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### The role of income effects in early retirement

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### *Abstract*

We provide a long term perspective on the individual retirement behavior and on the future of retirement by emphasizing the role of (negative) income effects. We consider a political economic theoretical framework, with actuarially "fair" and "unfair" early retirement schemes, and derive a political equilibrium with positive social security contribution rates and early retirement. A reduction in the wages in youth, consistent with the recent labor market trends since the massive introduction of temporary jobs, induces workers to postpone retirement, and -- in the "unfair" system -- leads to lower contribution rates. A reduction in the growth rate of the economy has opposite effects on the retirement decisions, leading -- in the "unfair" system -- to more early retirement. Aging induces a negative income effect, but has also an opposite political effects on social security contributions and retirement decisions. For an actuarially "fair" social security system, we provide conditions for the political effect to dominate; in an "unfair" scheme, numerical simulations confirm a slight predominance of the political effect, as contribution rates increase. These results may shed some light on the future of early retirement in aging societies.

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# 1 Introduction

Retirement decisions represent one of the hottest issues in the current social security debate. Several studies (see Blondal and Scarpetta, 1998, and Gruber and Wise, 1999 and 2004) suggest that the individual retirement behavior is strongly affected by the design of the social security system. In fact, most social security systems provide strong incentives, such as large implicit taxes on continuing to work, that create a substitution effect to anticipate retirement. However, the individual retirement behavior is also largely influenced by wealth or income effects. Several recent studies (see Costa, 1998, Coronado and Perozek, 2003, Büttler et al., 2005, and Euwals et al., 2006) show that both expected and unexpected increase in workers' income or wealth induce them to retire early.

The massive use of early retirement provisions and their generosity have contributed to the deterioration of the financial sustainability of the system, already under stress because of population aging. In fact, several international organizations - such as the European Union at the 2001 Lisbon Meetings - have advocated an increase in the effective retirement age, or - analogously - the increase in the activity rate among individuals aged above 55 years, as a key policy measure to control the rise in social security expenditure. Postponing the retirement age has thus become a common element to all social security reform's proposals. Yet, the actual implementation of these policy prescriptions is difficult.<sup>1</sup> Figure 1 displays the incentive to retire early in OECD countries in 1985 and 2003, as measured by the implicit tax on continuing to work. Different patterns emerge. Denmark and few other (Anglosaxon) countries (on the south-west corner of figure 1) have always had pension systems providing little incentive to retire early. In Sweden, Italy and, to a lesser extent in Germany and Norway, recent reforms have instead introduced the principle of actuarial fairness or neutrality<sup>2</sup>, due to a shift from a defined benefit to a notional defined contribution system, in which benefits are depend on lifetime contributions and are actuarially linked to retirement age. These recent reforms and the public debate make the analysis of fair pension systems a particularly interesting benchmark, against which to compare the other cases. However, it remains the case that several other OECD countries have failed to change their retirement systems.

Yet, the average retirement age may increase also absent modifications of the retirement schemes, due to economic and demographic factors. In particular, a

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<sup>1</sup>On the politics of early retirement, see Fenge and Pestieau, 2005, for a detailed discussion of early retirement issues, and Galasso and Profeta, 2002, for a survey of the political economy of social security.

<sup>2</sup>The OECD (see Queisser and Whitehouse, 2006) distinguishes the concept of actuarial fairness, which requires that the present value of lifetime contributions equals the present value of lifetime benefits, and the concept of actuarial neutrality, which requires that the present value of accrued pension benefits for working an additional year is the same as in the year before (meaning that benefits increase only by the additional entitlement earned in that year). The two terms are however often used interchangeably to imply marginal fairness between benefits and contribution, generally with reference to early retirement incentives.

recent empirical literature (see Munnell et al., 2009) has suggested that income effects may play a crucial role: when hit by negative wealth shocks on their (private) pension funds, workers tend to postpone retirement. So far, these phenomena have had only limited effects on the average retirement age, which in most countries has only slightly increased since the early 90s. A more recent phenomenon with potential long lasting effects has however occurred in the labor markets of many European countries: the introduction and the massive use of temporary contracts. According to OECD (2009) data, the share of temporary contracts among dependent workers has increased from 8% in 1980 to 14.4% in 2008 in the EU 15 countries, jumping from 4.7% (in 1985) to 13.9% in Italy, and from 15.5% (in 1987) to 29.3% in Spain. These contracts are largely concentrated among the young: in 2006, 52% of the twenty-five years old Spaniard workers, 36% of the Italians and 32% of the French of the same age cohort had a temporary contract. In most countries, workers on temporary jobs do not acquire the same pension rights as those on regular jobs. Furthermore, temporary contracts are associated with lower wages than permanent contracts.<sup>3</sup> The potential long term effects on the pension benefits – and thus on the future retirement behavior – of this current phenomenon<sup>4</sup> in the labor market of the young generations is estimated to be quite large.<sup>5</sup>

This paper provides a political economy framework to analyze the link between individual retirement decisions and the political determination of the social security contribution rates. The design of the social security system – and in particular the contribution rate and the generosity of the pension benefits – affects the individual retirement decisions, but so do economic and demographic factors. We use the notion of Markov equilibrium to relate the evolution of the social security system to the stock of capital, and study two pension systems providing different retirement incentives. Our political economy model characterizes the political equilibrium sequences of social security tax rates and the corresponding use of early retirement provisions, and suggests a non-trivial link between social security contributions and mass of early retirees. This link depends on the design of the social security system – in particular on its degree of redistributiveness – on the level of income inequality in the society, but also on the relative wages of young and old workers.

This paper’s main contribution is to analyze the impact on the political determination of social security contribution rates and on the individual retire-

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<sup>3</sup>In Spain, the wage gap is around 30% (see De la Rica, 2004). In Italy, the average wage of a thirty years old entering the labor market – and hence typically on a temporary job – is 20% lower than the average wage (see Rosolia and Torrini, 2005).

<sup>4</sup>Income effects have potential strong consequences especially for women. As pointed out by the OECD (2011), in most OECD countries old women will be more likely to be poor than men and to have a non adequate income for retirement, due to their overrepresentation in low-paid occupations, in part-time jobs and to career interruptions related to child caring, which, in many cases, are not recognized for credits and pension entitlements.

<sup>5</sup>Boeri and Galasso (2011) estimate that a current 25-years old Italian worker on a temporary contract may expect a monthly pension benefit around € 976-1070 (in 2009 euros) if retiring at age 65, whereas he could expect a monthly pension benefit around € 1263-1390, in a labor market featuring permanent contracts and a continuous working career.

ment age of (negative) income effects, as driven for instance by aging, economic slowdowns, and by the recent labor market dynamics. In particular, we emphasize the effects of a reduction in the wage of the young relative to the old workers, which has occurred in most European countries since the massive introduction of temporary contracts. When faced with lower wages in youth, and less generous pensions in old age, individuals opt for later retirement, even when generous early retirement provisions are still available. Furthermore, the equilibrium social security contribution rate may be reduced.

Persistent economic slowdowns, as captured by a decrease of the growth rate of the economy induce a similar, but more complex response. The social security contribution rate will typically be reduced, while the overall effect on the average retirement age will depend on the relative magnitude of direct effect – the reduction in the generosity of the pension benefits – and of the indirect effect – the change in the contribution rate. To fully characterize the analysis, we consider a (simpler) environment in which the social security system is actuarially "fair" at the margin, and an "unfair" system. In the former case, we are able to provide an analytical solution, while in the latter case we present a numerical example.

In line with the existing literature (see Galasso and Profeta, 2002), our theoretical framework suggests that aging has two opposite effects on the contribution rates: it tends to decrease them, since it makes the public pension system less profitable, but it makes the median voter poorer, and thus induces higher social security. Aging however induces a negative income effect that may lead to an overall increase in the retirement age, regardless of the change in the contribution rate. In fact, even if the contribution rate increases, the negative income effect of aging may dominate, and lead to postponing retirement. Alternatively, if the contribution rate decreases, both effects will go in the direction of increasing retirement age.

The paper is structured as follows. In the next section, we discuss the related theoretical and empirical literature. Section 3 presents a politico economic model, and Section 4 analyzes the impact of aging and of a negative income effect on the steady state level of early retirement and social security. Section 5 concludes.

