{-1}, \mu, z)$, $J^p(\epsilon, d_{n+1}, \mu, z)$, $J^t(\epsilon, d, \mu, z)$, $V^p(\epsilon, w_{-1}, \mu, z)$, $V^p(\epsilon, d_{n+1}, \mu, z)$ and $V^t(\epsilon, d, \mu, z)$ satisfy the Bellman equations.

2. *Free entry:* This condition and the profit maximization condition guarantee that in equilibrium the number of vacancies adjust to eliminate all rents associated to holding a vacancy; that is, $J^0(\mu, z) = 0$, implying

$$c = \beta q(\mu, z) \sum_{z'} \Pi(z'|z) J^t(\epsilon_e, d_1, \mu', z')$$

   for $z = \{z_1, ..., z_n\}$.

3. *Wage bargaining:* The equilibrium conditions from maximizing the surplus are

$$(1-\theta) S^p(\epsilon, w_{-1}, \mu, z) = J^p(\epsilon, w_{-1}, \mu, z) + cf(w_{-1})$$

$$\theta S^p(\epsilon, w_{-1}, \mu, z) = V^p(\epsilon, w_{-1}, \mu, z) - (V^0(\mu, z) + cf(w_{-1}))$$

4. *Rational expectations:* Individual decisions generate a distribution over tomorrow's aggregate state that is equivalent to the distribution implied by $G(\mu, z, z')$.

In this literature it is usual to concentrate only on equilibria where wages do not depend on the unemployment rate. We will follow this practice. Wages will depend on the aggregate shock but they will be independent of the distribution. The fact that such an equilibrium might exists is due to the timing and the assumption of free entry in the creation of vacancies. Wages do not depend on the unemployment rate because this is not the variable of interest for workers, but the rate at which workers find jobs, α. By homogeneity of the matching function, α depends on v/u and on the aggregate state z. But v/u is unknown when bargaining takes place, so that wages will only depend on the aggregate shock. That is, vacancies are not a state variable, they are forward-looking variables, unknown when bargaining is taking place.

The possibility of concentrating in this type of equilibria, in which the variables of interest are independent of the distribution is very useful because we do not need to deal with the aggregate uncertainty introduced in the model[15].

4 Calibration

In this section we explain the procedure we use to assign values to the parameters of the model and the selection of functional forms. The calibration consists on assigning values to parameters such that the model economy is able to replicate certain statistics in the real economy. In practice, most researchers do not use any optimization procedure to guarantee that this occurs. Sometimes, researchers even use estimates from the empirical literature. In this work we use two procedures. For the parameters that have a clear counterpart in the real economy we use the implied values. For the rest, we prefer not to use arbitrary estimations and we use the simulated method of moments. This optimization method consists in finding the values that minimize the distance between the statistics of the model economy and those of the real economy.

[15]For a discussion about the problem of aggregate uncertainty in models with heterogeneous agents see the chapter by Víctor Ríos-Rull in Cooley(1995).

4.1 Model period

We use firm-level data from the survey "Encuesta de Coyuntura Laboral". This is a quarterly data set covering the period 1990-96. The model period must be chosen such that it is consistent with the average duration of unemployment and reasonable from a computation point of view. Hence, we have chosen a quarter.

4.2 Preferences

The utility function is linear in consumption as usual in this literature. The value of the discount factor β is fixed such that it is consistent with the mean annual real interest rate in the reference period, 6%. Therefore, the implied β is 0.985.

4.3 Production technology

The production function is additive in the idiosyncratic and in the aggregate shocks $y(\epsilon, z) = \epsilon + z$.

One of the statistics that we want to approximate is the share of aggregate consumption in output. In the model, aggregate consumption is the output generated by firms plus household production less the costs of offering vacancies in the market. Output in the model economy does not include either a public or a external sector. We assume this value is approximately 0.85. Another statistic that we want to approximate is the wage share. This number is 0.65 in the Spanish economy.

