Voluntary and involuntary retirement decision : does real wage rigidity affects the effectiveness of pension reforms ?

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Voluntary and Involuntary Retirement Decision : Does Real Wage Rigidity Affects the Effectiveness of Pension Reforms ?

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Abstract

In this paper, we integrate the retirement deadline taking into account both labor demand and labor supply specificities. This approach reveals that firms' employment decisions play an active role in the early retirement decision. We show that, in a walrasian economy, social security reforms aimed at delaying the retirement age by introducing actuarially fair adjustments are particularly powerful to stimulate the employment of older workers. However, if real wages are rigid, two situations must be distinguished. First, if the wage is lower than its walrasian value, the separation date is determined by workers, fair adjustments would push back the retirement age. In contrast, when the wage exceeds its walrasian rate, the separation date is determined by firms. Trying to increase the rate of employment of older workers by introducing pension incentives seems to be an unattainable goal. Therefore, there is a good reason for focusing primarily on labor demand. In this case, it appears that paying a subsidy to firms is the best policy for attaining the optimal retirement age.

JEL Classification : H31, H55, J26
Keywords : Retirement age, Human capital investment, Real wage rigidity, Labor market reform.

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1 Introduction

It is now well known that the low employment rate of older workers accounts for a half of the European employment gap (see OECD [2006]). Combined with ageing of the population, this trend puts in doubt the financial viability of social security systems. There is a large literature which argues that the decrease in the labor force participation among older workers is mainly due to the trend of early retirement and thus emphasizes the negative role played by social security systems. In that literature workers evaluate prospective streams of wage, pension and social security payments and *freely* choose the retirement date that maximizes their expected utility. This suggests that there is large taxes associated to the social security system which push individuals to retire early. Indeed, the design of the benefits formulas reveals the presence of a tax on continued activity beyond the normal retirement age : the increase, if any, in pension entitlements due to additional years of work is often insufficient to cover the extra pension contributions (*explicit tax*) and the forgone pension payments (*implicit tax*). In response, most developed countries have established pension reforms in order to encourage the elderly to delay retirement by rewarding a longer working life with an increased pension. However, such a strategy is questioned by the employability of older workers. Crépon, Deniau and Perez-Duarte [2002] and Aubert, Caroli and Roger [2006] argue that older workers suffer from a biased technological progress. Under wage stickiness, this gives firms incentives to send older workers into early retirement. Hence, trying to increase the rate of employment of older workers by introducing pension incentives seems to be an unattainable goal.

This paper extends the large literature that analyzes early retirement from a labor-supply perspective and which stresses that the social security system discourages continued activity after the early retirement age. We integrate the retirement deadline taking into account both labor demand and labor supply specificities. This approach shows that firms' employment decisions play an active role in the early retirement decision. In addition, we show that this more general analysis changes the way of thinking about policies aimed at stimulating older workers' employment. A second contribution of this paper is to integrate investment on human capital and investigate the effect of social security system on human capital investment and its implications on the agents' behavior and thus on the retirement age. By simultaneously analyzing human capital and retirement decisions, our model allows us to spell out various complementarities over the life-cycle. Training intensity and timing of retirement constitute complements concerning the worker's optimal choice of labor supply and human capital formation. The first complementarity is that the more individuals work, the larger will be the returns to human capital investments. And, the more individuals learn, the larger are the incentives to work as wages are higher. The second complementarity is that the later individuals retire, the larger will be the returns to human capital investments. And, the more individuals learn, the more costly early retirement will be. We also show that not only the worker's choices are negatively affected by introducing a social security system with fixed benefits schemes but also the firm's decision does : from the worker's point of view, the social security system implies *direct* taxes on human capital investment and labor supply. From the firm's point of view this implies an *undirect* tax on labor demand because of the decrease of the worker's productivity. Indeed, the worker's productivity at the end of the life-cycle is a key determinant of the firm's separation decision. Hence, because the tax on training intensity reduces the human capital investment of the young workers, the worker's productivity and thus the firm's profits decrease when they become old. This makes production less profitable and thus the firm decides to reduce the job duration of the older workers.

