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Hector Sala
José I. Silva

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Forschungsinstitut
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Institute for the Study
of Labor

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Hector Sala
Universitat Autònoma de Barcelona
and IZA Bonn

José I. Silva
Universitat Autònoma de Barcelona
and Central Bank of Venezuela

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IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
Email: iza@iza.org

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ABSTRACT

The Relevance of Post-Match LTC: Why Has the Spanish Labor Market Become as Volatile as the US One?*

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, we find the Post-Match Labor Turnover Costs (PMLTC) to be 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. The scenario with a low degree of workers' heterogeneity illustrates its suitability to understand why the Spanish labor market has become as volatile as the US one.

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

Keywords: search, matching, training, firing costs, productivity differentials

Corresponding author:

Hector Sala
Department d'Economia Aplicada
Universitat Autònoma de Barcelona
Edifici B
08193 Bellaterra
Spain
Email: hector.sala@uab.es

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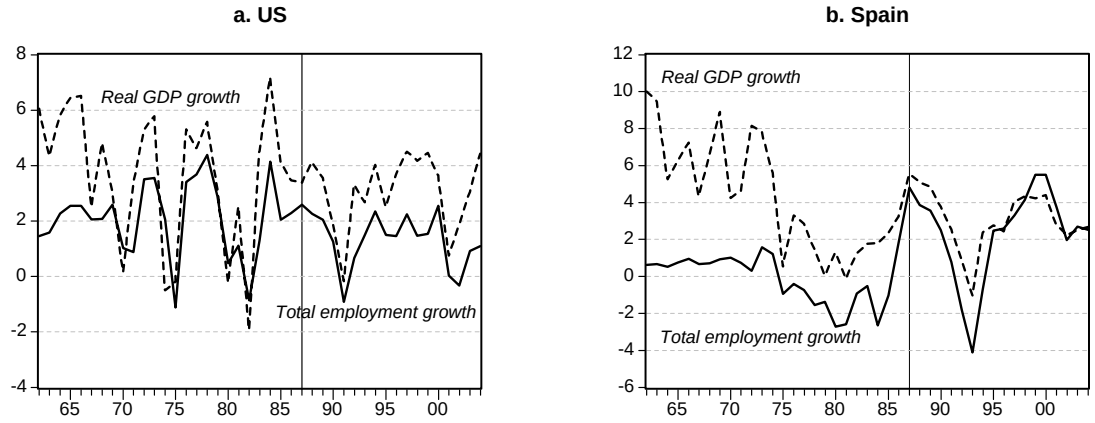
1. Introduction

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 structural 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. A summary of the main changes brought by these reforms is provided in Section 3, but it is worth mentioning that all of them aimed at enhancing the labor market flexibility. Given the increased sensitivity of employment to GDP growth, these reforms 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

[1] Other 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.

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 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.

In a recent paper analyzing the US labor market volatility, Silva and Toledo (2005) have outlined 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 to the fact of having permanent contracts with associated firing costs (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. For the entrants is 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. Summing up, 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 has already been used in the matching models of Wasmer (1999), Blanchard and Landier (2002), and Cahuc and Postel-Vinay (2002).

Of course, the use of the same modelling strategy for two different countries requires different targeted values in the calibration exercise, and different parameters accounting for the differences in PMLTC. We deal with these specificities throughout the paper

[2]It 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.

and use the calibrated parameters to replicate the main stylized facts of the US and the Spanish labor markets. It is under this benchmark that we analyze the cyclical implications of hitting these economies by different shocks and modifying some of their institutional features. The main findings from these simulations are the following. First, the US labor market augments its volatility mainly in response to productivity shocks, whereas shocks in the separation rate are the main driving force under the Spanish labor market volatility. 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.

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. Section 6 provides different simulations analyzing the consequences of altering some crucial parameters related to separation costs and labor productivity in the US and Spain. 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. The 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 used to compute the job finding and separation rates in the same way as Shimer (2005). Since only the aggregate series are available seasonally adjusted, to obtain consistent seasonally adjusted time series for all the series we use the U.S. Census Bureau's X12 seasonal adjustment program. From the CTRE, we obtain the series on average labor

productivity and wages. The time series on vacancies is obtained from the MEI. All these series are also seasonally adjusted by X12.

Table 1. Data: definitions and sources.

	Definitions:	**Sources:**	
		US	Spain
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 (-0.39 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 $v-u$, 0.36, is about 22 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 the 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*0.21) is close zero and thus virtually acyclic, implying that the $v-u$ ratio is intensively procyclical, with a standard deviation of 0.36. This ratio moves together with the job finding rate (the rate at which unemployed find jobs on average). 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 downturns. 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 empha-

sized 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.

Table 2. Summary statistics. Quarterly US data, 1987-2004.

		u	v	v/u	f	s	w	p
Std. deviation		0.154	0.213	0.363	0.115	0.054	0.018	0.014
Autocorrelation		0.949	0.948	0.950	0.921	0.711	0.929	0.785
	u	1	-0.905	-0.962	-0.958	0.407	0.101	0.343
	v		1	0.986	0.828	-0.605	-0.259	-0.379
	v/u			1	0.902	-0.534	-0.198	-0.392
Correlation	f				1	-0.184	0.058	-0.245
matrix	s					1	0.535	0.082
	w						1	0.540
	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, 0.525, is almost 50 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, 0.155, is multiplied by the standard deviation of vacancies, 0.41, the resulting value, 0.06, 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 observe the smaller correlation of the percentage deviation of unemployment and vacancies from trend in Spain, -0.64, as compared with the US, -0.91. The standard deviation of the separation rate is 0.11 and displays a negative correlation of -0.85 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 -0.76 with respect to vacancies (versus 0.54 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 the 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).

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

		u	v	v/u	f	s	w	p
Std. deviation		0.155	0.411	0.525	0.158	0.113	0.014	0.011
Autocorrelation		0.970	0.940	0.956	0.635	0.852	0.854	0.661
	u	1	-0.637	-0.798	-0.362	0.843	0.727	0.659
	v		1	0.973	0.536	-0.764	-0.336	-0.443
	v/u			1	0.528	-0.849	-0.480	-0.544
Correlation	f				1	-0.535	-0.247	-0.184
matrix	s					1	0.536	0.510
	w						1	0.594
	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: higher general labor productivity increases the relative number of vacancies to unemployment (θ), thus making easier for workers to find a job elsewhere, and more difficult for firms to recruit a worker. 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, 0.51). Since this implies 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 independent.