## 2 Related Literature

There exists a vast literature on retirement decisions. To account for the decline in the labor force participation of elderly workers, Feldstein (1974) and Boskin and Hurd (1978) identified two key determinants in the social security system: the income guarantee and the implicit tax on earnings. Endogenous retirement decisions have also been analyzed by showing how pension systems introduce distortions in the labor supply choice (see among others Diamond and Mirrless, 1978, Hu, 1979, Crawford and Lilien, 1981). While these works concentrate on the role of the substitution effects in retirement decisions, Michel and Pestieau (1999) use a growth model to suggest that income effects may also be relevant

in choosing when to retire. In an earlier paper, Sheshinski (1978) discusses the role of the (negative) income effect induced by population aging, via an increase in the social security contribution rate, in increasing the retirement age. This mechanism, together with the corresponding substitution effect generated by the higher contribution rate, is embedded in a political economy model in Lacomba and Lagos (2007).

In fact, a new literature has lately emerged on the political economy of early retirement (see Fenge and Pestieau, 2005, Casamatta et al., 2005, Cremer and Pestieau 2000, Cremer et al. 2004, Conde Ruiz and Galasso, 2003 and 2004). Some papers endogenized the political determination of some features of the early retirement system (most notably Casamatta et al., 2005, and Conde Ruiz and Galasso, 2003), but they assume specific functional forms for the utility function that lead to neglect the role of (aggregate) income effects. Our theoretical model is similar in spirit to the two period OLG model introduced by Conde Ruiz and Galasso, 2003 and 2004. Yet, while in their model the labor supply decision occurs in the first period, here retirement decisions take place in the second period of the life of an individual.<sup>6</sup> Furthermore, we specifically analyze income effects.

Politico-economic models of social security in a repeated voting environment have been studied by Cooley and Soares (1999), Galasso (1999), Boldrin and Rustichini (2000), Azariadis and Galasso (2002), Hassler et al (2003), Gonzalez-Eiras and Niepelt (2008), Forni (2005). These models however focus on social security and abstract from the role of retirement.

Recent contributions to the empirical literature have shown that income effects do play a role in retirement decisions. Most of the evidence on the role of income effects is derived from the consequences of higher exposure to market risks – in the US, older workers hold almost two thirds of their 401(k) balances in equities – on retirement decision. Have the recent decline in the stock market encouraged older workers to postpone retirement? Munnell et al. (2009) and Munnell and Saas (2008) report that participation rates among older workers have increased during the recessions of this decade – a dramatic change from previous experience. And Eschtruth and Gemus (2002) and Cahill, Giandrea, and Quinn (2006) suggest that the collapse of the stock market might explain why the labor force participation rate of older workers (55-64) jumped by 2 percentage points between early 2000 and 2002, an unprecedented increase that occurred during a recession when labor force participation usually declined. Moreover, according to Munnell et al. (2009), in 2002, 21% of 50-70 year old respondents in an AARP survey, who had not yet retired, reported that they had postponed their retirement as a result of stock market losses.

A consistent and similar dominant income effect in the economic decision of retirement is found by Gustman and Steinmeier (2002) and Coronado and Perozek (2003), who show that the unexpected positive shocks to wealth as a result of the stock market boom of the 1990s led to some additional retirement.

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<sup>6</sup>Due to this difference, aging may have a stronger economic effect in the model by Conde Ruiz and Galasso (2003 and 2004), since the impact of a reduction in the social security returns on the labor supply decision takes place directly in the first period.

Using US data on retirement expectations from the Health and Retirement Survey, Coronado and Perozek (2003) show that those who held corporate equity immediately prior to the bull market of the 1990s retired, on average, 7 months earlier than other respondents. Butler et al. (2005) obtain similar results in their analysis of the retirement decision in Switzerland. When individuals are credit constrained, the key determinant of retirement in the Swiss actuarially fair, mandatory funded system turns out to be "affordability", i.e., a sufficient retirement income: the higher the accumulated pension capital, the earlier individuals tend to leave the work force. Finally, Euwals et al (2006) analyze the impact on retirement decisions of a Dutch reform in the early 1990s, that reduced the pension generosity and increased the actuarial fairness of the scheme, to show these policy reforms have indeed induced workers to postpone retirement.

### 3 A Politico-Economic Model

#### 3.1 The Economic Environment

We introduce a simple two-period overlapping generations model. Every period, two generations are alive, we call them young and old. Population grows at a non-negative rate,  $n$ . We consider a continuum of individuals heterogeneous in young and old wage income. The wage of a type- $\delta$  individual is  $w_t^y = \delta \bar{w}_t^y$  in youth, and  $w_t^o = \delta \bar{w}_t^o$  in old age, where  $\bar{w}_t^y$  and  $\bar{w}_t^o$  are respectively the average wage of young and old workers. Individual types  $\delta$  are distributed according to some density function  $f(\delta)$  over an interval  $[\underline{\delta}, \bar{\delta}]$  with an average equal to 1 and cumulative density function  $F(\delta)$ .

Young individuals work: they receive a wage,  $w^y$ , pay a payroll tax,  $\tau^y$ , on labour income and save all their disposable income for old age consumption. Savings are done through claims to capital, which yield in return  $r$  units of tomorrow's consumption. Old individuals decide what fraction,  $z$ , of the second period to spend working; in other words, they decide when to retire. An old individual who works a proportion  $z$  of the second period receives a net labor income equal to  $w^o(1 - \tau^o)$ , for the fraction  $z$  of the period, and receives a pension  $p$ , which measures the overall pension transfer obtained in old age. The lifetime budget constraint for an agent born at time  $t$  is thus equal to:

$$c_{t+1}^o = (1 - \tau_t^y) w_t^y (1 + r) + (1 - \tau_{t+1}^o) z_{t+1} w_{t+1}^o + p_{t+1} \quad (1)$$

where subscripts indicate the calendar time, so that  $c_{t+1}^o$  is old age consumption at time  $t + 1$ , and  $\tau_t^y$  and  $\tau_{t+1}^o$  are the payroll taxes respectively paid by the young workers at time  $t$  and by the old workers at time  $t + 1$ .

Agents maximize a logarithmic utility function, which depends on old age consumption and leisure:

$$U(c_{t+1}, z_{t+1}) = \ln c_{t+1}^o + \phi \ln(1 - z_{t+1}) \quad (2)$$

where  $\phi < 1$  measures the relative importance of leisure to the individuals.

The consumption good is produced using labor supplied by young and elderly workers and physical capital. We consider a linear production function

$$Y_t = \int (w_t^y L_t^y + w_t^o L_t^o) f(\delta) d\delta + rK_t \quad (3)$$

where  $Y_t$  is the production of the only consumption good at time  $t$ ,  $L_t^y$  and  $L_t^o$  are the amount of labor by respectively young and elderly workers provided at time  $t$ ,  $K_t$  is the stock of capital in the economy and  $r$  is the return on capital. Moreover, we assume that labor productivity grows at a rate  $g$ , so that  $w_{t+1}^i = (1+g)w_t^i$  with  $i = y, o$ ; and that the economy is dynamically efficient,  $(1+r) > (1+n)(1+g)$ .

Agents determine their retirement age,  $z_{t+1}$ , in order to maximize their utility at equation (2) subject to the budget constraint at equation (1). The solution of this maximization problem yields the following optimal individual labor supply decision:

$$\hat{z}_{t+1} = \frac{1}{1+\phi} - \frac{\phi}{1+\phi} \frac{(1-\tau_t^y)w_t^y(1+r) + p_{t+1}}{(1-\tau_{t+1}^o)w_{t+1}^o} \quad (4)$$

This individual retirement decision displays standard properties.<sup>7</sup> A positive income effect, such as an increase in the net labor income in youth, induces all agents to retire early; while an increase in the net labor income in old age, or a decrease in the pension benefits, would lead them to postpone retirement – due mainly to a positive substitution effect.

