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A Positive Theory of Social Security

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Abstract

In many countries, social security accounts for a large fraction of the government budget. Why is this so, given that at any point in time the number of recipients of social security benefits is smaller than the number of contributors? In the overlapping-generations model studied in this paper, all individuals currently alive vote on social security in every period. In equilibrium, the size of social security is larger, the greater is the proportion of elderly people in the population, and the greater is the inequality of pre-tax income within each generation. Both predictions of the theory are supported by the empirical evidence in cross-country data.

Keywords: Social security; voting; inequality

JEL classification: *H*0; *I*3

I. Introduction

In many countries, social security comprises a large fraction of the government budget. Social security expenditures account for over a third of total government spending in most industrialized countries. Since the early 1980s, social security programs have grown in size almost everywhere. Yet, it is difficult to explain why a social security system exists, let alone why it is so large. At any given point in time, the number of recipients of social security benefits is smaller than the number of contributors. So, why do a large majority of citizens support a system that redistributes towards a minority?

The literature provides two answers to this question. The first stresses the intensity of preferences and forms of political participation other than through voting. Concentration of benefits among a few and diffusion of costs among many may explain why retired individuals successfully lobby to preserve the social security system.[1] But for this answer to be convincing, the costs of the program to the average taxpayer must be relatively small.

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[1] This explanation is proposed in e.g. Patton (1978). Hansson and Stuart (1989) study an overlapping-generations model that implicitly relies on this idea. The same assumption, that the old choose the equilibrium policy, is also used in Loewy (1988) and it is implicit in the work of Verbon (1988). More recently, Mulligan and Sala-i-Martin (1999a) have argued that the old are more successful at lobbying, because among other things they have more free time.

This cannot be said of the social security systems currently prevailing in many countries.[2] It seems unlikely that such programs would be politically viable without the support of a large number of working individuals.

The second answer provided by the literature attempts to explain why workers who pay taxes may favor social security. The explanation is based on the assumption of no future re-voting. If the current majority can commit future majorities to preserving the law, then even a worker would support social security, provided that his retirement age is sufficiently near.[3] But the assumption of no future re-voting is clearly counterfactual. Society cannot precommit its future decisions on social security legislation. And in practice, such legislation has been changed repeatedly over time.[4]

This paper suggests an alternative explanation as to why the social security system is politically viable. The central idea is that a social security program redistributes both across and within generations. The contributions to the system are linked to wage income, but the benefits are not (or are linked to a much smaller degree). As a result, a social security system also redistributes from high- to low-income households; for the US, this fact has been extensively documented by Boskin *et al.* (1987), Ferrara and Lott (1985) and Galasso (1998). Hence, poor workers/taxpayers may be in favor of the program, since the gain to their retired parents is larger than the cost to them.

In the first part of this paper, I study this idea in a simple overlapping-generations model with heterogeneous individuals and exogenous population growth. The social security program is chosen in each period under majority rule. All the generations currently alive are entitled to vote. Thus, there is no commitment and in any period the social security legislation could be repealed. The absence of commitment implies that future voting decisions are taken as given by today's voters. This breaks the link between current contributions and future benefits. In any period, a vote on the social security program is a vote on how much to transfer from the current young to the current old, with no repercussions on future legislation. A central feature of

[2]For instance, according to Boskin, Kotikoff, Puffert and Shoven (1987), more than half of the workers in the US pay more in OASDHI contributions than they pay in personal income taxes.

[3]This point has been explored in several papers; see e.g. Browning (1975) and more recently Boadway and Wildasin (1989a, 1989b), and Cukierman and Meltzer (1989). Persson and Tabellini (1999, 2000) survey the literature.

[4]Some interesting papers, including Kotlikoff, Persson and Svensson (1988), Sjoblom (1985), Boldrin and Rustichini (1996), Aziariadis and Galasso (1997), and Cooley and Soares (1999) argue that "reputation" can substitute for commitment. Succinctly, if a young generation reneges on a social security program, it can be punished by the succeeding generation that refuses to reinstate the program. The threat of this punishment may deter each young generation from reneging. These reputation equilibria are extensively and critically discussed in Persson and Tabellini (1990, 1999) who, in particular, point out that some of the equilibria considered in this literature are not renegotiation-proof.

the model is that there is bidirectional altruism: parents care about their children, and children care about their parents. However, this altruism is sufficiently weak that no private transfers occur in equilibrium. Altruism plays a role only in the political equilibrium.[5] A young voter trades off his tax burden from financing the program against the benefits received by his parent, and so does an old voter.

