

The relevance of Post-Match LTC: Why has the Spanish labor market become as volatile as the US one?*

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Abstract

We present a Search and Matching model with heterogeneous workers (entrants and incumbents) that replicates the stylized facts characterizing the US and the Spanish labor markets. Under this benchmark, Post-Match Labor Turnover Costs (PMLTC) are the centerpiece to explain why the Spanish labor market is as volatile as the US one. The two driving forces governing this volatility are the gaps between entrants and incumbents in terms of separation costs and productivity. We use the model to analyze the cyclical implications of changes in labor market institutions affecting these two gaps and show that this framework: (i) allows to deal with Shimer' puzzle; (ii) it also allows to generate sufficiently volatility without affecting the response of unemployment to a change in the unemployment benefit; and (iii) it is suitable to analyze why the Spanish labor market has become as volatile as the US.

Key Words: Search, Matching, Training, Firing costs, Productivity Differentials.

JEL Classification Numbers: J23, J24, J31, J41, J63, J64.

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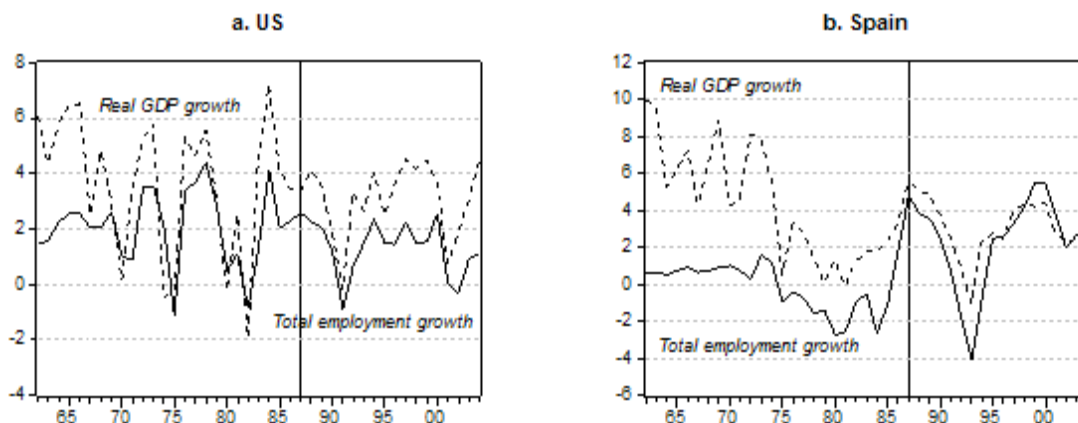
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1 Introduction

Despite their sharp differences in employment protection legislation (EPL henceforth), the Spanish labor market has recently achieved the same volatility historically displayed by the US one. This paper contributes to the understanding of this phenomena using an extended version of the Diamond-Mortensen-Pissarides (DMP henceforth) matching model.

The US labor market is generally known as the paradigm of a deregulated market. On the contrary, the Spanish labor market has always been characterized as rigid and regulated; even after several waves of labor market reforms it remains less flexible than in most OECD countries (OECD [1999a]). A very rough but informative way of grasping the consequences of these differences is to observe the sensitivity of employment variation *vis-à-vis* the business cycle. As shown in figure 1, employment and GDP growth in the US maintain today approximately the same pattern observed in the 60s. In contrast, a permanent change can be identified in Spain: whereas employment growth from the 60s to the mid 80s scarcely reacted to GDP, a structural change occurred in the mid 80s making the trajectory of both series progressively closer.

Figure 1. Employment and GDP growth in the US and Spain. 1962-2004.



We link this structural change to the institutional changes brought by several labor market reforms starting in 1984 and followed by the ones in 1994, 1997 and 2001.¹ These reforms have tackled the two main aspects of the EPL in Spain (the fixed-term contracts legislation and the firing restrictions on permanent contracts) and seem to have been successful in generating substantial volatility in the main dimensions of the labor market. In particular, the data underlying figure 1 illustrates the similar volatility achieved in Spain with respect to the US labor market. From 1987 to 2004, the annual employment growth rate in Spain was 2.41% (1.34% in the US), with a standard deviation of 2.51 (0.99 in the US), yielding a variation coefficient of 1.04 (0.74 in the US).² The latter values imply a higher employment volatility in Spain. The same

¹Other labor market reforms, such as the 1992 and the 2002 ones, have affected unemployment benefits. Since this concerns the unemployment protection legislation, they are not directly relevant to our analysis.

²It is important to remark that here we refer to the variation coefficient, which normalizes the standard deviation by the mean. In contrast, in Section 2 we do not need such a normalization given that we just examine the business-cycle components of the variables.

calculation for GDP growth yields a variation coefficient of 0.51 in Spain ($=1.60/3.14$) and 0.43 in the US ($=1.31/3.03$). Therefore, the distinct feature of this rough analysis is a similar degree of volatility.

We will analyze the volatility of these two labor markets using an extended version of the DMP model which is based in Silva and Toledo (2005). The reason for this extension is the need to solve the so called Shimer's puzzle (see Shimer [2005]) according to which the standard version of the DMP model is not capable to replicate the volatility of the main labor market variables. The objective of the paper is to match this volatility for the US and Spain labor markets and perform a quantitative economic policy analysis explaining why the latter has become as volatile as the former. It should thus be considered an applied paper, and not a theoretical one. In a companion paper, Silva and Toledo (2005) specifically deal with Shimer's puzzle in the US case.

Silva and Toledo (2005) outline the crucial role of (i) the gap between the incumbents and the entrants' productivity; and (ii) the gap between the incumbents and the entrants' separation costs. Both gaps are important parts of the Post-Match Labor Turnover Costs (PMLTC henceforth), which we find to be crucial to explain why the Spanish labor market has become as volatile as the US one. The PMLTC are those costs incurred by the firm once the search and matching process has concluded. They are mainly related to the training costs of new recruits (which are the entrants) and to the separation of the existing employees (which are the incumbents). We consider the entrants as workers still needing training to become fully productive (by definition of entrant), and have no significant separation costs. These low separation costs are either due to the absence of special abilities relevant for the firm (specially in the US where firms provide significant on-the-job-training) or to the fact that they have fixed-term contracts (which is the case in Spain). The incumbents have received training and entail separation costs for the firm either due to the disruption process caused by a full trained and productive worker when leaving the firm (particularly relevant in the US) or because of the firing costs associated with permanent contracts (higher in Spain in relative terms).

Since on-the-job-training is particularly important in the US, and it is closely linked to productivity, the gap between the incumbents and the entrants' productivity plays a central role in explaining the labor market volatility. In contrast, the main role in Spain corresponds to the gap between the incumbents and the entrants' separation costs. Entrants' separation costs are virtually zero, since they have fixed-term contracts, whereas for the incumbents is particularly high (compared with the US), due to the legislation on firing costs. Thus, the PMLTC are crucial in both countries, but for different reasons stemming from the deregulated environment where firms operate in the US, and the regulated one where firms operate in Spain.

Because of the direct association between entrants and temporary workers in Spain, we find the model by Silva and Toledo (2005) particularly suitable to analyze the Spanish labor market. This group of workers accounts for almost a third of the employees, have fixed-term contracts with no separation costs and represents around 90% of all new hires. The rest are tenured employees (incumbents in terms of the model), with permanent contracts and stringent separation costs. This association is not new in the literature and follows the spirit of distinguishing insiders and outsiders in the matching models of Wasmer (1999), Blanchard and Landier (2002), Kugler, Jimeno and Hernanz

(2002), Cahuc and Postel-Vinay (2002) and Osuna (2005).³

In Wasmer (1999) fixed-duration contracts can be interpreted as equivalent to a reduction in firing costs. In this context, the emergence of segmented labor markets arise from the firms's willingness to use temporary contracts when growth is low and there is a preference for 'high turnover workers with low turnover costs'. According to Blanchard and Landier (2002) 'the effects of a partial reform of employment protection by allowing firms to hire workers on fixed-term contracts may be perverse'. The reason is that, even in case it leads to lower unemployment, 'workers may be worse off, going through many spells of unemployment and entry-level jobs, before obtaining a regular job' (p. F214). This would offset the gains in efficiency stemming from the improved flexibility, which make the authors advocate broader reforms like a reduction of firing costs on all workers. Kugler, Jimeno and Hernanz (2002) extend Blanchard and Landier's framework by endogenizing dismissals of permanent workers and introducing payroll taxes. In this way they evaluate the consequences of the 1997 labor market reform in Spain, which reduced payroll taxes and dismissal costs. They find a positive net effect on permanent employment for young men and women (and, thus, a reduction in the segmentation faced by these groups of workers) but not for older men; and an increase in the transition probabilities from non-employment and temporary employment to permanent employment. With respect to the former models, the one in Cahuc and Postel-Vinay (2002) takes into account the possibility that firms offer both permanent and temporary jobs (in Blanchard and Landier firms just create 'entry-level' jobs) *and* the possibility of conversion of a certain share of the latter to permanent (in Wasmer they are necessarily destroyed). Under this benchmark they find that more flexible regulation of fixed-term contracts when firing costs are high 'may actually destroy jobs, increase unemployment, and reduce aggregate welfare': it fosters job creation, but increases job turnover. They stress the fact that it is the combination of temporary contracts and firing costs what has perverse effects, not the latter *per se*. The properties of a segmented labor market are also reproduced by the model in Osuna (2005), but in this case with the specific target of conducting a precise quantitative policy evaluation of the consequences of reducing firing costs in Spain via the removal of procedural wages.⁴ The main consequence is a reduction in the differences between temporary and permanent workers, both in terms of their wage gap and their job destruction rates (with a small increase in permanent job destruction and a significant reduction in temporary job destruction).

As generally done in this literature, we think on employment protection as lay-off costs which affect both hiring/firing decisions and wage bargaining. Our analysis however differs from the rest in several important aspects: (i) our model extends the standard DMP to deal with Shimer's puzzle; (ii) in doing so, it also deals with the so called Costain and Reiter's puzzle (see Costain and Reiter [2005]), according to which the standard DMP model can generate sufficiently large cyclical fluctuations in unemployment, or a sufficiently small response of unemployment to unemployment benefits, but it cannot do both; (iii) it is a short-run analysis in contrast to the long-run per-

³See these papers for many further references.