The optimization procedure generates the following values for the two parameters related to these statistics: $c = 0.15$ and $\theta = 0.15$. Previous studies have used values for c in the range $0.2 - 0.3$, not very different from the estimated value here, and the bargaining parameter has been set to 0.5 because of lack of information. Abowd and Lemieux (1993) estimate a value 0.3 for θ.

Aggregate shock parameters

The aggregate shock is modeled as a Markov chain. We assume that the process can just take two values, $\{z_1, z_2\}$, where z_1 is the value in recessions and z_2 the value in expansions. In addition, we assume that the expected duration of expansions and recessions coincide. This implies that $\Pi(z_1|z_2) = \Pi(z_2|z_1)$ and, therefore, it is only necessary to calibrate one parameter in the transition matrix.

To calibrate the aggregate process we use the equivalence between an autorregresive process $AR(1)$ and a first order Markov process. We define a first order Markov process with the same moments that the autorregresive process and use the estimations of the coefficient of correlation, ρ, and the standard deviation of the shock, σ_v, to calibrate the two values of the shock and the parameter in the transition matrix.

To obtain these estimations, we use quarterly GDP per employee in the period 1970-1998. The estimated values are $\rho = 0.76$ y $\sigma_v = 0.006$. These values imply $z_1 = 0.015$, $z_2 = -0.015$ y $\Pi_z(z_1|z_1) = 0.88$.

Transition Matrix for the quality of the match

We assume that the idiosyncratic shock is independent of the aggregate process. This implies $\Gamma[(\epsilon', z')|(\epsilon, z)] = \Pi(z'|z) * \pi(\epsilon'|\epsilon)$. In addition, we assume that there are five possible quality levels. In general, this two assumptions would imply that we need to impose 16 restrictions to fix the values of the conditional transition probabilities between different quality levels.

Given that we do not have direct information on the quality of the match or on tenure, we use Tauchen's procedure[16] to parametrize the five quality match values, as well as the transition probability values. To apply this procedure we need to know the mean, standard deviation and autocorrelation coefficient of the underlying idiosyncratic process. These parameters are obtained in the optimization procedure.

[16]See Tauchen (1986)

4.4 Household production technology

The return to household production represents the value of time for the household when not working in the market. The parameter b could be set such that it is $15-20\%$ of the lowest wage in the economy. Since wages are determined endogenously in the model, we prefer to obtain b from the optimization procedure, instead of imposing any a priori value. The value that results is $b = 0.004$, which is 14% of the lowest wage in the economy.

4.5 Matching technology

The matching function $m = m(v_t, u_t)$ is a Cobb-Douglas homogeneous of degree one function, $m = m(v, u) = A * v^{\eta}(u)^{1-\eta}$. The scale parameter A reflects the degree of mismatch in the economy and η is the value for the elasticity of the number of matches with respect to vacancies.

From the optimization procedure we obtain the following numbers: $\eta = 0.4$ y A=0.2. The value for η is congruent with the estimations in empirical studies in the range $0.4 - 0.6$.

4.6 Firing costs

In the period under study, firing a permanent worker entails a cost of 45 days salary per year worked with a maximum of 42 monthly salaries if the dismissal is declared unfair. To compute the equilibrium we need a firing cost function that depends on previous wage and reflects the average firing cost in the real economy. Bentolila (1997) estimates that 72% of all firing processes are declared unfair and that the average cost is around 1.5 million pesetas.

The firing cost function used to compute the equilibrium is $cf = 3.5w_{-1}$. For instance, firing a permanent worker with seven years tenure will entail 315 days salary. Given that the model period is a quarter, w corresponds to 90 days salary and $3.5w_{-1}$ would be the amount to be paid for 315 days. Assuming that the average monthly wage is around 150.000 pesetas, $3.5w_{-1}$ would imply a total cost of 1.575.000 pesetas, which is approximately the average firing cost.

