Dual Employment Protection Legislation:  
A framework for analysis*

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Abstract

In many countries Employment Protection Legislation (EPL) establishes different provisions for workers of different skills, trying to improve the labor market prospect of particular population groups with specific characteristics (young workers, women, unskilled workers, etc.) Moreover, quite often labor market reforms only change regulations to be applied to certain population groups who face more disadvantages in the labor market. An example is the introduction of atypical employment contracts (temporary contracts, determined-duration contracts) which ease firing restrictions for new entrants in the labor market and are usually unavailable for hiring adult prime-age male workers. Another example is the use of employment subsidies for hiring of workers with some specific individual characteristics.

This paper discusses the effects of EPL varying among workers of different skills on a wide range of labor market outcomes. By using an extension of Mortensen-Pissarides (1994)’s search model we are able to identify some key channels through which targeted EPL may impinge on equilibrium unemployment and on its incidence across population groups. Some simulation results show that the impact of differentiated firing costs by workers’ skills on unemployment, wages and welfare depends upon the initial state of the labor market and on the relative incidence of shocks affecting each type of worker. Hence, depending on the state of the economy and how shocks affect different types of workers, these partial reforms may be beneficial or detrimental and may receive more or less support from the electorate.
1. Introduction

In many European countries labor market reforms are often framed as employment promotion policies aimed at favoring particularly disadvantaged groups in the labor market. One example is the liberalization of “atypical” employment contracts (part-time, fixed-term, seasonal, etc.) which typically excludes prime-age workers to be eligible for being hired under such contracts.\(^1\) Other examples are employment subsidies targeted at specific population groups like, e.g., young, low-skilled or long-term unemployed workers. Differentiated or dual labor market policies with different provisions for high-wage and low-wage jobs are pervasive across the labor regulation in many countries. Some stylized features of unemployment, like its higher incidence among low-skill workers, have called for the introduction of targeted employment subsidies for this group in some countries (see, for instance, Drèze and Malinvaud, 1994). In the same vein, pay-roll taxes rebates for low-skill workers are also very common. Finally, there have been a number of recent reforms of Employment Protection Legislation (EPL, hereafter) where the availability of flexible contracts for hiring has been restricted to workers belonging to specific categories related to occupations, skills, age or educational attainments.

While there may be good political economy reasons for reforming the labor market through two-tier schemes (see Saint-Paul, 2000), the economic consequences of allowing for targeted employment regulations are less well understood. To our knowledge, most papers analyzing the effects of partial reforms have done so without taking the “targeted” nature of those policies (i.e., reductions of firing costs, employment

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\(^1\) See Booth, Dolado and Frank (2002).
subsidi es, etc.) into account. In view of this consideration, this paper aims at filling that gap by providing a useful analytical framework where to examine the effects of differentiated employment policies in labor markets with heterogeneous workers. In particular, our focus lies on policies that introduce differentiated firing costs by skill categories in order to analyze the effects of such policies on: equilibrium unemployment (and its distribution among workers of different types), job creation and job destruction, productivity and welfare.

This paper builds on a growing literature on equilibrium unemployment in labor markets with workers and jobs heterogeneity starting with the seminal paper by Mortensen and Pissarides (1994). Our contribution complements the available analysis of partial reforms which focuses on the conversion of fixed-term employment contracts into permanent ones (e.g., Blanchard and Landier, 2002, Cahuc and Postel-Vinay, 2002), stressing that these reforms may increase turnover and, hence, equilibrium unemployment. For instance, Blanchard and Landier (2002) find that, after a reduction of firing costs in entry-level jobs, firms find attractive to hire more workers. Nonetheless, they are also more reluctant to convert them into regular permanent employment contracts as, with low firing costs, taking the chance of matching with another worker may become an attractive option. Hence, this stream of the literature stresses one important feature of dual labor markets, namely the consequences of having the option to convert one type of labor contract to another one. However, it misses another important feature of dual labor markets, namely the fact that employment

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2 By contrast to Mortensen and Pissarides (1994) where two-sided heterogeneity is allowed for, we only allow for workers’ heterogeneity. However, in contrast to their analysis, we relax the assumption that the labor market is totally segmented.

3 Belot, Boone and van Ours (2002) analyze the trade-off between productivity and flexibility that may also influence the firm’s decision to convert a temporary job into a permanent one when job stability is productivity-enhancing.
policies are targeted to specific group of workers. Changing the regulation in one segment of the market may affect other segments, for instance through a change in the overall labor market tightness, which determines the exit rate out of unemployment for all workers as well as the profits of firms opening vacancies. Furthermore, in as far as these changes in labor market tightness affect workers’s outside option values we may also expect changes in firms’ hiring and firing decisions. An exhaustive analysis of partial reforms therefore requires a model with endogenous job creation and job destruction as the one we propose.

One of the motivations for this paper comes from our previous work on the functioning of labor markets with heterogeneous jobs and workers. In Dolado, Jansen and Jimeno (2003), we show that it is possible that differentiated firing costs may reduce equilibrium unemployment in labor markets with pervasive mismatch and on-the-job search. Our previous model is a matching model with two-sided heterogeneity (skilled and unskilled jobs and low-educated and high-educated workers), where high-educated workers can be mismatched (i.e., can occupy unskilled jobs), and, if so, on-the-job search is exerted. Mismatch of high-educated workers in low-skilled jobs implies a negative externality of on-the-job seekers on low-educated workers when both types of workers are equally productive at unskilled jobs. This is so since, having a higher quit rate, make those jobs more unstable and therefore firms are less prone to open unskilled vacancies. To the extent that larger firing costs for workers in skilled jobs reduces job creation and job destruction of these jobs, there are cases where this type of targeted

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4 Some theoretical analyses of fixed-term contracts (e.g., Cahuc and Postel-Vinay, 2002, and Nunziata and Staffolani, 2001) assume that there are some restrictions on the use of fixed-term contracts and impose a maximum value for the proportion of fixed-term employees that firms can hire. Note, however, that this restriction does not capture the targeted nature of “employment promotion contracts”.