We then turn to examine the pattern of policies aiming to restore early retirement to efficient levels. Our results suggest that, in a walrasian economy, social security reforms aimed at delaying the retirement age by introducing actuarially fair adjustments are particularly powerful to stimulate the employment of older workers. However, if real wages are rigid, two situations must be distinguished. First, if the separation date is determined by workers, fair adjustments push back the retirement age. In contrast, when the wage rate exceeds the walrasian rate, the separation date is determined by firms. Then, trying to increase the employment rate of older workers by introducing pension incentives seems to be an unattainable goal in a context where the firm's employment decision is more restrictive than the distortions imposed by the pension system. Consequently, there is a good reason for focusing primarily on labor demand. In this case, it appears that a subsidy paid to firms is the best policy for attaining the optimal retirement age. Indeed, subsidies reduce the production costs of the older workers. This makes production more profitable, then the firm decides to increases the job duration duration of the older workers.

The plan of the paper is as follows. Section 2 presents the model with perfect wage flexibility. Section 3 introduces wage rigidities and its implications for human capital investment, labor market activity and policies aimed at postponing retirement. The final section concludes.

2 The Effects of Pension Schemes on Agents' Decisions with Perfect Wage Flexibility

2.1 Worker Behaviors

We consider a simple two periods life-cycle model with endogenous human capital formation and retirement. The length of each period is normalized to unity. For the sake of simplicity, we assume that agents are risk-neutral and they do not have access to financial assets.

In the first period, an individual with productivity h_1 works and supplies a unit of labor. This young employee earns a wage ω_1, contributes at rate τ to social security and consumes c_1 units of the consumption good. Labor income depends on the productivity level : $\omega_1 = \omega h_1$, where ω is the wage rate per unity of human capital. Then, we can write the income constraint in period 1 as :

$$c_1 = (1-\tau)\omega h_1 \tag{1}$$

In period 1, the young employee decides about his human capital investment in order to maximize his working-life income. Human capital formation requires effort. We denote the training intensity by e. Disutility from education effort is measured by the following training cost function :

$$\phi(e) = \frac{(e)^2}{2} \tag{2}$$

We assume that there is no depreciation of knowledge, the level of worker's productivity in period 2, denoted by h_2, depends only on the training intensity and the worker's ability in the first period.

$$h_2 = (1+e)h_1 \tag{3}$$

Let U_1 denote the household's utility in the first period. Then, we can write :

$$U_1 = (1-\tau)\omega h_1 - \frac{(e)^2}{2} \tag{4}$$

In the second period, an individual with productivity h_2 decides both, how long he will be active in the labor market, and his retirement date. Before the moment of retirement the employee has a full-time job. After retirement, the individual does not work any more : the option of part-time work is ruled out by assumption. Let z^T denote the retirement age of a worker. During the working subperiod, the old employee earns a wage w_2, contributes at the same rate τ to social security and consumes c_2. Labor income depends on the length of the working subperiod, z^T, and on the productivity level, h_2, so that : $w_2 = wh_2z^T$. Given equation (3), the budget constraint writes as :

$$c_2 = (1-\tau)(1+e)wh_1z^T \tag{5}$$

In line with Crémer and Pestieau (2003), we assume that there is a disutility of labor denoted by $\psi(z^T)$, which increases with the retirement age. In the main text, we consider a simpler specification :

$$\psi(z^T) = \gamma\frac{(z^T)^2}{2} \qquad \gamma > 0 \tag{6}$$

During the retirement subperiod of length $1 - z^T$, the retiree's consumption, d_2, corresponds to the social security benefits. Let p denotes the pension benefits, so we have :

$$d_2 \quad = \quad (1 - z^T)p \tag{7}$$

Under these assumptions, the household's utility in the second period is defined as :

$$U_2 \quad = \quad (1-\tau)(1+e)wh_1 z^T - \gamma\frac{(z^T)^2}{2} + (1 - z^T)p \tag{8}$$

