DISCUSSION PAPER SERIES

IZA DP No. 2304

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September 2006

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

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September 2006

ABSTRACT

Employment Protection Reform in Search Economies*

The design of the employment protection legislation (EPL) is of a particular acuity in the European debate on the contours of the EPL reform. In this article we used an equilibrium unemployment model to investigate the virtue of an EPL reform whose modality is a lessening in the red tape and legal costs associated with layoffs and the introduction of an U.S. like experience rating system modelled as a combination of a layoff tax and a payroll subsidy. The reform considered shows that it is possible to improve both the consistency and the efficiency of employment protection policies while leaving the workers' protection untouched on the labor market. These results are consistent with the conventional wisdom that experience rating is desirable, not only as a part of unemployment compensation finance as most studies acknowledge but also as part and parcel of a virtuous EPL system.

JEL Classification: J41, J48, J60

Keywords: matching models, employment protection, experience rating

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* We are indebted to Tito Boeri, Pierre Cahuc, Olivier Charlot, Bruno Decreuse, Pietro Garibaldi, Jean-Olivier Hairault, Michael Kiley, Francis Kramarz, Jocelyn Martel, Christopher Pissarides, Fabien Postel-Vinay, André Zylberberg and to an anonymous referee for valuable comments and suggestions. This paper also benefited from discussions during presentation at EUREQua-Université Paris I, the Institute for the Study of Labor (IZA), CEPR DAEUP meetings, the T2M conference, EEA and ESEM conferences, the EALE conference and the ERC/METU conference. This paper has benefited from the support of the CEPR DAEUP network. All errors remain our sole responsibility.

1 Introduction

During the last decades, most continental European countries encountered high and persistent unemployment rates whereas the U.S. labor market performed relatively well. A bulk of labor market researches tackled this issue with a particular emphasis on the role played by the employment protection legislation, hereafter EPL, on labor market performances. As a result, the importance of labor market flexibility has been widely acknowledged and this view can be summarized by the expressed will of the E.U. council to give member States an incentive to "*review and, where appropriate, reform overly restrictive elements in employment legislation that affect labor market dynamics [...] and to undertake other appropriate measures to promote a better balance between work and private life and between flexibility and security*". It is however striking that most of the reforms undertaken in the last two decades sharply contrast with this latter recommendation in favoring reforms *at the margin* in continental Europe. More precisely, such reforms fostered two-tier systems as the increase in the labor market flexibility took place mainly through a series of marginal reforms that liberalized the use of fixed-term and/or atypical contracts, hence favoring the statu-quo for the stock of workers employed on conventional contracts (OECD, 2004, 2005). It follows that employment protection arises in a very specific form in such two-tier labor markets because there are both stable jobs with a high degree of protection and unstable jobs with very short durations and low protection. The marginal reforms give rise to a caesura leading to a non-egalitarian risk's repartition between workers and doubtful outcomes on economic performances (Blanchard and Landier, 2002, Cahuc and Postel-Vinay, 2002, or Boeri and Garibaldi, 2006). In addition several authors pointed out that workers with regular contracts are only outwardly protected as indicated by the very low amount of fair or justified dismissals in the job destruction flows (Boeri, Bertola and Cazes, 2002, Cahuc and Kramarz, 2005).

Designing Employment Protection Reform: Hence, due to the limitations of the actual EPL, it seems legitimate to wonder about what should be a good employment protection reform? This seemingly simple question is highly debated in the context of the European employment protection reforms (E.U. Council, 2003, OECD, 2004). In the particular case of France, a series of policy reports has recently tried to outline the design of such a reform (Blanchard and Tirole, 2003a, Cahuc, 2003, Cahuc *et al.*, 2005). In the words of Blanchard and Tirole (2003b) such a reform should :

> "[...] *increase the contribution rate of firms (that is to introduce a layoff tax, and*

decrease the corresponding tax) so firms internalize the cost of unemployment. [...] *limit the role of the judicial system. To the extent that firms are willing to incur the financial costs associated with laying off workers* [...] *judges should not be allowed to second guess the firms' decision.*"

With regards to the European institutions, it is obvious that these two recommendations are at odds with most European systems and in particular with the French labor market where firms marginal contribution rate is zero and where layoffs are subject to heavy administrative and legal controls. These recommendations borrow from the U.S. unemployment insurance system. As a matter of fact, it is worth noting that while layoffs costs are mostly due to EPL in European countries, they are essentially due to experience-rated unemployment insurance on the U.S. labor market. The systematic use of experience rating is an original feature of the U.S. unemployment benefits where in most states firms are taxed in proportion of their separations. Put differently, experience rating is a way to require employers to contribute to the payments of benefits they create through their firing decisions. It is then a mean to make firms internalize the cost of an additional layoff to the unemployment insurance system. To our knowledge, experience rating is unique to the U.S. (Baicker, Goldin and Katz, 1997) and is absent from all other OECD countries (see Holmlund (1998) for a survey).

In this article, we evaluate the effects of an EPL reform whose modality is the introduction of an U.S. like experience rating system, modelled as a combination of a layoff tax[1] and a payroll subsidy, and a reduction in the layoff's red tape and legal costs. At this stage, it is worth noting that whereas the debate on employment protection reform has mainly attempted to know whether it is desirable or not to tighten EPL's stringency, the points advocated here take a different perspective. Indeed, turning to this perspective the question is rather to know whether it is possible or not to improve EPL's efficiency for a constant degree of stringency, *ie.* to reform employment protection while leaving the workers' job security untouched.

What can we expect from the introduction of such a layoff tax? Since the seminal papers from Feldstein (1976) and Topel and Welsh (1980), there is already an abundant literature dealing with the effects of experience rating[2]. Feldstein (1976) is among the first to offer a theoretical analysis of experience rating in a model of temporary layoffs which are frequent in the U.S. economy. The arguments in favor of experience rating stem from the fact that

[1] In the remainder of the paper we will use interchangeably the terms layoff tax or experience-rated tax. See below for a discussion.

[2] See Holmlund (1998), Fougère and Margolis (2000) or Malherbet (2003) for a survey.

payroll taxes used to finance unemployment benefits give rise to inefficiently high levels of layoffs because firms do not take into account the cost associated to the financing of the benefits paid to the unemployed workers. To avoid this excess of job destruction, it is therefore required to finance unemployment benefits through a layoff (experience-rated) tax. Hence, a system with perfect experience rating is likely to reduce temporary layoffs and to improve the labor market performances. This view has been challenged[3] by Burdett and Wright (1989), Marceau (1993) and more recently by Mongrain and Roberts (2005) who show that a perfect experience rating system may have adverse outcomes on the labor market. Generally, empirical analysis of experience rating supports the results advocated by Feldstein (1976) and find strong evidence for experience rating to decrease unemployment (Anderson, 1993, Card and Levine, 1994 or Anderson and Meyer, 2000).

In light of the main U.S. studies on this topic, it may be tempting to generalize the results to the European case. However, one should note that in a European perspective, the results of U.S. contributions need to be considered with great caution for at least two reasons: *(i)* The U.S. labor market is specific to the extent that it is always considered as being dramatically flexible. Public policy complementarities and especially those related to EPL are liable to alter the case of the previous studies (Fougère *et al.*, 2000, Blanchard *et al.*, 2003a, L'Haridon, 2005); *(ii)* Temporary layoffs are much less common in Europe and other OECD countries than in the U.S. (OECD, 2002). For all these reasons, it is quite justified to consider an economic framework allowing for workers mobility across firms. Equilibrium unemployment models are, from this standpoint, good candidates to shed light on the effects of the EPL reform. Indeed such a class of models has proven to be relevant to take account of the effects of both the EPL and the permanent layoffs on labor market dynamics[4].

Related Literature: The contribution most closely related to our paper are Fath and Fuest (2005), Mongrain *et al.* (2005) and Cahuc *et al.* (2004) who provide a number of studies that sheds light on the effects of experience rating in the presence of miscellaneous labor market institutions. Fath and Fuest (2005) liken severance payments to experience rating in a dynamic efficiency wage model with endogenous workers' monitoring and endogenous layoffs. They find that the introduction of an experience-rated tax is favorable to employment and welfare in such a framework. The mechanism is simple. An increase in the experience rating's degree or in the severance payments lowers the monitoring intensity since this activity is costly to the firm.

[3]See Malherbet (2003) or Cahuc and Malherbet (2004) for a discussion.
[4]See Millard and Mortensen (1997) and Albrecht and Vroman (1994).

However in contrast with severance payments, experience rating cuts down the payroll tax and does not affect worker effort since the layoff tax is not a transfer from the firm to the worker. In a quite similar setting, Mongrain and Roberts (2005) show, in a static model where firms offer private insurance, that with a high degree of experience rating firms may reduce their severance payments by more than the unemployment benefits, hence resulting in a welfare loss for the workers. Cahuc and Malherbet (2004) use a search and matching model to highlight the effects of the introduction of an experience-rated tax on a prototypical European continental labor market with two-tiers contracts (short term and long term contracts) as well as other pervasive institutions. They consider a particular segment of the labor market where unskilled workers are paid the minimum wage. In such a context they find that the combination of minimum wage, temporary contracts and stringent EPL can give rise to a form of labor market regulation where experience rating is desirable.

This article is along the lines of the above mentioned contributions. Our analysis stands out from the efficiency wage model proposed by Fath *et al.* (2005) and Mongrain et *al.* (2005) in considering a more general framework with search frictions and in integrating another important EPL component, *ie.* the red tape and legal costs associated with layoffs whose predominance over severance payments is widely acknowledged in most European countries (See Blanchard (2000) and Kramarz and Michaud (2004) in the particular case of France.). In addition, our work generalizes the contribution of Cahuc and Malherbet (2004) to a more elaborate framework where the population is considered as a whole, wages are freely bargained and the economy is subject to macroeconomic turbulences. This latter component is introduced insofar as the effects of the introduction of an experience-rated tax are likely to be more harmful to firms when the aggregate conditions are depressed. Precisely, we provide a search and matching model in the fashion of Mortensen and Pissarides (1994) with the following key ingredients: *(i)* a match specific heterogeneity meant to reflect the quality of the firm-worker relationship; *(ii)* an aggregate productivity component intended to capture the change in the macroeconomic environment; *(iii)* a series of restricting EPL devices aimed at embedding the stringency of employment protection in the model and capturing on the one hand the red tape and legal costs and on the other hand the layoff or experience-rated tax; and *(iv)* a general wage setting mechanism meant to seize the effects of both EPL components on the salary scale. Our theoretical analysis lead us to argue that in the absence of macroeconomic turbulences, the EPL reform improves the labor market performance and lessens, for a constant degree of workers' protection, the unemployment rate. This latter is showed to converge to its *laissez-faire* value. Taking account

of the macroeconomic environment, it appears that the layoff tax differs significantly from the conventional EPL components, the experience-rated tax being state-dependent. The calibration of our model confirms that the EPL reform improves the overall labor market performance, hence alleviating the unemployment insurance budget, increasing production and decreasing both the aggregate and conditional unemployment rates, the latter effect being more important as macroeconomic conditions are low. In addition, time series analysis provides strong evidence for experience rating to stabilize labor market flows and employment over the business cycle. Generally speaking our analysis shows that the EPL reform can give rise to a form of labor market regulation where both the consistency and the efficiency of employment protection are improved while leaving the overall worker's security on the labor market unaltered. Finally, we address the question as to why experience rating is not used in Europe. It appears that the opportunity of the reform may to a certain extent depends on the government's preferences.

The outline of this article is as follows: The next section specifies the conceptual framework used to analyze the effects of the EPL reform. Section 3 presents a simplified version of the model and offers a theoretical insight into the effects of the reform. Section 4 provides a labor market general equilibrium perspective and presents a variety of simulations to assess the effects of the reform. Section 5 concludes.

2 The Model

This section outlines the economic environment where we study the employment effects of the EPL reform. The model builds on and extends the continuous time search and matching framework developed and surveyed by Mortensen and Pissarides (1999a,b) and Pissarides (2000).

2.1 Preliminary Assumptions

Essentially the assumptions are common to the search and matching literature[5] and are therefore only briefly sketched unless necessary.

Demography and Preferences: Time is continuous. There are two goods in the economy: labor which is the sole input and a numeraire good produced and consumed. The labor market is populated by a measure one of infinitely lived workers. Each worker supplies one unit of labor and can be either employed and producing or unemployed and searching. All agents discount future payoffs at rate, $\rho > 0$, and are risk neutral. The choice of a linear utility function is a

[5]See Rogerson, Shimer and Wright (2005) for an exhaustive survey.

standard assumption in the search literature and is used for simplicity's sake in order to keep the environment as simple as possible[6]. This implies that we restrict our analysis to the consequences of EPL reform on employment and thereby leave any insurance issue out of consideration which, although important, is beyond the scope of this paper[7].