5 There is also a positive externality on the supply of unskilled vacancies since more workers are looking for those jobs. However, it can be shown that the negative externality dominates.
employment protection policy may end up reducing mismatch and the unemployment rates of both types of workers in the presence of skilled-biased technological change.\textsuperscript{6}

In this paper, however, we abstract from on-the-job search by restricting the analysis to a single type of job which can be filled with either (cheap) low-productivity workers or (more expensive) high-productivity workers. This analytical simplification allows us to focus on the interactions between both types of workers in order to learn what is needed for a partial labor market reform to become successful. Our main finding is that the effects of partial reforms reducing firing costs for the less productive workers on unemployment rates and welfare depend on the initial state of the labor market. Thus, for instance, a reduction of firing costs for low-productivity workers in sclerotic labor markets (say, in a downturn) unambiguously reduces the unemployment rate of low-productivity workers while that of high-productivity workers hardly increases, or may even decrease, depending on the concavity of the job-finding rate as the labor market gets tighter. Further, this policy measure is welfare-enhancing for all workers in the sense that their asset values of being employed or unemployed raise (because the higher unemployment, if any, of high-productivity workers is more than compensated by their higher wages whilst both wages and employment of low-productivity workers raise) and total production (net of costs of opening vacancies) also increases. On the contrary, when labor market is very tight (say, in an upturn), such a targeted policy increases the unemployment rate of both types of workers and the asset values of low-productivity workers typically, albeit not always, decrease (since both their wages and employment

\textsuperscript{6} There are other papers using search equilibrium models with worker and/or job heterogeneity to analyze the effects of some policy measures. For instance, Acemoglu (2001) shows that unemployment benefits and minimum wages may raise welfare in a model with good and bad jobs in segmented markets. Albrecht and Vroman (2002) analyze a labour market in which low and high-educated workers can be hired for unskilled jobs while only high-educated workers can perform skilled jobs, without allowing for on-the-job-search as in Dolado, Jansen and Jimeno (2003).
rate fall) while the higher wages of high-productivity workers offsets their unemployment increase giving rise to higher assets in each labor market status. Only in the case when the probability of finding a job does not suffer from strong decreasing returns to labor market tightness, the asset values of the low-productivity workers may increase. The intuition behind the different outcomes of a differentiated firing-costs reform in depressed and tight labor markets has to do with the sensitivity of job creation to the increase in the profits of firms filling jobs with low-productivity workers after the reduction in their firing costs. In a sclerotic labor market, jobs are filled relatively fast. Thus, any increase in expected profits stemming from lower indemnities for less productive workers will therefore translate into both a strong increase in job creation and the number of matches which may end up cutting not only the unemployment of those workers affected by the reform but also the unemployment rate of the high-productive ones, especially if their job finding rate is not too concave in tightness. By contrast, in a tight labor market, vacancies remain unfilled for a longer time. Hence, changes in the profits of filled jobs induced from lower severance pay generally have a smaller effect on job creation, while the decrease in firing costs has a similar effect on job destruction in both states of the labor market.

The plan for the rest of the paper is as follows. Section 2 describes EPL and some recent labor market reforms in several countries, highlighting how common is the use of different regulations applying to workers with different skills. As will be seen, in many countries, not just in Western European, notice periods, procedures for dismissals and severance payments vary across worker occupations. Moreover, recent reforms typically amount to targeted reductions of firing costs through the introduction of “atypical contracts”, etc. but only for workers with worse employment prospects. Next, to search
for some empirical evidence on the effects of these reforms, Section 3 is devoted to summarize the empirical literature on targeted employment policies, both considering cross-country studies and case studies pertaining to specific country experiences. Section 4 contains the main contribution of the paper which lies in the theoretical analysis of these reforms in labor markets with heterogeneous workers. A wide range of simulations seem to support our main analytical findings. Lastly, Section 5 concludes. An Appendix gathers the derivation of the ergodic distribution of workers under different contracts which underlies the welfare analysis.

2. How EPL differs among population groups

It is well-known that EPL varies significantly across countries. However, less attention has been devoted to the fact that EPL also varies within countries depending on firm and worker characteristics, such as firm size, existence of collective agreement, tenure, skill, educational level, etc. As regards workers skill’s, there are two sources of variation in the enforcement of EPL. First, procedural requirements for dismissals, notice and severance pay provisions, and prevailing standards of and penalties for unfair dismissals are usually stricter for white-collar workers. Secondly, high-skill workers are not always entitled to be hired under “atypical” employment contracts with less strict EPL provisions.

As examples of countries with EPL provisions that are less strict for blue-collar workers, we can cite Austria, Belgium, Denmark, France, Greece and Italy. In Austria, Belgium, Denmark, Greece and Italy, the required notice period is shorter for blue-

7 OECD (1994) presents a detailed and comprehensive description of EPL in several countries and its variation by worker skills, tenure, the existence of collective agreements, and firm size. For a justification and the implications of variable enforcement of EPL by firm size, see Boeri and Jimeno (2003).
collar workers than for white-collar workers. Typically, severance pay for individual dismissals is similar for both blue-collar and white-collar workers, except in Denmark and Greece, where blue-collar workers are entitled to lower indemnities. Compensation pay for unjustified dismissal is also lower for blue-collar workers in Belgium and Greece.\textsuperscript{8}

With regard to partial reforms based on the introduction of “atypical” employment contracts, Spain provides a paradigmatic case study. Faced with an unemployment rate above 20\% in 1984, the Spanish government tried to implement a significant change in Employment Protection Legislation (EPL) by liberalizing temporary contracts in two main respects: (i) their use was extended to hire employees performing regular activities (not just seasonal activities or at the probation stage), and (ii) they entailed much lower severance payments than the regular permanent contracts. As a result of this two-tier reform (permanent contracts retained their previous indemnities for “fair” and “unfair” dismissals), the proportion of temporary employees in total (salaried) employment surged in the second half of the 1980s, staying above 30\% (35\% in 1995) since 1990. During the 1990s and early 2000s (1994, 1997, 2001 and 2002) there have been a series of countervailing labor market reforms aimed at reducing that share by providing a less stringent EPL for permanent contracts and considerable restrictions on the use of fixed-term contracts.\textsuperscript{9}

