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Early retirement

J. Ignacio Conde-Ruiz [a,b] and Vincenzo Galasso [c,d,e,f,*]

[a] *FEDEA, Calle Jorge Juan, 46, 28001 Madrid, Spain*
[b] *Department of Economics, Universitat Pompeu Fabra, Ramon Trias Fargas, 25-27, 08005 Barcelona, Spain*
[c] *Istituto di Economia Politica, Università Bocconi, via Gobbi 5, 20136 Milano, Italy*
[d] *IGIER, Milano, Italy*
[e] *Universidad Carlos III de Madrid, Spain*
[f] *CEPR, London, UK*

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Abstract

Generous early retirement provisions account for a large proportion of the drop in the labor force participation of elderly workers. The aim of this paper is to provide a positive theory of early retirement. We suggest that the political support for generous early retirement provisions relies on: (i) the existence of a significant group of elderly workers with incomplete working history, who are not entitled to an old age pension; and (ii) the intragenerational redistribution built in this provision via the utility from leisure that induces low-ability workers to retire early. The majority which supports early retirement in a bidimensional voting game is composed of elderly with incomplete working history and low-ability workers; social security is supported by retirees and low-ability workers.

JEL classification: H53; H55; D72

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1. Introduction

Generous early retirement provisions are largely responsible for the dramatic drop in the labor force participation among middle-aged and elderly workers of the last thirty years (see Gruber and Wise, 1999; Blöndal and Scarpetta, 1998). The generosity of

* Corresponding author.
E-mail addresses: conde-ruiz@fedea.es (J.I. Conde-Ruiz), vincenzo.galasso@uni-bocconi.it (V. Galasso).

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these provisions—measured by the implicit tax on continuing to work (Gruber and Wise, 1999) or by the replacement rate (Blöndal and Scarpetta, 1998)—has induced workers, in particular, low-educated ones, to retire early. Early retirement has thus complemented the aging process in increasing the ratio of retirees per worker—the dependency ratio. As argued in many studies (see Gruber and Wise, 1999; Blöndal and Scarpetta, 1998; Boldrin et al., 1999, among others), this phenomenon has rapidly become the crucial—endogenous—problem for the financial sustainability of the unfunded pension systems. Due to early retirement, in fact, fewer workers are required to finance the (generous) pensions of more retirees.

The aim of this paper is to provide a positive theory of early retirement. We propose a politico-economic explanation of the adoption of generous early retirement provisions. Why did a majority of voters, in most industrialized countries, decide to award large pensions to middle aged workers with incomplete working history? We suggest that the political support in favor of early retirement hinges on two crucial conditions. First, the appearance of a large group of redundant or unemployed elderly workers with incomplete working history, who are not entitled to an old-age pension. The introduction of early retirement awards them a pension transfer. Second, the existence in the early retirement provision of an element of intragenerational redistribution via the utility from leisure. In fact, while leisure is equally valued across ability types, the foregone labor income is lower for less productive types, who therefore find more convenient to retire early. This retirement behavior gives rise to an endogenous group of workers with incomplete working history, which guarantees the future constituency for this provision.[1]

The main contribution of the paper is to demonstrate that under these two conditions, a social security system with early retirement arises and is sustained as a politico-economic equilibrium outcome of a dynamic majoritarian voting game. The voting majority which supports early retirement is composed of elderly with incomplete working history and low-ability young, who expect to retire early. The size of the social security system is determined by a voting majority of all retirees and low-ability young. Although several studies have analyzed the economic determinants of the early retirement decisions (see among others, Feldstein, 1974; Boskin and Hurd, 1978; Diamond and Mirrless, 1978; Lazear, 1979; Crawford and Lilien, 1981), to our knowledge this is the first attempt to provide a theoretical explanation of the introduction of (generous) early retirement provisions.

Our analysis is motivated by two observations. First, in most European countries, between 1961 and 1977, generous early pathways from the labor market were made available to redundant or unemployed elderly workers under a wide array of early retirement schemes. These included special pensions to unemployed elderly workers (in Austria, Finland, and Germany), special contracted pensions for redundant workers (in Austria, Belgium, France, and Germany) and disability benefits awarded on the basis of

[1] This result is closely related to the recent literature on policy persistence. As in Coate and Morris (1999) and in Hassler et al. (2001), in our politico-economic equilibrium, the introduction of a policy, i.e., the institution of early retirement, induces the (low-ability young) agents to undertake certain actions in order to benefit from this policy. These actions, namely the use of the early retirement provision, are crucial to create a new (endogenous) group of elderly with incomplete working history, and thus to guarantee the future sustainability of the policy.

labor market considerations (in Denmark, Germany, Netherlands, Norway, Spain, and Sweden). During the 1970s and 1980s, these eligibility criteria were typically relaxed and early retirement provisions became more widely available to elderly workers. More emphasis was then put on programs that allowed early retirement in exchange for the employment of young unemployed workers. Second, a large majority of the workers who, over the years, have taken advantage of these early retirement provisions is composed of less educated workers.

We introduce a dynamically efficient overlapping generations economy with storage technology. Young workers may be of two ability types, low and high. They decide when to retire and their labor income depends on their retirement decision and on their initial ability. Old age retirement is mandatory. The social security system consists of a PAYG scheme. Young workers contribute a fixed proportion of their labor income to the system, and the proceedings are divided lump sum among the retirees. There may exist an early retirement provision, in which case workers who exit the labor market at an early stage, i.e., with an incomplete working history, are awarded an early retirement pension. Individuals who retire at mandatory age receive the full pension.

The social security system is determined in a bidimensional majoritarian voting game played by young and old agents. Voters cast a ballot over the payroll tax rate, which finances the social security system, and over the existence of an early retirement provision, which entitles agents with incomplete working history to a full pension. This political game displays two important features. First, because of the bidimensionality of the issue space, a Nash equilibrium of this majoritarian voting game may not exist. To overcome this problem, we use Shepsle's (1979) notion of structure induced equilibrium. In other words, we introduce a set of institutional restrictions which reduces our game to an issue-by-issue voting game. Second, in absence of a commitment device which restricts future policies, a social security system may not be politically sustainable. In fact, young workers may refuse to transfer resources to current retirees, as they have no guarantee of being rewarded with a corresponding pension in their old age. To deal with this feature, we consider an implicit contract among successive generations, and thus concentrate on subgame perfect equilibrium outcomes.[2] To summarize, we introduce a notion of stationary subgame perfect structure induced equilibrium which applies the idea of subgame perfection to the concept of structure induced equilibrium, introduced by Shepsle (1979).

The paper proceeds as follows: Section 2 presents some relevant facts on early retirement. Section 3 introduces the economic model and the social security system, while Section 4 analyzes the voting game and our notion of equilibrium. Section 5 characterizes the politico-economic equilibria, and Section 6 concludes. All formal definitions and proofs are in Appendix A.

[2] Cooley and Soares (1999), Galasso (1999), and Boldrin and Rustichini (2000) have applied the notion of subgame perfection to similar social security games. Alternatively, Krussell et al. (1997) have concentrated on Markov-perfect equilibria of dynamic political games. Azariadis and Galasso (2002) compare the sets of equilibrium outcomes under the different equilibrium notions in a simple social security game.

2. Some facts on early retirement

In the last thirty years, most OECD countries have experienced a dramatic drop in the labor force participation of their middle aged and elderly workers. In the OECD countries, the average labor force participation rate of male workers aged between 55 and 64 years has decreased from 84.2% in 1960 to 63.2% in 1990. This phenomenon has been stronger in Belgium, Finland, France, Italy, and the Netherlands, where the participation rate, which in the 1960s was well above 80%, has decreased in the year 2000 to around—or even below—50%, as shown in Table 1. This reduction has been less remarkable in other countries, such as Canada, Denmark, Spain, the UK, and the USA; however only in Japan, Norway, and Sweden the participation rate has remained above 70%.

The extent to which male elderly workers have decreased their participation in the labor market may also be captured by the reduction in the average retirement age, as defined by Latulippe (1996), or in the average age of transition to inactivity, as calculated by Blöndal and Scarpetta (1998). Latulippe (1996) estimates that the average retirement age for males in the OECD countries has dropped from 67.9 years in 1950 to 61.7 in 1990 (see Table 1 for data on several OECD countries). Blöndal and Scarpetta (1998) obtain similar estimates. For instance, they suggest that in 1950 French male workers moved into inactivity on average at age 66.1, while in 1995 this transition occurred at age 59.2. The average age of transition for Japanese workers, on the other hand, is virtually unchanged: 66.7 years in 1950 and 66.5 in 1995.

