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Transitions into unemployment and the nature of firing costs

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Abstract

We study the effects of firing taxes on labor market outcomes. These taxes, more common in European markets, include all administrative and procedural costs incurred by the firm. As such, they are independent of the dismissed worker's skill level. We establish that, for young workers, unemployment incidence increases with skill in high-firing-tax countries, while the opposite holds in economies with low firing taxes. The model is able to replicate these observations, while maintaining unemployment duration and the unemployment rate as decreasing functions of skill in all countries. Because of constant firing taxes, the effective tax rate diminishes with skill. Hence, the size of job destruction costs decreases with skill. Also, high-skill vacancies are more profitable, implying tighter markets. These two reasons generate the skill-incidence pattern.

JEL classification: E24; J41; J63; J64; J65

Keywords: Matching models; Firing costs; Unemployment; Job tenure; Wage profile

1. Introduction

This paper is at the intersection of two active strands of literature in labor economics: one deals with the differences between labor markets in the USA and in Europe, while the other deals with inequalities in labor outcomes between workers of different skills. European labor markets are characterized by regulations designed to protect employment and provide income security to the unemployed, while the US market is less regulated. These differences alone generate different wage and unemployment outcomes. In addition,

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workers of different skill levels vary greatly in their labor market prospects. Hence, the model attempts to analyze not only how policies affect labor markets, but also their impact on the different skill categories.

The paper focuses on the effects of firing costs on unemployment and wages. Firing costs can be classified into either *severance payments* (i.e., payments which are transfers between the firm and the worker and proportional to wage) or *firing taxes* (i.e., payments that are not received by the worker and typically not dependent on the worker's skill). Because severance payments can be undone in an efficient contract or bargaining process (in the sense that they do not influence equilibrium unemployment, just equilibrium wages), the model only incorporates firing taxes into the analysis. It is a well known fact that, in all countries, high-skill workers have a lower unemployment rate than low-skill ones, and also that they stay unemployed for a shorter period on average. It is found however, that the rate at which workers become unemployed does not exhibit the same pattern across countries. It is established, for a sample of young workers, that in countries with high firing taxes, the incidence of unemployment increases with skill, while it decreases with skill in economies where this type of costs are low or even absent. Section 4 uses a matching model of the labor market to replicate the facts just mentioned. A complementary result is that, in addition to having an impact on unemployment, firing regulations also affect wages and, in particular, the wage profile, which is made steeper by such regulations, a fact supported by Friesen (1996).

The plan of the paper is as follows. A review of the existing literature is provided in Section 2. Section 3 briefly describes the different types of firing taxes, as well as their magnitudes across countries, along with the empirical evidence establishing how unemployment incidence varies with skill in different countries. The model is developed in Section 4. Section 4.1 looks at the qualitative implications of the model, while Section 4.2 provides a calibration and numerical simulations. Finally, Section 5 concludes and mentions possible extensions.

2. Literature review

Theoretically, the effect of firing costs on unemployment is not unambiguously established. Earlier models, such as Bentolila and Bertola (1990) and Bertola (1990) determine a labor demand equation, in the presence of uncertainty and linear adjustment costs, in a partial equilibrium setting. They find that firing costs have more of an effect on the firing decision than on the hiring decision, thereby increasing long-term employment. Hopenhayn and Rogerson (1993) find that, in a calibrated general equilibrium model, with linear separation costs, but no hiring costs, an increase in firing taxes, causes job turnover to decrease, but employment to also decrease. This is because taxes on dismissals cause firms to be more cautious about job creation, reducing the need for job destruction. More recently, matching models, based on Mortensen and Pissarides (1994) have been applied to the study of labor market policies on unemployment. There are two main references: Millard and Mortensen (1997) and Mortensen and Pissarides (1999). The two papers differ in their assumptions regarding firing costs and because workers are homogenous in the former, while they are heterogeneous with respect to their skills in the latter. In Millard and Mortensen, employment protection regulations have opposite effects on unemployment incidence and duration, and hence an ambiguous effect on the unemployment rate. However, the model's assumptions imply that the firing costs weaken the firms' bargaining position by lowering their threat point, even at the time the match is formed. This increases the wage bargained, at all points in the match, and reduces firms' incentive to post vacancies. It does not take into account the fact that firing regulations generally are not in place at the beginning of the firm–worker relationship, but rather that they only come into effect after a certain tenure with the firm. The present paper explicitly assumes that firing regulations do not come into effect right away, and hence avoids the undesirable consequences on equilibrium wage and vacancy posting decision. This problem is avoided in Mortensen and Pissarides, because they assume that there is an "initial period during which the worker helps finance the match specific costs by working for a lower wage." While this leads to similar implications as assuming that regulations do not come into effect before a certain tenure with the firm, it does not specify why this is justified. More importantly, Mortensen and Pissarides consider workers heterogeneous with respect to their skills but, because they only look at one type of regulations (namely firing taxes assumed to be proportional to skill), their model implies that the probability of becoming unemployed always decreases with the skill level considered. This is at odds with the fact that the incidence of unemployment increases with the worker's skill in certain countries, while it decreases with worker's skill in other countries.

The empirical evidence is also inconclusive. Lazear (1990) finds a small positive effect of severance pay regulations on the unemployment rate. Bertola (1990) finds no strong correlation between the long-term unemployment rate and a general ranking of strictness of employment protection policies—including all form of firing restrictions. Finally, there is no empirical evidence on the effect of firing costs on the two components of unemployment: duration and incidence. This paper is an attempt at remedying this situation. From a different perspective, looking at the effect of firing costs on wages, Friesen (1996) studies the wages of workers covered by firing regulations. Using wage data from the different Canadian provinces, hence subject to different regulations, she determines that incumbent workers, protected by regulations, extract higher wages than workers not protected by these laws and that starting wages (for non-union workers) appear to fall to offset subsequent wage increases.

3. Empirical evidence

3.1. Labor market policies

Firing taxes include all types of administrative and procedural costs due to record keeping requirements, and the obligation to inform and consult with worker representatives and/or a third party. There is much evidence that these costs are far from trivial. Lyon-Caen (1993) mentions that "the complexity and multiplicity of regulations in France may suggest that labor relations are essentially determined by law, when in fact, it is primarily the social partners, unions and employer confederations, and the immediate labor market parties that transform and implement legal regulations in practice." For the French labor market, Abowd and Kramarz (1997) describe how, even for individual dismissals, the administrative authority at the Ministry of Labor must be informed. Short of a procedural error, the dismissal cannot be blocked, but this purely procedural requirement adds fixed costs to the firing of a worker. Collective dismissals involve more such procedural steps. All these various regulations are just legal minimum requirements and in many cases, additional protection is in place at the firm or industry level. All these requirements primarily take place in Europe, while in the USA these types of costs are practically nil. An important characteristic of these types of costs is that they are essentially fixed, i.e., the same regardless of the dismissed worker's wage (legal costs may conceivably be proportional to skill, however they are very small in Europe, where procedural costs dominate).