From the perspective of this paper, probably the most important reform was the one taking place in 1997. After the arrival to power in 1996 of the Partido Popular (a center-conservative power), the employers’ confederation (CEOE) and the two major

\textsuperscript{8} More institutional details of EPL in these countries are in OECD (1994), Annex 2.A. The information in the text refers to the end of the 1990s.
unions (CC.OO and UGT) reached an agreement to reform the system of labor contracts. The agreement called for the creation of new permanent contracts in case of “unfair dismissals” entailing a mandatory firing cost which was lower than that pertaining to the old permanent contracts (33 days of wages per year of seniority with a maximum of 24 months-wages against 45 days of wages and 42 months-wages, respectively). However, introducing the new permanent contracts for all workers raised a constitutional problem which implied constraining its availability to only certain groups of the population. The problem was that it is against the Spanish constitutional rights to have to identical workers holding an, otherwise, identical open-ended contract except for their severance payments. Thus, the government in accord with the parties in the agreement, made the new contracts only available for specific targeted groups for which it was legal to provide those contracts. They could be used for any hires, with the very relevant exception of workers aged 30-44 years with unemployment spells below one year. Conversely, the eligible groups were young workers (aged 18-29), long-term unemployed registered at the public employment office for at least twelve months, unemployed above 45 years of age, disabled people and workers whose contract were transformed from temporary into permanent ones. In the 2001 reform, in an attempt to extend the use of the new contacts, the government managed to add young workers between 16 and 30 years of age, long-term unemployed registered for at least six months, and unemployed women of any age working in sectors where they were under-represented.

Yet, Spain is not the only country that has liberalized atypical employment contracts or reduced firing costs contingent on some workers characteristics. In 1984 Italy also

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9 See Dolado, García-Serrano and Jimeno (20032) for a detailed description of those reforms.
introduced “employment promotion contracts” (*Contratti di Formazione e Lavoro*) aimed at the hiring and firm-based training of young workers (between 15 and 29 years of age). Moreover, fixed-term contracts were first introduced in France in 1979 but their scope was very much reduced by the socialist government in 1982. After a reform in 1990, fixed-term contracts can be used only for seasonal activities the replacement of an employee on leave, temporary increases in activity and for facilitating employment for targeted groups, ranging from the young to the long-term unemployed workers (see Blanchard and Landier, 2002).

In Latin America as well there have been labor market reforms, some to decrease firing costs (Colombia and Peru at the end of the 1980s), others to increase them (Brazil, Venezuela, Chile, the Dominican Republic, Nicaragua, and Panama). However, the only country which significantly liberalized the use of atypical contracts targeted on some demographic groups was Argentina, where a reform in 1991 introduced fixed-term contracts and training contracts for young workers, while a new reform in 1995 introduced special contracts to promote employment of certain population groups.

3. Empirical evidence on the effects of dual EPL

Broadly speaking, there are two streams in the empirical literature on the labor market effects of institutions. First, cross-country studies use some quantitative or qualitative indicators representing those institutions to explain international differences in labor market outcomes, such as employment and unemployment rates. Within this literature, a large number of recent studies have looked at the interactions between institutions and shocks and to the different impact of institutions on the labor market outcomes of
different population groups, such as youth and females. Most often in this literature, targeted employment policies or partial labor market reforms are considered, if anything, in the construction of the overall institutional indexes regarding EPL strength, but not separately as an institutional feature on its own. However, this approach can be fairly restrictive since a general reduction of firing costs has not the same labor market effects as a commensurate reduction in the firing costs of a certain group of workers.

Among those studies that estimate the labor market impact of some targeted employment policies, like temporary contracts, separately from aggregate indexes of employment protection legislation, Jimeno and Rodriguez-Palenzuela (2002) find that a less strict regulation of fixed-term employment contract tends to reduce youth unemployment rates without any impact on the prime-age male unemployment rate. Using an unbalanced panel of nine OECD countries during the second half of the 1980s and first half of the 1990s, Nunziata and Staffolani (2001) also estimate the effects of employment protection legislation distinguishing three types of regulations: employment protection legislation regarding firing of permanent employees, regulations regarding fixed-term employees, and temporary work agencies regulations. They find that less stringent fixed-term contract regulations had a significant positive impact on temporary and total employment in good states of the economy, but with no significant effects on total permanent employment. In the case of young workers (15-24 years of age), less stringent fixed-term contract regulations increase both temporary and permanent employment. Likewise, as regards the use of temporary-work agencies, they...

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10 See IDB (2003), chapter 7.
11 See Nickell and Layard (1999).
12 On interactions, see Blanchard and Wolfers (2000). On the different impact of labor market institutions across population groups, see Bertola, Blau, and Kahn (2003), Jimeno and Rodriguez-Palenzuela (2002), and Neumark and Wascher (2003). On the impact of employment protection legislation on employment adjustment, see Caballero, Engel and Micco (2003).
find that less stringent regulations tend to have an incremental effect on temporary employment and on total employment in downturns. Nonetheless, however, in the case of young workers, less stringent regulations of temporary work agencies raise temporary employment but reduce permanent employment.

The second stream of the empirical literature looks at specific country episodes to measure the effect of reforms by analyzing labor market outcomes before and after the reform, along the lines of the “differences-in-differences” evaluation approach. Studies of this kind are, for instance, Kugler, Jimeno and Hernanz (2003) on the Spanish 1997 reform, Blanchard and Landier (2002) on France, and Hopenhayn (2001) on the Argentinan reform. In Spain, Kugler et al. find that the reduction of firing costs (and payroll taxes) for young, older workers, and long-term unemployed had a positive effect on hiring for young workers, with little effect on dismissals, while its increased both dismissals and hiring for older men. Blanchard and Landier (2002), looking at transitions between temporary and permanent employment, observe increased turnover since 1983 in France, specially at younger cohorts, for whom the probability of holding a fixed-term job has increased while the probability of holding a permanent job has decreased. However, their probability of staying or becoming unemployed shows no clear trend. As for Argentina, Hopenhayn (2001) also finds that the introduction of fixed-term contract has had a very strong impact on labor turnover, inducing an increase in hiring but also some strong substitution of permanent jobs by temporary jobs.

