Unemployment Compensation Finance and Aggregate Employment Fluctuations[1]

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Abstract:

Experience rating which is often treated as a simple adjustment cost is an original feature of the U.S. unemployment benefit system. This paper extensively addresses the effect of experience rating as an alternative to standard job protection on a prototypical European labor market. We provide a simple matching model of unemployment that handles both idiosyncratic and aggregate shocks. In such a framework, we show that experience rating tends to increase labor market performance. Indeed, moving toward an experience rated system tends to stabilize employment. Additionally, for reasonable parameter values average employment is increased over the cycle. Therefore, it may be worthwhile to shift standard job protection measures toward a more experience rated system.

Résumé:

La modulation des cotisations patronales à l'assurance chômage qui est souvent traitée comme un simple coût d'ajustement est une caractéristique originale du système d'assurance chômage américain. Ce papier a pour objet d'analyser les effets cette modulation comme une alternative aux mesures standards de protection de l'emploi sur un marché du travail d'Europe continentale. Dans ce optique, nous construisons un modèle simple d'appariement avec des chocs de productivités micro et macro économiques. Dans ce cadre d'analyse, nous montrons que la modulation des cotisations patronales à l'assurance chômage améliore les performances du marché du travail.

JEL Codes: J41, J65

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1 Introduction

Most Continental Europe countries encountered high and persistent unemployment rates during last decades. Concurrently, the United States labor market performed relatively well. This statement was widely addressed and much attention has been devoted to the analysis of the consequences of job protection on labor market performances. As a result, stringent labor market regulations have often been blamed as a source of the poor unemployment performance of many European countries. Alongside the increase in job protection, in recent years several European countries introduced measures to enhance labor market flexibility noticeably thanks to short term contracts. Consequently, many European countries are now characterized by the coexistence of strong job protection measures and a widespread use of short term contracts. The simultaneous use of these two policy instruments highlights the European paradox since the former instrument induces an increase in job destruction and a decrease in job creation whereas the latter has exactly the opposite effects. The effects of introducing short term contracts (what is also referred as temporary jobs or fixed duration contracts) received close scrutiny recently (Blanchard and Landier, 2000 and Cahuc and Postel-Vinay, 2002) and consequently this issue is avoided here. The potential virtue of short term and long term contracts being to foster job creation and to decrease job destruction respectively, nothing entitles to question the existence of a policy instrument allowing to simultaneously increase job creation and decrease job destruction. Our paper precisely tackles this issue. We focus on the capacity of the unemployment compensation system to achieve this objective thanks to the introduction of an experience rated system. Experience rating is unique to the United States unemployment system (Baicker, Goldin and Katz, 1997, Fougere and Margolis, 2001). It is a way to require employers to contribute to the payment of unemployment benefits they create through their firing decisions or alternatively it is a mean to make firms internalize the social cost (the benefits payed to the unemployed workers) they induce through a taxation proportional to their separations. Quite surprisingly such a system is absent from nearly all others OECD countries[4] where unemployment benefits are financed thanks to payroll taxes payed by the employers or the employees and by government contributions (Holmlund, 1998). Since the seminal paper from Feldstein (1976), the literature devoted to experience rating has considerably grown. Among these contributions very few have been devoted to the analysis of the effects of experience rating on employment fluctuations. Noticeable exceptions in this field are the contributions from Anderson (1993) and Card and Levine (1994) which estimate dynamic labor demand models on US data and underline the cyclical properties of experience rating.

Anderson (1993) estimates a dynamic labor demand model using a unique administrative data set on over 8000 firms to analyze the effects of experience rating on seasonal labor demand in retail trade industry. She finds strong support for experience rating to stabilize employment. An increase in the marginal

[4]An European exception is the italian CIGS (Cassa Integrazione Guadagni Straordinaria) which applies to large firms only.

tax cost (the cost to the firm of a new unemployed worker) from 0.4 (the average in her sample) to 1 tends to reduce seasonal employment variability by 14%. Card and Levine (1994) using data from the Current Population Survey (CPS) for 1979-1987 in conjunction with a tax rates database consider the effects of experience rating on both seasonal and cyclical employment fluctuations. They find strong evidence for experience rating to dampen employment fluctuations over business cycles. The marginal tax cost shows a cyclical pattern with the largest effects in slumps and the smallest effect in booms. The empirical studies covering the US labor market show that experience rating is a mean to increase labor market performances and particularly to decrease employment variability.

The generality of the conclusions drawn from these contributions are nevertheless subject to caution from an European perspective. First, the US labor market is specific to the extent it is always considered as being dramatically flexible. The effect of an experience rated system in conjunction with the stringent European Employment Legislation is likely to alter the previous conclusions and consequently to affect economic policy recommendations. Second, both papers consider temporary layoffs[5] which are scarce in most European labor markets. Third, the theoretical background provided consists in dynamic labor demand models where the stochastic structure is restricted to idiosyncratic shocks. Accordingly, these models are likely to be irrelevant to account for aggregate employment fluctuations where both hiring and firing are simultaneous.

The aim of this paper is to theoretically address the effect of experience rating as an alternative to standard job protection on a prototypical European labor market. In particular but not exclusively, our concern is about the effect of experience rating on aggregate employment fluctuations. For all the reasons underlined previously, a natural framework to answer the question at hand seems to be an equilibrium model of unemployment allowing for workers mobility across firms. On this purpose, we build an equilibrium search and matching model of unemployment in the fashion of Mortensen and Pissarides (1993, 1994) that handles both idiosyncratic and aggregate shocks, and embeds an experience rated scheme. In such a framework and for reasonable parameter values, we show that experience rating tends to stabilize employment and to increase average employment and production over the cycle. Experience rating is therefore a mean to increase labor market flexibility and to stabilize employment. The paper is organized as follow: Section 2 offers a conceptual framework to analyze the effect of experience rating on a prototypical European labor market, Section 3 studies quantitatively the effects of labor market policies through some static comparative exercises, Section 4 provides the dynamic results and finally Section 5 concludes.

[5] Most papers related to experience rating focus on temporary layoffs. Noticeable exceptions in the literature are Millard and Mortensen (1997), Albrecht and Vroman (1999), Wang and Williamson (2000) and Cahuc and Malherbet (2002).

2 The Model

The model builds on and extends the continuous time Mortensen and Pissarides (1993, 1994) models with endogenous job destruction and macroeconomic shocks. At first, we focus on the setting of the model then the macroeconomic background is described as well as the general resolution method.

2.1 The labor market

We study an economy with two goods: labor, which is the sole input and a numeraire good produced and consumed. The labor force is composed of a continuum of agents which size is normalized to unity. Each worker supplies one unit of labor and can be either employed and producing or unemployed and searching for a job. Individuals have identical preferences represented by a linear utility function. The mass of firms is endogenous. Each firm has only one job which is either filled and producing or vacant and searching.

Vacant jobs and unemployed workers are matched together through an imperfect matching process due to the existence of a transaction cost. The rate at which vacant jobs and unemployed workers meet is determined by a matching function which satisfies the standard properties: it is increasing, continuously differentiable, homogenous of degree one and yields no hiring if the mass of the unemployed workers or the mass of vacant jobs is nil. The model is meant to be embedded in an aggregate framework. Consequently, we let the aggregate conditions move stochastically between n states according to an arbitrary Markov process with persistence. Aggregated states are indexed by subscript i ($i = 1...n$) and are ranked in a decreasing order so that $i = 1$ represents the best aggregate condition. In each state, the instantaneous flow of new matches is given by the following matching function $M(v_i, u_i)$ where v_i and u_i represent the vacancy and the unemployment rates in the aggregate state i respectively. The linear homogeneity of the matching function allows us to write the transition rate for vacancies as $M(v_i, u_i)/v_i = M(1, u_i/v_i) = m(\theta_i)$, 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 $M(v_i, u_i)/u_i = \theta_i m(\theta_i)$. The properties of the matching function imply that $m(\theta_i)$ and $\theta_i m(\theta_i)$ are decreasing and increasing functions of the labor market tightness respectively.

Productive activity is the purpose of job-worker matches. For a given aggregate state i, each job is endowed with an irreversible technology requiring one unit of labor to produce $p_i + \sigma\varepsilon$ units of output where p_i is an aggregate productivity parameter common to all jobs, σ is an indicator of the dispersion in the idiosyncratic component, and ε is a job specific productivity parameter. 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 an idiosyncratic shock, a new value of job specific productivity is drawn from a general distribution function $F(\varepsilon)$ with support in the range $[\varepsilon_l, \varepsilon_u]$. The aggregate component of productivity p_i changes according to the Markov process described above. For the sake of simplicity, we assume that entrant firms choose the best productivity available in the market and therefore create jobs at the upper support $p_i + \sigma\varepsilon_u$.

For a given aggregate state i and in case of a match specific shock, if the new value of ε is below the current endogenous threshold denoted by ε_{di}, the job is no longer profitable and therefore destroyed. Thus, the job destruction rate for the aggregate state i follows a Poisson process with parameter $\lambda F(\varepsilon_{di})$. Assuming there is no *on the job search* the law of motion of unemployment on the labor market for the aggregate state i is given by:

$$\dot{u_i} = \lambda F(\varepsilon_{di})(1 - u_i) - \theta_i m(\theta_i)u_i \tag{1}$$

If the aggregate shock takes on the same value repeatedly, the economy converges to a state in which unemployment is constant. Assuming a long sequence of realizations of aggregate shock i, one gets a Beveridge curve which equation is given by:

$$u_i = \frac{\lambda F(\varepsilon_{di})}{\lambda F(\varepsilon_{di}) + \theta_i m(\theta_i)} \tag{2}$$

Following Cole and Rogerson (1999), one denotes u_i as the conditional steady states unemployment rate the economy will converge to if the aggregate shock remains unchanged for many periods. This curve shows that the unemployment rate depends on the rates of job destruction as well as on the labor market tightness.