The labor supply of elderly individuals at time  $t+1$ , that is, the mass of employed elderly in the economy can easily be obtained by aggregating all individuals' retirement decisions  $L_{t+1}^o = \int_{\bar{\delta}}^{\bar{\delta}} \hat{z}_{t+1} f(\delta) d\delta$ . Young workers have instead inelastic labor supply, and hence  $L_t^y = 1$ . Finally, capital market clearing requires the stock of capital to equalize aggregate savings. Hence, the per-capita stock of capital becomes:

$$K_{t+1} = \frac{1}{1+n} \int_{\bar{\delta}}^{\bar{\delta}} (1-\tau_t^y) \delta \bar{w}_t^y dF(\delta) = \frac{(1-\tau_t^y) \bar{w}_t^y}{1+n} \quad (5)$$

### 3.1.1 The Social Security System

We consider a defined benefit social security system. Every individual's pension benefit depends in part on her wage and in part on the average wage in the economy. This combination, which has extensively been used in the literature (see Casamatta et al., 2000, Conde Ruiz and Profeta, 2007, and Kothenburger, Poutvaara and Profeta, 2008), induces an element of within-cohort redistribution, from high to low income individuals. As in Tabellini (2000), Casamatta

<sup>7</sup>To ensure that  $\hat{z}_{t+1} \in [0, 1] \forall t$  and  $\forall \delta$ , it is convenient to assume that  $\phi \leq \bar{w}_t^o / \bar{w}_t^y (1+r)$ . Additional restrictions have to be imposed on the dynamics of the contribution rates. We will return to these restrictions in the next section.

et al. (2000), and in Conde-Ruiz and Galasso (2005), this feature is crucial to ensure the political sustainability of social security system, through the support of the low ability young.<sup>8</sup> The pension benefit rule is:

$$p_{t+1} = \gamma (\alpha w_t^y + (1 - \alpha) \bar{w}_t^y) \quad (6)$$

where  $p_{t+1}$  represents the pension received by a  $\delta$ -type individual in old age,  $\alpha$  determines the relative importance of the own wage in the benefit calculation, and thus defines the degree of redistributiveness of the social security system (the higher is  $\alpha$ , the more Bismarckian, i.e., the less redistributive, the system is), and  $\gamma$  is a parameter that defines the overall generosity of the system. This last parameter is pinned down by the social security contribution rate through the budget constraint, as discussed below. Moreover, recall that  $w_t^y = \delta \bar{w}_t^y$ .

Pension benefits are financed through social security contributions. Total contributions,  $T_{t+1}$ , at time  $t + 1$  are equal to

$$T_{t+1} = (1 + n) \tau_{t+1}^y \bar{w}_{t+1}^y + \tau_{t+1}^o \int_{\underline{\delta}}^{\bar{\delta}} z_{t+1} w_{t+1}^o dF(\delta) \quad (7)$$

where the terms on the right hand side represent the total contributions paid respectively by the young and the elderly workers at time  $t + 1$ . We assume that the budget of this PAYG system is balanced every period, so that  $T_{t+1} = \int_{\underline{\delta}}^{\bar{\delta}} p_{t+1} dF(\delta)$ . Using equations (6) and (7), we obtain the following expressions for the generosity parameter:

$$\gamma = (1 + n) \tau_{t+1}^y \frac{\bar{w}_{t+1}^y}{\bar{w}_t^y} + \tau_{t+1}^o \int_{\underline{\delta}}^{\bar{\delta}} z_{t+1} \frac{w_{t+1}^o}{\bar{w}_t^y} dF(\delta)$$

and hence for the pension benefit

$$p_{t+1} = \left( (1 + n) \tau_{t+1}^y (1 + g) + \tau_{t+1}^o \int_{\underline{\delta}}^{\bar{\delta}} z_{t+1} \frac{w_{t+1}^o}{\bar{w}_t^y} dF(\delta) \right) (\alpha w_t^y + (1 - \alpha) \bar{w}_t^y) \quad (8)$$

Pension benefits depend on the benefit rule at equation (6), which defines how redistributive these systems are, but their average generosity is determined by the growth rate of the economy – given by productivity and population growth – and (positively) by the labor supply of the elderly workers, which add extra contributions to the system. This last element is particularly relevant because the elderly labor supply decision depends also on the pension that the elderly expect to receive, as shown at equation (4).

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<sup>8</sup>Our results are robust to modifying the model into a 3-period OLG, in which social security is supported by a voting coalition of old and middle aged individuals. See Galasso and Profeta (2002) for a discussion of different elements leading to the political sustainability of social security.

### 3.1.2 Two Pension Systems

In the remaining of the paper, we will analyze two different pension arrangements.<sup>9</sup> In the first scenario, which we call "fair", we consider a situation in which elderly workers do *not* contribute to the social security system, that is,  $\tau_t^o = 0 \forall t$ . This pension system is actuarially fair at the margin, since elderly workers do not contribute, and the total amount of pension received in old age does not depend on the retirement age. This is equivalent to a situation in which individuals do pay contributions in their old age,  $\tau_t^o > 0 \forall t$ , but their total pension benefits increases exactly by the amount of the contributions paid in old age (see Conde Ruiz et al., 2006). In the second scenario, which we call "unfair", we consider a case in which elderly workers do pay contributions, but these contributions do not bring any increase in their total pension benefits. Because of this, the system is actuarially *unfair* at the margin – hence providing an incentive to retire early.

#### The "Fair" Pension System

Setting the contributions of the elderly equal to zero,  $\tau_t^o = 0 \forall t$ , greatly simplifies the analysis, and allows us to obtain a political equilibrium with a closed form solution (see section 2.2). The individual pension benefit of a  $\delta$ -type agent at equation (8) can be written as

$$p_{t+1} = \tau_{t+1} (1+n) (1+g) \bar{w}_t^y (\alpha\delta + (1-\alpha)) \quad (9)$$

with  $\alpha = 1$  in a pure Bismarckian system and  $\alpha = 0$  in a pure Beveridgean scheme.

With the above specification for the pension benefits, the optimal individual labor supply decision<sup>10</sup> can be characterized as follows

$$\hat{z}_{t+1} = \frac{1}{1+\phi} - \frac{\phi}{1+\phi} \frac{(1-\tau_t^y)(1+r)\bar{w}_t^y}{\bar{w}_{t+1}^o} - \frac{\phi}{1+\phi} \frac{\tau_{t+1}^y (1+n) (1+g) \bar{w}_t^y (\alpha + (1-\alpha)/\delta)}{\bar{w}_{t+1}^o} \quad (10)$$

As this expression clearly shows, if individuals take into account the impact that an increase in wages has on their pension benefits, an overall raise in their wage at time  $t$  and  $t+1$  leaves the retirement decision unaffected, since the income and substitution effects perfectly compensate one another. However, changes in the relative wages between youth and old age, as recently observed in the European labor markets, do modify the individual retirement decisions.

In this fair system, we can easily obtain a simple analytical expression for

<sup>9</sup>See Casamatta et al. (2000) for a model in which the degree of distortion of the retirement system is endogenously determined in the political process.

<sup>10</sup>For positive contribution rates, a sufficient condition to have  $\hat{z}_{t+1} \in [0, 1] \forall t$  amounts to impose some restrictions on the dynamics of the contribution rates. In particular, we have that  $\tau_{t+1} < \frac{\bar{w}_{t+1}^o - \bar{w}_t^y (1+r)(1-\tau_t)}{(1+n)(1+g)\bar{w}_t^y (\alpha + (1-\alpha)/\delta)}$ .

the mass of employed elderly in the economy at time  $t + 1$ :

$$L_{t+1}^o = \frac{1}{1+\phi} - \frac{\phi}{1+\phi} \frac{(1-\tau_t^y)(1+r)\bar{w}_t^y}{\bar{w}_{t+1}^o} - \frac{\phi}{1+\phi} \frac{\tau_{t+1}^y(1+n)\bar{w}_{t+1}^y}{\bar{w}_{t+1}^o} (\alpha + (1-\alpha)\hat{\delta}) \quad (11)$$

with

$$\hat{\delta} = \int_{\underline{\delta}}^{\bar{\delta}} \frac{1}{\delta} f(\delta) d\delta \quad (12)$$

Since individuals with different income display different retirement behaviors, the mass of retirees will depend on the distribution of income in the economy. In particular, due to the incentive effect embedded in the model, high income elderly workers will be induced to retire later than low income workers. A (left) skewed income distribution hence tends to magnify the importance of the agents who enjoy very low income in old age and hence have an incentive to retire very early. The parameter  $\hat{\delta}$  captures this aspect by weighting the mass of these low income elderly by their retirement behavior. The larger – for instance – the share of low income elderly, the larger  $\hat{\delta}$  will be; and hence the larger the mass of (early) retirees.

Finally, by substituting the individual decision at equation (10) and the social security budget constraint, we can easily derive the indirect utility respectively of a type- $\delta$  young and old individual at time  $t$ , which we denote by  $v_t^y(\tau_t, \tau_{t+1}; \delta)$  and  $v_t^o(\tau_{t-1}, \tau_t; \delta)$ .