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 very close to the US one (-0.43 and -0.44 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 gap in separation costs and the gap in 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 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 detail 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.[3]

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, whereas the Spanish one is highly restrictive. The World Bank Doing Business survey provides a detailed study of the EPL in many countries, and estimates the separation cost in 2004 to be equivalent to 8 weeks of weekly wages in the US, and more than 8 times the US ones in Spain, reaching 68 weeks of weekly wages (the OECD mean is placed at 40.4).[4] This takes into account the cost of advanced notice requirements, severance payments and penalties due when firing a worker. In turn, a difficulty of firing index is placed at 10.0 in the US and 60.0 in Spain (the OECD average is 26.8).

Despite these figures, one of the most interesting features of the EPL in Spain are the changes undertaken in the last decades to reverse what traditionally has been one

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

[4] See pages 126 and 129 at http://www.doingbusiness.org/documents/DoingBusiness2005.PDF. The methodology used in the analysis is the one in Botero *et al.* (2004).

of the main distinctive features of the Spanish labor market: the persistence of its unemployment rate. The causes of this persistence have commonly been ascribed to a variety of institutional factors among which is the EPL -see Dolado and Jimeno (1997)-.[5] The two main elements of the Spanish EPL refer to the fixed-term legislation and the firing restrictions on permanent contracts.

Before democracy, the Spanish labor relations system was characterized by the existence of one official union (unions were legalized in 1977) and an essentially tenured-employment system. The Constitution in 1978 recognized the basic social and labor rights, and in 1980 the Worker's Statute comprising all the labor legislation was passed. 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. Despite fixed-term contracts were not introduced for the first time, the limits on their use were virtually abolished in 1984, prompting a boom in temporary employment.[6] 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: a labor market segmentation along the duality of contract statuses, with a flexible low-paid segment and an inflexible segment of permanent workers. 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.[7] This has had several negative consequences such as: i) a reduction in training and the formation of human capital (Jimeno and Toharia, 1993); and ii) a reduction in effort and labor productivity (Sánchez and Toharia, 2000).

Let's now turn to the firing costs which, together with the fixed-term contracts legislation, is the second main source of the gap in the separation costs of the entrants and the incumbents in the Spanish labor market. The Worker's Statute introduced a strong protection on permanent workers, establishing that firms could fire workers adducing personal reasons (having to do with problems caused by the worker) or economic reasons (related to the needs of the firm given its conjunctural situation). The legislation gives strong support to the worker's right to question the firm's decision, therefore in practice, the relevant severance payments have always been those set for dismissals due to personal reasons and qualified as unfair in the labor courts. This amounts to 45 days' wage per worked year, with 3.5 years-ceiling (compared to 20 day's wage per worked year in case of an economic or a fair personal dismissal, with a 1 year-ceiling). In contrast, fixed-term contracts' dismissal protection and severance payments are very low. In 1984 the latter were set to 12 day's wage per worked year, hardly relevant due to the short duration of these type of contracts. This explains the boom in fixed-term contracts and the subsequent effort in 1994 to reverse the consequences of the 1984 labor market reform with a new regulation affecting: i) the fixed-term contracts, aiming

[5] The OECD (1999a) ranks the strictness of the EPL for 27 countries. The Spanish labor market is placed in the second position.

[6] Güell and Petrognolo (2003) provide a detailed account of the legislation on fixed-term contracts in their Appendix.

[7] This 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.

at reducing temporary employment; and ii) the definition of dismissals for economic reasons, introducing the concept of dismissals for objective reasons.[8] Since this reform had scarce effects on the share of temporary employment, as soon as in 1997 a new reform was passed, again with the target of reducing the labor market segmentation, but this time directly affecting the legislation on permanent contracts. One of the main two changes was to reduce severance payments from 45 to 33 days' wage per worked year (with a 2 years-ceiling) of the new permanent contracts signed by young and old unemployed (less than 30 or more than 45 years old), long-term unemployed, disabled workers or workers employed under fixed-term or training contracts.[9] The other one was to introduce subsidies on the conversion from fixed-term contracts to permanent ones by reducing the payroll taxes.[10] Finally, the 2001 reform essentially extended the 1997 firm's incentives to hire on a permanent basis.

The question immediately arising from this analysis is the following: if, notwithstanding these changes, the overall characterization of the EPL in these labor markets is still the traditional one (the US EPL keeps among the less restrictive ones, whereas the Spanish EPL is highly restrictive), why has the Spanish labor market attained a similar volatility than the US?

The first part of the answer points to the gap in the separation costs between the entrants (with virtually no separation costs, as we have just seen) and the incumbents (subject to high severance payments, despite the recent labor market reforms). This has created a group of new hired workers which is mainly used by firms to quickly adjust their workforce in Spain.

The second part of the answer lies in the productivity gap between the entrants (essentially the fixed-term employees in Spain) and the incumbents (the permanent ones). One of the main determinants of this gap is the cumulative qualification experienced by tenured workers via learning-by-doing and on-the-job training.

3.2. The productivity gap

Firm-provided training in the US is crucial. Such an importance arises from the fact that this kind of training is mainly *specific* -as opposed to *general*, following the definition of Gary Becker- and induces firms and workers to be interested in keeping stable their relationship. From the firm's side, the interest lies in recovering its expenses in training in the form of higher labor productivity, whereas from the worker's side there is a capital loss in case of abandoning the firm. Therefore, 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, the separation costs for the firm in the US are mainly due to the loss of the firm's investment on the worker leaving the firm.

Barron, Berger and Black (1997) provide some information on the incidence of firm-provided training in the US. In particular, 95% of the entrants (new employees) receive

[8] Other changes were: i) the introduction of private employment agencies, breaking the monopoly of employment services hold by the National Employment Institute (*Instituto Nacional de Empleo, INEM*); and ii) measures to strength collective bargaining at a decentralized level with the goal of fostering labor mobility.

[9] An unfair dismissal for personal reasons, or a dismissal for objective reasons, remained at 20 day's wage per worked year with a 1 year-ceiling.

[10] Exhaustive details on the changes introduced by this reform are provided in table 1 of Kugler, Jimeno and Hernanz (2002).