Macroeconomic environment and Production: Unlike the standard search and matching framework, the model allows for turbulences at the macroeconomic level. We assume that the aggregate conditions move stochastically between n states according to an arbitrary Markov process with persistence. A transition matrix, Ω, whose elements indicate the transition probabilities from one state to another, is associated with this processus. Aggregate states are indexed by a subscript $i \in [1, n]$ and are ranked in descending order with $i = 1$ standing for the best aggregate state.

There is a continuum of small firms, the number of which is endogenous in equilibrium. Firms have a single job slot and either produce with one worker, or search with an open vacancy. For a given aggregate state i, each job is endowed with an irreversible production technology requiring one unit of labor to produce $p_i + \sigma\varepsilon$ units of output where σ is an indicator of the dispersion in the idiosyncratic component. The productivity is made up of two components: *(i)* an aggregate component, p_i, which is contingent to the state of nature and common to all jobs and *(ii)* an idiosyncratic component, $\sigma\varepsilon$, which is match-specific. Total productivity is therefore subject to a double source of uncertainty: *(i)* a microeconomic or idiosyncratic source and *(ii)* a macroeconomic or aggregate source. The product of a match changes from time to time without warning. The stochastic process governing the idiosyncratic component of productivity ε is Poisson with arrival rate λ. In the event of such a shock, a new value of job specific productivity is drawn from a cumulative distribution function $G(\varepsilon)$ with support in the range $[\varepsilon_l, \varepsilon_u]$. Given an aggregate state i, existing filled jobs are destroyed only if the new value of ε falls below an endogenous and state contingent threshold denoted by ε_{d_i}. As a consequence, the rate at which existing jobs are destroyed follows a Poisson process with parameter $\lambda G(\varepsilon_{d_i})$. The aggregate component of productivity p_i changes according to the Markov process described above. It is worth noting that although the aggregate shocks do not alter the job-specific productivity, they induce a change in the state contingent threshold, ε_{d_i}. As a result, aggregate turbulences may

[6]Introducing a non linear utility function into a search and matching model with endogenous job destruction and bargained wages adds a dimension of complexity we would rather avoid here.

[7]See Alvarez and Veracierto (2001), Bertola (2004), Blanchard and Tirole (2004) or Pissarides (2002) for papers that give an insurance role to employment protection.

lead to some jobs termination[8].

Matching: Vacant jobs and unemployed workers are brought together in pair via an imperfect matching process. In each state i, this process is captured by an aggregate matching function $M(v_i, u_i)$[9] where v_i and u_i designate the vacancy and the unemployment rates respectively. Function $M(v_i, u_i)$ is assumed to be strictly increasing with respect to each of its arguments and to have constant return to scale. The linear homogeneity of the matching function allows to write the transition rate for vacancies as $M(v_i, u_i)/v_i = M(1, u_i/v_i) = q(\theta_i)$, where $\theta_i = v_i/u_i$ stands for the labor market tightness in the aggregate state i. Similarly, the flow out of unemployment is given by $M(v_i, u_i)/u_i = \theta_i q(\theta_i)$. The properties of the matching function imply that $q(\theta_i)$ and $\theta_i q(\theta_i)$ are respectively decreasing and increasing in the labor market tightness. Upon meeting a common start-up productivity level[10], ε_u, is assumed for all job-worker matches. It follows that all vacancies in a given aggregate state are identical *ex-ante* and yield a productivity level equal to $p_i + \sigma\varepsilon_u$.

Employment Protection Legislation (EPL): Any employment relation may end at the expense of a cost, $f + \tau_{e_i}$, paid by the firm. The first component, f, stands for an unified measure of employment protection and is assumed to capture the red tape and legal costs associated with layoffs. This assumption is justified on two grounds: *(i)* in most European countries, and particularly in France, all these actions take time and have high costs, *(ii)* they generally vastly exceed the severance payments (Blanchard, 2000 or Kramarz and Michaud, 2004). Thereby, f amounts to a state-mandated cost rather than a transfer from the firm to the worker[11]. The second component, τ_{e_i}, is a layoff tax meant to finance the unemployment compensation system. This tax will be refereed as the experience-rated tax afterwards and has the following three characteristics[12] : *(i)* it is a layoff tax and, as a consequence, affects the firm's

[8]The mechanisms are detailed in more depth in Appendix 1.

[9]With this formulation, only unemployed persons are assumed to be jobs applicants. In other words, it comes down to neglecting on the job search (see Pissarides, 2000 for such an extension).

[10]This assumption is used for simplicity's sake. Under a stochastic job matching hypothesis (see Pissarides, 2000 chapter 6) it can be demonstrated that the properties of the model are unaffected. A technical appendix is available upon request from the authors.

[11]It is worth noting that the assumption not to formalize severance payments is justified for two reasons in our framework: First, and as already mentioned above, severance payments are generally smaller than red tape and legal costs. Second, the classical "bonding critique" emphasized by Lazear (1990) stipulates that, in the absence of contractual frictions, severance payments can be canceled with an appropriate wage contract. Then for reasons pointed out by Lazear (1990) and Burda (1992), the equilibrium values of the key decision variables remain unaffected by severance payments. Now since the framework used is exempt of contractual frictions this assumption is not restrictive. For more details on the effects of contractual frictions in search and matching models, see Cahuc and Zylberberg (1999) or Garibaldi and Violante (2005).

[12]It is worth noting that experience rating schemes as implemented in the United States are more complex.

layoff decision, *(ii)* it is used to finance unemployment benefits paid to unemployed workers and thereby constitutes a source of income for the unemployment compensation system, *(iii)* it is contingent to the state of nature since the charge of the system is indexed on the average length of the unemployment spells. We will return to these characteristics in more details below.

Wage Bargaining: The existence of transaction costs on the labor market gives rise to a local monopoly rent or surplus equal to the difference between what individuals obtains through the contractual job-worker relationship and their best opportunity outside the contract. Match surplus is divided between the firm and the worker according to a wage rule. Following the bulk of the search and matching literature, we assume the surplus is split between the firm and the worker according to a generalized Nash criterion (see for instance Mortensen and Pissarides, 1999a, Pissarides, 2000 or Rogerson and *al.*, 2005). Under such a scheme, bargaining gives each participant a share of the surplus proportional to her relative power where the relative power of the worker is denoted by $\gamma \in [0;1]$. This assumption has the merit of making the model immediately comparable with earlier EPL analysis in the search and matching framework without further distortions (see for example Millard and Mortensen, 1997, or Pissarides, 2000). Furthermore, and as pointed out by Mortensen and Pissarides (1999a), the most salient features of the theory are robust to the wage mechanism proposed. We assume wages are renegotiated each time new informations about the job-worker match are revealed which happens at Poisson rate λ. EPL modifies the shape of wage bargaining and implies a two-tier bargaining structure[13]. As a matter of fact, EPL requires to distinguish between wage negotiation upon meeting and wage renegotiation. EPL applies and is binding in the latter case but is not binding in the former since no contract has been yet signed. As mentioned earlier by Mortensen and Pissarides (1999a), this dual structure is similar to an *insider-outsider* conflict as termed by Lindbeck and Snower (1988) where the *outsiders* (the unemployed workers) do not take profit of EPL whereas

In particular, the experience rated tax is paid over time rather than at the time of layoffs or as unemployment benefits are paid out to workers. However, such a consideration entails a dimension of complexity we would rather avoid here. Hence, for simplicity's sake, we assume an experience rating schedule that has no memory. As far as we know, all the papers devoted to experience rating have adopted this assumption. The analysis of the dynamic consequences of an experience rating system with memory would be a very interesting extension to consider in future studies.

[13]Some authors reject the plausibility of this two-tier bargaining structure (Lindbeck and Snower, 1988 or McLeod and Malcomson, 1993). Indeed, in the absence of a two-tier agreement, hold-up problems may arise, and in such a case job creation outcomes are generally different. It may be demonstrated that alternative wage specifications do not alter the results of our model. For instance under a *pure insider model* it is shown (see Appendix 5 for a formal proof) that the qualitative results remain unchanged. As a consequence and coherently with the strategy of the paper, we restrict ourselves to the main effect of the reform without further distortions, which although interesting are beyond the scope of this paper (see Mortensen and Pissarides, 1999a for a discussion about rent sharing with turnover costs).

the *insiders* (the employed workers) use it to strengthen their position while negotiating.

2.2 Values

A job can be in one of the three following states: vacant, recently filled or continuing. To each of these states corresponds an asset value denoted by Π_{v_i} for a firm holding a vacancy, Π_{o_i} for a firm matched with an outsider and Π_{e_i} for a firm matched with an insider. A vacant job costs h per unit of time. Let $m(\theta_i)$ and Ω_{ij} denote the probability to fill a vacancy and to switch from aggregate state i to state j respectively. The asset value of a vacancy in state i satisfies:

$$\rho\Pi_{v_i} = -h + q(\theta_i)\left[\Pi_{o_i}(\varepsilon_u) - \Pi_{v_i}\right] + \sum_{i\neq j}^{n} \Omega_{ij}\left[\Pi_{v_j} - \Pi_{v_i}\right], \forall i, j = 1...n, \tag{1}$$

where $\Pi_{o_i}(\varepsilon_u)$ is the expected value of a new job at the upper support of the productivity distribution. This relation simply states that the firm pays a flow cost, h, realizes a capital gain, $[\Pi_{o_i}(\varepsilon_u) - \Pi_{v_i}]$, at the time of recruitment and takes account of the possible changes in the aggregate conditions with probability Ω_{ij}. As already mentioned EPL implies a two-tier agreement which requires to distinguish between the asset value of a newly created and a continuing job. Thus the value of a new match to the employer in state i is:

$$\begin{aligned}\rho\Pi_{o_i}(\varepsilon_u) = {} & p_i + \sigma\varepsilon_u - w_{o_i}(\varepsilon_u) - \tau_i \\ & + \lambda\left[\int Max\left[\Pi_{e_i}(\zeta), \Pi_{v_i} - \tau_{e_i} - f\right] dG(\zeta) - \Pi_{o_i}(\varepsilon_u)\right] \\ & + \sum_{i\neq j}^{n} \Omega_{ij}\left[\Pi_{o_j}(\varepsilon_u) - \Pi_{o_i}(\varepsilon_u)\right], \forall i, j = 1...n,\end{aligned} \tag{2}$$

where $w_{o_i}(\varepsilon_u)$ is the wage paid to outsiders and τ_i is a lump sum payroll tax. The equity value of the firm in state i is equal to an instantaneous flow profit, $p_i + \sigma\varepsilon_u - w_{o_i}(\varepsilon_u) - \tau_i$, plus the firm's anticipation of capital change due to either a specific or an aggregate shock. In the event of a specific shock, the firm retains the option of firing the worker if the new value of the productivity is below the reservation threshold, ε_{d_i}. In this case she carries out the dismissal costs, $\tau_{e_i} + f$. One should note that in the event of an aggregate shock which leads to a change in the equity value, the job is never destroyed since it is still at the upper bound, ε_u, of the productivity distribution. Finally, the value of continuing the match to the employer in state i is:

$$\begin{aligned}\rho\Pi_{e_i}(\varepsilon) = {} & p_i + \sigma\varepsilon - w_i(\varepsilon) - \tau_i \\ & + \lambda\left[\int Max\left[\Pi_{e_i}(\zeta), \Pi_{v_i} - \tau_{e_i} - f\right] dG(\zeta) - \Pi_{e_i}(\varepsilon)\right] \\ & + \sum_{i\neq j}^{n} \Omega_{ij}\left[Max\left[\Pi_{e_j}(\varepsilon), \Pi_{v_j} - \tau_{e_j} - f\right] - \Pi_{e_i}(\varepsilon)\right], \forall i, j = 1...n,\end{aligned} \tag{3}$$

where $w_i(\varepsilon)$ is the wage paid to insiders at productivity ε. However, unlike equation 2, shifts in the aggregate condition may lead to a job termination hence the Max operator in the last term of (3). Indeed, although aggregate shocks do not alter the idiosyncratic component of the productivity, they induce shifts in the endogenous and state contingent thresholds. In the case of an adverse shock, an increase in the thresholds can lead to terminate some job-workers matches since ε is spread over the range $[\varepsilon_l, \varepsilon_u]$[14].

