INVESTIGACIONES ECONÓMICAS. vol. XXXIII (2), 2009, 145-178

FLEXIBILITY AT THE MARGIN AND LABOUR MARKET VOLATILITY: THE CASE OF SPAIN

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The Spanish labour market is a prominent case of segmentation with flexibility at the margin (e.g., just affecting fixed-term employees). Flexibility at the margin produces a gap in separation costs between temporary and permanent workers which causes fixed-term contracts to be the main workforce adjustment device. It also leads to a productivity gap, due to high turnover and lack of on-the-job training of temporary employees. To explain the high volatility of the Spanish labour market we develop a matching model with temporary and permanent employees where these gaps play a central role. This model is calibrated and simulated to match the stylised facts and assess the cyclical implications of the 1984 and 1997 labour market reforms.

Keywords: flexibility at the margin, labour market volatility, firing costs, labour productivity, matching.

(*JEL* J23, J24, J41, J63)

1. Introduction

The Spanish labour market displays similar volatility than the Anglo-Saxon labour markets despite their sharp differences in employment protection legislation (see Sala, Silva and Toledo, 2008). This paper contributes to the understanding of this phenomenon by using an extended version of the Diamond-Mortensen-Pissarides matching model (henceforth DMP).[1] Our model involves heterogeneous workers and

We gratefully acknowledge the insightful comments and suggestions received by Manuel Toledo, an anonymous referee and the Editor, Pedro Mira. Héctor Sala is grateful to the Spanish Ministry of Education and Science for financial support through grant SEJ2006-14849/ECON. José I. Silva is grateful to the Generalitat Valenciana for financial support through grant GVPRE/2008/042.

[1] See the seminal contributions by Diamond (1982), Mortensen (1982) and Pissarides (1985), together with Mortensen and Pissarides (1994).

emphasises the role of two gaps between fixed-term and permanent employees: a gap in firing costs, arising directly from the employment protection legislation (EPL), and a productivity gap emerging from high turnover and the lack of on-the-job training for fixed-term employees.

More precisely, our model combines the ones developed in Silva and Toledo (2009) and Sala, Silva and Toledo (2008). Silva and Toledo (2009) extend the DMP model by considering post-match labour turnover costs (training and separation costs), which result in work heterogeneity. This extension comes closer to the data regarding the volatility of vacancies and unemployment, which is Shimer's (2005) critique to the standard DMP model. Along these lines, Silva and Toledo (2008) show that the enhanced volatility induced by separation costs can only take place with heterogeneous workers. Otherwise, the actual US volatility is only reproduced under unrealistic unemployment responses to unemployment benefits, which in turn is Costain and Reiter's (2008) critique to the standard DMP model. In turn, Sala, Silva and Toledo (2008) focus on the gap in separation costs between fixed-term and permanent employees, and explore to what extent it is a centerpiece to explain the high volatility achieved by the segmented OECD labour markets.

In this context the contribution of this paper is threefold. First, the model we present considers *jointly* the above mentioned gaps between fixed-term and permanent employees: the one in productivity, as Silva and Toledo (2009), and the one in firing costs, as Sala, Silva and Toledo (2008). Second, it improves the understanding of the volatility and cyclical properties of key magnitudes of the Spanish labour market through the lens a calibrated version of the DMP model. It does so by considering that: 1) firms face firing costs on fixed-term contracts, but these can be avoided by letting these contracts expire; and 2) by considering the volatility and cyclical properties of the share of fixed-term contracts, which is the highest among the OECD countries. The third contribution of the paper is the assessment of the effects of the 1984 and 1997 labour reforms using our extended DMP framework.

The consequences of the Spanish labour market reforms have been evaluated in several studies such as Alonso-Borrego *et al.* (2006), Dolado *et al.* (2007), Güell (2006), Kugler *et al.* (2003), and Osuna (2005), among others. Even though some, as ours, rely on matching models, all of them take a long-run perspective and evaluate the equilibrium outcomes (for example, in terms of unemployment, some times for specific targeted workers). In contrast, our analysis differs in scope and focuses on business cycle fluctuations.

The cyclical behaviour of the Spanish labour market has been previously examined by two other works. Cabrales and Hopenhayn (1997) evaluate the consequences on job creation and job destruction of introducing fixed-term contracts in a labour demand model calibrated to Spain to approximate the effects of the 1984 labour market reform. They find that firing costs are responsible for lower turnover rates and job reallocation (i.e., lower employment volatility), but have no significant effects on average labour demand. To the extent that the model in Cabrales and Hopenhayn (1997) focuses on firms' decisions and leaves out 1) labour reallocation issues due to mismatch and 2) wage bargaining considerations, it could be considered as complementary to our own analysis. Fonseca and Muñoz (2003) calibrate a matching model to the Spanish economy and use this model to assess the relative contributions of technological shocks (generating movements along the Beveridge curve) and reallocation shocks (shifting it).[2] Their model does not provide a full account of the Beveridge curve dynamics possibly, as they acknowledge, because the segmentation of the Spanish labour market is not taken into account.

The calibration and simulation of our extended DMP model allows us to replicate the cyclical behaviour of the key labour market variables, specially for employment (both temporary and permanent), unemployment and the share of fixed-term contracts, but also for the job finding and job separation rates. The model is also able to reproduce the Beveridge curve and replicate the procyclical behaviour of the share of fixed-term contracts. It falls short, however, in reproducing the standard deviation of vacancies and, thereby, of the labour market tightness. Even though we generally find the gap in labour productivity more influential, both gaps are important to match the actual volatility of the labour market. The role of the gap in firing costs as amplification mechanism cannot be dismissed because of the complementarities generated by the interaction between the two gaps.

These results are achieved in a context of large cyclical fluctuations in unemployment (relative to the DMP model with firing costs and no

[2] The Beveridge curve shows the relationship between unemployment and the job vacancy rate. It usually slopes downwards as a higher rate of unemployment normally occurs with a lower rate of vacancies.

productivity gap) and a small response of unemployment to unemployment benefits. In this way we avoid the problems of the standard DMP model with respect to the amplification mechanisms (Shimer, 2005), as well as the high sensitivity of unemployment to unemployment benefits of many matching models that try to solve the amplification problem (Costain and Reiter, 2008).

Beyond these central results, we also try to gain some insight into the cyclical implications of the 1984 and 1997 labour market reforms, which caused the segmentation of the Spanish labour market (the former), and aimed at reducing the large share of fixed-term contracts given its persistently large magnitude (the latter). Regarding the effects of the 1984 reform, our model rationalises the higher volatility of unemployment through a new workforce adjustment pattern more dependent on separations. In turn, our model is unsuccessful in reproducing the lower volatilities in temporary employment and the share of fixed-term contracts brought by the 1997 reform. This could either be due to the disregard of some important determinants of the cyclical labour market behaviour, or to a possible widening in the productivity gap that would countervail the lower gap in firing costs.

We conclude that it is because of the labour market dualism and the regulated environment where firms operate that workforce adjustments take place very intensively via flexibility at the margin. When this segmentation is suppressed and the labour market converges to a fully regulated scenario, most of the unemployment volatility vanishes. This paper, therefore, provides an evaluation of the effects of two tier reforms and may contribute to the discussion on the mechanisms whereby labour flexibility should be achieved.

The remaining of the paper is structured as follows. Section 2 characterises the Spanish labour market. Section 3 presents the model, which is calibrated and simulated in Section 4. Section 5 assesses the impact of the 1984 and 1997 labour market reforms on the volatility of the labour market. Section 6 concludes.

2. Characterisation of the Spanish labour market

This section characterises the cyclical behaviour of our key variables of interest and presents the gaps in firing costs and productivity. The latter can be related to the high turnover and low on-the-job training of new employees, and takes into account the productivity losses while a position is vacant.

2.1 Some stylised facts

To characterise the Spanish labour market we use data from various sources (see Table 1).[3] We obtain consistent seasonally adjusted time series by using the US Census Bureau's X12 seasonal adjustment program.

Table 2 presents the main stylised facts of the Spanish labour market. The ratio of vacancies to unemployment v/u is procyclical with a standard deviation about 26 times as large as the standard deviation of total output y, 0.010.[4] Another important stylised fact concerns unemployment, which displays a negative correlation with vacancies, -0.363, and a high degree of persistence, 0.887. The $v-u$ ratio moves together with the job finding rate, but with a larger volatility, 0.258 versus 0.128. The separation rate is half as volatile as the job finding rate, 0.061, and, even more important, displays a negative correlation of -0.563 with respect to y. This is an indication of the countercyclical pattern manifested by separations. Further, their correlation with unemployment is 0.700 (versus -0.074 the one of the job finding rate) and -0.324 with vacancies (versus 0.221 the one of the job finding rate). It is also worth noting the higher volatility of the share of temporary contracts (n^T/n) with respect to y (3.6 times), and its positive correlation with y (0.609), vacancies (0.342) and the job finding rate (0.373). Note, also, its negative correlation with unemployment (-0.422) and the job destruction rate (-0.318). This suggests that the increase of temporary jobs in the aftermath of a positive shock is larger than the rise in permanent jobs. Note that fixed-term employment is 3 times more volatile than open-ended employment.

