Unemployment benefits: between efficiency and equity*

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Abstract

This paper reconsiders the trade off between efficiency and equity of unemployment insurance in a job search model with precautionary saving. An analysis of the optimal level of unemployment benefits according to the utilitarian and rawlsian welfare criteria reveals a trade off between efficiency and equity. Yet, we show that a decreasing profile of unemployment benefits is able to alleviate this trade off. More precisely, the introduction of a declining profile of unemployment benefits is able to raise efficiency without harming the welfare of the agent in the most disadvantageous position. It requires generous unemployment benefits during a short period equal to 87% of the wage followed less generous unemployment benefits equal to 65%. Two mechanisms explain this result. The saving time profile changes. The short term unemployed begin to save for precautionary motive what they don't do when unemployment benefits are constant over time. When unemployment episode expands, the unemployed can support their consumption by dissaving. The decline in unemployment benefits occurs quickly and reduces significantly the income of the unemployed. Therefore, they search more. That is why unemployment rate decreases.

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1 Introduction

In 1959, the French national organization managing unemployment benefit schemes (UNEDIC) was created. Its goal was to provide a minimum payment when agents lose their job. From this point of view, the unemployment insurance is designed to reduce the inequality produced by the unemployment risk. If the existence of a redistribution mechanism is desirable (Baily [1978], Gruber [1997], Browning and Crossley [2001]), it is also criticized because of the negative effects which it is likely to cause.

The works which tried to solve the incentive problems which appear in any insurance relation show that a declining profile of unemployment benefits is a possible answer to the moral hazard. Shavell and Weiss [1979] and Hopenhayn and Nicolini [1997][1] consider a principal-agent model. They show that the principal must propose unemployment benefits which decrease with the unemployment spell because of the disincentive effects that unemployment benefits exert on search effort. Moreover, the study of Fredriksson and Holmlund [2001] shows in a job search model with endogenous wages and search efforts that a decreasing unemployment benefits profile satisfies the utilitarian welfare criterion.

Hansen and Imrohoroglu [1992] reconsider the optimal level of unemployment benefits when agents have access to a storage technology. They show that the optimal level of unemployment benefits is smaller in comparison with the case where agents cannot save. In the same line, Costain [1997] and Wang and Williamson [2002] show that the consumption smoothing effect of unemployment benefits is small because of the potential insurance that precautionary saving offers.

These different works suggest that unemployment benefits must be weak or declining. However, their analysis is based on the average welfare evaluation. The efficiency dimension seems to have prevailed over the equity dimension. When we analyze the consequences of a change in the unemployment insurance system, we must pay attention to the agents who are in the most disadvantageous situation because they are the most concerned by a change in the unemployment benefits programs. Decreasing the level of unemployment benefits or introducing a declining profile reduces the income that the unemployed receives during any unemployment period. His consumption is likely to decrease. Algan, Cheron, Hairault and Langot [2004] show that unemployment benefits

[1] The analysis of the latter enables to consider a larger set of contracts in comparison with Shavell and Weiss [1979]. They introduce a tax on the wage of the employed which is all the higher when the unemployment spell is long.

decrease inequalities in terms of unemployment risk coverage in comparison with precautionary saving. The assessment of the cost of the unemployment risk[2] reveals that the latter amounts to 83,6% when the agent in the most disadvantageous position can only save to insure against the unemployment risk. When the agent in the least advantageous position receives the unemployment benefit, this cost is smaller. It amounts only to 9.33%. Cahuc and Lehmann [2000] reconsider the consequences of the decrease in unemployment benefits on the unemployment rate and the Rawls justice criterion. They build a job search model in which wages are initially exogenous and become endogenous. If the introduction of a declining profile of unemployment benefits raises efficiency, it decreases the long term unemployed permanent consumption. Moreover, they show that the decrease in unemployment rate is smaller when wage becomes endogenous. Nevertheless, their analysis does not take into account the precautionary saving mechanism. When unemployment benefits become declining, agent can dissave to support his consumption. These both papers stress that there is a trade off between efficiency and equity.

In this paper we show the contrary. When agents save for a precautionary motive, a decreasing profile of unemployment benefits, which raises efficiency, could be introduced without harming the intertemporal utility of the unemployed in the least advantageous situation. The decline in unemployment benefits alleviates, under some conditions, the conflict between efficiency and equity. The theoretical framework is along the lines of the paper of Algan, Cheron, Hairault and Langot [2004]. Nevertheless, it departs from it in order to have a model close to that of Cahuc and Lehmann [2000]. The probability to exit of unemployment is endogenous. The latter depends on the job search effort. The unemployment benefits are declining. More precisely, the analysis is run under a job search model with precautionary saving, calibrated on French data. We assume that agents can save or dissave however cannot borrow assumption which is lacking in the above mentioned papers. The wage is assumed to be exogenous. Initially, unemployment benefits are assumed unconditional as in Hansen and Imrohoroglu [1992]. Unemployment benefits are independent of the unemployment spell and time unlimited. The characterization of the optimal level of unemployment benefits according to the utilitarian and rawlsian welfare criteria reveals a trade off between efficiency and equity. When the utilitarian welfare criterion prevails, it is optimal to set the replacement ratio to 49% of the wage. When the welfare analysis is based on the rawlsian welfare criterion, it turns out

[2] They calculate the percentage of permanent consumption that an agent is ready to forego in order to get rid of any uncertainty by living in a complete market structure.

to be optimal to set the replacement ratio to 72% of the wage. However, setting the replacement ratio to its optimal rawlsian level increases the unemployment rate. The average agent undergoes a permanent consumption loss equal to 0.94% when the replacement ratio is set to its optimal rawlsian level in lieu of its optimal utilitarian level. We show that the introduction of a declining profile of unemployment benefits, under some conditions, is able to alleviate the trade off between efficiency and equity. It requires that the agent who becomes short term unemployed receives during a short period (one quarter) a generous unemployment benefit set to 87% of the wage. When the unemployment episode expands the unemployment benefit must be smaller, equal to 65% of the wage. This result is due to a change in the time saving profile and an increase in the job search effort. As the income of the short term unemployed is quite close to that of the employed, the employed saves less for precautionary motive. Therefore, the employed hold less wealth when the profile of unemployment benefits is declining. The short term unemployed begins to save for precautionary motive whereas it is not the case when unemployment benefits are constant over time. When the unemployment episode goes on, he becomes long term unemployed and dissaves in order to support his consumption. Part of the saving effort made by the agent during the employment episode is postponed to the moment where he will be short term unemployed. Finally, the introduction of this declining profile of unemployment benefits raises efficiency. The permanent consumption of the average agent displays an increase of 0.65%. As the decline in unemployment benefits arises quickly and the drop in income is important, the short and long term unemployed are encouraged to increase the intensity of their job search effort and all the more as they saved less when they were employed. This is why the unemployment rate decreases.

The paper is organized as follows. The model is presented in section two. The third section discusses the calibration of the model. In section four, we characterize the optimal level of unemployment benefits according to utilitarian and rawlsian welfare criteria and then assess the effect of the decline in unemployment benefits. A robustness analysis is run in section five. The section six discusses assumption of exogenous wage. The last section concludes.

2 The model

The analysis is run under a job search model including precautionary saving. The model is calibrated on French data. Agents, who are risk averse, face idiosyncratic unemployment shocks.

They can be either employed or unemployed. The employed earns an exogenous wage[3] and pays a tax which finances the unemployment insurance system. When jobs are destroyed, the employed becomes unemployed. He receives unemployment benefits. The exit of unemployment depends on the job search effort as in Costain [1997]. The higher the job search effort is, the stronger the exit rate of unemployment is, however the bigger the disutility is. We assume that the job search effort is a private information. This choice is motivated by the will to offer a modelling close to that of Cahuc and Lehmann [2000]. Moreover, the empirical analysis of Van Den Berg [1990] reveals that the rejection rate of offers is very small in the Western Europe. That is why we do not follow Hansen and Imrohoroglu [1992]. They assume that the unemployed who receives job offers can reject it. If the reject is detected (the probability of detecting the reject is smaller than one), he loses his unemployment benefits. Agents have a limited access to financial markets. They cannot borrow.

2.1 The benchmark economy

We consider an economy where agents when unemployed receive an unemployment benefit b whose generosity is independent of the unemployment spell and constant over time. The unemployment insurance system is financed by a proportional tax paid by the employed.