2.2 Values of jobs and expected utilities

A vacant job costs h per unit of time and is filled at rate $m(\theta_i)$. Let r and t_{ij} denote the exogenous interest rate and the transition probability from aggregate state i to aggregate state j respectively. The asset value of a vacancy for the firm in the aggregate state i, Π_{vi}, satisfies:

$$r\Pi_{vi} = -h + m(\theta_i)\left[\Pi_{0i}(\varepsilon_u) - \Pi_{vi}\right] + \sum_{i \neq j}^{n} t_{ij}\left[\Pi_{vj} - \Pi_{vi}\right] \text{ with } i, j = 1...n \tag{3}$$

where $\Pi_{0i}(\varepsilon_u)$ is the expected value of a newly created job in state i and embedding the best technology available. Wages are bargained over while setting up a new contract and each time a shock hits the match. Job protection introduces a sharp distinction between newly created jobs and the continuing ones. At the very beginning of a new match *i.e.* while the *negotiation,* firms do not support any monetary firing restriction since no contract has been signed up. However, once a contract is signed firms support adjustment costs in case the value of the job falls below the state contingent reservation productivity ε_{di}.

The asset value of a newly appointed job in the aggregate state i reads as:

$$\begin{aligned} r\Pi_{0i}(\varepsilon_u) &= p_i + \sigma\varepsilon_u - w_{0i} - \tau_i \\ &\quad + \lambda\left[\int_{\varepsilon_l}^{\varepsilon_u} Max\left[\Pi_{ei}(\xi), \Pi_{vi} - \tau_{ei} - f\right] dF(\xi) - \Pi_{0i}(\varepsilon_u)\right] \\ &\quad + \sum_{i\neq j}^{n} t_{ij}\left[\Pi_{0j}(\varepsilon_u) - \Pi_{0i}(\varepsilon_u)\right] \end{aligned} \tag{4}$$

where w_{0i} is the wage bargained at the beginning of the match, τ_i is a lump sum tax on productive activities, $\Pi_{ei}(\varepsilon)$ is the expected value of a continuing job and $\tau_{ei} + f$ stands for the separation costs. One needs here to remark that in such a framework, job protection has two components. A fiscal component τ_{ei} linked to the government budget constraint and the firing costs, f, which are an unified measure of standard job protection.

The asset value of a continuing job satisfies in aggregate state i:

$$\begin{aligned} r\Pi_{ei}(\varepsilon) &= p_i + \sigma\varepsilon - w_i(\varepsilon) - \tau_i \\ &\quad + \lambda\left[\int_{\varepsilon_l}^{\varepsilon_u} Max\left[\Pi_{ei}(\xi), \Pi_{vi} - \tau_{ei} - f\right] dF(\xi) - \Pi_{ei}(\varepsilon)\right] \\ &\quad + \sum_{i\neq j}^{n} t_{ij}\left[Max\left[\Pi_{ej}(\varepsilon), \Pi_{vj} - \tau_{ej} - f\right] - \Pi_{ei}(\varepsilon)\right]. \end{aligned} \tag{5}$$

where $w_i(\varepsilon)$ is the outcome of the wage bargaining for the current idiosyncratic level of productivity ε. One needs here to note that a shift in the aggregate condition may lead to a job termination. As a matter of fact, even though the aggregate shock does not affect the idiosyncratic component of the productivity, it induces a shift in the endogenous threshold that may, in turn, lead to end up a match since ε is spread in the range $[\varepsilon_l, \varepsilon_u]$[6].

The expected value, V_{ui}, of the discounted stream of income of an unemployed worker in the aggregate state i satisfies:

$$rV_{ui} = b_i + \theta_i m(\theta_i)\left[V_{0i}(\varepsilon_u) - V_{ui}\right] + \sum_{i\neq j}^{n} t_{ij}\left[V_{uj} - V_{ui}\right] \tag{6}$$

where b_i are the unemployment benefits and $V_{0i}(\varepsilon_u)$ is the expected value of the stream of income of a newly hired worker. The instantaneous revenue of an unemployed worker is worth b_i. Two kinds of transitions may happen and change her situation on the labor market. First, she is likely to move into employment with probability $\theta_i m(\theta_i)$. Second, she expects the macroeconomic environment to switch from state i to state j with probability t_{ij}.

As above, one needs here to make a sharp distinction between the expected utility stream of a newly hired worker and the expected utility of a titular worker due to the transfers associated with the separation costs. Accordingly,

[6] Appendix (1) explains in detail the mecanisms driving the sources of job destruction.

the expected present utility, $V_{0i}(\varepsilon_u)$, of the stream of income of a newly hired worker is given by the following equation:

$$rV_{0i}(\varepsilon_u) = w_{0i} + \lambda \left[\int_{\varepsilon_l}^{\varepsilon_u} Max\left[V_{ei}(\xi), V_{ui}\right] dF(\xi) - V_{0i}(\varepsilon_u) \right] + \sum_{i \neq j}^{n} t_{ij} \left[V_{0j}(\varepsilon_u) - V_{0i}(\varepsilon_u)\right] \tag{7}$$

where V_{ei} is the expected utility stream of a titular worker. The newly hired worker gets an instantaneous income w_{0i} and expects the microeconomic and the macroeconomic conditions to change with probability λ and t_{ij} respectively. At the very beginning of a match, a shift in the aggregate component of the productivity can not cause a job destruction due to the fact that the match is created at the upper bound of the idiosyncratic productivity.

Finally, the expected utility stream of a titular worker, V_{ei}, reads as:

$$rV_{ei}(\varepsilon) = w_i(\varepsilon) + \lambda \left[\int_{\varepsilon_l}^{\varepsilon_u} Max\left[V_{ei}(\xi), V_{ui}\right] dF(\xi) - V_{ei}(\varepsilon) \right] + \sum_{i \neq j}^{n} t_{ij} \left[Max[V_{ej}(\varepsilon), V_{uj}] - V_{ei}(\varepsilon)\right]. \tag{8}$$

As previously, two kinds of shocks may happen and change the titular worker's situation on the labor market. First, the aggregate productivity may change with probability t_{ij} and second, the idiosyncratic productivity may change with probability λ. Both sources of disturbance may, in this case, induce a job termination.

2.3 Job destruction and job creation conditions

Wages are negotiated according to a Nash sharing rule which provides a share $\beta \in [0, 1]$ of the surplus generated by a match to the worker. This latter parameter β can be interpreted as the bargaining power of workers. In order to derive the job creation and job destruction conditions necessary to solve the model, it is convenient to define the surplus associated to a worker-firm pair. Every match yields a surplus which is equal to the sum of the expected value of the workers' and the employers' future income on the job minus the expected present value of their income in case of separation. Thus, the equations we derived above to define the expected profits and the expected utilities of a job allow us to strictly write the surplus contingent to the aggregate state i. One needs here to distinguish for the surplus of a new match, $S_{0i}(\varepsilon_u)$, and the surplus of a continuing match, $S_i(\varepsilon)$. At the very beginning of the match, an employer-worker pair does not support any separation costs since no contract has been signed up. Hence, an employer who accepts to be matched with a worker gets $\Pi_{0i}(\varepsilon_u)$ and obtains the asset value of a vacant job, Π_{vi} otherwise. Similarly, a matched worker gets an expected utility $V_{0i}(\varepsilon_u)$ or remains unemployed and therefore gets V_{ui}. Accordingly, the surplus value of a new match contingent to the aggregate state i is:

$$S_{0i}(\varepsilon_u) = \Pi_{0i}(\varepsilon_u) - \Pi_{vi} + V_{0i}(\varepsilon_u) - V_{ui}. \tag{9}$$

Obviously, once a contract is signed things turn out to be slightly different. As a matter of fact, in case of a split, the firm has to support the separation costs $\tau_{ei} + f$. On every continuing job with current productivity ε , an employer gets either $\Pi_{ei}(\varepsilon)$ or $\Pi_{vi} - \tau_{ei} - f$ in case of separation. Beside the change in the idiosyncratic productivity ε, the threat point for a worker remains identical. Thus, the surplus for a continuing job contingent to the aggregate state i is:

$$S_i(\varepsilon) = \Pi_{ei}(\varepsilon) - \Pi_{vi} + \tau_{ei} + f + V_{ei}(\varepsilon) - V_{ui}. \tag{10}$$

The first order conditions derived from the Nash programs satisfy, for the wage negotiation and for the wage renegotiations respectively, the following sharing rules:

$$\Pi_{0i}(\varepsilon_u) - \Pi_{vi} = (1-\beta)S_{0i}(\varepsilon_u),\ V_{0i}(\varepsilon_u) - V_{ui} = \beta S_{oi}(\varepsilon_u) \tag{11}$$

$$\Pi_{ei}(\varepsilon) - (\Pi_{vi} + \tau_{ei}) = (1-\beta)S_i(\varepsilon),\ V_{ei}(\varepsilon) - V_{ui} = \beta S_i(\varepsilon). \tag{12}$$

It is worth noting that the value of the surplus is independent of the wage since it does not hinge on the sharing rule. Therefore, wage equations are not required to define equilibrium. Equations (9) and (10) need to be expanded[7] to get the detailed expression of the surplus associated with a new match and with a continuing one.