### The "Unfair" Pension System

In this scenario, all workers – young and old – pay the same contribution rate,  $\tau_t^y = \tau_t^o = \tau_t \forall t$ . As suggested by equation (4), the individual labor supply decision of the elderly will now depend both on the pension benefit and on the contribution rate imposed on the labor income in old age. A higher contribution rate reduces the net wage in old age, and thus induces more early retirement. This distortionary element introduces a Laffer curve, which was not present in the previous scenario. In turn, the pension benefit will now depend on the overall contributions (by the young and the elderly), and thus by the proportion of early retirees, as shown at equation (8). The following expressions summarize respectively the pension benefits for a  $\delta$ -type retiree and the average labor supply by the elderly workers under this scenario:

$$p_{t+1} = \tau_{t+1} [(1+n)\bar{w}_{t+1}^y + G_{t+1}] (\alpha\delta + 1 - \alpha) \quad (13)$$

$$L_{t+1}^o = \frac{1}{1+\phi} - \frac{\phi}{1+\phi} \frac{(1-\tau_t)\bar{w}_t^y(1+r) + \tau_{t+1} [(1+n)\bar{w}_{t+1}^y + G_{t+1}] (\alpha + (1-\alpha)\hat{\delta})}{(1-\tau_{t+1})\bar{w}_{t+1}^o} \quad (14a)$$

where  $\widehat{\delta}$  is defined at equation (12) and

$$G_{t+1} = \int_{\delta} z_{t+1} \delta \bar{w}_{t+1}^o dF(\delta) = \frac{(1 - \tau_{t+1}) \bar{w}_{t+1}^o - \phi(1 - \tau_t) \bar{w}_t^y (1 + r) - \phi \tau_{t+1} (1 + n) \bar{w}_{t+1}^y}{1 + \phi - \tau_{t+1}} \quad (15)$$

represents the labor income of the elderly individuals at time  $t + 1$ .

As in the previous case, individuals with different income choose different retirement behaviors, so that the overall mass of retirees will depend on the degree of income inequality in the economy, through the parameter  $\widehat{\delta}$ . Again, a larger value of the  $\widehat{\delta}$ , corresponding to a large share of low income elderly, will be associated with more early retirees. A comparison of equations (9) and (13) shows instead the difference in terms of the distortionary effects of taxation. This "unfair" scenario allows to consider this distortionary effect, but at the cost of having to rely on a numerical solution.

Finally, we denote the indirect utility of a type- $\delta$  young and old individual at time  $t$  respectively by  $v_t^y(\tau_t, \tau_{t+1}; \delta)$  and  $v_t^o(\tau_{t-1}, \tau_t; \delta)$ .

### 3.2 The Political Equilibrium

As already discussed in the previous section, early retirement behavior is affected by specific features of the social security system, such as the size of contribution rates and pension benefits. Here, we study the political determination of this social security contribution rate under two retirement incentives schemes.<sup>11</sup> Every year, elections take place in which the current social security contribution rate is determined. All young and old agents participate at the elections. Their preferences over the contribution rate may differ – typically according to their income ( $\delta$  type) and age. We follow a well established tradition in political economics by concentrating on the median voter decision. Moreover, due to the intergenerational nature of the system, we allow for some interdependence between current and future political decisions. In particular, we analyze Markov perfect equilibrium outcomes of a repeated voting game over the social security contribution rate. As customary in this literature, we consider the state of the economy for the Markov equilibrium to be summarized by the stock of capital.<sup>12</sup> More specifically, at every period  $t$ , the median voter in each generation of voters – typically a young individual<sup>13</sup> – decides her most favorite social security

<sup>11</sup>It is important to notice that, depending on the scenario under analysis (namely whether we consider the "fair" or "unfair" system), the contribution rate,  $\tau_t$ , may characterize different features. In the "fair" system, in fact,  $\tau_t = \tau_t^y$  and  $\tau_t^o = 0 \forall t$ ; while in the "unfair" case,  $\tau_t = \tau_t^y = \tau_t^o \forall t$ . With this in mind, whenever it does not lead to confusion, we will hence drop the superscript and simply use  $\tau_t$ .

<sup>12</sup>Examples of Markov equilibria in social security games are in Krusell et al.(1997), Grossman and Helpman (1998), Azariadis and Galasso (2002), Hassler et al. (2003), Gonzalez-Eiras and Niepelt (2008), Forni (2005). Subgame perfect equilibrium outcomes of repeated games over social security have instead been analyzed by Boldrin and Rustichini (2000), Cooley and Soares (1999) and Galasso (1999) among many others.

<sup>13</sup>It is easy to show that, in this setting, every elderly voter will support a 100% contribution rate. For a positive population growth rate,  $n > 0$ , the median voter will hence be young.

system (i.e., the tax rate  $\tau_t$ ). In taking her decision, she expects her current decision to have an impact of future policies. In particular, her expectations about the future social security tax rate – and hence about her pension benefits – depend on the value of the state variable, i.e., on the stock of capital, according to a function  $\tau_{t+1} = q^e(K_{t+1})$ . Hence, future contribution rates depend on the stock of capital, which is in turn affected by the current voter's decision over the social security contribution rate, through its effect on the individual savings. The median voter's optimal decision can thus be obtained by maximizing her lifecycle utility with respect to  $\tau_t$ , given expectations on the next period policy function  $\tau_{t+1} = q^e(K_{t+1}) = Q(K_{t+1}(\tau_t))$ :

$$\max_{\tau_t} v_t^y(\tau_t, \tau_{t+1}, \delta) = \max_{\tau_t} v_t^y(\tau_t, Q(K_{t+1}(\tau_t)), \delta) \quad (16)$$

We can now define our political equilibrium as follows

**Definition 1** *A Markov political equilibrium is a pair of functions  $(Q, K)$ , where  $Q : [0, +\infty) \rightarrow [0, 1]$  is a policy rule,  $\tau_t = Q(K_{t+1})$ , and  $K : [0, 1] \rightarrow [0, +\infty)$  is an aggregation of private decision rules,  $K_{t+1}(\tau_t)$ , such that the following functional equations hold:*

- i)  $Q(K_{t+1}) = \arg \max_{\tau_t} v_t^y(\tau_t, \tau_{t+1}; \delta^{mv})$  subject to  $\tau_{t+1} = Q(K_{t+1}(\tau_t))$ ;
- ii)  $K_{t+1}(\tau_t) = (1 - \tau_t^y) \bar{w}_t^y / (1 + n)$ ;
- iii)  $\delta^{mv}$  identifies the median voter's type among the young.

The first and last equilibrium conditions require that  $\tau_t$  maximizes the objective function of the median voter – a type- $\delta^{mv}$  young individual – taking into account that the future social security system tax rate,  $\tau_{t+1}$ , depends on the current social security tax rate,  $\tau_t$ , via its effect on the private savings, and thus on the stock of capital. Furthermore, it requires  $Q(K_{t+1})$  to be a fixed point in the functional equation in part i) of the definition. In other words, if agents believe future benefits at any time  $t + j$  to be set according to  $\tau_{t+j} = Q(K_{t+j})$ , then the same function  $Q(K_{t+1})$  has to define the optimal voting decision today. The second equilibrium condition requires the stock of capital to be equal to the total savings.

In order to compute the political equilibrium, we have to consider the optimal social security tax rate chosen by the median voter at time  $t$  who maximizes the indirect utility function with respect to  $\tau_t$ , given her expectations that  $\tau_{t+1} = Q(K_{t+1}(\tau_t))$ .

The corresponding first order condition is:

$$-\delta^{mv} \bar{w}_t^y (1 + r) - z_{t+1}^o \delta^{mv} \bar{w}_{t+1}^o \frac{\partial \tau_{t+1}^o}{\partial \tau_t} + \frac{\partial p_{t+1}}{\partial \tau_{t+1}} \frac{\partial \tau_{t+1}}{\partial \tau_t} = 0 \quad (17)$$

where the first element represents the current cost to the median voter in terms of higher contributions, while the last term represents the future benefits corresponding to a higher pension, provided that a higher current contribution leads to a higher contribution rate also tomorrow:  $\partial \tau_{t+1} / \partial \tau_t > 0$ . In the "unfair" system, if  $\partial \tau_{t+1}^o / \partial \tau_t > 0$ , the median voter has to take into account the additional,

future cost of paying higher contributions. With a redistributive design of the social security system, i.e., for  $\alpha < 1$ , the most preferred contribution rate of a young individual is weakly decreasing in her income, since contributions depend on the wage income while – at least part of – the benefits do not.<sup>14</sup> The elderly most preferred social security contribution rate does not depend on their type and is always larger than any young's. These features command a distribution of preferences over social security contributions with elderly voters, who choose the highest tax rate, followed by the poorest young, and then by increasingly less poor young individuals.

It is now convenient to define the average return performance of the social security system relatively to the private claims to capital as  $N = (1 + n)(1 + g)/(1 + r)$ . Clearly, the individual profitability of the social security system depends also on the individual type,  $\delta$ , and on the degree of redistributiveness of the system, as measured by  $\alpha$ .

### **The "Fair" Pension System**

The next proposition characterizes the properties of the sequence of the equilibrium contribution rates in the "fair" social security scenario.