2.1.1 Description of economy

The employed receives a wage and pays a tax which finances the unemployment insurance system. Jobs are destroyed at the rate q so that the employed on these jobs become unemployed and get an unemployment benefit b. The exit of unemployment depends on the job search effort h. Agents are *ex ante* identical, but are *ex post* heterogeneous.

The preferences are summarized by the below utility function which is assumed additively separable in time:

$$E_0 \sum_{t=0}^{\infty} \beta^t U(c_t, h_t) = E_0 \sum_{t=0}^{\infty} [u(c_t) - v(h_t)]$$

where $\beta \in]0;1[$, c_t, h_t and u denote respectively the subjective discount rate, the consumption at date t, the job search effort at date t and the instantaneous utility. The latter is a standard CRRA function which is increasing, two times differentiable, strictly concave and satisfies the Inada

[3] As it is a simplification which is able to modify results, this assumption is discussed at the section six.

conditions:

$$u(c_t) = \frac{c_t^{1-\sigma} - 1}{1-\sigma}$$

where σ is the risk aversion parameter.

v is the instantaneous effort disutility function. The latter is a growing function of the effort:

$$v(h_t) = \gamma h_t$$

where $\gamma > 0$ is the sensitivity of the disutility to effort[4], namely the cost of job search.

The lack of incomplete insurance markets leads agents, who cannot borrow, to save during employment episode and dissave during the unemployment episode in order to smooth their consumption. The vector of state variables is given by the vector (a, s) where a represents the asset holdings at the beginning of the period. We have: $a \in \kappa \in \mathbb{R}^+$. s indicates the realization of the idiosyncratic events specific to the agent (*i.e.* his status on labor market: employed e or unemployed u). The agent solves the following recursive program where $V(a, e)$ and $V(a, u)$ denote respectively the intertemporal utility of an agent in status $i = e, u$:

Unemployed

$$V(a, u) = \max_{c,a',h} \left\{ u(c) - v(h) + \beta \left[\pi(h) V(a', e) + (1 - \pi(h)) V(a', u) \right] \right\} \tag{1}$$

subject to:

$$c + a' = (1 + r)a + b \tag{2}$$

$$a' \geq 0 \tag{3}$$

$$c \geq 0 \tag{4}$$

$$h \in]0; 1[$$

where a' and r are respectively the next period asset holdings and the interest rate.

Unemployment benefits are indexed on the before tax wage:

$$b = \theta w$$

where θ is the exogenous replacement rate.

[4] The work disutility is ignored.

$\pi(h)$ is the exit probability of unemployment. The latter is assumed to be strictly increasing and concave and have the following form:

$$\pi(h) = h^{\varphi}$$

where $\varphi \in]0;1[$.

We deduce the first order condition on the effort h of the unemployed:

$$\frac{dV(a,u)}{dh} = 0$$

We obtain:

$$h = \left[\frac{\varphi\beta\left(V(a',e) - V(a',u)\right)}{\gamma}\right]^{\frac{1}{1-\varphi}}$$

From this equation, it appears that the effect of φ on the job search effort depends on the value of φ. The higher γ is, the weaker the job search effort is. The job search effort is an increasing function of the difference between $V(a',e)$ and $V(a',u)$, the welfare gain due to the exit of unemployment[5]. Simulations show that this difference decreases as soon as the next period asset holdings increase. The job search effort is a decreasing function of next period asset holdings. The more the agent is wealthy, the less he is encouraged to exit of unemployment because he can support his consumption by dissaving. Whatever the next period asset holdings, simulations reveal that the difference between $V(a',e)$ and $V(a',u)$ decreases as soon as the replacement ratio θ increases. The job search effort is a decreasing function of the replacement ratio θ. The higher the replacement ratio θ is the smaller the consumption loss due to unemployment is. The unemployed is unwilling to search a job.

Employed

$$V(a,e) = \max_{c,a'} \left\{u(c) + \beta\left[(1-q)V(a',e) + qV(a',u)\right]\right\} \tag{5}$$

subject to:

$$a' + c = (1+r)a + w(1-\tau) \tag{6}$$

$$a' \geq 0 \tag{7}$$

$$c \geq 0 \tag{8}$$

where τ is the tax rate. At any given time, the government budget constraint is balanced.

[5]See the annexe for the calculation of the effect of φ, γ and $V(a',e) - V(a',u)$ on the job search effort.

2.1.2 Stationary equilibrium definition

Let $\Pi_{s,s'}(a)$ be the probability of an agent in status (a, s) to be at the next period in status (a', s') and $\lambda(a, s)$ the invariant probability distribution. The latter is the proportion of agents whose wealth is a and the status on the labor market is characterized by the random variable s. Given the price vector (r, w), a stationary equilibrium for this economy consists of a set of decision rules $c(a, s), h(a)$ and $a'(a, s)$, a set of value functions $V(a, e)$ and $V(a, u)$, the invariant probability distribution $\lambda(a, s)$ and a tax rate, τ, such that:

(i) the households' decision rules $c(a, s)$, $h(a)$ and $a'(a, s)$ solve either the Bellman equation (1) subject to (2) (3) and (4) or the Bellman equation (5) subject to (6), (7) and (8)

(ii) the invariant probability distribution solves the following equation:

$$\lambda\left(a', s'\right) = \sum_{s} \sum_{a:a'(a,s)} \Pi_{s,s'}(a)\lambda(a, s)$$

(iii) the government budget constraint is satisfied:

$$\tau w \sum_{a} \lambda(a, e) = \theta w(1 - \sum_{a} \lambda(a, e))$$

2.2 Declining unemployment benefits

In this paragraph, we describe the theoretical framework of the model when unemployment benefits are declining. The employed who becomes unemployed gets an unemployment benefit b during $1/\rho$ periods in average. When the unemployment episode expands, he get an unemployment benefit z $< b$ as in Cahuc and Lehmann [2000]. ρ is the probability to get the unemployment benefit z. For $\rho = 1$ the modelling coincides with that of Cahuc and Lehmann [2000].

2.2.1 Description of behaviours

Unlike the benchmark economy, there are two types of unemployed. We note $V(a, e)$, $V(a, u_{ST})$ and $V(a, u_{LT})$ the intertemporal utilities of the employed, the short term unemployed (he receives the unemployment benefit b) and the long term unemployed (he gets the unemployment benefit z). The program that the agent solves is the following:

Short term unemployed

$$\begin{aligned} V(a, u_{ST}) = \max_{c,a',h_{ST}} & \{u(c) - v(h_{ST}) + \beta[\pi(h_{ST}) V(a', e) \\ & +(1 - \pi(h_{ST}))((1 - \rho)V(a', u_{ST}) + \rho V(a', u_{LT}))]\} \end{aligned} \tag{9}$$

subject to:

$$c + a' = (1 + r)a + b \tag{10}$$

$$a' \geq 0 \tag{11}$$

$$c \geq 0 \tag{12}$$

$$h_{ST} \in]0, 1[$$

We deduce the first order condition on the job search effort h_{ST}:

$$\frac{dV(a, u_{ST})}{dh_{ST}} = 0$$

We obtain:

$$h_{ST} = \left[\frac{\varphi\beta \left\{ V(a', e) - [(1-\rho)V(a', u_{ST}) + \rho V(a', u_{LT})] \right\}}{\gamma} \right]^{\frac{1}{1-\varphi}}$$

$$\iff h_{ST} = \left[\frac{\varphi\beta \left\{ V(a', e) - V(a', u_{ST}) + \rho \left[V(a', u_{LT}) - V(a', u_{ST}) \right] \right\}}{\gamma} \right]^{\frac{1}{1-\varphi}}$$

We find again part of the previous results. The effect of γ on the job search effort h_{ST} is negative whereas the impact of φ on the job search effort h_{ST} depends on its value. The job search effort h_{ST} is an increasing function of ρ. The job search effort is an increasing function of the difference between $V(a', e)$ and $V(a', u_{ST})$ and the difference between $V(a', u_{LT})$ and $V(a', u_{ST})$, the welfare loss due to the long term unemployment[6]. Simulations show that these differences decrease as soon as the next period asset holdings increase. Consequently, the job search effort of the short term unemployed is a decreasing function of next period assets. Moreover simulations reveal that the difference between $V(a', u_{LT})$ and $V(a', u_{ST})$ decreases as soon as the long term replacement ratio ϕ increases. In other words, the job search effort is a decreasing function of the replacement ratio of long term ϕ. The higher the latter is, the smaller the difference between the short term replacement rate θ and the long term replacement ratio ϕ is and the smaller the consumption loss due to long term unemployment is. Finally, simulations indicate that an increase in the short term replacement ratio θ reduces the difference between $V(a', e)$ and $V(a', u_{ST})$ (effect 1) however increases the difference between $V(a', u_{ST})$ and $V(a', u_{LT})$ (effect 2). Simulations show that the effect 1 dominates the effect 2 if ρ is smaller than one.