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 counterpart of these efforts can be found in the rising productivity of the entrants. This is evaluated in Bishop (1997), who finds an increase of about a third in the average productivity of the 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. This information is used in Silva and Toledo (2005) to infer an initial 40% productivity gap between the entrants and the incumbents, progressively reduced and becoming fully closed after one year by means of learning-by-doing and on-the-job training processes. 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, where firm-provided training is not relevant and, according to Güell and Petrognolo (2003), the conversion rate from temporary to permanent contracts is only 10%.[11] Since 1986 on-the-job-training has been partially financed by the European Social Fund (ESF), together with a 0.7% of the payroll taxes paid by firms.[12] These funds were originally managed by the INEM, but since 1993 were transferred to the Foundation for Continuing Training (*Fundación para la Formación Continua, FORCEM*), which has been the institution in charge of the labor market training up to 2004.[13]. It is worth noting that, despite the INEM first -and the FORCEM afterwards- have managed the training programmes, they have been mostly carried out by private firms. This covers the bulk of on-the-job training in Spain.[14]

The FTFE (2003) provides some data that allows to have a sense of the importance of these programmes. For example, the number of participants in training programmes increased from 1.3 M. in 1997 to 1.8 M. in 2001, which amounts to approximately 11% of total employment. In terms of funds, in 1995 the ESF contributed with 278 M. of euros, whereas the firm's payroll taxes levy contributed with 93 M. These quantities were 664 M. and 227 M., respectively, in 2003. Despite these may seem important quantities in absolute terms, since the Spanish GDP in 2003 was of 781.000 M. of euros, the total amount of funds devoted to occupational training amounts just to 0.11% of GDP.[15]

[11] Kugler, Jimeno and Hernanz (2002) analyze the effects of the 1997 reform. They find that this reform increased permanent employment probabilities for young workers (but had virtually no effects for older men); and that the transition probabilities from non-employment and temporary employment to permanent employment increased.

[12] The other two blocks of vocational training in Spain, which are not relevant to our analysis, consist on: i) the formal educational system on vocational training (concerning specially students, which are classified as inactive); and ii) training programs for unemployed which are in the Plan FIP (Formación para la Inserción Profesional) in charge of the Ministry of Labor and Social Issues, the INEM and the ESF. These programs are usually called occupational training.

[13] In november 2004 it merged with the Fundación Tripartita para la Formación en el Empleo. The latter institution is, since 2005, the one in charge of organizing, managing and distributing the funds and activities related with the training of employees in the Spanish labor market. It is a foundation participated by the social partners: the Spanish Ministry of Labor and Social Issues, the unions (CCOO and UGT, among others) and the main employer's organizations (CEOE and CEPYME).

[14] The opposite situation holds in the US even after the Workforce Investment Act (WIA) enacted in 1998, which is the major recent piece of job training legislation in the US. Indeed, according to the General Accounting Office, the federal job training policy remains fragmented and inefficient. Thus it is the private firm-provided training what matters the most.

[15] The OECD (2004) places the total labor market training at 0.22% of GDP in 2002, of which 0.12

Furthermore, Spain appears as the only European country were the role of the firm on firm–provided training is weak,[16] even though it increases with the size of the firm. With respect to the number of hours devoted to training, the annual average per employee is placed at 59.1; and is higher the better is the qualification of the worker.

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. A very useful study on this issue for Spain is Albert, García-Serrano and Hernanz (2005), who find that workers with fixed-term contracts are less likely to be employed in firms providing training; that in firms providing training to have fixed-term contracts reduces the probability of being chosen to participate in training activities; and that the training incidence increases with the educational attainment and with the firm size (non-training firms are generally smaller than training firms).

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, the main conclusion of the analysis on the training situation in Spain is that, given the low incidence of on-the-job-training, we should refer to learning by doing processes instead of referring specifically to training itself. Foremost, given the low conversion rate, the productivity gap is hardly overcome by the entrants. This is in contrast with the US labor market, where the presence of firm-provided training and the higher conversion rates of the new hirees to incumbents 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; workers and firms 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 $\theta_{p,s}$ where, the higher the number of vacancies with respect to the number of unemployed workers, the easier is for each of these workers to find a job $f'(\theta_{p,s}) > 0$, and the more difficult is for a firm to fill its 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

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.

[16] 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.

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

$$rU_{p,s} = z + f(\theta_{p,s})(W^e_{p,s} - U_{p,s}) + \lambda(E_{p,s}U_{p',s'} - U_{p,s}), \tag{4.1}$$

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 $\left(W^e_{p,s} - U_{p,s}\right)$; 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

$$rW^e_{p,s} = w^e_{p,s} - s^e(W^e_{p,s} - U_{p,s}) + \iota(W^i_{p,s} - W^e_{p,s}) + \lambda(E_{p,s}W^e_{p',s'} - W^e_{p,s}) \tag{4.2}$$

According to this equation, entrants earn an endogenous wage $w^e_{p,s}$, but lose their job at the rate s^e with an expected capital loss represented by $(W^e_{p,s} - U_{p,s})$. Entrants become incumbents at a rate ι, which entails a capital gain amounting to $\left(W^i_{p,s} - W^e_{p,s}\right)$. Finally, since the aggregate shock arrives at a rate λ, the expected change in their match value is $\left(E_{p,s}W^e_{p's'} - W^e_{p,s}\right)$.

If an entrant is not separated from the firm, he 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

$$rW^i_{p,s} = w^i_{p,s} - s^i(W^i_{p,s} - U_{p,s} - \varphi\gamma) + \lambda(E_{p,s}W^i_{p',s'} - W^i_{p,s}), \tag{4.3}$$

where the first term of the RHS gives the incumbent's wage; the second reflects the loss if the employment relationship is finished at the rate s^i; and the last one captures the expected gain from the aggregate shock. When a match with an incumbent worker is terminated, a proportion φ of the firms's loss (γ) goes to the worker as a severance payment, whereas the rest $(1 - \varphi)\gamma$ is assumed to be fully wasted. This component of the firing costs reflects, for example, administrative and legal charges, or efficiency losses due to the disruption of the regular flow of work from the experienced and full productive employees.