⁴Procedural wages are one of the components of the firing cost. Once the firing decision has been taken, it can be contested. During the time elapsed until the judge issues a final decision, procedural wages are paid by the firm. At the end of 2002, the decree that had removed procedural wages in Spain since May 2002 was withdrawn. The paper asks if this was a lost opportunity of reducing firing costs and, therefore, of reducing the perverse dualism of the Spanish labor market.

spective generally taken in this literature; (iv) in contrast with Blanchard and Landier (2002), who examine the effects of decreasing the firing costs associated with entry-level jobs (given the firing costs associated with regular jobs), we focus on the effects of removing the differences between fixed-term and permanent workers; this is along the lines of Kugler, Jimeno and Hernanz (2002) and Osuna (2005), but with a crucial difference: they evaluate the effects of the 1997 and 2002 reforms that reduced firing costs, whereas we go back to the 1984 reform that actually caused the segmentation of the Spanish labor market; (v) finally, in contrast to relate our results to those found for other European countries, we relate all our analysis to what it is generally taken as the reference case: the US labor market. In particular, we analyze the cyclical implications of hitting these economies by different shocks and modifying some of their institutional features.

The main findings from this analysis are the following. First, the inclusion of PMLTC allows the DMP model to generate simultaneously sufficiently large cyclical fluctuations in labor market tightness and a sufficiently small response of unemployment to unemployment benefits; this solves, at least partially, both Shimer's and Costain and Reiter's puzzles. Second, changes in labor market volatility are a response to labor market reforms affecting the entrants and incumbents's gaps in productivity and separation costs. Third, the sign and extent of this response depends on the initial levels of PMLTC: when these gaps are raised from low values of PMLTC, the variability of the labor market tightness is increased; when these gaps are raised from large values of PMLTC, the volatility of the labor market is decreased. The main intuition behind this non-linear relationship is as follows: the larger the training and separation costs the lower the firms' surplus from a new filled position. Consequently, with low PMLTC, positive shocks enhance the firms' surplus, increasing their incentives to open relatively more vacancies during good times. Conversely, with high PMLTC, the intensity of the shocks needed to stimulate job creation is high, but such large shocks scarce; therefore firms have less opportunities to take advantage of booms, implying a lower frequency in the opening of additional vacancies and, thereby, in their variability. Since these gaps are actually wide in the US and Spain (although from different reasons), this analysis provides an explanation of why the Spanish labor market has become as volatile as the US one. Finally, we find that the segmentation of the labor market brought by the 1984 reform can be considered the main reason why the Spanish labor market has become as volatile as the US one; this is so even though our simulation overestimates the magnitude of the change in the labor market volatility.

The remaining of the paper is structured as follows. Section 2 presents the data and compares some stylized facts characterizing the US and the Spanish labor markets. Section 3 outlines some of their main differences in LTC. Section 4 presents the model, which is calibrated and simulated in section 5 under alternative scenarios of separation costs and labor productivity in the US and Spain. Section 6 specifically addresses the question asked in the title of the paper. Section 7 concludes.

2 Spain versus US: labor market differences

This section outlines some of the main differences between the Spanish and the US labor markets. It specially focuses on the cyclical behavior of the main variables in the DMP matching model.

2.1 Data

For the US, we take the database and sources used by Shimer (2004, 2005), available at the AER and Shimer's webpages. For Spain, our sources are the Labor Force Population Survey (*Encuesta de Población Activa, EPA*), the Quarterly National Accounts (*Contabilidad Trimestral de España, CTRE*) and the OECD Main Economic Indicators (MEI). From the EPA we obtain the series on active population, employment, unemployment, and some of their components (such as the short-run unemployment); from the CTRE we obtain the series on average labor productivity and wages; from the MEI we obtain the time series on vacancies. To obtain consistent seasonally adjusted time series we use the U.S. Census Bureau's X12 seasonal adjustment program.

Table 1. Data: definitions and sources.

		Sources:	
		US	Spain
	Definitions:		
u	Seasonally adjusted unemployment	BLS	EPA
v	Seasonally adjusted help-wanted advertising index	CB	MEI
v/u	Labor market tightness		
f	Job finding rate	Shimer (2005)*	EPA**
s	Separation rate	Shimer (2005)*	EPA**
w	Real hourly compensation (non-farm business sector)	BLS	CTRE
p	Seasonally adjusted average labor productivity	BLS	CTRE

Notes: BLS=Bureau of Labor Statistics; CB=Conference Board;
 All variables reported in logs as deviations from an HP trend with smoothing parameter 10^5 .
 (*) For additional details, see Shimer (2005) and <http://home.uchicago.edu/~shimer/data/flows/>.
 (**) Own calculations based on Shimer (2005) with data from the EPA.

2.2 Some stylized facts

Table 2 replicates the summary statistics presented in Shimer (2005), but restricting the sample period to years 1987-2004. Beyond the interest of this period in the Spanish economy, already outlined in the introduction, Shimer (2005) itself points to a change in the contemporaneous correlation between the US detrended productivity and the $v - u$ ratio in mid 80s: from 0.57 in the period 1951-1985 it becomes -0.37 in 1986-2003 (-0.32 for years 1987-2004, as shown in table 2). These values cast some doubts on the results obtained when analyzing the effects of productivity shocks under the DMP approach with a period of interest starting before the mid 80s, and confer extra relevance to our period of analysis.

Table 2 confirms a main stylized fact outlined in Shimer (2005): the standard deviation of the ratio $v - u$, 0.35, is about 25 times as large as the standard deviation of the average labor productivity, 0.014. Another important stylized fact concerns unemployment, which displays a high degree of persistence. Its standard deviation of 0.15 implies that detrended unemployment is often 30% above or below its trend. The comparison of this value with the standard deviation of vacancies, 0.21, gives information on the business-cycle-frequency fluctuations of the $v - u$ ratio. The product of the two ($0.15 \cdot 0.21$) is close zero and thus virtually acyclic, implying that the $v - u$ ratio is intensively procyclical, with a standard deviation of 0.35. This ratio moves together with the job finding rate. Given that the $v - u$ ratio is high in expansions, the job finding rate will be relatively high, in contrast with its lower values in economic down-

turns. These results are very much similar to Shimer's (2005). However, when looking at the separation rate we observe a lower standard deviation of 0.05 in years 1987-2004 (versus 0.08 in 1951-2004) and a smaller correlation with the $v - u$ ratio (-0.53 versus -0.72). Along these lines, it is also very important to remark the low volatility of the separation rate with respect to the job finding rate (0.12), and its lower correlation with unemployment and vacancies (0.41 and -0.61), relative to the one of the job finding rate (-0.96 and 0.83). As emphasized by both Hall (2005) and Shimer (2005), this suggests that cyclical movements of unemployment arise, principally, from changes in the rate at which unemployed workers find jobs. In other words, recessions are periods of sharp declines in firm's recruiting efforts, rather than periods of massive layoffs.

	u	v	v/u	f	s	w	p	
Std. deviation	0.15	0.21	0.35	0.11	0.05	0.02	0.01	
Autocorrelation	0.95	0.95	0.95	0.92	0.70	0.93	0.76	
Correlation matrix	u	1	-0.91	-0.97	-0.96	0.41	0.10	0.32
	v		1	0.98	0.83	-0.60	-0.26	-0.31
	v/u			1	0.90	-0.53	-0.20	-0.32
	f				1	-0.18	0.06	-0.25
	s					1	0.54	0.08
	w						1	0.54
	p							1

In Spain, the difference between the volatility of the $v - u$ ratio with respect to the productivity one is larger than in the US: the standard deviation of the former, 0.54, is almost 49 times as large as the standard deviation of the average labor productivity, 0.011. With respect to the business-cycle component of unemployment, both its persistence and its standard deviation is as large as in the US. When the latter, 0.15, is multiplied by the standard deviation of vacancies, 0.44, the resulting value, 0.07, is also close to zero, but more than doubles the US one. Therefore, the business-cycle-frequency fluctuations of the $v - u$ ratio are also procyclical, but not as strongly as the US one, and with a much higher standard deviation. The job finding rate will thus be higher in expansions and lower in recessions; not as much as in the US, but with substantially larger deviations. It is also worthwhile to note that in both countries there is a negative relationship between vacancies and unemployment, with a lower correlation in Spain (-0.64) with respect to the US (-0.91). The standard deviation of the separation rate is 0.12 and displays a negative correlation of -0.86 with respect to the $v - u$ ratio, confirming that separations display a countercyclical pattern. Both values are higher than in the US indicating that, despite separations may diverge more widely from their trend, they have evolved more clearly against the business cycle in years 1987-2004. Contrary to the US, the separation rate is almost as volatile as the job firing rate (0.16) and, even more important, displays a higher correlation with respect to the ratio $v - u$. In particular, the latter reaches 0.84 with respect to unemployment (versus -0.54 the job finding rate) and -0.78 with respect to vacancies (versus 0.52 the job finding rate). Following these results, it seems safely to conclude that, in recessions,

the Spanish firms adjust their workforce mainly through layoffs, rather than reducing their recruiting efforts.

Both in the US and Spain real wages appear to be acyclical, and are much less volatile than vacancies, unemployment and labor market tightness. That is, while unemployment rates are often 30% above or below their tendency, the rise and fall of the real wage is lower than 5% (also with respect to their tendency).⁵

Table 3. Summary statistics. Quarterly Spanish data, 1987-2004.

	u	v	v/u	f	s	w	p	
Std. deviation	0.15	0.44	0.54	0.16	0.12	0.01	0.01	
Autocorrelation	0.97	0.94	0.96	0.64	0.89	0.85	0.71	
	u	1	-0.64	-0.80	-0.36	0.84	0.73	0.67
	v		1	0.97	0.52	-0.78	-0.36	-0.31
	v/u			1	0.52	-0.86	-0.48	-0.45
Correlation	f				1	-0.54	-0.25	-0.15
matrix	s					1	0.53	0.42
	w						1	0.55
	p							1

With respect to the correlation between labor productivity (p) and the separation rate (s), Mortensen and Pissarides (1994) argue that it should be negative. As a consequence, wages get higher and more jobs are destroyed. According to Shimer (2005), this holds in the US in 1951-2003; however, with the same data we find a low positive relationship of 0.08 in 1987-2004, and in Spain it is also positive (and even higher, 0.42). Because this may imply that the endogenous job destruction process arising from an aggregate productivity shock does not characterize the economies we are analyzing, at least in our sample period, the shocks on productivity and the separation rate will be considered to be independent of one another.