[6] See the annexe for the calculation of the effect of φ, ρ, γ, $V(a', e) - V(a', u_{ST})$ and $V(a', u_{LT}) - V(a', u_{ST})$ on the job search effort h_{ST}.

Long term unemployed

$$V(a,u_{LT})=\max_{c,a',h_{LT}}\{u(c)-v(h_{LT})+\beta[\pi\left(h_{LT}\right)V(a',e)+$$
$$(1-\pi\left(h_{LT}\right))V(a',u_{LT})]\} \tag{13}$$

subject to:

$$c+a'=(1+r)a+z \tag{14}$$
$$a'\geq 0 \tag{15}$$
$$c\geq 0 \tag{16}$$
$$h_{LT}\in]0;1[$$

where $z=\phi w$ denotes the income of the long term unemployed.

We deduce the first order condition on the job search effort h_{LT}:

$$\frac{dV(a,u_{LT})}{dh_{LT}}=0$$

We obtain:

$$h_{LT}=\left[\frac{\varphi\beta\left\{V(a',e)-V(a',u_{LT})\right\}}{\gamma}\right]^{\frac{1}{1-\varphi}}$$

The impacts of φ, γ, a' and ϕ on the job search effort h_{LT} are the same as in the benchmark model which are summarised in the below table 1[7]:

Table 1: Impact on the job search effort of the long term unemployed

	h_{LT}
φ	depends on the value φ
γ	-
a'	-
ϕ	-

Employed

$$V(a,e)=\max_{c,a'}\left\{u(c)+\beta\left[(1-q)V(a',e)+qV(a',u_{ST})\right]\right\} \tag{17}$$

subject to:

$$a'+c=(1+r)a+w(1-\tau) \tag{18}$$
$$a'\geq 0 \tag{19}$$
$$c\geq 0 \tag{20}$$

[7] The sign minus indicates that the parameter influences negatively the job search effort h_{LT}.

2.2.2 Stationary equilibrium definition

The definition of the stationary equilibrium is unchanged with the exception of the definition of the equilibrium of the government budget constraint. The latter verifies:

$$\tau w \sum_a \lambda(a, e) = \theta w \sum_a \lambda(a, u_{ST}) + \phi w \sum_a \lambda(a, u_{LT})$$

3 Calibration

The model is calibrated on French data. The model period is the quarter. As regards subjective discount rate and risk aversion, there is not French estimation. For a quarterly calibration of the American economy, it is usually taken a subjective discount rate of 0.985 (Cooley and Prescott [1995]). That is why we set it to 0.985 which corresponds to the calibration adopted by several French studies (Algan, Cheron, Hairault and Langot [2004], Joseph and Weitzenblum [2003]). The different works made on American data show that the risk aversion σ ranges from 1 to 3. Consequently, we set the risk aversion to 2 which corresponds to an average value of these different studies.

We want to reproduce an unemployment rate of 10% and an average unemployment spell equal to 10 months[8]. It leads us to set the job destruction rate to 0.0334[9].

Algan and Terracol [2001] and Algan, Cheron, Hairault and Langot [2003] show that the financial asset which plays the role of precautionary saving against labor market risks corresponds to liquid deposits (Livret A, B, CODEVI) whose annual return is smaller than 0.375% per quarter. Joseph and Weitzenblum [2003] estimate to 0.25% the average return of the saving of the low paid workers over the period 1969-1996. That is why we set the interest rate r to 0.25%.

The macroeconomic production technology which is represented by a Cobb Douglas production

[8] The average unemployment duration in France was equal to 307 days in January 2003 (source : employment Ministry).

[9] At steady state, the flows of unemployed and employed are constants :

$$q(1-u) = \overline{\pi} u$$

where $\overline{\pi}$ is the average probability of unemployment exit. We obtain:

$$q = \overline{\pi}\frac{u}{(1-u)} \Longleftrightarrow q = \frac{u}{(1-u)\times\frac{1}{\overline{\pi}}}$$

where $\frac{1}{\overline{\pi}}$ is the average unemployment duration.

function, allows us to determine the wage:

$$Y = AK^{\alpha}L^{1-\alpha}$$

We deduce the border of the factor prices:

$$w = (1-\alpha)(A\left[\frac{\alpha}{r+\delta}\right]^{\alpha})^{\frac{1}{1-\alpha}}$$

where δ is the depreciation rate. The latter is set to 0.03. The share of the capital is set to 0.36.

The replacement rate is assigned the value taken from Martin [1996]. Therefore, we set $\theta = 0.6$. $\varphi = 0,23$ and $\gamma = 10.15$ are calibrated to reproduce an unemployment rate of 10% and an elasticity of the average duration of unemployment with respect to unemployment benefits of 0.58. As far as the elasticity of average duration of unemployment with respect to unemployment benefits is concerned, there is no consensus. Nevertheless, Layard, Nickell and Jackman [1991] underline that it ranges from 0.2 and 0.9. That is why we set it to 0.58 which seems to be fair *a priori* since it represents an average value of this interval[10]. Besides, Cahuc and Lehmann [2000] set it to 0.5. Table 2 summarizes all these choices.

Table 2: Calibration of structural parameters

β	σ	q	δ	α	A	θ	φ	γ	r
0.985	2	0.0334	0.03	0.36	1	0.6	0.23	10.15	0.0025

4 Results

The goal of this section is twofold. First, we characterize the optimal level of unemployment benefits according to the utilitarian and rawlsian welfare criteria in order to assess the trade off between efficiency and equity. Then, we determine the characteristics of the declining profile of unemployment benefits which raises efficiency and guarantees to the agent in the most disadvantageous position (described as rawlsian agent) the same utility as when the unemployment benefit is constant over time and set to its optimal rawlsian level (optimal rawlsian situation).

[10] An analysis of robustness (section six) is run in order to assess the impact of the elasticity of the average unemployment duration with respect to unemployment benefits.

4.1 Optimal unemployment benefits level

Marc Fleurbaey [2001] underlines that as regards equity, the assessment made on the life cycle is more suited than an instantaneous photography. Moreover, the work of Cohen [1999] suggests to analyze inequalities between unemployed and employed building on the intertemporal utility insofar as it allows to take into account the future prospects on the labor market. Indeed, if static inequalities are important, the evolution opportunities are important too because they can modify our perception of static inequalities. That is why the intertemporal utility (dynamic approach) is preferred to the instantaneous utility (static approach) to assess the optimal level of unemployment benefits according to the utilitarian and rawlsian welfare criteria.

To characterize the optimal level of unemployment benefits in the benchmark economy we solve the following program:

$$\underset{\theta}{Max} W = \left[\sum_{s=e,u} \int_{\kappa} \lambda(a,s) V(a,s)^{1-\xi} da \right]^{\frac{1}{1-\xi}}$$

The parameter ξ measures the degree of collective inequalities aversion. For $\xi = 0$ the utilitarian welfare criterion prevails. The society cares about the welfare of the average agent. On the other hand, when $\xi \to \infty$ the rawlsian welfare criterion applies. The society cares about the welfare the rawlsian agent. The gain or loss from setting the replacement ratio to some other level than the benchmark value ($\theta = 0.6$) are expressed in terms of relative variation of the permanent consumption $\widetilde{C}$. This is the consumption the agent would have in the economy without unemployment risk when his welfare level is equal to W. $\widetilde{C}$ verifies:

$$W = \frac{1}{(1-\beta)} \frac{\widetilde{C}^{1-\sigma} - 1}{1-\sigma}$$

The figures 1 and 2 depict the gains or losses which stems from setting the replacement ratio to some other level than the benchmark level ($\theta = 0.6$) for four different values of the collective inequalities aversion ξ ($\xi = 0, 10, 50$ and ∞).