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

$$\begin{array}{lll} rV_{p,s} & = -c + q(\theta_{p,s})(J^e_{p,s} - V_{p,s}) + \lambda(E_{p,s}V_{p',s'} - V_{p,s}) \equiv \Psi & if \;\; \theta_{p,s} > 0 \\ & = \max\{0, \Psi\} & if \;\; \theta_{p,s} = 0. \end{array} \tag{4.4}$$

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 one 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

$$rJ^e_{p,s} = (p^e - w^e_{p,s}) - s^e(J^e_{p,s} - V_{p,s}) + \iota(J^i_{p,s} - J^e_{p,s}) + \lambda(E_{p,s}J^e_{p's'} - J^e_{p.s}). \tag{4.5}$$

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, $p^e - w^e_{p,s}$. 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 new employees can reach the productivity level of the existing workers in the firm. The second term reflects the loss associated with terminating the entry-level job and opening a new vacancy, and the third one 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 to permanent, thereby changing the status of that worker to incumbent.[17]

Equation (4.6) characterizes the present value for the firm of having a tenured job. If this tenured job is the result of a fixed-term employee becoming an incumbent, it yields instantaneous profits equal to $\left(p - w^i_{p,s}\right)$. If this tenured job is destroyed, the firm faces the separation costs shown by the second term of the RHS of the equation. The first part, $\left(J^i_{p,s} - U_{p,s}\right)$, indicates the direct loss associated with the termination of the match whereas, as before, there is a firm loss, γ, occurring when a match with an incumbent worker is terminated. On the contrary, in case of entrants' separations we assume null costs for the firm. There are a number of ways to justify this assumption. One is that, in general, such new employees have not yet developed special organizational links with the rest of the employees, nor special abilities already relevant to the firm. It is also plausible to think that, before offering a permanent contract entailing higher firing restrictions than the fixed-term contracts usually offered to the new employees, firms may first want to screen the new worker and make sure that fits in the organization. In countries like Spain, where firing costs associated to a long-term employment relationship are significantly high, firms prefer to use fixed-term contracts to adjust their labor force. As shown in Sections 2 and 3, this stems from the absence of firing costs on fixed-term employees, their high labor turnover, and the Spanish firms' preference to use layoffs in adjusting their workforce. Taking all this into account, the Bellman equation characterizing the incumbent's position is given by

$$rJ^i_{p,s} = \left(p - w^i_{p,s}\right) - s^i(J^i_{p,s} - V_{p,s} + \gamma) + \lambda(E_{p,s}J^i_{p',s'} - J^i_{p,s}). \tag{4.6}$$

[17] To avoid this restriction, the alternative is to finish the employment relationship with that employee and hire a new worker. This is usually done and 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.

Given the state-contingent ratio of vacancies to unemployment ($\theta_{p,s}$), the unemployment rate (u), the 'short-term'(n^e) and the 'long-term' (n^i) employment rates evolve according to the following backward-looking differential equations:

$$\dot{u} = s(1-u) - f(\theta_{p,s})u = s^e n^e + s^i n^i - f(\theta_{p,s})u, \tag{4.7}$$

$$\dot{n^e} = f(\theta_{p,s})u - (s^e + \iota)n_e, \tag{4.8}$$

$$\dot{n^i} = \iota n^e - s^i n^i. \tag{4.9}$$

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:

$$V_{p,s} = 0. \tag{4.10}$$

Since neither workers nor employers can instantaneously find an alternative match partner in the labor market, and since hiring, training and firing decisions are costly, a match surplus exists. To divide this surplus some bargaining must be invoked and we assume wages to be the result of bilateral Nash bargaining between the worker and the firm. These wages 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:

$$(1-\beta)(W^e_{p,s} - U_{p,s}) = \beta(J^e_{p,s} - V_{p,s}), \tag{4.11}$$

$$(1-\beta)(W^i_{p,s} - U_{p,s} - \varphi\gamma) = \beta(J^i_{p,s} - V_{p,s} + \gamma), \tag{4.12}$$

where $\beta \in (0,1)$ denotes the workers' bargaining power relative to the firms' one. Note that the Nash condition for the incumbents displays two extra terms depending on γ. Since separation costs are now operational, they are explicitly considered in the wage negotiation. This implies that the firm's threat point when negotiating with an incumbent is no longer the value of a vacancy $V_{p,s}$, but $(V_{p,s} - \gamma)$; 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 $\theta_{p,s}$:

$$w^e_{p,s} = (1-\beta)z + \beta c\theta_{p,s} - \beta p(1-\xi) - \beta\iota\gamma - \iota(1-\beta)\varphi\gamma \tag{4.13}$$

$$w^i_{p,s} = (1-\beta)z + \beta c\theta_{p,s} + \beta p + \beta r\gamma + (1-\beta)r\varphi\gamma \tag{4.14}$$

Observe that the wage of fixed-term workers ($w^e_{p,s}$) 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 may turn into incumbent workers with some probability (given by the hazard rate ι), in which case firms become liable to separation costs. As a consequence, firms perceive these costs as an expected loss that reduce the expected match surplus

and explains the negative effect of separation costs (γ) on the entrants' wage. The incumbent's wage ($w^i_{s,p}$) is higher because they are full productive workers (i.e., the productivity gap, in case of coming from the status of entrant, is closed) and separation costs are now operational, which increase the incumbents' bargaining power.

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 these costs. Therefore, $w^e_{p,s}$ 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:

$$\begin{aligned}\frac{r+s^e+\iota+\lambda}{q(\theta_{p,s})}+\frac{r+s^i+\lambda+\iota}{r+s^i+\lambda}\beta\theta_{p,s} &= \frac{(1-\beta)}{c}\left[p(1-\xi)-z+\frac{\iota(p-z)}{r+s^i+\lambda}\right] \\ &\quad -\frac{(1-\beta)}{c}\frac{\iota\gamma}{(r+s^i+\lambda)}\left[(1-\varphi)s^i-\lambda\varphi\right]+\lambda E_{p,s}\frac{1}{q(\theta'_{p,s})} \\ &\quad +\frac{\lambda\iota}{(r+s^i+\lambda)}\left(\frac{\beta\gamma+E_{p,s}J^i_{p's'}}{c}\right). \qquad (4.15)\end{aligned}$$

For each state (p,s), there is only one $\theta_{p,s}$ that satisfies this equation. In section 6 we solve this equation numerically to get the quantitative results of the model.