[3] Labour Force Population Survey (*Encuesta de Población Activa, EPA*), Quarterly National Accounts (*Contabilidad Trimestral de España, CTRE*) and OECD Main Economic Indicators (MEI).

[4] The standard deviation is commonly taken as a measure of the shocks affecting a particular variable. For example, the value 0.01 implies that total output is often 1% above or below its trend.

TABLE 1
Data: definitions and sources

	Definitions:	Sources:
u	Seasonally adjusted unemployment	EPA
v	Seasonally adjusted help-wanted advertising index	MEI
v/u	Labour market tightness	
n_T	Seasonally adjusted temporary (dependent) employment	EPA
n_P	Seasonally adjusted permanent (dependent) employment	EPA
n	Aggregate employment ($=n^T+n^P$)	
n^T/n	Share of temporary workers	
f	Job finding rate	EPA*
s	Separation rate	EPA*
w	Real hourly compensation (non-farm business sector)	CTRE
y	Seasonally adjusted GDP	CTRE
y/n	Seasonally adjusted average labour productivity	CTRE

All variables are in logs as deviations from an HP trend (smoothing parameter 1600).
(*) Own calculations based on Shimer (2005) with data from the EPA.

Other noteworthy aspects of the Spanish labour market are the following. First, real wages are acyclical and much less volatile than vacancies, unemployment and labour market tightness.[5] Second, labour productivity (y/n) is correlated negatively with output (-0.252) and positively with the job destruction rate (0.211). Third, the business cycle component of productivity displays a very low standard deviation (0.008) and a negative correlation with v/u (-0.384).

The latter is important because one drawback of the traditional matching literature is the disability to replicate the cyclical behaviour of unemployment and vacancies unless making productivity implausibly volatile. This problem has prompted several extensions of the DMP approach discussed in Hornstein, Krusell and Violante (2005), Mortensen and Nagypal (2007), and Pissarides (2007). The model presented in Section 3 attempts to overcome this drawback for the Spanish case by identifying the gaps in firing costs and productivity between temporary and permanent employees as key amplification mechanisms.

[5] This fact is currently receiving a lot of attention. Following Shimer (2005) this is one of the problems the DMP model faces when replicating the stylised facts. In contrast Mortensen and Nagypal (2007) show that wage fluctuations is not *per se* an important determinant of the response of vacancies and unemployment to shocks.

TABLE 2
Summary statistics. Quarterly Spanish data, 1987-2004

		u	v	v/u	n^P	n^T	f	s	w	y/n	y	n^T/n
St. dv.		0.077	0.220	0.258	0.016	0.052	0.128	0.061	0.007	0.008	0.010	0.036
Autoc.		0.887	0.802	0.834	0.931	0.732	0.466	0.603	0.361	0.396	0.910	0.596
	u	1	-0.363	-0.607	-0.683	-0.614	-0.074	0.700	0.444	0.375	-0.776	-0.422
	v		1	0.959	0.464	0.445	0.221	-0.324	-0.192	-0.315	0.420	0.342
	v/u			1	0.601	0.566	0.218	-0.485	-0.293	-0.384	0.592	0.421
	n^P				1	0.484	0.226	-0.561	-0.228	-0.408	0.778	0.192
	n^T					1	0.401	-0.454	-0.385	-0.216	0.805	0.947
Correl.	f						1	-0.379	-0.143	-0.006	0.417	0.373
matrix	s							1	0.258	0.211	-0.563	-0.318
	w								1	0.110	-0.412	-0.326
	y/n									1	-0.252	-0.074
	y										1	0.609
	n^T/n											1

The first of these gaps is responsible for a segmented labour market in Spain, where a third of the employees hold fixed-term contracts. The average productivity gap also plays an important role because only 10% of the new hired workers become permanent and they are typically subject to high turnover. Since firms have scarce incentives to provide training, temporary employees present a productivity gap with respect to the permanent workers. The empirical significance of these gaps is explored next.

2.2 The gap in firing costs

In spite of the various labour market reforms undertaken in last decades, the overall characterisation of the EPL in Spain is still the traditional one: it is highly restrictive. The OECD (1999a) ranks the strictness of the EPL for 27 countries and places the Spanish labour market in the second position. In turn, the World Bank Doing Business survey provides a detailed study of the EPL in many countries, and estimates the firing cost in 2005 to be equivalent to 56 weeks of weekly wages in Spain (while the OECD mean is 35.1 weeks).[6] Moreover, a difficulty of firing index is placed at 50.0 in Spain (while the OECD average is 27.4).

[6] See http://www.doingbusiness.org and Botero *et al.* (2004) for the methodology.

The gap in firing costs is closely related to the two main elements of the EPL in Spain: the legislation on fixed-term contracts and the legislation on the firing restrictions on permanent contracts. The main outcome of this legislation is that temporary workers have virtually no separation costs, whereas the permanent workers are subject to high firing costs (even after the labour market reforms of the 1990s and early 2000s). Different accounts of the institutional framework of the Spanish labour market and its changes can be found in Dolado *et al.* (2002), Güell and Petrongolo (2007), Kugler *et al.* (2003) and Osuna (2005).

Despite fixed-term contracts were not introduced for the first time in 1984, the limits on their use were virtually abolished in that year and prompted a boom in temporary employment. At that time, non-permanent contracts, less than 10%, were just allowed to very concrete activities (seasonal, like tourism; construction) and the bulk of contracts remained on a permanent basis as before democracy. The subsequent labour market reforms in 1994 and 1997 (and the latter's extensions in 2001 and 2006) constitute several attempts to undo the consequences of the 1984 reform, which can be summarised in one outstanding feature: the appearance of a dual labour market with a flexible low-paid segment and an inflexible segment of permanent workers. Even after all these reforms, temporary workers account for almost a third of the employees, have fixed-term contracts with no separation costs, and represent around 90% of all new hires. From the extensive number of studies on the implications of the upsurge of fixed-term contracts in Spain, Dolado, García-Serrano and Jimeno (2002, p. F272) conclude that Spain quickly converged to a steady-state ratio of temporary workers of about a third.[7] This has negative consequences such as 1) segmentation of the labour market in a two-tier labour relation system (Jimeno and Toharia, 1993); and 2) a reduction in effort and labour productivity (Sánchez and Toharia, 2000).

Summarising, firing costs are, together with the legislation on fixed-term contracts, the main source of the gap in separation costs between temporary and permanent workers.

[7] This steady state is affected by six main determinants of which our model will explicitly consider three: 1) the relative wage of workers under fixed-term or permanent contracts; 2) the gap in firing costs between both type of contracts and 3) the volatility of labour demand along the business cycle. The other three are the elasticity of substitution between both type of workers, the difference in hiring costs and the average growth rate.

2.3 The productivity gap

The institutional set-up is also crucial for the productivity gap between temporary and permanent employees. Because of the fixed-term contract legislation and the stringent regulations concerning permanent workers, in Spain there is a low conversion rate of temporary workers into permanent and, as a consequence, little interest in firm-provided training.[8] Indeed, given the low incidence of on-the-job-training in Spain, we should refer to learning by doing processes instead of referring specifically to training itself. But even the learning by doing is severely limited by the high turnover of temporary employees. Combined with the low conversion rate of the new hires into permanent employees, this implies that temporary workers can hardly overcome the productivity gap.

According to Güell and Petrongolo (2007), the conversion rate from temporary to permanent contracts is only 6%. In turn, firm-provided training is not relevant: the total amount of funds devoted to occupational training was 0.11% of GDP in 2003.[9] With respect to the access of on-the-job training provided by firms, the OECD Employment Outlook (2002) finds that temporary workers in Europe have a lower probability to receive training. For Spain, Albert, García-Serrano and Hernanz (2005) find that: 1) workers with fixed-term contracts are less likely to be employed in firms providing training; 2) to have fixed-term contracts in firms providing training reduces the probability of being chosen to participate in training activities; and 3) the training incidence increases with the educational attainment and with the firm size (non-training firms are generally smaller than training firms). Along this line, Aguirregabiria and Alonso-Borrego (2004) estimate the productivity of a temporary worker to be on average 80% of the productivity of a permanent worker. This is consistent with Sánchez and Toharia's (2000) claim that a higher share of temporary workers reduces effort and productivity, and with Blanchard and

[8] Training fosters productivity (see Dearden *et al.*, 2006), but workers on temporary contracts are less likely to be trained. See OECD (2004) for a detailed study about on-the-job training activities by type of worker.