To derive the job destruction conditions, one needs to use the surplus of a continuing job. This surplus satisfies the following asset pricing equation:

$$\begin{aligned}(r + \lambda + \sum_{i\neq j}^{n} t_{ij})S_i(\varepsilon) = {} & p_i + \sigma\varepsilon - \tau_i - b_i - \frac{\theta_i \beta h}{(1-\beta)} + r(\tau_{ei} + f) + \lambda E(S_i) \\ & + \sum_{i\neq j}^{n} t_{ij}(\tau_{ei} + f - \tau_{ej} - f) \\ & + \sum_{i\neq j}^{n} t_{ij}\left[Max\left[S_j(\varepsilon), 0\right]\right],\end{aligned} \tag{13}$$

where $E(S_i)$ stands for the expected value of the surplus in the aggregate state i. When the contracts are renegotiated, the firm and the worker decide to split up as soon as the surplus becomes nil. The formal condition writes $S_i(\varepsilon_{di}) = 0$. Using this latter condition together with the surplus equation (13), one finally

[7] The formal derivations of the surplus associated to a new match and to a continuing match are derived in appendix (2).

gets the reservation productivity contingent to aggregate state i:

$$p_i + \sigma\varepsilon_{di} = b_i + \frac{\theta_i \beta h}{(1-\beta)} + \tau_i - r(\tau_{ei} + f) - \lambda E(S_i) \\ - \sum_{i \neq j}^{n} t_{ij}(\tau_{ei} - \tau_{ej}) - \sum_{i \neq j}^{n} t_{ij} \left[Max \left[S_j(\varepsilon_{di}), 0 \right] \right] \tag{14}$$

One can remark that the right-hand side of the equation shows that the reservation productivity depends of the opportunity cost of employment, $b_i + \theta_i \beta h/(1-\beta) + \tau_i$, which is the sum of the unemployment benefits, the expected value of search and the lump sum tax. One also needs to take into account the different sources of labor hoarding. Labor hoarding can be either institutional or voluntary and be put into effect at the microeconomic or the macroeconomic level. At the microeconomic level *i.e.* for a given aggregate state i, there are two sources of labor hoarding. First, the institutional one refers to the capitalized value of the separation costs $r(\tau_{ei} + f)$. These costs induce firms to lower the reservation productivity and therefore to destroy less jobs. Second, the voluntary one refers to the option value $\lambda E(S_i)$ of retaining an existing match or in others words the labor hoarding due to the expected change in the idiosyncratic productivity ε. Obviously, these two sources of labor hoarding are common to standard matching models that handle job protection. More interestingly, two additional sources of labor hoarding appear in our framework which we will refer to as macroeconomic. First, as the overall job protection is contingent to the macroeconomic environment, an aggregate productivity shock induces the level of the institutional separation costs to be shifted. More accurately, an expected increase in the separation costs leads firms to terminate more jobs in the current state to avoid higher termination costs later on. Second, the aggregate productivity shock also creates, for a given idiosyncratic productivity, a voluntary labor hoarding due to the shift in the surplus. Indeed, a positive aggregate shock shifts down the productivity threshold and therefore unveils a new range of productive matches.

To derive the job creation condition, it is convenient to write the surplus associated with a new match. According to appendix (2) this surplus satisfies:

$$(r + \lambda + \sum_{i \neq j}^{n} t_{ij}) S_{0i}(\varepsilon_u) = p_i + \sigma\varepsilon_u - \tau_i - b_i - \frac{\theta_i \beta h}{(1-\beta)} - \lambda(\tau_{ei} + f) + \lambda E(S_i) \\ + \sum_{i \neq j}^{n} t_{ij} S_{0j}(\varepsilon_u). \tag{15}$$

The job creation equation obtains from the free-entry condition $\Pi_{vi} = 0$, which implies, together with the asset value of a vacant job (4), that $h/m(\theta_i) = \Pi_{0i}(\varepsilon_u)$. Using the sharing rule (9), one finally gets the job creation condition as a function of the surplus of the new job:

$$\frac{h}{m(\theta_i)} = (1-\beta) S_{oi}(\varepsilon_u). \tag{16}$$

Finally, replacing (15) in this latter expression, one obtains the job creation condition:

$$
\begin{aligned}
(r+\lambda)\frac{h}{m(\theta_i)} &= (1-\beta)(p_i+\sigma\varepsilon_u-\tau_i-b_i-\frac{\theta_i\beta h}{(1-\beta)}) \\
&- (1-\beta)\lambda(\tau_{ei}+f)+(1-\beta)\lambda E(S_i) \\
&+ \sum_{i\neq j}^{n} t_{ij}\left[\frac{h}{m(\theta_j)}-\frac{h}{m(\theta_i)}\right]. \qquad (17)
\end{aligned}
$$

This equation indicates that the expected cost of a vacant job must equalize the expected profit on a new job. The left-hand side represents the expected capitalized value of the firm's hiring cost in the current state. Obviously, this cost increases with the labor market tightness θ_i because the higher the market tightness, the longer the time to fill a vacancy. The right-hand side of the equation stands for the expected profit of a vacant job. Expected profits are decreasing with the current labor market tightness, because a greater labor market tightness increases the exit rate from unemployment and accordingly the utility of an unemployed worker, which in turn, decreases the profit on any jobs. This expected profit can be divided in four terms. The first one refers to the net instantaneous profit of the firm. The second one is the expected loss to the firm due to a renegotiation of the labor contract. The third one represents the expected gains associated with an improvement in the match specific productivity. Finally, the last term reflects the expected changes in the hiring cost to the firm.

The job destruction (14) and job creation (17) are two key equations of the model. To solve the model for all unknowns, one needs now to take into account the balanced budget rule for the unemployment compensation system.

2.4 Labor market policy and balanced budget rule

To completely solve the model, one needs to establish a connection between the 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 set exogenous whereas the taxes collected to finance the unemployment insurance expenditures are endogenous. Unemployment benefits are financed thanks to two instruments: a lump sum tax τ_i paid on each filled job and a tax paid each time a job is destroyed, denoted by τ_{ei}. This second tax is introduced in order to take into account the effect of experience rating. Experience rating is said to be complete or perfect when $\tau_i = 0$ *i.e.* when the firm support 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_{ei} is worth zero. For all remaining cases, experience rating is incomplete. It is worth noting that incomplete experience rating is an original feature of the United States and is absent from most others OECD countries[8] where unemployment benefits are financed by taxes on payrolls paid by employers and employees or government contributions (Holmlund, 1998). The balanced budget rule reads as:

$$(1-u_i)\tau_i + (1-u_i)\lambda F(\varepsilon_{di})\tau_{ei} = u_i b_i \tag{18}$$

where $u_i b_i$ stands for the expenditures of the unemployment compensation system and the left-hand side represents the resources of the unemployment benefits system. These resources correspond to the sum of the payroll tax $(1-u_i)\tau_i$ – the mutualised part of unemployment benefits– and the revenue of experience rating $(1-u_i)\lambda F(\varepsilon_{di})\tau_{ei}$. This last term depends on the job destruction rate. Obviously, the greater the lay-offs, the higher the firms contributions to the financing system. Thus, one obtains from equation (18) the endogenous lump sum tax τ_i as a function of the firing tax τ_{ei}:

$$\tau_i = \frac{u_i}{1-u_i} b_i - \lambda F(\varepsilon_{di})\tau_{ei}. \tag{19}$$

One can remark that the lump sum tax is a decreasing function of the firing tax. Experience rating is a mean to make firms contribute to the social cost they induce by firing workers. As a matter of fact, an increase in the degree of experience rating tends to make firms support a greater part of the social cost they induce. As a corollary, the mutualised part of unemployment benefits will be reduced as well as the lump sum tax. The social cost of an unemployed worker satisfies the following asset value equation:

$$rC_i = b_i + \theta_i m(\theta_i)\left[0 - C_i\right] + \sum_{i\neq j}^{n} t_{ij}\left[C_j - C_i\right], \tag{20}$$

where C_i is the expected social cost. An unemployed worker gets an instantaneous income b_i and returns to employment with a transition rate $\theta_i m(\theta_i)$, in this case the social cost becomes nil. Moreover, this cost is likely to change with the shift in the aggregate condition. For the sake of simplicity, we assume that the level of the unemployment benefits is indexed on the macroeconomic environment. More accurately, the benefits received are contingent to the current aggregate state and then, are fixed independently of the initial state the worker was fired. Denoting by e the degree of experience rating, the lay-off social cost supported by the firm amounts to $\tau_{ei} = eC_i$ for $i = 1...n$. Substituting, this expression in (20), one finally obtains the following simple firing tax formula:

$$\tau_{ei} = \frac{eb_i + \sum_{i\neq j}^{n} t_{ij}\tau_{ej}}{r + \theta_i m(\theta_i) + \sum_{i\neq j}^{n} t_{ij}} \tag{21}$$

It is worth noting that the experience rated tax is a decreasing function of the labor market tightness. Indeed, one knows that the exit rate from unemployment is an increasing function of the labor market tightness. Therefore, a

[8] In this sense, most OECD countries are perfectly unexperience rated.

higher labor market tightness tends to lower the unemployment rate which in turn, lower the budget needed to finance unemployment benefits.

