Flexibility at the margin and labor market volatility in OECD countries*

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Abstract

We study the business cycle behavior of segmented labor markets with flexibility at the margin (e.g., just affecting fixed-term contracts). We present a matching model with temporary and permanent jobs where (i) there is a gap in the firing costs associated with these types of jobs, and (ii) there are restrictions in the creation and duration of fixed-term contracts. We show that a labor market with flexibility at the margin increases the unemployment volatility with respect to a fully regulated one. This analysis yields new insights into the interpretation of the recent volatility changes witnessed in the OECD area.

Key Words: Flexibility at the margin, Volatility, Separation costs, Search and Matching model.

JEL Classification Numbers: J23, J41, J63.

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I Introduction

In segmented labor markets, flexibility at the margin is achieved with high protection of permanent workers (i.e., those under open-ended contracts) and loose regulation of fixed-term employment. The main objective of this paper is to provide further understanding of the business cycle behavior of segmented labor markets with limitations in the use of fixed-term contracts.

Since the mid 80's, several waves of labor market reforms have been implemented in many OECD economies as a way of providing flexibility to their labor markets with high employment protection levels. These reforms affected the relative strictness of the employment protection legislation (EPL) on fixed-term and permanent contracts (see Table 2.A2.6 in OECD, 2004) and boosted fixed-term employment in non-Anglo-Saxon countries. Temporary contracts, however, have typically been subject to restrictions such as limited renewals and maximum durations. For example, the Spanish labor market reform in 1984 crucially broadened the scope of fixed-term contracts while, at the same time, restricted to 3 the maximum number of successive contracts with a maximum accumulated duration of 2 years (OECD, 2004). In Portugal, temporary contracts can also be renewed up to 3 times but with a longer maximum duration of 30 months. With flexibility at the margin, firms have adapted their hiring and firing policies, and seem to respond differently to business cycle shocks. Evidence in support of this hypothesis is provided in figures 1 and 2.

Figure 1 shows a change in the relationship between unemployment volatility and EPL on permanent contracts. For different detrending methods, figures 1a-1b and 1c-1d exhibit a shift from a negative correlation during the period 1970-1990 (-0.28 using the HP filter and -0.11 using the first log-difference) to a positive correlation in 1991-2006 (0.55 and 0.47). This positive correlation is in line with the negative relationship documented in Thomas (2006) and Veracierto (2008) for output and employment volatility. Moreover, Figure 1 reveals that while Anglo-Saxon type of labor markets exhibit a decrease in volatility from the first to the second period, the opposite happens to the other countries (with the exception of Sweden). Given that regulation on permanent contracts has not changed much in all these economies, the increase in volatility in the more regulated labor markets may be driven by the increase in flexibility at the margin, which is the natural consequence of the observed reduction in the level of EPL in temporary contracts.[1]

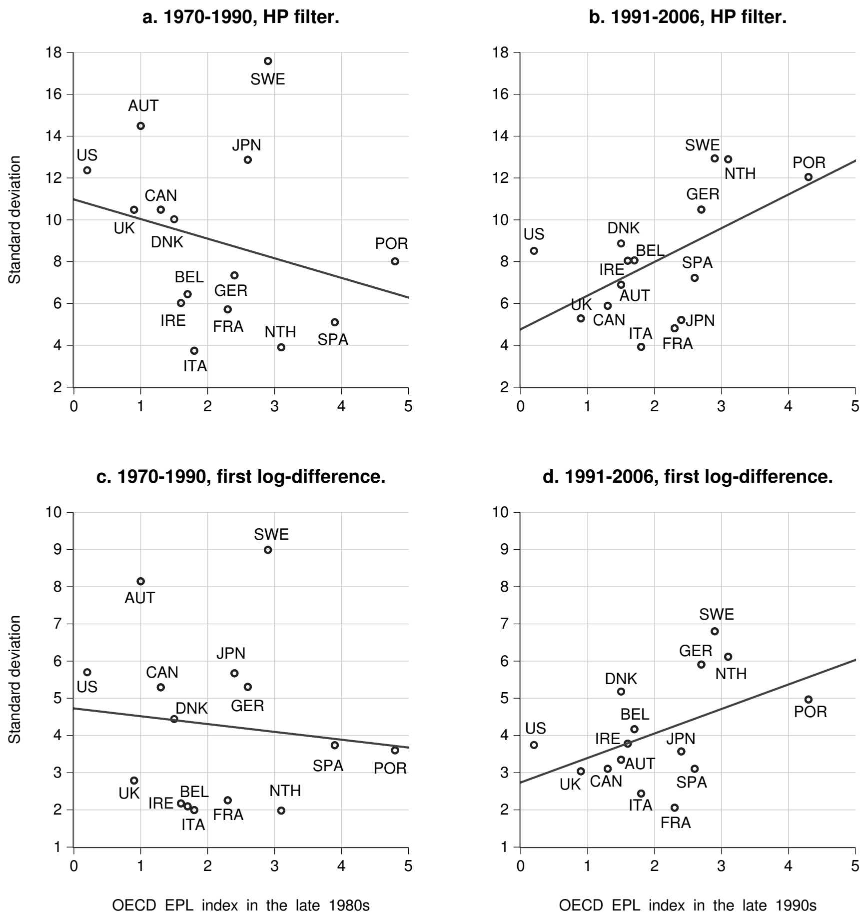
Figure 2 shows that in countries with limited flexibility in temporary work (see Table 1 for details) the relationship between unemployment volatility and EPL on temporary contracts has also changed. Figures 2a-2b and 2c-2d exhibit a jump from an almost null correlation in 1970-1990 (0.02 using the HP filter and 0.04 using the first log-difference) to a strong negative correlation in 1991-2006 (-0.75 and -0.87). This change may also be explained by the significant increase in the use of temporary contracts after the two-tier labor market reforms. Having the possibility of hiring on a fixed-term basis, firms use flexibility at the margin as an important mechanism to adjust employment. As a consequence, job creation and job destruction take place mainly in the segment of temporary work and explain the changes uncovered by figures 1 and 2.

In Table 1, we observe that countries with a high share of temporary employment are characterized by a relatively high levels of EPL on permanent contracts, high firing costs, and limitations on the renewal and duration of temporary contracts. For example, economies such as Portugal, Sweden, and Spain are among those with the highest EPL index values (4.3, 2.9 and 2.6) and display the largest shares of temporary workers (16.1%, 14.6% and 32.9%). Nevertheless, unemployment volatility in these dual labor markets is, on average, 33% more volatile than in the Anglo-Saxon labor markets where employment legislation is much less stringent.[2]

[1]The change in the volatility of unemployment can also be explained by other phenomena. Among them there is the general fall in business cycle volatility known as the "Great Moderation", with specific features in the Anglo-Saxon and Euro-zone countries (Stock and Watson, 2005). In addition, unemployment fluctuations have been magnified by the increasing international capital mobility, especially in the more responsive small economies (Azariadis and Pissarides, 2007).