[9] The OECD (2004) places the total labour market training at 0.22% of GDP in 2002, of which 0.12 percentage points is 'training for unemployed adults and those at risk', and 0.10 percentage points is 'training for employed adults', close to our calculation of 0.11% for 2003. In the OECD (1999b), Spain is shown to be among the countries with the lowest investment in training. The employers' costs for training courses as a share of total labour costs was 1% in 1994, just above Portugal and Italy.

Landier's (2002) argument that entry-level jobs are low productivity jobs.

3. The model

The economy consists of a measure 1 of risk-neutral, infinitely-lived workers and a continuum of risk-neutral, infinitely-lived firms. Workers and firms discount future payoffs at a common rate δ, and capital markets are perfect. In addition, time is discrete.

Workers can be either unemployed or employed. Unemployed workers get b units of the consumption good each period, which could be understood as the value of leisure, home production, and unemployment benefits. There is a time-consuming and costly process of matching unemployed workers and job vacancies. As in den Haan *et al.* (2000), we assume that the matching function takes the following form

$$m(u_t, v_t) = \frac{u_t v_t}{(u_t^{\varphi} + v_t^{\varphi})^{1/\varphi}}, \qquad \varphi > 0, \qquad [1]$$

where u_t denotes the unemployment rate and v_t are vacancies. This constant-return-to-scale (CRS) matching function ensures that the ratios $m(u_t, v_t)/u_t$ and $m(u_t, v_t)/v_t$ lie between 0 and 1. Due to the CRS assumption they only depend on the vacancy-unemployment ratio θ_t. The former represents the probability at which unemployed workers meet jobs, $f(\theta_t) = m(1, \theta_t)$, while the latter denotes the probability at which vacancies meet workers, $q(\theta_t) = m(1/\theta_t, 1)$. From the properties of the matching function, the higher the number of vacancies with respect to the number of unemployed workers, the easier to find a job and the more difficult to fill up vacancies.

Employed workers can either have a temporary (T) or a permanent (P) contract, with wages w_t^T and w_t^P, respectively. Temporary employees are less productive than permanent ones. Unemployed workers become temporary employees when they find a job. At the beginning of each period, a fixed-term contract expires with probability ι. If the contract expires, the firm can either keep the worker under a permanent contract or terminate the relationship at no cost. To some extent this reflects the Spanish legislation (even though the actual termination of fixed-term contracts is not exactly stochastic) and the firms' response to this legislation.

The firms' production technology is based on labour. Each firm consists of only one job which is either filled or vacant. Before a position is filled, the firm has to open a job vacancy with cost c per period. The firm's output depends on aggregate productivity A_t, the match-specific productivity term z_t, and the type of worker. Specifically, a job filled with a permanent contract produces $A_t z_t$, while a job filled with a temporary contract produces $A_t z_t (1 - \xi)$, with $\xi \in (0, 1)$. The parameter ξ represents the average productivity gap between temporary and permanent employees.

The match-specific productivity term z_t is assumed to be independent and identically distributed across firms and time, with a cumulative distribution function $G(z)$ and support $[0, \bar{z}]$. In other words, z moves to some new value independent from the former one, but with the same distribution probability, in response to the idiosyncratic productivity shock. We also assume that $\log A_t$ follows a Markovian stochastic process.

Firms may endogenously terminate employment relationships affecting both permanent and temporary workers. In the first case the cost amounts to γ^P, whereas in the second one the cost is γ^T. These firing costs are assumed to be fully wasted and not a transfer, reflecting some of the firing restrictions imposed by the government.[10] Firms can avoid firing costs for temporary workers by letting the fixed-term contract expire stochastically. The standard practice, in fact, is that firms avoid this firing cost by letting the fixed-term contract expire. Osuna (2005) places at 85% the temporary job destruction due to temporary contracts reaching its maximum length. The model also considers exogenous or workers-initiated separations, which are not subject to firing costs and occur with probability ϕ.

[10] Following the standard assumption in the literature, we do not consider severance payments (note that according to Lazear, 1990, these type of firing costs have neutral effects on the firm surplus and therefore on equilibrium).

To describe the firms' behaviour, the following Bellman equations characterise the value of vacancies, V_t, and the filled positions, $J_t^T(z_t)$ and $J_t^P(z_t)$,[11]

$$V_t = -c + \delta E_t \Bigg[q(\theta_t) \int_{\tilde{z}_{t+1}^I}^{\bar{z}} J_{t+1}^T(z) dG(z) + \\ + (1 - q(\theta_t)(1 - G(\tilde{z}_{t+1}^I)) V_{t+1} \Bigg], \qquad [2]$$

$$J_t^T(z_t) = A_t z_t (1-\xi) - w_t^T(z_t) + \\ +(1-\phi)\delta E_t \Bigg[\iota \left(\int_{\tilde{z}_{t+1}^C}^{\bar{z}} J_{t+1}^P(z) dG(z) + G(\tilde{z}_{t+1}^C) V_{t+1} \right) \\ +(1-\iota) \left(\int_{\tilde{z}_{t+1}^T}^{\bar{z}} J_{t+1}^T(z) dG(z) + G(\tilde{z}_{t+1}^T) \left(V_{t+1} - \gamma^T \right) \right) \Bigg] + \delta\phi E_t V_{t+1}, \qquad [3]$$

$$J_t^P(z_t) = A_t z_t - w_t^P(z_t) + (1-\phi)\delta E_t \Bigg[\int_{\tilde{z}_{t+1}^P}^{\bar{z}} J_{t+1}^P(z) dG(z) + \\ + G(\tilde{z}_{t+1}^P) \left(V_{t+1} - \gamma^P \right) \Bigg] + \delta\phi E_t V_{t+1}, \qquad [4]$$

where E are the expectation operators, which are taken over the distribution of next's periods aggregate productivity and $\tilde{z}^j$ $(j = I, T, C, P)$ are productivity thresholds defined such that nonprofitable matches (i.e., with negative surplus) are severed**.** The conditions defining these thresholds for temporary and permanent job destruction are:

$$J_t^T(\tilde{z}_t^I) - V_t = 0, \qquad [5]$$

$$J_t^T(\tilde{z}_t^T) - V_t + \gamma^T = 0, \qquad [6]$$

$$J_t^P(\tilde{z}_t^C) - V_t = 0, \qquad [7]$$

$$J_t^P(\tilde{z}_t^P) - V_t + \gamma^P = 0. \qquad [8]$$

Condition [5] refers to those unemployed workers who met a vacant job. Note that in this case the firm is not entailed to γ^T in the absence of agreement. Expressions [6] and [8] define the reservation productivity

[11] For expositional reasons, we omit the aggregate state variables $\{A_t, \theta_t\}$ as arguments of these value functions.

for current temporary and permanent workers, respectively. Equation [7] refers to those temporary workers on the verge of becoming permanent. That is, those who were drawn with probability ι. Recall that in this case firms have the option to avoid firing costs because fixed-term contracts have expired. This is in contrast with the model in Sala, Silva and Toledo (2008), where firms are forced to pay γ^T when choosing to avoid the conversion from a fixed-term to an open-ended contract.

It follows that the temporary and permanent employees separate with probabilities

$$\begin{aligned} s_t^T &= \phi + (1-\phi)\left[(1-\iota)G(\widetilde{z}_t^T) + \iota G(\widetilde{z}_t^C)\right], && [9] \\ s_t^P &= \phi + (1-\phi)G(\widetilde{z}_t^P). && [10] \end{aligned}$$

Moreover, job creation takes place with probability $q(\theta_t)(1-G(\widetilde{z}_{t+1}^I))$ when a firm and a worker meet and agree on a contract. Similarly, unemployed workers find a job with probability $f(\theta_t)(1-G(\widetilde{z}_{t+1}^I))$, and temporary employees become permanent with probability $(1-\phi)\iota(1-G(\widetilde{z}_{t+1}^C))$.