3.2. Unemployment incidence across countries

Evidence from the USA

We directly estimate US transition probabilities, based on the Kaplan–Meier estimator, using completed education as a proxy for skill. This method is equivalent to setting the estimated transition probability equal to the observed frequency of changing state (transition probabilities are assumed to follow a Markov process) and provides a consistent estimation. As per the CPS categories, any individual is in one of the following three states: (i) employed (E), (ii) unemployed (U), or (iii) not in the labor force (N). Looking at all age categories appeared to be misleading, as it introduced an age/tenure bias. For this reason, the sample was restricted to individuals less than thirty, and only included housekeeping as part of the "not in the labor force" state, since considering transitions in and out of schooling for a sample of young agents would include individuals, who do not show a strong attachment to the labor market (for example, students working part-time). The results are provided in Appendix A. All transition probabilities display monotonic patterns. Transitions from any state into employment are always increasing in education ($P^{\mathrm{h}}_{iE} > P^{\mathrm{l}}_{iE}$, $\forall i \in \{E, U, N\}$, h: high education, l: low education), which implies that higher education individuals tend to stay in employment longer, and when they leave employment, to go back to it faster, than lower education individuals. Also, lower education workers become unemployed more frequently and stay unemployed longer before finding a new job ($P^{\mathrm{h}}_{EU} < P^{\mathrm{l}}_{EU}$ and $P^{\mathrm{h}}_{UE} > P^{\mathrm{l}}_{UE}$). In other terms, incidence of unemployment is higher for lower education groups, and duration of unemployment is longer for these same groups. Looking in more detail at the differences between the two states of non-employment, it appears that transitions into and out of U on the one hand and transitions into and out of N on the other hand, display similar patterns: P_{iU} and P_{iN}, $i \in \{E, U, N\}$, are both decreasing functions of education, P_{UE} and P_{NE} are both increasing functions of education, and P_{Uj} and P_{Nj}, $j \in \{U, N\}$, are both decreasing functions of education.

Evidence from Europe

Transition probabilities out of employment were inferred using unemployment rate and duration data. The method takes advantage of the fact that in the model, transitions out of employment and unemployment follow Poisson processes. As a consequence, the transition rates are the inverse of the average employment (*AED*) and unemployment (*AUD*) durations, respectively. Hence, in steady state, u denoting the unemployment rate:

$$u = \frac{AUD}{AED + AUD}.$$

Thus, if unemployment rate and unemployment duration data are available, unemployment incidence can be inferred. This method implicitly assumes that there is no duration dependence in the transition probabilities. As reported in Machin and Manning (1999), the empirical analyses often cannot differentiate between true duration dependence and unobserved heterogeneity. In fact, regardless of the distribution of unobserved heterogeneity, negative duration dependence will appear to hold. These authors also mention that "differences in duration dependence do not seem to be the main explanation of differences in the incidence of long-term unemployment, with the exception of Sweden,"[1] which is not in the sample of countries considered. These considerations support the underlying assumption of no duration dependence, in the estimation in Appendix B.1. However, Appendix B.2 reports an estimation that assumes that all the observed negative duration dependence[2] is due to true duration dependence, and not to unobserved heterogeneity. The conclusion remains the same: unemployment incidence increases with education, for the European countries with the strictest firing taxes. In fact, under the assumption of true duration dependence, even more European countries (the ones with the strictest firing taxes) exhibit an upward sloping unemployment incidence/skill pattern, reinforcing the result.

The data used comes from OECD (1994a). Data on unemployment rates and a measure of long-term unemployment are reported for three levels of educational attainment (less than upper secondary, upper secondary, and post-secondary), and for eight different European countries (Belgium, Denmark, Germany, Ireland, Italy, the Netherlands, Spain, and the UK). The samples consist of 20 to 24 year old workers. Long-term unemployment is measured as the proportion of unemployed who have been unemployed for more than one year (hereafter called *LTU*). Since the transition out of unemployment follows a Poisson process with rate γ, the probability that a spell lasts exactly T follows an exponential distribution with parameter γ and, the probability that a spell lasts at least T is equal to $e^{-\gamma T}$. Therefore, long-term unemployment is equal to (T_0 is equal to one year):

$$LTU_i = e^{-T_0/AUD_i}, \quad i \in \{high, low\}.$$

Given that the *LTU* is available for each country, average duration can be determined for both lowest and highest education levels. The results are available in Appendix B.1. The estimated transition rates indicate that in Germany, Italy, the Netherlands, and Spain, unemployment duration decreases faster with education than the unemployment rate does,

[1] Although they recognize that additional evidence would be welcome.
[2] As estimated in Machin and Manning (1999, p. 3101).

and therefore that unemployment incidence increases with education.[3] Of course, the opposite is true in Belgium, Denmark, Ireland, and the UK.

To relate these facts to the employment protection policies in Europe, a survey from OECD (1994b) is used, which ranks European countries in terms of their strictness of employment protection policies. This study corroborates the results in Emerson (1988). The table, provided in Appendix C, ranks the Western European countries, in terms of their employment protection policies along two dimensions: (1) regular procedural inconveniences (such as procedures and delay to start of notice), and (2) difficulty of dismissal (such as definition of unfair dismissal, length of trial period, and possibility of reinstatement). The study shows that, out of these eight countries, Germany, Italy, the Netherlands, and Spain are ranked as the four countries with the strictest employment protection policies, when considering both regular procedural inconvenience and difficulty of dismissal.[4] This seems to point out towards a link between employment protection policies with high administrative and procedural costs and an increasing unemployment incidence as a function of skill (the USA is a country with low firing taxes and decreasing unemployment incidence as a function of skill). The reader can refer to Figs. 1 and 2

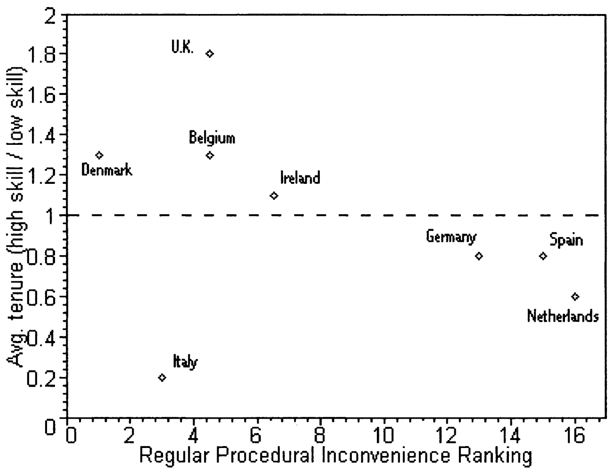

Fig. 1.