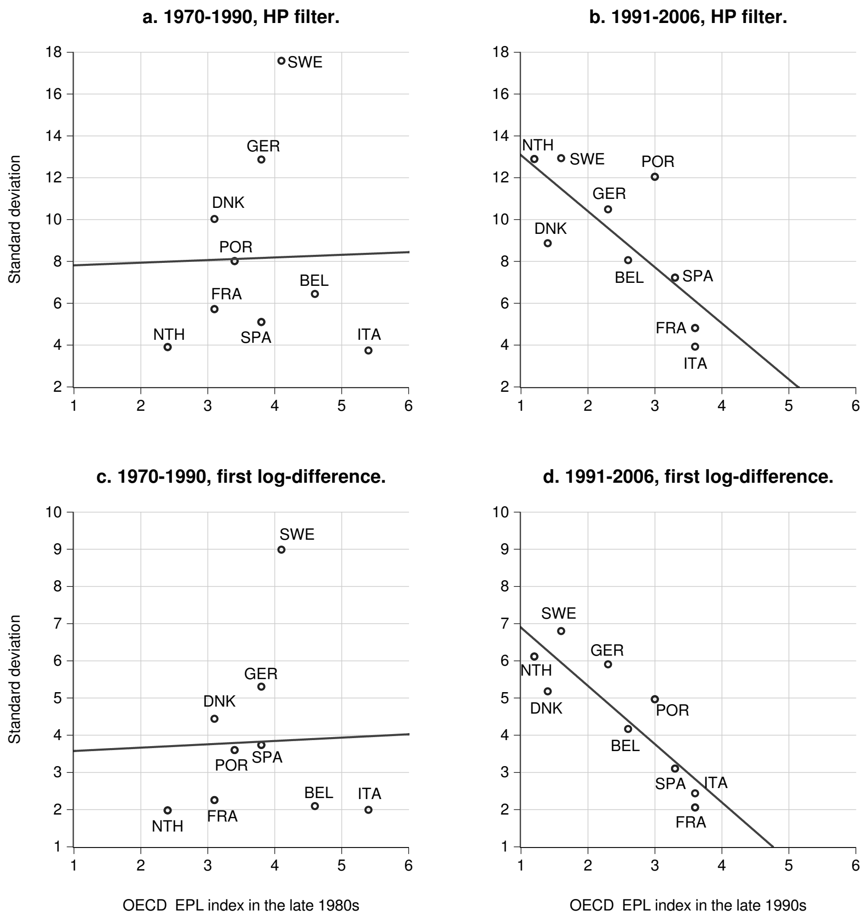
[2]It is worth noting that countries with firing costs and no limitations on temporary contracts (TCs) make extensive use of permanent contracts (PCs). TCs can be used for screening or training purposes or just to save on firing costs in case of economic turmoil and need of labor adjustments. Although this deserves further research and understanding, our hypothesis is that flexible labor markets make a larger use of TCs for screening or training purposes than those with flexibility at the margin, which in turn increases the probability of being on a permanent contract (OECD, 2004). This would imply

Figure 1: Unemployment volatility vs. EPL on permanent contracts



Note: The Employment Protection Legislation (EPL) index on permanent contracts is taken from the OECD (2004). Unemployment volatility is computed as the standard deviation of the cyclical component of seasonally adjusted standardized unemployment rate from OECD Main Economic Indicators. Unemployment is detrended using the HP filter with a smoothing parameter of 1600 in panels a and b, and using the first log-difference in panels c and d.

Figure 2: Unemployment volatility vs. EPL on temporary contracts in countries with limited flexibility in fixed-term employment



Note: The Employment Protection Legislation (EPL) index on temporary contracts is taken from the OECD (2004). Unemployment volatility is computed as the standard deviation of the cyclical component of seasonally adjusted standardized unemployment rate from OECD Main Economic Indicators. Unemployment is detrended using the HP filter with a smoothing parameter of 1600 in panels a and b, and using the first log-difference in panels c and d.

Table 1: Contract legislation and unemployment volatility in OECD countries

	Contract legislation				Volatility
	Restrictions on TCs [A]	EPL on PCs [B]	Firing costs [C]	Share of TCs [D]	Standard dev. u [E]
Australia	[NL]	1.5	4	5.8	6.9
Belgium	[L]	1.7	16	7.3	8.1
Canada	[NL]	1.3	28	12.3	5.9
Denmark	[L]	1.5	0	10.4	8.9
Finland	[L]	2.3	26	17.3	10.9
France	[L]	2.3	32	12.7	4.8
Germany	[L]	2.7	69	11.8	10.5
Ireland	[NL]	1.6	24	6.8	8.0
Italy	[L]	1.8	11	8.9	3.9
Japan	[NL]	2.4	4	11.6	5.2
Netherlands	[L]	3.1	17	12.5	12.9
Portugal	[L]	4.3	95	16.1	12.0
Spain	[L]	2.6	56	32.9	7.2
Sweden	[L]	2.9	26	14.6	12.9
UK	[NL]	0.9	22	6.3	5.3
US	[NL]	0.2	0	4.5	8.5
Average [L] countries		*2.4*	*34.8*	*14.4*	*9.2*
Average [NL] countries		*1.3*	*13.7*	*7.9*	*6.6*

[A] Refers to limited renewals and a maximum duration of temporary contracts (TCs) (OECD, 2004); [NL] stands for No Limitations, [L] for Limitations.
[B] EPL index on permanent contracts (PCs) in the late 1990s (OECD, 2004).
[C] Measured in weeks of salary (Doing Business Database, The World Bank, 2008)
[D] Share of TCs in 1991-2006 (Eurostat, 2007); except Australia (1997), Canada and Japan (1997-2004), and US (1995-2001) (OECD, 2006).
[E] Standard deviation of the cyclical component of the seasonally adjusted standardized unemployment rate in 1991:1 - 2006:4 (OECD Main Economic Indicators, 2007). Unemployment is detrended using the HP filter with a smoothing parameter of 1600.

To better understand the observed increase in the unemployment volatility of countries with limited flexibility in the use of temporary contracts, we extend the equilibrium matching model of Mortensen and Pissarides (1994) by introducing the possibility that firms hire workers on a fixed-term basis. In this way, our paper contributes to the understanding of the sources of unemployment volatility by assessing the role played by (i) different separation costs associated with fixed-term and permanent workers, and (ii) restrictions in the use of temporary contracts.

The relationship between employment protection and labor market fluctuations has been studied in Cabrales and Hopenhayn (1997), Thomas (2006), Veracierto (2008), Zanetti (2010), Sala and Silva (2009) and Costain *et al.* (2010).[3] Cabrales and Hopenhayn (1997) distinguish between permanent and temporary work, but calibrate a labor demand rather than a matching model. Veracierto (2008) develops a Real Business Cycle model and shows that firing costs are important in reducing business cycle fluctuations. These costs preclude employment adjustments and lower the response of the economy to aggregate productivity changes. Thomas (2006) reaches a similar conclusion using a matching model and considering economies with different firing costs. Zanetti (2010) studies the impact of unemployment benefits and firing taxes on business cycle fluctuations within the matching framework with nominal rigidities in the goods market. He finds that higher firing taxes reduce the volatility of output and employment. These three papers abstain from drawing a distinction between permanent and temporary jobs and cannot address the question, as we do in this paper, of how flexibility at the margin affects cyclical fluctuations in the labor market. This is done in Sala and Silva (2009) and Costain *et al.* (2010) using the Spanish economy as benchmark case. Here we extend this analysis to other countries and consider different scenarios of segmented labor markets including a fully flexible labor market.[4]

higher conversion rates from TCs to PCs and, therefore, an extensive use of PCs even in countries with firing costs and no limitations on TCs. At the other extreme, segmented labor markets would have low conversion rates as it has been documented by the OECD (2004).

[3]Our paper also differs from Boeri and Garibaldi (2007) and from Bentolila *et al.* (2010). The former studies the transitional dynamics after EPL reforms providing flexibility at the margin, whereas the latter studies the employment adjustment in France and Spain during the 2007-2010 recession.

[4]Another important difference with respect to Sala and Silva (2009) and Costain *et al.* (2010) is

We calibrate our baseline model to a representative European labor market with restricted flexibility at the margin. Simulations of our benchmark economy show a procyclical behavior of both temporary and permanent jobs and in the share of fixed-term contracts. The job finding and job conversion rates are also procyclical. These results are broadly consistent with the cyclical behavior observed in labor markets with limited flexibility in the use of temporary jobs.

We also find that our benchmark scenario of flexibility at the margin provides an intermediate situation, in terms of unemployment volatility, with respect to a fully regulated and a fully deregulated labor market.[5] Moreover, we show that within the scenario of limited flexibility in the use of temporary jobs, (i) an increase in firing costs for either temporary or permanent jobs, and (ii) tighter restrictions in the use of temporary contracts reduce the volatility of unemployment.