If the society seeks via the unemployment insurance system to reduce inequality (rawlsian welfare criterion) it is optimal to propose a more generous unemployment benefit whose replacement ratio amounts to 72% of the wage. The existence of liquidity constrained agents pushes upward the optimal ratio of replacement insofar as the generosity of the unemployment insurance system increases the intertemporal utility of the rawlsian agent. This result is quite similar to that of

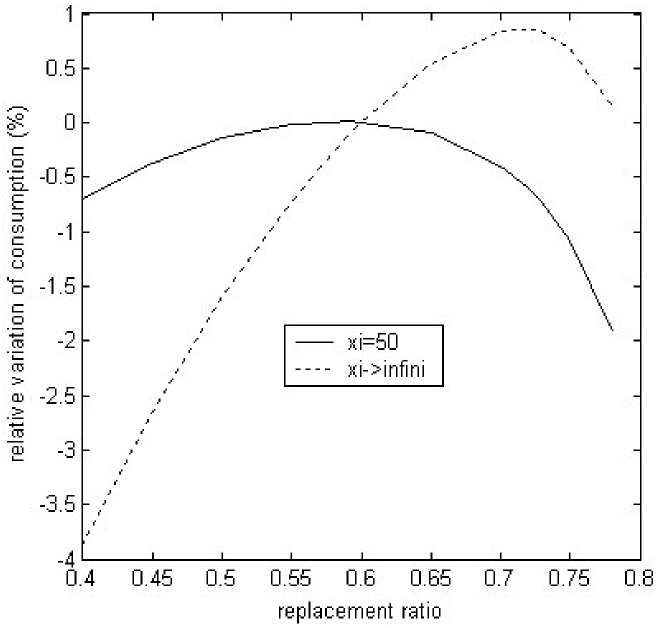

Figure 1: Gain/Loss of permanent consumption for $\xi = 50, \infty$

Joseph and Weitzenblum [2000]. If the characterization of the optimal replacement ratio rests on the instantaneous utility, it will be optimal to set it to 100%. When the society is less averse to inequalities ($\xi = 50$) however cares about of the situation of agents who are in a less advantageous position than the average agent, the optimal replacement ratio amounts to 59% of the wage.

When the society desires to maximize the welfare of the average agent (utilitarian welfare criterion), it is optimal to set a weaker replacement ratio equal to 49% of the wage. Too generous unemployment benefits reduce the job search effort and increase the tax rate which reduces the welfare of the employed. When the society considers agents who are in a less advantageous position than the average agent however close to this one ($\xi = 10$), the optimal replacement ratio increases somewhat. It amounts to 49.8% of the wage.

However, the improvement of the situation of the rawlsian agent has a price. The unemployment rate and the average unemployment duration increase. The unemployment rate amounts to 11.52%. The average unemployment duration goes from 3.33 quarters to 4 quarters (Table 3). In order to assess the trade off between efficiency and equity, we determine the permanent consumption gain for the rawlsian agent when the replacement ratio is set to its optimal rawlsian level in lieu of its

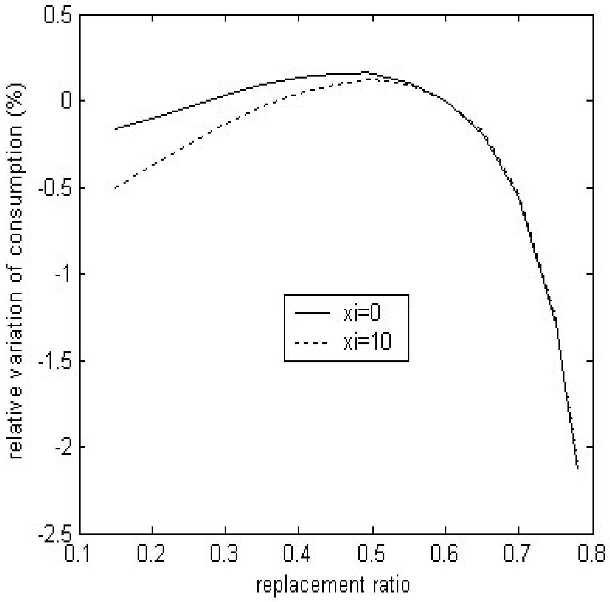

Figure 2: Gain/Loss of permanent consumption for $\xi = 0, 10$

optimal utilitarian level. In the same way, we determine the permanent consumption loss that the average agent undergoes when the replacement ratio is set to its optimal rawlsian level in lieu of its optimal utilitarian level.

Table 3: Optimal unemployment benefits according to the social welfare criterion

θ	0.2	0.3	0.4	**0.49**	0.5	0.6	0.7	**0.72**
u (%)	8.06	8.37	8.77	**9.22**	9.28	10	11.17	**11.52**
τ (%)	1.75	2.74	3.84	**4.97**	5.11	6.67	8.79	**9.36**
cf (%)	2.99	6.84	12.95	**21.67**	23.08	40.40	75.54	**78.95**
$\overline{a}$	5.81	4.28	2.94	**1.90**	1.80	0.87	0.21	**0.1183**
λ	2.64	2.75	2.88	**3.05**	3.07	3.33	3.77	**3.9**
$\Delta\widetilde{C}/\widetilde{C}_{\xi=0}$ (%)	−0.10	0.03	0.13	**0.161**	0.155	0	−0.56	**−0.78**
$\Delta\widetilde{C}/\widetilde{C}_{\xi\to\infty}$ (%)	−11.75	−7.02	−3.87	**−1.79**	−1.60	0	0.83	**0.85**

Note : u, $\overline{a}$, λ and cf are respectively the unemployment rate, the average wealth, the average unemployment duration and the number of liquidity constrained unemployed

The improvement of the situation of the rawlsian agent is costly in terms of efficiency. If setting the replacement ratio to its optimal rawlsian level leads to a sizeable increase in permanent consumption of the rawlsian agent of 2.7%, the average agent undergoes a loss of permanent consumption close to 1%.

Table 4: Gain/Loss of permanent consumption

$\theta = 49\% \rightarrow \theta = 72\%$	$\Delta\widetilde{C}/\widetilde{C}$
the average agent	-0.94%
the rawlsian agent	2.69%

Considering this result, is it possible to define an unemployment insurance system where efficiency and equity are optimized ?

These results show that employed save for a precautionary saving all the more as the unemployment benefits are weak. The importance of the precautionary saving depends on the generosity of the unemployment benefits. The average precautionary saving drops significantly when the replacement ratio increases. This one corresponds to 77% of the after tax wage when the replacement ratio is set to its optimal utilitarian level. When the replacement ratio is set to its optimal rawlsian level, the average precautionary saving corresponds only to 4.8% of the after tax wage.

4.2 The impact of the declining profile of unemployment benefits

If an unemployment benefit set to 72% of the wage enables to maximize the intertemporal utility of the rawlsian agent (optimal rawlsian situation) it raises inefficiency. It reduces the job search effort and consequently the exit rate of unemployment. The number of unemployed and the number of liquidity constrained unemployed increase.

If the decline in unemployment benefits is helpful to reduce moral hazard, it gives rise to a decrease in income which is likely to damage the welfare of the rawlsian agent. Nevertheless the decline in unemployment benefits leads unemployed to increase their job search effort. So we wonder if we can introduce a declining profile of unemployment benefits without harming the welfare of the rawlsian agent.

To answer this question we adopt the following approach. We set ϕ to a value which is smaller than 72%[11]. For different values of $\rho \in]0;1[$ and θ, we determine if it is possible to guarantee for

[11] The choice to set first the long term replacement ratio ϕ is arbitrary. We could choice to set first the short term replacement ratio θ and then identify the values of ρ and ϕ which enable to guarantee for the rawlsian agent the same intertemporal utility as in the optimal rawlsian situation. We would obtain the same results. Nevertheless since ϕw is the only source of income of the rawlsian agent (he has not wealth), it seemed us more obvious to identify first the value of the long term replacement ratio ϕ below which it is impossible to guarantee for the rawlsian agent the same intertemporal utility as in the rawlsian optimal situation.

Table 5: Characteristics of the optimal rawlsian situation

	$\theta = 72\%$
u (%)	11.52
λ	3.9
$\overline{a}$	0.1183
$\overline{a}_e$	0.1330
$\overline{a}_u$	0.0053
$\overline{h}$	0.0027
cf (%)	78.95
τ (%)	9.36

the rawlsian agent[12] the same intertemporal utility as in the optimal rawlsian situation. If it is the case we search among the combinations $\{\phi, \theta, \rho\}$ the one which enable to increase the most the intertemporal utility level of the average agent. These results are summarized in the table 6.

When the long term replacement ratio ϕ is smaller than 64%, whatever the duration of the payment of the unemployment benefits b, it is not possible to guarantee for the rawlsian agent the same level of intertemporal utility as in the optimal rawlsian situation. If the long term replacement ratio ϕ is greater than or equal to 65% of the wage, it is possible to find a short term replacement ratio θ (greater than 72%) which guarantees for the rawlsian agent an intertemporal utility similar to the one of the optimal rawlsian situation. The increase in the welfare of the average agent is all the more important as the long term replacement ratio ϕ is close to 65%. Moreover the higher ρ is, the higher the increase in the welfare of the average agent is because the short term unemployed search more.