[3] Italy and Spain exhibit an increasing unemployment rate as a function of education, for young workers. Although it could be the case that some specific feature of their respective labor markets may explain that result, the model has the property that, with sufficiently high firing taxes, the unemployment rate may indeed increase with education.

[4] To be precise, Germany, the Netherlands, and Spain are the three countries with the strictest regular procedural inconvenience (RPI) policies, and are among the four countries with the strictest difficulty of dismissal (DOD) policies. Although Italy does not have strict RPI policies, it is the country with the strictest DOD ones.

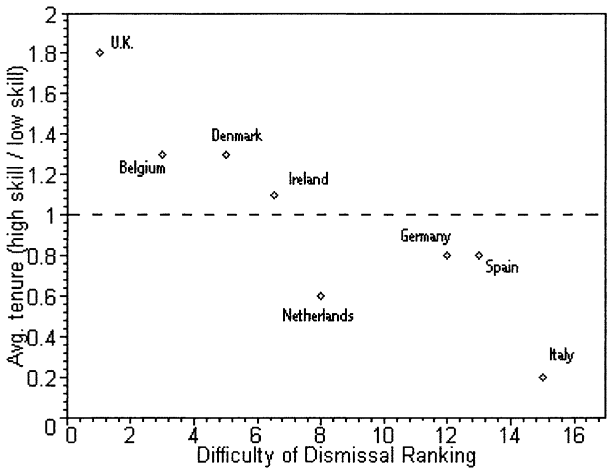

Fig. 2.

to confirm the patterns mentioned.[5] Section 4 develops a model that tries to account for these facts. The model also needs to imply that both unemployment duration and the unemployment rate decrease with skill across countries, to be consistent with the data.

4. A matching model

The model is based on the Mortensen and Pissarides (1994) matching framework. Workers are characterized by their skill or productivity p, which is assumed to be fully observable. It is assumed that markets are segmented along skill lines, i.e., that there is a market for each skill level. Hence, firms, when trying to fill a vacancy, look for one particular type of workers. In a given market, there is a continuum of workers, with a total mass of one. There is also a continuum of firms. Workers have linear preferences: employed workers receive a wage w and unemployed workers' opportunity cost of employment is denoted b, which comprises the value of leisure, as well as unemployment benefits. The output of a match is the product px, where x is an idiosyncratic productivity shock.

Workers can be in either one of two states: employed and producing, or unemployed and searching for a match. Similarly, firms can either be productive or vacant. Because of matching frictions, unemployed workers and vacant firms make contact randomly, as represented by a meeting function. The number of meetings per period between firms and workers is given by $M(N_u, N_v)$, where N_u and N_v are the numbers of unemployed workers and vacancies, respectively. The ratio of vacancies to unemployed workers, or

[5] These results hold for a sample of young workers, where tenure effects are presumably less relevant. Indeed, if wages are positively correlated with tenure and hence, with the accumulation of human specific capital, one may possibly observe decreasing unemployment incidence as a function of skill, in a sample of all ages. Looking at young workers removes this effect.

market tightness, is θ. Assuming the usual properties on the meeting function[6] ensures that (i) the meeting probabilities are functions of market tightness only, (ii) the probability that a worker finds a match in an interval $\mathrm{d}t$, $(M(N_\mathrm{u}, N_\mathrm{v})/N_\mathrm{u})\,\mathrm{d}t = m(\theta)\,\mathrm{d}t$, is increasing in θ, and (iii) the probability that a vacant job finds a match in an interval $\mathrm{d}t$, $(m(\theta)/\theta)\,\mathrm{d}t$, is decreasing in θ. In order to find a worker, firms have to post a vacancy at a cost $p\kappa$ per period of time. The assumption that vacancy posting costs are proportional to skill is justified by several authors, who find that hiring costs are larger for higher-skill workers.[7] Because firms can freely enter the search pool, they do so until the value of posting a vacancy is driven to zero (free entry condition). Once a match is formed, the two partners start producing. As is standard in the literature, it is assumed that the initial value of the idiosyncratic productivity shock is equal to its maximum value of $\bar{x}$. Following a Poisson process with rate λ, the match may be hit by a new idiosyncratic shock x, drawn from a distribution $F(x)$, $x \in [\underline{x}, \bar{x}]$. Two additional state variables are needed to define the economy: (i) an individual state variable characterizing matched workers and firms, the idiosyncratic shock x, and (ii) an aggregate state variable, the unemployment rate, or mass of workers in the search pool. However, it is shown in Cole and Rogerson (1999) that there always exists an equilibrium where wages only depend on x and not on the unemployment rate. The intuition is that, because of the free entry margin, vacancies adjust to the number of unemployed workers and, the relevant variable becomes the ratio of unemployed workers to vacancies, or market tightness θ. This is the equilibrium looked at here.

Random matching produces a local surplus between a given worker and firm, and the division of match output is bargained between the two parties, taking the market wage schedule as given. As traditional in the literature, the bargained wage is the solution to the Nash bargaining problem, with bargaining powers of β and $1-\beta$, for the worker and the firm, respectively. In equilibrium, the bargained wage is equal to the market wage.

The decision variables for the firm are: (i) how many vacancies to post, and (ii) when to break a match down (conditional of the value of the idiosyncratic shock governing the match), and the decision variable for a worker is: when to break a match down. Given the distribution of productivity shocks $F(x)$, the wage schedule $\{w(x)\colon x \in [\underline{x}, \bar{x}]\}$, and the other agents' strategies, workers maximize the lifetime discounted expected value of searching (S^w), as well as the lifetime discounted expected value of being matched in a match governed by an idiosyncratic shock x ($M^\mathrm{w}(x)$), and firms maximize the lifetime discounted expected value of being matched ($M^\mathrm{f}(x)$).

It is assumed that, upon termination of a match,[8] firms have to pay firing taxes equal to t. In addition, certain types of firing costs are only due after a certain tenure with the firm. For example, regulations about unfair dismissals do not take effect until completion of a trial period, whose length varies from a few months to two years, depending on the country. Hence, it is assumed that these costs are not due before the first idiosyncratic

[6] Increasing and concave in both arguments, and exhibiting constant returns to scale.

[7] Barron and Bishop (1985), Barron et al. (1985), Devine and Kiefer (1991), Abowd and Kramarz (1997), and Barron et al. (1997).