The main reason behind the higher unemployment volatility observed in the case of flexibility at the margin with respect to a fully regulated labor market is simple. The lower firing costs for temporary workers allow firms to adjust its employment level more intensively through these types of workers. Moreover, rather than converting fixed-term contracts into permanent ones, which potentially entails future firing costs, firms will let temporary contracts expire and hire new workers under temporary contracts. These two channels generate large fluctuations in the job destruction rate associated with temporary contracts and, as a result, in unemployment.

The volatility of the job destruction probability, however, falls with tighter limitations in hiring temporary workers and in the duration of fixed-term contracts. This happens because the share of temporary jobs falls as restrictions on fixed-term contracts increase. Therefore, since the job destruction rate in permanent contracts is less volatile than in temporary ones, the volatility of job destruction falls.

that firing costs in our model only affect the Nash rule for wage determination in continuing jobs. This distinction is relevant given that the firm does not incur in firing costs if there is not a wage agreement during the first meeting, because a contract has not yet been signed.

[5]By *fully regulated* labor market, we mean one with no temporary contracts and (non-negligible) firing costs for permanent jobs. A *fully deregulated* labor market has no firing cost or any other restriction associated with either contract.

When flexibility at the margin is suppressed in a scenario of employment protection, most of the unemployment volatility in our model vanishes. This gives rise to a scenario similar to the one before the introduction of the two-tier labor market reforms when fixed-term employment was much less prevalent.

Another important result is that the model is able to generate a countercyclical job destruction rate in both fully deregulated and flexibility-at-the-margin labor market types. This result clarifies a similar empirical finding for Spain in Messina and Vallanti (2007), and helps explain why the job turnover rate of some regulated labor markets displays a countercyclical behavior in contrast to the acyclical or even procyclical movements suggested by some studies (Garibaldi, 1998).

The remaining of the paper is structured as follows. Section 2 presents the model. In Section 3 we calibrate it to a benchmark labor market representative of an average European one with flexibility at the margin. In Section 4 we simulate our calibrated model and compare the results to an economy with essentially no legal restrictions in the use of temporary contracts, such as the US economy. In Section 5 we verify the robustness of our previous results by simulating additional scenarios of employment protection. Section 6 concludes.

II The model

The economy consists of a continuum of risk-neutral, infinitely-lived workers and firms. We normalize the measure of workers to 1. Workers and firms discount future payoffs at a common rate β. Moreover, capital markets are perfect and time is discrete.

Workers may be either unemployed or employed. Unemployed individuals enjoy an instantaneous utility b each period. Those who are employed can be so either under a temporary or a permanent contract. They can also be new entrants or incumbents. Thus, there are four types of workers who earn a wage w_{0t}^T, w_{0t}^P, w_t^T and w_t^P, where subscript 0 indicates new entrants and superscripts T and P denote temporary and permanent jobs. Each period any worker may be endogenously terminated if the firm chooses to do so, which entails an exogenous firing cost γ^T if temporary or γ^P if permanent. We assume that $\gamma^T < \gamma^P$. Exogenous separations may also occur at no cost with probability ϕ for any type of worker. When an employment relationship is broken, the worker becomes unemployed.

Moreover, each temporary contract expires each period with probability ι. This parameter reflects legal restrictions regarding the use of fixed-term contracts such as limited number of renewals and maximum duration. For instance, a higher ι indicates stringer legal restrictions in the use of temporary contracts. We use this stochastic approach to model the overall duration of fixed-term contracts for simplicity. When this type of contract expires the worker may be either hired under a permanent contract or laid off. That is, firms have the option of offering these workers a permanent contract (which we define as job conversion). Thus, although the expiration probability ι is constant, the job conversion probability is still an endogenous variable. Also notice that if separation occurs in this case, the firm pays no firing costs.

Each firm consists of only one job which is either filled or vacant, and uses only labor as input. If a job is filled, it produces $A_t z_t$ units of output each period t, where A_t and z_t represent aggregate and match-specific productivity levels, respectively. Aggregate productivity follows a Markov process whereas z_t is independent and identically distributed across firms and time, with cumulative distribution function $G(z)$ and support $[0, \bar{z}]$.

When a job is vacant, the firm searches for an unemployed worker to fill the position at a constant cost c per period. Search frictions in the labor market are captured by a constant-returns-to-scale matching function $m(u_t, v_t)$, where u_t denotes the unemployment rate and v_t is the vacancy rate in period t. We follow den Haan *et al.* (2000) and assume

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

This functional form ensures that the ratios $m(u_t, v_t)/u_t$ and $m(u_t, v_t)/v_t$ lie between 0 and 1. The former represents the probability that an unemployed worker meets a vacant job, which we write as $f(\theta_t) = m(1, \theta_t)$, where $\theta_t = v_t/u_t$. The latter denotes the probability at which vacancies meet workers, $q(\theta_t) = m(1/\theta_t, 1)$. This matching function also implies that the higher the number of vacancies with respect to the number of unemployed workers (i.e., larger θ), the easier to find a job and the more difficult to fill up vacancies.

Job creation takes place when an unemployed worker meets a vacant job and they agree on an employment contract. When there is a meeting, a match-specific productivity z_t is drawn. If the match is profitable, the firm hires the worker. With no restrictions, a firm would always offer a temporary contract due to our assumptions about separation costs. Namely, $\gamma^T < \gamma^P$ and no separation costs associated with the expiration of temporary contracts. We assume, however, that with probability α the firm is bound to offer a temporary contract if it chooses to hire the worker as in Cahuc and Postel-Vinay (2002). This is a policy parameter reflecting restrictions on hiring.

Within a period, the timing of events is as follows. At the beginning of each period unemployed workers and vacancies meet. At the same time, all existing matches (i.e., those who produced last period) learn whether they break exogenously with probability ϕ. Right after that, surviving temporary matches realize whether their contracts expire according to probability ι. Afterwards, each match (old and new) draws an idiosyncratic productivity z_t, and aggregate productivity A_t is realized. If z_t is sufficiently large and, consequently, the match has a positive surplus, production takes place. Otherwise, the firm either breaks the existing employment relationship or does not offer a contract to the new entrant. Moreover, it may choose to open a vacancy and search for a new worker next period.[6]

Accordingly, the value of vacancies V_t, and filled positions, $J_{0t}^T(z_t)$, $J_{0t}^P(z_t)$, $J_t^T(z_t)$ and $J_t^P(z_t)$, are represented by the following Bellman equations,

[6]In fact, in equilibrium, unmatched firms are indifferent between opening a new vacancy and completely withdrawing from the market.

