Wage Progression, Mobility and Unemployment Insurance System

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Abstract

Ascendent job mobility is traditionally considered as a major source of wage progression over the life cycle. In France, high wage progression over the life cycle and low workers' mobility rate coexist. To solve this puzzle, we investigate the possible effect of a well spread institution in Europe, wage-indexed unemployment benefits, on wage progression. We introduce a finite horizon, human capital accumulation, and endogenous unemployment benefits into Mortensen (1998)'s wage posting game, with frictions, on the job search and endogenous matches' productivity. We calibrate the model on French data and show that wage-indexed unemployment benefits increase workers' market power increasingly with age and therefore contribute significatively to wage progression. In the same time, by reducing the number of job openings and wage dispersion, their presence reduces workers' mobility. Eventually, we show that in such life cycle framework, wage indexed unemployment benefits can be optimal and, in the case of France, are optimal for a replacement rate around 70%.

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1 Introduction

European[1] labor markets are known for their relatively low job to job mobility rates compared to the U.S.'s. In France for instance, a worker has on average 9% of chance to move from one job to an other in one year, for 21% for his U.S. counterpart[2]. Yet, whereas job to job mobility is claimed to be the main mechanism behind wage progression both through actual moves (Burdett and Mortensen (1998) and Mortensen (1998)) and within a job through competition with counteroffers[3](Postel-Vinay and Robin (2002), Burdett and Coles (2010), Burdett and Coles (2003) and Beffy et al. (2006)), average wage progression over the life cycle is higher in France than in the U. S.: around 1.34% per year in France for 1.25% in the U.S.. Besides, French wage progression occurs all over the life cycle as figure 1 shows it, whereas workers' mobility in France decreases at the end of the life cycle: the 46 to 59 years old workers' mobility rate is only 6%. Contrary to what theory so far teaches us, weak workers' mobility is therefore not necessarily detrimental to wage progression.

European[4] labor markets differ from the U.S.'s by the strong presence of institutions. Among them, the European unemployment insurance has the specificity to be indexed backward and to allow workers to accumulate rights to benefits all over their working life. This institutional environment allows workers to progressively improve their outside options and could account for wage progression without high workers' mobility. Building a framework allowing to study the age-dependant effect of institutions is therefore necessary to understand wage progression in European countries. Life-cycle literature is developing yet life cycle equilibrium models most of the time exclude institutions (Bagger et al. (2012), Menzio et al. (2012)). The effect of institutions on the labor market outcomes have already been widely studied (Nickell (1997), Chéron and Langot (2010), Ljungqvist and Sargent (1998), Ljungqvist and Sargent (2008), Blanchard and Wolfers (2000), and Saint-Paul (2009)) yet not in a life cycle equilibrium framework.

In this paper, we search to understand how wage-indexed unemployment benefits (WIUB) affect labor market and in particular wage progression through its effect on workers' market power and workers' mobility. To do so, we build an equilibrium search model based on Mortensen (1998)'s, with a stylized three age classes life cycle, general human capital and WIUB. We decompose wage progression into three channels: this institutional channel (WIUB), the human capital channel and the wage game channel

[1]At the exception of United Kingdom and Ireland

[2]Data for France from French Labor Force Survey 2011, and for the U.S. from SIPP 2001 computed by Menzio et al. (2012)

[3]Note that in literature workers' mobility increase wage progression. As a consequence, returns to seniority are also found smaller in France than in the U.S. (Beffy et al. (2006))

[4]At the exception of United Kingdom and Ireland

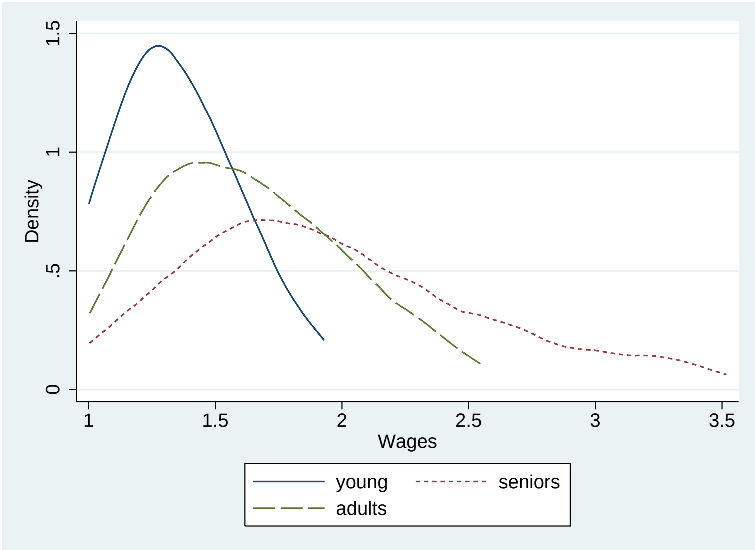

Figure 1: Wage distribution for French salaried men by age class (First 95%), expressed in French minimum wage

(pure age effect[5]).

Mortensen (1998) shows that augmenting Burdett and Mortensen (1998)'s wage posting game with firms' endogenous productivity resulting from training investments, allows to generate a realistic wage distribution[6], not rejected by the data (Chéron et al. (2008)). Labor market outcomes change greatly over life cycle: there exists a large difference in employment situation between the beginning and the end of the life-cycle. Agents enter in the labor market as unemployed and the youngest employed workers have not had the time to improve their careers. In opposite, at the end of the life cycle, workers are mostly insiders and their working experience has allowed them to find better job opportunities and possibly to accumulate human capital through learning by doing (Becker (1964)). In that context, WIUB reinforce these insiders' market power by raising workers' outside options with age. Yet they also act as implicit taxation for firms which reduce their job openings, and therefore diminish workers' opportunity of ascendent mobility. This backward dynamic is combined with the agents' forward looking behaviors: the older workers' short horizon reduces firms' willingness to invest in job openings, training and wage provided the difficulty to recoup investment costs (Hairault et al. (2010), Chéron et al. (2011)). General human capital obsolescence can also deter older workers' labor market situation (Aubert et al. (2004)). The model developed here allows us to understand the overall contribution of each channel, taking

[5] when workers are assumed evenly productive

[6] With only a very mild restriction on the shape of the production function: a decreasing return of human capital allows to reproduce the hump shape of the wage distribution

into account these two dynamics. Besides, Mortensen (1998) shows that the wage posting game designed by Burdett and Mortensen (1998) generates suboptimal training spending due to too high a workers' turnover. He shows that social optimality can yet be restored by reducing firms' monopsony power thanks to a minimum wage for instance. Thanks to our model, we also can assess which shape of unemployment benefits can be appropriate to improve social welfare when life cycle is taken into account.

Our model is calibrated and validated on French data (Enquête Emploi 2011). We use the calibrated model to achieve the wage progression channel decomposition. WIUB both raise workers' outside options increasingly with age and reduce the occurrence and outcomes of job to job mobility. According to our findings, in spite of this negative effect on workers' mobility, the former dominates and WIUB contributes to wage progression. This contribution occurs inhomogenously over the life cycle: they account for 16% of wage progression in the first part of life cycle and 40% in the second part. The WIUB-induced wage progression in France therefore partly substitute the job to job mobility-induced wage progression[7]. The price to pay to this wage progression is a sharp increase in seniors' unemployment: about 4 points of %. Yet we show that on the French economy, WIUB still allow to improve social optimum more than a flat unemployment benefits: the maximum social welfare is reached when the replacement rate is equal to 70%, which is above French replacement rate yet close to what most European countries have implemented[8]. The intuition behind this results is that decreasing workers' turnover on seniors' market requires higher unemployment benefits than on younger workers' market since due to their experience seniors are already offered higher wages in the laissez-faire economy. In this context, WIUB are better-designed than flat UB to have a significant effect on firms' monopsony power on each market.

The human capital channel contributes positively to wage progression all over the workers' life cycle: learning by doing dominates human capital depreciation. Contrary to Bagger et al. (2012), our finite horizon framework allows us to highlight the crucial role of human capital accumulation in the second part of the working life since it allows to compensate the seniors' unfavorable condition induced by their short horizon. Menzio et al. (2012) already show, in a directed search model, that the horizon effect can curve wage profile when assuming a linear human capital accumulation.

[7]Of course, French labor market is characterized by other strong institutions like employment protection. We can note that even if we do note take into account this institution in this paper, it is intuitive that this institution would reinforce these results. Employment protection increases job tenure; it therefore on one side raises the matches' specific human capital, the wages and eventually the unemployment benefits of workers, and one the other side reduces the workers' mobility.