At the workers' side the values of the different statuses - unemployed, U_t; temporary employee, $W_t^T(z_t)$; and permanent employee, $W_t^P(z_t)$ - are given by the following expressions:

$$U_t = b + \delta E_t\left[f(\theta_t)\int_{\widetilde{z}_{t+1}^I}^{\bar{z}} W_{t+1}^T(z)dG(z) + (1 - f(\theta_t)(1-G(\widetilde{z}_{t+1}^I))U_{t+1}\right], \quad [11]$$

$$\begin{aligned} W_t^T(z_t) = w_t^T(z_t) + \delta(1-\phi)E_t\Bigg[\iota\left(\int_{\widetilde{z}_{t+1}^C}^{\bar{z}} W_{t+1}^P(z)dG(z) + G(\widetilde{z}_{t+1}^C)U_{t+1}\right) \\ + (1-\iota)\left(\int_{\widetilde{z}_{t+1}^T}^{\bar{z}} W_{t+1}^T(z)dG(z) + G(\widetilde{z}_{t+1}^T)U_{t+1}\right)\Bigg] + \delta\phi E_t U_{t+1}, \end{aligned} \quad [12]$$

$$\begin{aligned} W_t^P(z_t) = w_t^P(z_t) + \delta E_t\Bigg[(1-\phi)\Bigg(\int_{\widetilde{z}_{t+1}^P}^{\bar{z}} W_{t+1}^P(z)dG(z) + \\ + G(\widetilde{z}_{t+1}^P)U_{t+1}\Bigg)\Bigg] + \delta\phi E_t U_{t+1}. \end{aligned} \quad [13]$$

To close the model, we need to add two more assumptions. One is the free entry condition for vacancies: firms will open vacancies until the expected value of doing so becomes zero. Therefore, in equilibrium

$$V_t = 0. \quad [14]$$

The other assumption is that wages are set through Nash bargaining. The Nash solution is the wage that maximises the weighted product of the worker's and firm's net return from the job match. The first-order conditions for the temporary and permanent employees yield:

$$(1-\beta)(W_t^T(z_t) - U_t) = \beta(J_t^T(z_t) - V_t + \gamma^T), \quad [15]$$

$$(1-\beta)(W_t^P(z_t) - U_t) = \beta(J_t^P(z_t) - V_t + \gamma^P), \quad [16]$$

where $\beta \in (0,1)$ denotes the workers' bargaining power relative to firms.

Using [2]-[16], we can now solve for the equilibrium wages,

$$\begin{aligned} w_t^T(z_t) &= (1-\beta)b + \beta\theta_t c + \beta A_t z_t(1-\xi) + \\ &+ \left[\delta f(\theta_t)(1 - G(\tilde{z}_{t+1}^I)) + 1 - (1-\iota)(1-\phi)\delta\right]\beta\gamma^T \\ &-(1-\phi)\iota(1 - G(\tilde{z}_{t+1}^C))\delta\beta\gamma^P, \end{aligned} \quad [17]$$

$$\begin{aligned} w_t^P(z_t) &= (1-\beta)b + \beta\theta_t c + \beta A_t z_t + \delta f(\theta_t)\left(1 - G(\tilde{z}_{t+1}^I)\right)\beta\gamma^T + \\ &+ \left[1 - (1-\phi)\delta\right]\beta\gamma^P. \end{aligned} \quad [18]$$

Because temporary workers are less productive than permanent ones, note that the match surplus for the firm, and thereby their wage (w_t^T), is reduced by a fraction of the average labour productivity gap ξ. Furthermore, temporary employees become permanent with some probability $(1-\phi)\iota(1 - G(\tilde{z}_{t+1}^C))$, in which case firms become liable to the firing costs associated to open-ended contracts, γ^P. Firms perceive these costs as an expected loss reducing the expected match surplus, which explains the negative effect of γ^P on the temporary wage. The wage of a permanent employee (w_t^P) is higher because she is more productive, and is further increased because γ^P becomes operational by rising the bargaining power of permanent workers. In turn, γ^T increases not only the permanent worker's wage but also the temporary's one. The reason is that these costs are also operational at the entry-level jobs, and thereby raise the implicit bargaining power of the temporary employees.

Summing up, two gaps, in terms of productivity and firing costs, account for the differences across workers by type of contract (or status) and accommodate the main features of a segmented labour market such as the Spanish one. It is important to note that removal of these gaps ($\gamma^T = \gamma^P = \gamma$ and $\xi = 0$) implies 1) the irrelevance of the conversion rate from fixed-term to open-ended contracts ι, 2) equal wages ($w^T = w^P$) and, therefore, 3) convergence to a single-job model.

To fully characterise the dynamics of this economy, we need to define the law of motion for unemployment and the mass of temporary and permanent workers (u_t, n_t^T and n_t^P, respectively). These evolve according to the following difference equations:

$$\begin{aligned} u_t &= u_{t-1} + s_t^T n_{t-1}^T + s_t^P n_{t-1}^P - f(\theta_{t-1})(1 - G(\tilde{z}_t^I))u_{t-1}, && [19] \\ n_t^T &= n_{t-1}^T + f(\theta_{t-1})(1 - G(\tilde{z}_t^I))u_{t-1} - s_t^T n_{t-1}^T - \\ &\quad -(1-\phi)\iota(1 - G(\tilde{z}_t^C))n_{t-1}^T, && [20] \\ n_t^P &= n_{t-1}^P + (1-\phi)\iota(1 - G(\tilde{z}_t^C))n_{t-1}^T - s_t^P n_{t-1}^P, && [21] \\ 1 &= u_t + n_t^T + n_t^P. && [22] \end{aligned}$$

Finally, we define the average separation probability as

$$s_t = \frac{s_t^T n_{t-1}^T + s_t^P n_{t-1}^P}{n_{t-1}}. \quad [23]$$

4. Calibration and simulation

In this Section we calibrate the model at quarterly frequencies from 1987 to 1996. This period is consistent with the Spanish economy between the 1984 and 1997 labour market reforms, whose impact is assessed below. Our parameterisation matches six targets, which are summarised in the upper part of Table 3.

The first one consist of the average unemployment rate, 20.0%. Thus, we set $u^* = 0.200$. The other five are taken from other studies, all related to the Spanish economy. First, we take a conversion rate from fixed-term to permanent contracts of 6%, in accordance with Güell and Petrongolo (2007). Thus, $conv^* = 0.060$. Second, based on Castillo, Jimeno and Licandro (1998), we target the elasticity of the matching function with respect to unemployment in the steady state $\varepsilon^*_{m,u} = 0.85$. Third and four, following Polavieja (2003) and Arranz, García-Serrano and Toharia (2005), we set the job tenure of temporary and permanent workers at 6 months and 10 years, respectively, so that $s^{*T} = 0.500$ and $s^{*P} = 0.025$.[12] Fifth, following Costain and Reiter (2008), we calibrate the model preventing an excessive sensitivity of unemployment duration to unemployment benefits in the steady state $\eta^{*}_{f,b}$. This elasticity is placed between 1.55 and 1.84 for Spain in Addison, Centeno and Portugal (2004). We set $\eta^{*}_{f,b} = 1.84$.

4.1 Calibrated parameters

We calibrate the model in the steady state with the following parameters, displayed in the second part of Table 3.

We set the discount factor $\delta = 0.99$, which implies a reasonable quarterly interest rate of nearly 1 percent. A^* is the mean aggregate labour productivity, which we normalise to 1. We assume that $\log A_t$ follows a first-order autoregressive process of the form

$$\log A_t = \rho \log A_{t-1} + \epsilon_t,$$

where ϵ_t is an i.i.d. $N(0, \sigma_\epsilon)$ random variable. The parameters of the AR(1) process, the autoregressive coefficient ρ and the standard deviation of the white noise process σ_ϵ, are calibrated to approximate the cyclical volatility and persistence of the Spanish total output y_t between 1987 and 1996.[13].

Next we turn to the gaps in firing costs $(\gamma^P - \gamma^T)$ and labour productivity (ξ). Following Osuna (2005), firing a permanent worker in Spain with a 10-year tenure amounts to 440 days of salary, which is equivalent to 4.82 quarterly wages.[14] These costs account for total severance payments received by the worker when becoming unemployed. In turn, Garibaldi and Violante (2005) place the ratio of firing tax over severance payments between 0.52 (when worker and firm reach

[12] To map the average duration of an event X to its probability level p, we assume that X is a geometrically distributed random variable with expected duration of $1/p$ periods.

[13] Total output y_t is equal to $y_t = A_t \bar{z}^P_t n^P_t + A_t \bar{z}^T_t (1-\xi) n^T_t - cv_t + bu_t$, where $\bar{z}^j = E[z | z \geq \tilde{z}^j]$. Thus, we set $\rho = 0.99$ and $\sigma_\epsilon = 0.014$

[14] More in detail, to estimate the total severance payments we use the following information from Osuna (2005): 1) 20 days of wages per year of seniority for legal indemnities in fair dismissals with a maximum of 12 monthly wages; 2) 45 days of wages per year of seniority for unfair dismissals with a maximum of 42 monthly wages dismissals; 3) mean tenure of around 10 years; 4) procedural wages of around two monthly wages; and 5) the fact that 72% of all firing processes were declared unfair in 1996. Thus, the calculation is: 0.72×10 years×45 days per year + 0.28×10 years×20 days per year + 60 days =440 days.

no off-court agreement) and 0.24 (when there is a 50% probability of reaching such agreement). We consider the most conservative of these scenarious and set this ratio at 0.24. Thus, the firing tax component of permanent jobs amounts to $\gamma^P = 4.82 \times w^{*P} \times 0.24 = 1.16 \times w^{*P}$.