One can now solve the model for all the unknowns in the steady states. The unemployment rate (2), the job destruction (14), the job creation (17), the lump sum tax (19) and the experience rated tax (21) define a set of five equations that determines the equilibrium key values of θ_i, ε_{di}, τ_i, τ_{ei} and u_i for $i = 1...n$, the others endogenous variables being easily deduced from those values. Hence, the model exhibits $5n$ non linear equations in (θ_i, ε_{di}, τ_i, τ_{ei}, u_i) which need to be jointly solved to determine the n steady states equilibria of the model. The analysis of the model highlights some persistent ambiguities[9]. Accordingly, to evaluate the comparative effects of firing costs and experience rating in our framework, one needs to proceed to some quantitative exercises allowing us to get rid of those ambiguities.

3 Job protection: an economic policy overview

The high non linearity of the model do not allow for analytical results. Therefore, in order to analyze the impact of economic policies, it is necessary to perform numerical exercises meant to rise the theoretical ambiguities the model exhibits. The calibration parameters characterize a representative European labor market namely the french labor market on a quarterly basis and with a strong empirical background. This calibration will be referred as the benchmark case afterwards. In line with 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. This latter parameter is set at $\alpha = 0.5$ which is in the range of the estimates obtained by Blanchard and Diamond (1989) and Pétrongolo and Pissarides (2001). For lack of better information, equal bargaining power is assumed by setting $\beta = 0.5$. The equality $\alpha = \beta$ implies that the Hosios condition holds (Hosios, 1990). The interest rate is set to 1% per quarter. The distribution of idiosyncratic shocks is assumed to be uniform on 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 t_{ij} for i, $j = 1, 2, 3$ are ranked in a 3x3 matrix. This chain is chosen to approximate an AR(1) process similar to $y_t = \rho y_{t-1} + \upsilon_t$ where ρ and υ are 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 $\rho = 0.94$ and $\upsilon = 0.007$. The vector of aggregate productivity components (p_1, p_2, p_3) is set to match the mean and

[9] The model may also exhibit some multiple equilibria. As documented by Rocheteau (1999), the existence of multiple equilibria is a generic property of matching models with balanced budget rules. Accordingly, we cannot rule out the occurence of multiple equilibria. However, we argue this not a problem here since the government is able (through fiscal instruments) to choose the low unemployment equilibrium and therefore to avoid any pathological equilibria.

Variables	Notation	Value
Matching elasticity	α	0.5
Bargaining power	β	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	ρ	0.94
Standard error	υ	0.007
Interest rate	r	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 variance of the underlying AR process. Assuming it is impossible to jump from an extreme state to another, the state to state transition matrix is given by:

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

The ergodic probabilities associated with this transition matrix yields $(p_1, p_2, p_3) = (0.0355, 0, -0.0355)$, where the subscripts $1, 2$ and 3 stand for the high, median and 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 Den Haan, Ramey and Watson (2000) and Gomes, Greenwood and Rebelo (2001). The key feature being that the contribution of the idiosyncratic productivity in total productivity variation is much more important than the contribution of the aggregate productivity (Davis and Haltiwanger, 1999). The amount of the firing restrictions f is set so as to represent 50% of the yearly average wage in the steady state. This level of firing costs is consistent with the findings of french empirical studies provided by Goux and Maurin (2000) and Kramarz and Michaud (2002). 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. The arrival rate of the job specific shock λ is calibrated in order to mimic employment flows as documented by Duhautois (1999). The level of the unemployment benefits is worth 60% of the average long term wage. This is in the range of the OECD estimates. Finally and for the base case, the experience rating index e is set to be nil. Parameter values used in the computations are reported in Table 1.

The results of this section rely on some comparative static exercises. In the

	Benchmark	Increase in firing costs ($\Delta f = 0.2$)	Increase in firing tax ($\Delta\tau_e = 0.2$)
ε_d	0.7630 (0.0701)	0.7185 (0.1146)	0.7133 (0.1197)
θ	0.2720 (0.5591)	0.2441 (0.5870)	0.2746 (0.5565)
u	10.48% (0.0367)	10.42% (0.0361)	9.82% (0.0301)
budget size	5.88% (0.0588)	5.89% (0.0589)	5.53% (0.0553)
Y	0.3059 (0.0074)	0.3035 (0.0098)	0.3046 (0.0087)

Table 2: Increase in job protection, various indicators. The buget size denotes the ratio between the budget and the production level. The values in brackets represent the distance to the First Best.

first place, we consider an economy without any aggregate disturbance so that to capture the elementary effects of experience rating relative to firing costs. In the second place, the previous constraint is slackened in order to integer aggregate productivity shocks into the analysis. In both case, the results the model highlights for some well defined criteria –the unemployment rate, the budget size and the production– speak in favor of experience rating.

3.1 Benchmark model

The benchmark model is meant to capture the elementary effects of experience rating. On this purpose, two numerical exercises are performed. First, we investigate the effect of an increase in job protection due to the introduction of a firing tax and we compare its outcome with an equivalent increase in firing costs. Second, we study the impact of a substitution between experience rating and firing costs assuming a constant degree of job protection. These exercises do not take into account the macroeconomic variability, the economy being stuck in the median state of aggregate productivity p_2. More accurately, we assume the transition probability t_{ij} for $i \neq j$ to be nil.

The first numerical exercise considers an *ex-ante* increase in the degree of job protection that is worth 0.2. In accordance with our framework, this goal can be achieved thanks to two independent policy instruments namely firing costs and experience rating. The *ex-ante* degree of experience rating is set in order to match the increase in firing costs i.e. $\Delta f = \Delta\tau_e = 0.2$ and yields $e = 62,24\%$. 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 as realistic. The summary results are reported in Table 2 for the reservation productivity, the labor market tightness, the unemployment rate, the budget size and the output level. The first column refers to the benchmark case – the economy at the median state – and the next two highlight the effects of both measures on the key variables.

The effects of firing costs in standard matching model are well documented (see Millard and Mortensen, 1997, Mortensen and Pissarides,1999a, b or Cahuc and Zylberberg, 1999 for details). An increase in the firing costs tends to lower

	Benchmark	Subst. firing costs / firing tax
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% (0.0553)
Y	0.3059 (0.0074)	0.3069 (0.0087)

Table 3: Introduction of a firing tax (experience rating) and substitution with firing costs. The values in brackets represent the distance to the First Best.

the reservation productivity and therefore the job destruction but it also decreases the labor market tightness and consequently the job creation. Accordingly, the effect of firing costs on unemployment is ambiguous. For the exercise at purpose, the overall impact of firing costs on unemployment appears to be negative. Therefore, the budget size is reduced. The introduction of a firing tax as a mean to enhance job protection reduces the mutualised part of the unemployment benefits. One knows from equation (19), that the payroll tax is negatively correlated with the firing tax, thus an increase in the degree of experience rating induces a decrease in the lump sum tax. This tax cut reduces the labor cost and consequently increases the profitability on any jobs. This fiscal effect allows to unveil a new range of productive matches that would have been destroyed in case of an adverse specific shock otherwise. Thus, experience rating induces a greater decrease in the reservation productivity than standard job protection which in turn, reinforces the labor hoarding phenomenon. At the very same time, job creation increases due to the profit improvement allowed by the lump sum tax cut. Both effects lead to a fall in the unemployment rate. Table 2 summarizes these results.

The second numerical exercise focuses on the effects of a perfect substitution between firing costs and experience rating. To make things clear, we consider a substitution level that yields the same *ex-post* degree of job protection. The benchmark case satisfies the triplet ($\tau_e = 0$, $f = 0.572$, $e = 0$) for an overall *ex-post* degree of job protection that is worth $\tau_e + f = 0.572$. Next, we consider the effect of a substitution between firing costs and experience rating that satisfies the triplet ($\tau_e = 0.2$, $f = 0.372$, $e = 0.6540$) for the same *ex-post* degree of job protection. The results are reported in Table 3.

As previously, it is worth noting that a substitution between firing costs and a tax devolved to finance unemployment benefits reduces the job destruction rate and increases the job creation rate. Thus, the lump sum tax cut is the crucial element inducing the rise in job creation and the decrease in job destruction. The indirect effect of experience rating through the decrease in the lump sum tax leads to a fall in the unemployment rate as well as in the budget size. Moreover, the production level is enhanced.

Our findings speak unambiguously in favor of experience rating and corroborate the analysis from Cahuc and Malherbet (2002). Introducing experience rating in such a labor market increases the economic efficiency. Therefore, the

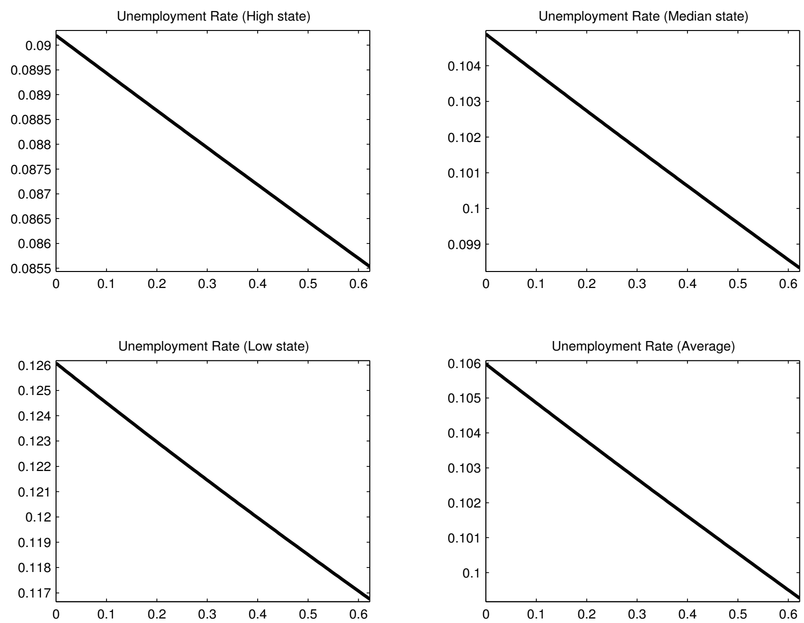

Figure 1: Average and conditional unemployment rates as a function of the experience rating index.

assertion according to which experience rating is similar to standard job protection is, in all likelihood, far from being right. To enlarge these first step conclusions, we now turn to a more general framework allowing for aggregate disturbance.