[8]Belgium (0.65 then digressive), Spain (0.7 then digressive), Portugal (0.65 then digressive), Germany (between 0.6 and 0.67), Switzerland (between 0.7 and 0.8), Luxembourg (between 0.8 and 0.85), Denmark (0.9)

In the second section, we present the model. The equilibrium definition is given by the third section. Section four is dedicated to the description of the empirical approach and section 5 gives the results. Section 6 concludes.

2 The model

2.1 Labor market setup and main notations

We introduce life-cycle in the Burdett and Mortensen (1998) theoretical framework. The life-cycle is cut in three working life periods, namely the young, the adults, and the seniors. We choose the three age classes segmentation in order to stay close to the main characteristics of the life-cycle data: the integration to the labor market, the intermediate period, and the seniority. All variables depending on the workers' age class are indexed by i, which can take the value $i = y$ for the young, $i = a$ for adults and $i = s$ for seniors. Age classes changes are stochastic and workers change age class with the probability p. As this probability is the same between each age class, in steady state the mass of workers noted m of each age class is the same. As in Burdett and Mortensen (1998), we only consider steady state and assume time is continuous. Between these three age periods, we allow workers to accumulate human capital. This accumulation affects the training cost paid by the firms β_i and their productivity at the workplace y_i. The trend of β_i and y_i over the workers' life is a priori unknown and is to be estimated by the model.

As in Burdett and Mortensen (1998), wages are posted by firms and there is no negotiation over them. Firms set wages in order to maximize their profits knowing that they cannot observe the status or the reservation wage of workers: information is imperfect. Firms can direct their search on workers' age class through experience requirements. When a firm enters one of the three markets, production generated by employing a worker from the two other markets is null. Therefore, workers do not cheat. When workers change age class, the contract is not broken unless the workers' value of keeping the contract obtained in the previous age period becomes lower than the value of being unemployed in his current age period. Firms which target the youth can therefore be exposed to employ senior workers eventually. As in Mortensen (1998), firms can create jobs with different levels of productivity depending on their initial and costly investment in specific human capital (training). Workers search for a job while unemployed and employed. The arrival frequency of job offers are λ_i^0 for the unemployed and λ_i for the employed. On the firms' side, firms receive applicants from unemployment with the frequency q_i^0 and from employment with the frequency q_i. Contact probabilities depend therefore on both their age and status and result from a matching process depending on the number of vacancies in each market. There are job destruction shocks: each employed worker is displaced into unemployment according to a Poisson process with parameter $s > 0$. All agents are risk neutral. We assume there exists an institutional minimum wage $\underline{w}$ which bounds below the wage distribution. Consistently with the French system, unemployed workers with a working experience are eligible to a benefit b depending on their previous wage at the rate ρ. To give the model the possibility to also model a Beveridge system, we add a flat allocation all. We use the specification of Chéron and Langot (2010) and the shape of the unemployment benefits is given by[9] :

$$b(w) = \rho \times w + all \tag{1}$$

If $\rho = 0$, either all is such that the unemployed reservation wage is below minimum wage and unemployment benefits has no effect on agent behaviors or all is such that the unemployed reservation wage is above minimum wage and minimum wage in the economy switches to this reservation wage. When $\rho = 0$, unemployment benefits have therefore no specific effect on labor market equilibrium. In this framework, studying the specific effect of unemployment benefits supposes to study the effect of WIUB that is of b when ρ is positive: the value of the parameter ρ gives the effect of the institution. Unemployment benefits are financed by a lump tax noted τ that all workers whether employed or unemployed pay.

2.2 Workers' behavior

The asset values of being employed at a wage w are noted $V_i^e(w)$ and solve in each age class:

$$rV_i^e(w) = w - \tau + \lambda_i \int_w^{\overline{w}} (V_i^e(x) - V_i^e(w)) dF_i(x) - s(V_i^e(w) - V_i^u(b(w))) - p(V_i^e(w) - V_{i+1}^e(w)) \tag{2}$$

We denote by r the actualization rate. Whatever the age class, the expected reward for being employed at a wage w is first composed by the wage flow w net of taxes. Then if the worker meets a firm offering a wage above w, he resigns and earns the difference between his current asset value and the value associated to this new wage. The cumulative distribution function of wage offered by firms is noted $F_i(w)$. Given the on the job search assumption, it is straightforward that high paid jobs last longer than low paid jobs: the resigning probability is a decreasing function of the wage. With the frequency s, his job is destroyed and he looses the difference between his current asset value and the asset value of being unemployed[10] noted V_i^u. Given the life cycle dimension of the model, workers can change age class and get or lose the difference

[9] We assume that for an unemployed with no working experience, $w = 0$

[10] The asset value of being unemployed will be proved to be always below the asset value of being employed later in this subsection

between the asset values of being employed at the wage w of the two age classes, or for seniors the asset values of being employed and being retired noted V_r such that $V^e_{s+1}(w) = V_r$ [11]

The asset values of unemployed workers receiving the benefit b are noted $V_i^u(b)$ and are given by:

$$rV_i^u(b) = b - \tau + \lambda_i^0 \int_{R_i(b)}^{\overline{w}} (V_i^e(x) - V_i^u(b(w)))dF_i(x) - p(V_i^u(b) - V_{i+1}^u(b)) \quad (3)$$

The expected reward for being unemployed is first composed by the flow of unemployment benefit b net of taxes. Then, if the worker meets a firm offering a wage above $R_i(b)$, the reservation wage induced by b, he accepts the offer and earns the difference between his current asset value and the value associated to being employed at this new wage. As employed workers, workers can change age class and get or lose the difference between the asset value of unemployed workers of the two age classes or for seniors the asset values of being unemployed and being retired such that $V^u_{s+1}(b) = V_r$. We can deduce from equations 2 and 3, the reservation wage of a worker receiving the benefits b by setting for each workers' age class: $V_i^u(b) = V_i^e(R_i)$.

$$R_i(b) = b + (\lambda_i^0 - \lambda_i) \int_{R_i}^{\overline{w}} (V_i^e(x) - V_i^e(R_i))dF_i(x) + s(V_i^u(b) - V_i^u(b(R_i))) + p(V_{i+1}^u(b) - V_{i+1}^e(R_i))$$

As in Chéron and Langot (2010), the workers' reservation wages and therefore the unemployment duration raise with the level of unemployment benefit b. The second term of these reservation wages shows that the workers also take into account the difference of opportunity between the status of unemployed and employed $\lambda_i^0 - \lambda_i$ to set their reservation wage[12]. The term $V_i^e(R_i) - V_i^u(b(R_i))$ accounts for the fact that the worker anticipates a possible job destruction and the loss it would generate. Even if $\lambda_0 = \lambda$, workers will reject a wage equal to b since this new wage will generate benefits lower than b, in the case of a job loss[13]. Life cycle dimension also affect reservation wage setting: If for example an adult knows that seniors' reservation wage is higher than the adults', he will anticipate that on a long run the status of employed is less valuable and will be more reluctant to accept a job as an adult and his reservation wage will increase.

[11]Note that we assume here that the probability to retire does not depend on the workers' status nor on the wage earned. In reality unemployed workers retire earlier than employed workers, Hairault et al. (2012) discuss this issue.

[12]This is discussed in Burdett and Mortensen (1998)

[13]This effect is discussed in Chéron and Langot (2010)

2.3 Firms' behavior

Firms' expected profit associated to the wage w and the level of specific human capital k on each market is given by:

$$\Pi_i(w,k) \quad = \quad h_i(w)(J_i(w,k) - \beta_i k) \tag{4}$$

Firms hire a worker at the frequency $h_i(w)$. Once the worker hired, firms can expect the surplus $J_i(w,k)$ net of the training cost $\beta_i k$ induced by the chosen level of human capital and depending on the first proxy for human capital accumulation (HKA). Firms' hiring frequency is the frequency at which they meet a worker, employed or unemployed, ready to accept the wage w. and depends on the cumulative distribution of workers according to their unemployment benefits $U_i(b)$ if unemployed and according to their wage $G_i(w)$ if employed, as it follows:

$$h_i(w) \quad = \quad q_i^0 \overline{u_i} U_i(R_i^{-1}(w)) + q_i(m - \overline{u_i})G_i(w)$$