[8] For simplicity, exogenous quits are not included, since they do not entail the firing costs that are the focus of this paper. However, as pointed out in Bentolila and Bertola (1990), quits would lessen the effects of firing costs.

shock hits the match. This is an important consideration, as it affects wage formation. Because of this assumption, it is necessary to define (i) the value of a match at match formation, or before regulations come into effect, and (ii) the value of a match after the regulations come into effect, hereafter called a continuing match. Alternatively, we could assume that the regulations come into effect, following a Poisson process with a different rate λ_2. The artificial link between the arrival of shocks and the arrival of regulations would thus be broken. However, the consideration to emphasize is that, because regulations do not come into effect immediately, the firm's bargaining position at match formation is not affected by the regulations. The assumption in this model is different from Garibaldi (1998) who assumes that firms can only fire workers when granted permission, and that these firing permissions arrive randomly. In this model, once the regulations (randomly) become effective, firms can fire workers at any time, yet at a cost.

The value functions are given by the following equations, in flow terms. M_0^{w} and M_0^{f} are the values of match formation to the worker and the firm, respectively. $M_{\mathrm{c}}^{\mathrm{w}}(x)$ and $M_{\mathrm{c}}^{\mathrm{f}}(x)$ are the values of a continuing match under idiosyncratic productivity x, after the first shock hits, to the worker and the firm, respectively. S^{w} is the value of unemployed search to the worker:[9]

$$rM_0^{\mathrm{w}} = w_0 + \lambda \int \left[\mathrm{Max}\left\{M_{\mathrm{c}}^{\mathrm{w}}(z), S^{\mathrm{w}}\right\} - M_0^{\mathrm{w}}\right] \mathrm{d}F(z), \tag{1}$$

$$rM_0^{\mathrm{f}} = p\bar{x} - w_0 + \lambda \int \left[\mathrm{Max}\left\{M_{\mathrm{c}}^{\mathrm{f}}(z), -t\right\} - M_0^{\mathrm{f}}\right] \mathrm{d}F(z), \tag{2}$$

$$rM_{\mathrm{c}}^{\mathrm{w}}(x) = w_{\mathrm{c}}(x) + \lambda \int \left[\mathrm{Max}\left\{M_{\mathrm{c}}^{\mathrm{w}}(z), S^{\mathrm{w}}\right\} - M_{\mathrm{c}}^{\mathrm{w}}(x)\right] \mathrm{d}F(z), \tag{3}$$

$$rM_{\mathrm{c}}^{\mathrm{f}}(x) = px - w_{\mathrm{c}}(x) + \lambda \int \left[\mathrm{Max}\left\{M_{\mathrm{c}}^{\mathrm{f}}(z), -t\right\} - M_{\mathrm{c}}^{\mathrm{f}}(x)\right] \mathrm{d}F(z). \tag{4}$$

Equation (1) reflects the fact the flow value of match formation to the worker is equal to the wage at match formation (w_0) plus the option value of being hit by a new shock, and having the opportunity of continuing the match or resuming search. Equations (2)–(4) can be interpreted similarly, the only difference being that continuing wages ($w_{\mathrm{c}}(x)$) reflect the payment of a firing tax by the firm in case of a breakdown. This affects the firm's threat point, and hence, the wage bargained. Similarly,

$$rS^{\mathrm{w}} = b + m(\theta)\left[M_0^{\mathrm{w}} - S^{\mathrm{w}}\right], \tag{5}$$

$$-p\kappa + \frac{m(\theta)}{\theta} M_0^{\mathrm{f}} = 0. \tag{6}$$

[9] Notice that the value functions are expressed, fully expecting that the firm pays t after a separation. Given that in the Mortensen and Pissarides matching framework, separations are privately efficient, the determination of which party initiates the breakdown is ambiguous. We take the stand that a separation due to economic conditions (which is the only reason to separate in this model), are layoffs, hence that they are initiated by firms. Empirically, layoffs for economic reasons have a higher probability of experiencing an intervening spell of unemployment than quits (McLaughlin, 1991). Hence, we categorize separations following a low idiosyncratic productivity shock as layoffs.

Equation (5) states that the value to a worker of being unemployed consists of the income during search, plus the option value of match formation. Equation (6) determines the free entry condition for firms.

Firms and workers split the surplus from matching. Denoting the total surplus at match formation by $S_0 = M_0^{\mathrm{w}} + M_0^{\mathrm{f}} - S^{\mathrm{w}}$, the wage at match formation, w_0, which prevails until a new shock hits the match is given by

$$M_0^{\mathrm{w}} - S^{\mathrm{w}} = \beta S_0, \qquad M_0^{\mathrm{f}} = (1-\beta) S_0.$$

Similarly, denoting the total surplus for a continuing match under productivity x by $S_{\mathrm{c}}(x) = M_{\mathrm{c}}^{\mathrm{w}}(x) + M_{\mathrm{c}}^{\mathrm{f}}(x) - S^{\mathrm{w}} + t$, the wage for a continuing match under productivity x, $w_{\mathrm{c}}(x)$, is given by

$$M_{\mathrm{c}}^{\mathrm{w}}(x) - S^{\mathrm{w}} = \beta S_{\mathrm{c}}(x), \qquad M_{\mathrm{c}}^{\mathrm{f}}(x) + t = (1-\beta) S_{\mathrm{c}}(x).$$

Adding (3) and (4), and using the definition of $S_{\mathrm{c}}(x)$:

$$(r+\lambda) S_{\mathrm{c}}(x) = px + \lambda \int \mathrm{Max}\{S_{\mathrm{c}}(z), 0\}\, \mathrm{d}F(z) - r(S^{\mathrm{w}} - t). \tag{7}$$

Therefore $S_{\mathrm{c}}(x)$ is an increasing function and hence, there exists a reservation value $x = x_{\mathrm{R}}$, below which the continuing match surplus is negative and the match is broken down. By definition, x_{R} must satisfy $S_{\mathrm{c}}(x_{\mathrm{R}}) = 0$. The continuing match surplus can be obtained, by subtracting equation (7) evaluated at $x = x_{\mathrm{R}}$ from the same equation expressed in terms of any arbitrary $x \geqslant x_{\mathrm{R}}$:

$$S_{\mathrm{c}}(x) = p \frac{x - x_{\mathrm{R}}}{r+\lambda}. \tag{8}$$

Combining (7) and (8) at $x = x_{\mathrm{R}}$:

$$r(S^{\mathrm{w}} - t) = p\left[x_{\mathrm{R}} + \frac{\lambda}{r+\lambda} \int_{x_{\mathrm{R}}}^{\bar{x}} (z - x_{\mathrm{R}})\, \mathrm{d}F(z)\right]. \tag{9}$$

Expression (9) states that, at the reservation shock, the combined opportunity cost of match continuation, $r(S^{\mathrm{w}} - t)$ is equal to the combined opportunity cost of match breakdown, current match output plus the capital gain option.