A worker can be in one of the three following states: unemployed, recently hired or tenured. To each of these states corresponds an asset value denoted by V_{u_i} for an unemployed worker, V_{o_i} for an outsider recently matched with a firm, and V_{e_i} for an insider already hired on a regular contract. The expected utility stream of a recently hired worker in state i verifies:

$$\rho V_{u_i} = b_i + \theta_i q(\theta_i) \left[V_{o_i}(\varepsilon_u) - V_{u_i}\right] + \sum_{i \neq j}^{n} \Omega_{ij} \left[V_{u_j} - V_{u_i}\right], \forall i, j = 1...n, \tag{4}$$

where b_i denote the unemployment benefits. This equation states that an unemployed worker finds a job with probability $\theta_i q(\theta_i)$, realizes a capital gain, $[V_{o_i}(\varepsilon_u) - V_{u_i}]$, at time of recruitment and takes into account the possible changes in the aggregate conditions with probability Ω_{ij}. As previously EPL requires to distinguish between the expected utility stream of a recently hired and a tenured worker. The initial value of the match to the worker in state i is:

$$\begin{aligned} \rho V_{o_i}(\varepsilon_u) = w_{o_i}(\varepsilon_u) + \lambda \left[\int Max\left[V_{e_i}(\zeta), V_{u_i}\right] dG(\zeta) - V_{o_i}(\varepsilon_u)\right] \\ + \sum_{i \neq j}^{n} \Omega_{ij} \left[V_{o_j}(\varepsilon_u) - V_{o_i}(\varepsilon_u)\right], \forall i, j = 1...n. \end{aligned} \tag{5}$$

A new worker is paid the outsider's wage, $w_{o_i}(\varepsilon_u)$, and expects the microeconomic and macroeconomic conditions to change with probability λ and Ω_{ij} respectively. Finally, the value of continuing the match to the worker in state i solves:

$$\begin{aligned} \rho V_{e_i}(\varepsilon) = w_i(\varepsilon) + \lambda \left[\int Max\left[V_{e_i}(\zeta), V_{u_i}\right] dG(\zeta) - V_{e_i}(\varepsilon)\right] \\ + \sum_{i \neq j}^{n} \Omega_{ij} \left[Max[V_{e_j}(\varepsilon), V_{u_j}\right] - V_{e_i}(\varepsilon)], \forall i, j = 1...n. \end{aligned} \tag{6}$$

A tenured worker is paid the insider's wage, $w_i(\varepsilon)$. Similarly, the same types of shocks are likely to occur and to change a tenured worker's felicity on the labor market. However both sources of turbulence are now likely to end up in a job termination, thereby the Max operator in the last term of (6).

[14] See Appendix 1 for the mechanisms driving the job destruction's sources.

2.3 Surplus, Exit, Entry and Wages

Surplus: Matches yield a surplus which is equal to the sum of the expected present value of the job to the worker and the employer net of the value to searching for an alternative partner. In order to derive the key equations necessary to solve the model, it is convenient to define the surplus associated to a job-worker pair. EPL and the related two-tier bargaining structure imply two different definitions of the surplus depending on whether we consider a new job-worker match (during an early negotiation stage) or a continuing (during a renegotiation stage) job-worker match. Let $S_{o_i}(\varepsilon_u)$ and $S_{e_i}(\varepsilon)$ be the surplus of a new match and the surplus of continuing match respectively. At the time of recruitment breaking off the bargaining entails no separation costs for the firm since no contract has yet been signed. Hence, the surplus of a new match to the job-worker pair contingent to aggregate state i is:

$$S_{o_i}(\varepsilon_u) = V_{o_i}(\varepsilon_u) - V_{u_i} + \Pi_{o_i}(\varepsilon) - \Pi_{v_i}. \tag{7}$$

When the worker and the employer clinch a bargain separation costs take effect if the negotiation fails. As a result, the surplus of a continuing match to the job-worker pair, contingent to aggregate state i, is:

$$S_{e_i}(\varepsilon) = V_{e_i}(\varepsilon) - V_{u_i} + \Pi_{e_i}(\varepsilon) - \Pi_{v_i} + f + \tau_{e_i}, \tag{8}$$

where $f + \tau_{e_i}$ represent the costs paid by the firm in case of separation.

Exit and Entry: The formal condition to proceed with a match is $S_{e_i}(\varepsilon) \geq 0$. The severance between the employer and the employee — the job destruction— occurs as soon as the idiosyncratic productivity ε falls below a certain threshold ε_{d_i} from which the surplus becomes negative. The formal condition for severance verifies:

$$S_{e_i}(\varepsilon_{d_i}) = 0, \tag{9}$$

which implicitly defines ε_{d_i} as the minimum idiosyncratic productivity required to ensure the match's profitability. The job creation is governed by free entry in the matching market. Free entry implies the exhaustion of all rents, and drives the value of holding a vacancy to zero. This latter condition is given by:

$$\Pi_{v_i} = 0. \tag{10}$$

Wages: Bargaining leads to a surplus-sharing rule *à la* Nash providing a share $\gamma \in [0; 1]$ of the surplus to the worker which can be interpreted as her bargaining power. In the first stage of the

negotiation, as the separation costs remain virtual, the Nash sharing rule for outsiders is $(1-\gamma)\left[V_{o_i}(\varepsilon_u) - V_{u_i}\right] = \gamma\left[\Pi_{o_i}(\varepsilon_u) - \Pi_{v_i}\right]$, whereas in the second stage, as the separation costs take effect, the Nash sharing rule for insiders is $(1-\gamma)\left[V_{e_i}(\varepsilon) - V_{u_i}\right] = \gamma\left[\Pi_{e_i}(\varepsilon) - (\Pi_{v_i} - f - \tau_{e_i})\right]$. Since EPL improves the threat point of the worker, the bargain yields a two-tier wages agreement denoted by $w_{o_i}(\varepsilon_u)$ and $w_i(\varepsilon)$ and is equal to[15]:

$$w_{o_i}(\varepsilon_u) = (1-\gamma)b_i + \gamma\left[p_i + \sigma\varepsilon_u - \tau_i + h\theta_i - \lambda\left(f + \tau_{e_i}\right)\right], \tag{11}$$

$$w_i(\varepsilon) = (1-\gamma)b_i + \gamma\left[p_i + \sigma\varepsilon - \tau_i + h\theta_i + \rho\left(f + \tau_{e_i}\right) + \sum_{i\neq j}^{n}\Omega_{ij}\left(\tau_{e_i} - \tau_{e_j}\right)\right]. \tag{12}$$

It is worth noting that EPL induces a discrepancy between the outsiders' wages and the insiders' wages. The explanation is intuitive. At the first tier, the outsiders are all set to concede a wage-cut in order to benefit from the EPL later on, hence the negative term, $-\lambda\left(f + \tau_{e_i}\right)$, in (11). Conversely, at the second tier, the insiders use the EPL in order to capture a greater part of the rent, hence the positive term, $\rho\left(f + \tau_{e_i}\right)$, in (12). These two effects are nevertheless common to the majority of EPL models with flexible wage setting. More interestingly, it appears that wages account for the variation in the experience-rated tax when the aggregate conditions change. Thus this second EPL component contrasts strongly with the first one —f in our model— in the sense that the experience-rated tax is state contingent.

2.4 Job-Worker Matches' Creation and Destruction

Using the entry and exit conditions, and the definitions of the surplus, we derive the two key relations required to define the equilibrium. These two relations will be referred hereafter as the job creation and the job destruction conditions[16].

Job Destruction: The separation between the worker and the firm takes place as soon as the rent of the match becomes nil. The formal condition satisfies the exit condition (9). After a few algebra one gets the job destruction condition for the state of nature i. The job destruction threshold therefore satisfies:

$$\begin{aligned} p_i + \sigma\varepsilon_{d_i} = b_i + \frac{\theta_i\gamma h}{1-\gamma} + \tau_i - \rho(\tau_{e_i} + f) - \lambda E(S_{e_i}) \\ - \sum_{i\neq j}^{n}\Omega_{ij}(\tau_{e_i} - \tau_{e_j}) - \sum_{i\neq j}^{n}\Omega_{ij}\left[Max\left[S_{e_j}(\varepsilon_{d_i}), 0\right]\right], \end{aligned} \tag{13}$$

[15] See Appendix 3 for the details of the calculus.
[16] See Appendix 4 for the details of the calculus.

where $E(S_{e_i})=\int \max\left[S_{e_i}(\zeta),0\right] dG(\zeta)$ stands for the expected value of the surplus in the aggregate state i. The RHS of (13) shows that the reservation's productivity depends on the opportunity cost of employment, $b_i + \theta_i \gamma h/(1-\gamma) + \tau_i$, which is the sum of the unemployment benefits, the expected value of search and the lump sum payroll tax. In our framework four labor hoarding's sources naturally arise. First, at the microeconomic level, that is to say for a given aggregate state, there are two sources of retention: *(i)* an institutional source captured by the term, $\rho(\tau_{e_i} + f)$, representing the capitalized value of the dismissal costs which induce firms to lower the productivity threshold and consequently to retain more workers; *(ii)* a voluntary source captured by the term, $\lambda E(S_{e_i})$, corresponding to the option value to maintain a job-worker match due to the expected change in the idiosyncratic productivity ε. Second, our framework encompasses two additional sources of labor hoarding at the macroeconomic level: *(iii)* an institutional source captured by the term, $\sum_{i\neq j}^{n} \Omega_{ij}(\tau_{e_i} - \tau_{e_j})$, underlining the fact that under an experience-rated system the adjustment costs are state-contingent. Hence, an expected increase in these costs gives the firms an incentive to terminate more jobs in the current state to avoid higher termination costs later on; *(iv)* a voluntary source captured by the term, $\sum_{i\neq j}^{n} \Omega_{i_j} \left[Max\left[S_{e_j}(\varepsilon_{d_i}),0\right]\right]$, indicating the expected labor hoarding following a shift in the aggregate condition. For instance, and given an idiosyncratic productivity, ε, a positive aggregate shock shifts down the productivity threshold and therefore unveils a new range of profitable jobs.

Job Creation: Firms enter the labor market until all profit opportunities from new jobs are exploited. In equilibrium, the rents from vacant jobs are nil and satisfy the free entry condition (10). After a few algebra, one gets the job creation condition for the state of the nature i. This condition which defines the labor market tightness reads:

$$\begin{aligned}\frac{h(\rho+\lambda)}{q(\theta_i)} &= (1-\gamma)\left[p_i + \sigma\varepsilon_u - \tau_i - b_i - \frac{\theta_i\gamma h}{1-\gamma}\right] \\ &\quad - (1-\gamma)\lambda(\tau_{e_i} + f) + (1-\gamma)\lambda E(S_{e_i}) \\ &\quad + \sum_{i\neq j}^{n} \Omega_{ij}\left[\frac{h}{q(\theta_j)} - \frac{h}{q(\theta_i)}\right]. \end{aligned} \tag{14}$$

This equation simply states that the expected value of search cost has to be equal to the expected profit of a new job to the firm. The LHS of (14) represents the expected capitalized value of the firm's hiring cost in the current state. This cost increases in the labor market tightness, θ_i, because the higher the market tightness, the longer the time to fill a vacancy. The RHS side of (14) stands for the expected profit of a vacant job. The expected profit decreases in the

labor market tightness because the utility of the unemployed workers is increasing in the labor market tightness. In other words a higher tightness improves the workers' outside opportunities and translates into a higher reservation wage. The RHS of (14) can be divided in four terms where: *(i)* $p_i + \sigma\varepsilon_u - \tau_i - b_i - \frac{\theta_i \gamma h}{1-\gamma}$ is the net instantaneous flow profit, *(ii)* $\lambda(\tau_{e_i} + f)$ is the expected loss to the firm due to a contract's renegotiation following an idiosyncratic productivity shock, *(iii)* $\lambda E(S_{e_i})$ represents the option value of retaining a job-worker match, and finally, *(iv)* $\sum_{i \neq j}^{n} t_{ij} \left[\frac{h}{q(\theta_j)} - \frac{h}{q(\theta_i)} \right]$, corresponds to the expected variation in the profit following a change in the aggregate conditions.

2.5 Balanced Budget Rule and Fiscality

Budget Rule: To close the model, it is necessary to establish a connection between unemployment benefits and their financing. For solvency reasons, the government needs to respect a balanced budget rule and cannot set independently the unemployment benefits and the taxes required to finance them. Accordingly, the level of unemployment benefits is exogenous whereas the taxes collected to finance the unemployment insurance expenditures are endogenous. Unemployment benefits are financed through two instruments: a lump sum payroll tax τ_i paid on each filled job and a tax paid each time a job is destroyed, denoted by τ_{e_i}. This second tax is introduced in order to take the effects of experience rating into account. Experience rating is said to be complete or perfect when $\tau_i = 0$, *i.e.* when the firm supports the entire cost of the expend she creates through her firing decisions. On the contrary, experience rating is said to be perfectly incomplete when τ_{e_i} is nil, *i.e.* when the unemployment benefits' fiscal cost is completely covered by the unemployment compensation system. For all remaining cases, experience rating is said to be incomplete. The balanced budget rule satisfies:

$$B_i \equiv (1 - u_i)\tau_i + (1 - u_i)\lambda G(\varepsilon_{d_i})\tau_{e_i} = u_i b_i, \tag{15}$$

where $u_i b_i$ and B_i denote the expenditures and the resources of the unemployment compensation system respectively. Resources are equal to the sum of the payroll tax $(1-u_i)\tau_i$ — the mutualized part of unemployment benefits— and the experience-rated tax $(1-u_i)\lambda G(\varepsilon_{d_i})\tau_{e_i}$. This last term depends on the job destruction rate. Accordingly, the greater the layoffs, the higher the firm's contributions to the financing system.