$\overline{u_i}$ is the mass of unemployed and $u_i * U_i(R_i^{-1}(w))$ the number of unemployed workers accepting offers greater than w. $\overline{m - \overline{u_i}}$ is the mass of employed and $(m - \overline{u_i})G_i(w)$ the number of employed workers accepting offers greater than w. The higher the wage offer, the larger the labor supply. Firms' expected surplus induced by employing a worker of each age class depends on w and k and is given by:

$$J_y(w,k) \quad = \quad \frac{y_y(k) - w + pJ_a(w,k)}{r + p + s + \lambda_y(1 - F_y(w))} \tag{5}$$

$$J_a(w,k) \quad = \quad \frac{y_a(k) - w + pJ_s(w,k)}{r + p + s + \lambda_a(1 - F_a(w))} \tag{6}$$

$$J_s(w,k) \quad = \quad \frac{y_s(k) - w}{r + p + s + \lambda_s(1 - F_s(w))} \tag{7}$$

When the production function is given by:

$$y_i(k) = y_i + \left(\frac{q}{\alpha}\right) k^\alpha \tag{8}$$

The parameters q and α are strictly positive exogenous parameters and y_i, a second proxy of HKA. The margin of the match evolves with the age of the worker: If firms hire a young, the match's productivity is first: $y_y + \left(\frac{q}{\alpha}\right) k^\alpha$, then it becomes: $y_a + \left(\frac{q}{\alpha}\right) k^\alpha$, and eventually: $y_s + \left(\frac{q}{\alpha}\right) k^\alpha$ [14]. Equation 5 suggests that the expected surplus of employing a young depends on the expected surplus of the other age class since firms anticipate that when workers age, they face different opportunities.

Property 1. *The contribution of workers' productivity y_i to firms' profit increases with wages offered by firms.*

Proof. Straightforward after derivation of 4 according to y_i. □

[14] Naturally, this progression or regression occurs if the job is not destroyed before the worker changes age class

3 Equilibrium

In a wage posting game, firms' behavior is central. In this model, firms choose, which market to enter, the wage posted and the amount of specific human capital invested. The model equilibrium is reached when four distributions and the labor market tightness are stationary on the three markets in the same time. We therefore compute here:

1. The offered wage distribution of firms F_i by maximizing profit according to wage (section 3.1).
2. The specific human capital investments distribution k_i by optimizing training investment (section 3.2).
3. The wage distribution G_i by equalizing workers' flows (appendix B, page 28).
4. The unemployment benefit distribution U_i by equalizing unemployed workers' flows (appendix A, page 28).
5. The labor market tightness θ_i by assuming firms' free entry condition (section 3.3).

3.1 Wage maximization of profit

In this section, we present how firms choose to post wages. To better understand the intuition behind firms' wage game, we can assume firms enter successively each market. When there is only one firm on the market, its maximum instantaneous profit is reached at the lowest wage possible (here minimum wage). Then, the second firm entering the market would have necessarily interest to offer a wage slightly superior to the first one to be able to poach the employed workers...and so on for the other firms entering the market. Eventually, Burdett and Mortensen (1998) show that at equilibrium, this wage game generates a wage distribution on an interval $[\underline{w};\overline{w}]$. As firms increase their wage offer, their surplus decreases, yet simultaneously $F(w)$ increases, and therefore so does their hiring frequency and their expected job duration. As on each market $F_i(w)$ cannot be superior to 1, there exists a $\overline{w_i}$ above which firms have no interest to post wages[15]. The lowest wage on each market $\underline{w_y}$, $\underline{w_a}$ and $\underline{w_s}$ can be different. Without any regulation on the minimum wage, the lowest wage offered by firms on each market is the wage which maximizes the profit when $F_i(w) = 0$ [16]. As the shape of profit is different from one market to an other, it is likely that these minimum wages would

[15] The maximum offered wage is the wage allowing to reach the equiprofit when $F(w) = 1$

[16] By definition, w such that $F_i(w) = 0$ is the lowest wage in the economy since no offered wage is below it

also be different. If the institutional minimum wage $\underline{w}$ is above these wages, then they equal this minimum wage. Minimum wages can be computed as it follows:

$$\underline{w_i} = \max\{\underset{w}{\operatorname{argmax}}\, \underline{\Pi_i}(w), \underline{w}\} \tag{9}$$

with $\underline{\Pi_y}$, $\underline{\Pi_a}$ and $\underline{\Pi_s}$ the profit of firms offering the lowest wage on each market (when $F_i(w) = 0$).

Then, on each age market, firms spread their wage offer out in order to insure the equiprofit. The offered wage distribution F_i solves on $[\underline{w_i};\overline{w_i}]$:

$$\Pi_i(\underline{w_i}) = \Pi_i(w) \tag{10}$$

3.2 Training investment optimization

Profit maximization according to specific human capital gives the following optimal level of capital in function of wage:

$$k_i(w) = \left(\frac{\alpha q D_i(w)}{\beta_i}\right)^{\frac{1}{1-\alpha}} \tag{11}$$

with D_i the discounted expected job duration on each market:

$$D_s(w) = \frac{1}{r+p+s+\lambda_s(1-F_s(w))} \tag{12}$$

$$D_a(w) = \frac{1}{r+p+s+\lambda_a(1-F_a(w))}\,(1+D_s(w)) \tag{13}$$

$$D_y(w) = \frac{1}{r+p+s+\lambda_y(1-F_y(w))}\,(1+D_a(w)) \tag{14}$$

The optimal specific human capital level given by equation 11 is the result of a trade-off between the training cost (denominator) and the return of it in terms of productivity (numerator). The result of this trade-off is age-dependant by two aspects:

1. The expected job duration $D_i(w)$ raises the investment return and differs according to workers' age class, in particular:

   Property 2. *At equal λ_i and F_i, the job duration decreases with workers' age class.*

   Proof. Straightforward when rewriting 12,13 and 14 with $\lambda_i \equiv \lambda$ and $F_i \equiv F$. □

   Job to job mobility rate also affects expected job duration. Over life cycle, the return of training necessarily evolves.

2. The training cost β_i differs according to the general human capital level of the workers: the higher the level of human capital, the lower β_i. Whether accumulation or depreciation dominates, this cost can decrease or increase with age.

3.3 Labor market tightness

We assume firms and workers meet according to the following matching process:

$$M_i = v_i^{\eta}(\phi^0 u_i + \phi(m - u_i))^{1-\eta}$$

with η the matching function elasticity, v_i the number of vacancies, and ϕ^0 and ϕ^1 the search effectiveness of respectively unemployed and employed workers.

We set $\theta_i = \frac{v_i}{\phi^0 u_i + \phi^1 (m-u_i)}$, the labor market tightness on each market. The meeting frequencies between workers and firms are given by:

$$\lambda_i = \phi\theta_i^{1-\eta} \text{ and } \lambda_i^0 = \phi^0\theta_i^{1-\eta}$$
$$q_i = \phi\theta_i^{-\eta} \text{ and } q_i^0 = \phi^0\theta_i^{-\eta}$$

At equilibrium, firms enter each market as long as profit is superior to vacancy cost, noted c. Labor market tightness on each market therefore solves:

$$\Pi_i(\underline{w_i}, \theta_i) = c \tag{15}$$

Property 3. *When we assume the institutional minimum wage $\underline{w}$ is such that on each market $\underline{w} > \underline{w_i}$[17], the level of firms' equiprofit on each market decreases with the labor market tightness.*

Proof. By showing $\frac{\partial \Pi_i(\underline{w}, \theta_i)}{\partial \theta_i} < 0$. □

Corollary. *When workers are ex ante equally productive (equal β_i and y_i), workers' mobility decreases with workers' age.*

Proof. At equal productivity, profit decreases with age and firms create fewer vacancies on older workers' market (property 3). □

4 Empirical Approach

4.1 The data source

We use the 2011 French Labor Force Survey (Enquête Emploi) data to calibrate the model. Conducted yearly on 150 000 people by the INSEE[18], the French Labor Force Survey provides data such as professions, earnings, working hours and individual characteristics. We restrict our study on self male wage-earners in private sector. We choose to restrict attention to a rather homogenous group of workers in terms of educational

[17] This assumption allows a greater simplicity in the calculation

[18] Institut National de la Statistique et des Etudes Economiques

attainment since in our theoretical framework, workers start their working life as homogenous [19]. We focus on workers whose educational attainment is the high school degree because they are the largest homogenous group in the sample.