A comprehensive study on eleven OECD countries edited by Gruber and Wise (1999) suggests that generous early retirement provisions are largely responsible for this drop in the (male) participation rates. Gruber and Wise (1999) and a parallel study by Blöndal and

Table 1

Country	Labor force participation, 55–64 males					Changes in average retirement age, 1950–1995 (year)
	1960s	1970	1980	1990	2000	
Austria*	70.4	47.2	34.5	n.a.	n.a.	−5.1
Belgium	n.a.	n.a.	50.5	35.4	36.3	−5.1
Canada	86.7	84.2	76.2	64.3	61.0	−4.4
Denmark	n.a.	n.a.	67.2	69.3	64.6	−4.6
Finland	83.2	71.1	57.3	47.1	48.1	−5.7
France	80.3	75.4	68.5	45.8	41.1	−4.6
Germany	83.0	82.2	65.5	60.5	55.2	−3.8
Italy*	60.5	48.2	39.6	36.0	31.4	−3.8
Japan	85.6	86.6	84.4	83.3	84.1	−0.7
Netherlands	n.a.	80.8	63.6	45.7	51.4	−7.8
Norway	n.a.	83.9	79.5	72.8	74.4	−3.9
Spain	n.a.	84.2	75.7	62.4	60.3	−9.1
Sweden	89.6	85.4	78.7	75.5	72.7	−2.2
UK	94.2	91.3	81.8	68.1	63.3	−4.0
USA	84.7	80.7	71.2	67.8	67.3	−3.2

Source. OECD, Labor market statistics (on-line), Latulippe (1996).

* Age 60–64.

Scarpetta (1998) identify two features of the early retirement provisions, which display a strong correlation with the departure of the elderly workers from the labor force: the early (and normal) retirement age and the tax burden which is imposed on the labor income of the individuals who continue to work after reaching the early retirement age.

These studies find that in most OECD countries the conditional probability for the male workers to exit the labor force (the hazard rate) peaks at the early (and at the normal) retirement age. In other words, most individuals leave the labor market as soon as they are entitled to collect a pension benefit. While this retirement behavior may be partially due to health considerations or to a large valuation of the leisure by the elderly, Gruber and Wise (1999) and Blöndal and Scarpetta (1998) argue that individuals are often induced to retire early because of the large implicit tax imposed on continuing to work after early retirement age. Agent's early retirement decision thus represents the optimal response to the economic incentives provided by the social security system. Interestingly, both studies stress that in several countries, such as Germany, Sweden or the Netherlands, the early exit from the labor market is achieved by drawing on disability or unemployment benefits—whose eligibility is often made contingent on labor market conditions—rather than on the official early retirement pension. For instance, Gruber and Wise (1999) report that the proportion of men receiving disability or unemployment benefits at age 59—which is typically below the early retirement age—is 21% in France, 22% in Belgium, 24% in Sweden, 27% in the Netherlands, 33% in the UK, and 37% in Germany, as opposed to only about 12% in Japan and the USA.

Blöndal and Scarpetta (1998) have also analyzed the characteristics of the workers who have used these early pathways from the labor market, in terms of their educational obtainments and of the sector they last worked in. In all the OECD countries shown in Table 2—except the UK, where there is virtually no variation—the proportion of early retirees is higher among the low and intermediate educational group. Unsurprisingly, the sectorial breakdown shows that early retirement is more common in manufacturing—where in 1995, among the males aged 55 to 64, the number of retirees exceeded the number of workers in every OECD country—in construction and in mining, while being least used in such sectors as wholesale and retail trade, hotels and restaurants, real estate and financial intermediation.

Much less research has been devoted to explaining why there has been such a wide spread adoption of the early retirement, although this provision has been proved to be largely responsible for the decrease in the labor force participation of the middle-aged and elderly workers, which—together with the aging process—has created financial distress to the social security system. Some explanations have however emerged in the debate. Gruber and Wise (1999), for instance, have suggested—albeit not endorsed—that early retirement may have been created to encourage elderly people to withdraw from the labor force in order to provide more job opportunities for young workers—a popular justification among politicians—or, alternatively, that this provision has been adopted to accommodate a secular pattern of decreasing labor force participation. An alternative view, in the spirit of Caballero and Hammour (1998), is that early retirements have represented an instrument to increase the share of the production appropriated by the labor factor—a phenomenon that took place in the late sixties, when Europe experienced a period of tensions and strikes. Our explanation is that the adoption of early retirement was due to

Table 2
Share of retirees among male workers 55–64 by level of education in 1995

Country	No further education (%)	Vocational education (%)	Third level education (%)
Austria	n.a.	48.7	24.6
Belgium	53.4	57.6	36.9
Denmark	32.5	24.1	15.1
Finland	35.0	43.6	30.2
France	51.1	47.6	28.9
Germany	29.2	28.5	21.6
Italy	44.7	47.4	22.2
Netherlands	56.8	48.2	40.8
Spain	24.9	26.9	21.6
Sweden	7.5	8.9	n.a.
UK	24.1	20.6	21.4

Source. Blöndal and Scarpetta (1998).

the appearance of a significant group of redundant or unemployed elderly workers, who were not yet entitled to an old age pension. Several measures—such as the introduction of formal early retirement provisions, the weakening of the eligibility criterion for disability pensions or the institution of "unemployment pensions" to be awarded to unemployed elderly workers—allowed this mass of redundant or unemployed elderly to withdraw from the labor market on a pension transfer.

To discriminate among these explanations, we use data provided in 1986 by the Economic Commission for Europe at the United Nations on the institutional details—such as the retirement age and the eligibility criterion—of the first early retirement provisions to be introduced in fifteen OECD countries (see also Mirkin, 1987). These features are reported in Table 3. These institutional characteristics suggest that almost everywhere in Europe, between 1961 and 1977, generous early pathways from the labor market were offered to redundant or unemployed elderly workers, who were allowed to collect benefits under a wide array of welfare schemes.

These early retirement programs can be categorized according to their eligibility requirements as

(i) special pensions to unemployed elderly workers (PU in Table 3) initially used in Austria, Finland, and Germany,
(ii) disability benefits awarded on the basis of labor market considerations (DU in Table 3) in Denmark, Germany, Netherlands, Norway, Spain, and Sweden, and
(iii) special contracted pensions for redundant workers (RW in Table 3) in Austria, Belgium, France, and Germany.

During the 1970s and 1980s, these eligibility criteria were typically relaxed to allow for more general early retirement provisions, often in exchange for the employment of young unemployed worker (YE in Table 3). On the other hand, general early retirement provisions—to be used by all elderly workers, regardless of their employment status—were made available from the beginning in Canada, Japan, and the USA. In the UK and

Table 3
Early retirement institutions

Country	Retirement age (male)		Program	Condition for eligibility
	Normal	Early	(year of adoption)	
Austria	65	55	UP (1961)	unemployed 1 year for economic or structural reasons
		60	RW (1961)	in certain sectors after 35 years of service
Belgium	65	55	RW (1974)	unemployed for at least 1 year (in certain cases ER age below 55)
		60	YE (1976)	employer must replace the worker by a young who must work for at least 1 year.
		60	UP (1978)	unemployed for at least 1 year
Canada	65	60	ER (1987)	
Denmark	67	18	DU (1977)	earning capacity that is permanently reduced (ill heath or social circumstances)
Finland	65	60	UP (1961)	person who has received UB for 200 days in previous 60 weeks (ER age reduced temporarily to 55)
		63	YE (1979)	retiree is replaced by unemployed under 25
France	65[a]–60[b]	60	RW (1962, 1972)	workers made redundant for economic reasons
		55	RW (1977, 1979, 1980)	workers made redundant for economic reasons
		55	YE (1982)	youth or unemployed must be hired for 2 years
		55 (50[c])	RW (1984)	protection of workers in the Steel industry undergoing restructuring
Germany	63–65	60	UP (1973)	unemployed for at least 52 weeks
		60	DU (1973)	35 years of contributions and unable to work also for market reasons
		63	ER (1973)	35 years of contributions
		59–58	RW (1979, 1981, 1982)	applied to certain sectors (steel, automobile, metal, chemical)
		58	YE (1984)	vacancy must be filled by a person outside the firm
Italy	60		ER (1965)	35 years of contributions
			DU (1965)	related to market conditions
		55	RW (1979)	unemployment due to economic crisis or industrial reorganization
		58	YE (1984)	company signs a collective agreement to increase employment accordingly
Japan	65	60	ER(1973)	
Netherlands	65	60	DU (1967)	employees with a disability of at least 15% and unemployed for at least 1 year
		60	RW (1977)	collective agreement in specific sectors
		62	UP (1977)	workers unemployed for preceeding $2\frac{1}{2}$ years
Norway	67	18	DU (1971)	working capacity reduced by at least 50%, account is also taken of likelihood of finding employment
Spain	65	60	AF (1967)	
		< 60	DU (1972)	related to labor market conditions
			YE (after 1972)	employer must replace with youth seeking first job
Sweden	65	60	AF (1963)	
		60	DU (1970)	working capacity reduced $\frac{1}{2}$ also on grounds of redundancy
		60	UP (1972)	unemployment benefit has been paid for a maximum period
		60	RW (1975)	collective agreement with large firms and some industries

Table 3 (*Continued*)

Country	Retirement age (male)		Program	Condition for eligibility
	Normal	Early	(year of adoption)	
UK	65		FPP (1970s)	depends on specific plan
		62–64	YE (1977)	employer must replace retiree by someone from unemployment register
		60	UP (1981)	men unemployed for at least 1 year
USA	65	62	AF (1961)	
		55	FPP (1970s)	depends on specific plan
		62	ER (1977)	note: new calculation of benefits increases generosity

Note. RW = pension to workers made redundant for economic reasons; UP = awarding of the pension requires a period of unemployment; DU = disability pension awarded also according to labor market conditions or to unemployed workers; AF = actuarially fair ER provision; ER = general early retirement provision; FP = firms' pension plans; YE = awarding of the Pension requires the employment of a young worker.
Sources. Economic Commission for Europe (1986), Gruber and Wise (1999), Casey (1992).