$$
\begin{aligned}
V_t &= -c + \beta E_t \Bigg[(1-q(\theta_t))V_{t+1} + q(\theta_t)\alpha \left(\int_{\widetilde{z}^T_{0,t+1}}^{\bar{z}} J^T_{0,t+1}(z)dG(z) + G(\widetilde{z}^T_{0,t+1})V_{t+1} \right) \\
&\quad + q(\theta_t)(1-\alpha) \left(\int_{\widetilde{z}^P_{0,t+1}}^{\bar{z}} (J^P_{0,t+1}(z))dG(z) + G(\widetilde{z}^P_{0,t+1})V_{t+1} \right) \Bigg], \quad (2) \\
J^T_{0t}(z_t) &= A_t z_t - w^T_{0t}(z_t) + \beta E_t \Bigg[(1-\phi)\iota \left(\int_{\widetilde{z}^P_{0,t+1}}^{\bar{z}} J^P_{0,t+1}(z)dG(z) + G(\widetilde{z}^P_{0,t+1})V_{t+1} \right) \\
&\quad + (1-\phi)(1-\iota) \left(\int_{\widetilde{z}^T_{t+1}}^{\bar{z}} J^T_{t+1}(z)dG(z) + G(\widetilde{z}^T_{t+1}) \left(V_{t+1} - \gamma^T \right) \right) + \phi V_{t+1} \Bigg], \quad (3) \\
J^P_{0t}(z_t) &= A_t z_t - w^P_{0t}(z_t) + \beta E_t \Bigg[(1-\phi) \left(\int_{\widetilde{z}^P_{t+1}}^{\bar{z}} J^P_{t+1}(z)dG(z) + G(\widetilde{z}^P_{t+1}) \left(V_{t+1} - \gamma^P \right) \right) \\
&\quad + \phi V_{t+1} \Bigg], \quad (4) \\
J^T_t(z_t) &= A_t z_t - w^T_t(z_t) + \beta E_t \Bigg[(1-\phi)\iota \left(\int_{\widetilde{z}^P_{0,t+1}}^{\bar{z}} J^P_{0,t+1}(z)dG(z) + G(\widetilde{z}^P_{0,t+1})V_{t+1} \right) \\
&\quad + (1-\phi)(1-\iota) \left(\int_{\widetilde{z}^T_{t+1}}^{\bar{z}} J^T_{t+1}(z)dG(z) + G(\widetilde{z}^T_{t+1}) \left(V_{t+1} - \gamma^T \right) \right) + \phi V_{t+1} \Bigg], \quad (5) \\
J^P_t(z_t) &= A_t z_t - w^P_t(z_t) + \beta E_t \Bigg[(1-\phi) \left(\int_{\widetilde{z}^P_{t+1}}^{\bar{z}} J^P_{t+1}(z)dG(z) + G(\widetilde{z}^P_{t+1}) \left(V_{t+1} - \gamma^P \right) \right) \\
&\quad + \phi V_{t+1} \Bigg], \quad (6)
\end{aligned}
$$

where $\widetilde{z}^j_0$ and $\widetilde{z}^j$, $j = T, P$, are productivity thresholds defined such that nonprofitable matches (i.e., with negative surplus) are severed.[7] Thus, the conditions defining these thresholds for job creation and destruction are:

$$
\begin{aligned}
J^T_{0t}(\widetilde{z}^T_{0t}) - V_t &= 0, && (7) \\
J^P_{0t}(\widetilde{z}^P_{0t}) - V_t &= 0, && (8) \\
J^T_t(\widetilde{z}^T_t) - V_t + \gamma^T &= 0, && (9) \\
J^P_t(\widetilde{z}^P_t) - V_t + \gamma^P &= 0. && (10)
\end{aligned}
$$

The first two expressions (7) and (8) are job creation conditions for temporary and

[7] Since the value of a match is increasing in z_t, we can prove that there exists a threshold $\widetilde{z}_t \in [0, \bar{z}]$ below which matches are no longer profitable.

permanent jobs, respectively. Note that in those cases the firm is not liable to pay γ^T or γ^P in the absence of agreement. Thus, unemployed workers find temporary and permanent jobs with probabilities

$$\chi_t^T = f(\theta_{t-1})\alpha(1 - G(\tilde{z}_{0t}^T)), \tag{11}$$

$$\chi_t^P = f(\theta_{t-1})(1 - \alpha)(1 - G(\tilde{z}_{0t}^P)). \tag{12}$$

Recall that when a firm and a worker meet they can only agree on a temporary contract with probability α. Finally, the (unconditional) job finding probability is simply

$$\chi_t = \chi_t^T + \chi_t^P. \tag{13}$$

Notice that condition (8) also defines the threshold for temporary-to-permanent conversions. Thus, temporary employees become permanent with the following job conversion probability

$$\zeta_t = (1 - \phi)\iota(1 - G(\tilde{z}_{0t}^P)). \tag{14}$$

Equations (9) and (10) set the reservation productivity for current temporary and permanent workers. Therefore, these two conditions, together with (8), characterize endogenous job destruction.[8] It follows that temporary and permanent matches separate with probabilities

$$\lambda_t^T = \phi + (1 - \phi)\left[(1 - \iota)G(\tilde{z}_t^T) + \iota G(\tilde{z}_{0t}^P)\right], \tag{15}$$

$$\lambda_t^P = \phi + (1 - \phi)G(\tilde{z}_t^P), \tag{16}$$

and the total job destruction probability is

$$\lambda_t = \frac{\lambda_t^T n_{t-1}^T + \lambda_t^P n_{t-1}^P}{1 - u_{t-1}}, \tag{17}$$

[8]Recall that firms may avoid temporary-to-permanent conversions when fixed-term contracts expire. Therefore, job destruction also depends on condition (8).

where n_t^T and n_t^P are the mass of temporary and permanent workers in period t. That is, those who actually are in productive matches that period.

From the worker's perspective, the values of being unemployed U_t, and employed, $W_{0t}^T(z_t)$, $W_{0t}^P(z_t)W_t^T(z_t)$ and $W_t^P(z_t)$, are expressed as follows,

$$
\begin{aligned}
U_t &= b + \beta E_t \Bigg[(1 - f(\theta_t))U_{t+1} + f(\theta_t)\alpha \left(\int_{\tilde{z}_{0,t+1}^T}^{\bar{z}} W_{0,t+1}^T(z)dG(z) + G(\tilde{z}_{0,t+1}^T)U_{t+1} \right) \\
&\quad + f(\theta_t)(1-\alpha) \left(\int_{\tilde{z}_{0,t+1}^P}^{\bar{z}} W_{0,t+1}^P(z)dG(z) + G(\tilde{z}_{0,t+1}^P)U_{t+1} \right) \Bigg], \qquad (18) \\
W_{0t}^T(z_t) &= w_{0t}^T(z_t) + \beta E_t \Bigg[(1-\phi)\iota \left(\int_{\tilde{z}_{0,t+1}^P}^{\bar{z}} W_{0,t+1}^P(z)dG(z) + G(\tilde{z}_{0,t+1}^P)U_{t+1} \right) \\
&\quad + (1-\phi)(1-\iota) \left(\int_{\tilde{z}_{t+1}^T}^{\bar{z}} W_{t+1}^T(z)dG(z) + G(\tilde{z}_{t+1}^T)U_{t+1} \right) + \phi U_{t+1} \Bigg], \qquad (19) \\
W_{0t}^P(z_t) &= w_{0t}^P(z_t) + \beta E_t \left[(1-\phi) \left(\int_{\tilde{z}_{t+1}^P}^{\bar{z}} W_{t+1}^P(z)dG(z) + G(\tilde{z}_{t+1}^P)U_{t+1} \right) + \phi U_{t+1} \right], \qquad (20) \\
W_t^T(z_t) &= w_t^T(z_t) + \beta E_t \Bigg[(1-\phi)\iota \left(\int_{\tilde{z}_{0,t+1}^P}^{\bar{z}} W_{0,t+1}^P(z)dG(z) + G(\tilde{z}_{0,t+1}^P)U_{t+1} \right) \\
&\quad + (1-\phi)(1-\iota) \left(\int_{\tilde{z}_{t+1}^T}^{\bar{z}} W_{t+1}^T(z)dG(z) + G(\tilde{z}_{t+1}^T)U_{t+1} \right) + \phi U_{t+1} \Bigg], \qquad (21) \\
W_t^P(z_t) &= w_t^P(z_t) + \beta E_t \left[(1-\phi) \left(\int_{\tilde{z}_{t+1}^P}^{\bar{z}} W_{t+1}^P(z)dG(z) + G(\tilde{z}_{t+1}^P)U_{t+1} \right) + \phi U_{t+1} \right]. \qquad (22)
\end{aligned}
$$