We have started this section outlining the change in the sign of the correlation between the business cycle components of productivity and the $v - u$ ratio in the US. This correlation is also negative in Spain and, from 1987 to 2004, quantitatively somewhat close to the US one (-0.45 and -0.32 respectively). The most important feature, though, is the small standard deviation observed in Spain (0.011), similar to the value already known for the US (0.014). This is precisely the source of the recent extensions in the DMP approach, given that the traditional developments were unable to replicate the cyclical behavior of unemployment and vacancies unless making productivity implausibly volatile. The model presented in section 4 takes this into account and overcomes this problem by identifying two driving forces of the labor market volatility: the gaps in separation costs and productivity between entrants and incumbents. The first of these gaps is responsible of a segmented labor market in Spain, where a third of the employees hold fixed-term contracts (entrants). In contrast, the

⁵This fact is currently receiving a lot of attention. Shimer (2005) argues that the problem of the DMP model is the excessive wage sensitivity which blocks the transmission mechanism of the shocks. In contrast Mortensen (2005) shows that wage fluctuations is not *per se* an important determinant of the response of vacancies and unemployment to shocks.

average productivity gap plays a less important role, the reason being that only 10% of the new hired workers become permanent (i.e., fully productive). Since firms have scarce incentives to provide training, this group of employees relies on learning-by-doing processes to slowly close the initial productivity gap with respect to the incumbents. In the US, where a substantial part of the entrants become incumbent, firm-provided training is crucial and the role of the average productivity gap is more important to explain the observed volatility of the labor market. These differences are explored in section 3.

3 Differences in PMLTC

Our analysis is based on Toledo and Silva (2005) because of their model's ability to match the stylized facts without causing an unrealistic strong volatility of productivity, like the standard DMP model. This is achieved by amplifying the mechanism whereby the shocks affect the labor market, which entails a division of employees in two groups, entrants and insiders. This distinction has two crucial consequences for our analysis:

- First, the LTC need to be divided in two components: i) costs associated with the hiring of a new employee (advertising costs, processing of applications, interviews); and ii) other costs generated once the match has taken place. The latter are what we call PMLTC. Note that in the standard DMP approach there is no need to differentiate between the two, since only hiring costs are relevant. In contrast, under a more realistic assumption of heterogeneous employees, the PMLTC become relevant. In a thorough analysis of the LTC in the US, Silva and Toledo (2005) estimate the PMLTC to be more than 10 times higher than the pre-match LTC. This shows that we are in the right direction in performing our analysis.
- Second, the productivity differential between entrants and insiders becomes crucial in the analysis, in sharp contrast with the single productivity level of the homogeneous workers in the standard DMP approach (where, once the match occurs, the new hiree is assumed to be equally productive than any other worker of the firm). Of course, the entrant's productivity level is substantially lower than the incumbent's one, and the two only converge after the entrant has been some time in the firm and becomes an incumbent.

Separation costs are usually viewed as the main component of the PMLTC (even though the productivity loss while the position is vacant and the on-the-job costs related to the training of the new employee are important too). In this paper, we also consider the productivity differential as central, and the two crucial variables of our modeling strategy are the gaps between entrants and incumbents in terms of separation costs and productivity.⁶

3.1 The gap in separation costs

It is well known that the US EPL is among the less restrictive ones of the OECD countries. On the contrary, despite the various labor market reforms undertaken in last

⁶Of course, this has nothing to do with the differences in absolute value between the US and Spain, which are irrelevant to our analysis.

decades, the overall characterization 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 labor 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 0 weeks of weekly wages in the US and 56 weeks of weekly wages in Spain (the OECD mean is 35.1 weeks).⁷ Moreover, a difficulty of firing index is placed at 10.0 in the US and 50.0 in Spain (the OECD average is 27.4).

The question immediately arising is the following: given these differences, why has the Spanish labor market attained a similar volatility than the US? The first part of the answer points to the gap in separation costs between entrants (essentially the fixed-term employees in Spain) and incumbents (the permanent ones). This gap explains the existence of a large and stable share of temporary workers in Spain, which is mainly used by firms to quickly adjust their workforce. The second part of the answer, examined in next subsection, lies in the productivity gap between entrants and incumbents, whose main determinant is the cumulative qualification experienced by tenured workers via learning-by-doing and on-the-job training.

The gap in separation costs is null in the US and closely related to the two main elements of the EPL in Spain: the legislation on (i) fixed-term contracts and (ii) the firing restrictions on permanent contracts. The main outcome of this legislation is that entrants have virtually no separation costs, whereas the incumbents are subject to high firing costs (even after the labor market reforms of the 1990s).

Despite fixed-term contracts were not introduced for the first time in 1984, the limits on their use were virtually abolished in that year, prompting 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 labor market reforms in 1994, 1997 and 2001 constitute several attempts to undo the consequences of the 1984 reform, which can be summarized in one outstanding feature: the appearance of a dual labor 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 represents 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), page F272, conclude that Spain quickly converged to a steady-state ratio of temporary and permanent workers.⁸ This has had several negative consequences such as (i) segmentation of the labor market in a two-tier labor relation system [Jimeno and Toharia (1993)] and (ii) a reduction in effort and labor productivity [Sánchez and Toharia (2000)].

Firing costs are, together with the legislation on fixed-term contracts, the second main source of the entrants-incumbents' gap in separation costs. Different accounts of the institutional framework of the Spanish labor market and its changes can be found

⁷See <http://www.doingbusiness.org> and Botero *et al.* (2004) for the methodology.

⁸This steady state is affected by six main determinants of which our model will explicitly consider three: i) the relative wage of workers under fixed-term or permanent contracts; ii) the gap in firing costs between both type of contracts; iii) the volatility of labor 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.

in Kugler, Jimeno and Hernanz (2002), Osuna (2005) and Güell and Petrongolo (2006), the latter with particular emphasis on the fixed-term contracts legislation.

Furthermore, the evolution of severance payments in Spain is studied in Malo and Toharia (2005). This is crucial for our analysis because it has allowed us to obtain data on this important variable.⁹ In particular, these series, together with the corresponding number of firings, allow the construction of the actual average severance payments incurred by Spanish firms due to a worker dismissal between 1987 and 2003. Expressed as a ratio on average wages, we find actual severance payments in this period to be on average equivalent to 57.9% of the annual wage or 30.1 weeks of weekly wages.¹⁰ It is important to note that this is a stable value: the time series of this ratio is perfectly stationary around this mean.

We use this information in the last exercise of the paper aimed at quantifying the change in the volatility of the Spanish labor market due to the 1984 labor market reform, that is due to the creation of a dual labor market. Since the model below distinguishes the total firing cost (including the costs from administrative and legal procedures) from the severance payments actually received by dismissed workers, we take the value of the total firing cost provided by the World Bank Business Doing survey (which takes into account the cost of advanced notice requirements, severance payments and penalties due when firing a worker) to proxy the part of the separation costs wasted on dismissal regulation. This part amounts to 46.2% of the total firing costs (25.9/56.0 weeks of weekly wages).

3.2 The productivity gap

Firm-provided training in the US is crucial because it is mainly *specific* -as opposed to *general*, following the definition of Gary Becker- and induces firms and workers to keep stable their relationship: from the firm's side, the interest lies in recovering its expenses in training in the form of higher labor productivity; from the worker's side there is a capital loss in case of abandoning the firm. Hence, firm-provided training produces incentives to reduce quits on the part of the worker, and layoffs on the part of the firm. Given the incidence of on-the-job training, firms' separation costs in the US are mainly due to the loss of firms' investment on the workers leaving the firm.

According to Barron, Berger and Black (1997) 95% of the entrants (new employees) receive some kind of training and spend, on average during the first quarter in the firm, 142 hours in training activities. When adding the contribution of the incumbents in training the new employees, which is placed at 87.5 hours on average, the resulting cost amounts to about 55% of the quarterly wage of the new hired. The rising productivity of the entrants is the counterpart of these costs. This is evaluated in Bishop (1997), who finds an increase of about a third in the average productivity of new employees in the first quarter at the firm, and an extra third between the second quarter and the end of the second year of job tenure. Thus, assuming that the productivity of a new hired worker reaches the average productivity of an incumbent employee in a period no longer than two years, we observe a starting productivity gap equivalent to about 40

⁹Malo and Toharia (2005) construct three series of severance payments depending on whether the firing is decided in the Units of Mediation (*Servicios de Mediación Arbitraje y Conciliación*, SMAC) or in the Social Affairs Courts (*Juzgados de lo Social*) in which case it can be declared fair or unfair.

¹⁰This value of the average actual severance payments is less than half the estimate given by Osuna (2005), which assumes 9 years of job tenure.

percent of the incumbent's productivity, which tends to be closed after a period of both on-the-job training and learning by doing. Given that a high proportion of entrants become incumbents, job turnover of incumbent workers imply dramatic productivity losses in the US.

The opposite situation holds in Spain. First, according to Güell and Petrongolo (2006), the conversion rate from temporary to permanent contracts is only 10%. Second, firm-provided training is not relevant: the total amount of funds devoted to occupational training was 0.11% of GDP in 2003.¹¹ With respect to the entrants and incumbents' access to firm-provided training, 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: (i) workers with fixed-term contracts are less likely to be employed in firms providing training; (ii) to have fixed-term contracts in firms providing training reduces the probability of being chosen to participate in training activities; and (iii) 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 Landier's (2002) argument that entry-level jobs are low productivity jobs.

Summing-up, the institutional set-up is crucial. In the US because of the relative absence of regulations. In Spain because of the fixed-term contract legislation and stringent regulations concerning permanent workers, implying a low conversion rate of temporary workers into permanents and, as a consequence, little interest in firm-provided training. 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. Foremost, given the low conversion rate of the new hires into incumbents, the productivity gap is hardly overcome by the entrants in contrast with the US labor market, where the presence of firm-provided training and the higher conversion rates allow a faster and more effective reduction of this productivity gap.

4 The model

The economy is integrated by a continuum of risk-neutral, infinitely-lived workers and firms; they discount future payoffs at a common rate r ; capital markets are perfect; and time is continuous.

There is a time-consuming and costly process of matching workers and job vacancies, captured by a standard constant-returns-to-scale matching function $m(u, v)$, where u denotes the unemployment rate and v is the vacancy rate. Unemployed workers find jobs at the rate $f(\theta_{p,s})$ and vacancies are filled at the rate $q(\theta_{p,s})$. From the properties of the matching function, these rates only depend on the vacancy-unemployment ratio $\theta_{p,s}$

¹¹Details on this calculation are given in Sala and Silva (2005). The OECD (2004) places the total labor 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.

where, the higher the number of vacancies with respect to the number of unemployed workers, the easier to find a job $f'(\theta_{p,s}) > 0$, and the more difficult fill up vacancies $q'(\theta_{p,s}) < 0$.