[a] Until 1983.

[b] From 1984.

[c] In certain cases.

the USA, (private) firm's pension plan played a crucial role in helping workers to withdraw from the labor marker (see Casey, 1992). Public programs were less relevant in the USA, whereas in the UK they aimed at replacing elderly workers with young unemployed workers (YE in Table 3). Finally, Italy represents a peculiar case in this scenario. In fact, despite that Italy had a general early retirement provision already in 1965, most early exits from the labor market draw on the more generous disability benefits, rather than on the early retirement pensions.

3. The economic environment

We consider a two period overlapping generations model with storage technology. Every period two generations are alive: Young and Old. Population grows at a constant rate, $n > 0$. There are two types of agents: low and high ability, in proportions q and $1 - q$. Their working abilities are respectively w^{L} and w^{H}, with $w^{\mathrm{L}} < w^{\mathrm{H}}$.

Young agents decide when to exit the labor market. They may decide to work during the entire working period, i.e., until they reach mandatory retirement age, or they may retire early. Old agents do not work. They receive a pension transfers, whose amount depends on when they retired. Let p_t be the pension awarded at time t to an old agent who retired at mandatory age (we will refer to p_t as the full pension). Let Γ_{t+1} be the percentage of the full pension transfer awarded at time $t+1$ to a type-j old agent born at time t, then

$$\Gamma_{t+1}\left(\phi_t^j\right) = \begin{cases} \alpha & \text{if } \Theta \leqslant \phi_t^j < 1, \\ 1 & \text{if } \phi_t^j = 1, \end{cases} \tag{3.1}$$

where subscripts indicate the calendar time; $\phi_t^j \in [\Theta, 1]$ represents the retirement age of a type-j agent, i.e., the proportion of the working period she spent working; Θ is the minimum retirement age to be eligible for a pension, i.e., the minimum length of the

working period; and α is the proportion of the full pension transfer to be paid to an agent who retires early.

A production function transforms the work of any type-j worker weighted by her ability, w^j, into the only consumption good, according to the duration of her working period, $y_t^j = \phi_t^j w^j$, with $j = \{\mathrm{L}, \mathrm{H}\}$. A storage technology converts a unit of today's consumption into $1+r$ units of tomorrow's consumption. All private intertemporal transfers of resources into the future are assumed to take place through this technology. Additionally, we assume that $r > n$, and thus that the economy is dynamically efficient.

Young agents have to decide the length of their working period, ϕ_t^j, that is, whether they retire early or at mandatory age. They pay a proportional tax on their labor income, and save all their resources for old age consumption through the storage technology. Old agents take no relevant economic decision; they simply consume all their wealth. The intertemporal budget constraint of a type-j agent born at time t is thus:

$$c_{t+1}^j = w^j \phi_t^j (1-\tau_t)(1+r) + \Gamma_{t+1}\left(\phi_t^j\right) p_{t+1}. \tag{3.2}$$

Agents value leisure in their working period and old age consumption, according to a linear utility function: $U(\phi_t^j, c_{t+1}^j) = (1-\phi_t^j)d + \beta c_{t+1}^j$, where β is the individual time discount factor, which we assume to be equal to the inverse of the real interest factor, $\beta = 1/(1+r)$. We interpret the utility that an agent attaches to leisure as the utility associated to the free time which becomes available after an early exit from the labor market, i.e., after early retirement. We assume that, in absence of a social security system, any agent prefers working to an early exit from the labor market: $d < w^{\mathrm{L}} < w^{\mathrm{H}}$. We abstract from consumption in youth. This assumption greatly simplifies the analysis, but at a cost, since we disregard a relevant element for social security: the saving decision.[3]

The linearity of the utility function and the shape of the function $\Gamma(\cdot)$ (see Eq. (3.1)) induce a binary retirement decision, which is consistent with the evidence reported in Gruber and Wise (1999). At time t, a type-j young agent retires early if her ability is below a threshold level w_t^{R}, or at mandatory retirement age, if it is above:

$$\phi_t^j = \begin{cases} \Theta & \text{if } w^j \leqslant w_t^{\mathrm{R}}, \\ 1 & \text{if } w^j > w_t^{\mathrm{R}}, \end{cases} \tag{3.3}$$

where

$$w_t^{\mathrm{R}} = \frac{d}{(1-\tau_t)} - \frac{(1-\alpha_{t+1})p_{t+1}}{(1-\tau_t)(1-\Theta)(1+r)}. \tag{3.4}$$

It is crucial to notice that, in every period but the initial one, $t > 1$, the threshold ability level, w_t^{R}, and thus the mass of young agents who retire early, is endogenous. An increase in the agents' valuation of their leisure, d, in the generosity of the early retirement provision

[3] In fact, the existence of a PAYG system induces changes in the factor prices of labor and capital, thereby affecting the saving decisions of the agents. In particular, the introduction of a PAYG social security system, by reducing the capital stock, may increase the real interest rate, decrease the wage rate, and thus modify the net wealth of the agents. Our model abstracts from these considerations, which are analyzed in Cooley and Soares (1999), Galasso (1999), and Boldrin and Rustichini (2000). See also Feldstein (1974) for the impact of the early retirement provision on the individual saving decisions.

α_{t+1}, or in the current tax burden, τ_t, increases the utility from retiring early, and thus the threshold ability level, w_t^{R} (see Eq. (3.4)). On the other hand, for $\alpha_{t+1} < 1$, i.e., when early retirement pensions are penalized, an increase in the future full pension transfer, p_{t+1}, raises the cost of retiring early, and thus reduces the threshold ability level, w_t^{R}.

In its initial period, $t = 1$, our economy is instead endowed with an initial distribution of retired people: a fraction ρ of them—of which ρ^{L} are low ability and ρ^{H} are high ability, with $\rho^{\mathrm{L}} + \rho^{\mathrm{H}} = \rho$—have incomplete working history, i.e., they retired early. The remaining fraction $1 - \rho$ have complete working history, since they retired at mandatory retirement age. These proportions are exogenous and represent the initial condition of our economy.

3.1. The social security system

We consider a pay-as-you-go (PAYG) social security system, in which workers contribute a fixed proportion of their labor income to the system, and the proceedings are divided among the old. A retired person receives a lump sum pension which may depend on the length of her working period, but not on her labor income. The system is assumed to be balanced every period, so that the sum of all awarded pensions is equal the sum of all received contributions. The full pension transfer which balances the budget constraint can easily be obtained:

$$p_t = \begin{cases} \dfrac{(1+n)\left[q\phi_t^{\mathrm{L}} w^{\mathrm{L}} + (1-q)\phi_t^{\mathrm{H}} w^{\mathrm{H}}\right]}{\rho\alpha_t + (1-\rho)}\tau_t, & t = 1, \\ \dfrac{(1+n)\left[q\phi_t^{\mathrm{L}} w^{\mathrm{L}} + (1-q)\phi_t^{\mathrm{H}} w^{\mathrm{H}}\right]}{q\Gamma_t\left(\phi_{t-1}^{\mathrm{L}}\right) + (1-q)\Gamma_t\left(\phi_{t-1}^{\mathrm{H}}\right)}\tau_t, & t > 1. \end{cases} \tag{3.5}$$

Because of dynamic efficiency, $r > n$, the social security system is—on average—a dominated saving device. In fact, its average internal rate of return relative to the other available saving technology is $N = (1+n)/(1+r) < 1$. However, it is important to highlight that, due to the combination of a proportional labor income tax and of a lump sum pension, the system entails an element of within cohorts redistribution, from the rich to the poor. As in Tabellini (2000) and in Conde-Ruiz and Galasso (1999), this feature is crucial in our political game, because it may induce low-ability young to support the social security system.[4]

In every period, the social security system can be characterized by a quadruple: the exogenous minimum retirement age, the payroll tax rate, the full pension, and the percentage of the full pension awarded to the early retirees, $(\Theta,\ \tau,\ p,\ \alpha)$. It greatly simplifies the analysis to assume that early retirees are either awarded the full pension or nothing at all, $\alpha \in \{0, 1\}$. Since α is determined by all electors in the voting game, this amounts to restrict the choice over α to whether to introduce the institution of a *generous* early retirement (which would pay the full pension) or not.[5]

[4] Evidence in favor of the existence of this within cohort redistribution can be found in Boskin et al. (1987) and Galasso (2002).