The firing costs on temporary contracts reflect a legal feature of the Spanish legislation. The duration of these contracts is limited to a minimum of six months, and may be extended by periods of at least six months until a total maximum of three years. If the contract is terminated before its agreed-upon time, the firm has to pay 12 days per year of seniority (or the proportional amount for shorter periods) and there are no court or regulatory procedures involved. Thus, severance payments of a temporary worker in Spain with a six months tenure amounts to 6 days of salary, which is equivalent to 0.07 quarterly wages. Consequently, the firing tax component amounts to $\gamma^T = 0.07 \times w^{*T} \times 0.24 = 0.02 \times w^{*T}$, even though firms can avoid γ^T by not renewing the temporary contract when it expires. Recall that this happens with probability ι.

TABLE 3
Calibration. Spain, 1987-1996

		Value	Source
Targets:			
Mean unemployment rate	u^*	0.200	[A]
Mean employment conversion rate	$conv^*$	0.060	[B]
Mean matching function elasticity with respect to u	$\varepsilon^*_{m,u}$	0.850	[B]
Mean separation probability of temporary jobs	s^{*T}	0.500	[B]
Mean separation probability of permanent jobs	s^{*P}	0.025	[B]
Mean elasticity of unemployment duration to unemployment benefits	$\eta^*_{f,b}$	1.840	[B]
Long-run parameters:			
Mean aggregate labour productivity	A^*	1.000	Normalised
Standard deviation of productivity shock	σ_ε	0.014	[C]
Persistence of aggregate productivity shock	ρ	0.990	[C]
Mean of log z	μ	0.000	Normalised
Standard deviation of log z	σ_z	0.200	[E]
Discount rate	δ	0.990	[A]
Exogenous separation probability	ϕ	0.025	[D]
Employment opportunity cost parameter	b	0.831	[D]
Cost of vacancy	c	0.019	[D]
Parameter of the Matching function	φ	3.122	[D]
Worker's bargaining power	β	0.716	[D]
Temporary separation costs	γ^T	0.017	[A]
Permanent separation costs	γ^P	1.193	[A]
Productivity gap	ξ	0.200	[B]
Contract conversion probability	ι	0.453	[D]

Note: [A] Own calculation based on original data;
[B] Other studies;
[C] Calibrated to match persistence and volatility of total output y_t;
[D] Calibrated to match the targets in steady state;
[E] Own assumption.

As noted, Aguirregabiria and Alonso-Borrego (2004) estimate the average productivity of a temporary worker in Spain to be on average 80% of the productivity of a permanent worker. Accordingly, we consider an average productivity gap of 20% and set $\xi = 0.20$. Following the standard assumption in the literature (see, for example, den Haan *et al.*, 2000), the idiosyncratic productivity z_t is assumed to be log-normally distributed with mean (μ) and standard deviation (σ_z) whose values are fixed, respectively, at 0 and 0.20.

The hiring cost c, the exogenous separation probability ϕ, the conversion contract probability ι, the matching technology parameter φ, the workers' bargaining power β, and the employment opportunity cost b are calibrated by solving the following system of steady-state equations,

$$
\begin{aligned}
\phi + (1-\phi)\left[(1-\iota)G\left(\widetilde{z}^{*T}(\Psi)\right) + \iota G\left(\widetilde{z}^{*C}(\Psi)\right)\right] &= s^{*T}, \\
\phi + (1-\phi)G\left(\widetilde{z}^{*P}(\Psi)\right) &= s^{*P}, \\
(1-\phi)\iota(1-G\left(\widetilde{z}^{*C}(\Psi)\right)) &= conv^{*}, \\
\frac{s^{*T}n^{*T}(\Psi) + s^{*P}n^{*P}(\Psi)}{f(\theta^{*}(\Psi);\varphi)(1-G(\widetilde{z}^{*I}(\Psi)))} &= u^{*}, \\
\theta^{*}(\Psi)^{\varphi}/(1+\theta^{*}(\Psi)^{\varphi}) &= \varepsilon^{*}_{m,u}, \\
\eta_{f(\theta^{*}(\Psi);\varphi),b}(\Psi) &= \eta^{*}_{f,b},
\end{aligned}
$$

where $\Psi = \{c, \phi, \iota, \varphi, \beta, b\}$ is the vector of calibrated parameters. Note that n^{*T}, n^{*P} and θ^{*}, and thresholds $\widetilde{z}^{*I}$, $\widetilde{z}^{*T}$, $\widetilde{z}^{*C}$ and $\widetilde{z}^{*P}$, correspond to the steady-state equilibrium solution. Clearly this solution depends on Ψ, which we explicitly state for expositional purposes. The first two of these equations arise from expressions [9] and [10]. The third one reflects the job conversion probability from temporary to permanent jobs. The fourth one comes from the law of motion of unemployment given by equation [19]. The fifth one is the elasticity of the matching function with respect to unemployment. The last equation is the elasticity of unemployment duration with respect to unemployment benefits, which does not have a closed form representation. Solving this system of equations yields $c = 0.019$, $\phi = 0.025$, $\iota = 0.453$, $\varphi = 3.122$, $\beta = 0.716$, and $b = 0.831$.

The calibrated share of temporary workers amounts to 0.294 in the steady state (see Table 5), which is very close to its actual mean of

0.301. Note also that $\phi = 0.025$ entails almost full exogeneity of s^{*P}.[15] The analytical reason for this is the high level of firing costs in permanent contracts and the resulting lack of incentives for laying off this type of workers. It is important to note that this result does not rule out the possibility of endogenous destruction in open-ended jobs. However, a huge productivity fall relative to its steady state level would be required. Moreover this result is empirically in line with the acyclical behaviour of the job destruction rate in permanent contracts, which is documented in Garibaldi (1998) for some European countries with strict EPL. For Spain the correlations between the cyclical components of the following series 1) total short-run unemployed (less than three months); 2) short-run unemployed whose previous situation was a temporary job, and 3) short-run unemployed whose previous situation was a permanent job, give some promising evidence that this should also be the case. The correlation coefficient between 1) and 2) is highly significant and equal to 0.93, while the one between 1) and 3) amounts to 0.25 and is not significant.[16].

This plausible picture is reinforced by other calibrated parameters. For example, a value of $c = 0.019$ implies that hiring costs represent 2.0% of the wage of new hired workers ($w^* = 0.973$, see Table 5), not distant to the value given in Silva and Toledo (2009) for the US, which is a 3.6% of the quarterly labour cost per full productive worker. Similarly, $b = 0.831$ implies that the employment opportunity cost amounts to 85.4% of the wage. This parameter includes home production, leisure activities, and the unemployment benefits replacement rate which, according to Nickell and Nunziata (2001), was 0.68 on average in Spain between 1988 and 1995.

4.2 Simulated results

This section provides the base-run simulation of the paper (in Table 5) with a twofold objective: 1) to show that the model is able to match the key characteristics of the Spanish labour market in 1987-1996 (dis-

[15] In fact, $\phi = 0.02499$ and, according to equation [10], the steady state endogenous job destruction probability of permanent contracts is $G(\widetilde{z}^{*P}) = 0.0001$. As noted before, we associate ϕ with worker-initiated separations (such as, for example, transitory leaves or retirement).

[16] These correlations are obtained from quarterly data taken from the Spanish LFS (EPA) filtered as explained in Table 1 to obtain the cyclical components of the series. The sample period is restricted to 1996-2004 because such detailed information is unavailable for previous years.

played in Table 4); and 2) to provide a benchmark case against which, in Section 5, we will compare two different scenarious, the one previous to the 1984 labour market reform and the one in the aftermath of the 1997 reform.

4.2.1 Extended DMP model (gaps in firing costs and labour productivity)

Table 5 shows the simulated results, which should be compared with the actual figures, displayed in Table 4. Note that the top of the table presents the steady state values of the relevant variables. These values are re-calibrated for each subsequent simulation (Tables 6, 9 and 11).