We assume that an aggregate shock hits the economy according to a Poisson process with arrival rate λ , at which point a new productivity p' and separation rate s' are drawn from a distribution conditional on the current state of p and s . Let $E_{p,s}X_{p',s'}$ represent the expected value of an arbitrary variable X , following the next aggregate shock conditional on the current state (p, s) . The aggregate shock yields a capital gain $(E_{p,s}X_{p',s'} - X_{p,s})$ for each value.

Workers can be either unemployed or employed. Unemployed workers are considered entrants once they find a job; their Bellman equation is given by

$$rU_{p,s} = z + f(\theta_{p,s})(W_{p,s}^e - U_{p,s}) + \lambda(E_{p,s}U_{p',s'} - U_{p,s}), \quad (1)$$

stating that unemployed workers obtain a constant current value from leisure z ; find a job at a rate $f(\theta_{p,s})$, which yields net a value gain $(W_{p,s}^e - U_{p,s})$; and receive shocks at a rate λ , with an expected capital gain $(E_{p,s}U_{p',s'} - U_{p,s})$. The sum of the right hand side (RHS henceforth) terms of this equation must be equal to the annuity value of being unemployed, $rU_{p,s}$.

When finding a job, the unemployed worker becomes an entrant or temporary employee (e). When the labor productivity or the separation rate change, the entrant's employment relationship can be renegotiated, either becoming finished or permanent. The Bellman equation characterizing the status of an entrant is given by

$$rW_{p,s}^e = w_{p,s}^e - s^e(W_{p,s}^e - U_{p,s} - \varphi\gamma^e) + \iota(W_{p,s}^i - W_{p,s}^e) + \lambda(E_{p,s}W_{p',s'}^e - W_{p,s}^e). \quad (2)$$

According to this equation, entrants earn an endogenous wage $w_{p,s}^e$, but lose their job at the rate s^e with an expected capital loss represented by $(W_{p,s}^e - U_{p,s} - \varphi\gamma^e)$; become incumbents at a rate ι , which entails a capital gain amounting to $(W_{p,s}^i - W_{p,s}^e)$; and face shocks at a rate λ , with an expected change in their match value of $(E_{p,s}W_{p',s'}^e - W_{p,s}^e)$. When a match with an entrant is terminated, a proportion φ of the firms's loss (γ^e) goes to the worker as a severance payment, whereas the rest, $(1 - \varphi)\gamma^e$, is assumed to be fully wasted (the reason for this distinction is explained below). When not separated from the firm, the entrant becomes an incumbent or permanent employee (i). This happens either because the entrant has finished his on-the-job training or screening process, or due to the presence of legal restrictions making this change of status compulsory.

An incumbent is a full productive worker whose status can be characterized by the following equation

$$rW_{p,s}^i = w_{p,s}^i - s^i(W_{p,s}^i - U_{p,s} - \varphi\gamma^i) + \lambda(E_{p,s}W_{p',s'}^i - W_{p,s}^i), \quad (3)$$

where the first term of the RHS gives the incumbent's wage; the second reflects the loss if the employment relationship is finished, which happens at the rate s^i ; and the last one captures the expected gain from the aggregate shock. Likewise the entrants, when firing an incumbent firms incur in firing costs $\gamma^i \geq \gamma^e$ with a fully wasted component $(1 - \varphi)\gamma^i$ reflecting, for example, administrative and legal charges, or efficiency losses due to the disruption of the regular flow of work.¹²

¹²Lazear (1990) shows that under efficient contracts severance payments are neutral when the whole

From the firms's side, a job can be either filled or vacant. Before a position is filled, the firm has to open a job vacancy with a flow cost c . The annuity value of a vacancy $rV_{p,s}$ is equal to

$$\begin{aligned} rV_{p,s} &= -c + q(\theta_{p,s})(J_{p,s}^e - V_{p,s}) + \lambda(E_{p,s}V_{p',s'} - V_{p,s}) \equiv \Psi \quad \text{if } \theta_{p,s} > 0 \\ &= \max\{0, \Psi\} \quad \text{if } \theta_{p,s} = 0. \end{aligned} \quad (4)$$

The second term on the RHS is the probability of filling a vacancy $q(\theta_{p,s})$ times the gain in the annuity value from the job creation process, which takes place when a firm and a worker meet and agree on an employment contract. The third term is the expected change in the value of a vacancy, as a consequence of the aggregate shock, $(E_{p,s}V_{p',s'} - V_{p,s})$.

Firms have a constant-returns-to-scale production technology with labor as a unique production factor. Each filled new job can be represented by the following Bellman equation

$$rJ_{p,s}^e = (p^e - w_{p,s}^e) - s^e(J_{p,s}^e - V_{p,s} + \gamma^e) + \iota(J_{p,s}^i - J_{p,s}^e) + \lambda(E_{p,s}J_{p',s'}^e - J_{p,s}^e). \quad (5)$$

The first term on the RHS gives the instantaneous profit of a match for the firm, which is equal to the difference between the entrant's labor productivity and the wage, $(p^e - w_{p,s}^e)$. We assume that $p^e = p(1 - \xi)$, where $0 \leq \xi \leq 1$, denotes the productivity gap between entrants and incumbents, which arises from the need of on-the-job training and/or learning-by-doing before the new employees can reach the productivity level of the incumbents. The second term reflects the loss associated with terminating the entry-level job and opening a new vacancy, whereas the third one is the expected change in the value of the job if the worker becomes an incumbent. Following the analysis provided in section 3, we associate this conversion process with the ending of the on-the-job training or screening processes in the US firms. In contrast, due to legal restrictions, after renewing a number of times a fixed-term contract, the Spanish firms are bounded to convert that contract into permanent, thereby changing the status of that worker.¹³ The last term represent the capital gain for the shock.

Equation (6) characterizes the present value for the firm of having a tenured job. If resulting from the conversion of a fixed-term employee, this tenured job yields instantaneous profits equal to $(p - w_{p,s}^i)$. If destroyed, the firm faces the separation costs shown by the second term of the RHS of the equation. The first part, $(J_{p,s}^i - V_{p,s})$, indicates the direct loss associated with the termination of the match whereas, as before, there is a firm loss, γ^i , occurring when a match with an incumbent is terminated. The third term is again the capital gain from the shock. The Bellman equation characterizing the incumbent's position is thus given by

$$rJ_{p,s}^i = (p - w_{p,s}^i) - s^i(J_{p,s}^i - V_{p,s} + \gamma^i) + \lambda(E_{p,s}J_{p',s'}^i - J_{p,s}^i). \quad (6)$$

Given the state-contingent ratio of vacancies to unemployment $(\theta_{p,s})$, the unemploy-

ment made by the firm is received by the worker. To avoid this neutrality (which holds for permanent jobs, but not for entry-level jobs) we consider both the severance and the tax component of firing costs in a way that encompasses the usual conceptions of firing costs to be found in the literature.

¹³To avoid this restriction, the alternative is to finish the employment relationship with that employee and hire a new worker. This explains the high labor turnover of entrants, the low incentives to provide on-the-job-training, and the small conversion rate from fixed-term to permanent contracts.

ment rate (u), and the ‘short-term’ (n^e) and ‘long-term’ (n^i) employment rates evolve according to the following backward-looking differential equations:

$$\dot{u} = s(1 - u) - f(\theta_{p,s})u = s^e n^e + s^i n^i - f(\theta_{p,s})u, \quad (7)$$

$$\dot{n}^e = f(\theta_{p,s})u - (s^e + \iota)n^e, \quad (8)$$

$$\dot{n}^i = \iota n^e - s^i n^i. \quad (9)$$

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

$$V_{p,s} = 0. \quad (10)$$

Because neither workers nor employers can instantaneously find an alternative match partner in the labor market, and because hiring, training and firing decisions are costly, a match surplus exists. To divide this surplus we assume wages to be the result of bilateral Nash bargaining between the worker and the firm. They are revised every period upon the occurrence of new shocks, and the Nash solution is the wage that maximizes the weighted product of the worker’s and the firm’s net return from the job match. The first-order conditions for entrants and incumbent employees yield the following two equations:

$$(1 - \beta)(W_{p,s}^e - U_{p,s} - \varphi\gamma^e) = \beta(J_{p,s}^e - V_{p,s} + \gamma^e), \quad (11)$$

$$(1 - \beta)(W_{p,s}^i - U_{p,s} - \varphi\gamma^i) = \beta(J_{p,s}^i - V_{p,s} + \gamma^i), \quad (12)$$

where $\beta \in (0, 1)$ denotes the workers’ bargaining power relative to the firms’ one. Note that the Nash conditions present terms depending on $\gamma^{e,i}$. Because separation costs are operational they are explicitly considered in the wage negotiation. This implies that the firm’s threat point when negotiating with a worker is no longer the value of a vacancy $V_{p,s}$, but $(V_{p,s} - \gamma^{e,i})$; and that the worker’s threat point depends on the proportion of firing costs (φ) obtained in case of disagreement.

By making the appropriate substitutions, we can solve for the equilibrium wages as a function of the current state of (p, s) and $\theta_{p,s}$:

$$\begin{aligned} w_{p,s}^e &= (1 - \beta)z + \beta c\theta_{p,s} + \beta p(1 - \xi) + \beta [f(\theta_{p,s}) + r] \gamma^e \\ &\quad + (1 - \beta) [f(\theta_{p,s}) + r] \varphi \gamma^e - \iota \beta (\gamma^i - \gamma^e) - \iota (1 - \beta) (\gamma^i - \gamma^e) \varphi \end{aligned} \quad (13)$$

$$w_{p,s}^i = (1 - \beta)z + \beta c\theta_{p,s} + \beta p + \beta r \gamma^i + (1 - \beta)r \varphi \gamma^i + \beta f(\theta_{p,s}) \gamma^e + (1 - \beta)f(\theta_{p,s}) \varphi \gamma^e \quad (14)$$

Observe that the wage of fixed-term workers ($w_{p,s}^e$) is decreased by a fraction of the average labor productivity gap ξ . Since new workers are less productive than incumbents, the match surplus for the firm, and thereby their wage, is reduced. Furthermore, new employees become incumbent with some probability (given by the hazard rate ι), in which case firms become liable to the firing costs associated with permanent employees, γ^i , and perceive these costs as an expected loss reducing the expected match surplus; this explains the negative effect of γ^i on the entrants’ wage. The incumbent’s

wage ($w_{s,p}^i$) is higher because they are full productive workers (if former entrants they have closed the productivity gap) and γ^i becomes operational increasing the incumbents' bargaining power. With respect to the model in Silva and Toledo's (2005) the difference is the presence of firing costs in entry-level jobs (γ^e), which increase not only the incumbent's wage but also the entrant's wage.¹⁴ The reason is that these costs are also now operational at the entry-level jobs and thereby raise the entrants' implicit bargaining power. In this way these two groups of workers differ in terms of both the productivity gap and the firing costs gap so that the model accomodates the main features of the US and the Spanish labor markets. We make use of this specific feature of the model below, when accountig for the effects of the Spanish 1984 reform on the labor market volatility.