In 2012, males' average retirement age in France for private sector is slightly inferior to 60 years old (59.7)[20]. In 2010, the average labor market entry age for young whose educational attainment is high school degree is 20 years old[21]. As in the theoretical model, we define three age classes evenly long: the 20 to 33 years old, the 33 to 46 years old, and the 46 to 59 years old, and therefore focus on workers between 20 and 59 years old. We study wages in cross section. If the real economy were in steady state as in the theoretical economy described in the model, the cross section approach would cause no problem, yet as it is naturally not the case, this approach can show some limits. By studying the wage of different age classes at a time t, we mix the notion of age and generation. Therefore, the wage of an age class depends also of the education level of the generation. For instance, workers between 46 and 59 years old in 2011 have the education standards of the seventies. One could argue that to avoid this problem, we should follow a cohort of workers over their life cycle. Yet, this approach supposes to compare wages at periods where the institutional environment is different which can alter greatly our results. We therefore choose the cross section approach, aware of its limits. Besides, restricting our study to the workers whose educational attainment is close, protects us partly from the bias generated by this approach.

We deduce hourly wages from the "monthly earnings" and the "hours worked" by workers and express wage in institutional minimum wage (7.06 euros net). Wage distributions are presented by figures 1[22]. We deduce unemployment rate from "workers' status", and job to job mobility rate from the "change in profession, jobs or workplace". Unemployment benefits distribution presented in figure 3 is given by the "last unemployment benefits received"[23] and unemployment duration by "unemployment seniority". These data are presented in table 2.

[19] The dispersion generated by the ex ante workers' heterogeneity cannot therefore be captured by the model. This limit could be overcome by assuming an exogenous distribution of the ex-ante productivity of young workers: y_y.

[20] "Pensions at a Glance 2013", OCDE

[21] "Quand l'école est finie...Premiers pas dans la vie actived'une génération", 2010 survey, Céreq

[22] As workers are assumed ex ante homogenous in the model, the model cannot pretend to reproduce the extreme wages existing in the actual wage distribution. We therefore calibrate this model on the first 95 percentiles of the wage distribution of each age.

[23] associated to the ARE (Aide au Retour à l'Emploi) system which is the standard unemployment insurance system in France

4.2 The calibration and validation of the model

We set the model period to one year and the annual interest rate r to 4%. In the data, life periods last 13 years, we therefore set the probability to change age class to $\frac{1}{13}$. We normalize the institutional minimum wage and the young workers' training cost, β_y, since only the difference between β_y, β_a and β_s matters here. We set the matching function elasticity to 0.7 as recently estimated by Borowczyk-Martins, Jolivet, Postel-Vinay, (2011)[24]. In France, unemployment benefits is a ratio of the previous wage[25]. We therefore set *all* to zero and calibrate ρ to reproduce mean unemployment benefits. The exogenous destruction rate is calibrated so that to reproduce the aggregated unemployment rate of 7.6%. Our calibration supposes therefore that jobs are exogenously destroyed on average every 11.8 years. The matching process efficiency parameters for unemployed and employed workers are respectively calibrated on unemployment duration, 11.3 months and average job to job mobility rate, 8.9%. The production function parameters are calibrated on wage distribution moments: the parameter q is set in order to reproduce the mean wage, α, the median wage, and the human capital accumulation parameters β_a and β_s, respectively the ratio between the 90th centile of the adults' and young's wage distribution and of the seniors' and young's wage distribution. These last two moments allow to capture the shape of the second half of wage distribution since specific human capital investment accounts for the existence of high wages. The return to capital α is equal to what is found in Chéron and Langot (2010). Workers' productivity y_y, y_a and y_s, are set in order to reproduce the median of their respective wage distribution.

Our calibration results suggests human capital accumulation all over the life cycle: training costs and workers' productivity respectively decrease and increases over the life cycle. Note that these two components are necessary to fit correctly the data, without one of these parameters, there is a conflict between an accurate wage distribution shape and the increasing path of wage with age. Indeed, the observed shape of wage distribution can only be obtained by assuming firms' endogenous productivity. Yet, in that case, firms are induced to create lower quality jobs to seniors because of their shorter working horizon. To fit the data, training costs should decrease. Workers' productivity is needed to account for a part of the wage distribution translation with age. Table 1 sums up the calibration results.

Table 2 presents the model ability to reproduce the evolution of the main targeted moments over the three life periods as well as some new moments. We did not search to reproduce these new moments while calibrating the model, we therefore propose to

[24]New Estimates of the Matching Function, Working Paper

[25]57.4% for workers earning more than 135% minimum wage and between 62% and 57.4%, below

Fixed and institutional parameters			Targets'value
r	0.04	discounted rate	
p	1/13	working life duration	59 years
$\underline{w}$	1	Normalized	
β_y	1	Normalized	
η	0.7	Fixed	
all	0	French regulation	
Calibrated parameters			
s	0.085	Unemployment rate	7.6%
ϕ^0	7.35	Unemployment duration	11.3 months
ϕ	1.3	Job to job transition	8.9%
q	0.265	Mean Wage	1.57
α	0.76	Median Wage	1.47
y_y	1.13	Median of young	1.3
y_a	1.26	Median of adults	1.5
y_s	1.32	Median of seniors	1.8
β_a	0.79	D9a/D9j	1.26
β_s	0.53	D9s/D9j	1.64
ρ	0.55	Mean unemployment benefit	0.85

Table 1: Calibration parameters

use them to validate the model. The aggregated moments that we used for calibration are notified in bold letters in the table .

This model fits well the trend of mean wage, job to job mobility rate, unemployment duration and unemployment benefits. Wage dispersion remains underestimated: the model shows its limits in explaining the very top of the distribution. The unemployment rate trend fits the data at the exception of the seniors' unemployment rate which seems overestimated by the model. Yet our model keeps record as unemployed workers, long term unemployed seniors or seniors with no search activity anymore, whereas these workers are recorded as inactive in the data. Based on this calibration, we can draw wage and unemployment benefit distribution. On figure 2, we observe that the simulated wage distributions shape is consistent with the actual one of figure 1. We can observe a small step on adults' and seniors' wage distribution close to respectively the wage 1.7 and 2.3 due to the report stop from wage distribution of the previous age class. These discontinuities have no consequence on our results and would fade away with an increase in age classes number. The simulated unemployment benefit distribution shows as the actual one presented in figure 3 a two-mode shape, in particular on seniors' market. This second mode represents long term unemployed workers, who are more numerous among seniors with high unemployment benefits (more job rejections).

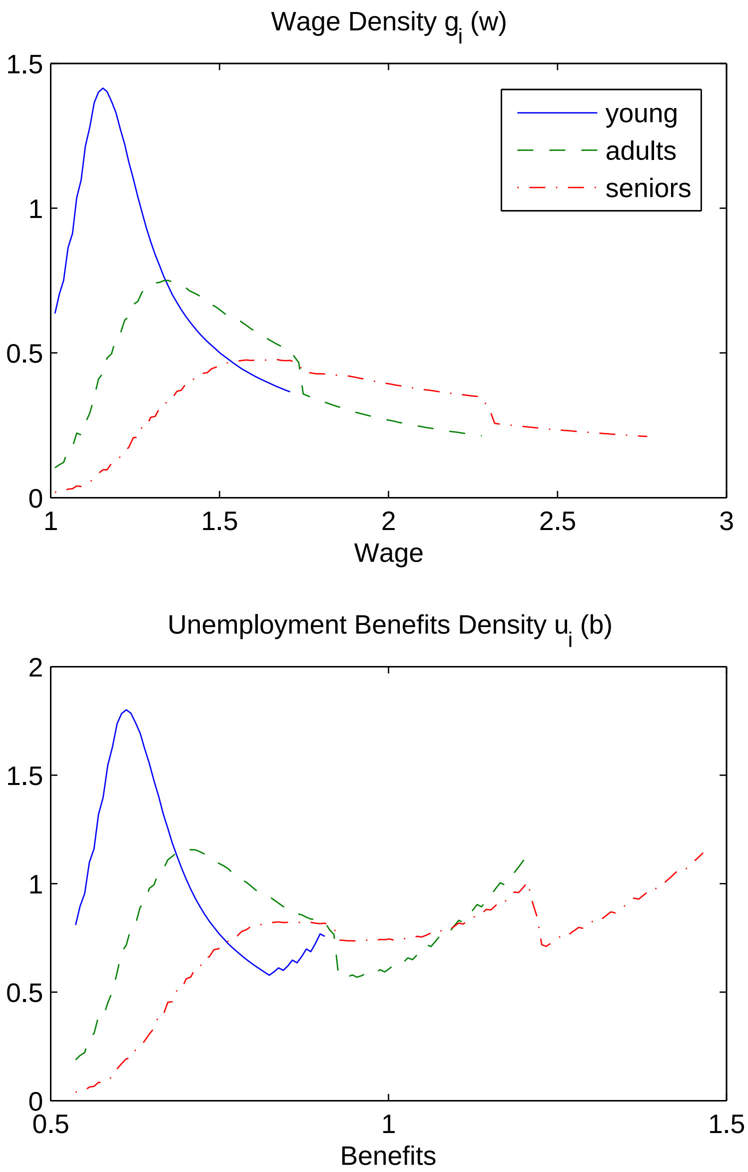

Figure 2: Simulated distribution of wage and unemployment benefits

Source: Simulated French benchmark economy.