TABLE 4
Summary statistics. Quarterly Spanish data, 1987-1996

		u	v	v/u	n^T	n^P	n^T/n	f	s	w	y/n	y
St. dv.		0.077	0.218	0.277	0.071	0.019	0.050	0.133	0.052	0.009	0.010	0.013
Autoc.		0.951	0.788	0.856	0.729	0.932	0.590	0.637	0.625	0.298	0.424	0.803
	u	1	-0.722	-0.845	-0.780	-0.833	-0.582	-0.339	0.683	0.471	0.536	-0.944
	v		1	0.979	0.639	0.657	0.517	0.294	-0.619	-0.358	-0.341	0.692
	v/u			1	0.720	0.747	0.571	0.327	-0.673	-0.408	-0.421	0.806
	n^T				1	0.518	0.959	0.538	-0.686	-0.415	-0.242	0.863
	n^P					1	0.269	0.188	-0.660	-0.238	-0.521	0.758
	n^T/n						1	0.541	-0.569	-0.364	-0.084	0.709
Correl.	f							1	-0.500	-0.155	0.091	0.526
matrix	s								1	0.260	0.193	-0.745
	w									1	0.111	-0.462
	y/n										1	-0.338
	y											1

TABLE 5
Simulated results for the extended DMP model. 1987-1996
$(\xi=0.20;\gamma^T=0.020\times w^{*T};\gamma^P=1.16\times w^{*P})$

		u	v	v/u	n^T	n^P	n^T/n	f	s	w	y/n	y
St. stt.		0.200	0.349	1.747	0.235	0.565	0.294	0.666	0.165	0.973	1.173	0.938
St. dv.		0.096	0.108	0.200	0.075	0.016	0.054	0.108	0.037	0.012	0.012	0.013
Autoc.		0.763	0.698	0.721	0.726	0.965	0.744	0.817	0.020	0.741	0.787	0.741
	u	1	-0.925	-0.979	-0.886	-0.419	-0.771	-0.981	0.551	-0.997	0.997	-0.998
	v		1	0.983	0.995	0.045	0.954	0.947	-0.497	0.953	-0.894	0.949
	v/u			1	0.961	0.206	0.884	0.981	-0.533	0.992	-0.961	0.991
	n^T				1	-0.050	0.979	0.925	-0.432	0.921	-0.849	0.915
	n^P					1	-0.255	0.301	-0.342	0.344	-0.485	0.358
	n^T/n						1	0.833	-0.347	0.820	-0.722	0.812
Correl.	f							1	-0.399	0.985	-0.972	0.984
matrix	s								1	-0.551	0.542	-0.557
	w									1	-0.987	0.999
	y/n										1	-0.989
	y											1

The simulated results show a fairly correct match of several key labour market characteristics. The standard deviations of employment, both temporary (n^T) and permanent (n^P), are 0.075 and 0.016, very close, respectively, to their actual values of 0.071 and 0.019. The volatility of the temporary share (n^T/n) is 0.054, also near the actual one, 0.050. The standard deviations of the average wage (w) and labour productivity (y/n) are both equal to 0.012 and almost match the actual ones (0.009 and 0.010, respectively). The standard deviation of unemployment (u) is 0.096, somewhat above the actual 0.077, and both the volatilities of the job finding and job destruction probabilities reproduce, respectively, 81% and 71% of their observed values. The results also show a large negative correlation between u and vacancies (v), and reproduce the procyclical behaviour of the share of temporary jobs. In particular, the simulated correlation between total output (y) and n^T/n is 0.812, similar to the actual 0.709. Note that by predicting an almost perfect negative correlation between y/n and y, -0.989, the model reproduces the countercyclical behaviour of labour productivity.

These simulations, however, perform somewhat off-target in terms of the standard deviation of v, which attains 0.108 below the actual 0.218, and causes the volatility of the labour market tightness (v/u) to be 0.200, 72% of its actual one (0.277). Note, too, that only the autocorrelations of n^T and n^P approach the actual ones.

Summing up, our benchmark model is able to reproduce more than 70% of the observed volatility in the Spanish labour market between 1987 and 1996. This is an important result because it shows that the extension of the standard DMP model with the gaps in firing costs and labour productivity generates sufficiently large cyclical fluctuations in the key Spanish labour market variables.

4.2.2 Restricted model (no firing costs and no gap in labour productivity)

Next we simulate the model in the absence of firing costs and no gap in labour productivity, which implies setting γ^P, γ^T and ξ equal to zero. This simulation takes into account the changes experienced by the economy in terms of the steady-state values of the relevant variables, which are adjusted in accordance with their actual changes: 1) more vacancies (v), because the surplus of temporary jobs increases with the lower gaps in firing costs and productivity; 2) lower unemployment (u), because a) it is easier for workers to find a job (f increases) and b) a lower proportion of jobs are destroyed (s decreases); and 3) higher wages (w) and total output (y). The results of this exercise are displayed in Table 6.

TABLE 6
Simulated results for the restricted model (no gaps). 1987-1996
(ξ=0.00;γ^T=0.00;γ^P=0.00)

	u	v	v/u	n	f	s	w	y/n	y
Steady state	0.107	0.410	3.819	0.893	0.909	0.109	1.041	1.142	1.019
Standard deviation	0.181	0.095	0.086	0.022	0.023	0.179	0.013	0.006	0.016
Autocorrelation	0.716	0.711	0.721	0.716	0.745	0.721	0.721	0.706	0.719
Correlation with y	-1.000	-0.999	1.000	1.000	1.000	-0.999	1.000	-0.999	1.000

The first important result is the enhanced cyclical behaviour of the key labour market variables, which manifests through a substantial increase in their (now perfect) correlation with total output. A second important result is the collapse of the Beveridge curve. In the absence of postmatch labour turnover costs, the correlation between vacancies and unemployment becomes highly positive, 0.999, because job destruction becomes much more sensitive than job creation. Thus, when a positive productivity shock hits the economy, firms react by laying off fewer workers, which reduces unemployment and, the recruiting needs being smaller, by posting less vacancies.

Regarding the labour market volatilities, the main results are the enhanced volatility of job destruction (from 0.037 to 0.179), the lower one of vacancies (from 0.108 to 0.095), and the resulting rise in the volatility of the unemployment rate (from 0.096 to 0.181). These findings are along the ones in Sala, Silva and Toledo (2008) for the OECD countries.

The intuition behind the negative relationship between the gaps (in labour productivity and firing costs) and the job destruction volatility is simple. Higher firing costs in permanent jobs and lower productivity in temporary positions rise the layoff cost of a fully-trained permanent worker. Their position is thus secured and firms focus the job turnover process on the temporary positions. This reduces the volatility of the average job destruction rate. In turn, the positive relationship between these gaps and the volatility of vacancies takes place because of the lower surplus induced by these gaps in temporary positions. The reason for this lower surplus is twofold: 1) temporary workers are less productive, and 2) job conversion from temporary to permanent contracts is more costly to firms due to the presence of higher firing costs in permanent jobs. And the consequence is that the firms' surplus associated to a temporary position becomes more responsive to variations in the level of the aggregate labour productivity. This generates a greater response in the job creation margin and, therefore, in the vacancy rate. In turn, the unemployment volatility increases if the higher volatility of the job destruction rate dominates the lower one in the vacancy rate.

4.2.3 Sensitivity analysis (to the gaps in firing costs and labour productivity)

As noted before, the higher volatility of the job destruction rate in the fully deregulated scenario is explained not only by the absence of firing costs and the subsequent lower separation costs (see Table 7, fourth row), but also by the absence of the labour productivity gap ($\xi = 0$). This can be observed by focusing on the intermediate scenario presented in the last row of Table 7. In the absence of firing costs ($\gamma^P = \gamma^T = 0.00$), but with the temporary workers' productivity at 80% of the permanents' one ($\xi = 0.20$), the standard deviation of s becomes very low (0.021). This is largely explained by the fall in the share of temporary workers (from 29% to 5%). In other words, in the absence of firing costs, firms have the incentive to offer permanent contracts and provide on-the-job training to their employees in order to avoid low productivity jobs and, therefore, high labour turnover in entry-level jobs. The conversion rate from temporary to permanent jobs in this case jumps from 6% to 44%.

TABLE 7
Short-run effects of the gaps. Standard deviations

	v/u	u	v	f	s
Actual volatility (table 4):	0.277	0.077	0.218	0.133	0.052
Volatility with gaps (table 5, ξ=0.20;γ^P=1.16w^{*P};γ^T=0.017w^{*T}):	0.200	0.096	0.108	0.108	0.037
Volatility without gaps (table 6, ξ=0.00;γ^P=0.00;γ^T=0.00):	0.086	0.181	0.095	0.023	0.179
Volatility without productivity gap (ξ=0.00;γ^P=1.16w^{*P};γ^T=0.02w^{*T}):	0.090	0.035	0.055	0.041	0.019
Volatility without firing costs gap (ξ=0.20;γ^P=0.00;γ^T=0.00):	0.102	0.042	0.060	0.023	0.021

Finally, it is interesting to know the relative role played by each gap in enhancing the volatility of the labour market. The productivity gap allows the volatility of v/u to increase from 0.086 to 0.102 (by around 20%), while the gap in firing costs allows a small rise, from 0.086 to 0.090. This difference originates when matching the unemployment rate behaviour (both gaps play the same role when vacancies are matched). The joint effect of the two gaps makes this volatility jump from 0.086 to 0.200, which is just above the sum of the two effects (0.192). Therefore, even if the contribution of the productivity gap is clearly more important, the gap in firing costs cannot be neglected due to the complementarities arising from the interaction between the two. As shown in Table 7, these complementarities originate when matching the cyclical behaviour of both unemployment and (to a lesser extent) vacancies.

Regarding the cyclical variation of the job finding rate (f), it is worth noting 1) the smaller contribution of the productivity gap (which is larger when explaining the job separation rate, s) and, specially, 2) the strong complementarities among the two gaps: their joint effect (0.108) explain near twice the volatility of their individual effects (0.064), and allow a good match of the actual figure (0.133).