To understand how the introduction of this declining profile does not damage the intertemporal utility of the rawlsian agent, we study the dynamics of consumption and wealth (figure 3) when unemployment benefits are constant (the optimal rawlsian situation) and declining (case 2 of the table 6). We consider an agent who is initially without wealth and unemployed (long term unemployed when unemployment benefits are declining over time) and confronted with a particular history on the labor market.

At each episode of employment, the consumption is higher when the unemployment benefit is declining over time (case 2). The introduction of a declining profile of unemployment benefits

[12] The introduction of a declining profile of unemployment benefits leads to distinguish the short term unemployed from the long term unemployed. In this case, the rawlsian agent corresponds to the long term unemployed without wealth.

Table 6: Impact of the introduction of a declining profile of unemployment benefits

$\phi = 65\%$	*case* 1 $\rho = 0.8$ $\theta = 87\%$	*case* 2 $\rho = 0.9$ $\theta = 87.35\%$	*case* 3 $\rho = 1$ $\theta = 87.55\%$
$\Delta\widetilde{C}/\widetilde{C}_{\xi=0}$ (%)	0.631	0.636	0.649
$\Delta\widetilde{C}/\widetilde{C}_{V_e}$ (%)	0.658	0.665	0.682
u (%)	10.47	10.44	10.43
λ	3.50	3.49	3.48
$\overline{a}$	0.0270	0.0378	0.0614
$\overline{a}_e$	0.0188	0.0309	0.0570
$\overline{a}_{u_{ST}}$	0.2563	0.2694	0.2893
$\overline{a}_{u_{LT}}$	0.0180	0.0199	0.0227
$\overline{h}_{ST}$	0.0041	0.0043	0.0044
$\overline{h}_{LT}$	0.0044	0.0044	0.0044
cf (%)	46.97	48.21	50.52
τ (%)	8.46	8.386	8.316

Note : $\overline{a}_e$, $\overline{a}_{u_{ST}}$ and $\overline{a}_{u_{ST}}$: average wealth of the employed, the long and short term unemployed
$\overline{h}_{ST}$, $\overline{h}_{LT}$: average job search effort of the long and short term unemployed
$\Delta\widetilde{C}/\widetilde{C}_{V_e}$: relative variation of the consumption of the employed in comparison with the optimal rawlsian situation

(case 2) reduces the unemployment rate and consequently the tax rate. The latter goes from 9.36% (optimal rawlsian situation) to 8.39%. The permanent consumption gain of the introduction of this declining profile of unemployment benefits amounts to 0.67%. As the income of the short term unemployed is quite close to that of the employed[13], the employed saves less for a precautionary saving. The analysis of the decision rule of the employed (Figure 4) confirms it.

When the unemployment benefits are declining (case 2), the employed stops accumulating as soon as his assets stock higher than 0.01 which corresponds to 0.44% of his after tax wage. In the optimal rawlsian situation, he dissaves as soon as his assets stock is greater than 0.16 which corresponds to 7.14% of his after tax wage. As result, the employed holds less wealth when unemployment benefits are declining. The average wealth amounts to 0.031 which represents 1.1% of his after tax wage. In the optimal rawlsian situation, his wealth amounts to 0.133 which represents 4.9% of his after tax wage. Part of the saving effort is postponed to the moment where

[13] The income of the short term unemployed in the case 2 is equal to 87.35% of the wage whereas the labor income of the employed amounts to 91.61% of the wage.

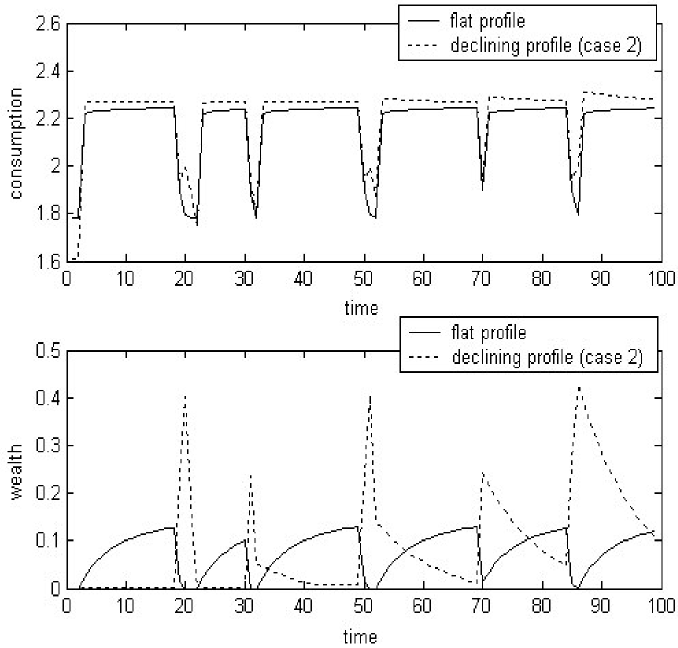

Figure 3: Dynamics of the consumption and the wealth

the employed will be short term unemployed.

When unemployment benefits are declining (case 2), the consumption drops less during the episodes of unemployment except for the first episode in comparison with the optimal rawlsian situation. As the unemployment benefits he gets if he becomes long term unemployed is smaller than the one he gets in the optimal rawlsian situation, the short term unemployed saves in order to smooth his consumption. The analysis of the decision rule of the short term unemployed shows it (Figure 5). When unemployment benefits are declining the short term unemployed accumulates until a level whereas the unemployed dissaves always in the optimal rawlsian situation.

In the optimal rawlsian situation the average wealth of the short term unemployed amounts to 0.0053 which represents 0.3% of his unemployment benefits. When unemployment benefits are declining (case 2) the average wealth is equal to 0.269 which represents 12.5% of the short term unemployment benefits.

The analysis of the wealth dynamics (figure 3) confirms it. The unemployed dissaves during the unemployment episode in the optimal rawlsian situation. When unemployment benefits are declining (case 2) the short term unemployed saves for a precautionary motive. When he becomes

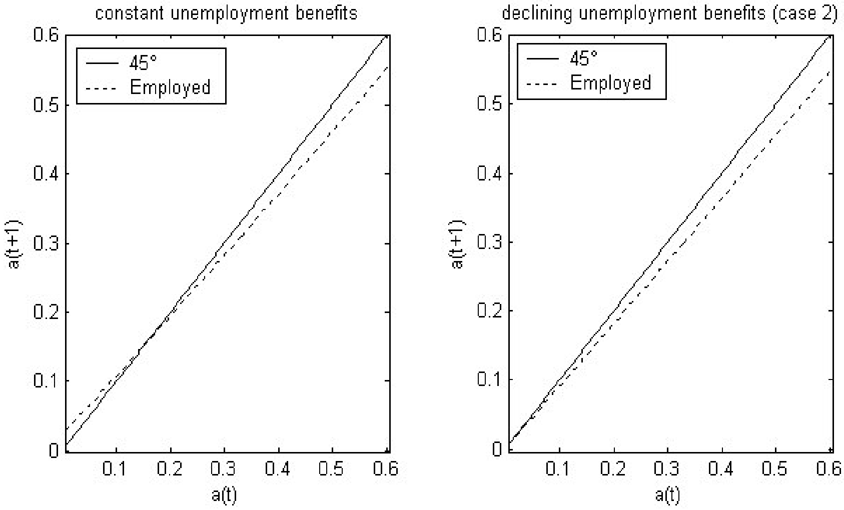

Figure 4: Decision rule of the employed

long term unemployed, he dissaves in order to smooth his consumption as the enlargement of the third episode shows (figure 6). The introduction of a generous unemployment benefit at the beginning of the unemployment period (t = 49 to 51) leads the short term unemployed to save. When the unemployment episode expands ($t = 51$ to $t = 52$), he becomes long term unemployed and dissaves in order to support his consumption to a greater level than the one he would get in the optimal rawlsian situation. Because the short term unemployed saves the number of liquidity constrained unemployed decreases. In the optimal rawlsian situation 79% of the unemployed are without wealth. They are only 48% when unemployment benefits are declining (case 2).