Note: (1;1): g_y, g_a, g_s refer to the wage density for respectively the young, the adults and the seniors (1;2): u_y, u_a, u_s refer to the unemployment benefits density for respectively the young, the adults and the seniors

	Total		Young (20-33)		Adults (33-46)		Senior (46-59)	
	Model	Data	Model	Data	Model	Data	Model	Data
Mean wage	**1.57**	**1.57**	1.32	1.33	1.6	1.63	1.96	1.97
Dispersion index	0.23	0.28	0.15	0.16	0.19	0.23	0.21	0.29
Job to job mobility rate	**8.9%**	**8.9%**	9%	10.8%	8.8%	7.8%	7.9%	6.2%
Unemployment duration	**11.3**	**11.3**	6.8	8.3	14.8	13.9	16.3	19.5
Unemployment rate	**7.6%**	**7.6%**	8.2%	11.1%	6.9%	5%	8.2%	4.9%
Unemployment Benefits	**0.85**	**0.85**	0.72	0.8	0.87	0.9	1.1	1

Table 2: Validation Results

Source: figures in "Model" come from simulation, figures in "Data" from data presented in section 4.1.
Note: Mean wages are computed thanks to g_i density (in minimum wage).
Dispersion index is the dispersion index of g_i density.
Job to job mobility rates are computed by $\lambda_i \int_{\underline{w}}^{\overline{w}} g_i(x)(1 - F_i(x))dx$;
Unemployment duration is computed by $\int_{\underline{b}}^{\overline{b}} \frac{u_i(x)}{u} \frac{1}{1-F_i(R^{-1}(x))} dx$;
Unemployment rates are computed as described in appendix A, page 28.
Unemployment benefits are computed by $\int_{\underline{b}}^{\overline{b}} \frac{u_i(x)}{u} x dx$, note that we exclude young workers with no working experience who gets $b = 0$ in our model since they are not taking into account in the data of unemployment benefits. Including them, mean unemployment benefits of the young become 0.44.
The number of high school graduates is different in the 90's that in the 70's. In order to make realistic comparison between simulation and data, we compute the model aggregated results so that the proportion of each population within the total population is similar to the one observed in the data.

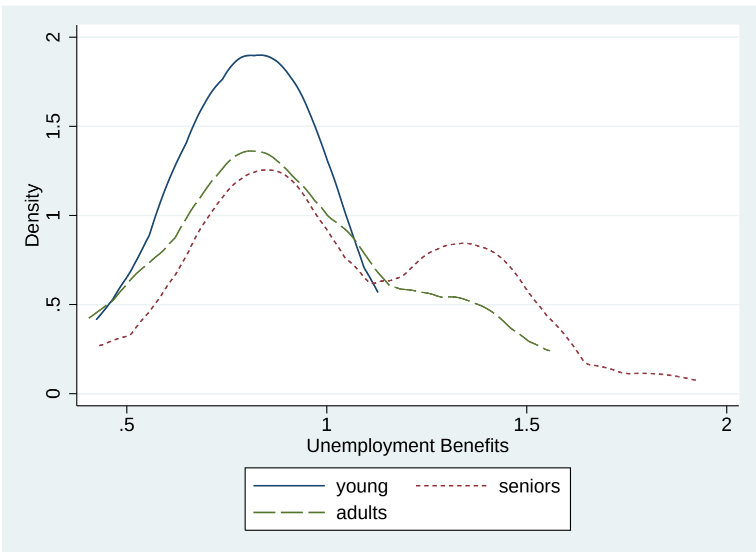

Figure 3: Unemployment benefits distribution in France

Source: French Enquête emploi data for salaried men in private sector (First 95%).

4.3 The analysis method

The objective of the paper is to assess the contribution of three wage progression channels: the **institutional channel**, the **human capital channel** and the **wage game channel**. To isolate the institutional channel, the method we use is to compare the French benchmark economy with the same economy without WIUB, i.e. $\rho = 0$, that we denote, *Simulation 1*. In difference, we can assess the effect of the policy on wage progression. Using the same method, we isolate the human capital channel by comparing *Simulation 1* with the same economy without HKA, that we denote *Simulation 2*. In *Simulation 2*, we set the cost of specific human capital β_a, and β_s equal to β_y and the workers' productivity y_a, and y_s equal to y_y and therefore assume workers do not learn over their life. The residual wage progression observed in *Simulation 2* is fueled by the simple wage game. Figure 4 sums up major labor market outcomes for these three simulations. In our framework, each of these channels affects workers' wage progression by two mechanisms : jobs selection and the evolution of workers' market power over life cycle.

Jobs selection : The possibility of on the job search allows workers to select themselves among the best paid jobs by, when employed and unemployed because of WIUB, rejecting low paid jobs and accepting better wage opportunity. This selection is modeled by the lower hiring probability of low wage offers and by the shorter tenure of low paid jobs. This selection allows workers to progressively climb the wage ladder over their life cycle. The extent of jobs selection over life cycle is naturally correlated with the occurrence of job to job mobility, since the selection supposes that workers move to better paid jobs. It therefore depends on the number of vacancies opened by firms for each age class and on the level of offered wage compared to the one of the previous age class : if offered wages decrease from one age class to the next period, workers will not change jobs in the next one. Besides, the gain from mobility in each age class depends on the wage dispersion: the larger wage dispersion, the larger the average gain from changing job is. Jobs selection includes these three parameters. In our model, jobs selection can be captured by comparing the gap between distributions f_i of offered wage and g_i of wage, at each age. If this gap between f_i and g_i increases with age, jobs selection contributes to wage progression over the working life. Intuitively, at equal firms' behavior over life cycle (same number of vacancies and same offered wage distribution), this gap raises with age since in each wage distribution g_i, past ascendant mobilities are kept in memory: the adults' wage distribution g_a partly inherits from the wage distribution of the first life period g_y during which workers already had time to select their job. Mechanically, the gap between g_a and f_a is therefore larger than the gap between g_y and f_y. Of course, a sharp reduction of the job to job mobility rate