[5] Notice, however, that this assumption will not affect the result of our voting game. In fact, if given the chance of voting for any $\alpha \in [0, 1]$, for a given tax rate, agents would still take a binary decision, either $\alpha = 0$ or

For a given minimum retirement age, Θ, the budget constraint in Eq. (3.5) can be used to obtain the full pension as a function of the other two policy parameters, $p_t(\tau_t, \alpha_t)$, since by Eq. (3.1) $\Gamma_t(\cdot)$ takes only two values: $\{\alpha_t, 1\}$. We can then examine the relation between the social security tax rate and the pension transfer, with or without early retirement provision. For $\alpha = 0$, no early retirement provision exists and the pension transfer is strictly increasing in τ. In any period but the initial one, $t > 1$, the full pension transfer is $p_t(\tau_t, 0) = (1+n)\overline{w}\tau_t$, where $\overline{w} = q w^{\mathrm{L}} + (1-q)w^{\mathrm{H}}$ is the average wage in the economy. In the initial period, $t = 1$, there is an initial endowment of elderly with incomplete working history, who do not receive the pension, and thus the pension transfer becomes $p_t(\tau_t, 0) = (1+n)\overline{w}\tau_t/(1-\rho)$.

For $\alpha = 1$, early retirement is available. Agents take their retirement decisions according to Eqs (3.3) and (3.4), where since $\alpha = 1$ the threshold ability level only depends on the value of the leisure, d, and on the current tax rate, τ_t. Thus, for low tax rates, nobody retires early; when the tax rate passes a certain threshold, $\tau_A = 1 - d/w^{\mathrm{L}}$, low-ability agents retire early; while also high-ability workers retire early if the tax rate reaches a higher threshold, $\tau_B = 1 - d/w^{\mathrm{H}}$. Clearly, these retirement decisions affect the tax base—by changing the composition of the workers who contribute to the system—and thus the pension transfers. Specifically, we have that:

$$p_t(\tau_t, 1) = \begin{cases} (1+n)\overline{w}\tau_t, & \text{if } \tau_t \leqslant \tau_A, \\ (1+n)\big(\overline{w} - q w^{\mathrm{L}}(1-\Theta)\big)\tau_t, & \text{if } \tau_A < \tau_t \leqslant \tau_B, \\ (1+n)\Theta\overline{w}\tau_t, & \text{if } \tau_t > \tau_B. \end{cases}$$

Figure 1 characterizes these relations between pension transfers and tax rates. In the case of early retirement, $p_t(\tau_t, 1)$, this relation may resemble a Laffer curve, with the maximum pension transfer being obtained for an interior solution of the tax rate. This is because, for a low tax rate, $\tau_t \leqslant \tau_A$, nobody retires early and thus an increase in the tax rate leads to an unambiguous increases in the pension transfer. As the tax rate increases above τ_A, all low-ability types retire early thereby provoking a drop in the tax base, and thus in the pension benefits. Further increases in the tax rate lead exclusively to an increase in the benefits, until τ_t passes the next threshold, τ_B, and all high-ability types retire early thus provoking a new drop in the tax base and in the pension benefits. From this point, all agents have retired early, and further increases in τ may only increase the pension benefits. To select the case which is more interesting to our analysis, in which the maximum pension transfer occurs when only the low-ability agents retire early, we impose some restrictions on the leisure parameter, d. In particular, it is easy to show that if $d \in [\underline{d}, \overline{d}]$, where

$$\underline{d} = \frac{(1-\Theta)q(w^{\mathrm{L}})^2 w^{\mathrm{H}}}{\overline{w}(w^{\mathrm{H}} - w^{\mathrm{L}}) + (1-\Theta)q(w^{\mathrm{L}})^2} \quad \text{and} \quad \overline{d} = \frac{(1-\Theta)w^{\mathrm{H}}(\overline{w} - q w^{\mathrm{L}})}{\overline{w} - (1-\Theta)q w^{\mathrm{L}}},$$

then the pension transfer, $p_t(\tau_t, 1)$, is maximized for $\tau_t = \tau_B$.

$\alpha = 1$. This is due to the fact that (low-ability) agents, who would retire early, would have their pension transfer maximized at $\alpha = 1$.

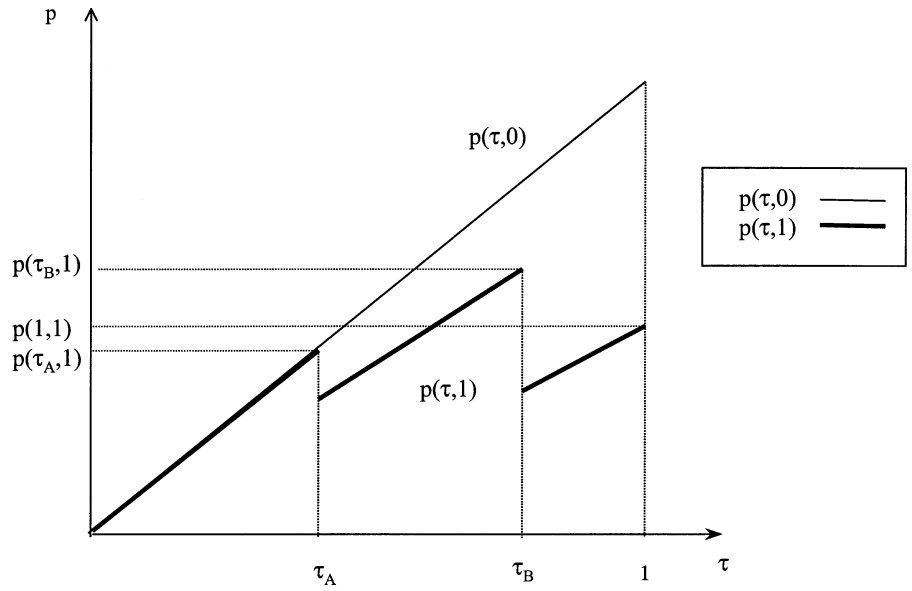

Fig. 1. Pension transfers and tax rates.

3.2. The economic equilibrium

The following definition introduces the economic equilibrium, given the values of the social security system, which will be determined in the political game.

Definition 3.1. For a given sequence $\{\tau_t, \alpha_t, p_t\}_{t=0}^{\infty}$, an early retirement age, Θ, an exogenous interest rate, r, and the function $\Gamma(\phi)$ defined in Eq. (3.1), an economic equilibrium is a sequence of allocations, $\{(\phi_t^j, c_{t+1}^j)\}_{j=\{\mathrm{L,H}\}}^{t=0,\ldots,\infty}$, such that:

- In every period agents solve the consumer problem, i.e., every type-j young individual maximizes her utility function $U(\phi_t^j, c_{t+1}^j)$ with respect to ϕ_t^j, and subject to Eq. (3.2);
- The social security budget constraint is balanced every period, i.e., Eq. (3.5) holds;
- The good market clears in the initial period, $t = 1$:

$$\sum_{j=\{\mathrm{L,H}\}} \left[\rho^j c_{t,\rho}^j + (1-\rho^j) c_{t,1-\rho}^j\right]$$

$$= \sum_{j=\{\mathrm{L,H}\}} \left[\rho^j w^j \Theta + (1-\rho^j) w^j\right](1+r)(1-\tau_{t-1})$$

$$+ (1+n)\tau_t \left[q\,\Gamma_t\left(\phi_{t-1}^{\mathrm{L}}\right) w^{\mathrm{L}} + (1-q)\,\Gamma_t\left(\phi_{t-1}^{\mathrm{H}}\right) w^{\mathrm{H}}\right],$$

and in all successive periods, $t > 1$:

$$qc_t^{\mathrm{L}} + (1-q)c_t^{\mathrm{H}} = (1+r)(1-\tau_{t-1})\left[q\phi_{t-1}^{\mathrm{L}}w^{\mathrm{L}} + (1-q)\phi_{t-1}^{\mathrm{H}}w^{\mathrm{H}}\right] + (1+n)\tau_t\left[q\Gamma_t\left(\phi_{t-1}^{\mathrm{L}}\right)w^{\mathrm{L}} + (1-q)\Gamma_t\left(\phi_{t-1}^{\mathrm{H}}\right)w^{\mathrm{H}}\right],$$

where $c_{t,\rho}^j$ and $c_{t,1-\rho}^j$ represent the old-age consumption at $t=1$ of a type-j agent who retired respectively early and at normal retirement age.

