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Incentive Schemes to Delay Retirement and the Equilibrium Interplay with Human Capital Investment

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Abstract

This article introduces the role of labor demand of the elderly in the analysis of retirement decisions. We integrate both human capital formation and up-dating costs on older workers' job and explore how Social Security system affects human capital investment and retirement decisions. We show that, from the worker"s point of view, human capital investment and retirement age decisions are interdependent and positively related. On the one hand, an actuarially unfair pay-as-you-go system imposes a tax on postponed retirement which encourages early retirement, thus reducing incentives to invest in human capital. On the other hand, the pension system imposes a tax on training intensity. As a result, workers have less incentives to continue working. From the firm"s point of view, this implies an indirect tax on labor demand due to the decrease in older workers" productivity. We then examine the pattern of the optimal policies according to flexibility versus rigidity of wages.

1. Introduction

Over the last decade, the trend of early retirement has been a widely debated issue, given that people are living longer and staying healthier at all ages. Several studies suggested that individual decisions are strongly affected by the Social Security system (Gruber and Wise (1998)]). The design of the pay-as-you-go (PAYG) system reveals the presence of a tax on continued activity beyond the normal retirement age. A general consequence of this literature is to advocate pension reform introducing incentives to continue working as a key policy measure to increase the effective retirement age (see e.g. Hairault, Langot and Sopraseuth (2008a) or (2008b)).

In opposition to available results (see e.g. Desmet and Pestieau (2003)), the purpose of this paper is to analyze the choice of retirement age when this decision is not a mutual agreement between the employer and the employee. Our approach shows that the firm's employment decisions play a key role in the early retirement phenomenon[1]. A second ambition of this paper is to analyze the interactions between Social Security schemes and private choices on both human capital investment and the up-dating cost on older workers' jobs. By introducing the possibility of updating, we allow firms to increase their expected profits by incorporating new technologies : the firm may decide to pay a renovation cost to update the technology and continue producing with the same worker. This renovation cost stands for the sum of both the costs of new equipment and the costs of training. We then argue that a low retirement age introduces a horizon beyond which firms have less incentives to update jobs occupied by old workers[2]. We find that, from the worker's point of view, human capital investment and retirement age decisions are interdependent, and thus, that an actuarially unfair Social Security system negatively affects the worker's choices of training intensity and retirement age with a "cumulative" effect. Then, from the firm's point of view, we show that the Social Social system implies an *indirect* tax on labor demand because of the decrease of the worker's productivity, implying a higher up-dating cost of the older workers' jobs.

We also examine the pattern of policies aiming at restoring human capital investment and retirement age to their efficient levels. There are two key questions considered in this paper : Starting from an actuarially unfair PAYG system, what is the impact of old-age policies on the retirement age and human capital formation decisions ? And second, what are the actual effects of these policies subject to the degree of wage adjustment ? It is found that, while pension incentives and subsidy of up-dating costs are substitutable and allow to delay the retirement age with an increase of older workers' productivity if wage is flexible, wage rigidity can imply that only a fraction of the tax distortions imposed by the PAYG should be eliminated if the retirement age is imposed by the firm.

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[1]It is important here to note that our model differs from other models where the retirement decision is based on the implicit contract model *à la* Lazear (1979). In this last type of model, firms and workers agree on a contract that pays younger workers below and older workers above their marginal product, allowing to prevent shirking behaviors. Because older workers' wages are higher than their productivities and their reservation wages, it is necessary to introduce a mandatory retirement age, implying involuntary separation form the worker's point of view.

[2]See Langot and Moreno-Galbis (2008) for an analysis of the optimal up-dating time when there are labor market frictions.