From the Nash bargaining solution, $\beta[M_{\mathrm{c}}^{\mathrm{f}}(x) + t] = (1-\beta)[M_{\mathrm{c}}^{\mathrm{w}}(x) - S^{\mathrm{w}}]$, and using (3) and (4), one obtains:

$$w_{\mathrm{c}}(x) = \beta(px + rt) + (1-\beta) r S^{\mathrm{w}}.$$

Similarly, using the fact that $\beta M_0^{\mathrm{f}} = (1-\beta)[M_0^{\mathrm{w}} - S^{\mathrm{w}}]$, as well as (1) and (2), one obtains:

$$w_0 = \beta(p\bar{x} - \lambda t) + (1-\beta) r S^{\mathrm{w}}.$$

Adding (1), (2) and (3), (4) expressed at $x = \bar{x}$, and using the definitions of S_0 and $S_{\mathrm{c}}(x)$, one gets:

$$S_0 = p \frac{\bar{x} - x_{\mathrm{R}}}{r+\lambda} - t. \tag{10}$$

Considering how the firm's and worker's bargaining positions, before and after the regulations become effective, are affected by the presence of firing costs, it is clear that firing costs result in a steeper wage profile. This can be confirmed by noticing that the difference between the wage at match formation and the wage for a continuing match (at the same productivity $\bar{x}$) is equal to

$$w_c(\bar{x}) - w_0 = (r+\lambda)\beta t. \tag{11}$$

In order to get the firms to accept to match, the wage w_0 has to be low enough, in anticipation of possible future firing costs. When bargaining at match formation, the firm fully expects that once the regulations come into play, its bargaining position will be weaker than what it is now (i.e., its threat point will be lower). Anticipating this, and given its current bargaining position before the regulations come into play, the firm is able to retain more of the match output. The worker has to accept a lower wage at first, knowing that, later in the match, he or she will be able to extract more from the match output, since the firm will try to avoid paying the firing costs. This is similar in spirit to the insider-outsider model developed by Lindbeck and Snower (1986). Because of insider power, wages for insiders and outsiders differ, as firms attempt to avoid turnover costs.

Using (10), Eqs. (5) and (6) can be rewritten as

$$rS^{w} = b + m(\theta)\beta\left[p\frac{\bar{x}-x_R}{r+\lambda} - t\right], \tag{12}$$

$$p\kappa = \frac{m(\theta)}{\theta}(1-\beta)\left[p\frac{\bar{x}-x_R}{r+\lambda} - t\right]. \tag{13}$$

Definition. A matching equilibrium is a triplet (x_R, θ, S^{w}) satisfying Eqs. (9), (12), and (13).

Remark. The equilibrium values of interest are $x_{R_{eq}}$ and θ_{eq}, since these give us the average employment duration $AED = 1/(\lambda F(x_{R_{eq}}))$ and average unemployment duration $AUD = 1/m(\theta_{eq})$.

4.1. Qualitative analysis of firing costs

The equilibrium can be characterized by two conditions, which easily lend themselves to economic interpretation. The first one is a job destruction condition (JD) that is obtained by combining (9) and (12) and defining $\sigma(x) = \int_x^{\bar{x}}(z-x)\,dF(z)$. We also divide the expression throughout by p to highlight the role of the *effective* tax per unit of skill t/p:

$$x_R + \frac{\lambda}{r+\lambda}\sigma(x_R) = \frac{b-rt}{p} + m(\theta)\beta\left[\frac{\bar{x}-x_R}{r+\lambda} - \frac{t}{p}\right]. \tag{JD}$$

As previously pointed out, (JD) is equivalent to an efficient breakdown condition. The other economically meaningful condition is a job creation condition (JC) given by (13):[10]

$$\kappa = \frac{m(\theta)}{\theta}(1-\beta)\left[\frac{\bar{x}-x_R}{r+\lambda} - \frac{t}{p}\right]. \tag{JC}$$

[10] In (θ, x_R) space, JD (JC) is an upward (downward) sloping curve.

The model can be used to explain the relationship between skill and unemployment incidence in the USA and Europe. Indeed, when $t = 0$ (as in the USA), the position of the job creation curve does not depend on the skill level p (since both match surplus and cost of vacancies are proportional to p). In the absence of separation costs, the total opportunity cost of match continuation (right-hand side of (JD)) increases at a slower rate than p, as the value of leisure is constant across skills. Hence, it is more costly for higher skill workers to return to unemployment. Consequently, the job destruction curve, which reflects efficient breakdowns, shifts down and equilibrium unemployment incidence decreases with p. Now suppose that $t > 0$ (as in most European countries). The cost of posting a vacancy is proportional to the worker's skill. On the other hand, the firm's share of the surplus at match formation is a function of (i) expected future match profit, which is proportional to skill and (ii) of possible future fixed separation costs. As a result, the match surplus increases faster than the skill level, giving firms more incentive to post vacancies for high skill workers, pushing the job creation curve up. Thus, this first effect tends to increase the incidence of unemployment for higher values of p. The movement of the job destruction curve as p increases depends on the sign of $b - rt$ and is qualitatively inconclusive when this expression is positive. Any reasonable calibration of t results in a positive value for that term. It is therefore necessary to simulate the model to determine the equilibrium effect of an increase in p on x_{R}. In fact, when $b - rt > 0$, one can show that (JD) rotates around a fixed point as p increases. This fixed point is given by (θ, x_{R}) such that $b - rt = m(\theta)\beta t$. This pair (θ, x_{R}) is always consistent with efficient breakdowns, regardless of p, since the fixed terms in the (JD) condition cancel out. As illustrated by Fig. 3, increases in p are associated with small rotations of the (JD) curve and larger shifts of the (JC) curve. As a result, incidence increases and duration of unemployment decreases with p.