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 has been around one third during the last 15 years; and ii) less than 10% of the new hirees become permanent. In the second part we use these calibrated parameters to simulate the model and discuss these two countries' labor market business cycle volatilities.

5.1. Calibrated parameters

The calibration involves the following process in the steady state. We normalize the average incumbent's labor productivity (p) to 1. We set the real interest rate (r) at 1% per quarter, a value consistent with available empirical work for both countries. Using the Spanish Labour Force Population Survey for 1987-1997, Polavieja (2003) identifies an average job tenure of around 6 months for temporary employees and 150 months for permanent ones. Similarly, Arranz, García-Serrano and Toharia (2005) find an average job duration of 7 months for entrants. We set the job tenure of the temporary and the permanent workers equal to 7 months and 10 years, respectively, so that $s^e = 0.42$ and $s^i = 0.025$. These values imply an average separation rate (s) of 0.155. For the US, an average separation rate around 9% per quarter is given by the Job Opening Labor Turnover Survey (JOLTS): we set $s = 0.09$. In the absence of additional information, we assume that the entrant's separations in the US coincide, on average, with the end of their on-the-job training process so that $s^e = \iota$. 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 (4.7), 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-.

Following the literature, we assume the matching function to be Cobb-Douglas,

$$f(\theta) = \kappa\theta^{1-\alpha}. \tag{5.1}$$

Furthermore, consistent with Blanchard and Diamond (1989), we set the elasticity of the matching function with respect to unemployment (α) equal to 0.5, both in the US and Spain. We also assume workers and firms set the wage so that each of them obtain the same gain, $\beta = 0.5$.

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

		US	Spain
Long-run parameters:			
Labor productivity	p	1	1
Aggregate separation rate	s	0.09	0.16
Entrants' separation rate	s^e	0.25	0.42
Incumbents' separation rate	s^i	0.055	0.025
Discount rate	r	0.01	0.01
Unemployment flow utility	z	0.860	0.927
Labor market tightness	$\theta_{p,s}$	0.44	0.021
Unemployment rate	u	0.055	0.170
Job finding rate	$f(\theta)$	1.54	0.54
Job filling rate	$q(\theta)$	3.48	3.48
Cost of vacancy	c	0.094	0.094
Matching efficiency	κ	2.32	4.40
Elasticity of $f(\theta)$	α	0.50	0.50
Worker's bargaining power	β	0.50	0.50
Total separation costs	γ	0.67	5.70
Severance payments parameter	φ	0.00	0.65
Training costs	ξ	0.31	0.03
Incumbent conversion rate	ι	0.250	0.051

With information reported in Barron and Bishop (1985) and Senesky (2003), based on the 1982 US Employer Opportunity Pilot Project (EOPP), we estimate the hiring cost per worker in the US to be 77.2 dollars of 1982.[18] Assuming the wage of a full productive worker to equal its labor productivity, we set the average hiring cost at 2.7% of the normalized labor productivity, $\frac{c}{q(\theta)} = 0.027$.[19] In the absence of data on hiring

[18] According to Barron and Bishop (1985), table 2, the number of manhours spent by companies to fullfill a vacancy (in personnel recruiting, screening and interviewing applicants) is 9.9. In turn, Senesky (2003) reports supervisor's and incumbent's hourly wage of 7.8 and 6.0 in 1982 USD, respectively. Given 480 hours of work during a quarter, the total average cost of hiring a new employee is thus $\frac{9.9\times7.8}{480\times6.0} = \frac{77.2}{2880} = 0.027$ 1982 USD.

[19] Since do not take into account other costs, like advertisement costs, for which we do not have estimates, job matching may be a more costly process in the US.

costs for Spain, we rely on Abowd and Kramarz's (2003) finding of zero hiring costs for short-term contracts, which constitute the bulk of hires in Spain.[20]. Thus, we assume hiring costs to be low in Spain and we set them equal to the US ones.

Barron, Berger and Black (1997) document an average duration of a vacancy around 17 days, so $\frac{1}{q(\theta)} = 0.29$ and $c = 0.094$ 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 ($\theta = \frac{f(\theta)}{q(\theta)}$) must be 0.44 and 0.21 in the US and Spain, respectively. With α, $f(\theta)$ and θ the parameter κ that captures the efficiency of the matching process is equal to 2.32 in US and 4.40 in Spain, .

Let us now turn to the PMLTC parameters (γ, φ, ι and ξ). Following the 2004 World Bank Doing Business survey and again under the assumption that the wage of a full productive worker equals its labor productivity, we set $\gamma = \frac{8}{12} = 0.67$ in the US and $\gamma = \frac{68}{12} = 5.7$ in Spain. Osuna (2005) calculates severance payments in Spain to be around 3.7 times the quarterly wage of a worker with 9 years of job tenure. In accordance with the theoretical setup, we assume part of these separation costs -35%- to be wasted on dismissal regulations such as lengthy administrative and legal procedures; therefore, $\varphi = 0.65$ implying severance payments of $\gamma\theta = 3.7$ times the incumbent's labor productivity. Given that in the US severance payments are not mandatory, we set them at zero, $\varphi = 0$. Consistent with the share of temporary workers in Spain, the average rate at which temporary employees become permanent (ι) is obtained from equation (4.9) 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.[21] 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 Petrognolo (2003). Contrary to Spain, ι in the US is more closely related to the training process of a new worker than to the presence of important firing costs and other legal restrictions. Bishop (1997) shows that it takes around one quarter for a worker to become fully trained in a new job (coinciding with the 34% increase in productivity mentioned in Section 3). In contrast, the additional third between the first quarter and the end of the second year, can be mostly explained by the presence of a learning-by-doing process. Thus, as 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 (4.7), (4.8) and (4.9), and setting $\dot{n}^e = \dot{n}^i = 0$, we obtain the quarterly separation rate of an incumbent (s^i) and the ratio of entrants to incumbents $\left(\frac{n^e}{(1-u)}\right)$ which are, respectively, 0.055 and 0.18.

Using information from Barron, Berger and Black (1997) and Senesky (2003), Silva and Toledo (2005) estimate an average training cost in the US equivalent to 1.2 times the

[20] Using a representative sample of French establishments matched with a representative sample of their employees, Abowd and Kramarz (2003) estimate hiring costs at 3.3% of the yearly labor cost of the average worker, with "zero" hiring costs for short-term contracts.