**Proposition 2** *In a "fair" social security system (i.e., for  $\tau_t^o = 0 \forall t$ ), if  $\delta^{mv} < \frac{N(1-\alpha)}{1-N\alpha}$  ( $< 1$ ) there exists a Markov political equilibrium sequence of social security contribution rates  $\{\tau_t^*\}_{t=s}^\infty \in [0, 1]$ , which evolves according to the following law of motion*

$$\tau_{t+1}^* = A - \frac{\delta^{mv}(1 - \tau_t^*)}{N(\alpha\delta^{mv} + 1 - \alpha)},$$

where  $A \in \left(\frac{1}{N\left[\alpha + \frac{1-\alpha}{\delta^{mv}}\right]}, 1\right)$  represents a free parameter pinned down by the first median voter's expectation of future policies, and  $\delta_t^{mv}$  is such that  $1 + (1 + n_t)F(\delta_t^{mv}) = 1 + n_t/2$ . This sequence converges to a non negative steady state:

$$\bar{\tau} = \frac{AN(\alpha\delta^{mv} + 1 - \alpha) - \delta^{mv}}{N(\alpha\delta^{mv} + 1 - \alpha) - \delta^{mv}}.$$

**Proof.** See Appendix.

The above proposition suggests that – even in this dynamically efficient economy – a stable steady state with a positive level of the social security contribution rate may emerge as an equilibrium of the political game, if the individual return from social security to the median voter is larger than the return from private assets. In a Bismarckian system, i.e., when  $\alpha = 1$ , an equilibrium with a positive level of social security contributions hence fails to exist. However, with some redistribution, if the median voter is sufficiently poor, social security will be supported. For instance, in a pure Beveridgean system, i.e., with  $\alpha = 0$ , the median voter type has to be such that  $\delta^{mv} < N$ . Hence,

<sup>14</sup>In fact, it is easy to see that equation (17) depends negatively on  $\delta$  both in a "fair" and in an "unfair" system, i.e., when  $p_{t+1}$  is defined respectively at equations (9) and (13).

for a social security system to be in place, together with a highly redistributive social security system, the economy has to feature a sufficiently high level of income inequality, as measured by the density function  $f(\delta)$ .

Social security contribution rates affect the individual retirement decisions and hence the overall use of the early retirement provisions (see equation (10)). An increase in the contribution rate has two effects on the agents. It raises their contributions in youth, and increases their pension benefits. The former represents a negative income effect which induces individuals to retire later, while the latter effect calls for early retirement. Which of the two effects prevails depends on the average performance of the social security system relatively to the private assets, on its redistributiveness and on the individual income. Different individuals will typically have different responses to an increase in the contribution rate. If the system is sufficiently redistributive, low income agents will anticipate their retirement, since the latter effect dominates, while high-income individuals will postpone it. The overall effect of an increase in income of the total mass of employed elderly will hence depend also on the distribution of ability in the society. For the fair system, the mass of employed elderly in the economy at a steady state is given by:

$$\bar{L}^o = \frac{1}{1+\phi} - \frac{\phi}{1+\phi} \frac{(1+r)\bar{w}^y}{\bar{w}^o} \left[ 1 + \bar{\tau} \left[ N \left( \alpha + (1-\alpha)\hat{\delta} \right) - 1 \right] \right]. \quad (18)$$

It is easy to see that, if  $N \left( \alpha + (1-\alpha)\hat{\delta} \right) > 1$ , with  $\hat{\delta}$  defined at equation (12), an increase in the contribution rate reduces the overall employment among the elderly – i.e., it leads to more early retirement. This is because the (early retirement) effect induced among the low income individuals is large enough to compensate for the increase in the retirement age of the high-ability types. This condition is more likely to hold the larger the share of low income individuals (as measured by  $\hat{\delta}$ ), the more Beveridgean ( $\alpha$ ) and the more efficient ( $N$ ), the system is. In fact, all these features characterize the impact of the contribution rate on the retirement decision of the low income elderly. We will return to this crucial condition in the next section when investigating the impact of labor market conditions, productivity growth and aging on retirement in a "fair" social security system.

### **The "Unfair" Pension System**

In the case of an "unfair" social security system, the political decision becomes more complex. First, an increase in tomorrow's contribution rate introduces an additional cost for today's median voter, as shown by the second term at equation (17). Second, higher contributions have a non-linear effect on the pension benefits, because of the existence of a Laffer curve created by the effect of the contribution rate on the retirement decision (see section 2), as shown in the following expression:

$$\frac{\partial p_{t+1}}{\partial \tau_{t+1}} = \left[ (1+n)\bar{w}_{t+1}^y + G_{t+1} + \frac{\partial G_{t+1}}{\partial \tau_{t+1}} \tau_{t+1} \right] (\alpha \delta^{mv} + 1 - \alpha) \quad (19)$$

where  $G_{t+1}$  represents the labor income of the elderly individuals at time  $t + 1$  (see equation (15)). We have to resort to a numerical solution to characterize the evolution of the political equilibrium social security contribution rates.

We consider two classes of pension systems: (i) a Beveridgean system, characterized by a high degree of intergenerational redistribution, and common in Anglo-saxon countries; and (ii) a Bismarckian system, featuring little redistribution, and more common in Continental Europe.

To parameterize these systems, we consider that every period corresponds to 25 years. The average performance of the social security system is given by its average internal rate of return, which is measured by the product of the real wage growth rate and the population growth rate. The performance of the alternative saving scheme – the claim to physical capital – is indicated by the annual real rate of return. Hence, the average relative performance of the social security system with respect to this other saving scheme is equal to  $N = (1 + n)^{25} (1 + g)^{25} / (1 + r)^{25}$ . In other words, social security pays out, on average  $N\%$  of what the private savings do over the lifecycle. Table 1 displays the value of the average relative performance of the social security system,  $N$ , and its degree of redistributiveness,  $\alpha$ , calculated for these two groups of countries.<sup>15</sup> A strong difference emerges between these two groups. Clearly, countries with Beveridgean systems have low values of  $\alpha$  – and hence a high degree of redistributiveness, but also a relatively poor performance of the social security system. The average values are  $\alpha = 0.28$ , and  $N = 0.56$ . Countries with Bismarckian systems, on the other hand, have a low degree of redistributiveness (the average value is  $\alpha = 0.8$ ), but a relatively better performance of the social security system,  $N = 0.71$ .

In our numerical exercise, we set the annual values of both the real wage growth rate and the population growth rate to 1.5% for all countries. However, to account for the differences in the performance of the social security system between the two groups of countries, we set the annual real rate of return to 3.5% for the Bismarckian countries and to 5.5% for the Beveridgean. This leads to an average relative performance of the social security system,  $N$ , of 55% for the Beveridgean countries and of 89% for the Bismarckian. The degree of redistributiveness is chosen to be equal to  $\alpha = 0.25$  for the Beveridgean systems and to  $\alpha = 0.7$  for the Bismarckian.<sup>16</sup>

<sup>15</sup>The average relative performance of the social security system is calculated by dividing the capitalized annual growth rate of the economy (1960-2009 data taken from World Bank, 2010) by the capitalized annual rate of return on equity (1900-2009 data taken from Credit Swiss, 2010). The degree of redistributiveness is obtained by using the pension replacement rates (i.e., the ratio between the pension and the wage prior to retirement) for workers with different wages (namely, at 75% and at 150% of the average wage), as provided by Whitehouse (2007).

<sup>16</sup>In our political economy model, the support for the pension system is based on the existence of an element of intragenerational redistribution. In the numerical simulation, this will allow for a better match of the Beveridgean systems, with respect to the Bismarckian. For an analysis of the political support of Bismarckian and Beveridgean systems see Conde-Ruiz and Profeta (2007).

To characterize the distribution of ability among the workers, we use the following cumulative Pareto distribution:  $F(\delta) = 1 - (\frac{c}{\delta})^a$  with  $\delta \in (c, \infty]$  and  $a > 1$ . To normalize the average ability type to one, we impose that  $c = (a - 1)/a$ . The skewness of the ability distribution is determined by the parameter  $a$ , which we choose equal to 1.25, in order for the ratio of the median to average income to be equal to 64%. Given the population growth rate, and hence the share of elderly – this delivers a median voter ability,  $\delta^{mv} = 0.47$ , and a value of the parameter  $\hat{\delta}$ , which weights the retirement behavior of the low income elderly, of 2.7. Moreover, we set the average wage of young and old workers at time  $t$  to be equal,  $\bar{w}_t^y = \bar{w}_t^o$ , and we normalize it to 1. This amounts to impose a flat wage profile by age in the initial numerical exercise.<sup>17</sup> The parameter that measures the relative importance of leisure to the individuals is set to  $\phi = 0.1$ . Finally, the constant of integration,  $A$ , is set to 0.25, in order to obtain that, in the Beveridgean system, the Markov political equilibrium sequence of social security contribution rates converges to a steady state value of  $\bar{\tau} = 15.5\%$ , which represents the average of the Beveridgean system (see Table 1). At this steady state, the average share of the old age workers is equal to  $\bar{L} = 58.9\%$ . For the Bismarckian systems, the steady state equilibrium contribution rate is  $\bar{\tau} = 14.8\%$ , and the associated average share of the old age workers is  $\bar{L} = 70.8\%$ .