4. A model of dual EPL
Our model draws on Mortensen and Pissarides (1994) with two extensions. First, we allow for heterogeneity in workers skills. And, secondly, we assume that the initial productivity of jobs is random. The first extension gets at how reforms aimed at easing firings of one type of workers affects unemployment, productivity and welfare of all workers, both those affected and those not affected by the reform. The second extension allows for a more detailed analysis of how the hiring of different types of workers depends crucially on the structure of hiring and firing costs.

As is conventional, the model is in continuous time and only steady states are considered. The economy is populated by a continuum of workers of measure one. Workers are risk neutral, infinitely lived, and are of two types depending on their productivity (low, L, and high, H) and firms know the worker’s type. L-type workers have lower productivity than H-type workers. The mass of workers of type L is $\alpha$.

The number of firms is endogenously determined. Each firm offers one job. The cost of opening a job vacancy is $c$. When a worker and a firm with a job vacancy meet, they realize the value of the match. The productivity of the match is a random draw from a c.d.f. $F_i(\epsilon)$ with support $[0, 1]$, $(i=L,H)$, such that $F_L(\epsilon)>F_H(\epsilon)$ for all $\epsilon$.

Job termination is endogenous. There are $i.i.d.$ productivity shocks with Poisson arrival rates $\lambda_i$ $(i=L,H)$. To terminate the job, firms must pay dismissal costs $K_i$ $(i=L,H)$, which are assumed to be a pure waste (not a transfer to the worker). Further, we assume that there are no quits involving no indemnity. By allowing for different termination costs for different types of workers we aim at capturing “targeted employment policies/two-tier” labor market reforms discussed at length in the previous sections. Our intuition is
that there are direct and indirect effects of reducing the firing costs for L-type workers. First, the direct effect stems from the fact that the productivity threshold at which L-type workers are dismissed is higher the lower $K_L$ is. The indirect effects, in turn, arise through the determination of the value of jobs filled with by H-type workers which changes when $K_L$ is reduced.

**Matching, hiring, and firing**

Job vacancies and unemployed workers meet according to a conventional CRS matching function:

$$ m(v,u), $$

where $v$ and $u$ denote, respectively, the masses of job vacancies and of unemployed workers. The matching function is increasing in both arguments and homogeneous of degree one. Labor market tightness is denoted by $\theta = v/u$.

Given the matching function, firms meet with L-type unemployed workers with probability $\delta q(\theta)$ and with H-type unemployed workers with probability $(1-\delta)q(\theta)$, where $\delta$ is the proportion of unemployed workers of type L and $q(\theta)=m(1,1/\theta)$. The matching rate of workers is $\theta q(\theta)$.

After meeting a worker and knowing the match-specific productivity, employers face a hiring decision. Thus, since the surplus of the match is increasing in productivity, there are productivity thresholds $(\varepsilon^h_L, \varepsilon^h_H)$ above which hiring takes place.
As for the firing decision, after being hit by a productivity shock, employers decide whether or not to terminate the job. Hence, for each worker’s type there are productivity thresholds \((\varepsilon^d_L, \varepsilon^d_H)\) below which jobs are terminated.

**Flows**

Given the matching probabilities and the hiring and firing rules, the flow equations are given by:

\[
\begin{align*}
(1 - \delta)u &= \frac{\lambda_L F^L (\varepsilon^L_L)}{[1 - F^L (\varepsilon^L_L)] \vartheta q(\theta) + \lambda_L F^L (\varepsilon^L_L)}, \\
(1 - \delta)u &= \frac{\lambda_H F^H (\varepsilon^H_H)}{[1 - F^H (\varepsilon^H_H)] \vartheta q(\theta) + \lambda_H F^H (\varepsilon^H_H)}.
\end{align*}
\]

where \(e_L\) and \(e_H\) are the masses of L and H-type employed workers, respectively. The left-hand-sides of (1) and (2) give the outflows from unemployment while the right-hand-sides give the inflows to unemployment (i.e., outflows from employment) for L and H-type workers, respectively.

Since \(\delta u + e_L = \alpha\) and \((1 - \delta)u + e_H = 1 - \alpha\), the steady state unemployment rates of both types of workers are:

\[
\begin{align*}
wr_L &= \frac{\delta u}{\alpha} = \frac{\lambda_L F^L (\varepsilon^L_L)}{[1 - F^L (\varepsilon^L_L)] \vartheta q(\theta) + \lambda_L F^L (\varepsilon^L_L)}, \\
wr_H &= \frac{(1 - \delta)u}{1 - \alpha} = \frac{\lambda_H F^H (\varepsilon^H_H)}{[1 - F^H (\varepsilon^H_H)] \vartheta q(\theta) + \lambda_H F^H (\varepsilon^H_H)}.
\end{align*}
\]

**Bellman equations**
Let U_i and W_i(\varepsilon) denote, respectively, the value of unemployment and the value of employment with productivity \varepsilon, for workers of type i (=L,H). Then, the corresponding Bellman equations are:

\begin{align}
    rU_i &= z_i + \theta q(\theta) \int_{\varepsilon_i}^1 \left[ W_i(x) - U_i \right] dF(x) \\
    rW_i(\varepsilon) &= w_i(\varepsilon) + \lambda_i F_i(\varepsilon) [U_i - W_i(\varepsilon)] + \int_{\varepsilon_i}^1 \left[ W_i(x) - W_i(\varepsilon) \right] dF(x)
\end{align}

where r is the interest rate, z is the flow utility while unemployed (interpreted as home production or leisure and, thus, not to be financed), and w is the wage. Notice that wages depend on productivity and are renegotiated every time a productivity shock occurs.