The lifetime utility obtained in equilibrium by a type-j young agent and the remaining lifetime utility for a type-j old agent are represented respectively by the following indirect utility functions:

$$v_t^{y,j}(\tau_t, \alpha_t, \tau_{t+1}, \alpha_{t+1}) = \max\left\{v_t^{\mathrm{M},j}, v_t^{\mathrm{E},j}\right\}, \tag{3.6}$$

$$v_t^{o,j}(\tau_t, \alpha_t) = K_t^j(1+r) + \Gamma_t\left(\phi_{t-1}^j\right)p_t, \tag{3.7}$$

where

$$v_t^{\mathrm{M},j}(\tau_t, \alpha_t, \tau_{t+1}, \alpha_{t+1}) = (1-\tau_t)w^j + \frac{p_{t+1}}{1+r} \tag{3.8}$$

and

$$v_t^{\mathrm{E},j}(\tau_t, \alpha_t, \tau_{t+1}, \alpha_{t+1}) = \Theta(1-\tau_t)w^j + (1-\Theta)d + \frac{\alpha_{t+1}p_{t+1}}{1+r}. \tag{3.9}$$

$v_t^{\mathrm{M},j}(\tau_t, \alpha_t, \tau_{t+1}, \alpha_{t+1})$ and $v_t^{\mathrm{E},j}(\tau_t, \alpha_t, \tau_{t+1}, \alpha_{t+1})$ represent respectively the utility of a type-j young individual when she retires at mandatory age and when she retires early, and K_t^j is a constant which does not depend on current or future values of the social security system.[6]

4. The voting game

The size and the composition of the social security system are determined through a political process which aggregates agents' preferences over the payroll tax rate, $\tau \in [0,1]$, and over the existence of early retirement, $\alpha \in \{0,1\}$. We consider a political system of majoritarian voting. Elections take place every period. All persons alive, young and old, cast a ballot over τ and α. However, since every agent has zero mass, no individual vote could affect the outcome of the election. Therefore, we assume sincere voting.

Two features of this majoritarian voting game are worth noticing. First, because of the bidimensionality of the issue space, (τ, α), Condorcet cycles may arise and a Nash equilibrium of this majoritarian voting game may not exist. To deal with this issue, we adopt the notion of structure induced equilibrium introduced by Shepsle (1979). He shows that under appropriate institutional restrictions, a multidimensional voting game can effectively be transformed into an issue by issue voting game, in which a (structure

[6] Specifically, $K_t^j = \begin{cases} (1-\tau_{t-1})w^j & \text{if } \phi_{t-1}^j = 1, \\ \Theta(1-\tau_{t-1})w^j & \text{if } \phi_{t-1}^j = \Theta. \end{cases}$

induced) equilibrium always exists. In our bidimensional election, this amounts to vote over τ for a given α, and over α for a given τ. A sufficient condition for (τ^*, α^*) to be a structure induced equilibrium outcome of the voting game (see Shepsle, 1979) is that τ^* represents the outcome of a majority voting over the τ, when the other dimension is fixed at its level α^*, and vice versa.

A second feature of our voting game is that, if no commitment device is available to restrict future policies, young people may refuse to transfer resources to current retirees, since there is no guarantee that this young-to-old transfer policy will be kept in the future. This represents a common element to most voting models of intergenerational transfers (see Galasso and Profeta, 2002). As others (see Cooley and Soares, 1999; Galasso, 1999; Boldrin and Rustichini, 2000, and Azariadis and Galasso, 2002), we consider subgame perfect equilibrium outcomes. If young agents expect their current vote to have no impact on future policies, they will vote for a zero social security tax rate, or they will incur in a net cost. However, young agents may believe that their current voting decision will influence future voters. In this case, as initially suggested by Hammond (1975), an implicit contract may arise among successive generations of voters, and young workers may agree to vote a pension to the current old as they expect to be rewarded in their old age with a corresponding pension.

These two features are captured in our notion of equilibrium, which we call stationary subgame perfect structure induced equilibrium (SSPSIE). In a SSPSIE, agents vote according to a stationary strategy profile, which is subgame perfect—and therefore allows them to take into account the effects of their current voting decisions on future ones—and which, in every period, is associated with the structure induced equilibrium of the static voting game. A formal description of the voting game and the definition of our equilibrium concept are provided in Appendix A.

5. Politico-economic equilibria

In this section, we analyze the voting behavior of the agents over the existence of the early retirement provision, α, and over the size of the social security system, τ. At every time t, young and old agents vote simultaneously, issue-by-issue over α and τ. In other words, we calculate the social security tax rate, which is most preferred by each voter, with and without early retirement provision, $\tau(\alpha)$. And, for every value of the social security tax rate, we examine whether voters would favor or oppose the introduction of early retirement, $\alpha(\tau)$. Voters' preferences over each issue are aggregated at simple majority. Thus, for each α, we identify the median vote for τ, and, for each τ, we identify the median vote for α. The points at which these median functions intersect, (τ^*, α^*), represent (structure induced) equilibrium outcomes of the game.

Notice that the voting behavior of the young depends on how they expect their current voting decision to influence future voters. For instance, if they believe their current decision over the size of the social security system to bear no impact on the future size, they should vote for a zero tax rate. We consider the case in which young voters expect to choose a policy which will not be modified by future voters. Clearly, future voters will agree not to

change the inherited policy, only if this is in their best interest. Proposition 5.1 will provide the conditions under which these expectations are consistent in equilibrium.

5.1. Voting on the social security tax rate

Consider first the case of no early retirement provision, $\alpha = 0$. Old with incomplete working history, that is, those who retired early in the previous period, are not entitled to a pension transfer, and are thus indifferent over the size of the system. Old with complete working history, on the other hand, will choose the tax rate that maximizes their pension transfer, and thus $\tau = 1$.

Among the young, those of high ability oppose the social security system, both because of its intragenerational redistributive component and of its low internal return as saving device. They vote for $\tau = 0$. Low-ability young, on the other hand, support a positive social security system if the within cohort redistribution compensates the low average internal return. In particular, they vote for $\tau = 1$, if $N = (1+n)/(1+r) \geqslant w_{\mathrm{L}}/\overline{w}$, and $\tau = 0$ otherwise.

Consider now that a generous early retirement provision exists, $\alpha = 1$. Regardless of their working history, the old receive a pension, $p(\tau, 1)$, and thus vote for the tax rate that maximizes this transfer: $\tau = \tau_B$ (see Fig. 1). The high-ability young will again oppose any social security system and vote for $\tau = 0$. Notice that, although for a high enough tax rate, $\tau > \tau_B$, they would choose to retire early, they are still better off with no pension system, due to its low average return and to its within cohort redistributive element.

Let now examine the low-ability young. If they do not expect to retire early, i.e., for $\tau \leqslant \tau_A$, they will support the social security system if its intragenerational redistributive component dominates the low average return. In particular, they vote for $\tau = \tau_A$, if $N \geqslant w_{\mathrm{L}}/\overline{w}$, and $\tau = 0$ otherwise. If, on the other hand, they expect to retire early, i.e., for $\tau > \tau_A$, they also take into account the leisure associated with an early exit from the labor market. It is important to stress that, in this environment, leisure represents an additional element of redistribution in favor of the low ability young. In fact, while leisure is equally valued across ability types, the foregone labor income varies. This induces the low-ability young to vote in favor of social security for an even lower average internal return from the system. Specifically, they vote for $\tau = \tau_B$, if $N \geqslant \Theta w_{\mathrm{L}}/(\overline{w} - q(1-\Theta)w_{\mathrm{L}})$, and $\tau = \tau_A$ otherwise.

We now have to examine whether the low-ability young are better off retiring at mandatory retirement age, with a tax rate equal to τ_A, or retiring early, with a tax rate equal to τ_B. This will clearly depend on the average internal return of the system, N, and on the utility that the agents obtain from retiring early, d. The low-ability voting decision over τ, for $\alpha = 1$, can be summarized as follows:

$$\tau = \begin{cases} \tau_B & \text{if } N \geqslant \frac{w_{\mathrm{L}}}{\overline{w}} \text{ and } d \geqslant d_A \text{ or } \frac{\Theta w_{\mathrm{L}}}{\overline{w} - q(1-\Theta)w_{\mathrm{L}}} \leqslant N < \frac{w_{\mathrm{L}}}{\overline{w}} \text{ and } d \geqslant d_B, \\ \tau_A & \text{if } N \geqslant \frac{w_{\mathrm{L}}}{\overline{w}} \text{ and } d < d_A, \\ 0 & \text{otherwise,} \end{cases}$$

where

$$d_A = \frac{(1-\Theta)qNw_{\mathrm{L}}w_{\mathrm{H}}}{(1-\Theta)qNw_{\mathrm{L}} + \left(\frac{\overline{w}N}{w_{\mathrm{L}}} - \Theta\right)(w_{\mathrm{H}} - w_{\mathrm{L}})} \quad \text{and}$$

$$d_B = \frac{w_H[w_L(1+qN(1-\Theta)) - N\overline{w}]}{w_L(\Theta+qN(1-\Theta)) - N\overline{w} + (1-\Theta)w_H}.$$

Therefore, if their return from the system is sufficiently high, low-ability young are always willing to vote in favor of social security. If the return is lower, however, they support the system only if they expect to retire early, and the leisure associated to an early exit from the labor market is sufficiently large. In all other cases, they oppose the system.