In a "*Laissez-faire*" economy, $\tau = p = 0$, a household with ability h_1 chooses the intensity of investment in humain capital formation and the retirement age to maximize his life-time utility :

$$\max_{e, z^T} \left\{ \omega h_1 - \frac{(e)^2}{2} + \beta \left[z^T (1+e) w h_1 - \gamma \frac{(z^T)^2}{2} \right] \right\}$$

where β is the time preference factor.
The first-order condition with respect to human capital is :

$$e \quad = \quad \beta z^T w h_1 \tag{9}$$

The left-hand side is the cost generated by an additional unit of training, and the right-hand side is the return to human capital investment in terms of labor income : this investment makes the worker more productive and thus increases the wage in the second period. The first-order condition with respect to retirement is :

$$\gamma z^T \quad = \quad (1+e)wh_1 \tag{10}$$

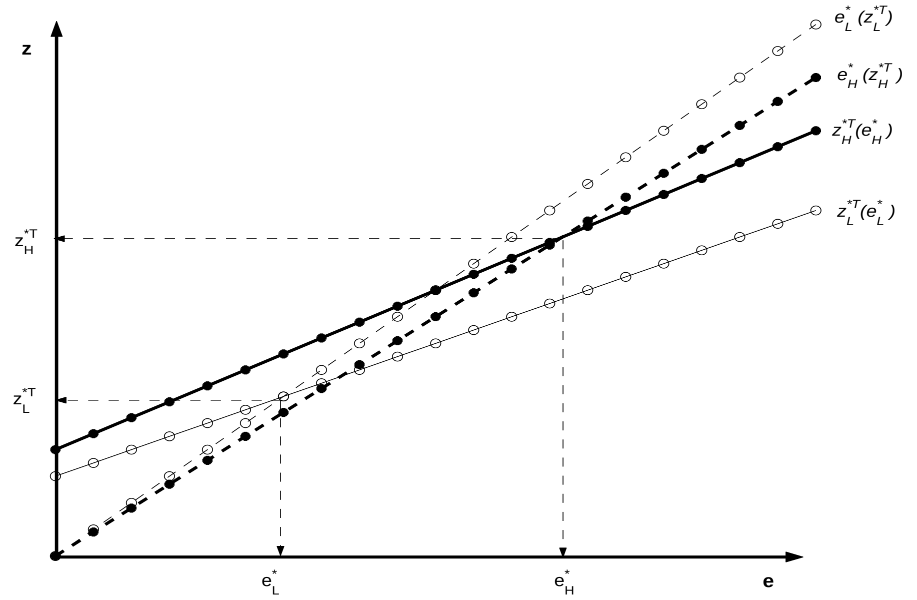
The left-hand side is the cost generated by an additional year of work measured by the effort cost of labor, and the right-hand side is the increase of labor income generated by this additional year of work.

These two equations determine the optimal choices of human capital investment and the date of retirement. They suggest that both e and z^T positively depend on the initial individual's ability, h_1. Hight skilled workers supply more labor. Indeed, a stylized fact is that higher educated workers have higher participation rates, and low unemployment rates.

The interaction between human capital investment and the timing of retirement can be graphically illustrated in a (e, z^T)-diagram. Assume for simplicity that there are only two types of individuals : type 1 with a high productivity and type 2 with a low productivity, so that $h_1^H > h_1^L$.

Note that by simultaneously analyzing human capital and retirement decisions, figure 1 allows us to spell out various complementarities over the

FIG. 1 – Interaction between human capital investment and the timing of retirement



life-cycle. Training intensity and timing of retirement constitute complements concerning the worker's optimal choice of labor supply and human capital formation. The first complementarity is that the more individuals work, the larger will be the returns to human capital investments. And, the more individuals learn the larger are the incentives to work, as wages are higher. The second complementarity is that the later individuals retire, the larger will be the returns to human capital investments. And, the more individuals learn, the more costly early retirement will be.

2.2 Firms' Decisions

We assume that the worker's productivity is perfectly known by employers. There is no other heterogeneity across workers. Moreover, any firm is free to decide the duration of the production match denoted z^F with the old worker in the second period. The probability of exogenous separation is zero. Firms are small and each has one job. Risk-neutral firms maximize the sum of their discounted profits. To simplify the model, we assume that firms have the same discount factor than workers β.