[21] To obtain this value, note that the number of entrants n^e in period $t-1$ becoming incumbents in period t is equal to $n^e_{t-1}e^{-s_e(t-t_0)}[1-e^{-\iota(t-t_0)}]$. Therefore, given the number of new hired workers n^e_0 starting to work in period t_0, the proportion of them converted to permanent is equal to the: *Entrant's conversion rate*$= \frac{\sum_{t=1}^{\infty} n^e_{t-1}e^{-s_e(t-t_0)}[1-e^{-\iota(t-t_0)}]}{n^e_0}$, where $t_0 = 0$.

quarterly labor productivity of a fully productive worker.[22] We thus set $\frac{\xi}{\iota} = 1.2$ and $\xi = 0.31$. In Spain it seems reasonable to expect a small incidence of firm-provided training, thereby implying that almost all the initial productivity gap is filled up via learning-by-doing processes (recall the analysis in Section 3 and the low conversion rate from temporary to permanent status). Aguirregabiria and Alonso-Borrego (2004) estimate the productivity of a temporary worker to be, on average, 80% of the productivity of a permanent worker. Since the initial productivity gap is closed after $\frac{1}{\iota}$ periods, the average productivity gap of 80% observed in Spain drives us to set the parameter for average training costs at $\xi = 0.03$. Thus, as in the US case, there is a normalized initial productivity gap is 40% in Spain, which is filled at a constant rate each quarter.

Finally, we choose the leisure value parameters, z, to satisfy the equilibrium condition (4.15) in the steady state. Thus, z is set equal to 0.860 in the US and 0.927 in Spain.

5.2. Simulated results

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 the aggregate shocks on these variables to be independent. Therefore,

- Given a constant separation rate, labor productivity must satisfy $p = z + e^y(p^* - z)$, where y is an Ornstein-Uhlenbeck process with persistence ζ and standard deviation σ, and $p^* = 1$ is the normalized measure of long-run average productivity.

- Given a constant productivity, the separation rate must satisfy $s = e^y s^*$, where s^* is the long-run average separation rate.

However, despite not observing movements in s to be driven by changes in p, one might be concerned that the simultaneous analysis of these shocks reveal some important interaction between the two impulses, along the lines of Mortensen and Pissarides' (1994). Thus, for the sake of completeness, we simulate the model with simultaneous movements in p and s, considering three cases: i) a perfect negative correlation between both shocks, $\rho(p, s) \approx -1$; ii) a perfect positive correlation, $\rho(p, s) \approx 1$; and iii) no correlation, $\rho(p, s) \approx 0$. Therefore,

- We assume p and s to behave according to the following two nonlinear functions of y: $p = z + e^y(p^* - z)$ and $s = e^{(-\sigma_s \omega_s + \sigma_s(1-\omega_s))y} s^*$. The parameter $\sigma_s > 0$ allows for different volatilities in these variables, while ω_s defines which case applies. When $\omega_s = 0$, p and s move in the same direction in response to shocks, whereas when $\omega_s = 1$ they move in opposite direction. Note, therefore, that i) when $\omega_s = 1$ for all shocks, $\rho(p, s) \approx -1$; ii) when $\omega_s = 0$ for all shocks, $\rho(p, s) \approx 1$; and iii) when ω_s is a vector taking randomly zeros and ones, $\rho(p, s) \approx 0$.

[22] This 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.

Table 5 shows the standard deviation (σ) and persistence (ζ) of the productivity and the separation rate processes needed to approximate the empirical behavior of these variables.

Table 5. Parameters required to simulate the shocks.

		US	Spain
Shocks in p given a constant s :	σ	0.064	0.099
	ζ	0.090	0.210
Shocks in s given a constant p :	σ	0.042	0.059
	ζ	0.210	0.005
Shocks in p and s with $\rho(p,s) \approx -1$:	σ	0.062	0.066
	σ_s	0.540	0.900
	ζ	0.090	0.005
Shocks in p and s with $\rho(p,s) \approx 1$:	σ	0.062	0.066
	σ_s	0.540	0.900
	ζ	0.090	0.005
Shocks in p and s with $\rho(p,s) \approx 0$:	σ	0.063	0.063
	σ_s	0.230	0.400
	ζ	0.090	0.005

We work with a discrete space state model with $2n + 1 = 201$ grid points, like the one described in Shimer (2005), and simulate it along the same lines: we start with an initial productivity level and its corresponding vacancy-unemployment ratio given by the solution of equation (4.15). Then we compute the time until the arrival of next shock, which is exponentially distributed with parameter λ. When the shock arrives, unemployment rate (u), the 'short-term'(n^e) and the 'long-term' (n^i) employment rates change according to equations (4.7)-(4.9); while p and s vary following the probabilities described in Shimer (2005). Overall, θ changes so that equation (4.15) is satisfied. At the end of each period (quarter) we record the level of each variable. We create 100 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 to capture the labor market volatility. Table 6 reports the standard deviations of the relevant variables after simulating the model for the US and Spain given the calibrated parameters of Section 5.1.

Compared with its response to shocks in the separation rate, when governed by shocks in productivity the US labor market displays substantial higher volatility in vacancies (v), unemployment (u) and, as a consequence, in labor market tightness (θ) and the job finding rate (f). Conversely, when the separation rate is the only source of shocks, the Spanish labor market displays higher volatilities than in case of being hitted by productivity shocks. These results are consistent with the data presented in Section 2, according to which recessions are periods of sharp declines in the US firm's recruiting efforts, rather than periods of massive layoffs; while in Spain firms tend to adjust their workforce mainly through layoffs, rather than reducing their recruiting activity. When assuming both shocks to hit the economy simultaneously, in case of negative correlation the amplification mechanism is vastly increased (the volatility of θ amounts to 0.79 in the US and 2.17 in Spain); reduced in case of positive correlation

(0.21 and 0.38, respectively); and diverse in the absence of correlation (scarce effects in the US, higher volatility in Spain). It is clear that none of these scenarios surpasses the ones with individual shocks.