3.2 Job protection and aggregate disturbances

A more general framework is now considered that takes into account the productivity shocks at the macroeconomic level. Analogously to the former analysis, two numerical exercises are released. On one hand, an enhancement in job protection due to an increase in either firing costs or in the experience rating index is analyzed. On the other hand, the substitution between both policies is studied. Thus, the exercises performed remain basically the same with the exception of the macroeconomic structure.

First, departing from the median state, we compare the effects of an increase in job protection. Accordingly, firing costs are increased by 0.2 or experience rating is introduced so as to match the increase in firing costs. Accordingly, the *ex-ante* level of experience rating in the median state is worth $e = 62.08\%$. Figures (1) and (2) plot the conditional steady state unemployment rate for each aggregate state and the average unemployment rate across states as a function of the experience rating index and of the firing costs.

At first glance, it is striking that experience rating decreases unemployment

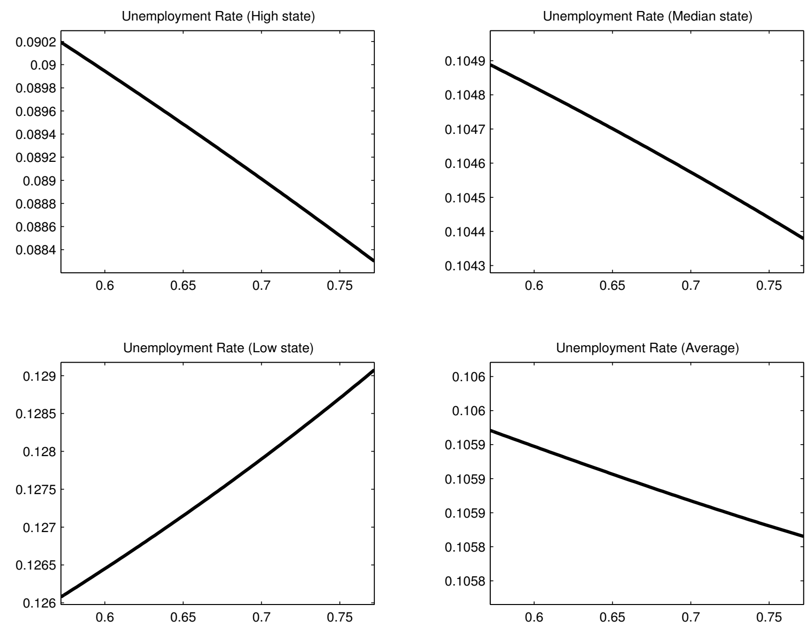

Figure 2: Average and conditional unemployment rates as a function of the firing costs.

for all aggregate states. Experience rating has two effects on job creation and job destruction. The first one, we will refer to as standard job protection effect, tends to reduce both job creation and job destruction. The second one, we will refer to as fiscal effect, tends to reduce job destruction and to increase job creation, the effects being similar to the one described above. The overall effect is positive on the unemployment rate. As a matter of fact, in our framework, the fiscal effect rules out the strong decrease in job creation induced by the standard job protection effect. Thus, the unemployment rate unambiguously falls with this measure of job protection. One can remark that introducing an experience rated firing tax leads to an endogenous state dependent job protection. According to equation (21), experience rating is a decreasing function of the labor market tightness. Consequently, the firing tax will be greater the lower the aggregate state[10]. The endogenous state dependent job protection consequences are threefold. First, the standard job protection effect will be greater the lower the aggregate state. Second, there is therefore an incitation to shift the destruction decisions in higher aggregate states. Accordingly, the labor hoarding or destruction effect will be greater the lower the aggregate state. Third, the decrease in the lump sum tax and therefore the fiscal effect is greater the lower

[10]In our numerical exercise and with an experience rating index that is worth 0.6208, the firing tax amounts to 0.1774 in the high state, to 0.2 in the median state and to 0.2341 in the low state.

the aggregate state. As a consequence, the overall fall in the destruction will be greater the lower the aggregate state[11]. As regards the job creation effect, an increase in the degree of experience rating has two effects. First, a standard job protection effect that tends to decrease the job creation. Second, a fiscal effect, that tends to improve the profits associated with any matches. For the exercises at purpose, the second effect rules out the first one for all states and consequently the job creation rate is increased. Finally, taking into account the effects of experience rating on both job destruction and job creation, the unemployment rate decrease in all states, this decrease being sharper the lower the aggregate state (Figure (1)). The effect of experience rating is asymmetrical across the aggregate states. Meanwhile, the labor hoarding and the fiscal effects always rule out the contraction in job creation induced by the standard job creation effect. This conclusion is at odd with the impact of standard job protection measures. In this case, there is no enhancement of job protection through a fiscal effect. The decrease in the job destruction is not always strong enough to make up for the decrease in job creation, a point documented by L'Haridon and Malherbet (2001). Accordingly, the impact of an increase in firing costs across aggregate state is not monotonic (Figure (2)). Not surprisingly, firing costs are therefore less efficient than experience rating. Appendix (3) enhances this conclusion for various comparative static exercises analyzing both policies for a set of well defined criteria.

The second exercise swoops down upon a perfect substitution between standard job protection and experience rating. The principles governing this exercise are similar to the ones we used previously. Roughly speaking, one aims at getting the same *ex-post* degree of job protection using either firing costs or experience rating. This exercise satisfies the triplet ($\tau_e = 0.2$, $f = 0.372$, $e = 0.6530$) at the median state. Results are reported in Table (4) for the unemployment rate, the production and the budget size in each aggregate state.

The labor market tightness being greater the higher the aggregate state, job creation, the unemployment spell and the firing tax are greater, shorter and lower respectively the higher the aggregate condition. Therefore, the perfect substitution between both policy instruments in the median state leads to a decrease of job protection in high states and to an increase in bad states. The destruction decisions tend to be shifted to the high and median states which experience a relatively low degree of job protection. In the recessionary state, the institutional labor hoarding is therefore important and its effect is enhanced by a joint decrease in the lump sum payroll tax. At the very same time, this fiscal effect induces an increase in the job creation rate. Consequently, substitution

[11] For the sake of simplicity, we exclude from the main text the voluntary labor hoarding analysis. Job protection tends to decrease the productivity threshold in all states. As we have seen, this decrease is greater the lower the aggregate state, inducing an asymetrical reaction of the idiosyncratic expected surplus. Since this reaction is proportional to the number of jobs protected at the margin, this expected surplus will be greater the lower the aggregate condition. This idiosyncratic voluntary labor hoarding effect reinforces the fiscal effect of experience rating. We know that the aggregate voluntary labor hoarding is greater the lower the aggregate state. However, the great decrease in the reservation productivity in the bad state leads to a negative shift in the aggregate voluntary labor hoarding.

		Benchmark model	Subst. firing costs firing tax	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 size	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 4: Introduction of a firing tax (expereince rating) and substitution with firing costs

between standard job protection and experience rating increases employment, production and reduces the budget size in all states. One has here to note that the effects of experience rating are greater the lower the aggregate state.

Obviously, experience rating has strong effects on the economic efficiency and differs from standard job protection measures. Implementing such measure in a macroeconomic framework leads us to argue that experience rating is likely to increase labor market performance and has strong asymmetrical effects across states, the degree of job protection being countercyclical.

4 Job protection and aggregate employment fluctuations

The analysis of the dynamic laws of motion for employment and workers flows implied by the model is described in appendix (4). Using these laws of motion, we build time series for job creation, job destruction, unemployment and production then the main statistics are calculated – means, variances and correlation coefficients. As previously, the same type of exercises are performed. First , the impact of job protection due to an increase in experience rating is studied. Second, the effects of a substitution between both instruments is analyzed. Table 5 summarizes our results.

According to the results of table 5, the means of job creation and job destruction obviously decrease in any cases. Theses effects are amplified by experience rating due to the fiscal effect. One should note that experience rating tends to strongly reduce the variances of job creation and job destruction, and therefore stabilizes the labor market flows. The outcomes obtained for the unemployment rate in the previous section remain valid in this more general framework. A key result concerns the link between employment variability and experience rating. An increase in the degree of experience rating or a substitution between firing

	Benchmark	Increase in firing tax	Subst. firing costs / firing tax
Mean(JC)	5.4861	5.1594	5.4686
Mean(JD)	5.4865	5.1591	5.4704
Std.dev.(JC)	0.23	0.19	0.18
Std.dev.(JD)	0.27	0.142	0.14
Corr.(JC,JD)	−0.45	−0.53	−0.51
Mean(u)	10.62	10.06	10.00
Std.dev.(u)	1.07	0.92	0.81
Corr.(u,v)	−0.50	−0.64	−0.57
Mean(Y)	0.3086	0.3040	0.3086
Std.dev.(Y)	0.02	0.0196	0.0187

Table 5: Simulation statistics for 100 simulated 120 quarters samples

costs and experience rating unambiguously leads to a decrease in employment variability. This issue is in line with the empirical works dealing with experience rating on the US labor market (Card and Levine, 1994 and Anderson, 1993). Previous analysis shed light on this phenomenon. One knows that the effect of experience rating is greater the lower the aggregate condition and unambiguously decreases unemployment, the distance across states between the unemployment rates being reduced. The variance of unemployment is therefore lower in presence of an experience rated tax. Finally, one can remark that this effect is enhanced when one considers a substitution between both instruments. The last striking result concerns the production level. An *ex-ante* increase in job protection tends to decrease the production level, this effect being smaller when experience rating is implemented. Shifting job protection from a standard measure to an experience rated one, one gets a system more favorable to job creation thanks to the fiscal effect.