$$\Pi = \sum_{t=1}^{2} \beta^{t-1}\Pi_t \tag{11}$$

In each period, the instantaneous profit of a filled job by a worker of productivity h_1, Π_t for $t = 1, 2$, is equal to the difference between the worker's production and the total costs per worker. In period 1, the profit is defined by :

$$\Pi_1 = (y - \omega)h_1 \tag{12}$$

Where y denotes the units of output per unit of human capital.
We assume that during the second period production requires additional costs. We also assume that these costs increase with the duration of production and decrease with the worker's human capital. Total cost in period 2 is composed of two parts : the wage w_2 and production's costs denoted by $\varphi(h_1, z^F)$.

$$\varphi(h_1, z^F) = \frac{f}{2h_1}(z^F)^2 \tag{13}$$

The profit in period 2 writes as :

$$\Pi_2 = (y - w)(1 + e)h_1 z^F - \frac{f}{2h_1}(z^F)^2 \tag{14}$$

Finally, we can express the problem of the firm as follows :

$$\max_{z^F} \left\{ (y - \omega)h_1 + \beta \left[(y - w)(1 + e)h_1 z^F - \frac{f}{2h_1}(z^F)^2 \right] \right\}$$

and the choice of z^F is given by :

$$(1 + e)yh_1 = (1 + e)wh_1 + \frac{f}{h_1}z^F \tag{15}$$

The left-hand side stands for the marginal revenue generated by an additional year of production and the right-hand side for the marginal costs of this year in terms of the wage $(1 + e)wh_1$ and the production costs $\frac{f}{h_1}z^F$.

From equation (15), we deduce the optimal separation date for the firm :

$$z^F = \frac{(y - w)(1 + e)h_1}{f/h_1} \tag{16}$$

A crucial implication of this condition is that the level of human capital is a key determinant, not only from the worker's point of view but also from that of the firm. Hence, not only the worker's optimal retirement age (z^T) positively depends on the worker's productivity but also the firm's optimal separation date (z^F). This suggest that low-skilled workers may be fired more frequently because firms refuse to employ them for a long period.

2.3 The *"Laissez-Faire"* Equilibrium

Under the assumption of a walrasian adjustment of wages, there is a wage level that ensures the *"Laissez-Faire"* equilibrium. According to the dynamics given by the usual adjustment through the supply and demand laws, the wage is assumed to be continuously adjusted to the current labor supply and labor demand. In our case, this implies the existence of an employment contract which ensures that separations at the end of life are mutually advantageous. Explicitly, this equilibrium is characterized by the following relationship : $z^F = z^T$. Knowing equations (10) and (16), the equilibrium wage writes as :

$$w^* = \frac{\gamma h_1}{\gamma h_1 + f} y \tag{17}$$

This expression shows that the wage increases with the level of human capital and the disutility of labor and decreases with the production' costs incurred by the firm. Moreover, this wage rate results from a specific rule of sharing of output. Expression (17) can in fact be rewritten as :

$$w^* = \frac{\gamma}{\gamma + \frac{f}{h_1}} y$$

Interestingly, this equation shows how the wage is fixed according to a specific rule : the value $\gamma + \frac{f}{h_1}$ represents the total cost of an additional year of work for both the worker and the firm. This global cost is equal to the sum of the disutility of work, γ, for the employee, and the production cost, $\frac{f}{h_1}$, for the firm. As γ represents the cost for the employee, in terms of the disutility of working an additional year, the value $\frac{\gamma}{\gamma + \frac{f}{h_1}}$ can be interpreted as the relative cost supported by the employee in relation to the global cost generated by delaying retirement for one year. Thus, the output is divided such that each agent receives a share which is proportional to his relative cost.

2.4 The Effects of the Pay-As-You-Go System

We first consider a given Pay-As-You-Go (PAYG) System with fixed benefits and examine to what extent such a system affects the choice of agents. We assume here that the pension level is independent of the age of retirement. We then investigate the impact of a social security reform.