2. The Model

We consider a simple two period life-cycle model. Time is discrete and indexed by t=1,2. The length of each period is normalized to unity. Moreover, the economy is populated by two types of risk-neutral agents, namely, workers and firms. The young worker is characterized by a level of initial ability, h_1, which is perfectly observable. The first period is fully active. However the second is endogenously divided into a working period of length equal to a fraction $z \leq 1$ of that period and a retirement period. The variable z can also be interpreted as the retirement age. Thus, total active life lasts $1+z$ and retirement life $1-z$.

2.1 Worker's Behavior

In the first period, a young worker with productivity h_1 supplies a unit of labor, contributes at rate τ to the PAYG system and consumes his total net labor income[3] : $c_1 = (1-\tau)\omega h_1 - T$. where ω is the wage rate per unity of human capital and T a non-distortionary tax. Furthermore, 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 : $\phi(e) = \frac{e^2}{2}$. We assume that there is no depreciation of knowledge, the level of worker's productivity in period 2, denoted by h_2, verifies : $h_2 = (1 + e)h_1$.

In the second period, the old worker earns a labor income $(1 - \tau)wh_2$ during his working period, where w is the wage rate per unity of human capital, and a pension p during his retirement period. The pension level is assumed to be independent of the retirement age[4]. Then, the total second period consumption is : $c_2 = z(1-\tau)wh_2 - T + (1-z)p$. Furthermore, in line with Cremer and Pestieau (2003), we assume that there is a disutility of labor denoted by $\psi(z)$, which increases with the retirement age : $\psi(z) = \frac{\gamma z^2}{2}$. where $\gamma > 0$ captures the intensity of preferences for early retirement. Let β denote the discount factor. Finally, lifetime utility, which is assumed to be additive and separable, is given by :

$$u(c_1, c_2, z) = u(c_1 - \phi(e)) + \beta u(c_2 - \psi(z)) \tag{1}$$

2.2 Firm's Behavior

Each firm is reduced to one job. We assume that the only factor of production is labor. The total output of a job filled by a worker of age t and productivity h_t is simply equal to : yh_t, where y denotes the units of output per unit of human capital, and the firm earns a profit denoted by Π_t. In the first period, we have : $\Pi_1 = (y - \omega)h_1$. Furthermore, we assume that during the second period, production requires additional costs : specific organization of the job must be up-dated in order to maintain its productivity. We assume that these up-dating costs increase with the duration of production : $\varphi(z) = \frac{fz^2}{2}$, where $f > 0$ can be viewed as a fixed cost per an additional period. Then, the second period profit writes as :

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[3]We assume that agents do not have access to financial assets.

[4]This assumption is counterfactual in many countries. A more general approach would be to assume that the overall benefits increase, but not in actuarially fair way, with the retirement age. This approach would make the analysis more difficult without bringing more insights to our results.

$\Pi_2 = z(y-w)h_2 - \varphi(z)$, and the total discounted profit as :

$$\Pi(z, \varphi(z)) \quad = \quad \Pi_1 + \beta\Pi_2(z, \varphi(z)) \tag{2}$$

3. Partial Equilibrium Analysis

3.1 The Worker's Decisions

The household chooses the intensity of human capital investment and the retirement age maximizing his life-time utility. The worker's dynamic program is :

$$\max_{e,z} \left\{ (1-\tau)\omega h_1 - T - \frac{e^2}{2} + \beta \left[(1-\tau)(1+e)wh_1 z - T - \frac{\gamma z^2}{2} + (1-z)p \right] \right\} \tag{3}$$

In a laissez-faire economy, $\tau = p = 0$, these choices are respectively given by :

$$e^* \quad = \quad \beta w h_1 z^* \tag{4}$$

$$z^* \quad = \quad \frac{(1+e^*)wh_1}{\gamma} \tag{5}$$

These equations show that the initial level of human capital positively affects the individual decisions : high-skilled worker will work longer with high productivity in the second period. More importantly, human capital investment and retirement age decisions are interdependent. Indeed, equations (4) and (5) allow us to spell out various complementarities over the life-cycle. The first complementarity is that the more an individual works, the larger will be the returns to his human capital investment. And, the more an individual learns, the larger are the incentives to work, as wages are higher. The second complementarity is that the later an individual retires, the larger will be the returns to his human capital investments. And, the more an individual learns, the more costly early retirement will be.