## 4 Income Effects and the Future of Early Retirement

### 4.1 The Role of the Income effects

In this section we highlight the role of the income effects on the social security equilibrium tax rate, and on the retirement decisions. The political economy model presented in section 3 may help to understand how changes in the individual retirement decisions induced by income effects modify the political determination of social security and hence the equilibrium mass of early retirees. To analyze the role of the income effect, we consider two different experiments. First, we examine a permanent variation in the growth rate of the economy,  $g$ , which affects the average return of the social security system, and the wages. This drop in the growth rate induces two effects on the retirement decisions: a direct negative impact due to lower pension benefits and an indirect effect driven by the change in the contribution rate, and in the wage in old age. Second, inspired by the recent dynamics in most European labor markets since the introduction of the temporary contracts, we analyze a (negative) income effect due to a relative drop in the wages at youth versus the wages in old age. This relative reduction in the wages in youth reduces the individual net income, and also her pension benefits.

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<sup>17</sup>Notice, however, that a different wage profile, for instance with  $\bar{w}_t^y < \bar{w}_t^o$ , or a normalization to a different level  $\bar{w}_t^y = \bar{w}_t^o \neq 1$  would modify the quantitative results, but not the qualitative features presented in section 4.

### The "Fair" Pension System

Let  $D = N \left( \alpha + (1 - \alpha) \widehat{\delta} \right)$  characterize the impact of a change in the social security contribution on the low income individuals' pension, and

$$\varepsilon_{\tau,g} = \frac{\frac{\partial \bar{\tau}}{\partial g} \bar{\tau} + g}{\bar{\tau}} = \frac{(1 - A) N \delta^{mv} (\alpha \delta^{mv} + 1 - \alpha)}{[N (\alpha \delta^{mv} + 1 - \alpha) - \delta^{mv}] [AN (\alpha \delta^{mv} + 1 - \alpha) - \delta^{mv}]}$$

be the elasticity of the equilibrium social security contribution to the economic growth, which can be written as a function of the parameters of the model. The next proposition summarizes the effects on the overall employment among the elderly at steady state, in a "fair" social security system.

**Proposition 3** *Consider a "fair" social security system (i.e., for  $\tau_t^o = 0 \forall t$ ). A reduction in the growth rate of the economy ( $g$ ) increases the steady state mass of employed elderly,  $\frac{\partial \bar{L}}{\partial g} < 0$ , if  $D > 1$  and  $\varepsilon_{\tau,g} > \frac{D}{1-D}$ , or if  $D < 1$  and  $\varepsilon_{\tau,g} < \frac{D}{1-D}$ . A reduction in the wage in youth ( $\bar{w}^y$ ) increases the steady state mass of employed elderly,  $\frac{\partial \bar{L}}{\partial \bar{w}^y} < 0$ .*

**Proof.** See Appendix.

A reduction in the growth rate of the economy has a direct impact on the incentive to retire: by reducing the pension benefit – for a given contribution rate – it always makes early retirement less appealing. But if the economy slows down, there will also be an indirect effect, through the contribution rates. This indirect effect may go in opposite directions. This proposition suggests that economic slowdowns lead to later retirement in two circumstances. As already discussed in section 2.2, when  $N \left( \alpha + (1 - \alpha) \widehat{\delta} \right) > 1$ , an increase in the contribution rate reduces the overall employment among the elderly. If lower economic growth leads to lower contribution rates, then the overall retirement age will certainly be postponed. But even when the contribution rate increases, the overall retirement age may still increase, provided that the direct effect dominates. Whether this will occur depends on the elasticity of the contribution rate with respect to a change in the growth rate of the economy,  $\varepsilon_{\tau,g}$ . If instead  $N \left( \alpha + (1 - \alpha) \widehat{\delta} \right) < 1$ , higher contribution rates increase the overall employment among the elderly. In this case, the direct and indirect effects will both lead to postponing the average retirement age if economic slowdowns are associated with higher contribution rates. Yet, this drop in economic growth may still be associated with later overall retirement even if the contribution rate drops, if the direct effect prevails.

A reduction in the wage rate in youth, relative to the old age wages, has a simpler and unambiguous effect. Being poorer – due to lower income in youth – and facing lower pension benefits (due to the reduction in the tax revenues driven by the lower wages in youth), individuals will choose to retire later. Notice that, at least in this "fair" system, this drop in the wages in youth does not affect the political determination of social security contributions. Young

individuals thus face the same contribution rates, but enjoy lower wages, less generous pensions, and are thus "forced" to retire later.

#### **The "Unfair" Pension System**

In an "unfair" system, a reduction in the growth rate or in the wage in youth has additional effects through the Laffer curve induced by the taxation on the elderly workers. In this case, however, no closed form solution can be obtained. We thus provide a numerical exercise for both the average Bismarckian and the average Beveridgean system (as discussed at the end of section 3.2) to analyze the effects of a change in the growth rate. The results are summarized at table 2. In both pension systems, an increase in the growth rate of the economy leads to more social security contributions, since the pension system becomes more efficient. Yet, despite the more generous pensions, the average retirement age increases, due to the contemporaneous raise in the old age wage, which represents the opportunity cost of retiring. This numerical exercise thus suggests that lower growth could lead to lower pensions, lower wages and yet to early retirement. When instead only a reduction in the wages in youth is considered, the tax base shrinks – thus inducing lower contribution rates in both pension systems, and individuals react to the lower lifetime income by working longer years. As shown in table 3, in fact, the steady state mass of elderly workers increases. Notice that in this "unfair" case, the reduction in the youth wage is associated with lower contribution rates.

## **4.2 Aging and Income Effects**

The equilibrium policy function obtained in the previous section for the "fair" social security system allows us to analyze the effects of aging on the social security tax rate and on the use of early retirement. In line with standard political economy models of social security (for a survey, see Galasso and Profeta, 2002), in our model, aging has opposite economic and political effects on the steady state social security tax rate. Aging reduces the profitability of the PAYG pension system with respect to alternative savings; and may convince the median voter to downsize the system – in order to increase her private provision of retirement income through alternative private assets. Yet, aging tends to change the identity of the median voter, who becomes poorer, and hence keener on increasing the contribution rate. Moreover, for a given contribution rate, an increase in the share of elderly in the population amounts to a negative income effect that reduces the pension benefits, thereby inducing the elderly to postpone retirement (see Sheshinski, 1978).

#### **The "Fair" Pension System**

It is convenient to define the elasticity of the equilibrium social security

contribution to the population growth as

$$\varepsilon_{\tau,n} = \frac{\partial \bar{\tau}}{\partial n} \frac{1+n}{\bar{\tau}} = \frac{(1-A)N}{[AN(\alpha\delta^{mv} + 1 - \alpha) - \delta^{mv}][N(\alpha\delta^{mv} + 1 - \alpha) - \delta^{mv}]} * \\ * \left\{ \delta^{mv}(\alpha\delta^{mv} + 1 - \alpha) - \frac{1 - \alpha}{2(1+n)^2 f(\delta^{mv})} \right\}.$$

The next proposition addresses the effect of aging on the social security contribution rate and on the overall employment among the elderly at steady state.

**Proposition 4** Consider a "fair" social security system (i.e., for  $\tau_t^o = 0 \forall t$ ). Aging (corresponding to a reduction in the population growth rate) decreases the steady state social security contribution rate,  $\frac{\partial \bar{\tau}}{\partial n} > 0$ , if  $f(\delta^{mv}) > \frac{1-\alpha}{2(1+n)(\alpha+(1-\alpha)\delta^{mv})\delta^{mv}}$ . Aging increases the steady state mass of employed elderly,  $\frac{\partial \bar{L}}{\partial n} < 0$ , if  $D > 1$  and  $\varepsilon_{\tau,n} > \frac{D}{1-D}$ , or if  $D < 1$  and  $\varepsilon_{\tau,n} < \frac{D}{1-D}$ .