We also assume that there is free entry for firms. Hence firms open vacancies until the expected value of doing so becomes zero. Therefore, in equilibrium:

$$V_t = 0. \qquad (23)$$

Furthermore, because neither workers nor employers can instantaneously find an alternative match partner in the labor market, and because hiring 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 workers and firms. 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 workers' and the firms' net return from the job match. The first-order conditions for the temporary and permanent employees yield the following four equations:

$$(1-\eta)(W_{0t}^{T}(z_t)-U_t) = \eta(J_{0t}^{T}(z_t)-V_t), \tag{24}$$

$$(1-\eta)(W_{0t}^{P}(z_t)-U_t) = \eta(J_{0t}^{P}(z_t)-V_t), \tag{25}$$

$$(1-\eta)(W_{t}^{T}(z_t)-U_t) = \eta(J_{t}^{T}(z_t)-V_t+\gamma^T), \tag{26}$$

$$(1-\eta)(W_{t}^{P}(z_t)-U_t) = \eta(J_{t}^{P}(z_t)-V_t+\gamma^P), \tag{27}$$

where $\eta \in (0,1)$ denotes the workers' bargaining power relative to firms. Note that the last two Nash conditions present terms depending on γ^T and γ^P. Because separation costs are operational, they are explicitly considered in the wage negotiation. This implies that the firms' threat point when negotiating with a worker is no longer the value of a vacancy V_t but $(V_t-\gamma^T)$ or $(V_t-\gamma^P)$ depending on the type of worker. This is not the case for entrant workers. If the firm and the new entrant cannot agree on a wage and therefore an employment relationship is not established, the firm is not liable for firing costs. This is why γ^T and γ^P do not appear in the first two Nash conditions.

By substituting the Bellman equations (3)-(6) and (19)-(22) into the respective first-order conditions (24)-(27) and solving for the wages, we obtain

$$w_{0t}^{T}(z_t) = \eta(A_t z_t + c\theta_t - \beta(1-\phi)(1-\iota)\gamma^T) + (1-\eta)b, \tag{28}$$

$$w_{0t}^{P}(z_t) = \eta(A_t z_t + c\theta_t - \beta(1-\phi)\gamma^P) + (1-\eta)b, \tag{29}$$

$$w_{t}^{T}(z_t) = \eta(A_t z_t + c\theta_t + [1-\beta(1-\phi)(1-\iota)]\gamma^T) + (1-\eta)b, \tag{30}$$

$$w_{t}^{P}(z_t) = \eta(A_t z_t + c\theta_t + [1-\beta(1-\phi)]\gamma^P) + (1-\eta)b. \tag{31}$$

For a given level of productivity, the wages of continuing temporary and permanent workers, $w_t^T(z_t)$ and $w_t^P(z_t)$, are higher than the new entry wages, $w_{0t}^T(z_t)$ and $w_{0t}^P(z_t)$ in each case. This result takes place because γ^T and γ^P become operational once the new entry wages are renegotiated, which in turn rise the implicit bargaining power of continuing employees.

To fully characterize the dynamics of the model economy, we need to define the law of motion for the unemployment rate u_t, and the mass of temporary and permanent workers, n_t^T and n_t^P. These evolve according to the following difference equations,

$$u_t = u_{t-1} + \lambda_t^T n_{t-1}^T + \lambda_t^P n_{t-1}^P - \chi_t^T u_{t-1} - \chi_t^P u_{t-1}, \tag{32}$$

$$n_t^T = n_{t-1}^T + \chi_t^T u_{t-1} - \lambda_t^T n_{t-1}^T - \zeta_t n_{t-1}^T, \tag{33}$$

$$n_t^P = n_{t-1}^P + \chi_t^P u_{t-1} + \zeta_t n_{t-1}^T - \lambda_t^P n_{t-1}^P, \tag{34}$$

with $u_t + n_t^T + n_t^P = 1$.

Finally, aggregate output Y_t is equal to

$$Y_t = A_t \left[\bar{z}_t^P (1 - \lambda_t^P) n_{t-1}^P + \bar{z}_{0t}^P \left(\chi_t^P u_{t-1} + \zeta_t n_{t-1}^T \right) + \bar{z}_t^T (1 - \lambda_t^T) n_{t-1}^T + \bar{z}_{0t}^T \chi_t^T u_{t-1} \right] - c v_t, \tag{35}$$

where $\bar{z}^j = E[z | z \geq \widetilde{z}^j]$.

III Calibration

We calibrate the model at quarterly frequency in order to match seven targets that characterize a representative European labor market with limited flexibility in the use of fixed-term contracts. Our benchmark parametrization is summarized in Table 2. The first two targets are an average unemployment rate of 8.4% and an average share of temporary workers on total dependent employment of 14.4% during the period 1991-2006 (Table 1). Thus, we target $u_{ss} = 0.084$ and $\frac{n_{ss}^T}{(1-u_{ss})} = 0.144$.

Elsby *et al.* (2009) estimate monthly job finding probabilities for a set of OECD countries. For those with limited flexibility, we take their average value of 0.105 between 1991 and 2006. This monthly rate implies a quarterly job finding probability χ_{ss} of 0.283.[9] We also target a quarterly job finding probability χ_{ss}^P of 0.036 for permanent

[9] More in detail, since the probability of not finding a job within a month is 0.895, then the probability of not finding a job within a quarter equals $0.895^3 = 0.717$ and, therefore, the probability of finding a job equals 0.283

contracts, given that in countries with limited flexibility in temporary contracts approximately 13.7% of unemployed workers find a permanent job within a year (OECD, 2002).[10] Also according to the OECD (2002), around 30% of temporary jobs become permanent within a year. Thus, we target a quarterly job conversion probability of $\zeta_{ss} = [1 - (1 - 0.30)^{(1/4)}] = 0.085$.

Our next target pins down firing costs for permanent contracts. We rely on several sources. Based on the World Bank's Doing Business survey and its detailed study of EPL in many countries, we take an average firing costs associated with permanent contracts in economies with limited flexibility equal to 34.8 weeks of weekly wages (see Table 1). Moreover, according to Garibaldi and Violante (2005), the ratio of firing tax over total firing costs is between around 0.35 (when worker and firm reach no off-court agreement) and 0.20 (when there is a 50% probability of reaching such agreement) in Italy. Unfortunately, we do not have detailed information for other countries with limited flexibility. Since court dismissals are frequently used in some European countries such as France and Spain (see Güell, 2010, for a discussion), we take the first of these two scenarios and set this firing tax ratio to 0.35. Thus, the firing tax component of permanent jobs amounts to $\gamma^P = 34.8 \times (w^P_{ss}/12) \times 0.35 = 1.015 w^P_{ss}$.[11]

Countries with limited flexibility have much lower firing costs for temporary contracts. For example, if the contract is terminated before it expires; the firm has to pay to the worker 3 and 8 days per year of seniority in France and Spain, respectively. Additionally, and in contrast to permanent contracts, there are no courts or regulatory procedures related to the firing process of temporary workers. According to Garibaldi and Violante (2005), the tax component of firing costs comes from legal costs, delayed payments in social insurance contributions, and other sanctions generated during the court conflict. Thus, given that severance payments are basically the only component of firing costs in temporary contracts, we assume no effective firing tax on temporary jobs and set $\gamma^T = 0$.

[10] In this case, the probability of finding a job with a permanent contract within a quarter equals $[1 - (1 - 0.137)^{(1/4)}] = 0.036$.

[11] We divide w^P_{ss} by 12 to obtain the weekly wage.

Table 2: Calibrated parameters for the benchmark economy

Parameter		Value	Source
Discount rate	β	0.99	[A]
Standard deviation for the distribution of $\log z$	σ_z	0.2	[A]
Workers' bargaining power	η	0.5	[A]
Expiration probability of a temporary contract	ι	0.0936	[C]
Parameter of the matching function	φ	0.424	[C]
Firing tax of permanent contracts	γ^P	1.0466	[C]
Firing tax of temporary contracts	γ^T	0	[A]
Exogenous separation probability	ϕ	0.0182	[C]
Hiring probability of a temporary contract	α	0.87	[C]
Persistence parameter of A	ρ	0.674	[B]
Standard deviation of ϵ	σ_ϵ	0.00684	[B]
Hiring costs	c	0.0169	[C]
Employment opportunity cost	b	0.9687	[C]

[A] Other studies or own assumptions as explained in main text.