5.2. *Voting on the existence of early retirement*

The elderly have a simple decision. In absence of an early retirement provision, the resources collected from the current workers are exclusively shared among the old with complete working history. The institution of an early retirement provision entitles all the elderly, regardless of their working history, to an equal pension transfer. Therefore, old with complete working history oppose this provision, since, for a given tax rate, the entitlement of a pension to additional retirees would reduce their pension transfer, and vote $\alpha = 0$; while old with incomplete working history, who retired early in the previous period, vote $\alpha = 1$.

In analyzing the voting behavior of the young over the existence of early retirement, we have to take into account that—depending on the value of the tax rate—they may or may not take advantage of the early retirement provision. This decision is summarized at Eqs. (3.3) and (3.4), where now α can take only two values: $\alpha = \{0, 1\}$.

Consider the decision of a high-ability young first. If early retirement exists, for low values of the tax rate, $\tau \leqslant \tau_A$, nobody would retire early, and thus she would be indifferent between voting $\alpha = 0$ or $\alpha = 1$. For intermediate values of the tax rate, $\tau_A < \tau \leqslant \tau_B$, only the low-ability young would retire early. Since this leads to a reduction in the future pension transfer, due to the decrease in the tax base (see Fig. 1), the high-ability young would oppose the provision, $\alpha = 0$. Finally, for large tax rates, $\tau > \tau_B$, all agents retire early. In this case, the high-ability young have to compare the leisure obtained from retiring early with the decrease in the pension transfer due to the further reduction in the tax base. They vote for $\alpha = 0$, if $d < N\overline{w}$. The voting behavior of the high-ability young can thus be summarized as follows:

$$\alpha = \begin{cases} 0 \text{ or } 1 & \text{for } \tau \leqslant \tau_A, \\ 0 & \text{for } \tau_A < \tau \leqslant \tau_B, \text{ and for } \tau > \tau_B \text{ if } d < N\overline{w}. \end{cases}$$

Consider now the low-ability young. For $\tau \leqslant \tau_A$, nobody retires early, and thus they are indifferent between voting $\alpha = 0$ or $\alpha = 1$. For higher values of the tax rate, $\tau > \tau_A$, low-ability young would retire early. Thus, in deciding over the existence of the early retirement provision, they have to consider that early retirement provides them with additional leisure, but it decreases the pension transfer by reducing the tax base (see $p(\tau, 0)$ and $p(\tau, 1)$ in Fig. 1). A sufficiently large valuation of their leisure (a large d) would clearly induce them to vote for $\alpha = 1$. For example, for $\tau = \tau_B$—the tax rate that maximizes the pension benefit under early retirement—low-ability young would support the existence of an early retirement provision if

$$d \geqslant d_C = \frac{qNw_Lw_H}{w_H - w_L(1-qN)}.$$

For $\tau > \tau_B$ the pension transfer is further reduced due to the early retirement of the high-ability young. To vote for $\alpha = 1$, low-ability young would then need to have an even larger valuation of their leisure. For instance, for $\tau = 1$, they would vote for $\alpha = 1$, only if $d > N\overline{w}$. A useful example of the voting behavior of the low-ability young is the following. If $d = d_C$,

$$\alpha = \begin{cases} 0 \text{ or } 1 & \text{for } \tau \leqslant \tau_A, \\ 0 & \text{for } \tau_A < \tau < \tau_B \text{ and } \tau > \tau_B, \\ 1 & \text{for } \tau = \tau_B. \end{cases}$$

Clearly, a higher valuation of their leisure, $d > d_C$, would induce them to vote for $\alpha = 1$ for some other values of $\tau \in (\tau_A, \tau_B]$, since the higher value of the leisure would compensate the reduction in the pension transfer.

5.3. *The equilibria*

We now aggregate the votes over the two issues, α and τ, as characterized in the previous sections, to describe the politico-economic equilibria of the voting game.

It is useful to begin with the analysis of the initial period and to concentrate[7] on a sufficiently large average internal return, $N \geqslant w_L/\overline{w}$. As in the previous sections, we consider that young voters expect to choose a policy which will not be modified by future voters. Whether the initial young expectations are correct depends on the voting behavior of the future young in the successive periods. We will analyze this aspect next.

Recall that, at $t = 1$, the proportion of elderly with incomplete working history is exogenously given. It represents an initial condition of our economy and is equal to ρ. If no early retirement provision exists, elderly with incomplete working history, who are not entitled to a pension, are indifferent over the social security tax rate. Then, the median vote is $\tau = 1$, provided that there are enough old with complete working history and low-ability young: $1 - \rho + 2q(1+n) > 1 + n$. If early retirement exists, all the elderly vote in favor of social security and thus fewer low-ability young are needed to support the system: $q > n/2(1+n)$. These low-ability young vote in favor of social security and retire early if their valuation of leisure is sufficiently high, $d \geqslant d_A$. The median vote is then $\tau = \tau_B$ (see Fig. 1).

When aggregating preferences over the early retirement provision, the existence of elderly with incomplete working history becomes crucial. For intermediate level of the tax rate, if there are enough elderly with incomplete working history—who would not receive a pension unless early retirement is introduced—and enough low-ability young—who favor early retirement because their valuation of leisure is sufficiently high, $d \geqslant d_C$—that is if $\rho + q(1+n) > (2+n)/2$, the median vote is $\alpha = 1$, and early retirement is introduced. No

[7] A characterization of the politico-economic equilibrium outcomes is in Proposition 5.1.

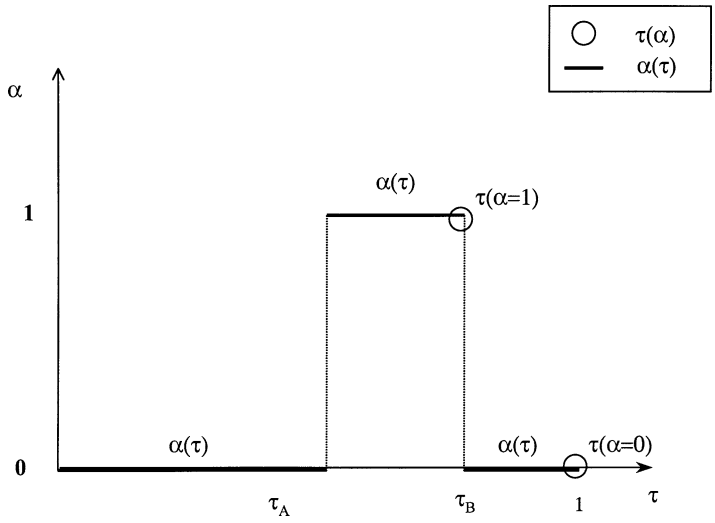

Fig. 2. Median voting functions.

young voters support early retirement for low and high level of the tax rate.[8] In this case, the median vote is $\alpha = 0$.

From this analysis of the initial period, we obtain two voting functions, $\tau^*(\alpha)$ and $\alpha^*(\tau)$, which describe respectively the median vote over τ for a given α and the median vote over α for a given τ. These two functions are drawn in Fig. 2. Notice that, since α only takes up two values, 0 and 1, the function $\tau^*(\alpha)$ amounts to two points, $\tau^*(0) = 1$ and $\tau^*(1) = \tau_B$, which we draw as circles. The points in which these two functions intercept, ($\tau^* = 1$, $\alpha^* = 0$) and ($\tau^* = \tau_B$, $\alpha^* = 1$), are candidates for being equilibrium outcomes of our voting game. To guarantee that they are indeed equilibrium outcomes, we need to ensure that the expectations of the young in the initial period are consistent with the voting behavior of the future young. We thus turn to the analysis of the subsequent periods.

First, notice that after the initial period, $t > 1$, the mass of elderly with incomplete working history is endogenous, and corresponds to the mass of young who, in the previous period, $t - 1$, decided to retire early. If no early retirement exists, there would be no elderly with incomplete working history, since no young would have retired early in the past. Then, every old votes in favor of social security, and the median vote is $\tau = 1$, provided that there are enough low-ability young: $q > n/2(1 + n)$. In this case, the expectations of the initial young voters, who believed their vote, $\tau = 1$, not to be modified in the future, are validated.[9] If early retirement exists, the voting behavior in the subsequent periods, $t > 1$,

[8] For low level of the tax rate, nobody would retire early and thus the young would be indifferent whether to introduce this provision or not. For high level of the tax rate, every young would retire early, thereby greatly reducing the tax base and the pension benefits. Every young would then prefer not to introduce the provision to avoid this distortion.

[9] Clearly, also subsequent generations of young voters have to expect their decisions not to be amended in the future. However, since after the initial period the game becomes stationary and successive generations of voters

perfectly resembles that of the initial period, $t = 1$: the median vote is $\tau = \tau_B$, if $d \geqslant d_A$ and $q > n/2(1+n)$.