Finally, the economic analysis of the effects of these two alternative job protection policies using an equilibrium matching model leads us to argue that experience rating is not, in all likelihood, similar to firing costs and is likely to improve the main economic indicators.

5 Conclusion

Much attention has been devoted to the analysis of the consequences of job protection during recent years. This paper is a first attempt to compare the virtues of two alternative job protection instruments namely firing costs and experience rating. The latter being remarkable due to the fact that it is not only a simple job protection measure but also a fiscal one. Our model suggests that the impact of job protection is strongly influenced by the design of such policies. Our results advocate for experience rating since it improves the overall labor market performance. As a matter of fact, experience rating tends to decrease unemployment, the unemployment benefits budget and to increase production. Moreover, our time series simulations also suggests that experience rating is likely to reduce employment fluctuations at the aggregate level. Obviously, experience rating is not similar to firing costs, our results beings at odd with standard job protection effects. One knows that job protection induces an adverse job creation effects. Experience rating introduces a fiscal effect that is likely to counteract this adverse creation effect. To conclude, our results speak in favor of experience rating and it may be worthwhile to shift standard job protection measures toward an experience rated system, experience rating being a mean to increase labor market flexibility and to stabilize employment contrary to short term contracts. However, in most continental European Markets short term contracts are not only a mean to increase labor market flexibility but also became a strong device to screen new employees. This latter point is obviously a limitation to our analysis.

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6 Appendix

6.1 Appendix 1: Sources of job destruction

As soon as the surplus of a match becomes negative, there is no longer an incentive to pursue the employment relationship. The matches are subject to two sources of productivity disturbances, consequently there are two sources of job termination. The graphic below describes the way destructions work in our framework. The reservation productivities ε_{di} are ranked from the best aggregate state (state 1) to the worst aggregate state (state n).

Figure Productivity about here

First, if one assumes a given aggregate environment, the only remaining source of disturbance is the microeconomic one. Once an idiosyncratic shock occurs, a new match specific productivity is drawn from the general distribution F. Two cases may therefore arise. If the new productivity is above or equal to the current aggregate threshold ε_{di} then the match is pursued otherwise the match is terminated. This is the microeconomic source of destruction. Second, assuming a given idiosyncratic productivity (ε given), the only remaining source of disturbance is the aggregate one. An aggregate shock causes the productivity threshold to be shifted up (in case of a bad shock) or to be shifted down (in case of a good shock). Consequently, in case of a bad shock, some jobs may be terminated if the new threshold is above the current idiosyncratic productivity of the match[12]. This is the macroeconomic source of destruction.

6.2 Appendix 2: Surplus

6.2.1 Surplus of a continuing Job

The surplus associated with a continuing job is defined by equation (10). Using equations (5), (8) and the zero-profit condition $\Pi_{vi} = 0$, one gets:

$$\begin{aligned}(r + \lambda + \sum_{i \neq j}^{n} t_{ij})S_i(\varepsilon) = {} & p_i + \sigma_i \varepsilon - \tau_i - (r + \sum_{i \neq j}^{n} t_{ij})(V_{ui} - f - \tau_{ei}) \\ & + \sum_{i \neq j}^{n} t_{ij}(V_{uj} - f - \tau_{ej}) \\ & + \lambda(E(\Pi_{ei}) + E(V_{ei}) - V_{ui} + f + \tau_{ei}) \\ & + \sum_{i \neq j}^{n} t_{ij} Max[\Pi_{ej}(\varepsilon) + V_{ej}(\varepsilon) - V_{uj} + f + \tau_{ej}, 0] \qquad (22)\end{aligned}$$

[12]Obviously, a good shock can not induce any job termination since the threshold is shifted down and thus unveils a new range of productive jobs.

where $E(\Pi_{ei})$ and $E(V_{ei})$ denote the means over the idiosyncratic component ε of the expected value of a filled job and of the expected utility of an employed worker respectively. It is worth noting that the mean of the expected value of the surplus of a continuing job can be written as $E(S_i) = E(\Pi_{ei}) + E(V_{ei}) - V_{ui} + f + \tau_{ei}$ since nor the instantaneous utility of an unemployed worker nor the firing costs are dependent of the idiosyncratic productivity component ε. Using this property together with relation (10), the surplus can be expressed as:

$$\begin{aligned}(r+\lambda+\sum_{i\neq j}^{n} t_{ij})S_i(\varepsilon) = p_i + \sigma_i\varepsilon - \tau_i - (r+\sum_{i\neq j}^{n} t_{ij})(V_{ui} - f - \tau_{ei})\\ + \sum_{i\neq j}^{n} t_{ij}(V_{uj} - f - \tau_{ej})\\ + \lambda E(S_{ei}) + \sum_{i\neq j}^{n} t_{ij} Max[S_j(\varepsilon), 0]. \qquad (23)\end{aligned}$$

The expected utility of an unemployed worker contingent to aggregate state i is given by equation (6). This relation together with the sharing rules (11) and (12), the expected value of a vacant job (3) and the free entry condition, allow us to write the surplus of a continuing job as:

$$\begin{aligned}(r+\lambda+\sum_{i\neq j}^{n} t_{ij})S_i(\varepsilon) = p_i + \sigma_i\varepsilon - \tau_i - b_i - \frac{\theta_i\beta h}{(1-\beta)} + r\,(f+\tau_{ei}) + \lambda E(S_i)\\ + \sum_{i\neq j}^{n} t_{ij}(\tau_{ei} + f - \tau_{ej} - f)\\ + \sum_{i\neq j}^{n} t_{ij}\left[Max\left[S_j(\varepsilon), 0\right]\right]. \qquad (24)\end{aligned}$$

6.2.2 Surplus of a new job

The surplus of a starting job is defined by (9). Using equations (4) and (7) together with the free entry condition, the surplus reads as:

$$\begin{aligned}(r+\lambda+\sum_{i\neq j}^{n} t_{ij})S_{0i}(\varepsilon_u) = p_i + \sigma_i\varepsilon_u - \tau_i - \lambda\,(f+\tau_{ei})\\ - (r+\sum_{i\neq j}^{n} t_{ij})V_{ui} + \sum_{i\neq j}^{n} t_{ij}V_{uj}\\ + \lambda(E(\Pi_{ei}) + E(V_{ei}) - V_{ui} + f + \tau_{ei})\\ + \sum_{i\neq j}^{n} t_{ij}(\Pi_{0j}(\varepsilon_u) + V_{0j}(\varepsilon_u) - V_{uj}). \qquad (25)\end{aligned}$$

The expressions of the surplus for both a continuing job and a new one are respectively given by equations (9) and (10). Making use of these two relations, one gets a new expression for the surplus:

$$(r+\lambda+\sum_{i\neq j}^{n} t_{ij})S_{0i}(\varepsilon_u) = p_i + \sigma_i\varepsilon_u - \tau_i - \lambda\left(f+\tau_{ei}\right) - rV_{ui} + \lambda E(S_i) + \sum_{i\neq j}^{n} t_{ij}(V_{uj}-V_{ui}) + \sum_{i\neq j}^{n} t_{ij}S_{0j}. \tag{26}$$

And finally, using the sharing rules (11) and (12), the expected utility of an unemployed worker (6), the expected value of a vacant job (3) together with the free entry condition, the expression of the surplus for new job contingent to aggregate state i satisfies:

$$(r+\lambda+\sum_{i\neq j}^{n} t_{ij})S_{0i}(\varepsilon_u) = p_i + \sigma_i\varepsilon_u - \tau_i - b_i - \frac{\theta_i\beta h}{(1-\beta)} - \lambda\left(f+\tau_{ei}\right) + \lambda E(S_i) + \sum_{i\neq j}^{n} t_{ij}S_{0j}. \tag{27}$$

6.3 Appendix 3: Further static comparative elements

Figure 3 plots the firing tax τ_e as a function of the degree of experience rating. One can remark that the firing tax is state dependent. For a given level of experience rating, the amount of job protection (the firing tax) is greater the lower the aggregate state. As a corollary, the labor hoarding and the fiscal effect are stronger the lower the aggregate state.

Graphic 3 about here

The next two figures, Figure 4 and Figure 5 plot the budget (as a percentage of the production) as a function of the two alternative job protection measures. These figures shed light on the respective effect of experience rating and firing costs. Experience rating thanks to the fiscal effect tends to decrease unemployment and thus the budget for any aggregate state (Figure 4). It is well-known that firing costs have an ambiguous effect on the unemployment rate. In our framework, this ambiguity leads to a non monotone relationship between the size of the budget and the level of the firing costs (Figure 5).

Graphics 4 and 5 about here

Figure 6 plots the job destruction rate as a function of the experience rating index. Obviously, the labor hoarding effect (destruction effect) is greater the lower the aggregate state.