[B] Set to match the cyclical volatility and persistence of labor productivity in economies with limited flexibility.

[C] Set to match our seven targets.

Our final target is an elasticity of the matching function with respect to unemployment of 0.6. Petrongolo and Pissarides (2001) find that this elasticity is in the range 0.5-0.7.

The logarithm of the aggregate labor productivity A_t follows an AR(1) process $\log A_t = \rho \log A_{t-1} + \epsilon_t$, with $\epsilon_t \sim N(0, \sigma_\epsilon)$. The values of the autoregressive parameter ρ and the standard deviation of the white noise process σ_ϵ are calibrated to match the average standard deviation (0.009) and autocorrelation (0.7) of the cyclical component of labor productivity, $Y_t/(1-u_t)$.[12] Thus, we set $\rho = 0.674$ and $\sigma_\epsilon = 0.00684$.

The logarithm of the idiosyncratic productivity z_t is assumed to be $N(0, \sigma_z)$ as in den Haan *et al.* (2000). The standard deviation σ_z is set to 0.2. The literature provides a range of values for this parameter between 0.1 (den Haan *et al.*, 2000) and 0.4 (Trigari, 2009). We choose an intermediate case (see also Burgess and Turon, 2010; and Walsh, 2005, who use values within this range).

[12]Data on labor productivity for each country with limited flexibility is taken from the OECD's Main Economic Indicators Database. It is reported as deviations from an HP trend with smoothing parameter 1,600.

We set the quarterly discount rate β to 0.99, and the bargaining parameter η to 0.5.

Finally, the firing tax parameter of permanent contracts, γ^P, the parameter of the matching function, φ, the vacancy cost parameter, c, the exogenous separation probability, ϕ, the conversion contract probability, ι, the exogenous hiring probability of a new temporary job, α, and the employment opportunity cost, b, are calibrated to match our seven targets. This yields $\gamma^P = 1.0466$, $\varphi = 0.424$, $c = 0.0169$, $\phi = 0.0182$, $\iota = 0.0936$, $\alpha = 0.8702$, and $b = 0.9687$.

The calibrated steady-state values (first row in Table 3) come close to the average figures characterizing economies with limited flexibility. For example, a value of $\iota = 0.0936$ implies an average duration of 3.5 years in temporary jobs ($\lambda^T_{ss} = 0.072$) consistent with roughly 20% of temporary contracts having a job tenure above three years, and about 10 percent above five years (OECD, 2002, Table 3.7). The calibrated vacancy cost parameter implies that hiring costs amount to 1.7% of the average wage, not far from the 3% estimate for France in Abowd and Kramarz (2003). Finally, $b = 0.9687$ implies an employment opportunity cost that amounts to 94% of the average steady-state wage. This parameter includes home production and leisure activities as well as unemployment benefits. The UB replacement rate is on average 50% among countries with limited flexibility according to OECD's (2006) Benefits and Wages indicators. Hagedorn and Manovskii (2008) calibrate this parameter for the US economy to match the elasticity of wages with respect to labor productivity. Although we do not target this elasticity, our calibration implies an elasticity of wages with respect to labor productivity of about 1, which is consistent with Folmer's (2009) estimate of .919 for a group of European countries with limited flexibility (including the ones considered in Table 1).

IV Simulations

The model is solved by a first-order log-linearization procedure implemented in Dynare for Matlab. This program also simulates the model and computes the steady state and business cycle statistics.[13] Table 3 summarizes the results from our benchmark simulation with limited flexibility.

Our simulated model generates a standard deviation of unemployment of 0.062, which is about 2/3 of the average for countries with flexibility at the margin in Table 1. Another salient result is that we match the observed behavior of some other relevant variables such as employment (both temporary and permanent), the share of fixed-term employment, and the job conversion probability. In countries with limited flexibility like Spain (see Sala and Silva, 2009) temporary employment is more volatile and procyclical than permanent employment. Moreover, both the job conversion probability ζ and the share of fixed-term contracts are procyclical in our simulations. This is also the case in countries with limited flexibility in the use of temporary contracts.

Although not perfect, our calibrated model provides an accurate picture of what can be thought as a representative European labor market with flexibility at the margin. Of course, it cannot be specifically associated with a particular country, but it provides, in broad terms, an appropriate benchmark for assessing the impact of different labor market reforms on the volatility of the unemployment rate. This is done in Section 5. Before, it is important to check to what extent our benchmark economy generates cyclical fluctuations in the labor market similar to those observed in a fully deregulated labor market.

Accordingly, we next simulate an alternative labor market with essentially no legal labor restrictions. Following Table 1, such economy is characterized by no firing costs, and no limitations on the renewal and duration of fixed-term contracts. In terms of our model, this implies the existence of just one type of job because permanent and temporary contracts become perfect substitutes. Hence, parameters γ^T, α, γ^P and ι become irrelevant and we can set them all equal to zero. For this labor market with no employment protection, we calibrate parameters φ, b, c and ϕ in order to satisfy the same elasticity of unemployment with respect to the matching function of 0.6 as in our

[13] Notice that since $\log A_t = \rho \log A_{t-1} + \epsilon_t$ has been calibrated to match the standard deviation and autocorrelation coefficient of the cyclical component of labor productivity, it is not necessary to detrend the simulated series with the HP filter.

Table 3: Simulated results for a typical European economy with limited flexibility

	u	n^T	n^P	n^T/n	ζ	χ	λ	λ^T	w	y/n
Steady state	.084	.132	.784	.144	.085	.283	.026	.072	1.030	1.032
Std. deviation	.062	.027	.004	.023	.017	.036	.060	.158	.006	.009
Autocorrelation	.942	.907	.990	.905	.674	.814	.626	.674	.673	.700
Correlation matrix										
u	1	-.832	-.737	-.749	-.773	-.902	.729	.773	-.773	-.797
n^T		1	.234	.991	.812	.907	-.753	-.812	.811	.836
n^P			1	.105	.365	.475	-.360	-.365	.366	.379
n^T/n				1	.780	.862	-.720	-.780	.779	.803
ζ					1	.843	-.995	-1.000	1.000	.999
χ						1	-.803	-.843	.842	.861
λ							1	.995	-.995	-.990
λ^T								1	-1.000	-.999
w									1	.999

Table 4: Summary statistics for US data and for a simulated economy with full flexibility

	US data (1991-2003)			Simulated economy		
	u	χ	λ	u	χ	λ
Std. deviation	.090	.059	.042	.106	.019	.100
Autocorrelation	.928	.757	.360	.785	.788	.674
Correlation matrix						
u		-.868	.295		-.896	.984
χ			-.040			-.803

US data: unemployment rate comes from OECD Main Economic Indicators (2007); the job finding and job destruction rates come from Shimer (2005).
We detrend the quarterly data using the HP filter with smoothing parameter 1600.

benchmark calibration, the job average unemployment rate of 5.4%, and the average job finding probability of 0.83 observed in the US labor market.[14] This yields the following parameter values: $\varphi = 3.4741$, $b = 0.8765$, $c = 0.1233$, and $\phi = 0.0119$. The simulated business cycle results for this economy are summarized in Table 4 together with the relevant data for the US (the sole flexible country in Table 1 with zero firing costs).

Notice that the simulated standard deviation of unemployment under full flexibility (0.106) is only 18% higher than the observed one in the US labor market (0.090). Also, the simulated correlations between unemployment, the job finding, and job destruction

[14]Shimer (2005) estimates a monthly job finding probability of 0.45, which implies a quarterly probability of $1-(1-0.45)^3] = 0.83$. Thus, we also target $\chi_{ss} = 0.83$.

probabilities are consistent with those in the data. The model, however, overestimates the volatility of the job destruction probability (0.10 vs. 0.042) and underestimates the volatility of the job finding probability (0.019 vs. 0.059).