Lump Sum Payroll Tax: Using (15), we can determine the endogenous lump sum tax, τ_i:

$$\tau_i = \frac{u_i}{1 - u_i} b_i - \lambda G(\varepsilon_{d_i})\tau_{e_i}. \tag{16}$$

As can be seen τ_i is decreasing in τ_{e_i}. Experience rating is a mean to make firms contribute to the fiscal cost they induce through their firing decisions. An increase in the degree of experience rating tends to make firms bear a greater part of the fiscal cost they create. As a consequence, the mutualized part of the fiscal cost decreases with the degree of experience rating.

Experience-rated tax: In the event of separation, the tax incurred by the firm is determined according to a fiscal-cost criterion. The fiscal cost of an unemployed worker, C_i, is given by the following arbitrage equation:

$$\rho C_i = b_i + \theta_i q(\theta_i) \left[0 - C_i\right] + \sum_{i \neq j}^{n} \Omega_{ij} \left[C_j - C_i\right], \tag{17}$$

where C_i is the expected fiscal cost. An unemployed worker gets an instantaneous income b_i and returns to employment with a transition rate $\theta_i q(\theta_i)$. In this case, her fiscal cost to the unemployment compensation system becomes nil. In addition, it is worth noticing that this cost is likely to change due to the shift in the aggregate conditions. We assume that the benefits received are contingent to the current aggregate state, hence fixed independently of the initial state the worker has been fired. Let $e \in [0; 1]$ be the degree or index of experience rating, the layoff cost incurred by the firm amounts to $\tau_{e_i} = eC_i$ for $i = 1...n$. Substituting this last expression into (17), we get:

$$\tau_{e_i} = \frac{eb_i + \sum_{i \neq j}^{n} \Omega_{ij} \tau_{e_j}}{\rho + \theta_i q(\theta_i) + \sum_{i \neq j}^{n} \Omega_{ij}}. \tag{18}$$

In partial equilibrium, the firing tax defined by (18) has the following properties:

- *(i)* it is increasing in the unemployment benefits, b_i. The higher the unemployment benefits the higher the overall cost of a worker on the dole to the firm for any positive values of the index.

- *(ii)* it is increasing in the experience rating index, e. A higher experience rating index lowers the mutualized part of the unemployment benefits and therefore makes dearer the cost incurred by the firm;

- *(iii)* it is decreasing in the labor market tightness, θ_i. A higher labor market tightness raises the unemployment's exit rate and consequently shortens the unemployment spells. As a result, the expected fiscal cost is smaller, hence the cost borne by the firm.

2.6 Flows Equilibrium

Given an aggregate state i, the labor market tightness, θ_i, and the productivity threshold, ε_{d_i}, the equilibrium unemployment rate, u_i, evolves under the influence of the job destruction rate $\lambda G\left(\varepsilon_{d_i}\right)$ and of the exit rate of unemployment $\theta_i q\left(\theta_i\right)$. Assuming there is no *on the job search* the law of motion of unemployment on the labor market in state i is:

$$\frac{du_i}{dt} = \lambda G(\varepsilon_{d_i})(1 - u_i) - \theta_i q(\theta_i) u_i. \tag{19}$$

Conditional Unemployment Rate: If the aggregate component of productivity, p_i, takes on the same value repeatedly, the economy converges to a state in which unemployment is constant. Assuming a long sequence of realizations of such an aggregate shock, the stationary unemployment rate obtains from the stock-flow condition for constant unemployment:

$$u_i = \frac{\lambda G(\varepsilon_{d_i})}{\lambda G(\varepsilon_{d_i}) + \theta_i q(\theta_i)}. \tag{20}$$

In line with Cole and Rogerson (1999), u_i denotes the conditional steady state unemployment rate the economy will converge to if the macroeconomic environment remains unchanged for many periods. This last relation traditionally expresses the equilibrium of worker flows between employment and unemployment given the properties of the matching function and yields the Beveridge curve. It is decreasing and increasing in the labor market tightness and the reservation productivity respectively.

2.7 Equilibrium

Definition (Conditional Stationary Equilibrium): In each state a conditional stationary equilibrium for a given labor market policy $(e; f)$ is defined by a *n-tuple* $(\varepsilon^*_{d_i},\ \theta^*_i,\ \tau^*_i,\ \tau^*_{e_i},\ u^*_i)$ composed of the reservation productivity, the labor market tightness, the payroll tax, the experience-rated tax and the equilibrium unemployment rate. This vector solves the set of equations defined by (13), (14), (16), (18) and (20). Formally the system reads:
(i) the reservation productivity

$$\begin{aligned} p_i + \sigma\varepsilon^*_{d_i} = b_i + \theta^*_i \frac{\gamma}{1-\gamma} h + \tau^*_i - \rho(\tau^*_{e_i} + f) - \lambda E(S_{e_i}) \\ - \sum_{i \neq j}^{n} \Omega_{ij}(\tau^*_{e_i} - \tau^*_{e_j}) - \sum_{i \neq j}^{n} \Omega_{ij} \left[Max \left[S_{e_j}(\varepsilon^*_{d_i}), 0 \right] \right], \end{aligned} \tag{21}$$

(ii) the labor tightness

$$\frac{h(\rho+\lambda)}{q(\theta_i^*)} = (1-\gamma)\left[p_i + \sigma\varepsilon_u - \tau_i^* - b_i - \theta_i^*\frac{\gamma}{1-\gamma}h - \lambda(\tau_{e_i}^* + f) + \lambda E(S_{e_i})\right] + \sum_{i\neq j}^{n}\Omega_{ij}\left[\frac{h}{q(\theta_j^*)} - \frac{h}{q(\theta_i^*)}\right], \tag{22}$$

(iii) the payroll tax

$$\tau_i^* = \frac{u_i^*}{1-u_i^*}b_i - \lambda G(\varepsilon_{d_i}^*)\tau_{e_i}^*, \tag{23}$$

(iv) the experience-rated tax

$$\tau_{e_i}^* = \frac{eb_i + \sum_{i\neq j}^{n}\Omega_{ij}\tau_{e_j}^*}{\rho + \theta_i^* q(\theta_i^*) + \sum_{i\neq j}^{n}\Omega_{ij}}, \tag{24}$$

(v) the unemployment rate

$$u_i^* = \frac{\lambda G(\varepsilon_{d_i}^*)}{\lambda G(\varepsilon_{d_i}^*) + \theta_i^* q(\theta_i^*)}. \tag{25}$$

This system defines the equilibrium key values in each aggregate state i. *In fine*, the model exhibits $5n$ non linear equations in $(\theta_i, \varepsilon_{di}, \tau_i, \tau_{ei}, u_i)$ which need to be jointly solved to determine the n conditional equilibria. Given its complexity the model cannot be solved analytically under its general form , hence the necessity to use a numerical approach[17].

3 A Simplified Economy

First, we present a simplified version of the model, which abstracts from the macroeconomic turbulence, in order to capture the elementary effects of the EPL reform. Hence, we assume that the economy is in the median state of aggregate productivity and as a result, the transition probabilities Ω_{ij} for $i \neq j$ are nil and we omit the subscript i.

Simplified Model: In the absence of aggregate turbulence and assuming that the budget B is given and balanced, the unemployment benefits are endogenous. The stationary equilibrium is defined by the following two functional equations:

$$\frac{h}{q(\theta)} = (1-\gamma)\left[\sigma\left(\frac{\varepsilon_u - \varepsilon_d}{\rho+\lambda}\right) - \tau_e - f\right], \tag{26}$$

$$p + \sigma\varepsilon_d = \Psi + \frac{\theta\gamma h}{1-\gamma} - \lambda G(\varepsilon_d)\tau_e - \rho(\tau_e + f) - \frac{\lambda\sigma}{\rho+\lambda}\int_{\varepsilon_d}^{\varepsilon_u}(\zeta - \varepsilon_d)dG(\zeta), \tag{27}$$

where $\Psi = \frac{B}{u(1-u)}$[18]. Differentiation and rearrangement of (26) and (27) with respect to the

[17] In addition, the model may exhibit multiple equilibria. As pointed out by Rocheteau (1999), the existence of multiple equilibria is a generic property of search and matching economies with balanced budget rule. As a consequence, we cannot rule out the occurrence of such equilibria. However, we argue this not a problem here since the government is able (through proper fiscal instruments) to choose the low unemployment equilibrium and therefore to avoid any pathological equilibria.

[18] The properties of Ψ imply $\frac{\partial\Psi}{\partial\theta} > 0$ and $\frac{\partial\Psi}{\partial\varepsilon_d} < 0$, if $u < 0.5$. We assume this condition to be fulfilled.

reservation productivity, ε_d, and to the labor market tightness, θ, yields:

$$\left.\frac{\partial \varepsilon_d}{\partial \theta}\right|_{JC} = \frac{hq'(\theta)}{\left[(q(\theta)\right]^2} \frac{\rho+\lambda}{\sigma\left(1-\gamma\right)} < 0 \ ,$$

$$\left.\frac{\partial \varepsilon_d}{\partial \theta}\right|_{JD} = \frac{(\rho+\lambda)\left(\frac{\partial \Psi}{\partial \theta} + \frac{\gamma h}{1-\gamma}\right)}{\sigma\left[\rho+\lambda G(\varepsilon_d)\right] + (\rho+\lambda)\left[\lambda G'(\varepsilon_d)\tau_e - \frac{\partial \Psi}{\partial \varepsilon_d}\right]} > 0$$

The equilibrium values of the labor market tightness θ^* and the reservation productivity ε_d^* are determined by the intersection of a downward-sloping job creation curve and an upward-sloping job destruction curve.

EPL Reform[19]: In order to assess the properties of experience rating, we consider the effects of a reform which consists in a perfect substitution between the firing costs, f, and the experience-rated tax, τ_e, for a constant degree of EPL stringency. Such a reform entails the formal relation $d\tau_e = -df$. Under the perfect substitution hypothesis, differentiation of (26) and (27) with respect to θ, ε_d, f, et τ_e yields[20]:

$$\left.\frac{\partial \theta}{\partial \tau_e}\right|_{d\tau_e=-df} > 0 \quad \text{and} \quad \left.\frac{\partial \varepsilon_d}{\partial \tau_e}\right|_{d\tau_e=-df} < 0 \ . \tag{28}$$

One should remark that perfect substitution between the firing costs, f, and the experience-rated tax, τ_e, increases the labor market tightness and decreases the productivity threshold. The signs of the derivatives imply that the EPL effects are different depending on whether one considers a variation in the experience-rated tax or a variation in the firing costs. It follows that the claim according to which the effects of experience rating are similar to those of firing costs is, in all likelihood, far from being accurate. To be more specific, one should note that experience rating has two effects on the job creation and the job destruction: *(i)* A standard EPL effect, and *(ii)* a fiscal effect. The first effect acts exactly as an EPL device. A higher experience-rated tax increases the turnover costs, hence promoting labor hoarding. As a result, the job destruction rate is decreased. In the same time, the expected profits on new jobs fall. It follows that the job creation rate is also decreased. At this stage, one should remark that the effects of the two EPL components offset each other. There is however a fiscal counterpart to experience rating —the fiscal effect— which is absent from the common EPL tools. The introduction of an experience rating scheme increases EPL strictness but above all reduces the mutualized part of the unemployment benefits. Using (16), it is straightforward to see that an increase in the experience rating induces a decline in the payroll tax. This tax cut lowers the

[19] As a first approximation, we neglect the retroactive effect of the tightness on the experience-rated tax.
[20] See Appendix 5 for the details of the calculus.

labor cost and improves the profitability on any job. All other things being equal, the fiscal effect unveils a new range of productive matches. In other words experience rating induces a more significant decrease in the productivity threshold than common EPL measures, hence an additional degree of labor hoarding. It makes firms internalize the cost associated with their layoff decisions.