As for the employer’s, the value functions of an unfilled vacancy (V) and the value functions of filled vacancies with worker of type i (J_i) are given by the following Bellman equations:

\begin{align}
    rV &= -c + \delta q(\theta) \int_{\varepsilon_L}^1 \left[ J_i(x) - V \right] dF(x) + (1 - \delta) q(\theta) \int_{\varepsilon_H}^1 \left[ J_i(x) - V \right] dF(x) \\
    rJ_i(\varepsilon) &= \varepsilon - w_i(\varepsilon) + \lambda_i F_i(\varepsilon) [V - J_i(\varepsilon) - K_i] + \int_{\varepsilon_i}^1 \left[ J_i(x) - J_i(\varepsilon) \right] dF(x)
\end{align}

Wage determination

When a match is formed, wages are determined by symmetric Nash bargaining with continuous renegotiation. This implies:
Hence, we give insider power to the workers since the beginning of the match to extract the rents from firing costs. In other words, the possibility of undoing the detrimental effect of firing costs on firm’s profits by the worker accepting a wage cut (a so-called bonding scheme) at the beginning of the match is excluded. As shown by Ljungqvist (2002), this assumption is key for the analysis of the employment effects of firing costs. When firing costs are assumed to reduce the firm’s threat point in the initial match (as in equation (7)), firing costs tend to increase equilibrium unemployment, while they tend to increase employment when the worker’s relative share of match surplus is assumed to stay constant when varying severance pay.\(^\text{13}\)

Equilibrium

The productivity thresholds at which hiring start to take place are those at which the value of a filled vacancy is equal to the value of an unfilled vacancy. Since there is free entry, \(V=0\) in equilibrium. Likewise, jobs are terminated when the value of the job is equal to the value of an unfilled vacancy minus termination costs. Thus,

\[
J_i(e_i^b) = V = 0
\]

\[
J_i(e_i^d) + K_i = V = 0
\]  

Solving the model

\(^\text{13}\) Mortensen and Pissarides (1999) propose alternative specifications of the bargaining process in which the worker extract rents from firing costs in continuing matches but not in the first match, as in the bonding scheme.
The surplus of a job of productivity $\varepsilon$ occupied by a worker of type $i$ is

$$S_i(\varepsilon) = J_i(\varepsilon) - V + K_i + W_i(\varepsilon) - U_i$$

Equations (4) and (6) can be rewritten as follows:

$$(r + \lambda_i)[W_i(\varepsilon) - U_i] = w_i(\varepsilon) - z_i + \lambda_i \int \frac{1}{\varepsilon_i} [W_i(x) - U_i]dF^i(x) - \theta q(\theta) \int \frac{1}{\varepsilon_i} [W_i(x) - U_i]dF^i(x) \quad (4')$$

$$(r + \lambda_i)[J_i(\varepsilon) - V + K_i] = \varepsilon - w_i(\varepsilon) + \lambda_i \int \frac{1}{\varepsilon_i} [J_i(x) - V + K_i]dF^i(x) - r(V - K_i) \quad (6')$$

and, hence, adding up the two above equations and using (7) yields

$$(r + \lambda_i)S_i(\varepsilon) = \varepsilon - z_i + \lambda_i \int \frac{1}{\varepsilon_i} S_i(x)dF^i(x) - \frac{\theta q(\theta)}{2} \int \frac{1}{\varepsilon_i} S_i(x)dF^i(x) - (V - K_i) \quad (9)$$

Noting that $S_i'(\varepsilon) = \frac{1}{r + \lambda_i}$ and integrating by parts yields

$$\int \frac{1}{\varepsilon} S_i(x)dF^i(x) = \frac{1}{r + \lambda_i} \int [1 - F^i(x)]dx \text{ for all } \varepsilon$$

Thus,

$$(r + \lambda_i)S_i(\varepsilon) = \varepsilon - z_i + \frac{\lambda_i}{r + \lambda_i} \int [1 - F^i(x)]dx - \frac{\theta q(\theta)}{2(r + \lambda_i)} \int [1 - F^i(x)]dx - r(V - K_i) \quad (10)$$

This equation gives the productivity thresholds values for hiring and firing.

Since $S_i'(-\varepsilon) = 0$ and $S_i'(\varepsilon) = 2K_i$, and in equilibrium the value of an unfilled vacancy is nil,

$$\varepsilon_i^l = z_i - \frac{\lambda_i}{r + \lambda_i} \int [1 - F^i(x)]dx + \frac{\theta q(\theta)}{2(r + \lambda_i)} \int [1 - F^i(x)]dx - rK_i \quad (11)$$
\[ \varepsilon^h_i = z_i - \frac{\lambda_i}{r + \lambda_i} \int_{c_l}^1 \left[ 1 - F^i(x) \right] dx + \frac{\theta q(\theta)}{2(r + \lambda_i)} \int_{c_l}^1 \left[ 1 - F^i(x) \right] dx + (r + 2\lambda_i)K_i \]  

so that \( \varepsilon^h_i - \varepsilon^d_i = 2(r + \lambda_i)K_i \). These are the job creation and job destruction rules. Notice that they depend on labor market tightness and that they are interrelated.

Finally, in equilibrium the supply of vacancies is determined by

\[
\frac{c}{q(\theta)} = \delta \int_{c_l^2}^1 \left[ \frac{1}{2} S_L(x) - K_L \right] dF^L(x) + (1 - \delta) \int_{c_h^2}^1 \left[ \frac{1}{2} S_H(x) - K_H \right] dF^H(x) = \\
= \frac{\delta}{2(r + \lambda_L)} \int_{c_l^2}^1 [1 - F^L(x)] dx + \frac{1 - \delta}{2(r + \lambda_H)} \int_{c_h^2}^1 [1 - F^H(x)] dx - \delta \int_{c_h^2}^1 [1 - F^L(\varepsilon^h_L)] K_L - \delta \int_{c_h^2}^1 [1 - F^H(\varepsilon^h_H)] K_H 
\]

\( (13) \)

**Simulations**

To solve the model we must find for the vector of variables \((\delta, u, \varepsilon^h_L, \varepsilon^d_L, \varepsilon^h_H, \varepsilon^d_H)\) satisfying equations \((1')\), \((2')\), \((11)\), \((12)\) and \((13)\). Note that equations \((11)\) and \((12)\) come in pairs, so that we have 7 unknowns and 7 equations. To simulate the model, we assume that \(\varepsilon_L\) is uniformly distributed in \([0, 1]\) for L-type workers and that \(\varepsilon_H\) is uniformly distributed in \([\varepsilon_{H\text{min}}, 1]\) for H-type workers. Thus, 14

\[ F^i(x) = \frac{x - \varepsilon^i_{\text{min}}}{1 - \varepsilon^i_{\text{min}}} \quad \varepsilon^i_{\text{min}} \leq x \leq 1 \]

with \(\varepsilon^i_{L\text{min}} = 0\) and \(\varepsilon^i_{H\text{min}} > 0\)