The main analytical result is that, with sufficient inequality in labor income, a social security program is supported in equilibrium by a majority of the voters. Moreover, with aggregate shocks to the income of each generation, the political equilibrium mimics an *ex-ante* optimal policy of intergenerational risk sharing, such as that characterized by Gordon and Varian (1988).

The analysis also yields two positive implications: in equilibrium, the size of social security is larger, the greater is the pre-tax income inequality and the larger is the fraction of elderly people in the population. In the second part of the paper, I explore these two empirical implications. I compare the size of social security programs in more than 40 countries by means of simple cross-country regressions. I find that cross-country differences are in fact well explained by the inequality of pre-tax income and by the age composition of the population, according to the predictions of the theory. This finding is robust to alternative specifications and to the possibility of measurement error in the explanatory variables.

The outline of the paper is as follows. The model is described in Section II. Section III characterizes the economic equilibrium. The voters' preferences are set out in Section IV, while Section V characterizes the political equilibrium. The empirical evidence is explored in Section VI. Section VII concludes.

II. The Model

The economy is populated by overlapping generations. Each generation lives for two periods; hence, two generations are alive in every period. Members of the old generation are called "parents"; members of the young generation are called "kids". Every parent has $(1+n)$ kids; thus, $n > 0$ is the rate of population growth. Parents and kids are linked by mutual altruism. Specifically, let i denote the ith household. The preferences of the ith kid born in period t are represented by:

$$J_t^i = \max\left[\frac{\gamma}{1+n} H_t^i + U(c_t^i) + E_t H_{t+1}^i\right], \tag{1}$$

[5] Altonji, Hayashi and Kotlikoff (1989) provide empirical support for this assumption.

where c_t^i is consumption of the ith kid in period t, $U(\cdot)$ is a well-behaved utility function, E_t is the expectations operator and H_t^i is the indirect utility function of the period t parent in the ith household. The parameter $1 > \gamma > 0$ represents the degree of kids' altruism. Since a period t kid becomes a parent in period $t+1$, he does not discount the utility function H_{t+1}^i. The preferences of the period t parent in the ith household are:

$$H_t^i = \max[d_t^i + \delta(1+n)J_t^i], \tag{2}$$

where d_t^i is the consumption of the ith parent in period t and $1 > \delta > 0$ is a parameter that measures parents' altruism. According to (1) and (2), altruism depends on family size. As n grows, parents become less selfish and kids more selfish.[6]

Different households have the same preferences but different endowments. At the beginning of his life, the ith kid receives an endowment $w_t(1+e_t^i)$. The individual-specific endowment e_t^i can be either positive or negative and is distributed in the population according to a known function $G(\cdot)$, with bounded support $[\underline{e}, \overline{e}]$ inside the unit circle, zero mean and negative median. The aggregate endowment w_t is drawn at random from a known distribution with support $[\underline{w}, \overline{w}]$. The variables w_t and e_t^i are mutually uncorrelated, and their period t realizations are known to everyone at the start of period t. The serial correlation properties of w_t and e_t^i do not matter. Hence, in particular, it does not matter whether the incomes of parents and kids belonging to the same household are correlated with each other or not. As will become clear below, this is because of the linearity of consumption in the parents' preferences.

Each kid pays a non-negative social security tax proportional to his endowment and may receive a non-negative bequest, $b_t^i/(1+n)$, from his parent. He can consume, save and leave a non-negative gift to his parent. Hence, the budget constraint of the ith kid in period t is:

$$w_t(1+e_t^i)(1-\tau_t) + \frac{b_t^i}{1+n} \geqslant c_t^i + s_t^i + f_t^i, \tag{3}$$

where τ_t is the social security tax rate and s_t^i and f_t^i denote savings and gifts, respectively. Individuals can freely borrow or lend. Hence, savings can be positive or negative.

In the second period of his life, each individual receives an endowment a

[6]The specification of preferences is plausible and simplifies the algebra, but is not crucial for most of the results. Equally unimportant is the assumption that individuals care about the indirect utility (rather than the consumption) of their relatives.

from nature and a non-negative lump-sum social security benefit g_t from the government, plus any gift from his kids. Hence, the budget constraint of the ith parent in period t is:

$$a + g_t + R_{t-1}s^i_{t-1} + f^i_t(1+n) \geqslant d^i_t + b^i_t, \tag{4}$$

where R_{t-1} is the rate of return on the savings accumulated (loans contracted) in period $t-1$. By the non-negativity constraints on private transfers, f^i_t, $b^i_t \geqslant 0$, all i, t.