**Proof.** See Appendix.

The first part of this proposition summarizes the two effects of aging on social security discussed above. If the density function of the ability type around the median voter is sufficiently large, the impact of aging on the identity of the median voter will only be marginal. The political effect will hence be relatively small, and the economic effect will dominate.<sup>18</sup> Aging will then lead to a reduction in the social security contribution rate, due to the lower return from social security. The second part of the proposition studies the effect of aging on the retirement decisions. Aging has a direct impact on the incentive to retire: by reducing the pension benefit – for a given contribution rate – it always makes early retirement less appealing. But aging has also an indirect effect, through the change that it induces in the contribution rate. This indirect effect may go in opposite directions. This proposition characterizes the two circumstances under which aging leads to postponing retirement. First, consider the case in which  $N(\alpha + (1 - \alpha)\hat{\delta}) > 1$ , that is, an increase in the contribution rate reduces the overall employment among the elderly, because it induces a large effect among the low income individuals. If aging leads to a reduction in the contribution rate, then both the direct and the indirect effects will go in the same direction: postponing the overall retirement age. But, even if the contribution rate increases – thereby leading to a reduction in the overall employment among the elderly, aging may still lead to an increase in the overall retirement age, provided that the direct effect dominates. The above proposition summarizes this condition in terms of the elasticity of the contribution rate with respect to a change in the population growth rate. Second, consider that  $N(\alpha + (1 - \alpha)\hat{\delta}) < 1$ ,

<sup>18</sup>Which effect will dominate represents an empirical question that remains to be settled. For instance, Galasso and Profeta (2004) simulate the political effect to prevail, whereas Razin's et al (2002) empirical analysis leads to the opposite results. See also Disney (2007), Simonovits (2007) and Galasso and Profeta (2007) for empirical and theoretical contributions on this debate.

i.e., higher contribution rates now increase the overall employment among the elderly, because the effect is larger among the high-income individuals. In this case, if aging implies a higher contribution rate, the direct and indirect effects will both lead to postponing the average retirement age. Yet, even if the contribution rate drops, aging may still be associated with later overall retirement, if the direct effect prevails.

### **The "Unfair" Pension System**

How does aging affect the social security contribution rate and the overall employment among the elderly at steady state in an "unfair" pension system? Table 4 summarizes the results of our numerical simulation of a change in the population growth rate on the social security contribution rate and on the retirement age. In both the average Bismarckian and Beveridgean system, population aging – defined as a reduction in the population growth rate – lead to higher contribution rates. In our numerical example, the political effect thus prevails. Aging brings also a slight increase in the average age of retirement. This is in line with the existence of a direct effect of aging on retirement decisions, due to the reduction of the pension benefits. The indirect effect associated with the higher contribution rate partially moderates the direct impact. Overall, the retirement age increases only marginally.

## **5 Conclusions**

This paper concentrates on the role of the income effects as long term determinants of the retirement decisions and on their impact on the future evolution of social security system and early retirement provisions. In our politico-economic environment, every period a young low income median voter determines the social security contribution by considering the evolution of the early retirement behavior. We emphasize the role of substitution and income effects in these retirement decisions. The incentive effects have been analyzed by a large empirical literature, which shows how non-actuarially fair (at the margin) pension systems may induce rational agents to retire early, by reducing the opportunity cost of leisure. Income effects have instead largely been neglected in models of retirement and social security, despite the empirical evidence suggesting that variation in income and wealth do modify individual retirement decisions.

However, the recent dynamics of the European labor markets with the increasing flow of low paid, temporary jobs among the young workers suggest that negative income effects may dominate the future retirement decisions. To this respect, our model shows that a decrease in the relative wage income in youth leads to postponing retirement, even when early retirement provisions, with their generous incentives, are still available. Moreover, numerical simulations suggest that equilibrium social security tax rate may decrease. When we concentrate instead on reduction in the economic growth rate, the results are mixed. We provide conditions for lower growth to lead to higher labor participation rates among the elderly in a "fair" system. However, numerical simulations

of "unfair" systems suggest that lower growth may be associated with lower tax rates and more early retirement.

In line with the existing political economy literature (see Galasso and Profeta, 2002), in our model, aging has opposite economic and political effects on social security. We provide conditions for either effect to dominate in a "fair" social security system. Numerical simulations for "unfair" social security systems suggest that the political effect slightly prevails and contribution rates increase. However, aging also entails a negative income effect that may lead to a reduction in the widespread use of early retirement provisions. By commanding less generous pension benefits (for a given level of contribution rates), aging induces workers to postpone retirement. If the political effect is not so overwhelming as to determine a sizable increase in social security contributions, and thus also in pension benefits, at steady state aging societies will be associated with less early retirement. Simulations for "unfair" social security systems confirm these findings.

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## 6 Appendix

### 6.1 Proof of proposition 2

Using equation (9), the first order condition of the median voter at equation (17) can be written as:

$$-\delta^{mv} \bar{w}_t^y (1+r) + (1+n)(1+g)(\alpha \delta^{mv} + (1-\alpha)) \bar{w}_{t+1}^y \frac{\partial \tau_{t+1}}{\partial \tau_t} = 0 \quad (20)$$

where, given the median voter’s expectations on the next median voter’s behavior,

$$\frac{\partial \tau_{t+1}}{\partial \tau_t} = Q' \frac{\partial K_{t+1}}{\partial \tau_t} \quad (21)$$

with

$$Q' = \frac{\partial Q}{\partial K_{t+1}} \quad (22)$$

and

$$\frac{\partial K_{t+1}}{\partial \tau_t} = \frac{-\bar{w}_t^y}{1+n} \quad (23)$$

Using the above equations, we obtain

$$Q' = -\frac{\delta^{mv}(1+r)}{(1+g)\bar{w}_t^y(\alpha\delta^{mv} + (1-\alpha))} \quad (24)$$

Integrating the above equation with respect to  $K_{t+1}$  we obtain

$$\tau_{t+1} = Q(K_{t+1}) = A - \frac{\delta^{mv}(1+r)}{(1+g)\bar{w}_t^y(\alpha\delta^{mv} + (1-\alpha))}K_{t+1} \quad (25)$$

where  $A$  is a constant of integration.

Using equations (5) and (25) can be written as

$$\tau_{t+1} = A - \frac{\delta^{mv}(1-\tau_t)}{N(\alpha\delta^{mv} + 1 - \alpha)}$$

where  $N = (1+n)(1+g)/(1+r)$ . It is easy to see that this linear law of motion features non-negative social security contribution rates converging to a non-negative steady state if  $A - \frac{1}{N[\alpha + \frac{1-\alpha}{\delta^{mv}}]} > 0$  and  $\frac{1}{N[\alpha + \frac{1-\alpha}{\delta^{mv}}]} < 1$ . Furthermore, the steady state value of the contribution rate is less than 1 if  $A < 1$ .

Finally, to determine the identity of the median voter, notice that – by differentiating equation (20) w.r.t.  $\delta$  – the most preferred social security contribution rate among the young is weakly decreasing in their income; and that the old always command a higher tax rate than the any young. For non-negative population growth rates, the median voter is a young individual and has a type  $\delta^{mv}$ , which divides the distribution of preference in halves:  $1 + (1+n_t)F(\delta^{mv}) = 1 + n_t/2$ .

## 6.2 Proof of proposition 3

Consider the steady state social security contribution rates at proposition 2. It is easy to see that economic slowdowns reduces the contribution rate. In fact

$$\frac{\partial \bar{\tau}}{\partial g} = \frac{(1-A)\delta^{mv}(\alpha\delta^{mv} + 1 - \alpha)}{[N(\alpha\delta^{mv} + 1 - \alpha) - \delta^{mv}]^2} \frac{1+n}{1+r} > 0.$$

Consider now the steady state mass of employed elderly at equation (18). An economic slowdown induces a direct effect on this overall retirement age (see the first term in the equation below) and an indirect effect, through the changes in the contribution rate (second term):

$$\begin{aligned} \frac{\partial \bar{L}^o}{\partial g} &= -\frac{\phi}{1+\phi} \frac{\bar{\tau}(1+n)\bar{w}^y}{\bar{w}^o} \left( \alpha + (1-\alpha)\hat{\delta} \right) + \\ &+ \frac{\partial \bar{\tau}}{\partial g} \frac{\phi}{1+\phi} \frac{\bar{w}^y}{\bar{w}^o} \left[ 1+r - (1+n)(1+g) \left( \alpha + (1-\alpha)\hat{\delta} \right) \right] \end{aligned}$$

which can more conveniently be written as

$$\frac{\partial \bar{L}^o}{\partial g} = \frac{\phi}{1+\phi} \frac{\bar{\tau}(1+r)\bar{w}^y}{(1+g)\bar{w}^o} \left[ \varepsilon_{\tau,g} \left[ 1 - N \left( \alpha + (1-\alpha)\hat{\delta} \right) \right] - N \left( \alpha + (1-\alpha)\hat{\delta} \right) \right]$$

with  $\varepsilon_{\tau,g} = \frac{\partial \bar{\tau}}{\partial g} \frac{1+g}{\bar{\tau}}$ . Hence, it is straightforward to see that for  $N \left( \alpha + (1-\alpha)\hat{\delta} \right) > 1$ ,  $\frac{\partial \bar{L}}{\partial g} < 0$ , if  $\varepsilon_{\tau,g} > \frac{N(\alpha+(1-\alpha)\hat{\delta})}{1-N(\alpha+(1-\alpha)\hat{\delta})}$ . For  $N \left( \alpha + (1-\alpha)\hat{\delta} \right) < 1$ , instead  $\frac{\partial \bar{L}}{\partial g} < 0$ , if  $\varepsilon_{\tau,g} < \frac{N(\alpha+(1-\alpha)\hat{\delta})}{1-N(\alpha+(1-\alpha)\hat{\delta})}$ .