As for the matching function, we take

\[ m(u, v) = \frac{huv}{(u^\gamma + v^\gamma)^{\gamma}} \]

where \(h > 0\) is a shift parameter and \(\gamma\) is a parameter capturing the decreasing returns in the elasticity of the
job finding-rate w.r.t. tightness so that for higher values of \( \gamma \) concavity increases.\(^{15}\)

Under these assumptions the system of seven equations to be solved is as follows:

\[
ur_L = \frac{\lambda_L e^d_L}{(1 - e^b_L)\theta q(\theta) + \lambda_L e^d_L} 
\]

\[
ur_H = \frac{\lambda_H (e^d_H - e^\text{min}_H)}{(1 - e^b_H)\theta q(\theta) + \lambda_H (e^d_H - e^\text{min}_H)} 
\]

\[
e^d_L = z_L - \frac{\lambda_L (1 - e^d_L)^2}{2(r + \lambda_L)} + \frac{\theta q(\theta)(1 - e^b_L)^2}{4(r + \lambda_L)} - rK_L 
\]

\[
e^d_H = z_H - \frac{\lambda_H (1 - e^d_H)^2}{2(r + \lambda_H)(1 - e^\text{min}_H)} + \frac{\theta q(\theta)(1 - e^b_H)^2}{4(r + \lambda_H)(1 - e^\text{min}_H)} - rK_H 
\]

\[
e^b_L - e^d_L = 2(r + \lambda_L)K_L 
\]

\[
e^b_H - e^d_H = 2(r + \lambda_H)K_H 
\]

\[
c = \frac{\delta (1 - e^b_L)^2}{4(r + \lambda_L)} + \frac{(1 - \delta)(1 - e^b_H)^2}{4(r + \lambda_H)(1 - e^\text{min}_H)} - \delta (1 - e^b_L)K_L - \frac{(1 - \delta)(1 - e^b_H)K_H}{1 - e^\text{min}_H} 
\]

Throughout the set of simulations presented below we keep constant the following parameter values: \( r=3\% \), \( \alpha \) (proportion of L-type workers) = \( \frac{1}{2} \), \( e^\text{min}_H = 0.25 \), \( c \) (costs of keeping a vacancy unfilled) = 0.25, \( K_H \) (firing costs for H-type workers) = 0.5. As for the matching function, we perform simulations with \( h=1 \) and \( \gamma \) either equals 1 (strong concavity, i.e., SC in short) or 0 (no concavity or Cobb-Douglas case, i.e., CD in short).

Then, for different values of \( z_L, z_H, \lambda_L \) and \( \lambda_H \), we look at the effects of changing the firing costs for L-type workers (\( K_L \)) in the range \([0, K_H] \) on: i) labor market tightness

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\(^{14}\) This assumption simplifies the computation, but at a heavy loss. By assuming uniform distributions for productivity we are minimizing the employment changes after variations in the hiring and destruction thresholds which would be significantly higher with more skewed distributions.

\(^{15}\) This functional form has been proposed by Den Haan, Ramey and Watson (2000). Note that when \( \gamma \uparrow 0 \), it becomes the Cobb -Douglas \( m(u, v) = h u^{\alpha} v^{1-\alpha} \). Furthermore, the elasticity of the matching rate of workers, \( \theta q(\theta) \), with respect to \( \theta \) for this functional form is \( (1+\theta')^{-1} \). Thus, the higher is \( \gamma \), the lower will be that elasticity. In the Cobb-Douglas case, the elasticity is \( \frac{1}{2} \) and, thus, constant.
(0), ii) unemployment rates, iii) the productivity thresholds levels for hiring and firing, iv) asset values for each type of worker and employment status, and v) welfare approximated by the average productivity and total production (net of vacancy costs) under the ergodic distribution of employment. The results of this simulation exercise are depicted in Figures 1 to 4, for the linear matching function, and Figures 5 to 8 for the Cobb-Douglas matching function. Hereafter we comment on the main salient features of the results and discuss the economic forces at work.

**CASE #1 (Figure 1 and Figure 5):** In this case, by setting high values of the unemployment flow income ($z_L = z_H = 0.5$), we simulate a very sclerotic labor market, as illustrated by a low value of labor market tightness ($\theta$ around 0.08 in Figure 1, and around 0.14 in Figure 5) and the very high unemployment rates of L-type workers (about 50% and 25%, respectively) and H-type workers (about 10% and 14%, respectively). As observed in panel 1 of Figure 1, under a SC matching function, a reduction of $K_L$ from 0.5 (the benchmark value) to 0 increases tightness, giving rise to a reduction of the unemployment rate of L-type workers by about 20 percentage points, while the unemployment rate of H-type workers only increases by about 4 percentage points (panel 2). However, in Figure 5, with the CD matching function, the unemployment rate of H-type workers decreases as well as the firing costs of low skill workers do. The reason is that with a CD matching function, decreasing returns in the job-finding rate do not apply and hence job creation is so strong (relative to the SC case where they do apply) that is also favors the employment outcomes of workers not directly affected by the partial reform. Also, as $K_L$ falls and the labor market becomes tighter, the firing rate of L-type workers increases sharply (as reflected in panels 3 of

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16A detailed derivation of the ergodic distribution of employment can be found in the Appendix.
Figures 1 and 5) while their hiring threshold increases more smoothly. Nonetheless, the increase in the labor market tightness dominates the higher destruction rate and $ur_L$ falls. By contrast, for H-type workers we observe a parallel increase in the hiring and firing thresholds (as $K_H$ remains unchanged), resulting, as discussed above, in a small rise in $ur_H$ under the SC specification and a slight fall under the CD specification (panels 2 and 4). Welfare of both types of workers increases, regardless of their employment status (panel 5), the reason being that their wages (conditional on having a job) raise, because of the higher value of being unemployed (higher $\theta q(0)$) and the higher average productivity of employed workers (panel 6). Notice also that, while average productivity is decreasing in the firing costs of low skill workers, total production (net of vacancy costs) is increasing.\(^{18}\)