The consequences of the EPL reform, in the context of our simplified economy, are represented in figure 1. EPL reform induces a shift from the (JD) curve to the north west. The

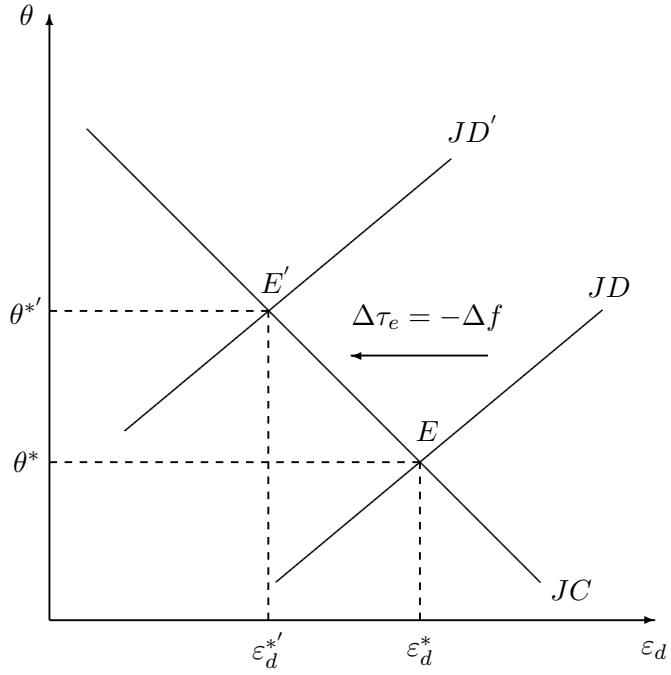

Figure 1: Effects of perfect substitution between the firing costs, f, and the experience-rated tax, τ_e, in the benchmark model.

steady state equilibrium moves from E to E'. Hence, the perfect substitution between the firing costs and the experience rated-tax leads to a decrease in the reservation productivity and an increase in the labor market tightness. Consequently, the EPL reform fosters the exit rate from unemployment as well as the labor hoarding. It follows that the unemployment rate unambiguously decreases together with the expenditures of the unemployment compensation system. In addition, it can be noted that the effect on production remains ambiguous since the job creation increases (more jobs are created) but the job destruction falls (more low productivity jobs are protected).

As mentioned earlier the model cannot be solved analytically under its general specification. Therefore, to refine the theoretical analysis, we turn to a series of numerical evaluations based on

a calibrated version of the model on a prototypical European labor market, namely the French labor market.

4 A General Equilibrium Perspective

4.1 Baseline Calibration

The analysis is conducted on a quarterly basis with the interest rate set to 1%. Along the lines of Mortensen and Pissarides (1999a, b), a matching function of the Cobb-Douglas form is assumed such that $M(u_i, v_i) = k u_i^{\alpha} v_i^{1-\alpha}$ where k is a mismatch parameter and α and $1-\alpha$ are the elasticities of the matching function with respect to search inputs. We assume α to be equal to 0.5 which is in the range of the estimates obtained by Blanchard and Diamond (1989), Petrongolo and Pissarides (2001), and more specifically Fève and Langot (1996) for the French labor market. We assume equal bargaining power between firms and workers so that γ is equal to 0.5. The equality between α and γ implies that the Diamond-Hosios-Pissarides condition holds. The distribution of idiosyncratic shocks is assumed to be uniform over the support $[\varepsilon_l, \varepsilon_u]$. Following Gomes, Greenwood and Rebelo (2001) the properties of the aggregate technology shock are summarized by a three-point Markov chain on the set (p_1, p_2, p_3) where the state to state transition probabilities $\Omega_{ij}, \forall i,\ j = 1, 2, 3$ are ranked in the square matrix Ω. This chain is chosen to approximate an AR(1) process similar to $y_t = \phi y_{t-1} + \upsilon_t$ where ϕ and υ denote the autocorrelation coefficient and the standard error of the innovation respectively. Using French data over the period 1970-1996, Karamé and Mihoubi (1998) estimates of these parameters are $\phi = 0.94$ and $\upsilon = 0.007$. The vector of aggregate productivity components (p_1, p_2, p_3) is set to match the mean and the variance of the underlying AR process. Assuming that it is impossible to jump from an extreme state to another, the state to state transition matrix reads:

$$[\Omega_{ij}] = \begin{bmatrix} \phi & 1-\phi & 0 \\ \frac{1-\phi}{4} & \frac{1+\phi}{2} & \frac{1-\phi}{4} \\ 0 & 1-\phi & \phi \end{bmatrix} = \begin{bmatrix} 0.94 & 0.06 & 0 \\ 0.015 & 0.97 & 0.015 \\ 0 & 0.06 & 0.94 \end{bmatrix}.$$

The ergodic probabilities associated with this matrix yield $(p_1, p_2, p_3) = (0.0355, 0, -0.0355)$, where the subscripts $1, 2$ and 3 stand for the high, the median and the low aggregate state respectively. The idiosyncratic dispersion indicator σ is set to reproduce a relative variance between the aggregate and the idiosyncratic shocks in the range of those found in earlier studies provided by Karamé (2000) on French data and by Den Haan, Ramey and Watson (2000) and Gomes et *al.* (2001) on U.S. data. The key feature is that the contribution of the idiosyncratic productivity in total productivity variation is much more important than the contribution of

Variables	Notation	Value
Matching elasticity	α	0.5
Bargaining power	γ	0.5
Idiosyncratic dispersion indicator	σ	0.3637
Idiosyncratic shock arrival rate	λ	0.08
Upper support	ε_u	1
Lower support	ε_l	0
Autocorrelation coefficient	ϕ	0.94
Standard error	υ	0.007
Interest rate	ρ	0.01
Mismatch parameter	k	1
Vacancy cost	h	0.37
Firing cost	f	0.572
Experience rating index	e	0

Table 1: Baseline parameters for the French labor market.

the aggregate productivity (Davis and Haltiwanger, 1999). The level of the red tape and legal costs, f, is set to represent 50% of the average annual wage in the steady state. This level is consistent with the findings of French empirical studies detailed, for instance, by Kramarz et *al.* (2004). In the base case, the experience rating index e is set to be nil since this characteristic is absent from the French labor market. The level of the unemployment benefits is worth 60% of the average long term wage which is in the range of the OECD estimates. The remaining free parameters, k, λ and h are chosen in order to match key characteristics of the French labor market. Precisely, the scale parameter k and the cost of vacant jobs h are set to approximate the mean unemployment rate to 10.6% and to be consistent with the average cost of posting a vacancy as documented by Kramarz et *al.* (2004). From an empirical point of view, it is difficult to disentangle the arrival shocks λ from the reservation productivity ε_{d_i}. Accordingly, λ is calibrated so as to represent an average job destruction rate of 5.5% by quarter (Duhautois, 2002) and an average unemployment spell assumed to be equal to eight months. Parameter values used in the computations are reported in table 1.

4.2 Steady States

Simplified Model: As a corollary to the theoretical part, we begin the quantitative analysis with an illustration of the reform's effects in the simplified model. The transition probabilities are still supposed to be nil. We assume the economy to be in the median state of aggregate productivity and the modality of the reform remains identical. Thus, we consider a substitution between the EPL components implying the same *ex-post* degree of employment protection.

Formally the benchmark case satisfies the labor market policy triplet ($\tau_e = 0$, $f = 0.572$, $e = 0$) whereas in the EPL reform case, one gets the triplet ($\tau_e = 0.2$, $f = 0.372$, $e = 0.6540$[21]) for an overall *ex-post* degree of employment protection that is worth $\tau_e + f = 0.572$. Simulation results are reported in table 2.

	Benchmark	EPL Reform
ε_d	0.7630 (0.0701)	0.7576 (0.1198)
θ	0.2720 (0.5591)	0.3040 (0.5565)
u	10.48% (0.0367)	9.91% (0.0301)
budget size	5.88% (0.0588)	5.54% (0.0554)
Y	0.3059 (0.0074)	0.3069 (0.0087)

Table 2: Effects of the reform using the simplified specification. The values in brackets represent the distance to the *laissez-faire* economy.

This first general equilibrium illustration allows to size the effects of the reform when one takes account of the retroactive effect of the tightness on the experience-rated tax. Consistent with the theoretical analysis, the reform implies a lower reservation productivity and a higher labor market tightness. It follows that the job creation and the job destruction rates are decreased, yielding a 0.57 percentage point decrease in the unemployment rate. In addition the decrease in the unemployment rate leads to a stabilization of the unemployment compensation finance. It can be remarked too that the production increases, though slightly[22].

The results support experience rating and confute the assertion according to which experience rating acts exactly as a common EPL device. One should also note that the results advocated in the benchmark model corroborate those from Cahuc et *al.* (2004) in a more general setting. Table 2 sheds light on another aspect of the reform as attested by the values in brackets that represent the distance to the *laissez-faire* equilibrium. First, the unemployment rate converges to its *laissez-faire* value. Second, job destruction appears to be too low as indicated by the reservation productivity. We now turn to the general framework, hence allowing for aggregate turbulences.

General model: The restrictions imposed on the benchmark model are now relaxed in order to take account of the macroeconomic variability. The principle of the reform remains the same and consists in a perfect substitution between the two EPL components. We consider a vector yielding a set of policies that satisfy a constant *ex-post* EPL stringency in the median aggregate

[21] This number is in the range of average experience rating index in the U.S. economy over the years $1988-1997$ (UIPL, 1999) and therefore is deemed realistic.

[22] The aggregate production net of the search costs is equal to $Y = \left[\varepsilon_u + \int_{\varepsilon_d}^{\varepsilon_u} (\zeta - \varepsilon_u) G(\zeta)\right](1-u) - uh\theta$.

state of productivity. This vector reads as $(\tau_e = 0.2; f = 0.372; e = 0.6530)$. In order to gauge the reform, three criteria are used in each state: the unemployment rate, the production and the budget size. Simulation results are reported in table 3.

		Benchmark Case	EPL reform Perfect Substitution between f and τ_e	Net Variation
Unemployment	High State	9.02%	8.73%	−0.29
	Median State	10.49%	9.92%	−0.57
	Low State	12.61%	11.54%	−1.07
Production	High State	0.3402	0.3410	0.0008
	Median State	0.3059	0.3069	0.0010
	Low State	0.2704	0.2721	0.0017
Budget	High State	4.55%	4.39%	−0.16
	Median State	5.88%	5.54%	−0.34
	Low State	8.00%	7.28%	−0.72

Table 3: Effects of the reform using the general specification.

At first sight one should note that previous results are confirmed under the general specification. Thereby, for each aggregate state, the unemployment rate decreases, the production increases and the unemployment insurance budget cuts down. Hence, the results of the model appear robust to any number of specification. Our framework sheds light on another property of experience rating, *ie.* its cyclical dependence. As can be seen from the last column of 3, the effects of the reform are more pronounced the lower the aggregate condition. Because the experience-rated tax depends on the average unemployment spell and duration depends on the aggregate conditions, the tax is contingent to the cycle. The tax is therefore higher the lower the aggregate conditions. It makes firms more prone to postpone their layoff decisions until the macroeconomic environment improves, hence lowering the severance costs.

To be more specific, let us recall that the effects of the experience-rated tax transit through two channels: *(i)* a standard EPL channel and *(ii)* a fiscal channel. The overall effect of experience rating results in the combination of these two channels. The EPL cyclical dependence has multiple consequences on both the job destruction and the job creation (see equations 13 and 14). An increase in the experience rating index induces a variation in the fiscal components, τ_e and τ, all the more pronounced that the macroeconomic environment is depressed[23]. It follows that firms are more prone to retain workers the lower the cycle. Put differently, the decrease in the reservation productivity is higher the lower the aggregate conditions. The overall effect of an increase in the experience rating index on job creation is a little more tedious to sketch since both

[23]See Appendix 2 for an illustration in the three states case.

fiscal variables have contradictory effects on the tightness. Numerical experimentations permit however to show that for reasonable parameter values the —favorable— fiscal effect rules the —adverse— EPL effect in each aggregate state. Furthermore the extent of the net effect on the tightness is all the more important that the cycle is low. In other words, the elasticity of job creation to the experience-rated tax is lower than the elasticity of the job creation to the payroll tax, and this discrepancy is higher the lower the aggregate conditions. In the end, taking account of the effects of experience rating on both the job destruction and the job creation, the unemployment rate decreases in all states, this diminution being sharper the lower the aggregate conditions. One should note that this original result is proven to be robust to a large set of parametric specifications.

Let us return to the EPL reform. The labor market tightness being, *ceteris paribus*, all the more important that the aggregate conditions are favorable, the job creations, the unemployment spells and the layoff taxes are greater, shorter and lower respectively the higher the aggregate productivity. The substitution between the two EPL components in the median state of productivity leads to a decrease in the overall EPL strictness in the good states and to an increase in the bad states. Layoff decisions tend to be deferred to the good and median states where EPL stringency is less restricting. Hence firms are all the more deterred to shed labor that the macroeconomic environment is depressed. This effect is reinforced by the fiscal effect which one knows to be negatively correlated with the cycle. At the same time, the fiscal effect improves the labor market tightness and fosters job creation. It follows that the reform lowers the unemployment rate, increases the production and curtails the expenditure of the unemployment compensation system in any states as reported in table 3.

Hence it appears that experience rating has strong effects on the labor market and contrasts sharply with standard EPL components. In addition, the layoff tax is proven to be asymmetric over the business cycle, the experience-rated tax being countercyclical.