We now introduce the PAYG system with constant benefits. In this case, the training intensity and the retirement age are respectively given by the following expressions :

$$e(\tau, p) \quad = \quad \beta w h_1 z(\tau, p)(1-\tau) \tag{6}$$

$$z(\tau, p) \quad = \quad \frac{[1+e(\tau, p)]wh_1}{\gamma} \left\{ 1 - \left[\tau + \frac{p}{[1+e(\tau, p)]wh_1} \right] \right\} \tag{7}$$

These conditions suggest that the training intensity and the retirement age are reduced compared to the laissez-faire setting. First, for a given retirement age, 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 accumulation of human capital decreases. Second, equation (7) shows that, for a given training intensity, an increase in z implies a tax, in terms of extra pension contributions and forgone pension payments : $\lambda(\tau, p) = \tau + \frac{p}{[1+e(\tau,p)]wh_1}$, which is known in the literature as the tax on postponed activity (TPA). It is important to note here that, as human capital investment and retirement age decisions are interdependent, these two negative effects also interact. The PAYG system impose negative "cumulative" effects on the worker's decisions :

- First, if the tax on continued activity increases, the retirement age decreases. In response, because the horizon of older workers is shorter, workers invest less in human capital accumulation.
- Second, if the tax on labor income of the elderly increases, the marginal benefits of training intensity decreases. Thus, workers invest less in human capital. In response, because productivity and thus labor income of older workers decrease, workers have less incentives to continue working and reduce their retirement age.

PROPOSITION 3. *The PAYG system imposes an "total" tax $\theta(\tau, p) > \tau$ on training intensity and an "total" tax $\Theta(\tau, p) > \lambda(\tau, p)$ on retirement age, such that :*

$$e(\tau, p) = e^*(1 - \theta(\tau, p)) \quad \text{and} \quad z(\tau, p) = z^*(1 - \Theta(\tau, p)) \tag{8}$$

The impact of incentive schemes to work longer

We now introduce a policy aimed at eliminating the taxes imposed by the PAYG system. By considering the situation of combining work with pension receipt : agents who work when old receive the total benefits due to them during the continuing working year. However, when retired, workers will not receive any additional benefits. Let s denotes the value of these redistributed taxes. In this case, the total second period consumption becomes :

$$c_2(s) \quad = \quad z[(1 - \tau)wh_2 + s] - T + (1 - z)p \tag{9}$$

Then, we deduce the following expression of z :

$$z(\tau, p, s) \quad = \quad \frac{[1 + e(\tau, p, s)]wh_1}{\gamma} \left\{1 - [\lambda(\tau, p, s) - S]\right\} \tag{10}$$

where $S = \frac{s}{[1 + e(\tau, p, s)]wh_1}$.

The PAYG system is actuarially fair at the margin, if and only if :

$$\lambda(\tau, p, s) = S \Longleftrightarrow s^*(\tau, p) \quad = \quad \tau wh_2 + p \tag{11}$$

This equation says that additional contributions by working another year and the foregone pension due to this delayed retirement should be exactly equal to the incentive benefits. In the second period budgetary constraint of the worker, we then have :

$$c_2(s^*) \quad = \quad zw(1 + e)h_1 - T + p \tag{12}$$

We verify that, at the margin, the individual decisions of e and z are not affected by the current system. More importantly, this reform does not lead to an increase of the social security system deficits. Finally, it is also important to note that an actuarially fair reform of the PAYG system has a double positive effect because both employment and productivity of older workers are increased.