2.4.1 Agents' Decisions under Fixed Benefits Schemes

Let us introduce a social security system in which benefits depend only on the wage income during the first period. Let p_1 denote the benefit that an individual receives if he decides to retire at the age of the full rate. We assume that p_1 ensures the budget balance of the PAYG system for this retirement age. Then, p_1 verifies :

$$p_1 \quad = \quad \tau\omega h_1 \tag{18}$$

In this economy, each worker maximizes the present value of his total utility with respect to the decision variables z^T and e :

$$\max_{e,z^T}\left\{(1-\tau)\omega h_1 - \frac{(e)^2}{2} + \beta\left[(1-\tau)(1+e)wh_1z^T - \gamma\frac{(z^T)^2}{2} + (1-z^T)p_1\right]\right\}$$

The first-order condition with respect to training intensity is :

$$e \quad = \quad \beta z^T wh_1(1-\tau) \tag{19}$$

The first-order condition with respect to retirement is :

$$\gamma z^T \quad = \quad (1+e)wh_1(1-\tau) - p_1 \tag{20}$$

We can rewrite condition (20) as :

$$\gamma z^T \quad = \quad (1+e)wh_1\left\{1-\left[\tau + \frac{p_1}{(1+e)wh_1}\right]\right\} \tag{21}$$

Conditions (19) and (21), which determine the optimal choices of human capital investment and the date of retirement, suggest that social security provisions impose strong constraints on both training intensity and retirement age. First, because the contributions to the social security at the rate τ reduce the marginal benefit of an increase in the training intensity in terms of labor income (the right-hand side of equation (19)), the accumulation of human capital decreases. Second, equation (21) shows that an increase in z^T implies a tax $\lambda = \tau + \frac{p_1}{(1+e)wh_1}$, which is known in the literature as a tax on postponed activity in terms of extra pension contributions and forgone pension payments.

It is also important to note that not only the worker's choices are negatively affected by introducing a social security system with fixed benefits schemes but also the firm's decision. Indeed, the worker's productivity in the second period is a key determinant of the firm's separation decision. Hence, because the tax on training intensity, τ, reduces the human capital investment in period 1, the worker's productivity and thus the firm's profits are decreased in period 2. Because production becomes less profitable, the firm decides to reduce its duration in the second period.

2.4.2 The Equilibrium with Constant Benefits System

The introduction of a pension system in which benefits are constant and independent of the duration of activity beyond the normal retirement age (the end of the first period) implies two types of taxes : first, from the worker's point of view, the social security system implies a *direct* tax rate on human capital investment and labor supply. Second, from the firm's point of view this implies an *undirect* tax on labor demand because of the decrease in the worker's productivity. Obviously, this modifies the agents' decisions. Combining equations (16) and (21), the equilibrium is defined as :

$$z^T = z^F \iff w = \frac{\gamma h_1}{\gamma h_1 + f(1-\lambda)} y \tag{22}$$

This expression shows that the introduction of a social security system leads to an increase in the wage rate which is positively correlated with the tax on labor supply, λ. Consequently, introducing actuarially fair adjustments to delay the retirement decreases the wage rate as the duration of the activity increases the additional production costs supported by the firm.

2.4.3 The Impact of Social Security Incentives

We now introduce a policy aimed at eliminating the tax rates implied by the fixed benefit schemes. We consider a social security system in which benefits depend on the retirement age. In particular, pension benefits are determined as a function of wage income during both the first and second period of work. In this case, social security benefits write as :

$$p = p_1 + p_2(e, z^T)$$

The first-order condition with respect to human capital investment is :

$$e = \beta \left\{ z^T(1-\tau)wh_1 + (1-z^T)\frac{\partial p_2}{\partial e} \right\} \tag{23}$$

And the first-order condition with respect to retirement is :

$$\gamma z^T = (1-\tau)(1+e)wh_1 - p_1 + (1-z^T)\frac{\partial p_2}{\partial z_T} \tag{24}$$

These conditions can be written as :

$$e = \beta z^T wh_1 \left\{ 1 - \left[\tau - \frac{(1-z^T)\frac{\partial p_2}{\partial e}}{z^T} \right] \right\} \tag{25}$$

$$\gamma z^T = (1+e)wh_1 \left\{ 1 - \left[\tau + \frac{p_1}{(1+e)wh_1} - \frac{(1-z^T)\frac{\partial p_2}{\partial z^T}}{(1+e)wh_1} \right] \right\} \tag{26}$$