Output is non-storable and there are no outside assets (such as fiat money or government debt). Hence, in every period the kids' aggregate savings must be zero in equilibrium:

$$\int s^i_t \, \mathrm{d}F_t(s^i_t) = 0, \tag{5}$$

where $F_t(\cdot)$ is the period t distribution of savings among the kids' population (to be derived below).

Finally, the government budget must be balanced in every period. Since the mean of e^i_t is zero, the government budget constraint is:

$$g_t = (1+n)w_t\tau_t. \tag{6}$$

Two features of this model are worth noting. First and most important, the social security program redistributes from parent to kid as well as from rich to poor. This occurs because the benefit g_t is lump sum, whereas the contribution is proportional to income. This feature of the model reflects the redistributive character of existing social security programs. Since there is no crucial discontinuity in the model, the results hold even for less extreme asymmetries between contributions and benefits. Second, the linearity of consumption in the parents' welfare implies that all income effects are absorbed by this term. This in turn implies that private intergenerational transfers are the same for all households, irrespective of their relative incomes. While this feature considerably simplifies the description of the political equilibrium, it is not crucial for the qualitative results.

Events unfold according to the following timing. At the beginning of each period, the policy (τ, g) is chosen under majority rule. By the government budget constraint, only one of the two policy instruments, say τ, can be freely set. Then private agents make their economic decisions. A political–economic equilibrium must satisfy two conditions: (i) economic equilibrium: for any given policy, economic decisions are optimal for private agents and markets clear; (ii) political equilibrium: the policy is (weakly) preferred by at least 50 percent of the voters to any other policy in a pairwise comparison.[7]

III. Economic Equilibrium

Consider first the economic equilibrium for a given policy. The first-order conditions with respect to gifts and bequests imply (a subscript denotes a partial derivative);

$$1 \geqslant \delta U_c(c_t^i) \geqslant \delta\gamma \tag{7}$$

where the first (second) inequality is strict if the non-negativity constraint on bequests (gifts) is binding. Throughout the paper I assume that altruism is sufficiently weak that private transfers never occur, irrespective of the policy or of the realization of aggregate output. Specifically, I assume that:

$$\frac{1}{U_c(0)} > \delta, \quad U_c(\overline{w}(1+\overline{e})) > \gamma. \tag{8}$$

Under (8), the inequalities in (7) always hold as strict inequalities, so that $f_t = b_t = 0$. Relaxing this assumption would make it more likely that the political equilibrium involves a positive transfer through the social security system (since voters would be more altruistic), even though it would complicate the description of the voters' preferences.

The optimal amount of savings is determined by the first-order condition:

$$R_t = U_c(c_t^i), \quad \text{all } i. \tag{9}$$

Imposing the equilibrium condition (5), and exploiting the budget constraints, we then obtain a complete description of the economic equilibrium as a function of the policy τ_t:

$$\begin{aligned} c_t^i &= w_t(1-\tau_t) \quad \text{all } i \\ s_t^i &= e_t^i w_t(1-\tau_t) \\ d_t^i &= a + (1+n)w_t\tau_t + R_{t-1}w_{t-1}(1-\tau_{t-1})e_{t-1}^i \\ R_t &= U_c(w_t(1-\tau_t)). \end{aligned} \tag{10}$$

[7]Meltzer and Richard (1981) have analyzed the determinants of the size of redistributive policies in a related framework. However, they study a static model, in which the issues of intergenerational redistribution and commitment do not arise.

IV. The Voters' Preferences

I now turn to a description of the voters' preferences for the policy. Throughout the rest of the paper, by policy I mean a social security tax rate, τ_t. The government budget constraint then determines g_t residually.

Insert the equilibrium expressions (10) into the utility function of kids and parents. After some transformations, we obtain their utility as a function of past, current and future policies:

$$J_t^i = \frac{1}{1-\delta\gamma}\Bigg\{U(w_t(1-\tau_t)) + \gamma w_t \tau_t + R_t w_t (1-\tau_t) e_t^i + \frac{\gamma}{1+n} R_{t-1} w_{t-1}(1-\tau_{t-1}) e_{t-1}^i + (1+n) E_t w_{t+1}\tau_{t+1} + \mu + \delta(1+n) E_t J_{t-1}^t\Bigg\}$$

$$H_t^i = a + (1+n) w_t \tau_t + R_{t-1} w_{t-1}(1-\tau_{t-1}) e_{t-1}^i + \delta(1+n) J_t^i, \qquad (11)$$

where $\mu = \gamma a/(1+n) + a$. Although rather complicated, these expressions are linear in the individual specific parameters e^i. This is because all income effects are absorbed by consumption when old, d^i, which in turn enters linearly into the utility of each generation. This property of the utility function considerably simplifies the characterization of the political equilibrium.