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3.2 The Firm's Decisions

Let now analyze the separation age for the firm. The problem of the firm is as follows :

$$\max_{z} \left\{ (y - \omega)h_1 + \beta \left[z(y - w)(1 + e)h_1 - \frac{fz^2}{2} \right] \right\} \tag{13}$$

From the firm's point of view, the first-order condition of the program (13) writes as :

$$(1 + e)yh_1 = (1 + e)wh_1 + fz \tag{14}$$

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 up-dating costs fz. In the laissez-faire setting, we deduce the following separation date for the firm :

$$z^* = \frac{(y - w)(1 + e^*)h_1}{f} \tag{15}$$

The firm's optimal separation date positively depends on the worker's productivity. This suggest that low-skilled workers may be fired earlier because firms refuse to employ them for a long period. However, given equation (8), we obtain the following separation age in the presence of the pension system :

$$z(\tau, p) = \frac{(y - w)[1 + e^*(1 - \theta(\tau, p))]h_1}{f} \tag{16}$$

A crucial implication of this condition is that the firm's decision is also negatively affected by an actuarially unfair PAYG system. Indeed, because the tax on training intensity, $\theta(\tau, p)$, reduces the human capital investment, the worker's productivity and thus the firm's profits decrease in period 2. Hence, the production becomes less profitable, the firm decides to reduce the job duration in the second period.

Given the decrease in older workers' productivity, subsidizing employment may be a desirable option, especially if the worker's skills acquired over his working life are not easily transferable to other available jobs. In such policy option, firms would be paid a fraction π of the up-dating costs $\varphi(z)$ in order to compensate the low productivity of the retained worker. In this case, the second period profit of the firm becomes :

$$\Pi_2 = z(y - w) \left\{ 1 + e^* \left[1 - \theta(\tau, p) \right] \right\} h_1 - (1 - \pi)\frac{fz^2}{2} \tag{17}$$

Then, we deduce the following separation date :

$$z(\tau, p, \pi) = \frac{(y - w)[1 + e^*(1 - \theta(\tau, p))]h_1}{(1 - \pi)f} \tag{18}$$

It is straightforward to verify that $\frac{\partial z}{\partial \pi} > 0$. Then, there exists a subsidy such that the separation age chosen by the firm equals the one without distortions given by :

$$\pi^* = \frac{e^* \times \theta(\tau, p)}{1 + e^*} \tag{19}$$

The value of the subsidy increase with the tax imposed by the PAYG on the training intensity. In the absence of these distortions, $\theta(\tau, p) = 0$, the subsidy also equals zero.

4. General Equilibrium Analysis

There is an exogenous number of workers in the economy. Firms, which each employs one worker, enter in the market until all individuals have a job. Then, each period, we have $2 \times N$ firms. For the young worker, competitive equilibrium leads to $\omega = y$. For the old worker, walrasian adjustment of wages ensures the equilibrium between the retirement age proposed by the worker and the one demanded by the firm. This implies the existence of an employment contract which ensures that separations at the end of life are mutually advantageous. Equations (10) and (18) then allow us to deduce the following equilibrium wage :

$$ w = \frac{\gamma}{\gamma + (1 - \pi)f(1 - \lambda + S)} \times y \qquad (20) $$

The value $\gamma + f$ represents the total marginal cost of an additional year of work after the full rate age for both the worker and the firm. As γ represents the cost for the employee, in terms of the disutility of working an additional year when $\pi = \lambda = S = 0$, the output is divided such that each agent receives a share which is proportional to his relative cost[5]. Equation (20) also implies that an actuarially unfair PAYG system leads to an increase in the wage. Therefore, on the one hand, for a given retirement age, social security taxes increase the wage. On the other hand, for a given wage, they decrease the retirement age. Overall, the global effect of these taxes leads to a decrease in the retirement age and also the elderly's productivity.