Note that the implementation of incentives positively affects the worker's choices. The social security system in which benefits depend on the retirement age and the wage income during the full duration of work encourages human capital investment and thus delays retirement. Indeed, the tax rates on training intensity and labor supply are reduced compared to the system without incentives. These two tax rates are respectively determined by :

$$\tau' \quad = \quad \tau - \frac{(1-z^T)\frac{\partial p_2}{\partial e}}{z^T} \tag{27}$$

$$\lambda' \quad = \quad \tau + \frac{p_1}{(1+e)wh_1} - \frac{(1-z^T)\frac{\partial p_2}{\partial z^T}}{(1+e)wh_1} \tag{28}$$

These two equations allow us to characterize the pattern of an actuarially fair system. In such a system, the tax rates on training intensity and retirement age are equal to zero. We obtain :

$$\tau' = 0 \Longrightarrow \frac{\partial p_2}{\partial e} = \frac{\tau z^T}{(1-z^T)} \tag{29}$$

$$\lambda' = 0 \Longrightarrow \frac{\partial p_2}{\partial z^T} = \frac{\tau(1+e)wh_1 + p_1}{(1-z^T)} \tag{30}$$

It is straightforward to verify that these conditions ensure the optimality of the worker' choices.

3 Real Wage Rigidity and Labor Market Policies

In this section we explore the consequences of introducing real wage rigidity and examine the implications concerning policies aimed at delaying the retirement age, in particular social security reforms. In the case of perfect flexibility, wage adjustments ensure that there is an implicit agreement between workers and firms about the employment contract. This agreement implies that separations are mutually advantageous. However, when wages are rigid, the adjustment is primarily made by changing the duration of activity in period 2, not by changing wages. In this context, the retirement age is not subject to any specific agreement between firms and workers. Each worker maximizes his total utility by taking into account the firm's decision :

$$\max_{e,z^T} \left\{ (1-\tau)\omega h_1 - \frac{(e)^2}{2} + \beta \left[(1-\tau)(1+e)z^T wh_1 - \gamma\frac{(z^T)^2}{2} + (1-z^T)p \right] \right\}$$

subject to

$$z^T \leq z^F$$

Similarly, firms maximize the sum of their discounted profits over both periods given the labor supply :

$$\max_{z^F} \left\{ (y-\omega)h_1 + \beta \left[z^F (y-w)(1+e)h_1 - \frac{f}{2h_1}(z^F)^2 \right] \right\}$$

subject to

$$z^F \leq z^T$$

In this context, because the duration of activity in period 2 can be unilaterally chosen by workers or firms, the "effective" separation date denoted z^E is defined as : $z^E = min\{z^T, z^F\}$. Thus, two cases are possible. First, if the wage rate is below the walrasian rate, the effective retirement age coincides with the worker's optimal age : $z^E = z^T$. In this case, social security reforms introducing actuarially fair adjustments are particularly powerful to push back the retirement age. Second, when the wage rate exceeds the walrasian rate, it is the firm that determines the separation date : $z^E = z^F$ and thus workers can not attain their optimal retirement age. Consequently, trying to increase the employment rate of older workers by introducing pension incentives seems to be an unattainable goal if wages are rigid. In this case, it appears that subsidies paid to firms are the best policy to attain the optimal retirement age.

3.1 Introducing Labor Supply Incentives

Let us assume that the wage rate is below the walrasian rate. This can be written as : $w = (1-\delta)w^*$ with $\delta > 0$. The worker's lifetime utility can be rewritten as :

$$\max_{e,z^T} \left\{ \begin{array}{c} (1-\tau)\omega h_1 - \frac{(e)^2}{2} \\ +\beta \left[(1-\tau)(1+e)(1-\delta)z^T w^* h_1 - \gamma \frac{(z^T)^2}{2} + (1-z^T)p_1 \right] \end{array} \right\}$$

The first-order conditions with respect to human capital investment and retirement age are given by :

$$e = \beta z^T w^* h_1 \left[(1-\tau)(1-\delta) \right] \tag{31}$$

$$\gamma z^T = (1+e)w^* h_1 \left\{ 1 - \left[\left(\tau + \frac{p_1}{(1+e)wh_1} \right) + \delta(1-\tau) \right] \right\} \tag{32}$$

These expressions show that the social security system in conjunction with the low wage level are two different sources of distortion. First, the optimality functions with respect to human capital investment and with respect to the retirement age are distorted by the "standard" tax rates imposed by the social security system. And second, they are shifted downward by the parameter δ which provides a measure of the real wage cuts. In this context, introducing actuarially fair adjustments eliminates only social security' distortions. To restore the optimality functions prevailing in a laissez-faire situation, the pension incentives must be accompanied by subsidies paid to workers at level $\delta(1-\tau)$.