The introduction of this declining profile of unemployment benefits raises efficiency. The unemployment rate decreases. It goes from 11.52% (optimal rawlsian situation) to 10.44% (case 2 of the table 6). The decline in unemployment rate increases the average intertemporal utility (Table 6 line 2). As the decline in unemployment benefits arises quickly and the drop in income is important, the short term unemployed is encouraged to increase the intensity of his job search effort and all the more as he has saved less when he was employed. In the optimal rawlsian situation, the job search effort of the unemployed is equal to 0.0027. When unemployment benefits are declining the short term unemployed increases his job search effort in order to avoid long term unemployment. His job search effort is equal to 0.0043 which corresponds to an increase of 60%. Moreover, the job search effort of the long term unemployed becomes higher because the long term replacement ratio

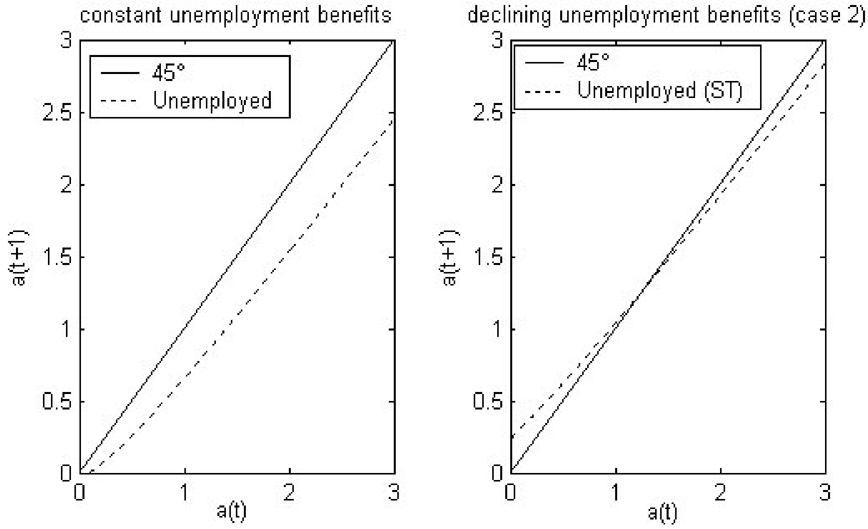

Figure 5: Decision rule of the unemployed

is smaller than the optimal rawlsian replacement ratio. Finally the efficiency gain is all the more as ρ is high.

Table 7: Consumption loss not to be to the optimal utilitarian unemployment benefit

$\phi = 66\%$	$\Delta\widetilde{C}/\widetilde{C}$
$\rho = 0.8$, $\theta = 87\%$	-0.316%
$\rho = 0.9$, $\theta = 87.35\%$	-0.311%
$\rho = 1$, $\theta = 87.55\%$	-0.298%

The loss of consumption due to the setting of the replacement ratio to its optimal rawlsian level reduces (table 7) thanks to the introduction of this declining profile of unemployment benefits. The consumption loss not to be to the optimal utilitarian level amounts henceforth to 0.30% against 0.94% in the optimal rawlsian situation.

It appears that the short term replacement ratio must be high if we do not wish the unemployed suffers from a fall in his consumption. Moreover, the short term unemployment benefit must be short and followed by a smaller unemployment benefit to prevent unemployment from lasting. From this point of view, it appears that this declining profile enables to optimize the trade off between efficiency and equity.

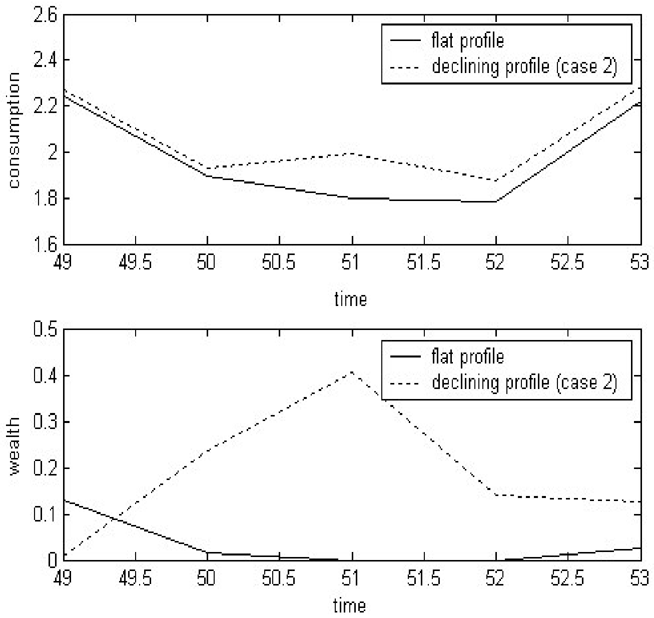

Figure 6: Enlargement of the third episode of unemployment

5 Robustness

The goal of this section is to analyze the effect of the elasticity of the average unemployment duration with respect to unemployment benefits on the results. To do this, we set the elasticity of the average unemployment duration with respect to unemployment benefits to 0.71. It requires to increase the elasticity of the probability to exit of unemployment with respect to the effort φ. As we want to reproduce an unemployment rate of 10%, it is necessary to reduce γ. The other parameters are unchanged.

Table 8: Calibration of parameters

β	σ	q	δ	α	A	θ	φ	γ	r
0.985	2	0.0334	0.03	0.36	1	0.6	0.28	5.13	0.0025

5.1 Optimal level of unemployment benefits

The increase in the elasticity of the average unemployment duration with respect to unemployment benefits modifies the optimal level of unemployment benefits according to utilitarian and rawlsian social welfare criteria.

Table 9: Optimal level of unemployment benefits

θ	0.2	0.3	0.4	**0.43**	0.5	**0.6**	0.7
u (%)	7.69	8.05	8.51	**8.67**	9.12	**10**	11.49
τ (%)	1.665	2.63	3.72	**4.085**	5.01	**6.67**	9.08
cf (%)	3.23	7.1	13.56	**15.65**	23.81	**40.31**	76.30
$\overline{a}$	5.44	4.08	2.85	**2.52**	1.78	**0.88**	0.20
λ	2.51	2.64	2.80	**2.85**	3.01	**3.33**	3.89
$\Delta\widetilde{C}/\widetilde{C}_{\xi=0}$ (%)	0.12	0.23	0.29	**0.30**	0.26	**0**	-0.81
$\Delta\widetilde{C}/\widetilde{C}_{\xi\to\infty}$ (%)	-10.83	-6.50	-3.59	**−2.88**	-1.46	**0**	0.61

The optimal utilitarian replacement ratio is now equal to 43% of the wage. The increase in the elasticity of the average unemployment duration with respect to unemployment benefits exacerbates the negative effect that unemployment benefits exert on the job search effort. When the replacement ratio increases from 60% to 70% the unemployment rate increases from 10% to 11.49% (Table 9). When the elasticity of the average unemployment duration with respect to unemployment benefits amounts to 0.58% the unemployment rate goes only from 10% to 11.17% (Table 3).

The optimal rawlsian replacement ratio decreases when the elasticity of the average unemployment duration with respect to unemployment benefits is equal to 0.71. It amounts to 70% of the wage in lieu of 72% of the wage. The increase in the elasticity of the average unemployment duration with respect to unemployment benefits reduces the number of liquidity constrained unemployed. 40.4% of unemployed are without wealth when the elasticity of the average unemployment duration with respect to unemployment benefits is equal to 0.58. They are only 40.31% of the unemployed when the elasticity of the average unemployment duration with respect to unemployment benefits is equal to 0.71.

The optimal utilitarian replacement ratio decreases more than the optimal rawlsian replacement ratio. The trade off between efficiency and equity is modified.

Table 10: Gain/Loss of consumption

$\theta = 43\% \to \theta = 70\%$	$\Delta\widetilde{C}/\widetilde{C}$
the average agent	-1.11%
the rawlsian agent	3.59%

When the elasticity of the average unemployment duration with respect to unemployment benefits increases, setting the replacement ratio to its optimal rawlsian level leads to a higher increase in consumption of the rawlsian agent equal to 3.59%. The average agent undergoes a higher loss of consumption equal to 1.11%. The increase in the elasticity of the average unemployment duration with respect to unemployment benefits exacerbates the trade off between efficiency and equity.

5.2 Effect of the declining unemployment benefits

In this section we assess the impact of the introduction of a declining profile of unemployment benefits when the elasticity of the average unemployment duration with respect to unemployment benefits increases. The table (11) calls back the characteristics of the optimal rawlsian situation (the replacement ratio is constant over time and set to its optimal rawlsian level equal to 70% of the wage).