The intuition is as follows. Firms post more vacancies for higher skill jobs, as the return from these high skill vacancies is higher. With tighter markets, the value of search is higher, and because breakdowns are efficient, matches break down more often. Also, the relative size of job destruction costs decreases with p, making it relatively less costly to fire higher skill workers. Intuitively, for high skill workers, the effective tax t/p have less of an impact on the job destruction decision. In fact, it is straightforward to establish from (JC) and (JD),

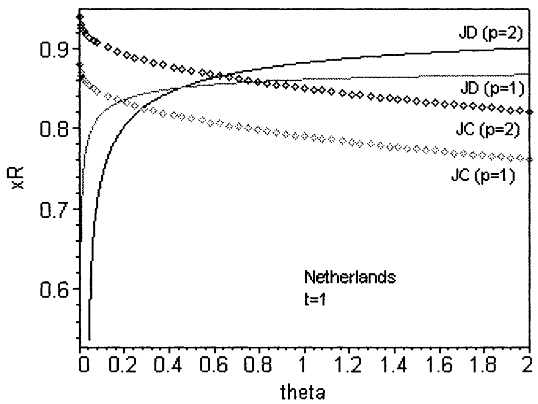

Fig. 3.

that a higher firing tax pushes both job creation and job destruction down, unambiguously resulting in a lower unemployment incidence, at all skill levels. However, one can check from Fig. 4 that the effect of such a fixed tax is felt more strongly at low skill levels. This implies that if t is high enough, average job tenure may be increased significantly more at low than high skill levels, resulting in an increasing skill/unemployment incidence pattern.

4.2. Calibration

We now carry out a quantitative evaluation of the model, to confirm the insight from the previous section and check robustness of the results. We calibrate the economy to a high-firing-tax, European country. The Netherlands was chosen, because it is the country with the most stringent procedural restrictions (OECD, 1994b) and is the only OECD country where an administrative authorization is required before a layoff (OECD, 1993). There are two kinds of parameters to calibrate: structural ones ($r, b, \beta, \kappa, \eta$ (elasticity of the matching function with respect to vacancies[11]), $\underline{x}$, $\bar{x}$, and λ) and policy ones: the replacement rate ρ for unemployment benefits[12] and firing taxes t. The calibration of the structural parameters is derived from aggregate data, which is assumed to apply to the market for the average worker. This exercise has been carried out in Millard and Mortensen (1997) already. In particular, these authors found values of $r = 0.02$, $\beta = 0.6$, $b = 0.3$ (or value of home production and leisure equal to 30% of maximum average output), $\kappa = 0.3$, $\eta = 0.6$ (as estimated in Blanchard and Diamond (1989)), $\lambda = 0.1$ (as in Mortensen (1994)), and $\{\underline{x}, \bar{x}\} = \{0.7, 1\}$. Their calibration, however, is based on data for the entire population. For this reason, it is necessary to recalibrate the parameters, since the empirical evidence, which the model attempts to replicate, is for a sample of young workers. Among all the structural parameters, only b may differ between the general and the young populations. Hence, only this value is recalibrated: a value of $b = 0.4$ is chosen so as to match the average unemployment rate for workers, aged 20 to 24, between 1979 and 1994, in the Netherlands (OECD, 1996). The value of home production and leisure is higher than in Millard and Mortensen (1997). This is not necessarily surprising, if one considers that young workers may be less productive (i.e., have a higher value of home production relative to market production) and have a higher value of leisure.

The unemployment benefits system may differ across countries along several dimensions. Accordingly, the replacement rate is calibrated using an index of benefit entitlement, or average of unemployment benefit replacement rates for two earnings levels, three family situation and three duration of unemployment (OECD, 1994b, 1996). Between 1979 and 1994, this index averaged $\rho = 45\%$ in the Netherlands. The costs imposed by procedural regulations are harder to quantify in terms of output. As mentioned in Section 3.1, they include all record keeping and reporting requirements and can be quite sizable. Firing taxes in the Netherlands (especially due to regular procedural inconvenience) are among the highest in Europe. Hence, we choose $t_{\mathrm{NL}} = 1$ (or one quarter of output) as the base case. However, we also allow t_{NL} to vary.

[11] With a Cobb–Douglas matching function.

[12] In the calibration, unemployment benefits $\rho\widetilde{w}$ are assumed to be proportional to the average wage $\widetilde{w} = F(x_{\mathrm{R}})w_0 + \int_{x_{\mathrm{R}}}^{\bar{x}} w_{\mathrm{C}}(x)\,\mathrm{d}F(x)$.

We proceeded as follows. We first checked how unemployment incidence and duration, as well as the unemployment rate varied with skill in the calibrated economy, to show that the pattern observed in the data could be replicated (Table 1). We then varied firing taxes to determine their effects on unemployment incidence and duration, at different skill levels (Figs. 4, 5). Finally, we conducted sensitivity analysis by varying the generosity of unemployment benefits ρ and the workers' bargaining power β and thus verified that the results were robust to such variations (Figs. 6, 7).[13]

Table 1 allows us to verify that average job tenure decreases with skill in the Netherlands. We also find that lower-skill workers stay unemployed for a longer period of time on average than their high-skill counterparts. Finally, the unemployment rate is indeed higher for lower-skill workers. We varied the firing taxes t (Figs. 4, 5) to study their effects on unemployment incidence and duration for different p's. We found that increasing t raised job tenure, as well as unemployment duration, and that in both cases, the effects were more pronounced for lower-skill workers than for higher-skill ones. Consequently, the skill-job tenure pattern inverted itself, as t increased—increasing when $t = 0$ and decreasing for high values of t. The changes on unemployment incidence and duration have opposite effects on the unemployment rate. However, the "incidence" effect turns out to dominate the "duration" effect, and consequently, firing taxes were found to decrease the unemployment rate. This result calls for two remarks. First, this may seem counter-intuitive, since from casual observation, European countries, with more stringent firing restrictions than the USA, also exhibit higher unemployment rates. One should keep in mind, however, that European countries also offer more generous unemployment benefits. In this setup, benefits increase both duration and incidence of unemployment, as a higher replacement rate implies a higher search value, a shift up of the JD curve and consequently both higher unemployment incidence and duration. Second, introducing a minimum wage may reverse the observation that firing taxes decrease the unemployment rate. Indeed, if a wage floor prevents the wage at match formation to decrease enough to compensate for

Table 1

p	*AED*	*AUD*	U (%)
0.9	22.7	4.2	15.6
1	22.4	2.8	10.9
1.2	21.1	1.9	8.4
1.5	19.6	1.6	7.3
2	18.2	1.3	6.8
3	16.8	1.2	6.5

AED: avg. employment duration (qtrs); *AUD*: avg. unemp. duration (qtrs); U%: unemp. rate.

[13] We also conducted the following experiment. First, we calibrated an economy to the USA and found that, at all skill levels, average job tenure, average unemployment spell and the unemployment rate were higher in Netherlands than in the USA, as expected. Second, we simulated two artificial economies, one using US structural parameters, but policy parameters from the Netherlands, and the other one using structural parameters for the Netherlands, but US policy parameters. We found that the pattern of unemployment incidence was determined by the policy, and not the structural parameters.