In sum, the calibration involves the assignment of values to two types of parameters. The discount rate and the parameters of the aggregate process are the only ones that are set independently of the rest since they have clear counterparts in the real economy. The remaining parameters, the transition matrix parameters for the quality of the match, the cost of open a vacancy ce, the elasticity of new matches with respect to the vacancy input η, the scale parameter in the matching function A, workers bargaining power θ and the household production parameter b, are obtained using the method of simulated moments [17].

5 Simulation results

Tables 4, 5 and 6 show simulation results[18]. To compute the model statistics we have generated series of job creation and destruction rates (aggregate and disaggregate by type of contract), temporary employment rates, job conversion rates and wage and consumption shares. Then, we have computed means, standard deviations and the correlations of interest for each of the 50 simulations of 50 periods of length each. And finally, we have computed means and standard deviations of these statistics. Since all variables are stationary, it is not necessary to detrend the series to make the calculations.

Table 4 shows that the model is able to replicate the *means* of job creation and job destruction rates. This is true both, for *aggregate* and *permanent* employment, while it falls short when replicating the rates of *temporary* job creation and job destruction[19]. In addition, the model is able to reproduce the *means* of temporary employment and job conversion rates.

[17]The process is the following. Starting with some initial values, the optimization routine calls a subroutine that computes the equilibrium and the statistics. If the statistics generated by the model are sufficiently close to the real ones, the program ends. Otherwise, the optimization routine modifies the initial parameter values in some direction and calls again the subroutine that computes the equilibrium, and so on.

[18]All the statistics are quaterly.

[19]Note that the model has been calibrated to match job creation rates, both aggregate and disaggregate, the wage share, the consumption share, the correlation between the conversion rate and GDP growth rate, the correlation between the job reallocation rate and GDP growth rate and the correlation between temporary job creation and destruction rates.

Table 4: Means

Statistics	Simulated Model	Spanish Data
Aggregate Job creation rate (JC)	3.72	2.72
Aggregate Job destruction rate (JD)	3.77	3.21
Permanent creation rate (JC^p)	2.25	2.76
Permanent destruction rate (JD^p)	2.19	3.08
Temporary creation rate (JC^t)	8.36	11.9
Temporary destruction rate (JD^t)	8.56	13.1
Temporary employment rate	28.78	30.0
Conversion rate	4.16	3.0
Wage share	70.0	65.0
Consumption share	79.49	85.0

To study the *cyclical behavior* of job creation and job destruction we have used various indicators. First, we have computed *relative standard deviations* of job creation and job destruction, both for *aggregate* and *disaggregate (permanent/temporary)* employment. As Table 5 shows, the model is consistent with the fact that job destruction rates are more volatile than job creation rates for both types of employment. However, the relative volatility of temporary employment is too low and that of permanent employment too high.

Table 5: Relative standard deviations

Statistics	Simulated Model	Spanish data
Rel. std. dev. JD y JC ($\frac{\sigma_{JD}}{\sigma_{JC}}$)	1.61	1.79
Rel. std. dev. JD^p y JC^p ($\frac{\sigma_{JD^p}}{\sigma_{JC^p}}$)	1.4	1.17
Rel. std. dev. JD^t y JC^t ($\frac{\sigma_{JD^t}}{\sigma_{JC^t}}$)	1.3	1.55

The second indicator to look at the *cyclical behavior* of job creation and destruction is the correlation of these rates with net employment rate (NET), an indicator of the cycle. The first two rows in Table 6 show the correlations of *aggregate* job creation and destruction rates with NET. They are quite similar to the observed in the data and confirm the "stylized fact" that the job reallocation process is more intense in recessions than in expansions.

Table 6 also shows the correlations of *permanent* job creation and destruction with the cycle. The correlation of *permanent* job creation must be analyzed with some care. The reason is that there are important differences between the process of *permanent* job creation in this model and in the real economy. First, permanent job creation is only possible via conversion of temporary contracts into permanent jobs, since every job starts as temporary; and second, firms do not have incentives to convert temporary contracts into permanent jobs prior to their expiration (3 years). These two features of the model play against a more procyclical reaction of permanent job creation in response to a positive shock[20].