4.3 Dynamic

Until now the analysis has only focussed on steady-states. From now on we turn to a pure dynamic analysis with the objective, *inter alia*, to shed light on the cyclical properties of the model. For this purpose we proceed in two steps: *(i)* we evaluate the effects of the EPL reform on a series of key labor market variables with a particular emphasis on the cyclical properties, *(ii)* we check, according to well defined criteria, for the consistency and desirability of the reform[24].

[24]See Appendix 6 for mathematical details.

Methodology: Using the laws of motion of the key labor market variables, we build time series for each variable and calculate the relevant statistics namely the mean, the standard deviation and the correlation coefficient. To obtain these statistics we simulate the model for 500 periods and discard the 100 first observations to circumvent problems pertaining to initial dependance. The remaining 400 observations are then logged and filtered using the Hodrick-Prescott filter. We repeat this process 100 times and compute average for the 100 samples [25].

4.3.1 Creation, Destruction and Unemployment

We now focus on the effects of the EPL reform on the cyclical properties of job flows and of the unemployment rate. Table 4 and 5 report the simulation results for the means, the standard deviations and the correlation coefficients. From table 4, it is straightforward to see

	Benchmark Case	EPL Reform
Job Creations (JC)	5.4909	5.4764
Job Destructions (JD)	5.4904	5.4760
Unemployment Rate (u)	10.6945	10.0471

Table 4: Simulation Statistics for 100 series of 400 quarters. Means of the job creations, job destructions and unemployment rate.

that, on average, the reform decreases both the job creations and the job destructions. The unemployment rate is also unambiguously decreased by about 0.65 percentage point, hence corroborating the steady state analysis. The next table highlights the cyclical properties of the model. As can be noted the EPL reform tends to lessen the standard deviation of both

	Benchmark Case	EPL Reform
Standard Deviation (JC)	0.2176	0.1741
Standard Deviation (JD)	0.2491	0.1406
Correlation (JC,JD)	-0.6045	-0.6159
Standard Deviation (u)	0.5480	0.3986
Correlation (u,v)	-0.1077	-0.1889

Table 5: Simulation Statistics for 100 series of 400 quarters. Cyclical properties. Data are logged and HP filtered.

the job creations (JC) and the job destructions (JD). In other words, the experience-rated tax tends to reduce the variability of job flows and consequently to stabilize labor market flows.

[25] This procedure is usual in the literature and particularly in the bulk of the Real Business Cycle (RBC) models (for a discussion, see Cole et *al.*, 1999). It is also worth noting that the qualitative results of the model, and particularly the cyclical properties, do not depend on this procedure.

The key result of this table pertains however to the connection between the experience-rated tax and the aggregate employment fluctuations. Table 5 also reports that the EPL reform decreases the aggregate employment variability by about 25%. As a matter of fact, one knows the effects of experience rating to be greater the lower the aggregate conditions, hence leading to a decrease in the unemployment rate all the more pronounced that the macroeconomic conditions are depressed (see table 3 for details). It follows that the distance across states between the conditional unemployment rates is reduced. The variance of the aggregate unemployment rate is therefore lower with the experience-rated tax. This result appears to be robust to a wide range of specifications. Precisely to test for robustness, we have considered a series of numerical simulations focussing on an increase in the experience rating index (for a constant value of the firing costs f) from $e = 0$ —the benchmark value— to $e = 0.65$ —the average value in the previous simulations. Simulations results[26] show that employment variability is strongly influenced (decreased) by experience rating, a result in line with those advocated by the U.S. empirical studies (see for instance Anderson, 1993 and Card et *al.*, 1994). Furthermore, one could ask if the results are not tied to the degree of persistency, ϕ, of the aggregate shocks. We show that for reasonable values of $\phi \in [0.91; 0.97]$, the experience-rated tax strongly influences employment variability.

At this stage, the dynamic analysis supports the desirability of experience rating. An EPL reform whose mainstay consists in the introduction of an experience-rated tax in place of the mandatory firing costs appears to improve labor market performances by fostering and stabilizing employment.

4.3.2 Government Social Objective and Production

So far our analysis has demonstrated that experience rating improves the overall labor market performances and stabilizes the employment over the business cycle. This last key result is questionable to a certain extent since it seems justified to wonder about the stabilizing virtue of experience rating. Put differently, is it worthwhile for a government to sustain such an EPL reform and to stabilize employment over the business cycle? To gauge this important issue and to evaluate the desirability of the reform, we introduce a government objective function which depends on the employment rate (a natural criterion in our framework). Furthermore, one should note that in the absence of risk aversion, production is an alternative criterion to

[26]Results are available upon request from the authors.

evaluate the relevance of the reform (see for instance, Cahuc and Zylberberg, 2004). Accordingly, we present this criterion as an additional mean to check for the desirability of the reform.

Government Objective Function: We consider a government objective function exhibiting loss aversion. This type of functions has recently received close scrutiny to assess the demand for protection emanating from the society. For instance, Freund and Ozden (2004) used such a specification to account for the effects of reforms in the State commercial policies. More recently, Layard (2006) has underlined that loss aversion is a key element to take into account while designing stabilization policies and evaluating the costs pertaining to fluctuations. In this respect, it appears natural to consider a government objective function embedding loss aversion to evaluate the desirability of employment protection reforms. Such a specification implies that the government evaluates employment variations with respect to a reference point. It reflects the well established fact that economic agents tend to be more sensitive to losses than to gains, hence resulting in an utility function which is steeper for losses. In other words, in our framework an increase in the unemployment rate is more costly to the government than the gains associated to a decrease in the unemployment rate. More than that this type of specifications permit to judge the EPL reform according to new criteria which appear to be complementary to the traditional criterion based on aggregate production. Formally, the government objective function reads:

$$\Lambda_t(x) = \begin{cases} x_t^{\alpha} & \text{if } x_t \geqslant 0 \\ -\kappa(-x_t)^{\alpha} & \text{if } x_t < 0 \end{cases} \tag{29}$$

where x_t, κ and α denote the employment variation in t, the loss aversion parameter and the utility function parameter respectively. For computational purpose, we assume κ to be equal to 2 — a usual value in the literature — and α to be equal to 0.7[27] — a value denoting a reasonable relative risk aversion of 0.3 for a CRRA function. The cornerstone of the formal specification of the function pertains to the definition of the reference point mentioned earlier. Precisely, this reference point governs the appreciation of the variation in the employment. Two specifications are considered: *(i)* the government has a long term view. In this case, the reference point is the expected value of the unemployment rate in the steady-state. The choice of the reference point is therefore grounded on the long term structure of the economy; *(ii)* the government is myopic or is alternatively vote-catching. In this case, the reference point is the unemployment rate of the previous period. The choice of the reference point is then grounded on the cyclical behavior of the economy. In other words any short term decrease in the unemployment rate is a

[27]It is worth noting that for reasonable parameter values in the range $\alpha \in [0.1; 0.9]$, the qualitative results remain unchanged, hence proving the robustness of the results.

gain to the government whereas any short term increase is a loss. Table 6 presents the value of the government objective function with respect to the two reference points as well as the value of production. In line with the steady-states analysis, production is slightly increased after the

	Benchmark Case	EPL Reform
Type-1 Government		
Structural Objective	-1.399	-1.057
Type-2 Government		
Vote-Catching Objective	-0.048	-0.085
Production	30.73	30.77

Table 6: Evaluation of the EPL reform for three criteria.

EPL reform. Hence, according to this criterion the reform is desirable since the efficiency of the economy is improved. However, Table 6 also indicates that the desirability of the reform is likely to change according to the objective considered, *i.e.* a structural (long term) objective or a vote-catching (short term) objective. The average value of the objective function for a type-1 government increases from -1.399 before the reform to -1.057 after the reform. In a dynamic framework, the choice of the type-1 government is therefore to uphold the EPL reform since the gains associated with a higher employment rate are sufficient to compensate for the losses induced by the fluctuations. In contrast, the situation of a type-2 government is depreciated after the reform. As a consequence, it is in the interest of such a government to maintain the statu-quo even if the average unemployment rate is higher. Put differently a vote-catching government that does not take account of the whole employment fluctuations but rather focus on day to day fluctuations is led to reject the EPL reform, the losses associated to fluctuations being too large.

5 Conclusion

Using an equilibrium unemployment model, we investigated the virtue of an employment legislation reform (EPL) which aims at reducing the red tape and legal costs associated with layoffs and introducing of a U.S. like experience rating system modelled as a combination of a layoff tax and a payroll subsidy. The experience-rated tax is thus remarkable since it is an EPL component with a fiscal counterpart. Our results suggest that the EPL efficiency is strongly influenced by the design of such a reform. These results are consistent with the conventional wisdom that experience rating is desirable, not only as a part of unemployment compensation finance as most studies acknowledge but also as part and parcel of a virtuous EPL system. The EPL reform

considered emphasizes several orignal results: *(i)* contrary to the red tape and legal costs, the effects of the experience-rated tax are asymmetric over the business cycle; *(ii)* the EPL reform improves the overall labor market performance, hence alleviating the unemployment insurance budget, increasing production and decreasing both the aggregate and conditional unemployment rates, the decrease in the latter being more pronounced as the macroeconomic environment is depressed; *(iii)* the EPL reform reduces the employment aggregate variability, the layoff tax reducing the effects of a change in the aggregate conditions on the employment.

More generally, the reform considered shows that it is possible (and desirable) to improve both the consistency and the efficiency of employment protection policies while leaving the workers' protection untouched on the labor market. These results are of particular acuity in the European debate on the contours of employment protection reform as recently sketched by Blanchard and Tirole (2003a,b) or Cahuc and Kramarz (2005). They suggest that an EPL component adapted from the U.S. experience rating system is an efficient mean to improve the labor market performance while bringing down the average unemployment and stabilizing the employment over the business cycle. It may be however legitimate to wonder about the virtue of experience rating since such a system is absent from most OECD countries. In other words, what is the rationale not to implement the reform ? A possible element of the answer pertains to the time schedule of the reform. A short term oriented government (vote-catching) being reluctant to uphold the reform due to the *ad hoc* losses prefers to favor marginal reform which appears to be politically less costly. To some extent, it parallels the experience of Europe and particularly Continental Europe where the use of experience rating has been advocated since the mid 90's (OECD, 1994) and where marginal reform were preferred (Saint-Paul, 2002, 2004 or Boeri and Garibaldi, 2006).

Our research could be extended in several directions. The results advocated in this paper are complementary to the work of Cahuc and Zylberberg (2006) who argue that in an optimal taxation framework, "*layoff taxes are not only a counterpart to the state provision of unemployment benefits but also a natural counterpart to other public expenditures*". In such a context, the introduction of a layoff tax allows to take account of the unemployment's social cost which amounts to the unemployment benefits paid to the fired worker plus the fiscal losses to the government when the job is destroyed. From this perspective, an extension that combines a search and matching framework with an optimal taxation scheme is relevant to further capture the distortions induced by the firms' layoff decision. A second and perhaps more natural extension is justified on the ground that there is no explicit reason for public policies in our model since

workers are assumed to be risk neutral. Through this assumption we have intentionally focussed only on the consequences of the reform on employment and thereby laid any insurance issue aside. An extension that incorporate both considerations would allow an explicit welfare evaluation. Finally, in order to fine-tune the comprehension of the EPL reform (or more generally the introduction of layoff tax), it would be worthwhile to consider a model that allows for workers heterogeneity for at least two reasons: *(i)* a layoff tax might have strong redistributive effects across individuals with different abilities and, *(ii)* it might durably exclude workers from the labor market, hence fostering transition from unemployment to inactivity. These developments are on our research agenda.

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Appendix

Appendix 1 - Sources of Job-Worker Match Destruction

As soon as the surplus of a job-worker match becomes nil or negative, there is no incentive to pursue the employment relationship. The job-worker match is subject to two sources of productivity hazard (idiosyncratic or aggregate). The graphic below permits to illustrate the way job destruction works in our framework. The cutoff productivities, $\varepsilon_{d_i}, \forall i = 1...n$, are ranked in descending order where the subscript 1 stands for the best aggregate state and the subscript n stands for the worst.

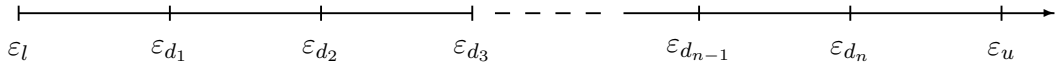

Figure 2: Reservation (cutoff) productivities contingent to the aggregate state i, $\forall i = 1...n$.