5. Assessing the effects of the 1984 and 1997 reforms

5.1 The 1984 reform: firing costs in entry-level jobs

Spain witnessed a large increase in the volatility of unemployment in the aftermath of the 1984 reform. This reform enhanced the use of fixed-term jobs, whose share grew rapidly to about a third of total dependent employment.[17] Since our model considers the possibility of firing costs in entry-level jobs (γ^T), it allows an evaluation of the effects of the 1984 Spanish labour market reform on the volatility of vacancies, unemployment and labour market tightness. We interpret the introduction of temporary contracts and, thus, the possibility of hiring new workers not liable to dismissal costs, as a reform effectively lowering γ^T.

Table 8 presents some key observed volatilities for years 1980-1984. Note that the volatility of u was 0.039, which implies it doubled after the 1984 reform (to 0.077), while the volatility of v was 0.211 and remained virtually unchanged (0.218 after the reform).

[17] Detailed accounts of the changes brought by the 1984 labour market reform and the subsequent *counterreforms* are already available in the literature (see, among others, Dolado *et al.*, 2002; Güell and Petrongolo, 2007; Kugler *et al.*, 2003; and Osuna, 2005).

TABLE 8
Summary statistics. Quarterly Spanish data, 1980-1984

	u	v	v/u	n	f	s	y/n	y
Standard deviation	0.039	0.211	0.222	0.015	na	na	0.009	0.009
Autocorrelation	0.785	0.648	0.618	0.896	na	na	0.380	0.840
Correlation with y	-0.843	0.063	0.209	0.864	na	na	-0.040	1.000

The objective of next exercise is, primarily, of a qualitative nature: Is our model able to reproduce the direction of the changes in these volatilities? Provided this is the case, we further attempt to proxy the quantitative impact of the 1984 labour market reform.

It is well known that this reform entailed the transition from a one-tier to a two-tier labour relation system. Accordingly, we revert this dualism by restricting the model so that the gaps in post match labour turnover costs, needed to match the labour market volatility in the post-reform period, do not play any role. This implies that we evaluate the consequences of adopting, today, the main aspect of the EPL in those years which was the high level of firing costs for virtually all workers (90% had permanent contracts). We thus restrict the model so that $\gamma^T = \gamma^P = 1.16 \times w^*$, which implies no incentives for firms to use fixed-term contracts. Our second assumption is to set $\iota = 0$, since the conversion probability from temporary to permanent contracts is now irrelevant. Under homogeneity in both sides of the labour market, the productivity gap also becomes irrelevant and we can safely set $\xi = 0$. This is our third assumption. Note that according to these assumptions equation [17] converges to [18], so that there is only one type of wage. The results of the resulting simulated model are presented in Table 9.

Note that in the absence of the 1984 labour market reform the volatilities of u, v and s would have been 0.023, 0.181 and 0.000, instead of our benchmark predictions of 0.096, 0.108 and 0.037 for the post reform period (Table 5). Thus, according to our analysis, the volatility of unemployment and job destruction increased after the reform, while the volatility of vacancies declined. This can be explained as follows. Under stringent EPL and no temporary contracts, job destruction becomes less volatile because it is too expensive to layoff workers. Thus, separations only take place when workers decide to leave the firm which happens with an exogenous probability of $s = \phi = 0.025$. In this case firms do not incur in firing costs and, therefore, there is no variation in the job destruction rate ($std(s) = 0.000$). In contrast vacancies become more volatile, because workforce adjustment only takes place through the job creation margin. Overall the reduction in the unemployment volatility is driven by the lower volatility in job destruction.

TABLE 9
Simulated results by reversing the 1984 reform
(ξ=0.00;γ^T=1.16×w*;γ^P=1.16×w*)

	u	v	v/u	n	f	s	w	y/n	y
Steady state	0.413	0.567	1.375	0.587	0.036	0.025	1.046	1.585	0.931
Standard deviation	0.023	0.181	0.186	0.016	0.173	0.000	0.020	0.015	0.010
Autocorrelation	0.964	0.711	0.721	0.964	0.820	0.000	0.750	0.880	0.752
Correlation with y	-0.468	0.946	0.979	0.468	0.976	0.000	0.981	0.189	1.000

The conclusion we derive is that our model is helpful in explaining the direction of the change in unemployment in response to policy changes introducing the possibility of hiring new workers not liable to dismissal costs (which is equivalent to a reduction of firing costs in entry-level jobs). In particular, the segmentation of the labour market brought by the 1984 reform, still unresolved by subsequent reforms, can be considered the main reason why the volatility of the Spanish unemployment rate increased considerably since the middle of the 1980s. Our simulations, however, are unable to reproduce the observed cyclical behaviour in the standard deviation of vacancies. Finally, comparison of the results shown in Tables 5, 6, and 9 yield the conclusion that the actual scenario of limited flexibility in the use of temporary contracts and high firing costs on permanent jobs is just an intermediate situation, in terms of unemployment volatility, between a fully regulated and a fully deregulated labour market.

It is also interesting to observe the change in the cyclical pattern of the job separation rate (s). In the aftermath of the 1984 reform its observed correlation with GDP (y) was -0.745 (Table 4), and its pattern clearly countercyclical (our extended DMP model matches this negative correlation with a simulated value of -0.557). When this reform is reversed, however, the absence of correlation (Table 9) denotes a pure acyclical behaviour. This result has been recently rationalised in Messina and Vallanti (2007), who find the labour flows in Continental Europe largely acyclical, but also point out that flexibility at the margin may revert the acyclical behaviour of the job separation rate.

5.2 The 1997 reform: lower gap in firing costs

Given the large share of fixed-term contracts, the government undertook a series of *counterreforms* in 1994 and 1997 (the latter amended and extended in 2001 and 2006), which aimed at reducing this share. From the point of view of our analysis, the most important change took place in 1997 when a *permanent employment promotion contract* was introduced to foster stable employment. It was subsidised and entailed lower firing costs than the previous regular open-ended contract (33 days of wages per year of seniority, with a maximum of 24 monthly wages, rather than 45 days of wages per year of seniority with a maximum of 42 monthly wages in case of unfair dismissal).

Table 10 characterises the labour market in the aftermath of the 1997 reform and reveals three main changes with respect to 1987-1996 (Table 4). First, the persistence in u, v and v/u fell substantially. Second, the correlation between u and v decreased significantly, from -0.722 to -0.001. Third, while the volatility of u and v remained almost unchanged, the volatility of n_T and n^T/n decreased from 0.071 and 0.050, to 0.012 and 0.007, respectively.

TABLE 10
Summary statistics. Quarterly Spanish data, 1997-2004

		u	v	v/u	n^T	n^P	n^T/n	f	s	w	y/n	y
St. dv.		0.082	0.226	0.240	0.012	0.012	0.007	0.130	0.075	0.005	0.005	0.007
Autoc.		0.805	0.769	0.763	0.708	0.856	0.382	0.230	0.585	0.575	0.375	0.889
	u	1	-0.001	-0.337	-0.518	-0.475	-0.073	0.249	0.732	0.485	0.102	-0.547
	v		1	0.940	0.113	0.182	-0.066	0.133	-0.099	0.089	-0.385	0.063
	v/u			1	0.284	0.333	-0.034	0.053	-0.344	-0.075	-0.400	0.247
	n^T				1	0.604	0.484	0.031	-0.355	-0.343	-0.036	0.660
	n^P					1	-0.404	0.328	-0.536	-0.350	0.004	0.912
	n^T/n						1	-0.318	0.181	-0.012	-0.044	-0.240
Correl.	f							1	-0.291	-0.141	-0.263	0.237
matrix	s								1	0.374	0.269	-0.478
	w									1	0.186	-0.324
	y/n										1	0.067
	y											1

To what extent can our model account for these changes? What lessons can be learned from a policy that reduces the gap in firing costs? We attempt to answer these questions by taking into account the new open-ended contract and its reduced firing cost.

According to the change in legislation, severance payments are reduced by 24% (from 4.82 to 3.67 of quarterly wages).[18] Thus, the firing tax parameter for permanent jobs is reduced to $\gamma^P = 3.66 \times w^{*P} \times 0.24 = 0.88 \times w^{*P}$, which is to be compared with the previous value, $\gamma^P = 1.16 \times w^{*P}$. Since firing costs on fixed-term jobs remained similar, we keep $\gamma^T = 0.02 \times w^{*T}$. The results with the new gap in firing costs $\left(\gamma^P - \gamma^T\right)$ are displayed in Table 11. As before, the simulation takes into account the changes experienced by the economy in terms of the steady-state values of the relevant variables, which are adjusted in accordance to their actual changes.