The only firm's decision concerns the number of new workers to be hired. In the presence of firing restrictions, firms prefer to hire an entrant allowing themselves to avoid paying firing costs. Therefore, $w_{p,s}^e$ is the relevant wage to determine the vacancy-unemployment ratio. As in Shimer (2005), we define an equilibrium where the $v-u$ ratio depends only on the current value of p and s , and satisfies the following forward-looking non-linear equation:

$$\begin{aligned} & \frac{r + s^e + \iota + \lambda}{q(\theta_{p,s})} + \frac{r + s^i + \lambda + \iota}{r + s^i + \lambda} \beta \theta_{p,s} + \frac{f(\theta_{p,s})}{c} \left[\iota \left(\frac{\beta + (1 - \beta)\varphi}{r + s^i + \lambda} \right) + \beta + (1 - \beta)\varphi \right] \gamma^e \\ = & \frac{(1 - \beta)}{c} \left[p(1 - \xi) - z + \frac{\iota(p - z)}{r + s^i + \lambda} \right] - \frac{(1 - \beta)\iota\gamma^i}{c} \left[\frac{(1 - \varphi)s^i - \lambda\varphi}{(r + s^i + \lambda)} \right] + \lambda E_s \frac{1}{q(\theta'_{p,s})} \\ & - \frac{\gamma^e}{c} [\beta(r + \iota + s^e) + (1 - \beta)(r + \iota)\varphi] + \frac{\lambda\iota}{(r + s^i + \lambda)} \left(\frac{\beta\gamma^i + E_s J_{s'}^i}{c} \right). \end{aligned} \quad (15)$$

For each state (p, s) , there is only one labor market market tightness (θ) that satisfies this equation. In section 5 we solve it numerically to get the quantitative results of the model.

One of our main concerns when developing this setup is to improve the capacity of the standard DMP model to generate larger cyclical fluctuations in the main dimensions of the labor market. The intuition behind is simple. With PMLTC the expected value of a new position, J^e , falls both because entrants are less productive than incumbents and because separations become more costly. Therefore, when J^e is small and given the free entry condition $J^e = \frac{c}{q(\theta)}$, positive shocks induce large percentage increases of J^e and a large number of vacancies must be created until the free entry condition is restored, increasing the sensitivity of the labor market tightness.¹⁵ In other words, expansions are perceived as even better times and thereby firms open even more vacancies than in the absence of PMLTC. Equations (16)-(18) show the qualitative effects of the PMLTC

¹⁴The fact that we consider the entrants to have legal separation costs ($\gamma^e > 0$) does not necessarily imply that firms are bounded to pay them. For example, they exist in Spain even though in practice firms avoid paying them. Osuna (2005) places at 85% the temporary job destruction due to temporary contracts reaching its maximum length.

¹⁵Hall (2005), Costain and Reiter (2005), and Horstein, Krusell and Violante (2005) discuss the role of the firm's surplus in the amplification mechanism of the underlying shocks.

parameters ξ , γ^i and γ^e on J^e for a given θ :¹⁶

$$\frac{\partial J^e}{\partial \xi} = -\frac{(1-\beta)p}{(r+s^e+\iota)} < 0, \quad (16)$$

because training costs reduce the net productivity of an entrant;

$$\frac{\partial J^e}{\partial \gamma^i} = -\frac{(1-\varphi)(1-\beta)}{(r+s^i)} < 0, \quad (17)$$

because firing costs in permanent jobs generate a direct negative effect on firms' surpluses (they represent an explicit cost for firms) and strengthen the incumbents' negotiating position (which pushes up their wages). However, these negative effects are partially reversed by lowering the wages of the entrants: knowing that new employees become incumbent with probability ι , in which case γ^i becomes liable, firms subtract them at the beginning of the employment relationship;¹⁷ and

$$\frac{\partial J^e}{\partial \gamma^e} = -\left\{ \frac{\beta[f(\theta) + r + \iota] + (1-\beta)[f(\theta) + r + \varphi\iota] + s^e}{(r+s^e+\iota)} \right\} - \left\{ \frac{\iota f(\theta)[\beta + (1-\beta)\varphi]}{(r+s^e+\iota)(r+s^i)} \right\} < 0, \quad (18)$$

because firing costs in entry-level jobs not only give additional bargaining power to the incumbents but also increase the entrant's bargaining power, and therefore, their wages.

5 Calibration and simulation

In the first part of this section we calibrate the model at quarterly frequencies to be consistent with the average US and Spanish unemployment rates. For Spain the parameterization must match, in addition, two empirical facts: (i) the share of temporary employees is around one third (like during the last 15 years); and (ii) the conversion rate of fixed-term contracts is less than 10%. Finally, and following Constain and Reiter (2005), we calibrate the model preventing an excessive sensitivity of unemployment duration to unemployment benefits. This implies we are not necessarily selecting those parameters giving the best fit. In the second and third parts we discuss the results and outline the PMLTC contribution to the analysis.

5.1 Calibrated parameters

We calibrate the model in the steady state ($\lambda = 0$) with the following parameters, displayed in table 4. The average incumbent's labor productivity (p) is normalized to 1. The real interest rate (r) is fixed at 1% per quarter, which is consistent with available empirical work for both countries. The average separation rate in the US is placed at 9% per quarter, $s = 0.09$, according to the Job Opening Labor Turnover Survey (JOLTS).

¹⁶To obtain these expressions consider the free entry condition (10) and solve for J^e and J^i in equations (5) and (6) with $\lambda = 0$. Then take derivatives with respect to the PMLTC parameters.

¹⁷Note that with full severance payments, $\varphi = 1$, firing costs in permanent jobs have neutral effects on the firm surplus and therefore on equilibrium (Lazear [1990]). This is the case in Osuna (2005) who includes minimum wage restrictions to avoid this neutrality.

In the absence of additional information, we assume entrant's separations to coincide, on average, with the end of their on-the-job training process so that $s^e = \iota$. For Spain, following Polavieja (2003) and Arranz, García-Serrano and Toharia (2005), we set the job tenure of temporary and permanent workers at 7 months and 10 years, respectively, so that $s^e = 0.42$ and $s^i = 0.025$. Given the share of temporary workers, these values imply an average separation rate (s) of 0.155. From 1987 to 2004, the quarterly average unemployment rates in the US and Spain were 5.5% and 17%. Substituting these values and those of s in equation (7), with $\dot{u} = 0$, we find an average monthly job finding probability for unemployed workers of 0.56 in the US and 0.25 in Spain - $f(\theta)$ is equal to 1.54 in the US and 0.54 in Spain-. As standard in the literature, we assume the matching function to be Cobb-Douglas, $f(\theta) = \kappa\theta^{1-\alpha}$, where α is the elasticity of the matching function with respect to unemployment. As in Shimer (2005) we set $\alpha = 0.72$ in the US, and based on Castillo, Jimeno and Licandro (1998) we set $\alpha = 0.85$ for Spain. In accordance to Abowd and Kramarz (2003), who estimate hiring costs per hire to be 3.3% of the yearly labor cost of an average worker in France,¹⁸ we set the average hiring cost at 13% of the normalized labor productivity in both countries, $\frac{c}{q(\theta)} = 0.13$. Considering an average duration of a vacancy of around 17 days, as in Barron, Berger and Black (1997), we set $q(\theta) = 3.45$ and $c = 0.453$ in both countries. Given the values of $f(\theta)$, $q(\theta)$ and the properties of the matching function, the average ratio of vacancies to unemployment ($\theta = \frac{f(\theta)}{q(\theta)}$) is 0.44 in the US and 0.21 in Spain. With α , $f(\theta)$ and θ , the efficiency of the matching process (κ) is then 1.94 in the US and 0.95 in Spain.

Let us now turn to the PMLTC parameters (γ , φ , ι and ξ). According to section 3.1 we set $\gamma^e = \gamma^i = 0.00$ in the US and $\gamma^i = \frac{56}{12} = 4.67$ in Spain, with the severance payments parameter $\varphi = \frac{30}{56} = 0.535$ (that is, 46.5% of the separation costs are considered to be wasted). Given the separation of an entrant takes place when the fixed-term contract expires, we set $\gamma^e = 0.00$. Consistent with the share of temporary workers in Spain, the average rate at which temporary employees become permanent (ι) is obtained from equation (9) with $\dot{n}_i = 0$ and gives $\iota = 0.051$. This value together with the calibrated separation rate of the temporary workers implies that only 7% of them become permanent.¹⁹ This conversion rate lies between the average ratio of indefinite to total contracts signed in Spain from 1987 to 2004 (3%), and the 10% conversion rate estimated by Güell and Petrongolo (2006). Contrary to Spain, ι in the US is more closely related to the training process of a new worker. In accordance with Bishop (1997) and Silva and Toledo (2005) we assume that entrants need one year in the US to become fully productive, $\iota = s^e = 0.25$, implying a 38% conversion rate from employees being trained to a new status of fully productive workers. Given ι , from equations (8) and (9), and setting $\dot{n}^e = \dot{n}^i = 0$, we obtain the quarterly separation rate of an incum-

¹⁸Similarly, the US 2004 Saratoga Institute Diagnostic Report (<http://www.pwcglobal.com/us/eng/tax/hrs/wds-exec-summary.pdf>) estimates hiring costs to be equivalent to 3.6% of the annual employee compensation.