Table 6. Simulated standard deviations, 1987-2004.

	u	v	v/u	f	s	w	p
US							
Data	0.154	0.213	0.363	0.115	0.054	0.018	0.014
Shocks in:							
p (given a constant s)	0.132	0.199	0.313	0.156	-	0.015	0.014
s (given a constant p)	0.001	0.02	0.020	0.005	0.054	0.000	-
p and s $[\rho(p,s) \approx -1]$	0.237	0.590	0.785	0.393	0.054	0.017	0.014
p and s $[\rho(p,s) \approx 1]$	0.034	0.174	0.205	0.103	0.054	0.013	0.014
p and s $[\rho(p,s) \approx 0]$	0.123	0.220	0.325	0.163	0.054	0.014	0.014
Spain							
Data	0.155	0.411	0.525	0.158	0.113	0.014	0.011
Shocks in:							
p (given a constant s)	0.011	0.014	0.030	0.012	-	0.010	0.014
s (given a constant p)	0.127	0.454	0.514	0.257	0.113	0.002	-
p and s $[\rho(p,s) \approx -1]$	0.185	2.057	2.169	1.085	0.113	0.015	0.011
p and s $[\rho(p,s) \approx 1]$	0.038	0.371	0.383	0.186	0.113	0.011	0.011
p and s $[\rho(p,s) \approx 0]$	0.127	1.477	1.549	0.774	0.113	0.012	0.011

Of course, all these 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 driving shock, the higher its amplification mechanism. Nevertheless, this exercise shows that our model with PMLTC provides a good account of the labor market specificities of these two countries when considering labor productivity in the US and separation rates in Spain as main sources of shocks.

6. Scenarios

The gaps between the incumbents and the entrants' productivity (ξ) and separation costs (s) are the crucial parameters of the analysis: they capture the main aspects of the EPL in Spain (the fixed-term contracts legislation and the firing restrictions on permanent contracts) and define the main differences in terms of PMLTC between the US and the Spanish labor markets. In this section we examine the consequences of altering these parameters on the labor market volatility.

6.1. Labor market sensibility to changes in PMLTC

Our first exercise examines the cyclical implications of modifying ξ and γ, assuming, for simplicity, that only productivity shocks hit the US labor market and only shocks in the separation rate affect Spain. Recall that the values underlying the simulated

volatility of the ratio of vacancies to unemployment θ (displayed in the second row of table 7) are: $\xi_{spain} = 0.03$, $\xi_{us} = 0.31$, $\gamma_{us} = 0.67$ and $\gamma_{spain} = 5.70$.

Table 7 shows a high and non-linear sensibility of the labor market volatility to changes in PMLTC. When γ and ξ are raised from low values, θ displays a higher volatility; however, when γ and ξ are raised from large enough values, the variability of θ is reduced. The initial positive effect has been documented by Millard (1997),[23] but the change in the sign of this relationship is a new outcome arising from the interaction between the annuity value of a vacancy (4.4), and the free entry condition (4.10) whereby firms open vacancies whenever the expected value of doing so is positive. In the presence of high PMLTC, positive productivity 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.

Table 7. Short-run effects of PMLTC. Standard deviations of θ.

	US		Spain	
Actual		0.363		0.525
Simulated		0.313		0.514
Scenarios				
	Individual effects of ξ:			
	$\xi = 0.03$	0.131	$\boldsymbol{\xi = 0.03}$	**0.514**
	$\boldsymbol{\xi = 0.31}$	**0.313**	$\xi = 0.05$	1.656
	$\xi = 0.40$	2.538	$\xi = 0.10$	2.545
	$\xi = 0.60$	1.286	$\xi = 0.20$	0.532
	$\xi = 1.00$	0.000	$\xi = 0.31$	0.000
	Individual effects of γ:			
	$\boldsymbol{\gamma = 0.67}$	**0.313**	$\gamma = 0.67$	0.075
	$\gamma = 1.00$	0.484	$\boldsymbol{\gamma = 5.70}$	**0.514**
	$\gamma = 2.00$	6.642	$\gamma = 10.00$	2.349
	$\gamma = 2.50$	0.056	$\gamma = 20.00$	0.814
	$\gamma = 3.00$	0.000	$\gamma = 40.00$	0.000
	Simultaneous effects (DMP model without PMLTC):			
	$\xi = 0, \gamma = 0$	0.103	$\xi = 0, \gamma = 0$	0.050

Finally, the last row of table 7 presents the results from an 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

[23] Using a version of Mortensen and Pissarides' (1994) matching model he finds that an increase in labor market flexibility expressed in a reduction of firing costs leads to a lower volatility in employment and unemployment. The main intuition behind this negative relationship is explained in Silva and Toledo (2005): with larger training and firing costs, the firms' surplus from a new filled position is reduced because newly hired workers are less productive and separation of incumbent positions are more costly for firms. Consequently, at some level of PMLTC, shocks have a greater impact on the firms' surplus, increasing their incentives to open relatively more vacancies during good times.

countries further outlines the significant role played by these gaps in explaining the observed volatility in the US and the Spanish labor markets. However, 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 that time the presence of firing restrictions was still 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.

6.2. Firing costs in entry-level jobs

In the spirit of the work by Blanchard and Landier (2002) next we introduce firing costs, γ^e, in entry-level jobs. The goal of this exercise is to illustrate, in the context of our analysis, 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.[24] This implies, first, to set $\gamma^e = 0$ and, second, to modify equations (4.5) and (4.2) as follows:

$$rJ_s^e = (p^e - w_s^e) - s^e(J_s^e - V_s + \gamma^e) + \iota(J_s^i - J_s^e) + \lambda(E_s J_{s'}^e - J_s^e) \tag{6.1}$$

$$rW_s^e = w_s^e - s^e(W_s^e - U_s - \varphi\gamma^e) + \iota(W_s^i - W_s^e) + \lambda(E_s W_{s'}^e - W_s^e). \tag{6.2}$$

Obviously, the rest of the Bellman equations (4.1), (4.3), (4.4), and (4.6), remain unchanged. By making the appropriate substitutions, we solve again the model and obtain the following modified equilibrium wages:

$$\begin{aligned} w_s^e &= (1-\beta)z + \beta c\theta_s + \beta p(1-\xi) + \beta\left[f(\theta_s) + r\right]\gamma^e \\ &\quad +(1-\beta)\left[f(\theta_s) + r\right]\varphi\gamma^e - \iota\beta\left(\gamma - \gamma^e\right) - \iota(1-\beta)\left(\gamma - \gamma^e\right)\varphi \end{aligned} \tag{6.3}$$

$$w_s^i = (1-\beta)z + \beta c\theta_s + \beta p + \beta r\gamma + (1-\beta)r\varphi\gamma + \beta f(\theta_s)\gamma^e + (1-\beta)f(\theta_s)\varphi\gamma^e \tag{6.4}$$

Note that both the entrant's and the incumbent's wages are now increased by a fraction of γ^e, while the negative effect of the incumbents' separation costs on the entrants' wage is still present. The reason is that these costs are now operational at the entry-level jobs thereby raising the entrants' implicit bargaining power.