\textit{CASE #2 (Figure 2 and Figure 6):} In a relatively tight labor market, defined by lower values of the reservation wages ($z_L = z_H = 0.3$), with $\theta$ around 0.55 and unemployment rates around 12\% and 2\% (panels 1 and 2), a reduction in $K_L$ increases $ur_L$ and $ur_H$ by one and two percentage points, respectively (panel 2), in the case of SC matching function, while the rise of unemployment is lower with a CD specification. Furthermore, as before, the hiring and firing thresholds of L and H-type workers increase (panels 3 and 4). Thus, in this tighter labor market, the turnover effect tends to dominate the increase in job creation and both unemployment rates go up. More precisely, due to the lower firing costs more workers are laid off but the increase in the allocative efficiency translates in few additional jobs as the matching rate in a tight

\(^{17}\) Note that, in order to follow the correct direction of changes as $K_L$ decreases, the graphs should be looked from right to left since the horizontal axis of the panels display increasing values of $K_L$.\(^{18}\) We also simulated a comprehensive reform in a sclerotic market, reducing $K_L$ and $K_H$ to 1/3 (which is commensurate with $K_L = 0$ $K_H = 0.5$ ). In this case, with a linear matching function, $ur_L$ only falls to 33.9\% while $ur_H$ increases to 17.2\%. Hence, a comprehensive labor market reform yields, for these parameter values, higher unemployment rates than a two-tier reform.
labour market is relatively insensitive to changes in $\theta$.\textsuperscript{19} Finally, in a tight market, partial reforms raise the welfare of H-type workers (employed and unemployed) while L-type workers suffer a welfare loss (panel 5). This, however, only occurs in the case of the SC matching function, not in the CD case. Again the difference is due to the loss of insider power for L-type workers following the reduction in their firing costs. Moreover, as shown in panel 6, the welfare changes are accompanied by a rise of average productivity and a fall in total production (net of vacancy costs). The fact that welfare effects may differ across the two types of worker is obviously relevant for an analysis of targeted reforms from a political-economy perspective. In particular, while H-type workers tend to favor a partial reform\textsuperscript{20} all low-productivity workers (including those that are unemployed) would lose from such a reform. Hence, the political feasibility of the partial reform will depend on the composition of the labour force.

\textit{CASES \#3 and \#4 (Figures 3 and 4, and Figures 7 and 8):} We now consider how differences in the volatilities of productivity across groups, captured by changes in the Poisson rate of arrival of the shocks ($\lambda_H$ and $\lambda_L$), affect the impact of reductions in $K_L$. When there is higher volatility in the productivity of matches with L-type workers and lower volatility in the productivity of matches with H-type workers (that is, for a higher $\lambda_L$ moving from 0.1 to 0.2 and a lower $\lambda_H$ moving from 0.1 to 0.05), a reduction in $K_L$ leads to a fall in the unemployment rates of both types of workers in a sclerotic labor market (Figure 3). Furthermore, the reduction for the L-type workers is larger than in CASE \#1, although the initial unemployment rate of low-productivity workers is much higher than before (comparing Figure 1 and 3). Similarly, in the case of a tight labour

\textsuperscript{19} See footnote 15.

\textsuperscript{20} Conditional on their employment status, all H-type workers gain from a partial reform. Nonetheless, H-type workers will anticipate the increase in the firing threshold. Some H-type workers will therefore lose
market we now observe a steep rise in the unemployment rate of L-type workers, while the unemployment rate of H-type workers remains virtually unchanged. The strong decrease in \( ur_L \) in Figure 3 is due to the higher sensitivity of profits and job creation to changes in \( K_L \). This results in many more jobs and a high increase in the number of matches. By contrast, in a tight labour market the hiring threshold for L-type workers does not respond very much to changes in \( K_L \). Hence, after a partial reform we obtain much more frequent churning of L-type workers and little additional hiring, resulting in a doubling of the unemployment rate of these workers. As before, the effects on unemployment tend to be smaller in the case of the CD matching function than in the case of the SC specification. Interestingly, we find one case in which total production (net of vacancy costs) is non-monotonic with respect to \( K_L \) (panel 6 in Figure 7).

5. Concluding remarks

One relevant feature of employment policies and labor market reforms is that they are very often targeted at some demographic groups, especially at those facing more difficulties in finding jobs (youth, female, long-term unemployed, etc). Some empirical studies trying to estimate the effects of this type of policies conclude that the impact on the labor market outcomes for different population groups can be very different, and do not always move in the same direction.

In this paper we have presented a search equilibrium model with worker heterogeneity which illustrates why it may be difficult to precisely estimate the consequences of two-tier labor market reforms. According to some simulation results, the impact of targeted
reductions of firing costs on unemployment and welfare of different groups of workers may depend on the initial state of the labor market (more or less tight) and on the volatility of productivity on continuing jobs. An interesting outcome of our analysis is that support for partial reforms is likely (subject to our parameter choice) to be larger in sclerotic labor markets than in tight ones since in the former situation, the welfare of all workers increase. There has been some debate in the literature (see, e.g., Saint-Paul, 1996) about the optimal timing of reforms. It is often argued that reductions in firing costs should be taken in expansions rather than in recessions but Saint-Paul (1996) presents compelling evidence that the opposite happens in practice. To the extent that a sclerotic labor market corresponds to “bad” times and a tight labor market to “good” times, the above implication of our model would provide a rationale for the observed practice.