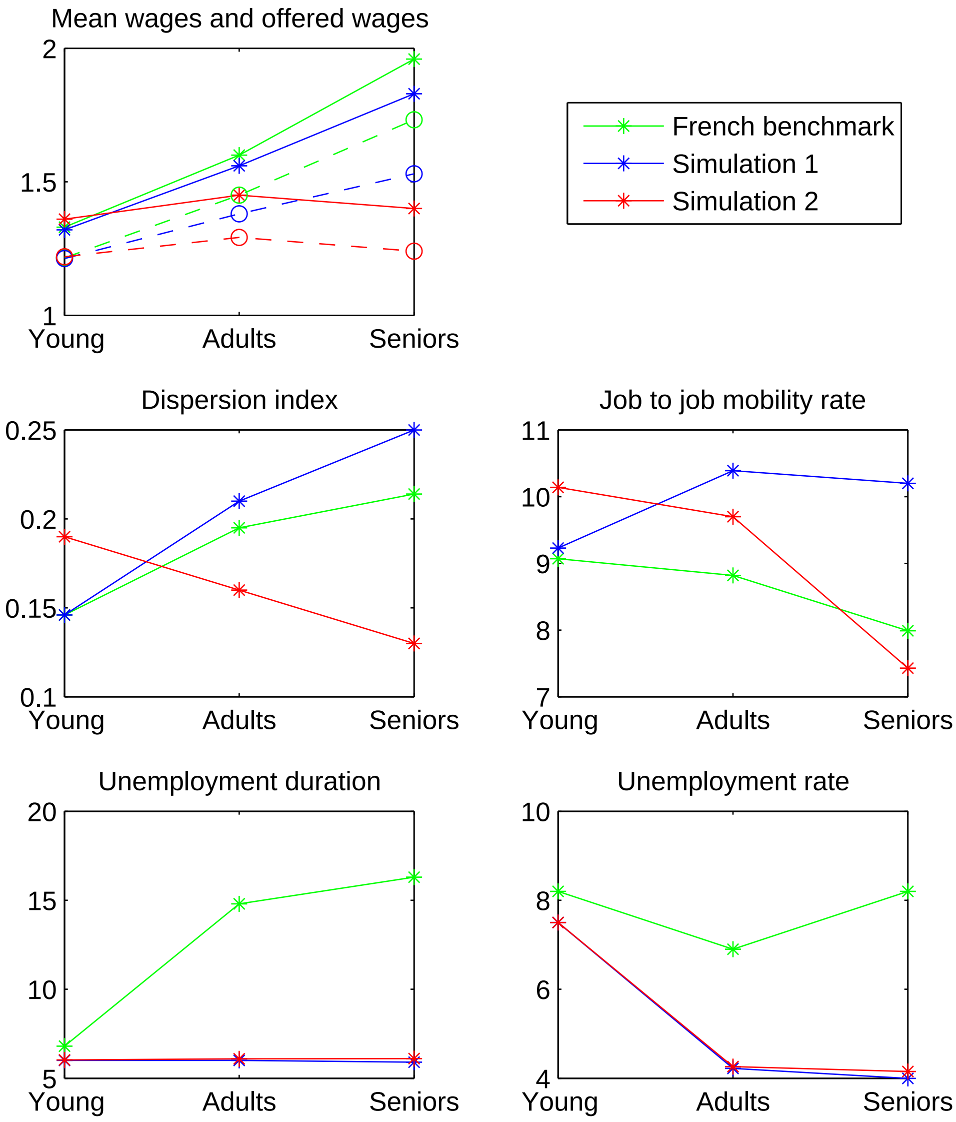

Figure 4: Labor market outcomes in three simulations: French benchmark, without WIUB and without WIUB and HKA

Source: Model simulations.

Legend: Simulation 1 stands for French benchmark without WIUB and simulation 2 for simulation 1 without HKA.

Note: (1;1): Mean wages are computed thanks to g_i density (solid line), mean offered wage thanks to f_i density (dashed line).

(2;1): Dispersion index is the dispersion index of g_i density.

(2;2): Mean job to job mobility rates are computed by $\lambda_i \int_{\underline{w}}^{\overline{w}} g_i(x)(1 - F_i(x))dx$.

(3;1): Unemployment duration is computed by $\int_{\underline{b}}^{\overline{b}} \frac{u_i(x)}{u} \frac{1}{1-F_i(R^{-1}(x))} dx$.

(3;2): Unemployment rates are computed as described in appendix A, page 28.

or of the offered wage over life cycle can easily reverse this mechanism.

The evolution of workers' market power over life cycle : The workers' capacity to force firms to raise their wage offers is the workers' market power, its evolution over life-cycle naturally affects wage progression. The workers' mobility is the first source of the workers' market power since it forces firms to compete to get a share of the workforce and to keep it. Yet the workers' market power can also be affected by a change in their outside option, like WIUB, or productivity, like HKA. The evolution of workers' market power over life cycle is simply the evolution of the offered wage distribution f_i since it is the capacity of workers to raise firms' wage offers over the monopsony wage, here equal to 1.

Of course, these two mechanisms are co-dependant. It is important to distinguish channels from these two mechanisms. The mechanisms are the ways channels affect the wage distribution, whereas channels correspond to the source of wage progression. For that matter, it is possible to cut off a wage progression channel, like by assuming there is no human capital accumulation or no policy, yet it is impossible to cut off one of the mechanisms since they constitute the model in itself.

5 The results

5.1 The institutional channel

Table 3 displays the extent and the source of wage progression in the economy with and without WIUB. On figure 4, the extent of this channel contribution can be deduced by the difference between French benchmark and *simulation 1.* According to our results, in an economy with WIUB, wage progression is stronger and less fueled by jobs selection.

5.1.1 Effect on workers' market power

The comparison of offered wages in table 3 shows that the share of wage progression induced by the increase of the workers' market power over life cycle increases when WIUB are introduced. Without WIUB, the increase of the workers' market power with age explains 1.08 points of % (resp. 0.84) of wage progression in the first part of the life cycle (resp. the second part). With WIUB, this increase explains 1.53 points of % (resp. 1.49). This power reinforcement is stronger in the second part of life cycle. Young workers, when they enter in the labor market, are entitled to the minimum benefits. Over their working life, thanks to working experience, they acquire rights to WIUB. Besides, as the wage raises with workers' age (*simulation 1*), the adults are entitled to higher WIUB than the young, and the seniors higher than the adults. On

	Young	Adults	Seniors	Evolution per year Young → Adults	Evolution per year Adults → Seniors
French benchmark economy					
Mean wage (g_i)	1.33	1.6	1.96	1.56%	1.73%*
Mean offered wage (f_i)	1.21	1.45	1.73	1.53%	1.49%$^\sharp$
Share of jobs selection				0.04%	0.25%†
French benchmark economy without WIUB					
Mean wage (g_i)	1.32	1.56	1.83	1.4%	1.33%
Mean offered wage (f_i)	1.21	1.38	1.53	1.08%	0.84%
Share of jobs selection				0.32%	0.5%
Contribution of WIUB				0.16%	0.4%$^\natural$

Table 3: Extent and source of wage progression in the French benchmark economy and in the economy without WIUB.

Source: Simulated French benchmark economy and simulation 1

Note: $*$ Over the second half of the working life, mean wage raises by 1.73% per year in the benchmark economy : $\left(\frac{1.96}{1.6} - 1\right) . \frac{1}{13}$

$\sharp$ On the 1.73% of yearly wage increase over the second half of the working life, 1.49 point of % are induced by the increase of the workers' market power in the benchmark economy: $\left(\frac{1.73}{1.45} - 1\right) . \frac{1}{13}$

$\dagger$ On the 1.73% of yearly wage increase over the second half of the working life, 0.25 point of % are induced by jobs selection in the benchmark economy: $1.73\% - 1.49\% \left(\frac{\Delta_t g}{g} - \frac{\Delta_t f}{f}\right)$

$\natural$ Yearly wage progression is reinforced by 0.4 point of % thanks to WIUB in the second part of the life cycle : $1.73\% - 1.33\%$

the adults' and the senior's market, higher benefits induce reservation wages likely to be above minimum wage. On these last two markets, firms are therefore forced to give up a larger part of their rent and raise their wage offers to avoid too many job rejections: the workers' market power raises for older workers.

5.1.2 Effect on jobs selection

The comparison of the gap between offered wages and wages in table 3 shows that the share of wage progression induced by jobs selection over life cycle decreases when WIUB are introduced. Without WIUB, jobs selection explains 0.32 points of % (resp. 0.5) of wage progression in the first part of the life cycle (resp. the second part). With WIUB, it explains 0.04 points of % (resp. 0.25). WIUB have a priori ambiguous effects on jobs selection. First, WIUB raise firms' labor cost and therefore reduce firms' expected profit, the number of vacancies (property 3) and job to job mobility occurrence (graph (2;2) of figure 4). Second, they decrease the gain from mobility because facing indemnified workers, firms concentrate their offered wage around the mode (graph (2;1) of figure 4): if wages are close to one another, wage offers close to this mode are more likely to be accepted since WIUB respect $b(w) < w$. In other terms, the unemployment insurance system causes fewer job rejections with a smaller wage dispersion. As wage offers are more concentrated, the workers' mobility at given job to job mobility rate generates lower wage gain[26]. These two effects tend to reduce workers' jobs selection. Yet, WIUB also reinforce jobs selection since they induce job rejections from unemployed workers: indemnified unemployed also select jobs. Graph (3;2) of figure 4 indeed shows the sharp increase in unemployment duration partly due to job rejection (the number of vacancies also affects unemployment duration). At the bottom line, our results show that the first two effects take the upper hand on the third: the decrease in job to job mobility occurrence and gain decreases the extent of the jobs selection mechanism.

In spite of its negative effect on workers' jobs selection, WIUB reinforce wage progression thanks to its increasing effect on the workers' market power and have an overall contribution to wage progression of 0.16 points of percentage in the first part of the working life and of 0.4 in the second part (table 3). Besides, WIUB partly account for the lower mobility of French workers: seniors' job to job mobility rate would be 2.5% higher in France without WIUB[27] (graph (2;2) of figure 4). WIUB partly explain low workers' mobility in France and substitute for its effect on wage progression, in

[26] If workers had a mobility cost, the shift in gain from mobility could in this case also affect mobility occurrence

[27] This raise would be higher if we took into account mobility costs: the raise in gain from mobility would also raise job to job mobility occurrence

particular in the second part of the working life.

5.2 The human capital and wage game channel

According to our calibration results, HKA over life cycle dominates depreciation. On figure 4, the extent of this channel contribution can be deduced by the difference between *simulation 1* and *2*. Graph (1;1) of figure 4 (solid line) shows that HKA contributes to wage progression. Note that in this section we exclude WIUB.