Note that the fall in the firing costs gap not only reduces unemployment (from 0.20 to 0.126), but also the share of temporary contracts (from 0.29 to 0.20). The implied decline in unemployment mimics the actual evolution of the unemployment rate between 1997 and 2004, in contrast with the share of temporary contracts, which has remained stubbornly high at values above 30%. This has led Dolado *et al.* (2002) to refer to a sort of steady state share of fixed-term contracts. The decline implied by our analysis should be interpreted with caution and taken as a sort of *caeteris paribus* consequence of the lower gap in firing costs brought by the reform. Our model is obviously too simplistic to hypothesise on the determinants of this share, but yields an interesting downward prediction.

TABLE 11
Simulated results for the 1997 reform
(ξ=0.20;γ^T=0.02×w^{*T};γ^P=0.88×w^{*P})

	u	v	v/u	n^T	n^P	n^T/n	f	s	w	y/n	y
Steady state	0.126	0.275	2.194	0.178	0.697	0.203	0.751	0.108	0.997	1.100	0.960
Standard deviation	0.085	0.082	0.162	0.052	0.011	0.044	0.075	0.036	0.015	0.003	0.015
Autocorrelation	0.709	0.755	0.721	0.631	0.961	0.660	0.721	0.282	0.742	0.745	0.727
Correlation with y	-0.989	0.944	0.996	0.805	0.413	0.678	0.990	-0.738	0.999	0.893	1.000

The performance of the model in matching the observed changes brought by the reform is disappointing. Clearly, the model is not able to reproduce a situation of lower variability in both the temporary jobs and their share. Further, while our model shows a decrease in the volatilities of unemployment, vacancies and the job finding rate, the data shows that these volatilities remained almost unchanged. Thus, the lower gap in firing costs does not help to explain the observed labour market performance in the aftermath of the 1997 reform.

[18] The calculation is: 0.72×10 years×**33 days** per year + 0.28×10 years×20 days per year + 60 days =353 days=3.67 quarters.

These results call for additional research on the impact of other changes experienced by the Spanish labour market in these years.[19] In the context of our analysis, however, an important question emerges. To what extent has the productivity gap changed (not necessarily because of the reform) after the 1997 reform? A preliminary hypotheses to explain our absence of significant findings is that a larger productivity gap could be offsetting the enhanced volatility brought by the lower gap in firing costs. Despite this issue is beyond the scope of the present paper, Figure 1 shows some interesting information that may denote a widening of the productivity gap.

First, after the 1997 labour market reform, there was a sudden rise in the share of permanent contracts (PCs) on the total amount of contracts, which almost doubled (from an average of 4.7% in years 1989-1996, there is a jump to a share around 9%). Second, from 1992 to 1996, only 0.5% of total contracts were converted into permanent, whereas from 1997 to 2005 this average was multiplied by 6 and reached 3.2%. For new PCs[20] these values are 0.2% and 2.2% of total contracts, which implies that the rise of almost 4.5 percentage points in the share of PCs is due to these increases of, respectively, 2.7 and 2.0 percentage points. As a consequence, there has been an important recomposition of PCs by type as shown in figure 1b. Ordinary PCs have decreased from an average of 80.5% before the 1997 reform to 27.5% afterwards, whereas converted fixed-term contracts and new PCs have increased from 10.3% and 5.2%, respectively, to 37.2% and 25.6%.

Summing up, it seems that firms 1) are much less reluctant to hire new workers on a permanent basis, and 2) they are more prone to consolidate fixed-term employees already working in the firm. This may have had positive consequences in terms of worker turnover, productivity of this group of workers, and training incentives for the firms.[21] This

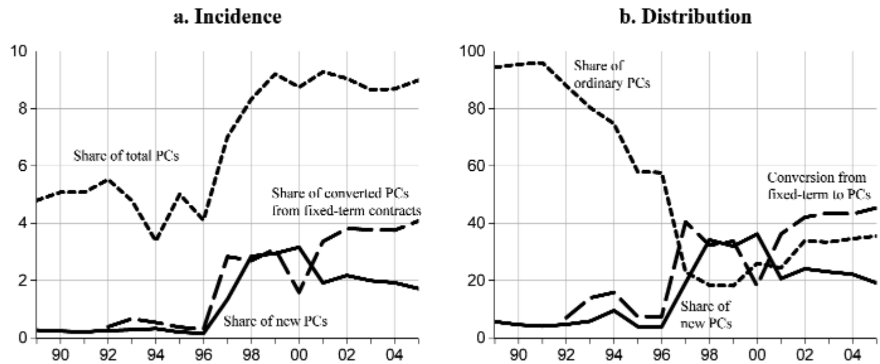
[19] For example, our analysis does not take into account that the 1997 one is a targeted reform. Therefore, further research should explore in more detail the particular consequences of this reform for specific groups of workes. A more suitable model for this task is probably the one by Dolado, Jansen and Jimeno (2007).

[20] These are *employment-promotion* open-ended contracts and thus differ from the other three categories: ordinary, converted and part-time PCs (in Figure 2 the latter are not considered due to the methodological changes in 2002 that made them to be split and assigned to their specific category).

[21] See Albert *et al.* (2005) for an in-depth analysis on the relationship between firm-provided training and temporary contracts in Spain. See, also, Sánchez and Toharia (2000) for the link between fixed-term contracts, effort and productivity.

would, thus, provide a rough indication that the gap in productivity is widening.

FIGURE 1
Incidence and distribution of permanent contracts. 1989-2005



Note: Shares in Figure 1a over total contracts.
Source: Boletín de Estadísticas Laborales.

6. Conclusions

This paper focuses on the role of the non-wage labour costs in the labour market, an issue that has become increasingly important in the design of labour market policies in OECD countries. The EPL is at the heart of the non-wage labour costs. It has been the target of the two main labour market reforms in Spain, undertaken in 1984 and 1997. The main consequence of the first one was the creation of a segmented labour market and entailed a structural change in terms of increased unemployment volatility. This higher volatility is by itself an important feature, but still more important is to know the channels whereby Spanish firms achieve their flexibility, and its consequences.

With respect to the channels, given the existing EPL firms are more prone to hire workers in response to short-term needs, no matter if these needs consolidate or vanish. As a consequence: 1) the conversion rate from temporary to permanent employees is extremely low; and therefore 2) there is a reduction in specific training offered by firms implying important costs in terms of productivity attainment.

Our analytical setup is close to a recent set of models (Silva and Toledo, 2008 and 2009; Sala, Silva and Toledo, 2008) that extend the standard DMP by considering heterogenous workers (temporary and permanent) and their resulting gaps in terms of firing costs and labour productivity. These gaps provide crucial amplification mechanisms for the labour market volatility and contribute to overcome Shimer's (2005) critique on the standard DMP model.

In a labour market as segmented as the Spanish one, these gaps are important. The gap in firing costs is mainly a regulatory issue, while the productivity gap is more structural but it is also affected by the gap in firing costs. Consideration of these gaps has allowed the identification of the Spanish EPL as the ultimate cause of the Spanish firms and workers' cyclical behaviour. In particular, our model is able to reproduce the Beveridge curve and the procyclical behaviour of the share of fixed-term contracts. Similarly, it also replicates the volatility of temporary and permanent employment, unemployment, and the share of fixed-term contracts, and further approximates the standard deviation of the job finding and job destruction rates. In addition, the model matches the direction of the 1984 reform. In particular, it matches the higher volatility observed in the unemployment rate after the reform.

Regarding the 1997 reform, the model is unsuccessful in matching the reduction in the volatilities of temporary employment and the share of fixed-term contracts. Our model is surely too simplistic to account for all significant changes that have affected the labour market in the aftermath of that reform. However, a potential reason why the lower gap in firing costs may be irrelevant would be a counterbalancing effect from a wider productivity gap. The relevance of such hypothesis is an important issue certainly deserving further attention in the near future.

This analysis offers a stepping stone towards understanding the role played by the gaps in productivity and firing costs in explaining the cyclical behaviour of segmented labour markets with flexibility at the margin. However, our model assumes a reduced form where on-the-job training, which affects productivity, is not set by firms. This entails the exogeneity of the training process and, therefore, of the productivity gap. Further research on the impact of institutional changes should consider the firms' response in terms of the workers' time allocation to productive activities and on-the-job training.

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Resumen

El mercado de trabajo español es un caso destacado de segmentación con flexibilidad en el margen (e.g., aquélla que sólo afecta a los trabajadores temporales). Dicha flexibilidad produce una brecha en los costes de despido de trabajadores temporales y permanentes que convierte la contratación temporal en el principal mecanismo de ajuste de la mano de obra. También produce una brecha de productividad debido a la elevada rotación y a la falta de formación en el empleo de los trabajadores temporales. Para explicar la elevada volatilidad del mercado de trabajo español desarrollamos un modelo de búsqueda y emparejamiento con trabajadores temporales y permanentes en el que dichas brechas tienen un papel fundamental. Calibramos y simulamos el modelo con el fin de reproducir los principales hechos estilizados y evaluar las implicaciones cíclicas de las reformas laborales de 1984 y 1997.

Recepción del original, octubre de 2007
Versión final, octubre de 2008