Finally, although we have analyzed a reduction of firing costs for less productive workers, it is plausible that the effects of other targeted employment policies (like targeted reductions of non-wage costs or differentiated minimum wages) could also be contingent on the initial characteristics of the labor market being analyzed.
Appendix: The ergodic distribution of productivity

To derive the ergodic distribution of productivity let us just consider one type of worker. Let $G(x)$, $\varepsilon^d \leq x \leq 1$, be the ergodic distribution of productivity, $x$, where $\varepsilon^d$ is the level of productivity at which jobs are destroyed, and let $F(x)$ be the distribution function from which productivity shocks are drawn. Workers are hired from the pool of unemployed when $x \geq \varepsilon^h$, being $\varepsilon^d \leq \varepsilon^h$.

Consider first the support of the distribution $\varepsilon^d \leq x \leq \varepsilon^h$. In any infinitesimally small time interval, $dt$, the mass of employed workers $\lambda dt$ receive a productivity shock, hence, the number of jobs with productivity $x' \leq x$, increases by the number of jobs with productivity above $x$ downgrading their productivity between $x$ and the destruction threshold $\varepsilon^d$:

$$(1-u)[1-G(x)][F(x)-F(\varepsilon^d)]\lambda dt, \quad \text{for } \varepsilon^d \leq x \leq \varepsilon^h$$

The number of jobs of productivity $x' \leq x$, for $\varepsilon^d \leq x \leq \varepsilon^h$, being destroyed in any infinitesimally small time interval, $dt$, is given by the number of jobs which upgrade their productivity above $x$ and those being destroyed with productivity below the destruction threshold $\varepsilon^d$:

$$(1-u)G(x)[1-[F(x)-F(\varepsilon^d)]]\lambda dt, \quad \text{for } \varepsilon^d \leq x \leq \varepsilon^h$$

Now, consider the rest of the support of the distribution, $x > \varepsilon^h$. In any infinitesimally small time interval, $dt$, the mass of employed workers $\lambda dt$ receive a productivity shock, while a mass of $\theta q(\theta) dt$ are hired. Thus, the number of jobs with productivity $x' \leq x$, increases by additions from firms with productivity above $x$ and firms form the lower segment of the distribution, $\varepsilon^d \leq x \leq \varepsilon^h$, changing their productivity between $x$ and $\varepsilon^h$, and by the new hires:

$$(1-u)[1-G(x)+G(\varepsilon^h)][F(x)-F(\varepsilon^h)]\lambda dt + \theta q(\theta)[F(x)-F(\varepsilon^h)] dt, \quad \text{for } x > \varepsilon^h$$

On the other hand, the number of jobs of productivity $x' \leq x$, for $x > \varepsilon^h$, being destroyed is given by the jobs which upgrade their productivity below $x$ and the jobs which downgrade their productivity below the hiring threshold $\varepsilon^h$:

$$(1-u)[G(x)-G(\varepsilon^h)][1-[F(x)-F(\varepsilon^h)]]\lambda dt, \quad \text{for } x > \varepsilon^h$$

Thus, the ergodic distribution must satisfy

$$[1-G(x)][F(x)-F(\varepsilon^d)] = G(x)[1-[F(x)-F(\varepsilon^d)]], \quad \text{for } \varepsilon^d \leq x \leq \varepsilon^h$$

$$\left[1-G(x)+G(\varepsilon^h) + \frac{F(\varepsilon^d)}{1-F(\varepsilon^h)}\right][F(x)-F(\varepsilon^d)] = [G(x)-G(\varepsilon^h)][1-[F(x)-F(\varepsilon^h)]], \quad \text{for } x > \varepsilon^h$$
where, to derive the second expression, we make use of the steady state condition for unemployment inflows and outflows which yields

$$\frac{u\theta q(\theta)}{\lambda (1-u)} = \frac{F(\varepsilon^d)}{1-F(\varepsilon^h)}$$

These two equations give, respectively

$$G(x) = F(x) - F(\varepsilon^d), \quad \text{for } \varepsilon^d \leq x \leq \varepsilon^h$$

$$G(x) = F(x) - F(\varepsilon^d) + \frac{F(\varepsilon^d)}{1-F(\varepsilon^h)}[F(x) - F(\varepsilon^h)], \quad \text{for } x > \varepsilon^h$$

Hence, the ergodic distribution is

$$G(x) = \begin{cases} 
0, & \text{for } x < \varepsilon^d \\
F(x) - F(\varepsilon^d), & \text{for } \varepsilon^d \leq x \leq \varepsilon^h \\
F(x) - F(\varepsilon^d) + \frac{F(\varepsilon^d)}{1-F(\varepsilon^h)}[F(x) - F(\varepsilon^h)], & \text{for } x > \varepsilon^h 
\end{cases}$$

Notice that if there are no firing costs, so that $\varepsilon^d = \varepsilon^h$, then

$$G(x) = \frac{F(x) - F(\varepsilon^h)}{1-F(\varepsilon^h)}, \quad \text{for } x \geq \varepsilon^h$$

In the case of $F(x)$ being uniform in the interval $[\varepsilon^\text{min},1]$, with $\varepsilon^\text{min} < \varepsilon^d$, so that $F(x) = \frac{x - \varepsilon^\text{min}}{1-\varepsilon^\text{min}}$, the ergodic distribution is

$$G(x) = \begin{cases} 
0, & \text{for } x < \varepsilon^d \\
\frac{x - \varepsilon^d}{1-\varepsilon^\text{min}}, & \text{for } \varepsilon^d \leq x \leq \varepsilon^h \\
\frac{x - \varepsilon^d}{1-\varepsilon^\text{min}} + \frac{\varepsilon^d - \varepsilon^\text{min}}{1-\varepsilon^h} \frac{x - \varepsilon^h}{1-\varepsilon^\text{min}}, & \text{for } x > \varepsilon^h 
\end{cases}$$

Finally, in our model with a mass $\alpha$ of low-skilled workers and a mass $(1-\alpha)$ of high-skilled workers, the ergodic distribution of productivity, conditioned on employment, is

$$(\alpha - \delta u)G^L(x) + [1-\alpha -(1-\delta)u]G^H(x)$$

where $G^i(x)$ $(i=L,H)$ is the ergodic distribution related to $F^i(x)$ as indicated above. Using this distribution we compute average productivity
and total production, net of vacancy costs, given by:

\[(1-u)\text{avprod} - \theta uc\]
References


Figure 2
Figure 3
Figure 5
Figure 7