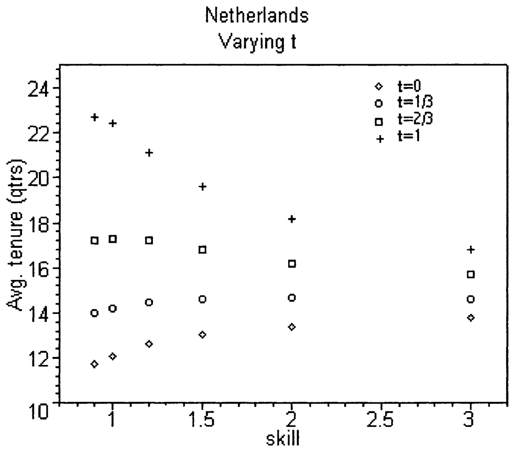

Fig. 4.

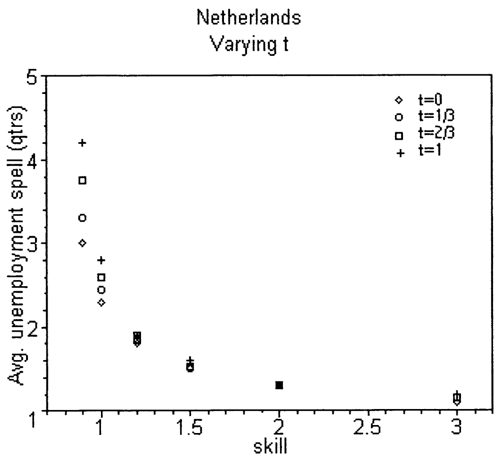

Fig. 5.

higher future expected wages (once the regulations are in place), then firms would post fewer vacancies, enhancing the "duration" effect at the expense of the "incidence" effect, possibly reversing the conclusion on the unemployment rate. In fact, Garibaldi and Violante (1999) looks at how a minimum wage floor may interact with employment protection policy to determine unemployment.[14]

[14] Their paper differs from this one along several lines, and hence makes comparison difficult. In particular, their model makes different assumptions on how firing costs enter the model. They also consider homogeneous workers and do not include unemployment benefits. Finally, they treat non-transfer costs as negligible relative to transfers and use that as the basis for their calibration. On the contrary, we argue that fixed costs (and in particular procedural costs) are quite sizable.

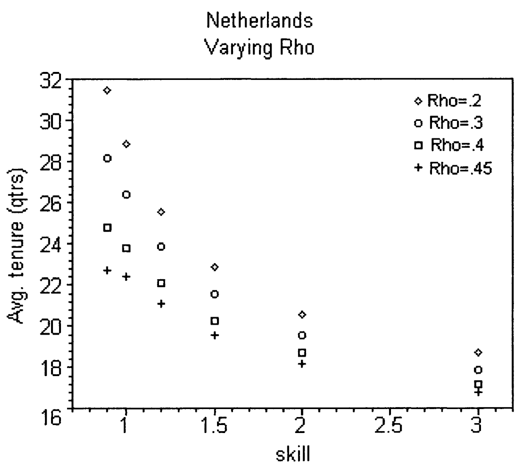

Fig. 6.

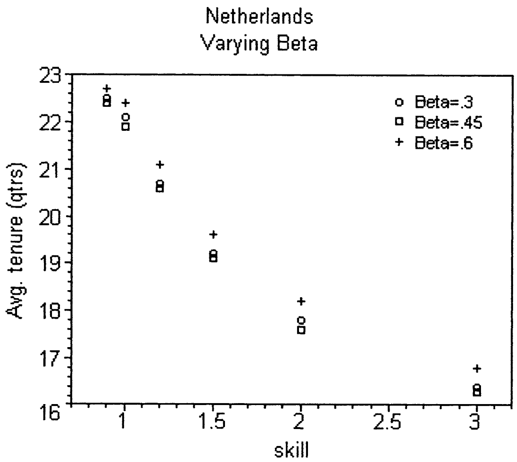

Fig. 7.

We also conducted sensitivity analysis with regards to the generosity of unemployment benefits and the workers' bargaining power (Figs. 6, 7). We were able to replicate a diminishing tenure profile as a function of skill, for a wide range of $\rho \in [0.2, 0.5]$ ($\rho = 0.2$ was a lower bound for most European countries, while a value of $b = 0.4$ prevented us from increasing beyond $\rho = 0.5$). Unemployment duration and the unemployment rate also remained decreasing functions of skill over the range considered. As with firing taxes, a change in the labor market policy parameter ρ seemed to have more of an effect on low-skilled rather than high-skilled workers. Finally, average tenure did not vary much, when alternative values of the workers' bargaining power β were considered ($\beta \in [0.3, 0.6]$). This is because increasing β has effects on job creation and job destruction, which cancel out, with regards to x_R. Nonetheless, average tenures always exhibited decreasing patterns for various values of β, as did unemployment duration and rates. As can be expected, the primary effect of varying β is on the average unemployment spell, since it reduces the profitability of posting vacancies.

5. Conclusion

The paper studied the effects of fixed firing taxes on labor market outcomes. The model was able to replicate the fact that for young workers, average job tenure decreases with skill in high-firing-tax countries, while the opposite holds in economies with low firing taxes. The calibrated version found that unemployment duration and the unemployment rate were decreasing functions of skill in both cases, as required to match the data. The intuition for this result is twofold. Because the effective tax rate diminishes with skill, firing taxes are relatively less costly to a firm employing a high-skill worker. Also, relatively lower tax rates imply that high-skill markets are tighter, and hence skilled workers and firms are more willing to separate.

The paper highlights the importance of administrative and procedural costs. This means that empirical investigation should also focus on firing taxes, in addition to other traditional forms of firing costs, such as severance payment. Of course, procedural costs are hard to quantify. Nevertheless, this paper shows that they are the ones that should be the focus of attention.

It was also assumed that wages could fully adjust in response to firing costs. It would be interesting to look at the case where, due to minimum wage constraints for example, the wage is restrained from adjusting, hence magnifying the effects of firing regulations.

Acknowledgments

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Appendix A. Estimation of US transition probabilities

Movements from employment, March 1977–1988 (annual frequency, both sexes, N: housekeeping, age < 30) are given in Table A.

Table A

Educ.	$E\to E$	$E\to U$	$E\to N$	$U\to E$	$U\to U$	$U\to N$	$N\to E$	$N\to U$	$N\to N$
$\leqslant 9$	0.861	0.097	0.042	0.496	0.378	0.126	0.132	0.060	0.808
10–11	0.885	0.087	0.028	0.597	0.327	0.076	0.175	0.078	0.746
12	0.903	0.057	0.040	0.581	0.302	0.118	0.203	0.046	0.752
13–14	0.933	0.038	0.029	0.679	0.235	0.086	0.225	0.038	0.737
15–16	0.951	0.023	0.026	0.752	0.176	0.071	0.238	0.027	0.734
17–18	0.974	0.010	0.015	0.649	0.270	0.081	0.361	0.014	0.626

Appendix B. Estimation of European transition probabilities

B.1. *Estimation assuming no true duration dependence in the transition rates*

Table B1 presents the estimation reported in the text, assuming constant exit rates out of unemployment.