When we compare both simulated economies, the most important result is that the unemployment volatility with no employment protection (0.106) is 71% higher than the one representative of limited flexibility (0.062). This is in contrast with the data. Recall that the average standard deviation for countries with limited flexibility is 0.092 whereas in the US it is slightly lower. This implies that, on their own, restrictions affecting the use of temporary work as well as EPL on permanent employment do not push high enough the volatility of our flexibility-at-the-margin labor market. In this context, the relevant question is how flexible our benchmark (dual) labor market should be in order to display a similar volatility of a fully deregulated economy. Section 5 is devoted to this issue.

V Assessing the impact of EPL changes

Here we simulate our model with flexibility at the margin under different scenarios. These scenarios may be interpreted as describing labor market reforms consisting on changes in legislation that shift four crucial parameters governing hiring and firing decisions in our model: α, ι, γ^T, and γ^P. The departing point is our baseline European-like economy as presented in the previous two sections, which we modify in the following ways:

Scenario 1: For given levels of restrictions on temporary work (i.e., α and ι), we lower firing costs for permanent jobs. In particular, we set $\frac{\gamma^P}{w^P_{ss}} = 0.2$.

Scenario 2: Given α and ι, firing costs for temporary jobs increase to $\frac{\gamma^T}{w^T_{ss}} = 0.75$. Since now $\gamma^T > 0$, firms are bound to pay firing costs for fixed-term contracts provided the employment relationship terminates before it expires.

Scenario 3: Given ι, and separation costs, we consider more restrictions to hire a temporary worker by lowering α to 0.2.

Scenario 4: Given α and separation costs, we increase the expiration probability of temporary contracts. Thus, we set $\iota = 1$, which implies that the average duration of a temporary worker is one quarter.

Scenario 5: Here we consider a *fully regulated* labor market with employment protection and no fixed-term contracts. This attempts to mimic several OECD economies before labor market reforms in the 1980-90s. A paradigmatic case is Spain before its 1984 labor market reform. In terms of the model, this means that firms are no longer able to hire temporary workers. Thus, we set $\alpha = 0$. Moreover, $\gamma^P = \gamma > 0$, and both ι and γ^T become irrelevant.

Next we describe the steady-sate effects of these EPL changes. Then, we simulate each of the above scenarios and assess their impact on the cyclical volatility of labor market variables. We discuss the main results by comparing the benchmark case with respect to the five scenarios considered.

Steady-state results

The bulk of the impact of changes in employment protection on unemployment takes place through the job destruction margin (see Table 5). This is, in a nutshell, the main finding of this exercise.

The job finding probability χ remains virtually unchanged across scenarios, whereas the job destruction rate λ declines when there are more restrictions in the creation of fixed-term employment - i.e., higher α as in scenario 3 - and when the probability of expiration of temporary contracts increases - i.e., higher ι as in scenario 4.

Moreover, the higher the firing costs for either temporary or permanent contracts, the lower λ (see scenarios 1, 2, and 5). As a result, unemployment falls with increasing separation costs as well as more restrictions on temporary work. Güell (2010) argues that both theoretical models and empirical studies lead to ambiguous results when analyzing the effect of firing costs on aggregate employment. As she says, “the overall effects of firing costs depend on whether these reduce more the flows to or from

Table 5: Simulated steady-states under different EPL scenarios (%)

	u	χ	λ	λ^T	$\frac{n^T}{1-u}$
Benchmark scenario of limited flexibility ($\alpha = 0.87, \iota = 0.0936$, $\gamma^P/w^P_{ss} = 1.015, \gamma^T = 0$)	8.40	28.30	2.60	7.20	14.40
Scenario 1: $\gamma^P/w^P_{ss} = 0.2$	8.82	28.30	2.74	7.22	15.20
Scenario 2: $\gamma^T/w^T_{ss} = 0.75$	6.32	28.13	1.90	2.36	15.00
Scenario 3: $\alpha = 0.2$	6.44	28.14	1.93	6.38	2.61
Scenario 4: $\iota = 1$	6.34	28.13	1.91	7.67	1.67
Scenario 5: $\alpha = 0$					
$\gamma/w_{ss} = 0.2$	6.27	28.11	1.88	—	—
$\gamma/w_{ss} = 1.015$	6.07	28.11	1.82	—	—

Notes: Simulated steady states results for the unemployment rate, u; the job finding probability, χ; the share of temporary contracts, $\frac{n^T}{1-u}$; and the average and temporary job separation probabilities, λ and λ^T, respectively. In turn, the adjusted policy parameters are the temporary and permanent firing tax components, γ^T and γ^P; the probability of meeting a temporary position, α; and the probability that a temporary contract is either transformed into a permanent one or terminated, ι. The rest of parameters remains unchanged.

unemployment" (p.7). In our case, the decline in the flows to unemployment clearly dominates.

The response of job destruction in a scenario of employment protection and no temporary contracts (scenario 5) is a well-known result in the literature. The higher the firing costs in permanent contracts, $\frac{\gamma^P}{w^P_{ss}}$ the more expensive it becomes to shed workers, and the lower the job destruction probability λ.

Notice that this negative relationship between firing costs and job destruction is also present in an economy with limited flexibility in the use of temporary contracts. For example, a reduction of firing costs for permanent workers increases the job destruction probability in scenario 1. Similarly, the introduction of firing costs for temporary jobs has a significant negative impact on λ (scenario 2).

The model also shows a negative relationship between restrictions in the creation and use of temporary contracts and job separations. That is, the more difficult is to hire a worker under a fixed-term contract - i.e., higher α as in scenario 3 - the lower the rate at which firms destroy temporary jobs at a lower rate. This is indicated by the fall in λ^T, which in turn reduces λ. Moreover, when the expiration probability of temporary contracts increases - i.e., higher ι as in scenario 4 -, λ falls because of the large drop in the share of temporary workers. In this case, however, the temporary job destruction probability rises to prevent transitions to a permanent status entailing future firing costs.

A further result, not reported in Table 5, is the absence of endogenous job destruction of permanent jobs whenever $\frac{\gamma^P}{w^P_{ss}}$ is greater than 0.2. Intuitively, this implies that firms will choose to keep their permanent workers to avoid incurring in high separation costs. Analytically, this is equivalent to a situation where separations become exogenous to firms' decisions.

Business cycle results

We now discuss the impact of EPL changes on the cyclical volatility of the labor market. Table 6 presents the results.

The first main result is that stricter labor market legislation (i.e., larger firing costs, higher ι, or lower α) increases the volatility of the job finding probability χ because job creation becomes more sensitive to productivity shocks. The quantitative effect, however, seems to be small.

Moreover, more stringent EPL lowers the volatility of the aggregate job separation rate λ. This effect is especially significant in a fully regulated labor market (scenario 5), where firms cannot use temporary contracts. In this case, sufficiently high firing costs

Table 6: Simulated standard deviations under different EPL scenarios (%)

	u	χ	λ	λ^T	$\frac{n^T}{1-u}$
Benchmark scenario of limited flexibility $\left(\alpha = 0.87, \iota = 0.0936, \gamma^P/w^P_{ss} = 1.015, \gamma^T = 0\right)$	6.16	3.57	6.02	15.84	2.28
Scenario 1: $\gamma^P/w^P_{ss} = 0.2$	7.33	3.56	7.74	15.83	2.44
Scenario 2: $\gamma^T/w^T_{ss} = 0.75$	3.23	3.77	0.94	5.06	0.78
Scenario 3: $\alpha = 0.2$	3.36	3.75	1.27	15.74	3.14
Scenario 4: $\iota = 1$	3.29	3.70	1.08	16.86	2.92
Scenario 5: $\alpha = 0$					
$\gamma/w_{ss} = 0.2$	3.68	3.79	1.60	—	—
$\gamma/w_{ss} = 1.015$	2.66	3.79	0.00	—	—

Notes: Simulated standard deviations for the unemployment rate, u; the job finding probability, χ; the share of temporary contracts, $\frac{n^T}{1-u}$; and the average and temporary job separation probabilities, λ and λ^T, respectively. In turn, the adjusted policy parameters are the temporary and permanent firing tax components, γ^T and γ^P; the probability of meeting a temporary position, α; and the probability that a temporary contract is either transformed into a permanent one or terminated, ι. The rest of parameters remains unchanged.

eliminates the volatility of the job destruction rate. This negative relationship between firing costs and the job destruction rate is also found by Garibaldi (1998) and Thomas (2007). Their basic intuition is that the higher the firing costs, the more expensive it becomes to shed workers, in which case the job destruction rate becomes less sensitive to shocks. In the case of flexibility at the margin (scenarios 1 and 2), the volatility of λ is also inversely related to firing costs essentially because of the same reason.