In any case, it is possible to test the ability of the model to replicate the cyclical behavior of *permanent* job creation by looking at the appropriate statistic, i.e. the *job conversion rate.* Hence, Table 6 also shows the correlation of the job conversion rate (JCconv) with NET. This correlation is, in fact, very close to the observed in the data. Finally, the cyclical behavior of *permanent* job destruction is also consistent.

Regarding the cyclical behavior of *temporary* job creation and destruction, job creation is too procyclical and job destruction is not so countercyclical as in the data. There are two reasons explaining the latter result. First, in the model job conversion implies temporary job destruction; and second, most temporary job destruction happens upon temporary contracts expiration. Both features bias the correlation of *temporary* job destruction downwards. In fact, this correlation improves by substracting from temporary job destruction the component due to job conversion.

Table 6: Correlations with NET

Statistics	Simulated Model	Spanish Data
Correlation (JC,NET)	0.38	0.60
Correlation (JD,NET)	-0.54	-0.89
Correlation (JC^p,NET)	-0.1	0.24
Correlation (JCconv,NET)	-0.09	0.04
Correlation (JD^p,NET)	-0.38	-0.48
Correlation (JC^t, NET)	0.63	0.44
Correlation (JD^t, NET)	-0.34	-0.70

In sum, the model is able to replicate the means and cyclical behavior of job creation and destruction rates both, for *aggregate* and *permanent* employ-

[20] One way to get a procyclical rate of permanent job creation is by allowing workers to search on the job and firms to hire workers directly on a permanent basis. Another way is by incorporating an assumption of the efficiency wage type. These assumptions would be enough to give firms incentives to convert contracts prior to expiration when the quality of the match is above a reservation level.

ment. However, it fails to reproduce the absolute values of the correlations of *temporary* job creation and destruction with the cycle.

6 Effects of a reduction in firing costs

The goal in this section is to quantify the effects of a 40% reduction in the firing costs associated with permanent contracts, i.e. from the mandated 45 days salary per year worked (in the period under consideration) to 25 days salary per year worked.

Tables 7 shows that the effects on the *means* of job creation and destruction rates are negligible. At first sight, this result could seem surprising, since it contradicts one of the main conclusions from the partial equilibrium labor demand literature [21]. According to this literature, one would expect an increase in *permanent* job creation and destruction after a reduction in the firing costs associated with these contracts. However, two features of the model, the wage determination process and the way permanent job creation takes place (job conversion), help shed some light on this result.

Permanent job destruction rates do not increase because neither the opportunity cost of continuing with the match nor the opportunity cost of breaking it changes.

Regarding *permanent job creation*, the behavior of the job conversion rate agrees with the predictions of the above mentioned models. The decrease in the firing costs improves firms's bargaining position, lowering wages and, therefore, increasing the incentives to convert jobs from temporary into permanent. In fact, the job conversion rate increases substantially, from 4% to 6.5%.

The most relevant effects of the reduction in firing costs are (i) a 11.6% reduction in the *temporary employment rate*, from 29% to 25.5% and (ii) a 57% increase in the *job conversion rate* from temporary into permanent contracts, from 4% to 6.5% (see table 7).

[21] See Bentolila and Bertola (1990), Bentolila and Saint-Paul (1994), Bertola (1990, 1992) and Nickell (1978, 1986).

Table 7: Means

Statistics	Model cf high	Model cf low
Aggregate Job creation rate (JC)	3.72	3.55
Aggregate Job destruction rate (JD)	3.77	3.55
Permanent job creation rate (JC^p)	2.25	2.13
Permanent Job destruction rate (JD^p)	2.19	2.04
Temporary job creation rate (JC^t)	8.36	9.07
Temporary job destruction rate (JD^t)	8.56	9.06
Temporary employment rate	28.78	25.45
Conversion rate	4.16	6.53

Table 8 shows The *cyclical behavior* of job creation and destruction rates before and after the reduction in firing costs. *Permanent* employment is more sensible to the cycle after this reduction, while *temporary* job creation and destruction evolve in the opposite way. The reason is clear. Since permanent workers are now easier to fire, firms will try to reallocate when the opportunity cost (in terms of loss output) is lower, that is, in recessions.