Graphic 6 about here

Figure 7 plots the job destruction rate as a function of firing costs. In opposition to the previous figure, the decrease in the job destruction rate is greater the higher the aggregate state. This point is documented in L'Haridon and Malherbet (2001).

Graphic 7 about here

6.4 Appendix 4: Dynamic

This appendix develop the dynamic law of motion for employment and the worker flows implied by the macroeconomic model we have developed above. θ and ε_d are forward-looking variables that jump on the impact to their new steady state equilibrium values as the aggregate state changes (Pissarides, 2000).Unemployment is a sticky variable that is driven by the co-movement in the two forward looking variables. We divide time 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, the job destruction flows and the aggregate production at period t respectively. Thus, the aggregate law of motion of employment is given by the following equation:

$$N_{t+1} = N_t + C_t - D_t. \tag{28}$$

The following equation describe the law of motion for employment for each idiosyncratic component of productivity ε. We assume that the aggregate shock only occurs at the beginning of the time period. Hence, once the macroeconomic environment is defined, the only remaining source of job destruction is the idiosyncratic one. Let $n_t(\varepsilon)$ represent the number of workers employed at the current productivity ε at the beginning of period t. Accordingly, the number of workers whose productivity is ε at the beginning of period $t + 1$ reads as:

$$n_{t+1}(\varepsilon) = \begin{cases} (1-\lambda)n_t(\varepsilon) + \lambda F'(\varepsilon)\left[N_t - \int_{\varepsilon_l}^{\varepsilon_{dit}} n_t(\zeta)d\zeta\right] \text{ if } \varepsilon_u > \varepsilon \geq \varepsilon_{dit} \\ 0 \text{ if } \varepsilon < \varepsilon_{dit} \end{cases} \tag{29}$$

where ε_{dit} is the reservation productivity contingent to the current aggregate state i and for the time period t. The first term of equation (29) represents the jobs which idiosyncratic productivity is ε and that are not hit by a job-specific shock. The second term refers to all the surviving occupied jobs which idiosyncratic productivity becomes ε due to the change in the idiosyncratic component. The dynamic law of motion for employment is given by the first line of equation (29) provided the idiosyncratic component is in the range $[\varepsilon_{dit}, \varepsilon_u[$ and by the second term for all others remaining values. The job creation rate is equal to the rate vacant jobs are getting matched. Thus, the job creation flow in period t reads as:

$$C_t = \theta_t m(\theta_t)(1 - N_t) \tag{30}$$

where $\theta_t m(\theta_t)$ is the job finding rate.

Jobs are destroyed for one of two reasons. First, a bad aggregate shock may occur and causes the reservation productivity threshold to be shifted up. Therefore, all jobs which idiosyncratic productivity lies between the old and the new threshold are terminated. Second, jobs may be hit by an adverse microeconomic shock causing the job-specific productivity to fall below the current reservation threshold. The destruction flow is then given by:

$$D_t = \int_{\varepsilon_l}^{\varepsilon_{dit}} n_t(\zeta)d\zeta + \lambda F(\varepsilon_{dit})\left[N_t - \int_{\varepsilon_l}^{\varepsilon_{dit}} n_t(\zeta)d\zeta\right]. \tag{31}$$

The laws of motion of unemployment U_t, of the number of starting jobs n_h and of the number of continuing jobs n_c are given respectively by:

$$U_t = 1 - N_t, \tag{32}$$

$$n_{h,t+1} = C_t + (1-\lambda)\, n_{h,t} \tag{33}$$

$$n_{c,t+1} = n_{c,t} + \lambda\,(1 - F(\varepsilon_{dit}))\, n_{h,t} - D_t. \tag{34}$$

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

$$Y_t = n_{h,t}\,(p_{it} + \sigma\varepsilon_u) + n_{c,t}\int_{\varepsilon_{dit}}^{\varepsilon_u}(p_{it} + \sigma x)dF(x), \tag{35}$$

it follows:

$$Y_t = n_{h,t}\sigma\varepsilon_u + n_{c,t}\sigma\int_{\varepsilon_{dit}}^{\varepsilon_u} x dF(x) + N_t p_{it}. \tag{36}$$

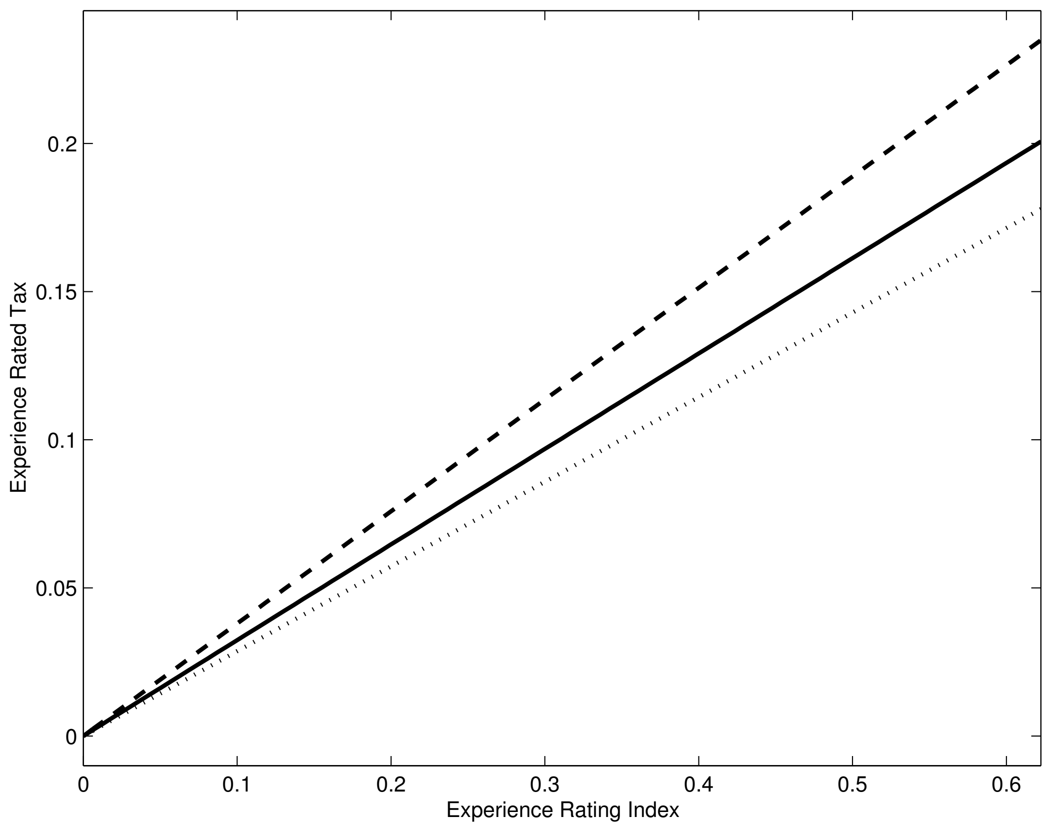

Figure 3: Experience Rated Tax as a function of the experience rating index. Short dashed, plain and long dashed lines apply to high, median and low aggregate state respectively.

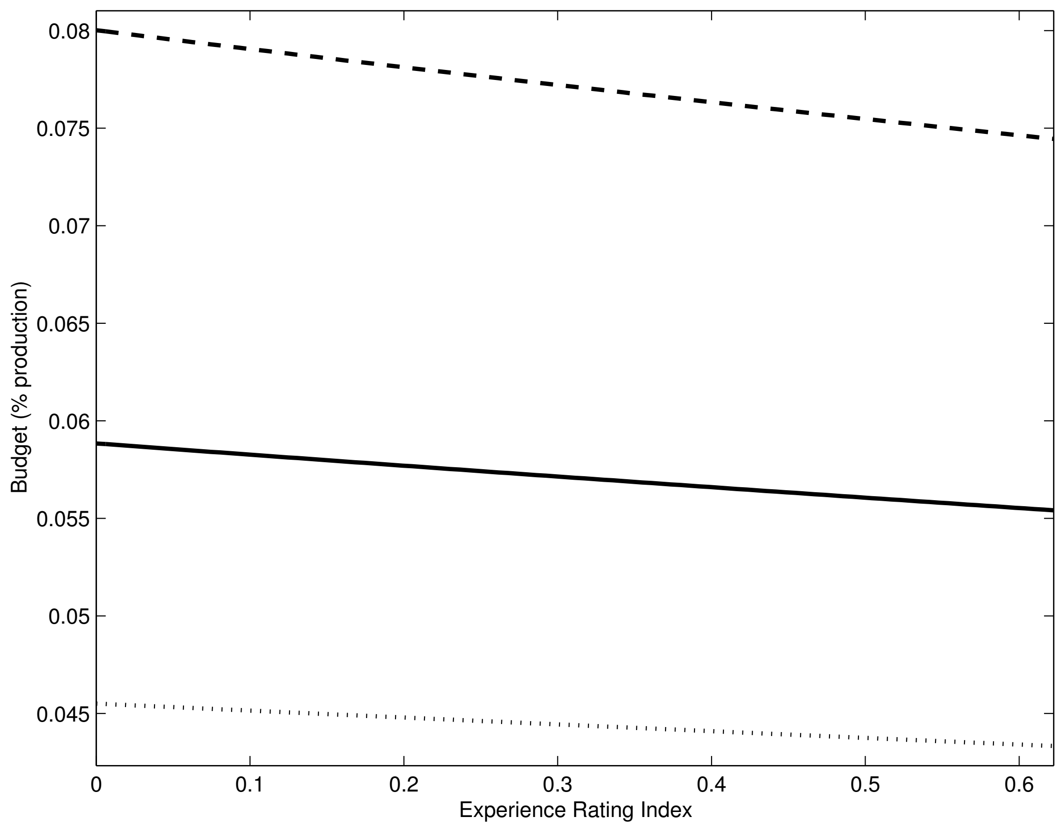

Figure 4: Budget size as a function of the experience rating index. Short dashed, plain and long dashed lines apply to high, median and low aggregate state respectively.