3.2 The Implementation of Labor Demand Incentives

In this section, we assume that the wage rate exceeds the walrasian level which implies that effective retirement age corresponds to the firm's optimal separation date. Consequently, the increase in the employment rate of older workers can not be attained by introducing pension incentives which are fully received by workers.

Let us write the wage as : $w = w^*(1+\kappa)$ with $\kappa > 0$. The firm maximizes total profits with respect to the duration of production z^F :

$$\max_{z^F} \left\{ (y-\omega)h_1 + \beta \left[z^F (y - w^*(1+\kappa))(1+e)h_1 - \frac{f}{2h_1}(z^F)^2 \right] \right\}$$

The decision about the retirement age depends on the firm's evaluation of marginal revenue and the marginal costs. Thus we obtain :

$$z^F = \frac{(y - w^*(1+\kappa))(1+e)h_1}{(f/h_1)} \tag{33}$$

This expression shows that the separation date of the firm decreases with κ. Indeed, an increase in the parameter κ, which implies a higher wage cost, makes production less profitable. Hence, the firm decides to reduce the duration of production in the second period. This implies that workers cannot attain their optimal retirement age because firms refuse to employ them a longer period and, thus, retirement does not result from a voluntary decision of workers. In that case, the firm's behavior plays an important role in accounting for the decrease in employment at the end of the life cycle. It appears then that policies aiming to encourage firms to maintain workers a longer period are particulary powerful to stimulate the employment of older workers. Such goal seems to be attainable by introducing subsidies to firms in order to *directly* reduce the production costs.

The firm's profit in period 2 is modified by introducing a subsidy π which reduces the production cost, $\varphi(h_1, z^F)$. Given this, the firm's problem becomes :

$$\max_{z^F} \left\{ (y-\omega)h_1 + \beta \left[z^F (y - w^*(1+\kappa))(1+e)h_1 - (1-\pi)\frac{f}{2h_1}(z^F)^2 \right] \right\}$$

The optimal decision for the separation date is given by :

$$z^F = \frac{(y - w^*(1+\kappa))(1+e)h_1}{(1-\pi)(f/h_1)} \tag{34}$$

As it is shown in this equation, the additional costs of production that have to be supported by firms for an additional unit of labor demand are reduced by subsidies. Finally, the value of the optimal subsidy is given by :

$$\pi^* = \frac{\kappa w^*}{y - w^*} \tag{35}$$

4 Conclusion

This paper is aimed at studying the retirement decision from a labor supply and demand perspective. Our model includes the firms employment decision about how long they must continue production with the older workers beyond the normal retirement age. Our enlarged approach reveals that the firm's employment decision can significantly affect the implications of social security reforms aimed at delaying the retirement age by introducing actuarially fair adjustments. Furthermore, we integrate human capital investment decision and investigate how different social security schemes may affect training intensity and its implications on the labor supply-and-demand. The contribution of this paper is twofold. First, we show that not only the worker's choices are negatively affected by a social security system but also the firm's decision : from the worker's point of view, social security system implies *direct* taxes on human capital investment and labor supply. And, from the firms point of view this implies an *indirect* tax on labor demand because of the decrease of worker's productivity. Secondly, our results suggest that, in a walrasian economy, social security reforms aimed at delaying the retirement age by introducing actuarially fair adjustments are particularly powerful to stimulate the employment of older workers. However, if real wages are rigid, two situations must be distinguished. First, if the separation date is determined by workers, fair adjustments would push back the retirement age. In contrast, when the wage exceeds its walrasian value, the separation date is determined by firms. Then, trying to increase the employment of older workers by introducing pension incentives seems to be an unattainable goal in a context where the firm's employment decision is more restrictive than the distortions imposed by pension system. As a result, there is a good reason for focusing primarily on the labor demand. In this case, it appears that subsidies paid to firms are the best policy for attaining the optimal retirement age.

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