Tabla 8: Correlations with net employment rate

Statistics	Model cf high	Model cf low
Correlation (JC, NET)	0.38	0.40
Correlation (JD,NET)	-0.54	-0.51
Correlation (JC^p, NET)	-0.1	-0.04
Correlation (JD^p, NET)	-0.38	-0.45
Correlation (JC^t, NET)	0.63	0.61
Correlation (JD^t, NET)	-0.34	-0.14

Last, this exercise confirms the puzzle presented in the beginning. That is, a high firing cost economy (rigid economy) may offer the same aggregate statistics than a low firing cost economy (flexible economy). The reason is that the reduction in firing costs affects differently the cyclical behavior of permanent and temporary employment (see Table 8). Temporary employment is no longer used as an adjustment mechanism but, instead, is simply used as a screening device. In fact, as we have seen in this exercise, the increase in the job conversion rate from temporary into permanent employment is one of the most significant effects.

7 Conclusions

In this paper we have accomplished two goals. The first was to build a model that is able to replicate the Spanish labor market facts concerning job creation and destruction. The second was to quantify the effects of a reduction in the firing costs associated with permanent contracts.

The motivation of the paper was the surprising similarity between Spanish and US aggregate statistics (job creation and destruction rates), resembling very efficient labor markets, despite the obvious differences in labor protection laws. As shown in Section 6, it is possible that an economy characterized by (i) high firing costs associated to permanent contracts, (ii) segmentation in the labor market, (iii) excessive turnover, (iv) high temporary rates and (v) low job conversion rates from temporary into permanent contracts offers the same aggregate statistics than a flexible economy, characterized by low firing costs. Hence, the countercyclical behavior of the Spanish job reallocation rate cannot be attributed to the existence of negligible firing costs, as argued in most studies when comparing job reallocation rates across US and European labor markets, but to the existence of temporary contracts that have opened a way to circumvent them.

Once the model was able to replicate reasonably well the behavior of Spanish job creation and job destruction rates, we performed a simulation exercise consisting of a 40% reduction in the firing costs associated with permanent contracts. The main effects were a decrease in the temporary employment rate from 29% to %25.5 and an increase in the job conversion rate from 4% to 6.5%. In this flexible economy (low firing costs), temporary employment is no longer used as an adjustment mechanism since permanent employment has become cheaper, but as a screening device. Note that these two effects, the decrease in the temporary rate and the increase in the job conversion rate have important implications for workers productivity, since excessive turnover prevents workers from acquiring firm specific skills.

The most surprising result was the negligible effect on the *permanent* job destruction rate. However, once we take into account the way wages are determined, it is reasonable that permanent job destruction does not increase after the reduction in firing costs. On the other hand, the effects on the *permanent* job creation rate (the job conversion rate in this model) are coherent with the predictions from the partial equilibrium models of labor demand.

Finally, job creation and destruction cyclical behavior changed as expected. Permanent job reallocation became more countercyclical while temporary job reallocation reacted in the opposite way. The fact that permanent employment became cheaper after the reduction in firing costs, made firms reallocate more efficiently. That is, job reallocation was mostly accomplished in recessions, when the opportunity costs, in terms of output losses, was lower.

This model has mainly two limitations. First, it would be desirable to introduce on the job search to get correlations more similar to the observed in the data. For instance, the permanent job reallocation rate and the permanent relative standard deviations in the model are too high. This is because firms are not allowed to hire permanent workers directly and there is no on the job search. These elements would make job creation more procyclical and, as a consequence, the job reallocation rate would be less countercyclical, as in the data. Second, the way wages are determined weakens the effects of the reduction in firing costs on job creation and job destruction .

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