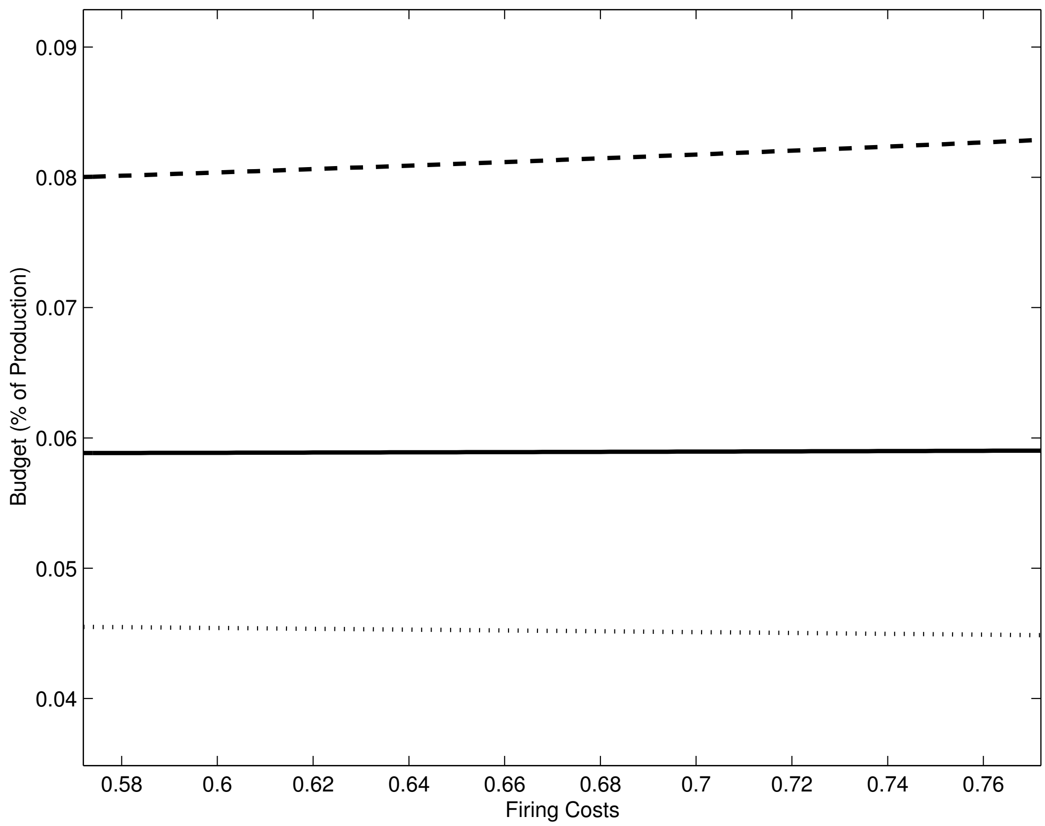

Figure 5: Budget size as a function of the firing costs. Short dashed, plain and long dashed lines apply to high, median and low aggregate state respectively.

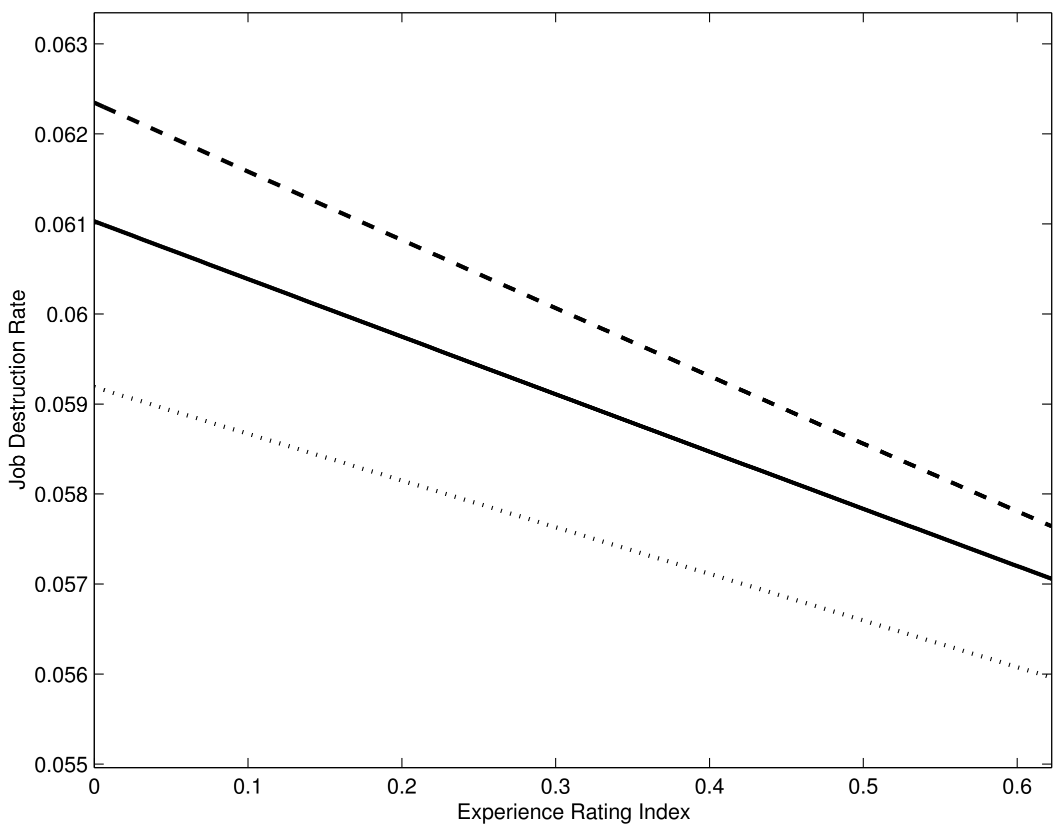

Figure 6: Job destruction rate as a function of the experience rating index. Short dashed, plain and long dashed lines apply to high, median and low aggregate state respectively.

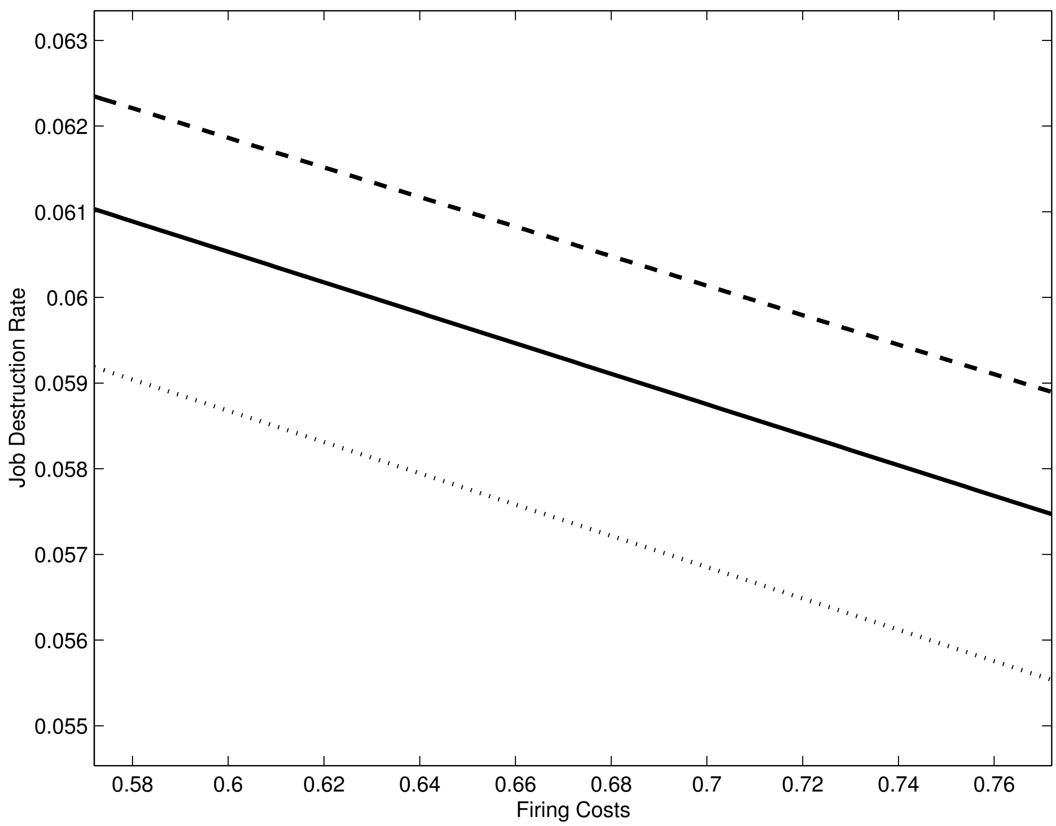

Figure 7: Job destruction rate as a function of the firing costs. Short dashed, plain and long dashed lines apply to high, median and low aggregate state respectively.