¹⁹To obtain this value, note that the number of entrants n^e in period $t - 1$ becoming incumbents in period t is equal to $n_{t-1}^e e^{-s_e(t-t_0)} [1 - e^{-\iota(t-t_0)}]$. Therefore, given the number of new hired workers n_0^e starting to work in period t_0 , the proportion of them converted to permanent is equal to the:

$$\text{conversion rate} = \frac{\sum_{t=1}^{\infty} n_{t-1}^e e^{-s_e(t-t_0)} [1 - e^{-\iota(t-t_0)}]}{n_0^e}, \text{ where } t_0 = 0.$$

bent (s^i) and the ratio of entrants to incumbents ($\frac{n^e}{n^i}$) which are, respectively, 0.055 and 0.18. The average training cost in the US is taken from Silva and Toledo (2005), who estimate it to be equivalent to 1.2 times the quarterly labor productivity of a fully productive worker.²⁰ We thus set $\frac{\xi}{\iota} = 1.2$ and $\xi = 0.31$. For Spain, Aguirregabiria and Alonso-Borrego (2004) estimate the productivity of a temporary worker to be on average 80% of the productivity of a permanent worker. Because the initial productivity gap is closed after $\frac{1}{\iota}$ periods, we set the average training costs at $\xi = 0.03$. Thus, as in the US case, there is a normalized initial productivity gap of 40% in Spain, which is filled at a constant rate each quarter.

Table 4. Calibrated parameters for the US and Spain, 1987-2004.

		US		Spain	
		Value	Source	Value	Source
Long-run parameters:					
Labor productivity	p	1	Normalized	1	Normalized
Aggregate separation rate	s	0.09	[A]	0.16	[E]
Entrants' separation rate	s^e	0.25	[A]	0.42	[B]
Incumbents' separation rate	s^i	0.055	[C]	0.025	[B]
Discount rate	r	0.01	[B]	0.01	[B]
Net replacement rate	π	0.16	[B]	0.49	[B]
Leisure parameter	b	0.72	[D]	0.42	[D]
Cost of vacancy	c	0.45	[B]	0.45	[B]
Matching efficiency	κ	1.94	[C]	0.95	[C]
Elasticity of $f(\theta)$	α	0.72	[B]	0.85	[B]
Worker's bargaining power	β	0.16	[D]	0.15	[D]
Entrant's separation costs	γ^e	0.00	[A]	0.00	[A]
Incumbent's separation costs	γ^i	0.00	[A]	4.67	[A]
Severance payments parameter	φ	0.00	[A]	0.54	[A]
Training costs	ξ	0.31	[B]	0.03	[B]
Incumbent conversion rate	ι	0.25	[B]	0.05	[E]
Labor market tightness	θ	0.44	[C]	0.21	[C]
Unemployment rate	u	0.055	[A]	0.170	[A]
Job finding rate	$f(\theta)$	1.54	[C]	0.54	[C]
Job filling rate	$q(\theta)$	3.45	[B]	3.45	[B]
Note:	[A] Own calculation based on original data; [B] Other studies; [C] Obtained from model;				
	[D] Obtained from model according to target elasticity $\eta_{f(\theta),\pi}$;				
	[E] Obtained from model according to target share $\frac{n^e}{(1-u)}$				

The remaining parameters are the employment opportunity cost (z) and the worker's bargaining power (β). As in Mortensen and Pissarides (1999) z has two components: leisure (b) and the net average unemployment benefits replacement rate (π). We set the latter in accordance with Cahuc and Zylberberg (2004), p. 156: $\pi = 0.16$ in the US and $\pi = 0.49$ in Spain. In turn, the other two are chosen to simultaneously satisfy

²⁰This takes into account: (i) the initial productivity gap between entrants and incumbents; and (ii) what both kind of workers fail to produce while receiving and providing on-the-job training. According to Silva and Toledo (2005), two thirds of these costs are related to the initial productivity gap of around 40% between entrants and incumbents.

the equilibrium condition (15) and the target elasticity of unemployment duration with respect to unemployment benefits, $\eta_{f(\theta),\pi}$. For the US, Katz and Meyer (1990) estimate it to be between 0.8 and 0.9 and we fix $\eta_{f(\theta),\pi} = 0.9$ (see also Cahuc and Zylberberg [2004], p. 158); while Addison Centeno and Portugal (2004) place it in Spain between 1.55 and 1.84 and we set $\eta_{f(\theta),\pi} = 1.84$. The remaining parameters are, for the US $\beta = 0.16$ and $b = z - \pi = 0.72$, whereas for Spain we have $\beta = 0.15$ and $b = z - \pi = 0.42$.

5.2 Simulated results

This section provides the base-run simulation of the paper with a twofold objective: (i) to show that the model is able to match the key characteristics of the US and the Spanish labor markets; and (ii) to provide a benchmark case against which the results in section 6 can be compared.

The relationship between the separation rate and productivity is endogenous in Mortensen and Pissarides (1994), but exogenous in Shimer (2005). Given the low correlation of these variables in the US and Spain, we follow Shimer (2005) and consider shocks on these variables to be simultaneous but independent. Therefore, we assume s^e , s^i and p to behave according to the following three nonlinear functions: $s^e = e^{(\sigma_{se}\omega_s y)} s_*^e$, $s^i = e^{(\sigma_{si}\omega_s y)} s_*^i$ and $p = z + (p^* - z) e^{(\sigma_p\omega_p y)}$, where y is an Ornstein-Uhlenbeck process with persistence ζ and standard deviation σ_y ; ²¹ σ_{se} , σ_{si} and σ_p are the parameters for the relative volatilities of entrants and incumbents' separation rates and labor productivity; p^* , s_*^i and s_*^e are the long-run values of the corresponding variables; and ω_s and ω_p are vectors taking randomly zeros and ones, such that $\rho(p, s) \approx 0$. Note that: (i) the case where σ_{se} , σ_{si} and σ_p are positive but take different values allows for different volatilities of s^e , s^i and p (also encompassing the particular case where $\sigma_{se} = \sigma_{si} = \sigma_p = 1$, in which case the volatility of s^e , s^i and p is the same); and (ii) when the vector $\omega_s = 0$ and $\omega_p \neq 0$, p is the only driving force of the model, whereas when $\omega_p = 0$ and $\omega_s \neq 0$, there are only separation shocks.

We work with a discrete space state model with $2n + 1 = 101$ grid points, and simulate it in the following way: we start with an initial level of s^e , s^i and p , and its corresponding vacancy-unemployment ratio (θ) given by the solution of equation (15). Then we compute the time until the arrival of next shock, which is exponentially distributed with parameter λ . When the shock arrives, the unemployment rate (u), the 'short-term' (n^e) and the 'long-term' (n^i) employment rates change according to equations (7)-(9); while s^e , s^i and p vary as described in Shimer's (2005) appendix C. Overall, θ changes so that equation (15) is satisfied. At the end of each period (quarter) we record the level of each variable. We create 1000 sample paths of 1072 quarters, throw away the first 1000 and keep the 72 quarters corresponding to 1987-2004; detrend the generated data using the HP filter with the smoothing parameter equal to 10^5 ; and calculate the standard deviations, autocorrelation coefficients and correlation matrix.

Tables 5 and 6 are the simulated counterparts of tables 2 and 3. At the top, they show the assumption on the values of σ_y , σ_{si} , σ_{se} , σ_p and ζ needed to approximate the standard deviations as well as the autocorrelation process of the aggregate separation rate (s) and labor productivity (p) in the US and Spain, respectively. The assumption on σ_{si} and σ_{se} deserves further comment. Ideally they should be obtained from the stylized

²¹See section 2D and appendix C in Shimer (2005), and section 8.5 in Taylor and Karlin (1998) for further details on this process.

facts, but in Spain we lack data on the short-run unemployment (less than 3 months) before 1987. Nevertheless, we have data on the number of unemployed that have been less than 6 months in this situation. Our second best is thus to consider this group as short-run unemployed and compute the aggregate separation rate (s). When examining the volatility of s , the main feature is that it doubles in the mid 1980s, after the labor market reform.²² This has already been documented (see García-Fontes y Hopenhayn [1996]) and allows us to infer that the volatility of the incumbents' separation rate is half the entrants' one ($\sigma_{si} = 0.5\sigma_{se}$). In the US we also expect differences because high-tenured workers have job-specific capital and low-tenured workers are the natural candidates for separation; in the absence of additional information, we also assume $\sigma_{si} = 0.5\sigma_{se}$ for this country.

Table 5. Simulated results for the US with PMLTC. 1987-2004.

Parameters required to simulate the shocks:								
	$\sigma_{se} = 0.5;$	$\zeta = 0.09;$	$\sigma_{si} = 0.5\sigma_{se};$	$\sigma_p = 1;$				
	$\sigma_y = 0.08;$	$\omega_s = 1$	for all $p;$	$\omega_p \neq 0.$				
	u	v	v/u	f	s	w	p	
Std. deviation	0.07	0.17	0.22	0.06	0.05	0.01	0.01	
Autocorrelation	0.73	0.72	0.79	0.79	0.19	0.79	0.79	
	u	1	-0.66	-0.81	-0.81	0.33	-0.78	-0.77
	v		1	0.97	0.97	0.05	0.96	0.96
	v/u			1	1.00	-0.06	0.98	0.98
Correlation	f				1	-0.06	0.98	0.98
matrix	s					1	-0.02	0.00
	w						1	1.00
	p							1

The results in tables 5 and 6 show a fairly correct match of some labor market characteristics. In particular, they yield strong predictions with respect to some contemporaneous correlations, like the negative one between unemployment (u) and vacancies (v), placed at -0.66 in the US and -0.63 in Spain; or the standard deviation of vacancies in both countries (0.17 and 0.39), which are very close to the actual ones (0.21 and 0.44). However, they perform somewhat off-target in other dimensions, like the autocorrelation of v , labor market tightness (θ) and the job finding rate (f), that are rather lower; the standard deviation of θ in the US (0.22 below the actual 0.35) and Spain (0.43 below 0.54); that of u in the US (0.07 below 0.15) and Spain (0.10 below 0.16); and that of f in the US (0.07 below 0.11) and Spain (0.06 below 0.16).

²²In particular, the standard deviation of the cyclical component of s rised from 0.07 in 1980-1986 to 0.14 in 1987-2004.

Table 6. Simulated results for Spain with PMLTC. 1987-2004.