Source: OECD (1994a)—national submissions to the OECD's Indicators of Education Systems (INES) project for the unemployment rates and Eurostat on the basis of each country's labor force survey. Age: 20–24. Year: 1991.

Two education levels: high h: post-secondary, low l: less than upper secondary (except Denmark, where l is upper secondary).

B.2. *Estimation assuming all observed duration dependence is true duration dependence*

Let us assume that all observed duration dependence is "true" duration dependence and show that the qualitative conclusions do not change. The treatment comes from Machin and Manning (1999). We use the traditional Weibull specification for the duration structure of incomplete spells. The outflow rate out of unemployment for individuals who have been unemployed for a duration t, after integrating out any unobserved heterogeneity, is given by $h(t)=\mu^{\alpha}\alpha^{1-\alpha}\Gamma(1/\alpha)^{\alpha}t^{a-1}$, where $\Gamma(.)$ is the complete gamma function, $1/\mu$ the average

Table B1

Country	$U\%h$	$U\%l$	LTU_h	LTU_l	AUD_h	AUD_l	AED_h	AED_l	AED_h/AED_l
Belgium	5.5%	21.7%	10.7%	53.4%	1.8	6.4	30.8	23.0	1.3
Denmark	13.2%	27.2%	16.0%	38.3%	2.2	4.2	14.4	11.2	1.3
Germany	5.9%	10.1%	5.9%	27.5%	1.4	3.1	22.5	27.6	0.8
Ireland	12.8%	31.3%	24.3%	60.5%	2.8	8.0	19.3	17.5	1.1
Italy	47.4%	22.7%	48.6%	70.0%	5.5	11.2	6.2	38.2	0.2
Netherlands	8.5%	10.2%	13.6%	34.8%	2.0	3.8	21.6	33.4	0.6
Spain	37.6%	29.9%	50.7%	46.8%	5.9	5.3	9.8	12.4	0.8
UK	8.3%	25.4%	5.8%	26.5%	1.4	3.0	15.5	8.8	1.8

Employment and unemployment durations are measured in quarters.

duration of unemployment spells and α quantifies duration dependence. From $h(t)$, one can compute the distribution of completed spells $G(t)$ and the density of completed spells $g(t)$,

$$G(t) = 1 - \exp\left(-\int_0^t h(s)\,\mathrm{d}s\right) \quad \text{and} \quad g(t) = h(t)[1 - G(t)].$$

The measure of long-term unemployment is based on the distribution of current duration of unemployment spells. In steady state, N being the constant inflow into unemployment, $N[1 - G(t)]$ represents the number of people who have entered unemployment t periods ago and have not found a job. Hence, the percentage of people unemployed for more than t (incomplete spells) is given by

$$\int_t^{+\infty} \big[1 - G(s)\big]\,\mathrm{d}s \Bigg/ \int_0^{+\infty} \big[1 - G(s)\big]\,\mathrm{d}s.$$

In steady state, it is still the case that $u = AUD/(AUD + AED)$. We can use the same methodology as before, except that the relationship between *LTU* (long-term unemployment) and *AUD* reflects duration dependence. We use MM's estimates of duration dependence for the various countries from their Table 5 (assuming that the extent of duration dependence, as measured by α, is the same for young workers and the general population). Using the traditional Weibull specification for $h(t)$, we find that (calculations available upon request):

$$\begin{aligned} AUD &= 1/\mu, \\ LTU &= \mu \int_{T_0}^{+\infty} \exp\left[-\left(\frac{\mu\Gamma(1/\alpha)}{\alpha} s\right)^{\alpha}\right] \mathrm{d}s. \end{aligned}$$

Notice that, with no duration dependence ($\alpha = 1$), we get the same expression as in Section 3.2. Hence, one can again estimate AED_h and AED_l for each country. Of course, with duration dependence, the estimated *AUD* drops (the lower α, the more estimated *AUD* drops), and therefore estimated *AED* also drops. Now, most European countries have $AED_h < AED_l$. In fact, what we find is in Table B2. One can check that even though

Table B2

	AED_h/AED_l	
	without duration dependence	with duration dependence
UK	1.8	1.20
Belgium	1.3	0.98
Denmark	1.3	0.92
Ireland	1.1	0.85
Germany	0.8	0.81
Spain	0.8	0.69
Netherlands	0.6	0.59
Italy	0.2	0.16

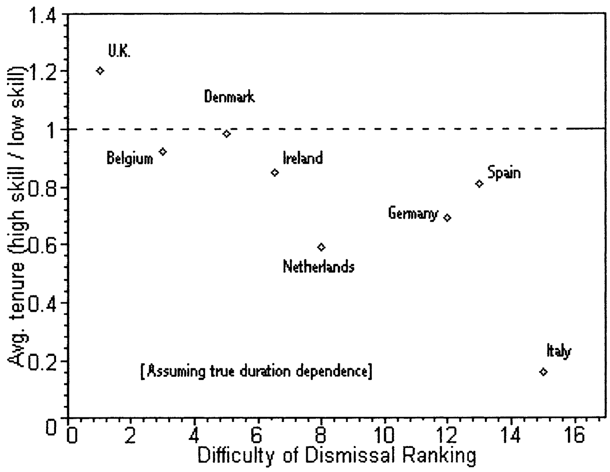

Fig. 8.

the relative values of AED_h/AED_l have decreased, the ranking of countries along that dimension is very similar, with or without duration dependence. It implies that there still is a negative correlation between the relative employment durations and the strictness of firing regulations (this is verified in Fig. 8). That is, the higher the firing tax t, the lower the average job tenure of high skill workers is relative to low skill workers. Hence, we arrive at the same qualitative conclusion, regardless of the methodology used.

Appendix C. Employment protection policies

Source: OECD (1994b)—a lower ranking (higher number) corresponds to a stricter policy. Table C only includes OECD countries for which information on both $U\%$ and LTU conditional on education was available (see Appendix B).

Table C

Regular procedural inconvenience	Difficulty of dismissal
1. Denmark	1. UK
2. Italy	2. Belgium
3. Belgium[a]	3. Denmark
3. UK[a]	4. Ireland
4. Ireland	5. Netherlands
5. Germany	6. Germany
6. Spain	7. Spain
7. Netherlands	8. Italy

[a] Tied in third place.

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