Table 11: Characteristics of the optimal rawlsian situation

	$\theta = 70\%$
u (%)	11.49%
λ	3.89
$\overline{a}$	0.20
$\overline{a}_e$	0.2239
$\overline{a}_u$	0.0166
h_m	0.0079
cf (%)	76.30
τ (%)	9.08

The increase in the elasticity of the average unemployment duration with respect to unemployment benefits modifies the declining profile which guarantees for the rawlsian agent the same intertemporal utility as in the optimal rawlsian situation. It reduces the value of the long term replacement ratio ϕ which guarantees for the rawlsian agent the same intertemporal utility as in the optimal rawlsian situation. It amounts henceforth to 62%. The short term replacement ratio θ must be higher to have an increase in welfare of the average agent. The efficiency gain depends on the gap between ϕ and θ. The permanent consumption gain of the introduction of the declining profile of unemployment benefits is the highest for $\{\phi, \theta, \rho\} = \{62\%, 89.9\%, 1\}$. It suggests that the increase in φ and the decrease in γ influences the parameter ϕ which enables to guarantee for the rawlsian agent the same intertemporal utility as in the optimal rawlsian situation.

We find again the mechanisms stresses for the elasticity of the average unemployment duration

Table 12: Impact of the decline in unemployment benefit

$\phi = 62\%$	*case* 1 $\rho = 0,8$ $\theta = 89.09\%$	*case* 2 $\rho = 0,9$ $\theta = 89.20\%$	*case* 3 $\rho = 1$ $\theta = 89.9\%$
$\Delta\widetilde{C}/\widetilde{C}_{\xi=0}$ (%)	0.776	0.794	0.803
$\Delta\widetilde{C}/\widetilde{C}_{V_e}$ (%)	0.796	0.819	0.83
u (%)	10.18	10.15	10.12
λ	3.40	3.38	3.37
$\overline{a}$	0.1052	0.1377	0.1538
$\overline{a}_e$	0.0986	0.1348	0.1528
$\overline{a}_{u_{ST}}$	0.3951	0.4177	0.4373
$\overline{a}_{u_{LT}}$	0.0415	0.0444	0.0467
$\overline{h}_{ST}$	0.0120	0.0125	0.0131
h_{LT}	0.0131	0.0131	0.0131
cf (%)	43.20	45.21	46.50
τ (%)	8.08	7.98	7.911

with respect to unemployment benefits equal to 0.58. The employed benefits from a decrease in tax rate thanks to the introduction of this declining profile. The latter goes from 9.08% to 7.98% (case 2). Consequently, he can consume more. The permanent consumption gain due to the introduction of this declining profile of unemployment benefits amounts to 0.82% (case 2). The employed saves less for a precautionary motive. In the optimal rawlsian situation, his average wealth is equal to 0.224. It is only equal to 0.135 when the unemployment benefit is declining (case 2). Part of the saving effort is postponed to the moment where the employed will short term unemployed. The average wealth of the short term unemployed amounts to 0.418 when unemployment benefits are declining (case 2). In the optimal rawlsian situation the average wealth of the unemployed is only equal to 0.017.

The introduction of this declining profile of unemployment benefits enables to reduce the unemployment rate. The latter goes from 11.49% to 10.15% (case 2). It comes from the increase in the job search effort of the long and short term unemployed. The efficiency gain amounts to 0.79% in terms of permanent consumption. It is higher than that of the optimal rawlsian situation.

When the elasticity of the average unemployment duration with respect to unemployment benefits increases, the permanent consumption gain due to the introduction of this declining profile of unemployment benefits is higher. Nevertheless, the efficiency loss which persists (due to the fact that the replacement ratio is not to its optimal utilitarian level) is higher as shows the table 13.

Table 13: Consumption loss in comparison with the optimal utilitarian unemployment benefit

$\phi = 62\%$	$\Delta\widetilde{C}/\widetilde{C}$
$\rho = 0.8$, $\theta = 89.09\%$	-0.346%
$\rho = 0.9$, $\theta = 89.20\%$	-0.328%
$\rho = 1$, $\theta = 89.9\%$	-0.318%

6 Discussion

In our model we have assumed that wages are exogenous for the sake of simplicity. When wages are endogenous Cahuc and Lehmann [2000] show that the decrease in unemployment rate due the introduction a declining profile of unemployment benefits is smaller. Moreover the permanent consumption loss that the long term unemployed undergoes is higher. To give up this assumption should reduce the efficiency gain of the introduction of the declining profile of unemployment benefits. The introduction of a declining profile will lead the insiders to bargain a higher wage which will reduce the decrease in unemployment rate. Nevertheless the analysis of Costain [1997] enables to doubt. He builds a general equilibrium job search model with precautionary saving. Agents when they are unemployed get an unemployment benefit during two periods. The exit of unemployment depends on the job search effort and is source of disutility. Firms hire workers purchase physical capital and pay taxes to finance unemployment benefits. Their capital corresponds to the saving of the households. A matching function relates unemployment rate, job search effort and hiring expenditure. The wage is the result of the process of the bargaining. The analysis of the effect of the generosity of unemployment benefits run by Costain [1997] reveals that a less generous unemployment benefits decreases more the unemployment rate when wages are endogenous in comparison with the situation where wages are exogenous. It suggests that the introduction of a declining profile of unemployment benefits in this framework would lead to a higher decrease in unemployment rate when wages are endogenous. It is not sure that giving up the assumption of exogenous wage leads ineluctably to a smaller efficiency gain.

7 Conclusion

This paper has reconsidered the trade off between efficiency and equity as regards unemployment insurance. Is it possible to optimize efficiency and equity and by which policy ? Can we achieve it thanks to a declining profile of unemployment benefits ? To answer these questions we have built a job search model including precautionary saving calibrated on French data. The characterization of the optimal level of unemployment benefits according to the utilitarian and rawlsian welfare criteria has revealed a trade off between efficiency and equity. Yet, the introduction a declining profile of unemployment benefits, under some conditions, has raised efficiency without lowering the intertemporal utility of the rawlsian agent. It required a short term replacement ratio which is more generous than the one of the optimal rawlsian replacement ratio then a long term replacement ratio which is less generous than the optimal rawlsian replacement ratio. As the income of the short term unemployed was quite close to the one of the employed, the latter saved less. Thus, the employed held less wealth. Moreover, the generosity of unemployment benefits at the beginning of the unemployment episode led the short term unemployed agent to save whereas he always dissaves in the optimal rawlsian situation. When he became long term unemployed, he could dip into one's precautionary saving to support his consumption. The introduction of a very generous short term unemployment benefit had not disincentive effects because the period during which the short term unemployed got the unemployment benefit was very short. The drop in income due to the decline in unemployment benefits led the unemployed to search more a job.

We have obtained these results in a simple framework. The analysis disregards the human capital depreciation and the decline in job search efficiency as soon as the unemployment episode lasts. It will be interesting to deepen this result in a more realistic theoretical framework. Nevertheless because we would stress the interest to take into account the mechanism of precautionary saving, we have seemed preliminary to run the analysis in a model which is close to that of Cahuc and Lehmann [2000].

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8 Annexe

8.1 Properties of the job search effort function

8.1.1 Constant unemployment benefits

Impact of γ, φ and $V(a', e) - V(a', u)$ on the job search effort h

- Impact of γ on the job search effort h

$$\frac{dh}{d\gamma} = -\frac{\left[\varphi\beta\left(V(a', e) - V(a', u)\right)\right]^{\frac{1}{1-\varphi}}}{(1-\varphi)\gamma^{\frac{1}{1-\varphi}+1}} = -\frac{h}{(1-\varphi)\gamma}$$

By assumption, $h \in [0; 1]$, $\varphi \in]0; 1[\Longrightarrow 1 - \varphi \in]0; 1[$

We deduce:

$$\frac{dh}{d\gamma} < 0$$

- Impact of $V(a', e) - V(a', u)$ on the job search effort h

$$\begin{aligned} \frac{dh}{d\left(V(a', e) - V(a', u)\right)} &= \left(\frac{\varphi\beta}{\gamma}\right)^{\frac{1}{1-\varphi}} \frac{\left[V(a', e) - V(a', u)\right]^{\frac{1}{1-\varphi}-1}}{(1-\varphi)} \\ &= \frac{h}{(1-\varphi)\left[V(a', e) - V(a', u)\right]} \end{aligned}$$

By assumption, $h \in [0; 1]$, $\varphi \in]0; 1[\Longrightarrow 1 - \varphi \in]0; 1[$. Moreover, $(1 - \tau) > \theta \Longrightarrow V(a', e) - V(a', u) > 0$. We deduce:

$$\frac{dh}{d\left(V(a', e) - V(a', u)\right)} > 0$$

- Impact of φ on the job search effort h

$$\frac{dh}{d\varphi} = h\left(\frac{\ln\left(\frac{\varphi\beta\left(V(a', e) - V(a', u)\right)}{\gamma}\right)}{(1-\varphi)^2} + \frac{1}{(1-\varphi)\varphi}\right) = \frac{h(\ln h + \frac{1}{\varphi})}{(1-\varphi)}$$

$\frac{dh}{d\varphi} > 0 \Longleftrightarrow \ln h + \frac{1}{\varphi} > 0 \Longleftrightarrow h > \exp(-\frac{1}{\varphi})$

The impact of φ on the job search effort h depends on the value of φ. For a same level of effort, the probability to exit of unemployment decreases when φ increases. The exit of unemployment requires a higher job search effort. However, a higher job search effort is source of desutility. Moreover, the weaker φ is, the smaller the limit $\exp(-\frac{1}{\varphi})$ is. It indicates that for small values of φ, an increase in this parameter will increase the job search effort h.