HKA allows firms to create higher quality jobs on older workers' market since workers with high level of human capital have a better return to specific human capital investment. HKA also induces firms to compete more intensively to hire and retain older workers and therefore to offer these workers higher wages because of its effect on workers' productivity (see property 1). On graph (1;1) of figure 4, the shift between *simulation 1* and *2* in dashed line on the adults and seniors' market shows that HKA allows workers' market power to raise with age. If workers had the same amount of human capital all over their lives (*simulation 2*), adults and seniors would be offered equal or lower wages than the young: at equal workers' ex ante productivity, [28] firms would be reluctant to create high quality jobs for workers too close to their horizon (see property 2). The same graph of figure 4 also shows that jobs selection is increasing with age in *simulation 1* when remains stable in *simulation 2*. HKA is therefore needed to workers to select effectively among best paid jobs all over their working life. Without HKA, three parameters would hamper this selection:

1. As the wage offer lottery evolves unfavorably over their life cycle (dashed line on graph (1;1) of figure 4), after a certain age, workers have increasingly more difficulties to find better opportunities.

2. Fewer firms are created on the market of workers close to their horizon. Job to job mobility rate decreases (graph (2;2) of figure 4) and jobs selection is slowed down (the theoretical foundation of this effect is given by property 3's corollary).

3. Wage dispersion lowers with age without HKA (graph (2;1) of figure 4). The remained mobilities therefore yield a small wage gain.

At the bottom line, without HKA, firms do not even try to poach employed workers close to their horizon since high wages, high human capital investment and vacancy costs cannot be amortized on the long run. They choose instead low wage strategies which target senior unemployed workers arriving though exogenous destruction. The seniors' market is a two-speed market: already employed workers earn rather high wages even if they cannot progress, while unemployed workers can only find low paid jobs.

[28] Workers' productivity can still differ in function of specific human capital investment of firms

The human capital channel explains a large part wage progression over the life cycle. Seniors are employed by high quality jobs for two reasons: because due to their higher level of human capital, firms are induced to offer high wages, and because the favorable evolution of offered wage lottery (level and dispersion) and more vacancies allows them to effectively select among the best paid jobs. The only wage game evolution contributes very lightly to wage progression in the first half of the working life and contributes negatively to this progression in the second half. Without HKA, the workers' finite horizon penalizes greatly seniors who could be only hired at low paid jobs.

5.3 Unemployment, welfare and unemployment insurance

Comparing French benchmark and *simulation 1* shows us that unemployment benefits as they exist in France unambiguously generate extra unemployment especially among the oldest: an extra 0.7 points of % for the young, 2.7 for the adults and 4.2 for the seniors (graph (3;1) on figure 4) . First, WIUB induce some job rejections from unemployed workers since their reservation wages are heterogenous. Second, they decrease firms' expected profits and therefore the number of vacancies in the economy. The first type of unemployment is inefficient, yet the second also allow to reduce firms' monopsony power and could, as explained in Mortensen (1998) increase global welfare: too much vacancies and therefore too much workers' turnover induce suboptimal training investments and a waste in terms of vacancy and training cost. A decrease in firms' monopsony power has ambiguous effect on welfare since it causes both a raise in unemployment and an increase in production per worker. We therefore need to compute economy's global welfare, that we note Ω, to find out if WIUB should be implemented and if they should, with which replacement ratio. To do so, we subtract vacancy and training spending from total production:

$$\begin{aligned}\Omega =& Y - c(v_j + v_a + v_s) - \beta_y\theta_y \int_{\underline{w}}^{\overline{w}} h_y(x)f_y(x)k_y(x)dx - \beta_a\theta_a \int_{\underline{w}}^{\overline{w}} h_a(x)f_a(x)k_a(x)dx \\ &- \beta_s\theta_s \int_{\underline{w}}^{\overline{w}} h_s(x)f_s(x)k_s(x)dx\end{aligned} \quad (16)$$

Appendix C page 29 presents details of this computation. Table 4 shows respectively how WIUB and flat UB affect welfare and production per market. In both cases, as replacement rate raises, firms' monopsony power decreases: average production per worker increases as firms invest more on jobs with higher expected duration, yet employment decreases. Lower workers' turnover also induces lower global training spending (TS).

Figure 5: Simulated distribution of offered wage

Source: French economy without WIUB (Simulation 1).

Note: f_y, f_a, f_s refer to the offered wage density for respectively the young, the adults and the seniors

ρ	all	Ω	M(Y)	L	M(Y_y)	L_y	M(Y_a)	L_a	M(Y_s)	L_s	TS
0	0	2.5190	2.8478	0.9507	1.9635	0.3097	2.78608	0.3202	3.7884	0.3208	0.1621
0.4	0	2.5250	2.8554	0.9496	1.9623	0.3098	2.7569	0.3201	3.8193	0.3197	0.1616
0.5	0	2.5467	2.8871	0.9448	1.9536	0.3099	2.7781	0.3186	3.9111	0.3164	0.1590
0.6	0	2.5843	2.9629	0.9292	1.9638	0.3084	2.8145	0.3121	4.1108	0.3088	0.1514
0.7	**0**	**2.6506**	**3.1281**	**0.8964**	**2.0176**	**0.3006**	**3.0192**	**0.3003**	**4.3684**	**0.2955**	**0.1393**
0.8	0	2.6403	3.3411	0.8302	2.1365	0.2779	3.2254	0.2787	4.6821	0.2737	0.1211
0	1	2.4399	2.7642	0.9496	1.7852	0.3104	2.7052	0.3191	3.7721	0.3201	0.1615
0	**1.1**	**2.5861**	**2.9250**	**0.9419**	**2.1015**	**0.3036**	**2.8037**	**0.3186**	**3.8276**	**0.3198**	**0.1521**

Table 4: Welfare analysis in function of unemployment benefits system

Source: Simulations of the model with calibration on French data.
Note: M(Y) stands for the workers' average production and M(Y_i) for the age i workers' average production.
L stands for total employment $m_y + m_a + m_s - u_y - u_a - u_s$, knowing that $m_i = 0.25$, and L_i for age i workers' employment $m_i - u_i$.
TS stands for total training spending $\beta_y\theta_y \int_{\underline{w}}^{\overline{w}} h_y(x)f_y(x)k_y(x)dx + \beta_a\theta_a \int_{\underline{w}}^{\overline{w}} h_a(x)f_a(x)k_a(x)dx + \beta_s\theta_s \int_{\underline{w}}^{\overline{w}} h_s(x)f_s(x)k_s(x)dx$.

When unemployment benefits are wage-indexed, these trends are particularly striking for older workers since WIUB are higher on their market. For replacement ratio below $\rho < 0.7$, the increase in average productivity more than compensates the decrease in employment and increasing the replacement ratio improves welfare. It is no longer the case after 0.7 and the maximum welfare is reached at $\rho = 0.7$. When unemployment benefits are flat, the maximum welfare is lower than with WIUB and is reached for $all = 1.1$. Note that the effect of flat UB with linear utility function is similar to the effect of minimum wage. For $all > 1.1$, firms stop employing young workers provided their productivity $y_y = 1.12$. Firms' monopsony power on the young's market are slightly similar between the two optima. Yet on the adults' and especially on the seniors' market, WIUB allow to decrease far more firms' power. Decreasing firms' monopsony power on the seniors' market requires indeed higher unemployment benefits than on younger workers' market since, due to their experience, seniors are already offered higher wages in the laissez-faire economy (Figure 5). In this context, WIUB are better-designed than flat UB to have a significant effect on firms' monopsony power on each market. The consequence of this is that production ($M(Y_i) * L_i$) on young's and adults' market is similar whatever the UB's shape, yet higher on the seniors' market (0.97 versus 0.92) when UB are wage-induced. At the bottom line, the optimal WIUB yield a larger welfare than flat UB contrary to what Chéron and Langot (2010) study without life cycle[29]. Taking into account workers' risk aversion, this result stands up to a coefficient of relative risk aversion of 3 (see table 5): Maximum welfare is reached

[29]Note that they also assume concave utility function

when $all = 1.1$ at -0.0793 for -0.0799 when $\rho = 0.7$. Welfare computation in the case of workers'risk aversion is presented in appendix C page 29. This result can be moderated

$\sigma = 1.3$			$\sigma = 2$			$\sigma = 3$		
ρ	all	W	ρ	all	W	ρ	all	W
0.7	0	-2.5031	0.7	0	-0.3898	0.7	0	-0.0799
0	1.1	-2.5168	0	1.1	-0.3946	0	1.1	-0.0793

Table 5: Welfare analysis in function of relative risk aversion coefficient

Source: Simulations of the model with calibration on French data.
Note: When workers' utility function in function of an income ω is: $\frac{\omega^{1-\sigma}}{1-\sigma}$

by recalling that it stands for rather low paid workers and therefore low unemployment benefits: in our calibration they do not exceed 160% of minimum wage, when in France it can reach almost 6 times minimum wage.