A job-worker match is destroyed for one of two reasons: *(i)* For a given aggregate productivity, the only remaining source of disturbance is idiosyncratic. The job-specific productivity changes at Poisson rate λ in which case the firm compares the option value of dissolving the match to the value of pursuing the employment relationship. In the event of such a shock a new value of the job-specific productivity is drawn from the general distribution G. According to the current endogenous productivity threshold, ε_{d_i}, the job is destroyed if the new value of the productivity is below this cutoff productivity or is kept otherwise. This is the microeconomic source of job destruction; *(ii)* For a given idiosyncratic productivity, the only remaining source of disturbance is aggregate. A change in the macroeconomic conditions causes the cutoff productivity to be shifted up (in case of an adverse shock) or down (in case of a good shock). In other words, a positive shock unveils a new range of productive jobs (say from ε_{d_n} to $\varepsilon_{d_{n-1}}$) whereas an adverse shock covers up an old range of productive jobs (say from $\varepsilon_{d_{n-1}}$ to ε_{d_n}). This is the macroeconomic source of job destruction.

Appendix 2 - Taxes as a Function of the Experience Rating Index e

Effect of an increase in the index e on the experience rated tax τ_e:

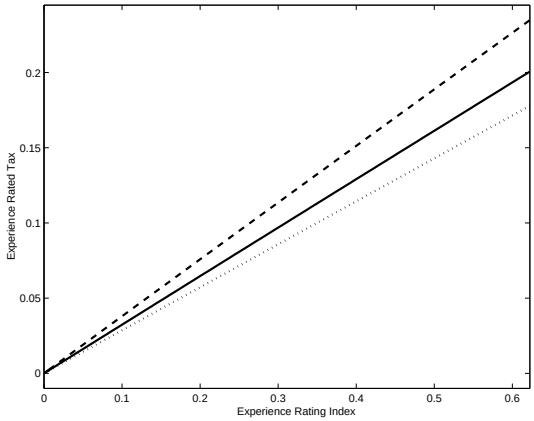

Figure 3: Experience Rated Tax as a function of the Experience Rating Index. Short dashed, plain, and long dashed apply to high, median and low aggregate state respectively.

From figure 3, it is straightforward to remark that:

$$\left|\frac{\Delta\tau_e}{\Delta e}\right|_{low} > \left|\frac{\Delta\tau_e}{\Delta e}\right|_{median} > \left|\frac{\Delta\tau_e}{\Delta e}\right|_{high}$$

Effect of an increase in the index e on the lump sum payroll tax τ:

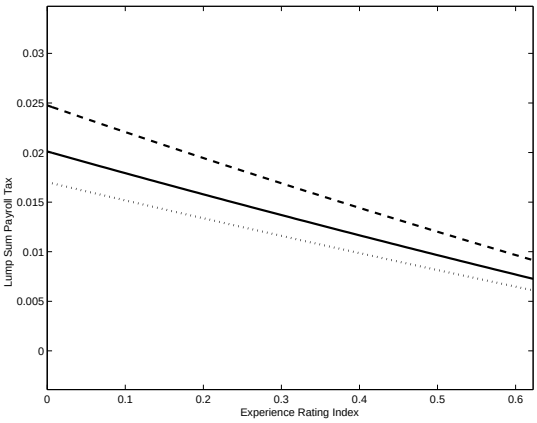

Figure 4: Lump Sum Payroll Tax as a function of the Experience Rating Index. Short dashed, plain, and long dashed apply to high, median and low aggregate state respectively.

From figure 4, it is straightforward to remark that:

$$\left|\frac{\Delta\tau}{\Delta e}\right|_{low} > \left|\frac{\Delta\tau}{\Delta e}\right|_{median} > \left|\frac{\Delta\tau}{\Delta e}\right|_{high}$$

Appendix 3 - Wage Rules

Outsiders' Wages — Negotiation —

Wages are the outcome of a Nash sharing rule providing a share $\gamma \in [0;1]$ of the surplus to the worker. The wage on a new job solves:

$$w_{o_i}(\varepsilon_u) = \arg\max \left(V_{o_i}(\varepsilon_u) - V_{u_i}\right)^{\gamma} \left(\Pi_{o_i}(\varepsilon_u) - \Pi_{v_i}\right)^{1-\gamma} \tag{A-1}$$

The bargain yields the following sharing rules:

$$V_{o_i}(\varepsilon_u) - V_{u_i} = \gamma S_{o_i}(\varepsilon_u) \quad and \quad \Pi_{o_i}(\varepsilon_u) - \Pi_{v_i} = (1-\gamma) S_{o_i}(\varepsilon_u)$$

where $S_{o_i}(\varepsilon_u)$ denotes the surplus on a new job. Taking account of the free entry condition, $\Pi_{v_i} = 0$, one simply gets:

$$(1-\gamma)\left[V_{o_i}(\varepsilon_u) - V_{u_i}\right] = \gamma \Pi_{o_i}(\varepsilon_u) \tag{A-2}$$

Using equations (2) and (5), presented in the text, one gets:

$$\begin{aligned}\left(\rho + \lambda + \sum_{i \neq j}^{n} \Omega_{ij}\right) \Pi_{o_i}(\varepsilon_u) = {} & p_i + \sigma \varepsilon_u - \tau_i - w_{o_i}(\varepsilon_u) \\ & + \lambda \left[\int Max\left[\Pi_{e_i}(\zeta) + f + \tau_{e_i}, 0\right] dG(\zeta))\right] \\ & + \sum_{i \neq j}^{n} \Omega_{ij} \left[\Pi_{o_j}(\varepsilon_u)\right] - \lambda \left(f + \tau_{e_i}\right),\end{aligned} \tag{A-3}$$

$$\begin{aligned}\left(\rho + \lambda + \sum_{i \neq j}^{n} \Omega_{ij}\right) \left(V_{o_i}(\varepsilon_u) - V_{u_i}\right) = {} & w_{o_i}(\varepsilon_u) \\ & + \lambda \left[\int Max\left[V_{e_i}(\zeta) - V_{u_i}, 0\right] dG(\zeta)\right] \\ & + \sum_{i \neq j}^{n} \Omega_{ij} \left[V_{o_j}(\varepsilon_u) - V_{u_j}\right] \\ & - \rho V_{u_i} - \sum_{i \neq j}^{n} \Omega_{ij} \left(V_{u_i} - V_{u_j}\right).\end{aligned} \tag{A-4}$$

Again, using the sharing rules as well as the free entry condition, the expected utility of an unemployed worker reads:

$$\rho V_{u_i} + \sum_{i \neq j}^{n} \Omega_{ij} \left(V_{u_i} - V_{u_j}\right) = b_i + \theta_i \frac{\gamma}{1-\gamma} h. \tag{A-5}$$

Finally, using the previous expressions together with the sharing rules, the wage on a new job reads in state i:

$$w_{o_i}(\varepsilon_u) = (1-\gamma)\left[b_i + \theta_i \frac{\gamma}{1-\gamma} h\right] + \gamma\left[p_i + \sigma\varepsilon_u - \tau_i - \lambda\left(f + \tau_{e_i}\right)\right]. \tag{A-6}$$

Insiders' Wages — Renegotiation —

The wage on a continuing job solves:

$$w_i(\varepsilon) = \arg\max (V_{e_i}(\varepsilon) - V_{u_i})^{\gamma} \left(\Pi_{e_i}(\varepsilon) - \Pi_{v_i} + f + \tau_{e_i}\right)^{1-\gamma} \tag{A-7}$$

The bargain yields the following sharing rules:

$$V_{e_i}(\varepsilon) - V_{u_i} = \gamma S_{e_i}(\varepsilon) \quad and \quad \Pi_{e_i}(\varepsilon) - \Pi_{v_i} + f + \tau_{e_i} = (1-\gamma) S_{e_i}(\varepsilon)$$

where $S_{e_i}(\varepsilon)$ denotes the surplus on a continuing job. Taking account of the free entry condition, $\Pi_{v_i} = 0$, one simply gets:

$$(1-\gamma)\left(V_{e_i}(\varepsilon) - V_{u_i}\right) = \gamma\left(\Pi_{e_i}(\varepsilon) + f + \tau_{e_i}\right) \tag{A-8}$$

Using equations (3) and (6), detailed in the text, one gets:

$$\begin{aligned}\left(\rho + \lambda + \sum_{i\neq j}^{n} \Omega_{ij}\right)\left(\Pi_{e_i}(\varepsilon) + f + \tau_{e_i}\right) = {} & p_i + \sigma\varepsilon - \tau_i - w_i(\varepsilon) \\ & + \lambda\left[\int Max\left[\Pi_{e_i}(\zeta) + f + \tau_{e_i}, 0\right] dG(\zeta)\right] \\ & + \sum_{i\neq j}^{n} \Omega_{ij}\left[Max\left[\Pi_{e_j}(\varepsilon) + f + \tau_{e_j}, 0\right]\right] \\ & + \rho\left(f + \tau_{e_i}\right) + \sum_{i\neq j}^{n} \Omega_{ij}\left(\tau_{e_i} - \tau_{e_j}\right),\end{aligned} \tag{A-9}$$

$$\begin{aligned}\left(\rho + \lambda + \sum_{i\neq j}^{n} \Omega_{ij}\right)\left(V_{e_i}(\varepsilon) - V_{u_i}\right) = {} & w_i(\varepsilon) \\ & + \lambda\left[\int Max\left[V_{e_i}(\zeta) - V_{u_i}, 0\right] dG(\zeta)\right] \\ & + \sum_{i\neq j}^{n} \Omega_{ij}\left[Max[V_{e_j}(\varepsilon) - V_{u_j}, 0]\right] \\ & - \rho V_{u_i} - \sum_{i\neq j}^{n} \Omega_{ij}\left(V_{u_i} - V_{u_j}\right).\end{aligned} \tag{A-10}$$

Finally, using the previous equations together with the sharing rules as well as the expected utility of an unemployed worker, the wage on a continuing job reads in state i:

$$w_i(\varepsilon) = (1-\gamma)\left[b_i + \theta_i \frac{\gamma}{1-\gamma} h\right] + \gamma\left[p_i + \sigma\varepsilon - \tau_i + \rho\left(f + \tau_{e_i}\right) + \sum_{i\neq j}^{n} \Omega_{ij}\left(\tau_{e_i} - \tau_{e_j}\right)\right]. \quad \text{(A-11)}$$

Appendix 4 - Surplus, Job Destruction and Job Creation

Surplus on a New Job

The surplus on a new job is defined by (7). Using equations (2) and (5) detailed in the text together with the free entry condition , $\Pi_{v_i} = 0$, one gets:

$$\begin{aligned}(\rho + \lambda + \sum_{i\neq j}^{n} \Omega_{ij}) S_{o_i}(\varepsilon_u) = p_i + \sigma\varepsilon_u - \tau_i - \lambda\left(f + \tau_{e_i}\right) - \rho V_{u_i} \\ + \lambda E(S_{e_i}) + \sum_{i\neq j}^{n} \Omega_{ij}(V_{u_j} - V_{u_i}) + \sum_{i\neq j}^{n} \Omega_{ij} S_{o_j}(\varepsilon_u). \quad \text{(A-12)}\end{aligned}$$

Then, using the sharing rules detailed above together with (1), (4) and the free entry condition, the surplus on a new job in state i reads:

$$\begin{aligned}(\rho + \lambda + \sum_{i\neq j}^{n} \Omega_{ij}) S_{o_i}(\varepsilon_u) = p_i + \sigma\varepsilon_u - \tau_i - b_i - \theta_i \frac{\gamma}{1-\gamma} h - \lambda\left(f + \tau_{e_i}\right) \\ + \lambda E(S_{e_i}) + \sum_{i\neq j}^{n} \Omega_{ij} S_{o_j}(\varepsilon_u). \quad \text{(A-13)}\end{aligned}$$

Surplus on a Continuing Job

The surplus on a continuing job is defined by (8). Using equations (3) and (6) detailed in the text together with the free entry condition, $\Pi_{v_i} = 0$, one gets:

$$\begin{aligned}(\rho + \lambda + \sum_{i\neq j}^{n} \Omega_{ij}) S_{e_i}(\varepsilon) = p_i + \sigma\varepsilon - \tau_i - (\rho + \sum_{i\neq j}^{n} \Omega_{ij})(V_{u_i} - f - \tau_{e_i}) \\ + \sum_{i\neq j}^{n} \Omega_{ij}(V_{u_j} - f - \tau_{e_j}) \\ + \lambda E(S_{e_i}) + \sum_{i\neq j}^{n} \Omega_{ij} Max[S_{e_j}(\varepsilon), 0]. \quad \text{(A-14)}\end{aligned}$$

Finally, using the sharing rules detailed above together with (1), (4) and the free entry condition, the surplus on a continuing job in state i reads:

$$(\rho+\lambda+\sum_{i\neq j}^{n}\Omega_{ij})S_{e_i}(\varepsilon)=p_i+\sigma\varepsilon-\tau_i-b_i-\theta_i\frac{\gamma}{1-\gamma}h+\rho\left(f+\tau_{e_i}\right)+\lambda E(S_{e_i})$$
$$+\sum_{i\neq j}^{n}\Omega_{ij}(\tau_{e_i}+f-\tau_{e_j}-f)$$
$$+\sum_{i\neq j}^{n}\Omega_{ij}\left[Max\left[S_{e_j}(\varepsilon),0\right]\right]. \tag{A-15}$$

Job Destruction

Combining the formal condition for severance (9) with (A-15), it is easy after a few algebra to get (13), that is to say the relation defining the job destruction threshold —the cutoff productivity— in state i.