Finally, using equation (17), and noticing that  $\bar{\tau}$  at Proposition 2 does not depend on  $\bar{w}^y$ , it is easy to see that  $\frac{\partial \bar{L}}{\partial \bar{w}^y} < 0$ .

### 6.3 Proof of proposition 4

Consider the steady state social security contribution rates at proposition 2. It is easy to see that – for a given median voter type,  $\delta^{mv}$  – aging reduces the contribution rate. In fact

$$\frac{\partial \bar{\tau}}{\partial n}_{|\delta^{mv}} = \frac{(1-A)\delta^{mv}(\alpha\delta^{mv}+1-\alpha)(1+g)}{[N(\alpha\delta^{mv}+1-\alpha)-\delta^{mv}]^2(1+r)} > 0.$$

Yet, aging affect also the median voter type, since  $\frac{\partial \delta^{mv}}{\partial n} = \frac{1}{2(1+n)^2 f(\delta^{mv})}$ . Moreover, a change in the median voter type induces the following political effect on the contribution rate:

$$\frac{\partial \bar{\tau}}{\partial \delta^{mv}} = -\frac{N(1-A)(1-\alpha)}{[N(\alpha\delta^{mv}+1-\alpha)-\delta^{mv}]^2} < 0.$$

Hence, the overall effect of aging on the steady state social security contribution rate, when also the change in the median voter type is considered becomes

$$\frac{\partial \bar{\tau}}{\partial n} = \frac{(1-A)N}{(1+n)[N(\alpha\delta^{mv}+1-\alpha)-\delta^{mv}]^2} \left\{ \delta^{mv}(\alpha\delta^{mv}+1-\alpha) - \frac{1-\alpha}{2(1+n)^2 f(\delta^{mv})} \right\}$$

so that the sign of the overall effect will depend on the term in parenthesis.

Consider now the steady state mass of employed elderly at equation (18). Aging induces a direct effect on this overall retirement age (see the first term in the equation below) and an indirect effect, through the changes in the contribution rate (second term):

$$\begin{aligned} \frac{\partial \bar{L}^o}{\partial n} &= -\frac{\phi}{1+\phi} \frac{\bar{\tau}(1+g)\bar{w}^y}{\bar{w}^o} \left( \alpha + (1-\alpha)\hat{\delta} \right) + \\ &+ \frac{\partial \bar{\tau}}{\partial n} \frac{\phi}{1+\phi} \frac{\bar{w}^y}{\bar{w}^o} \left[ 1+r - (1+n)(1+g) \left( \alpha + (1-\alpha)\hat{\delta} \right) \right] \end{aligned}$$

which can more conveniently be written as

$$\frac{\partial \bar{L}^o}{\partial n} = \frac{\phi}{1 + \phi} \frac{\bar{\tau}(1+r)\bar{w}^y}{(1+n)\bar{w}^o} \left[ \varepsilon_{\tau,n} \left[ 1 - N(\alpha + (1-\alpha)\hat{\delta}) \right] - N(\alpha + (1-\alpha)\hat{\delta}) \right]$$

with  $\varepsilon_{\tau,n} = \frac{\partial \bar{\tau}}{\partial n} \frac{1+n}{\bar{\tau}}$ . Hence, it is straightforward to see that for  $N(\alpha + (1-\alpha)\hat{\delta}) > 1$ ,  $\frac{\partial \bar{L}}{\partial n} < 0$ , if  $\varepsilon_{\tau,n} > \frac{N(\alpha + (1-\alpha)\hat{\delta})}{1 - N(\alpha + (1-\alpha)\hat{\delta})}$ . For  $N(\alpha + (1-\alpha)\hat{\delta}) < 1$ , instead  $\frac{\partial \bar{L}}{\partial n} < 0$ , if  $\varepsilon_{\tau,n} < \frac{N(\alpha + (1-\alpha)\hat{\delta})}{1 - N(\alpha + (1-\alpha)\hat{\delta})}$ .

Table 1

	N	$\alpha$	$\tau$
New Zealand	40%	10%	general taxation
Ireland	110%	21%	12.1%
Canada	45%	21%	9.9%
Denmark	46%	31%	general taxation
UK	47%	39%	24.3%
Australia	36%	48%	general taxation
Average Beveridgean	56%	28%	15.5%
Switzerland	52%	61%	8.4%
Japan	95%	63%	16.1%
Belgium	99%	65%	16.4%
Norway	75%	66%	21.9%
US	44%	71%	12.4%
France	83%	72%	14.95%
Sweden	38%	87%	17.2%
Netherland	54%	96%	17.9%
Spain	80%	98%	28.3%
Italy	98%	100%	33%
Finland	57%	100%	22.2%
Germany	71%	100%	19.9%
Average Bismarckian	71%	81%	19%

Table 2

	$g$	$\tau$	$L$
Average	1%	14.7%	56.4%
Beveridgean	1.25%	15.1%	57.7%
	1.5%	15.5%	58.9%
	1.75%	15.9%	60%
	2%	16.3%	61%
Average	1%	14%	69.2%
Bismarckian	1.25%	14.5%	70.1%
	1.5%	14.8%	70.8%
	1.75%	15.2%	71.5%
	2%	15.6%	72.2%

Table 3

	$w_y$	$w_o$	$\tau$	$L$
Average	0.9	1	15.1%	62%
Beveridgean	1	1	15.5%	58.9%
	1.1	1	15.9%	55.8%
Average	0.9	1	14.4%	72.8%
Bismarckian	1	1	14.8%	70.8%
	1.1	1	15.3%	68.8%

Note:  $\phi = 0.1$ ;  $A = 0.25$ ;  $g = 1.5\%$ ,  $n = 1.5\%$

Table 4

	$n$	$\tau$	$L$
Average	1%	15.9%	59.3%
Beveridgean	1.5%	15.5%	58.9%
	2%	15.2%	58.4%
Average	1%	15.2%	71.1%
Bismarckian	1.5%	14.8%	70.8%
	2%	14.5%	70.5%

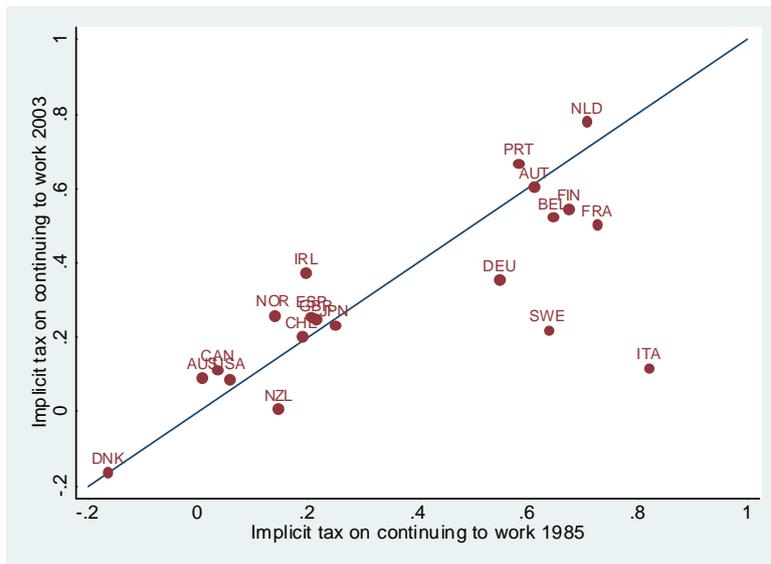


Figure 1: Built-in Incentive to Retire Early 1985-2003