There exists a set $\{S_{\geq 0}, \pi_{\geq 0}\}$ of incentives which allows the decentralized economy with PAYG system to be efficient[6]. Indeed, if we introduce a labor supply incentives in which the additional retirement benefits are not adjusted in an actuarially fair way, $S < \lambda$, the employer should compensate the elderly only for the part of the retirement benefits that is not adjusted in an actuarially fair way. The lower the incentives S, the higher the net tax $(\lambda - S)$, the higher the wage, and hence the higher the subsidy. As a borderline case, if the PAYG system is actuarially fair at the margin, which means that the total expected social Security Surplus from the delayed retirement is completely redistributed as incentives to workers, $\lambda = S$, such system does not distort the worker's decisions and thus there is no need to subsidy the firm $(\pi = 0)$.

But, overall, the existence of an optimal retirement age is the consequence of an optimal (flexible) wage scheme which ensures that the worker-firm separation occurs at the appropriate time. But one important issue remains : What happens if this assumption is relaxed ?

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[5] We can see that if $f = \gamma$, the production is equally divided between the worker and the firm : $w = \frac{1}{2} \times y$. If $f = 0$ (there is no costs of updating the older worker jobs), the wage is equal to the marginal product of a worker : $w = y$.

[6] These incentives are financed by the additional Social Security revenue (foregone pension and additional contribution during the continuing working period) and the non-distortionary tax.

5. Unilateral Retirement Decision

We consider the consequences of introducing "one-party" retirement decision[7]. In this context, the separation age can be "unilaterally" imposed by one party, thus the separation date denoted z^U is defined as : $z^U = min\{z^W, z^F\}$, where z^W and z^F denote the optimal separation time for the worker and the firm, respectively. Then the worker maximizes (3) subject to $z^W \leq z^F$ and, similarly, the firm maximizes (13) subject to $z^F \leq z^W$. Two cases arise :

1. First, if $z^U = z^W(w < w^*)$: the retirement age coincides with that of the worker. Training intensity and retirement age are derived from (6) and (7), and actuarially fair adjustments are particularly powerful to delay the retirement age. In contrast, subsidy of up-dating costs does not work any more.

2. Second, if $z^U = z^F$, the problem for the worker is to choose his training intensity $\tilde{e}$ subject to the constraint that he could not attain his optimal retirement age. This constrained training intensity is :

$$\tilde{e} = \beta(1-\tau)wh_1z^F \tag{21}$$

The problem then for the firm is now to choose z^F subject to the constraint that $\tilde{e}$ is given by (21). We deduce the following separation date :

$$z^F = \frac{(y-w)h_1}{(1-\pi)f - (y-w)(1-\tau)\beta wh_1^2} \tag{22}$$

This equation shows that when we give to individuals only a fraction of the actuarially fair incentives (such as an exemption from the tax contributions to the PAYG, i.e, $\tau = 0$), the decentralized economy with PAYG system could be efficient without introducing any subsidy. However, without Social Security provision reforms, subsidies should be given to firms in order to keep older workers in employment. When subsidies increase, the firm delays the retirement age. The incentives to delay z are twofold : first the instantaneous profit rises, and second the training intensity is higher. This ensures the efficiency of this type of policy when employment-retirement transition is chosen by the firm.

6. Concluding Remarks

This paper aims at studying the interaction between retirement decisions and human capital formation by explicitly introducing the labor demand of the elderly in the presence of up-dating costs on the older worker jobs. First, our approach reveals that an actuarially unfair PAYG system negatively affects both human capital investment and retirement decisions. Second, it is found that the effects of old-age policies strongly depend on the degree of wage adjustment. Indeed, if wages are flexible, pension incentives or subsidy of up-dating costs become substitutable and allow to delay the retirement age. In contrast, in the context of wage rigidity, it can be efficient to give individuals only a fraction of the actuarially fair incentives in case of postponed retirement.

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[7]In this context, the retirement age is not subject to any specific agreement between firms and workers. Another equivalent assumption is to consider that wages are rigid.

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