Parameters required to simulate the shocks:								
	$\sigma_{se} = 1;$ $\sigma_y = 0.07$	$\zeta = 0.04;$ $\omega_p = 1$	$\sigma_{si} = 0.5\sigma_{se};$ for all $s;$	$\sigma_p = 0.28.$ $\omega_s \neq 0.$				
	u	v	v/u	f	s	w	p	
Std. deviation	0.10	0.39	0.43	0.07	0.12	0.01	0.01	
Autocorrelation	0.93	0.69	0.75	0.75	0.82	0.74	0.68	
Correlation matrix	u	1	-0.63	-0.64	-0.64	0.84	-0.15	-0.09
	v		1	0.78	0.78	-0.11	0.41	0.78
	v/u			1	1.00	-0.51	0.48	0.62
	f				1	-0.51	0.48	0.62
	s					1	-0.11	0.10
	w						1	0.66
	p							1

To show the relevance of PMLTC, in table 7 we present the simulated results without PMLTC ($\gamma^e = \gamma^i = \xi = 0$). As in Shimer (2005) and Silva and Toledo (2005), the model without training and separation costs yields a relatively low variability of the relevant variables, with standard deviations that are at most 50 percent as volatile as in the case with PMLTC. It is important to emphasize that a reduction in these costs forces the employment opportunity cost (z) to be larger in order to keep unchanged the rest of parameters and target elasticities. In particular, to maintain the benchmark steady state, z needs to increase from 0.88 to 0.95 in the US and from 0.90 to 0.95 in Spain. This result has a far-reaching implication: our matching model with PMLTC is able to generate (i) sufficiently large cyclical fluctuations in labor market tightness, and thereby deal with Shimer's puzzle; and (ii) a sufficiently small response of unemployment to unemployment benefits solving at least partially Costain and Reiter's puzzle.²³

Table 7. Simulated results *without* PMLTC. 1987-2004.

	u	v	v/u	f	s	w	p
Standard deviations							
US ($z = 0.95$)	0.04	0.09	0.11	0.03	0.05	0.01	0.01
Spain ($z = 0.95$)	0.08	0.10	0.14	0.02	0.12	0.01	0.01

5.3 PMLTC and the Beveridge curve

The previous results are strongly related to the volatility of the different shocks (σ) and the persistence of their stochastic processes (ζ): the more persistent and volatile is the

²³To see why it happens, let us calculate the elasticity of θ with respect to z from the equilibrium condition (15). For simplicity, we assume $\varphi = 0$ and $s^e = s^i$. Therefore, $\frac{d \log(\theta)}{d \log(z)} = -\frac{z}{\{(r+s)[p(1-\xi)-z]+\iota[(p-z)+\gamma^i s]\}} \frac{(r+s+\iota)[r+s+f(\theta)\beta]}{[\alpha(r+s)+f(\theta)\beta]}$. Clearly, the direct effect of γ^i reduces this elasticity. At the same time, although the direct effect of ξ tends to increase it, the underlying presence of the training conversion rate (ι) may revert this positive effect, at least partially. Notice that higher values of z enhance this elasticity. Thus, under our strategy of calibration higher PMLTC require lower values of z to maintain the target elasticity, and vice-versa.

driving shock, the higher its amplification mechanism.²⁴ Besides, further simulations with different combinations of shocks (that is, on p given s ; on s given p ; and on s and p with perfect positive and perfect negative correlation) reveal one extra important feature: the larger the negative correlation between s and p , the more important is the amplification mechanism of the shock.²⁵ A related and important issue concerns the relationship between PMLTC and the Beveridge curve. PMLTC allow the model to induce a negative correlation between vacancies and unemployment both under just labor productivity shocks (for a given s) and with just the separation rate as driving force. This qualitative result is in contrast with the standard search and matching model where, as outlined in Shimer (2005), there is a simultaneous rise in unemployment and vacancies in response to a shock in s and a positive correlation between these two variables, ‘an event that has essentially never been observed in the United States at business cycle frequencies’. To illustrate this result, in table 8 we show how the Beveridge curve in the US shifts in response to different scenarios of PMLTC and shocks to separations (as before, z is correspondingly adjusted to maintain the same steady state).²⁶

Table 8. PMLTC and the Beveridge Curve in the US. Shocks in s (given p).

Parameters for the shock: $\sigma_{se} = 1; \sigma_{si} = 0.5\sigma_{se}; \sigma_p = 0; \zeta = 0.009; \sigma_y = 0.06$							
Scenarios:	Standard deviations			Coefficient of Correlations			
	u	v/u	v	$\rho(s, u)$	$\rho(s, \theta)$	$\rho(s, v)$	$\rho(v, u)$
$\gamma^i = 0.0$							
$\xi = 0.0$	0.13	0.05	0.09	0.93	-0.99	0.83	0.96
$\xi = 0.30$	0.17	0.60	0.51	0.92	-0.94	-0.01	0.19
$\xi = 0.60$	0.23	1.80	1.65	0.85	-0.82	-0.23	-0.11
$\xi = 0.0$							
$\gamma^i = 1.0$	0.15	0.18	0.12	0.93	-0.97	0.16	0.40
$\gamma^i = 2.0$	0.21	1.22	1.10	0.91	-0.89	-0.16	-0.01
$\gamma^i = 4.0$	0.30	2.70	2.49	0.79	-0.70	-0.27	-0.23

In the standard case, without PMLTC ($\gamma^e = \gamma^i = \xi = 0$), there is a strong and positive correlation between vacancies (v) and unemployment (u). Once PMLTC are operational, the higher the firing and training costs the weaker this positive relationship, which is eventually reverted. The rationale under this result is simple. With firing and training costs labor market tightness (θ) becomes more sensitive than u in response to shocks in s ; given $v = \theta u$, the negative effect on θ dominates the positive impact on u and reduces v during the shock.

²⁴The role played by the persistence of shocks is studied in Section 8 of Hornstein, Krussell and Violante (2005).

²⁵The amplification mechanism of countercyclical movements in the job destruction rate has been analyzed in den Hann, Ramey and Watson (2000) and in Mortensen (2005).

²⁶This is a general qualitative result of the search and matching model with PMLTC. For the sake of brevity we just present the US case.

5.4 Sensitivity to changes in PMLTC

Next we examine the implications of modifying ξ , γ^e and γ^i on the volatility of the labor market tightness (θ). The steady-state values of v , u and θ are adjusted in accordance with these changes, which implies: lower v (the surplus of new hires (J^e) falls with higher PMLTC); higher u (it is more difficult for workers to find a match); and, therefore, lower θ (given s). Recall that the values underlying our benchmark simulation (displayed in boldface in table 9) are $\gamma^e = \gamma^i = 0.00$, $\xi = 0.31$ for the US, and $\gamma^e = 0.00$, $\gamma^i = 4.67$, $\xi = 0.03$ for Spain.

Table 9. Short-run effects of PMLTC. Standard deviations of θ.				
	US		Spain	
Actual		0.35		0.54
Simulated		0.22		0.43
Scenarios:				
Individual effects of ξ :	$\xi = 0.03$	0.11	$\xi = 0.03$	0.43
	$\xi = 0.31$	0.22	$\xi = 0.05$	0.66
	$\xi = 0.60$	4.86	$\xi = 0.10$	2.60
	$\xi = 0.70$	0.21	$\xi = 0.25$	0.81
	$\xi = 0.80$	0.00	$\xi = 0.31$	0.00
Individual effects of γ^i :	$\gamma^i = 0.00$	0.22	$\gamma^i = 0.00$	0.13
	$\gamma^i = 1.00$	0.34	$\gamma^i = 4.67$	0.43
	$\gamma^i = 2.00$	4.33	$\gamma^i = 10.00$	2.90
	$\gamma^i = 4.00$	0.48	$\gamma^i = 20.00$	0.27
	$\gamma^i = 5.00$	0.00	$\gamma^i = 40.00$	0.00
Individual effects of γ^e :	$\gamma^e = 0.00$	0.22	$\gamma^e = 0.00$	0.43
	$\gamma^e = 1.00$	0.67	$\gamma^e = 1.00$	0.84
	$\gamma^e = 1.75$	1.51	$\gamma^e = 2.00$	0.39
	$\gamma^e = 3.00$	0.00	$\gamma^e = 4.00$	0.00
Simultaneous effects (DMP model; no PMLTC):				
	$\xi = 0, \gamma = 0$	0.11	$\xi = 0, \gamma = 0$	0.12

As shown in table 9, there is a large and non-linear sensitivity of the labor market tightness volatility to changes in PMLTC. When $\gamma^{e,i}$ and ξ are raised from low values, θ displays a higher volatility; however, when $\gamma^{e,i}$ and ξ are raised from large enough values, the variability of θ is reduced. The initial positive effect has been documented by Millard (2000) and Silva and Toledo (2005), but the change in the sign of this relationship is a new outcome arising from the interaction between the annuity value of a vacancy (4), and the free entry condition (10) whereby firms open vacancies whenever the expected value of doing so is positive. In the presence of high PMLTC, positive shocks need to be sufficiently large to stimulate job creation. The frequency of such shocks is scarce, firms have less opportunities to take advantage of them and reduce the frequency of job creation and, at some level, its variability. At the limit there is a situation where firing costs are large enough so as to prevent firms to hire at all and the variability is null.²⁷ This result is consistent with the static comparative analysis provided by equations (17) and (18) showing a higher sensitivity of the firm's surplus

²⁷In terms of the model, this situation implies $J_e < 0$ for all values of (p, s) .

with respect to γ^e than to γ^i . The reason is clear: γ^e gives bargaining power to the entrants (apart from the incumbents) which reduces the firms' surplus (J_e) and makes firms even more sensitive to shocks.

Finally, along the lines of the exercise presented in table 7, the last row of table 9 displays the results from a scenario without heterogeneity among matched workers (that is, in the absence of gaps in productivity and separation costs so that the conversion rate between entrants and incumbents becomes irrelevant). The fact that the standard deviation of θ is considerably reduced in both countries further outlines the significant role played by these gaps in explaining the observed volatility in the US and the Spanish labor markets. However, remember that this exercise not only eliminates these gaps, but also any kind of PMLTC, which is not the case of Spain before the first reform introduced in 1984 (at the time the presence of firing restrictions was the main feature of its EPL). To provide a realistic explanation of why the Spanish labor market has achieved the same volatility of the US one we need to consider an scenario with lower segmentation, but with PMLTC.

6 Firing costs in entry-level jobs: reversing the 1984 reform

Our model with firing costs in entry-level jobs (γ^e) confers realism to our theoretical setup and allows an evaluation of the effects of the 1984 Spanish labor market reform on the volatility of vacancies, unemployment and labor 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 firing costs for entry-level jobs.

Provided the volatility of the labor market changes in the right direction, the objective of next exercise is to proxy the quantitative impact of the 1984 labor market reform. It is well known that this reform entailed the transition from a one-tier to a two-tier labor relation system; hence, to capture its impact we revert this dualism precisely by restricting the model so that the gaps in PMLTC, needed to match the labor market volatility in the post-reform period, do not play any role. Thus, it is important to note that we evaluate the consequences of adopting today the main aspect of the EPL in those years: the high level of firing costs for all workers (recall that about 90% had permanent contracts).