When voting over early retirement, the existence of a mass of elderly with incomplete working history, which is now endogenous, is again crucial. In fact, for intermediate levels of the tax rate, early retirement is sustained, i.e., the median vote is $\alpha = 1$, if the mass of low-ability elderly—who retired early in the previous period, and thus have an incomplete working history—and of low-ability young—who favor early retirement because of their high valuation of leisure, $d \geqslant d_C$—constitutes a majority: $q > 1/2$. Notice that this condition is necessary to validate the expectation of the previous low-ability young, who retired early and expected to receive a pension in their old age. Finally, for low and high levels of the tax rate, the analysis does not differ from the initial period.

The message of this analysis is that the introduction of social security, with or without early retirement, requires two conditions: the support of a majority of the voters in the initial period, i.e., when there is an exogenous mass of elderly with incomplete working history, and in all future periods, i.e., when the mass of elderly with incomplete working history becomes endogenous, since it depends on the young agents' retirement decisions. These results have an alternative and more realistic interpretation. Consider that an economy with a pre-existing social security system, but no early retirement provision, is hit by a shock which gives rise to a mass of elderly people with incomplete working history. In this case, our two conditions would represent the initial response to the shock and the long-term dynamics.

The next proposition characterizes the politico-economic equilibrium outcomes of our voting game.

Proposition 5.1. *There exists a SSPSIE of the voting game* (τ^*, α^*) *such that*:

- *For* $N < \Theta w_L/(\overline{w} - q(1-\Theta)w_L)$, $\tau^* = 0$ *and* $\alpha^* = \{0, 1\}$;
- *For* $\Theta w_L/(\overline{w} - q(1-\Theta)w_L) \leqslant N < w_L/\overline{w}$,

$$\begin{aligned} &(\tau^* = \tau_B,\ \alpha^* = 1) && \text{if } d \geqslant d_B,\ q \geqslant 1/2,\ \rho + (1+n)q > (2+n)/2, \\ &(\tau^* = 0,\ \alpha^* = \{0,1\}) && \text{otherwise}; \end{aligned}$$

- *For* $N \geqslant w_L/\overline{w}$

$$\begin{aligned} &(\tau^* = \tau_B,\ \alpha^* = 1) && \text{if } d \geqslant d_C,\ q \geqslant 1/2,\ \rho + (1+n)q > (2+n)/2, \\ &(\tau^* = 1,\ \alpha^* = 0) && \text{if } q \geqslant n/2(1+n),\ 1 - \rho + 2(1+n)q > 1+n, \\ &(\tau^* = 0,\ \alpha^* = \{0,1\}) && \text{otherwise}. \end{aligned}$$

Figure 3 provides a graphic interpretation of the above proposition, which we prove in Appendix A. The area delimited by the dashed line represents the combination of ρ and q, i.e., of the mass of initial elderly with incomplete working history and of low-ability young, such that, for $N \geqslant w_L/\overline{w}$, a politico-economic equilibrium with social security

face the same decision, a stationary voting strategy profile would require all these voters to take the same decision (see the proof of Proposition 5.1).

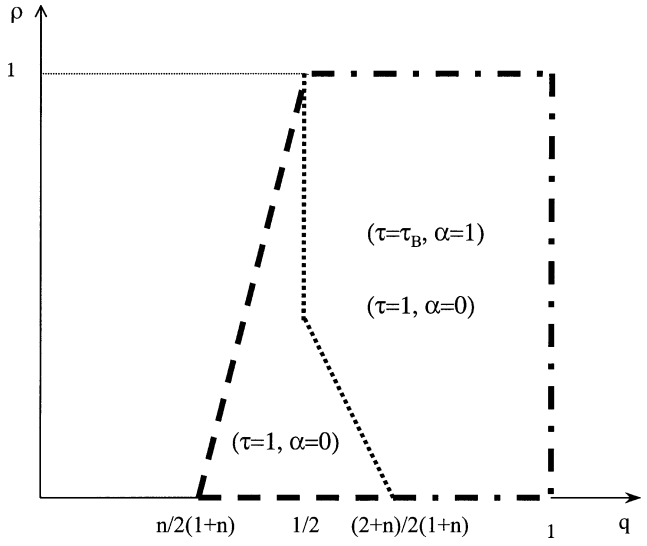

Fig. 3. Politico-economic equilibria.

and no early retirement exists. Notice the relation between the number of elderly with incomplete working history, i.e., of voters who are indifferent regarding the pension and thus abstain from voting, and the minimum number of low-ability young needed to sustain social security: if ρ increases, then q has to increase as well. However, for a large mass of low-ability young, $q \geqslant 1/2$, social security arises regardless of the initial conditions, ρ.

The area within the dotted lines displays the combination of ρ and q such that an equilibrium with social security and early retirement exists. For an early retirement provision to be introduced, there has to be a sufficiently large mass of initial elderly with incomplete working history, ρ, who are not entitled to a pension transfer, unless early retirement is instituted, and this provision has to induce a sufficiently large number of young—the low-ability, q—to retire early, and thus to become elderly with incomplete working history in the future period. The latter condition requires the low-ability young to have a high enough valuation of the leisure that they enjoy when they retire early.

The difference in the areas in Fig. 3 shows that, for large values of the average return of the system, $N \geqslant w_{\mathrm{L}}/\overline{w}$, an equilibrium with social security and early retirement requires more restrictive conditions on the initial mass of early retirees and of low-ability young than one with no early retirement. For a lower average return,

$$N \in \left[\Theta w_{\mathrm{L}}/\left(\overline{w} - q(1-\Theta)w_{\mathrm{L}}\right),\ w_{\mathrm{L}}/\overline{w}\right];$$

however, social security may be sustained only if the early retirement provision exists. In this case, low-ability young are willing to sustain the social security system, despite its low return, because they add to the gain from the within cohort redistribute element, the leisure that they obtain from retiring early.

Finally, notice that for $N \geqslant w_{\mathrm{L}}/\overline{w}$, if $d \geqslant d_C$, $q \geqslant 1/2$, and $\rho + (1+n)q > (2+n)/2$, i.e., in the dotted area in Fig. 3, there are multiple equilibria since both a social security

system with no early retirement and a tax rate equal to 1, and a social security system with early retirement and a tax rate equal to τ_B may be sustained.

6. Conclusions

Generous early retirement provisions exacerbate the financial distress of current unfunded social security systems by increasing the dependency ratio. In fact, by inducing early exits from the labor market, these provisions reduce the number of workers—and thus of contributors to the social security system—while increasing the number of retirees—and thus of recipients from the system.

We introduce the simplest overlapping generations model that is able to reproduce these characteristics, and we analyze the political determinants which may lead to the adoption of early retirement. In our setting, low- and high-ability agents decide when to retire in order to maximize a linear utility function, which attributes value to leisure in youth and to old-age consumption. Our qualitative results would however also hold true in a more general model, with several types of agents and a concave—rather than linear—utility function.

The main message of this paper is that the initial political support and the long run political sustainability of early retirement provisions require two conditions: a large initial shock to the labor market that gives rise to a mass of redundant elderly workers and some degree of intragenerational redistribution in the provision.

We argue that the initial adoption of this institution relies heavily on the existence of an initial stock of redundant or unemployed elderly people who exited the labor market with an incomplete working history, and who, therefore, were not entitled to an old age pension. The adoption of early retirement awarded them a pension. An analysis of the eligibility criteria of the initial early retirement provisions to be adopted in Europe between 1961 and 1977 confirms this view. Despite the heterogeneity of these programs across countries already pointed out by Gruber and Wise (1999), these early pathways from the labor market were mainly targeted to redundant and unemployed elderly workers. In fact, they included different types of pensions to unemployed elderly workers, special contracted pensions for redundant workers, and disability benefits awarded on the basis of labor market considerations. More general early retirement provisions were later introduced.

The long run political sustainability of this institution—we further suggest—is based on the generosity of these provisions and on the existence of an element of within cohort redistribution through the utility from leisure. Early retirement provides generous pension transfers to the middle-aged, and allows them to enjoy additional leisure, which may also be interpreted as the income obtained from working on the black market. Moreover, while leisure has a similar valuation across ability types, the foregone labor income is lower for less productive types, thereby introducing an element of within cohort redistribution. These features induce workers—especially low ability ones—to retire early and thus create an endogenous group of workers with incomplete working history, which guarantees the future support to early retirement. Evidence from Blöndal and Scarpetta (1998) confirms that, over the years, less educated workers have indeed used these provisions more extensively.

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Appendix A

A.1. The voting game and the notion of equilibrium

In this appendix, we define the voting game and formalize our concept of equilibrium: the stationary subgame perfect structure induced equilibrium.

The public history of the game at time t, $h_t = \{(\tau_0, \alpha_0), \ldots, (\tau_{t-1}, \alpha_{t-1})\} \in H_t$, is the sequence of social security tax rates and early retirement parameters until $t-1$, where H_t is the set of all possible history at time t. An action for a type-j young individual at time t is a pair of social security tax rate and early retirement parameter, $a^y_{t,j} = (\tau, \alpha) \in [0,1] \times \{0,1\}$, where $j = \{\mathrm{L}, \mathrm{H}\}$. Analogously, an action for a type-j old individual at time t is $a^o_{t,j} = (\tau, \alpha) \in [0,1] \times \{0,1\}$. Thus, at time t every voter chooses a pair (τ, α). We identify with a_t the action profile of all individuals (young and old) at time t: $a_t = (a^y_t \cup a^o_t)$, where $a^y_t = a^y_{t,\mathrm{L}} \cup a^y_{t,\mathrm{H}}$ and $a^o_t = a^o_{t,\mathrm{L}} \cup a^o_{t,\mathrm{H}}$.