8.1.2 Declining unemployment benefits

Impact of γ, φ, ρ, $V(a',e)-V(a',u_{CT})$ and $V(a',u_{CT})-V(a',u_{LT})$ on the job search effort h_{CT}

- Impact of ρ on the job search effort h_{CT}

$$\begin{aligned}\frac{dh_{CT}}{d\rho} &= \left(\frac{\varphi\beta}{\gamma}\right)^{\frac{1}{1-\varphi}} \frac{\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\}^{\frac{1}{1-\varphi}-1}}{(V(a',u_{CT})-V(a',u_{LT}))^{-1}(1-\varphi)} \\ &= \frac{(V(a',u_{CT})-V(a',u_{LT}))h_{CT}}{(1-\varphi)\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\}}\end{aligned}$$

By assumption, $h_{CT}\in[0;1]$, $\varphi\in]0;1[\Longrightarrow 1-\varphi\in]0;1[$. Moreover:

$$\left.\begin{array}{c}\theta>\phi\Longrightarrow V(a',u_{CT})-V(a',u_{LT})\\ \rho>0\\ (1-\tau)>\theta\Longrightarrow V(a',e)-V(a',u_{LT})\end{array}\right\}\Longrightarrow\left\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\right\}>0$$

We deduce:

$$\frac{dh_{CT}}{d\rho}>0$$

- Impact of γ on the job search effort h_{CT}

$$\frac{dh_{CT}}{d\gamma}=-\frac{[\varphi\beta\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\}]^{\frac{1}{1-\varphi}}}{(1-\varphi)\gamma^{\frac{1}{1-\varphi}+1}}=-\frac{h_{CT}}{(1-\varphi)\gamma}$$

Since $h_{CT}\in[0;1]$ and $1-\varphi\in]0;1[$, we have:

$$\frac{dh_{CT}}{d\gamma}<0$$

- Impact of $V(a',e)-V(a',u_{CT})$ on the job search effort h_{CT}

$$\begin{aligned}\frac{dh_{CT}}{d\left(V(a',e)-V(a',u_{CT})\right)} &= \left(\frac{\varphi\beta}{\gamma}\right)^{\frac{1}{1-\varphi}} \frac{\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\}^{\frac{1}{1-\varphi}-1}}{(1-\varphi)} \\ &= \frac{h_{CT}}{(1-\varphi)\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\}}\end{aligned}$$

We have shown that:

$$\left\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\right\}>0$$

By assumption $h_{CT} \in [0;1]$ and $1-\varphi \in]0;1[$. We deduce:

$$\frac{dh_{CT}}{d\left(V(a',e)-V(a',u_{CT})\right)} > 0$$

- Impact of $V(a',u_{CT})-V(a',u_{LT})$ on the job search effort h_{CT}

$$\begin{aligned}\frac{dh_{CT}}{d\left(V(a',u_{CT})-V(a',u_{LT})\right)} &= \left(\frac{\varphi\beta}{\gamma}\right)^{\frac{1}{1-\varphi}} \frac{\rho\left\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\right\}^{\frac{1}{1-\varphi}-1}}{(1-\varphi)} \\ &= \frac{h_{CT}}{\rho(1-\varphi)\left\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\right\}}\end{aligned}$$

We deduce:

$$\frac{dh_{CT}}{d\left(V(a',u_{CT})-V(a',u_{LT})\right)} > 0$$

- Impact of $V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))$ on the job search effort h_{CT}

Let be $x = V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))$

$$\begin{aligned}\frac{dh_{CT}}{dx} &= \left(\frac{\varphi\beta}{\gamma}\right)^{\frac{1}{1-\varphi}} \frac{\left\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\right\}^{\frac{1}{1-\varphi}-1}}{(1-\varphi)} \\ &= \frac{h_{CT}}{(1-\varphi)\left\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\right\}}\end{aligned}$$

By assumption $h_{CT} \in [0;1]$ and $1-\varphi \in]0;1[$. Moreover, we have shown that:

$$\left\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\right\} > 0$$

We deduce:

$$\frac{dh_{CT}}{d\left\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\right\}} > 0$$

- Impact of φ on the job search effort h_{CT}

$$\begin{aligned}\frac{dh_{CT}}{d\varphi} &= h_{CT}\left(\frac{\ln(\frac{\varphi\beta\left\{V(a',e)-V(a',u_{CT})+\rho(V(a',u_{CT})-V(a',u_{LT}))\right\}}{\gamma})}{(1-\varphi)^2} + \frac{1}{(1-\varphi)\varphi}\right) \\ &= \frac{h_{CT}(\ln h_{CT} + \frac{1}{\varphi})}{(1-\varphi)}\end{aligned}$$

$\frac{dh_{CT}}{d\varphi} > 0 \Longleftrightarrow \ln h_{CT} + \frac{1}{\varphi} > 0 \Longleftrightarrow h_{CT} > \exp(-\frac{1}{\varphi})$

The impact of φ on the job search effort h_{CT} depends on the value of φ.

Impact of γ, φ, $V(a',e) - V(a',u_{LT})$ on the job search effort h_{LT}

- Impact of γ on the job search effort h_{LT}

$$\frac{dh_{LT}}{d\gamma} = -\frac{\left[\varphi\beta\left(V(a',e) - V(a',u_{LT})\right)\right]^{\frac{1}{1-\varphi}}}{(1-\varphi)\gamma^{\frac{1}{1-\varphi}+1}} = -\frac{h_{LT}}{(1-\varphi)\gamma}$$

Since $h_{LT} \in [0;1]$ and $1-\varphi \in]0;1[$, we have:

$$\frac{dh_{LT}}{d\gamma} < 0$$

- Impact of $V(a',e) - V(a',u_{LT})$ on the job search effort h_{LT}

$$\begin{aligned}
\frac{dh_{LT}}{d\left(V(a',e) - V(a',u_{LT})\right)} &= \left(\frac{\varphi\beta}{\gamma}\right)^{\frac{1}{1-\varphi}} \frac{\left[V(a',e) - V(a',u_{LT})\right]^{\frac{1}{1-\varphi}-1}}{(1-\varphi)} \\
&= \frac{h_{LT}}{(1-\varphi)\left[V(a',e) - V(a',u_{LT})\right]}
\end{aligned}$$

By assumption $h_{LT} \in [0;1]$ and $1-\varphi \in]0;1[$. Moreover, $(1-\tau) > \phi \Rightarrow V(a',e) - V(a',u_{LT}) > 0$

We deduce:

$$\frac{dh_{LT}}{d\left(V(a',e) - V(a',u_{LT})\right)} > 0$$

- Impact of φ on the job search effort h_{LT}

$$\begin{aligned}
\frac{dh_{LT}}{d\varphi} &= h\left(\frac{\ln\left(\frac{\varphi\beta\left(V(a',e) - V(a',u_{LT})\right)}{\gamma}\right)}{(1-\varphi)^2} + \frac{1}{(1-\varphi)\varphi}\right) \\
&= \frac{h_{LT}(\ln h_{LT} + \frac{1}{\varphi})}{(1-\varphi)}
\end{aligned}$$

$\frac{dh_{LT}}{d\varphi} > 0 \Longleftrightarrow \ln h_{LT} + \frac{1}{\varphi} > 0 \Longleftrightarrow h_{LT} > \exp(-\frac{1}{\varphi})$

The impact of φ on the job search effort h_{LT} depends on the value of φ.