6 Conclusion

This paper allows to assess the life cycle effect of a major European institution. A significant share of wage progression in France is fueled by the unemployment insurance system. Besides, WIUB have a strong negative effect on employment especially among seniors, yet according to our results, this unemployment benefits-induced seniors' unemployment can be seen as a price to pay to have higher quality jobs and to eventually maximize their market's production. WIUB by allowing to reduce firms' monopsony power on each market even the seniors, are well designed and maximize global welfare for a replacement rate of 0.7. Unemployment benefits are therefore not only a tool for redistribution but also for production increase. This replacement ratio is above what is implemented in France, yet close or below what is implemented in other European countries.

This insurance system also accounts for a large decrease of search-induced wage progression, via its negative effect on both mobility rate and wage dispersion. The presence of unemployment benefits partly accounts for the lower mobility of French workers, yet not entirely. Yet by taking into account mobility costs, the unemployment insurance-induced wage contraction could partly explain the remaining gap between the job to job mobility rate in France and in the U. S.. Adding mobility costs on the workers' side could reinforce the negative effect of the unemployment insurance system on the mobility rate and decrease this optimal replacement rate.

In this paper we restrict our study to low skilled workers, do WIUB have the same contribution to wage progression for skilled workers? The work done in this paper could also be carried on for different category of workers. As the extent of WIUB effect on wage progression and unemployment depends on structural feature of the labor market such as wage dispersion and initial wage progression in the laissez-faire economy, it is likely that different category of workers would benefit differently from such institution.

A Unemployed workers' flows

As no firm has interest in offering a wage that no worker can accept, there is no job rejection from unemployed workers receiving the minimal allocation. The density function derived from the cumulative distribution $U_i(b)$ of workers according to their unemployment benefits is noted u_i.The mass of these workers solves the following flows equations:

$$\begin{aligned}
&[\lambda_j^0 + p]\overline{u_y} u_y(all) = p \cdot m \\
&[\lambda_a^0 + p]\overline{u_a} u_a(all) = p u_y(all) \\
&[\lambda_s^0 + p]\overline{u_s} u_s(all) = p u_a(all)
\end{aligned} \tag{17}$$

All young workers entering the labor market $(p \cdot m)$ receive these minimum unemployment benefits. Among the adults and the seniors, the workers who receive these minimum benefits are those who have never worked since they enter the labor market. For $b > all$, the mass of unemployed workers solves in steady state the following flows equations:

$$\begin{aligned}
&[\lambda_y^0(1 - F_y(R_y(b))) + p]\overline{u_y} u_y(b) = s(m - \overline{u_y}) g_y \left(\frac{b - all}{\rho}\right) \\
&[\lambda_a^0(1 - F_a(R_a(b))) + p]\overline{u_a} u_a(b) = s(m - \overline{u_a}) g_a \left(\frac{b - all}{\rho}\right) + p\overline{u_y} u_y(b) \\
&[\lambda_s^0(1 - F_s(R_s(b))) + p]\overline{u_s} u_s(b) = s(m - \overline{u_s}) g_s \left(\frac{b - all}{\rho}\right) + p\overline{u_a} u_a(b)
\end{aligned} \tag{18}$$

Unemployed workers who receive a benefit b accept a job if the wage proposal associated to this job is above $R_i(b)$. Note that exit rate from unemployment differs with unemployment benefit. The number of unemployed on each market $\overline{u_s}$ can be deduced from 17 and 18 by summing unemployment for each level of unemployment benefits.

B Employed workers' flows

In steady state, the flows into and out of firms offering a wage no greater than w for each age class are equal. The mass of workers receiving a wage no greater than w is represented for each age class by $(m - u_i)G_i(w)$ and solves:

$$\begin{aligned}
&(p + s + \lambda_y(1 - F_y(w)))(m - u_y)G_y(w) = \lambda_y^0 \int_{\underline{w}}^{w} f_y(x) U_y(R_y^{-1}(x)) dx \\
&(p + s + \lambda_a(1 - F_a(w)))(m - u_a)G_a(w) = \lambda_a^0 \int_{\underline{w}}^{w} f_a(x) U_a(R_a^{-1}(x)) dx + p(m - u_y)G_y(w) \\
&(p + s + \lambda_s(1 - F_s(w)))(m - u_s)G_s(w) = \lambda_s^0 \int_{\underline{w}}^{w} f_s(x) U_s(R_s^{-1}(x)) dx + p(m - u_a)G_a(w)
\end{aligned} \tag{19}$$

On the left side of these equations, there is the flow of workers out of firms offering a wage no greater than w. These workers either experience an exogenous shock, change age class or resign to be employed by a higher paying job. On the right side there is the flow of workers into firms offering a wage no greater than w. The second term of the left side for adults and seniors refers to the part of the workers already employed when they change age class (the youth all start as unemployed). The adults' wage distribution partly depends on the report of the youth' wage distribution, and similarly for seniors. Note that wage distribution depends on unemployment benefits distribution.

C Welfare computation

C.1 Without risk aversion

This welfare does not take into account the redistributive effect of unemployment benefits. Consequently there is also no need to take into account UB and the taxes financing them. Production Y is such that:

- Young workers employed at w product $y_y + \left(\frac{q}{\alpha}\right) k_y(w)^\alpha$
- Adult workers employed at w when young product $y_a + \left(\frac{q}{\alpha}\right) k_y(w)^\alpha$
- Adult workers employed at w when adult product $y_a + \left(\frac{q}{\alpha}\right) k_a(w)^\alpha$
- Senior workers employed at w when young product $y_s + \left(\frac{q}{\alpha}\right) k_y(w)^\alpha$
- Senior workers employed at w when adults product $y_s + \left(\frac{q}{\alpha}\right) k_a(w)^\alpha$
- Senior workers employed at w when seniors product $y_s + \left(\frac{q}{\alpha}\right) k_s(w)^\alpha$

.

C.2 With risk aversion

With risk aversion, welfare W is the sum of workers' income. We assume workers own the firms and share their profit through dividend distribution D. All workers finance unemployment benefits through taxes τ. As total population m equals to 1 and assuming σ the coefficient of relative risk aversion, this welfare is given by:

$$
\begin{aligned}
\tau &= \int_{\underline{b_y}}^{\overline{b_y}} bu_y(b)db + \int_{\underline{b_a}}^{\overline{b_a}} bu_a(b)db + \int_{\underline{b_s}}^{\overline{b_s}} bu_s(b)db \\
D &= \Omega - \int_{\underline{w_y}}^{\overline{w_y}} wg_y(w)dw - \int_{\underline{w_a}}^{\overline{w_a}} wg_a(w)dw - \int_{\underline{w_s}}^{\overline{w_s}} wg_s(w)dw \\
W &= \int_{\underline{b_y}}^{\overline{b_y}} \frac{(b+D-\tau)^{1-\sigma}}{1-\sigma} u_y(b)db - \int_{\underline{b_a}}^{\overline{b_a}} \frac{(b+D-\tau)^{1-\sigma}}{1-\sigma} u_a(b)db + \int_{\underline{b_s}}^{\overline{b_s}} \frac{(b+D-\tau)^{1-\sigma}}{1-\sigma} u_s(b)db \\
&+ \int_{\underline{w_y}}^{\overline{w_y}} \frac{(w+D-\tau)^{1-\sigma}}{1-\sigma} g_y(w)dw + \int_{\underline{w_a}}^{\overline{w_a}} \frac{(w+D-\tau)^{1-\sigma}}{1-\sigma} g_a(w)dw + \int_{\underline{w_s}}^{\overline{w_s}} \frac{(w+D-\tau)^{1-\sigma}}{1-\sigma} g_s(w)dw
\end{aligned} \tag{20}
$$

Naturally in this case, unemployed workers' reservation wage solves:

$$
\frac{(R_i(b)+D-\tau)^{1-\sigma}}{1-\sigma} = \frac{(b+D-\tau)^{1-\sigma}}{1-\sigma} + (\lambda_i^0 - \lambda_i) \int_{R_i}^{\overline{w}} (V_i^e(x) - V_i^e(R_i))dF_i(x) + s(V_i^u(b) - V_i^u(b(R_i))) + p(V_{i+1}^u(b) - V_{i+1}^e
$$

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