When the restrictions in the creation and duration of temporary contracts are increased, as in scenarios 3 and 4, the volatility of λ falls sharply. This happens because the share of temporary jobs falls as restrictions on fixed-term contracts increase and, therefore, since λ^P is less volatile than λ^T, the volatility of job destruction falls.

One conclusion we can draw from our simulation results is that a more stringent legislation on temporary jobs makes firms relatively more prone to adjust vacancies rather than to destroy jobs in response to productivity shocks.

Another result concerns the response of unemployment to changes in employment legislation. This response depends on whether the fall in the volatility of separations exceeds the increase in the volatility of the job finding rate. Note that in our analysis it does and, therefore, the volatility of unemployment declines as a result of higher firing costs, more restrictions in the creation of fixed-term employment (i.e., higher α as in scenario 3), and a shorter duration of temporary contracts (i.e., higher ι as in scenario 4.)

As a result, when the economy moves from a scenario with strict employment protection (scenario 5), to a scenario where firms may use fixed-term contracts not subject to firing costs (benchmark scenario), the unemployment volatility increases. This helps understand why some countries that in 1980-90s undertook labor market reforms introducing flexibility at the margin have experienced a rise in the volatility of unemployment. For example, the volatility of unemployment in the Netherlands, Portugal and Spain has increased from 3.91, 8.02, and 5.10, respectively, in 1970-1990, to 12.89, 12.04, and 7.24 in 1991-2006.

Finally, it is important to highlight that, in terms of unemployment volatility, our benchmark economy of flexibility at the margin represents an intermediate scenario between a highly regulated (as the one in scenario 5 with unemployment volatility of 2.66%) and a fully deregulated labor market (with unemployment volatility of 10.60% as shown in the first row of Table 4).

Table 7: Simulated correlations and the business cycle.

	Fully flexible labor market	Fully regulated labor market	Benchmark economy with limited flexibility
$corr(Y_t/n_t, \chi_t)$	0.814	0.847	0.861
$corr(Y_t/n_t, \lambda_t)$	-0.999	0.000	-0.990

V.1 Employment protection and simulated correlations

Messina and Vallanti (2007) have recently examined the impact of firing restrictions on job flow dynamics. They provide evidence that firms with tight firing restrictions smooth job destruction over the business cycle so that job turnover becomes less countercyclical. This result is in line with previous studies that suggest an acyclical behavior of labor flows in continental Europe in contrast to their countercyclical pattern in Anglo-Saxon countries (see Garibaldi, 1998). They also find, however, empirical evidence suggesting that the presence of temporary contracts may revert the acyclical behavior of the job destruction rate. This possibility is what we explore next. In particular, we ask our model to what extent the coexistence of EPL on permanent contracts with flexibility at the margin has an impact on the cyclical behavior of the separation rate λ_t as well as the job finding probability χ_t. We measure this effect through the correlation between these variables and the business cycle. The answer is provided in Table 7 where we distinguish three stylized cases: (i) a fully deregulated market, where $\gamma^T = \gamma^P = 0$ (corresponding to Table 4); (ii) a fully regulated market with no temporary jobs, where $\alpha = 0$ and $\gamma/w_{ss} = 1.015$ (second row of scenario 5 in Table 6); and (iii) a regulated market with restricted flexibility at the margin, where $\alpha = 0.87$, $\iota = 0.0936$, $\gamma^T = 0$, and $\gamma^P/w^P_{ss} = 1.015$ (our benchmark case).

It is interesting to observe that in the first case, which we associate with the Anglo-Saxon type labor market, there is an almost perfect negative correlation between the job separation rate and the business cycle (-0.999). Also noteworthy is the acyclical relationship obtained in a regulated market with no flexibility at the margin. This is commonly associated with some continental European labor markets, as in Garibaldi (1998). The added value of this exercise, however, lies in the third case, where the use of fixed-term contracts is restricted. We associate this case with the flexibility-at-the-margin type of labor market defined in the introduction. As shown in Table 7, the negative correlation between the job destruction rate and the business cycle (-0.990) resembles that of a fully deregulated labor market (see Sala and Silva, 2009, for the Spanish case, where it attains -0.26).

VI Conclusions

Flexibility at the margin is achieved in segmented labor markets with high protection of permanent workers and loose regulation of fixed-term employment. Does this type of flexibility warrant similar cyclical volatility as in fully flexible labor markets? Does it explain the recent change witnessed in the OECD area in the correlation between employment protection legislation and unemployment? In this paper we explore whether, and to what extent, flexibility at the margin is helpful in answering these questions. We develop a matching model with heterogenous workers (regular and fixed-term employees) and focus our analysis on a twofold dimension of segmented labor markets. First, on the effects that the gap in firing costs among these two type of workers has on the volatility of the labor market. Second, on the additional effects that arise from restricting the creation and duration of fixed-term contracts.

Our model is calibrated to a stylized economy representative of a European labor market with flexibility at the margin and limitations in the use of temporary employment. This benchmark economy is then used to examine the consequences of EPL changes affecting the main parameters governing the firm's hiring and firing decisions. We find that our benchmark scenario of flexibility at the margin increases the volatility of unemployment relative to a fully regulated labor market with strict EPL and no temporary contracts. Moreover, our simulations reveal that higher firing costs in either temporary or permanent jobs as well as more stringent restrictions in the use of fixed-term contracts reduce the volatility of unemployment.

Our simulation exercises show, however, that our model with limited flexibility in the use of temporary contracts cannot generate unemployment volatility of the same magnitude as an economy with a fully flexible labor market. Therefore, our model is not able to fully explain why most of the OECD countries' labor markets with limited flexibility in the use of temporary contracts have become more volatile than those of countries with flexible labor markets. This leads us to the conclusion that this is not the whole story and other factors may be at work.

Among these factors we have those that affect workers' bargaining power. For example, the degree of unionization or collective wage bargaining, which would fit in our distinction between flexible and dual labor markets. Another relevant aspect may be the extent of wage rigidity. In our model we assume that wages are revised every period upon the occurrence of new shocks. In a recent study, however, Babecky et al. (2010) find a positive relationship between nominal wage rigidity and the level of EPL, especially in firms with a high share of permanent contracts. It may also be important that flexibility at the margin not only produces a gap in separation costs between temporary and permanent workers but also leads to a productivity gap because of the high turnover and lack of on-the-job training of temporary employees (See, among others, OECD, 2002; Aguirregabiria and Alonso-Borrego, 2009; and Albert, García-Serrano and Hernanz, 2005). As suggested by Sala and Silva (2009), these productivity differences make temporary workers more vulnerable to productivity shocks, which increases the volatility of unemployment.

A final important result is the almost perfect negative correlation we find between job destruction and the business cycle both in the Anglo-Saxon and the flexibility at the margin labor market types. This result clarifies the analogous finding for Spain in Messina and Vallanti (2007), which could not be confirmed for the rest of the countries in the context of their analysis. Our paper, in fact, provides the rationale for such finding.

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