Job Creation

Combining the sharing rules together with (1) and (10), it is straightforward to get:

$$\frac{h}{q\left(\theta\right)}=\left(1-\gamma\right)S_{o_i}\left(\varepsilon_u\right)$$

Then using this latter expression together with , it is easy after a few algebra to get (14), that is to say the relation defining the job creation —the labor market tightness— in state i.

Appendix 5 - Comparative Static

Two-tier Bargaining Structure: Using equations (26) and (27) from the simplified model, it is easy to sketch the effects of the reform. Differentiation with respect to θ, ε_d, f et τ_e yields:

$$-\frac{hq'(\theta)}{\left[q(\theta)\right]^2}d\theta=-\frac{(1-\gamma)\sigma}{\rho+\lambda}d\varepsilon_d-\left(1-\gamma\right)\left[d\tau_e+df\right], \tag{A-16}$$

$$\begin{aligned}\sigma d\varepsilon_d &= \frac{\partial\Psi}{\partial\varepsilon_d}d\varepsilon_d+\frac{\partial\Psi}{\partial\theta}d\theta+\frac{\gamma h}{1-\gamma}d\theta-\rho(d\tau_e+df) \\ &\quad -\lambda G(\varepsilon_d)d\tau_e-\lambda G'(\varepsilon_d)\tau_e d\varepsilon_d+\frac{\lambda\sigma\left[1-G(\varepsilon_d)\right]}{\rho+\lambda}d\varepsilon_d,\end{aligned} \tag{A-17}$$

where $\Psi\equiv\Psi\left(\theta,\varepsilon_d\right)=\frac{B}{u(1-u)}$ with $\frac{\partial\Psi}{\partial\theta}=\frac{\partial\Psi}{\partial u}\frac{\partial u}{\partial\theta}>0$ and $\frac{\partial\Psi}{\partial\varepsilon_d}=\frac{\partial\Psi}{\partial u}\frac{\partial u}{\partial\varepsilon_d}<0$ when $u<0,5$. Assuming a perfect substitution between the two EPL components, $d\tau_e=-df$, the Jacobian of the system reads:

$$J=\begin{pmatrix}-\frac{hq'(\theta)}{\left[q(\theta)\right]^2} & \frac{(1-\gamma)\sigma}{\rho+\lambda} \\ \left(\frac{\partial\Psi}{\partial\theta}+\frac{\gamma h}{1-\gamma}\right) & -\frac{\sigma[\rho+\lambda G(\varepsilon_d)]+(\rho+\lambda)\left[\lambda G'(\varepsilon_d)\tau_e-\frac{\partial\Psi}{\partial\varepsilon_d}\right]}{\rho+\lambda}\end{pmatrix}$$

The determinant of the matrix **J** reads:

$$\det|J| = \frac{hq'(\theta)}{[q(\theta)]^2}\frac{\sigma[\rho+\lambda G(\varepsilon_d)]+(\rho+\lambda)\left[\lambda G'(\varepsilon_d)\tau_e - \frac{\partial\Psi}{\partial\varepsilon_d}\right]}{\rho+\lambda} - \frac{(1-\gamma)\sigma}{\rho+\lambda}\left(\frac{\partial\Psi}{\partial\theta}+\frac{\gamma h}{1-\gamma}\right) < 0$$

since $q'(\theta) < 0$, $\frac{\partial\Psi}{\partial\theta} > 0$ and $\frac{\partial\Psi}{\partial\varepsilon_d} < 0$. Using Cramer's rule, one simply gets:

$$\left.\frac{d\theta}{d\tau_e}\right|_{d\tau_e=-df} = -\frac{1}{det\mathbf{J}}\frac{\lambda G(\varepsilon_d)(1-\gamma)\sigma}{\rho+\lambda} > 0$$

$$\left.\frac{d\varepsilon_d}{d\tau_e}\right|_{d\tau_e=-df} = -\frac{1}{det\mathbf{J}}\frac{hq'(\theta)\lambda G(\varepsilon_d)}{[q(\theta)]^2} < 0$$

Hence for a constant degree of EPL stringency, the reform increases the labor market tightness and decreases the reservation productivity.

Pure Insider Bargaining Structure: Under a pure insider bargaining structure the simplified version of the model boils down to the two fundamental equations below:

$$\frac{h}{q(\theta)} = (1-\gamma)\sigma\left(\frac{\varepsilon_u-\varepsilon_d}{\rho+\lambda}\right) - f - \tau_e \tag{A-18}$$

$$p+\sigma\varepsilon_d = \Psi + \frac{\gamma}{1-\gamma}[\theta h + \theta q(\theta)(f+\tau_e)] - \rho(f+\tau_e) - \lambda G(\varepsilon_d)\tau_e - \frac{\sigma\lambda}{\rho+\lambda}\int_{\varepsilon_d}^{\varepsilon_u}(\zeta-\varepsilon_d)\,dG(\zeta) \tag{A-19}$$

Using equations (A-18) and (A-19), differentiation with respect to θ, ε_d, f et τ_e yields:

$$-\frac{hq'(\theta)}{[q(\theta)]^2}d\theta = -\frac{(1-\gamma)\sigma}{\rho+\lambda}d\varepsilon_d - [d\tau_e + df], \tag{A-20}$$

$$\begin{aligned}\sigma d\varepsilon_d &= \frac{\partial\Psi}{\partial\varepsilon_d}d\varepsilon_d + \frac{\partial\Psi}{\partial\theta}d\theta + \frac{\gamma h}{1-\gamma}d\theta + \frac{\theta q(\theta)\gamma}{1-\gamma}(d\tau_e+df) + \frac{\gamma(f+\tau_e)}{1-\gamma}q(\theta)[1-\eta(\theta)]\,d\theta \\ &\quad -\rho(d\tau_e+df) - \lambda G(\varepsilon_d)\,d\tau_e - \lambda G'(\varepsilon_d)\tau_e d\varepsilon_d + \frac{\lambda\sigma[1-G(\varepsilon_d)]}{\rho+\lambda}d\varepsilon_d,\end{aligned} \tag{A-21}$$

where $\eta(\theta) \in [0;1]$ is the elasticity of the job-filling rate with respect to the labor market tightness. Assuming again a perfect substitution between the two EPL components, $d\tau_e = -df$, the Jacobian of the system reads:

$$J = \begin{pmatrix} -\frac{hq'(\theta)}{[q(\theta)]^2} & \frac{(1-\gamma)\sigma}{\rho+\lambda} \\ \left(\frac{\partial\Psi}{\partial\theta}+\frac{\gamma h}{1-\gamma}+\frac{\gamma(f+\tau_e)[1-\eta(\theta)]q(\theta)}{1-\gamma}\right) & -\frac{\sigma[\rho+\lambda G(\varepsilon_d)]+(\rho+\lambda)\left[\lambda G'(\varepsilon_d)\tau_e-\frac{\partial\Psi}{\partial\varepsilon_d}\right]}{\rho+\lambda} \end{pmatrix}$$

Remarking that $\frac{\gamma(f+\tau_e)[1-\eta(\theta)]q(\theta)}{1-\gamma} > 0$ since $\eta(\theta) \in [0;1]$ and noting that $q'(\theta) < 0$, $\frac{\partial\Psi}{\partial\theta} > 0$ and $\frac{\partial\Psi}{\partial\varepsilon_d} < 0$, it is straightforward to see that the sign of the determinant is negative, *i.e.* $\det|J| < 0$. Finally using Cramer's rule, one simply gets:

$$\left.\frac{d\theta}{d\tau_e}\right|_{d\tau_e=-df} = -\frac{1}{det\mathbf{J}}\frac{\lambda G(\varepsilon_d)(1-\gamma)\sigma}{\rho+\lambda} > 0$$

$$\left.\frac{d\varepsilon_d}{d\tau_e}\right|_{d\tau_e=-df} = -\frac{1}{det\mathbf{J}}\frac{hq'(\theta)\lambda G(\varepsilon_d)}{[q(\theta)]^2} < 0$$

Hence for a constant degree of EPL stringency, the reform yields the same qualitative results under a two-tier bargaining assumption or under a pure insider assumption. However since the determinant is higher under the pure insider hypothesis the quantitative results are likely to be smaller.

Appendix 6 - Laws of Motion

This appendix develops the dynamic law of motion for employment and worker flows. The labor market tightness, θ, and the reservation productivity, ε_d, are forward-looking variables that jump on the impact to their new steady-state equilibrium values as the environment changes. The unemployment rate, u, is a sticky variable that is driven by the co-movement in the two forward looking variables. Time is divided into discrete periods indexed by the subscript t where $t = 0, 1, ...$ represents a quarterly sequence. Let N_t, C_t, D_t and Y_t denote the employment at the beginning of period t, the job creation flows, the job destruction flows and the aggregate production at time t respectively. The aggregate law of motion for employment reads:

$$N_{t+1} = N_t + C_t - D_t. \tag{A-22}$$

We now turn to the equations describing the law of motion for employment for each idiosyncratic component of productivity ε. We assume that the aggregate conditions change at the beginning of the time period. It follows that once the macroeconomic environment is revealed, the only remaining source of job destruction is idiosyncratic. Let $n_t(\varepsilon)$ and $n_{t+1}(\varepsilon)$ represents the number of workers whose productivity on the job is ε in t and $t+1$ respectively. The number of workers whose productivity is ε at the beginning of period $t+1$ reads:

$$n_{t+1}(\varepsilon) = \begin{cases} (1-\lambda)n_t(\varepsilon) + \lambda G'(\varepsilon)\left[N_t - \int_{\varepsilon_l}^{\varepsilon_{d_{it}}} n_t(\zeta)d\zeta\right] & \text{if } \varepsilon_u > \varepsilon \geq \varepsilon_{d_{it}} \\ 0 & \text{if } \varepsilon < \varepsilon_{d_{it}} \end{cases} \tag{A-23}$$

where $\varepsilon_{d_{it}}$ is the reservation productivity contingent to the current aggregate state i and for the time period t. The dynamic law of motion for employment is given by the first line of equation (A-23) provided the idiosyncratic component is in the range $[\varepsilon_{d_{it}}, \varepsilon_u[$ and by the second term for all other values. The first term of (A-23) denotes the mass of jobs that has not been hit by an idiosyncratic productivity shock whereas the second term refers to the mass of surviving jobs with job-specific component equal to ε that has been hit by an idiosyncratic productivity shock.

The job creation flow in period t reads:

$$C_t = \theta_{it} q(\theta_{it})(1 - N_t) \tag{A-24}$$

where $\theta_{it} q(\theta_{it})$ is the job finding rate. Jobs are destroyed for one of two reasons. First, the aggregate conditions may worsen and cause productivity threshold to be shifted up. As a consequence, all jobs whose productivity is below the new cutoff value are destroyed. Second, the idiosyncratic productivity may change at Poisson rate λ and causes the job-specific component to fall below the existing cutoff value. The job destruction flow reads:

$$D_t = \int_{\varepsilon_l}^{\varepsilon_{d_{it}}} n_t(\zeta) d\zeta + \lambda G(\varepsilon_{d_{it}}) \left[N_t - \int_{\varepsilon_l}^{\varepsilon_{d_{it}}} n_t(\zeta) d\zeta \right]. \tag{A-25}$$

The laws of motion for unemployment, U_t, for new jobs, n_h, and for continuing jobs, n_c, read respectively:

$$U_t = 1 - N_t, \tag{A-26}$$

$$n_{h_{t+1}} = C_t + (1 - \lambda) n_{h_t} \tag{A-27}$$

$$n_{c_{t+1}} = n_{c_t} + \lambda \left[1 - G(\varepsilon_{d_{it}}) \right] n_{h_t} - D_t \tag{A-28}$$

Finally, the aggregate production, Y_t, is the sum of the productivity of new and continuing jobs:

$$Y_t = n_{h_t} (p_{it} + \sigma \varepsilon_u) + n_{c_t} \int_{\varepsilon_{d_{it}}}^{\varepsilon_u} (p_{it} + \sigma \zeta) dG(\zeta), \tag{A-29}$$

it follows:

$$Y_t = n_{h_t} \sigma \varepsilon_u + n_{c_t} \sigma \int_{\varepsilon_{dit}}^{\varepsilon_u} \zeta dG(\zeta) + N_t p_{it}. \tag{A-30}$$