The forward-looking non-linear difference equation for the equilibrium vacancy-

[24] It is important to note that this exercise does not seek to reproduce the labor market characteristics before 1984, but to examine the consequences of adopting today the main aspect of the EPL in those years, which is the high level of firing costs for all workers (90% had indefinite contracts). In any case, due to data limitations we would not be able to calibrate the labor market before 1984. Moreover, even if this was possible, such an exercise would prevent the analysis to disentangle the effects of the reduction in firing costs from the change in the calibrated parameters. Hence, our exercise provides a simple and clean way of studying if the volatility is in part a consequence of the Spanish labor market segmentation brought by the 1984 labor market reform.

unemployment ratio is now:

$$\begin{aligned} & \frac{r+s^e+\iota+\lambda}{q(\theta_s)}+\frac{r+s^i+\lambda+\iota}{r+s^i+\lambda}\beta\theta_s+\frac{f(\theta_s)}{c}\left[\iota\left(\frac{\beta+(1-\beta)\varphi}{r+s^i+\lambda}\right)+\beta+(1-\beta)\varphi\right]\gamma^e \\ = & \frac{(1-\beta)}{c}\left[p(1-\xi)-z+\frac{\iota(p-z)}{r+s^i+\lambda}\right]-\frac{(1-\beta)\iota\gamma}{c}\left[\frac{(1-\varphi)s^i-\lambda\varphi}{(r+s^i+\lambda)}\right]+\lambda E_s\frac{1}{q(\theta'_s)} \\ & -\frac{\gamma^e}{c}\left[\beta(r+\iota+s^e)+(1-\beta)(r+\iota)\varphi\right]+\frac{\lambda\iota}{(r+s^i+\lambda)}\left(\frac{\beta\gamma+E_sJ^i_{s'}}{c}\right). \end{aligned} \tag{6.5}$$

To show that a change in the Spanish labor market volatility has effectively occurred, table 8 shows the summary statistics of the relevant variables before and after the structural change occurred in the mid 80s as a consequence of the 1984 labor market reform.[25] Three main differences arise: first, unemployment persistence has risen substantially, from 0.75 to 0.86; second, the correlation between vacancies and unemployment has also risen, from -0.46 to -0.61; third, there is a much more volatile behavior in unemployment, vacancies and, therefore, in the labor market tightness: when the effects of the reform are fully active, its volatility increases by more than 60%.

Table 8. The change in the Spanish labor market volatility, 1980-1993.

	1980-1986			1987-1993		
	u	v	v/u	u	v	v/u
Std. deviation	0.063	0.357	0.319	0.121	0.455	0.516
Autocorrelation	0.754	0.887	0.795	0.860	0.880	0.865
Correlation Matrix						
	u	v	v/u	u	v	v/u
u	1	-0.461	-0.699	1	-0.608	-0.766
v		1	0.912		1	0.976
v/u			1			1

Having characterized the differences in the two periods of analysis, in table 9 we present a simulation that rises sequentially the entrant's firing cost (γ^e) prompting, with each rise, a reduction in the differences with respect to the incumbents. Observe that the starting volatility of θ, 0.514, corresponds to our benchmark case in table 7 (i.e., for years 1987-2004, the calibrated parameters of table 5 and $\gamma^e = 0$). Then we give γ^e positive values and adjust the steady-state values of unemployment, vacancies and labor market tightness in accordance with years 1980-86, keeping constant the rest of the calibrated parameters. The results show that the higher the separation costs at the entry-level jobs (0.5, 1 and 2), the lower the volatility of unemployment, vacancies and, therefore, of the labor market tightness (0.197, 0.046 and 0.0, respectively).

[25] The 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. The last year of the second period is 1993, just before the 1994 labor market reform. In this way, we obtain the closest approximation to the change in the labor market volatility derived from the 1984 labor market reform.

Table 9. Firing costs in entry-level jobs. Simulated standard deviations.

Scenarios:	v/u	s
$\gamma = 5.7$, $\gamma^e = 0$	0.525	0.113
$\gamma = 5.7$, $\gamma^e = 0.5$	0.197	0.113
$\gamma = 5.7$, $\gamma^e = 1$	0.046	0.113
$\gamma = 5.7$, $\gamma^e = 2$	0.000	0.113

Note: s is assumed to have equal volatility and persistence in all cases.

The conclusion we drive from this exercise is that our model is helpful in explaining changes in volatility in response to labor market reforms introducing the possibility of hiring new workers not liable to dismissal costs (which is equivalent to a reduction of firing costs for entry-level jobs). Of course, now we also know that the relationship between PMLTC and labor market volatility not only depends on the productivity and the separation costs gaps, but also on the starting level of their parameters. This sensitivity to the degree of employment protection calls for further analysis, explicitly attempting to quantify the magnitude of this protection, of its change in the aftermath of a labor market reform, and the precise impact on this change on the labor market volatility.

7. Conclusions

This paper focuses on the non-wage labor costs, which have become the central object of the labor market economic policy in 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 one was the creation of a segmented labor market, which has been tried to be reversed by the subsequent reforms. Overall, a structural change in the sensibility of employment with respect to GDP growth occurred in the mid 80s, and was further enhanced in the mid 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 and, thereby, 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 match the US and the Spanish stylized facts and to analyze the consequences of shocks affecting some crucial parameters representative of these two gaps. We find shocks on productivity to be central in the US and shocks in separation

costs to be central in Spain. When the gaps between the incumbents and the entrants' productivity and separation costs increase in response to these 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; is they are wide enough, 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 (i.e., 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. Since the gaps in productivity and separation costs are wide enough in Spain, the labor market response to their increase is a higher volatility. Therefore, 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: by rising the entrant's and incumbents' gaps in productivity and separation costs at the entry-level jobs, which were already high after the 1984 labor market reform.

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, whose control was lost 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", page 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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