To conduct this exercise implies the following assumptions. First, in section 4 our model distinguishes the entrant's from the incumbents' firing cost, with $\gamma^e \neq \gamma^i$. Because before the reform this was indistinguishable, we set $\gamma^e = \gamma^i$. In the context of our model, this implies firms have no incentives to use fixed-term contracts. Hence, our second assumption is to set $\iota = 0$, since the conversion rate from temporary to permanent contracts is irrelevant. Under homogeneity in both sides of the labor market, the productivity gap also becomes irrelevant and we can safely set $\xi = 0$,²⁸ which is our third assumption. Observe that according to equations (13) and (14) this implies $w_{p,s}^e = w_{p,s}^i$ so that the model reduces to the standard insider model of Mortensen and Pissarides (1999). The fourth assumption concerns the aggregate separation rate (s).

²⁸In our model this parameter is not crucial to explain the volatility of the labor market. We also know on-the-job training is not important in Spain.

Any policy change alters the dynamics of both the job creation and the job destruction processes, but s is exogenous. Thus, to provide an accurate quantitative measure of the impact of the 1984 reform we need to disentangle these two effects which drives us to perform the exercise in several steps.

- First, we simulate the model holding the *post-reform* level and volatility of s and we set $s^e = s^i = s = 0.155$ with standard deviation equal to 0.12. These results are presented in the first block of table 10 and add the effects of the labor market reform via the job creation process (which come from the simulation) and via s (because we have assumed the post-reform characteristics of s).
- Second, we assume the level and volatility of s take their lower *pre-reform* values and we set $s^e = s^i = s = 0.025$ with standard deviation equal to 0.06. These results are presented in the second block of table 10 and show how would have been the post-reform volatility if just the job creation process had been operational. The comparison with the results in block 1 allow us to know the role played by the job destruction process.
- Third, we assume the level of s takes its pre-reform value, $s^e = s^i = s = 0.025$, and the volatility its post-reform value, $\sigma_s = 0.12$. These results are presented in the third block of table 10 and show how would have been the post-reform volatility considering the job creation process and the part of the job destruction process associated with a higher volatility (but not the part associated with a change in the level of s). In this way, we just capture one of these two components and we can further explain our results (see below).

Table 10. Changes in volatility due to the 1984 reform

	$s = 0.155$			$s = 0.025$			$s = 0.025$		
	<i>std.dev.</i> = 0.12			<i>std.dev.</i> = 0.06			<i>std.dev.</i> = 0.12		
	u	v	v/u	u	v	v/u	u	v	v/u
Std. deviation	0.02	0.06	0.05	0.01	0.05	0.05	0.02	0.16	0.16
Autocorrelation	0.97	0.97	0.84	0.98	0.98	0.83	0.98	0.98	0.84
Correlation Matrix									
	u	v	v/u	u	v	v/u	u	v	v/u
u	1	0.99	0.00	1	0.98	0.00	1	0.95	0.00
v		1	0.00		1	0.00		1	0.05
v/u			1			1			1

From block 1 we observe that in the absence of the 1984 labor market reform the volatility of u , v and v/u would have been 0.02, 0.06 and 0.05 instead of our benchmark predictions of 0.10, 0.39 and 0.43 in table 6. This implies that according to our model, the volatility of these three variables increased 5.0, 6.5 and 8.6 times, respectively. If just the job creation channel had been operational (results shown in block 2), these volatilities would have been 0.01, 0.05 and 0.05, which implies that the job destruction channel did not have a substantial effect on the volatility of the labor market tightness. Of course, the natural question to be asked given this results is: Why the dramatic change in the behavior of the job destruction process in the post-reform period does not affect the volatility of the relevant variables? Although a lower volatility in s reduces

the variability of the labor market tightness, a reduction in the level of the separation rate rises it, both effects cancel out and the job destruction process has no impact on the volatility of the labor market in response to the policy change. Had the change in the volatility of the job destruction process been operational (that is, had this process not been cancelled out by the level effect), the volatilities of u , v and v/u would have been increased three times and achieved, respectively, 0.02, 0.16 and 0.16 (third block in table 10). Of course, this did not happen, but clarifies why the job destruction process does not play a significant role and, therefore, why we can conduct this analysis despite s has not been endogenized.

What is the actual variation in the volatility we are trying to match? This is shown in table 11,²⁹ which reveals three main changes: (i) the persistence in u , v and v/u rose substantially, reaching almost 1 in all cases; (ii) the correlation between u and v increased significantly, from -0.34 to -0.64;³⁰ and (iii) the volatility of u , v and v/u increased from 0.05, 0.22 and 0.26 to 0.16, 0.44 and 0.54. This implies volatilities 3 times (in the first case) and 2 times higher, far below our predictions of 5.0, 6.5 and 8.6.

	Pre-reform (1980-84)			Post-reform (1987-2004)		
	u	v	v/u	u	v	v/u
Std. deviation	0.05	0.22	0.26	0.16	0.44	0.54
Autocorrelation	0.71	0.57	0.59	0.97	0.94	0.96
Correlation Matrix						
	u	v	v/u	u	v	v/u
	u	1	-0.34	-0.78	1	-0.64
	v		1	0.84		1
	v/u			1		1

The conclusion we drive from this exercise is that our model is helpful in explaining the direction of the change in the labor market volatility 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 labor market brought by the 1984 reform and still unresolved by subsequent reforms (see Dolado, García-Serrano and Jimeno [2002] and Osuna [2005]) can be considered the main reason why the Spanish labor market has become as volatile as the US one. However, from a quantitative point of view, our simulations clearly overestimate the magnitude of the change in the volatility of the key labor market variables.

7 Conclusions

This paper focuses on the role of the non-wage labor costs in the labor market, an issue that has become increasingly important in the design of the labor market policies in

²⁹The starting year of the first period is 1980, when the Worker's Statute was passed. The first year of the second period is 1987, coinciding with a new methodology of the Labor Force Survey that, for the first time, distinguishes temporary from permanent workers.

³⁰We do not interpret the results in terms of correlations because underlying these simulations there are high firing costs. Hence, in terms of the model, there is virtually no incentive to open vacancies in good times which generates counterfactual implications for the simulated correlations.

the OECD countries. Among the non-wage costs, we distinguish between pre-match LTC (mainly hiring costs) and PMLTC, which have been the target of the main labor market reforms occurred in Spain in 1984, 1994, 1997 and 2001. The main consequence of the first reform was the creation of a segmented labor market, which has been tried to be reversed by the subsequent ones. Overall, a structural change in the sensitivity of employment with respect to GDP growth occurred in the mid 80s, and was further enhanced in the 90s, making the Spanish labor market as volatile as the US one. This similar volatility is by itself an important feature to be outlined, but still more important is to know the channels whereby Spanish and US firms achieve this flexibility, and its consequences.

With respect to the channels, US firms seem to consider a new hiring from the perspective of starting a long-term employment relationship: they get involved in providing training and enhancing the productivity of the new worker. In Spain, 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: (i) the conversion rate from entrants to incumbents is extremely low; and therefore (ii) there is a reduction in specific training offered by firms implying important costs in terms of productivity attainment. Our analysis extends the standard DMP model with heterogeneous workers and identifies the Spanish EPL as the ultimate cause of the Spanish firms' behavior, via the resulting gaps between entrants and incumbents in productivity and separation costs.

Our model allows to approximate the US and the Spanish stylized facts and to analyze the consequences of shocks affecting some crucial parameters representative of these two gaps. When these gaps increase in response to shocks, the simulated standard deviation of the labor market tightness varies depending on the initial values of PMLTC: if they are narrow, the labor market volatility is enhanced; if wide enough, the labor market volatility is reduced. This implies a non-linear relationship which calls for further research. What is even more important in terms of this paper are the results of the computational experiment we have conducted, consisting in simulating the Spanish economy with lower worker's heterogeneity. The advantages of performing this simulation are twofold. From a theoretical point of view, to remove this heterogeneity drives us to the well known standard DMP model (still extended with firing costs). From the empirical perspective, it allows us to seize the consequences of the segmentation in the Spanish labor market (that is, to consider a virtual scenario with lower segmentation, as before the mid 80s). Therefore, this simulation naturally provides an evaluation of the value added of this approach in explaining why the Spanish labor market has become as volatile as the US one. Not only we can explain why the Spanish labor market is as volatile as the US one, but also the mechanism whereby this volatility was achieved: via the entrant's and incumbents' gaps in productivity and separation costs at the entry-level jobs.

Our quantitative results have to be interpreted with caution. To answer the question opening this paper we have performed a quantitative exercise which is based on a qualitative interpretation of the policy change. Indeed, the analysis made of the effects of the 1984 Spanish labor market reform has been carried out by reversing the effects of this reform in years 1987-2004 and considering a change from a two-tier to a one-tier labor relations system. One limitation of our analysis is the exogeneity of the separation rate, even if different scenarios for this variable suggest that the job destruction process

did not play a significant role on the observed change in the volatility of the labor market when the reform was introduced. In any case, to push forward this analysis we would need separations to be endogenous which is left for future research.

To conclude, it is very important to note that achieving a similar labor market volatility is not synonymous of securing a similar labor market performance. On the contrary, this enhanced flexibility entails different problems that may threaten the Spanish economic performance in the new context of the EU-25. Labor costs have traditionally been the Spanish main source of competitiveness (together with exchange rate fluctuations, which disappeared with the Euro in 1999); thus, in the last decades, the labor market reforms have tackled the non-wage labor costs as the main device to compensate wage-costs increases. The fact that the EU has expanded its membership towards countries with much lower labor costs questions this strategy and directly challenges the Spanish economic strategy in the near future. Our analysis points to the importance of two gaps between entrants and incumbents: the one on separation costs, being mainly a regulatory issue; and a more structural one on productivity, directly affected by the first gap and, still more important, pointing to firm-provided training as a key factor. Albert, García-Serrano and Hernanz (2005) end up stating that ‘the fact that non-training firms are more prone to use temporary contracts is likely to be associated to productive features such as their job structure and the technology they use’, p. 84. Our last thoughts go in the same direction, but claiming that the causality of this association goes from the EPL to the production function. The challenge for Spain is to run away from its traditional labor cost competitiveness and devote much more effort to qualify its labor force in accordance with firms’ needs that should progressively converge to the more advanced countries’ ones.

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