A strategy for a type-j young individual at time t is a mapping from the history of the game into the action space: $s^y_{t,j} : h_t \to [0,1] \times \{0,1\}$. Analogously, a strategy for a type-j old individual at time t is $s^o_{t,j} : h_t \to [0,1] \times \{0,1\}$. We denote with s_t the strategy profile played by all individuals at time t, i.e., $s_t = (s^y_t \cup s^o_t)$, where $s^y_t = s^y_{t,\mathrm{L}} \cup s^y_{t,\mathrm{H}}$ and $s^o_t = s^o_{t,\mathrm{L}} \cup s^o_{t,\mathrm{H}}$.

For a given action profile at time t, a_t, let (τ^m_t, α^m_t) be respectively the median of the distribution of tax rates, and the median of the distribution of the early retirement parameters. We call (τ^m_t, α^m_t) the outcome function of the voting game at time t. Notice that this outcome function corresponds to the structure induced equilibrium outcome of a voting game at time t in which agents can commit to the future policy.

The history of the game is updated according to the outcome function; at time $t+1$: $h_{t+1} = \{(\tau_0, \alpha_0), \ldots, (\tau_{t-1}, \alpha_{t-1}), (\tau^m_t, \alpha^m_t)\} \in H_{t+1}$.

For a given sequence of action profiles, $(a_0, \ldots, a_t, a_{t+1}, \ldots)$, and their corresponding realizations, $((\tau_0, \alpha_0), \ldots, (\tau_t, \alpha_t), (\tau_{t+1}, \alpha_{t+1}), \ldots)$, the expected payoff function for a type-j young individual at time t is $v^{y,j}_t(\tau_t, \alpha_t, \tau_{t+1}, \alpha_{t+1})$, according to Eq. (3.6), and for a type-j old agent is $v^{o,j}_t(\tau_t, \alpha_t)$, according to Eq. (3.7).

Let $s^y_{t|\hat{j}} = s^y_t / s^y_{t,j}$ be the strategy profile at time t for all the young individuals except for the type-$\hat{j}$ young individual, and let $s^o_{t|\hat{j}} = s^o_t / s^o_{t,j}$ be the strategy profile at time t for all the old individuals except for the type-$\hat{j}$ old individual. At time t, the type-$\hat{j}$ young individual maximizes the following function:

$$V_t^{y,\hat{j}}\left(s_o, \ldots, \left(s^y_{t|\hat{j}}, s^y_{t,\hat{j}}\right), s^o_t, s_{t+1}, \ldots\right) = v_t^{y,\hat{j}}\left(\tau^m_t, \alpha^m_t, \tau^m_{t+1}, \tau^m_{t+1}\right),$$

and a type-$\hat{j}$ old individual, at time t, maximizes the following function:

$$V_t^{o,\hat{j}}\left(s_o, \ldots, \left(s^o_{t|\hat{j}}, s^o_{t,\hat{j}}\right), s^y_t, s_{t+1}, \ldots\right) = v_t^{o,\hat{j}}\left(\tau^m_t, \alpha^m_t\right),$$

where, according to our previous definition of the outcome function, (τ^m_t, α^m_t) and $(\tau^m_{t+1}, \alpha^m_{t+1})$ are, respectively, the median among the actions over the two parameters of the social security system played at time t and $t+1$.

We can now define a stationary subgame perfect structure induced equilibrium of the voting game as follows.

Definition A.1 (SSPSIE). A stationary voting strategy profile $s = \{(s^y_t \cup s^o_t)\}_{t=0}^{\infty}$ is a Stationary Subgame Perfect Structure Induced Equilibrium (SSPSIE) if the following conditions are satisfied:

(i) s is a subgame perfect equilibrium.
(ii) At every time t, the equilibrium outcome associated to s is a Structure Induced Equilibrium of the static game with commitment over future policy.

A.2. Proof of Proposition 5.1

Consider first a game in which current voters can commit to future policies, and agents thus vote over constant sequences of τ and α. By Shepsle (1979, Theorem 4.1), a necessary and sufficient condition for (τ^*, α^*) to be a SIE outcome of this voting game is that the two (median) voting functions, $\tau(\alpha)$ and $\alpha(\tau)$, cross at (τ^*, α^*) (see Fig. 2). From the discussion in Section 5, it is easy to see that the conditions in this proposition guarantee (τ^*, α^*) to be a SIE outcome of the voting game with commitment over future policy, for any $t \geqslant 1$.

It remains to be shown that these outcomes (τ^*, α^*) are also subgame perfect equilibrium outcomes of the game described in this appendix. Let concentrate first on the outcome $(\tau^* = \tau_B,\ \alpha^* = 1)$, for $N \geqslant \Theta w_{\mathrm{L}}/(\overline{w} - q(1-\Theta)w_{\mathrm{L}})$. Define the following sets of realization of the history of the game:

$$H_t^{0,0} = \left\{h_t \in H_t \;\middle|\; (\tau_s = 0,\ \alpha_s = 0)\ s = 0, \ldots, t-1\right\}$$

and

$$H_t^{\tau,1} = \left\{h_t \in H_t \;\middle|\; \exists t_0 \in \{0, 1, \ldots, t-1\}\colon (\tau_s = 0,\ \alpha_s = 0)\ \forall s < t_0,\ (\tau_s = \tau_B,\ \alpha_s = 1)\ \forall s \geqslant t_0\right\};$$

notice that $H_t^{0,0} \cap H_t^{\tau,1} = \emptyset$.

Consider the following voting strategy profile:

- for low-ability young:

$$s_{t,\mathrm{L}}^{y} = \begin{cases} (\tau_B, 1) & \text{if } h_t \in H_t^{0,0} \cup H_t^{\tau,1}, \\ (0,0) & \text{if } h_t \in H_t \big/ \{H_t^{0,0} \cup H_t^{\tau,1}\}, \end{cases}$$

- for high-ability young: $s_{t,\mathrm{H}}^{y} = (0,0)\ \forall h_t \in H_t$,
- for the old with complete working history: $s_t^o = (\tau_B, 0)\ \forall h_t \in H_t$, and
- for the old with incomplete working history: $s_t^o = (\tau_B, 1)\ \forall h_t \in H_t$.

Notice that low-ability young have no incentive to deviate from this voting strategy. In fact, their best deviation, $(\tau = 0,\ \alpha = 0)$, would provide them with a utility level, $v_t^{y,\mathrm{L}}(0,0,0,0)$, which is lower than the utility from the strategy above, $v_t^{y,j}(\tau_B, 1, \tau_B, 1)$, if $d > d_B$ (notice that $d_C \geqslant d_B$ for $N \geqslant w_{\mathrm{L}}/\overline{w}$). Analogously, it is incentive compatible to punish a previous deviator, since the utility level associated with providing a pension to a deviator, $v_t^{y,\mathrm{L}}(\tau \geqslant 0, 1, 0, 0)$, is always lower than the utility from punishing her, $v_t^{y,\mathrm{L}}(0,0,0,0)$. Therefore, if $(\tau^* = \tau_B,\ \alpha^* = 1)$ is a SIE outcome, it is also a SSPSIE outcome.

Let now examine the SIE with outcome $(\tau^* = 1,\ \alpha^* = 0)$. Define the following set of realization of the history of the game:

$$H_t^{\tau,0} = \big\{h_t \in H_t \mid \exists t_0 \in \{0, 1, \ldots, t-1\}\colon \tau_s = 0\ \forall s < t_0,\ \tau_s = 1\ \forall s \geqslant t_0,\ \alpha = 0\ \forall t\big\};$$

notice that $H_{t-1}^{0,0} \cap H_{t-1}^{\tau,0} = \emptyset$.

For $N \geqslant w_{\mathrm{L}}/\overline{w}$, consider the following voting strategy profile:

- for low-ability young:

$$s_{t,\mathrm{L}}^{y} = \begin{cases} (1,0) & \text{if } h_t \in H_t^{0,0} \cup H_t^{\tau,0}, \\ (0,0) & \text{if } h_t \in H_t \big/ \{H_t^{0,0} \cup H_t^{\tau,0}\}, \end{cases}$$

- for high-ability young: $s_{t,\mathrm{H}}^{y} = (0,0)\ \forall h_t \in H_t$,
- for the old with complete working history: $s_t^o = (1,0)\ \forall h_t \in H_t$, while those with incomplete working history abstain.

It is easy to see that no agent has an incentive to deviate from this voting strategy profile, and thus if $(\tau^* = 1,\ \alpha^* = 0)$ is a SIE outcome; it is also a SSPSIE outcome.

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