Since there is no outside asset and the voters' preferences are additively separable in τ_t, there is no intertemporal link in the voters' optimization problem: the policy optimal for voter i in period t is independent of previous and future voting decisions.

Consider the effect of changing τ_t on the ith kid and parent welfare at time t. Differentiating (11) with respect to τ_t and simplifying:

$$J_{\tau_t}^i = \frac{w_t}{1-\delta\gamma}\left[\gamma - R_t - \frac{(1-r)}{1-\delta\gamma} R_t e_t^i\right] \qquad (12)$$

$$H_{\tau_t}^i = (1+n)[w_t + \delta J_{\tau_t}^i], \qquad (13)$$

where $J_{\tau_t}^i$ and $H_{\tau_t}^i$ denote the partial derivatives of J_t^i and H_t^i with respect to τ_t, respectively, and $r_t = -U_{cc}(c_t)c_t/U_c(c_t) > 0$ is the coefficient of relative risk aversion of $U(\cdot)$. Throughout the rest of the paper, I assume that $r_t < 1$ for any c_t.

For the average voter (i.e., if $e_t^i = 0$), equation (12) can be shown to imply $J_{\tau_t} < 0$ and $H_{\tau_t} > 0$ for any $1 \geqslant \tau_t \geqslant 0$.[8] This is not surprising. For the average voter, the social security programme only redistributes across generations, with no intra-generational consequences. Hence, average kids want no social security, and their parents want as much of it as possible.

But for non-average kids (i.e., if $e_t^i \neq 0$), the policy also has intra-generational effects, since it redistributes from rich to poor households. Specifically, if the *i*th kid is richer than the average (if $e_t^i > 0$), then he will be even more opposed to the social security system, while his parent will be less strongly in favour (or may even oppose it, if e_t^i is sufficiently large). And conversely, a poor kid may support the social security system, while his parent will be even more strongly in favour of it.

More generally, by (12) and (13), the voters' preferences can be ranked according to the kids' relative income, e_t^i: the larger the kids' income, the lower the preferred social security tax, for both kids and parents.[9] But the parents always prefer a higher social security tax than their kids. Under the additional assumption that the second-order conditions of the voting problem are satisfied for every voter, we can then conclude that the voters' preferences are single-peaked. The political equilibrium is thus given by the policy preferred by the median voter.[10]

To identify the median voter, we have to combine the two groups of voters, parents and kids. Consider a kid with endowment e_t^k. By (12) and (13), the optimal value of τ_t for this kid is the same as for the parent of a kid with endowment e_t^p, defined by:[11]

[8] If $e_t^i = 0$, (12) and (13) reduce to:

$$J_{\tau_t} = \frac{w_t}{1 - \delta\gamma}(\gamma - R_t)$$

$$H_{\tau_t} = \frac{(1+n)w_t}{1 - \delta\gamma}(1 - \delta R_t).$$

Combining (7)–(9), we see that $J_{\tau_t} < 0$ and $H_{\tau_t} > 0$ for any $1 \geqslant \tau_t \geqslant 0$.

[9] Note that all that matters here is the kids' relative income and not that of their parents. This is because the social security tax is proportional to the kids' income, and parents have a constant marginal utility of consumption.

[10] As in any optimal taxation problem, the second-order conditions of the policy optimization problem are more restrictive than just concavity of the utility function. Since the voters' utility functions are linear in the individual specific parameter e^i, they belong to the class of intermediate preferences defined by Grandmont (1978). Preferences in this class are single peaked.

[11] Equation (14) has been obtained by setting the RHS of (12) and (13) equal to zero and simplifying.

$$e_t^p = e_t^k + \frac{(1-\delta\gamma)^2}{\delta(1-r_t)R_t}. \tag{14}$$

Equation (14) enables us to match each kid with a parent who votes exactly like he does. As expected, the pth parent is wealthier than the kth kid, since parents always tend to favor the social security system more than their own kids.

We are now ready to identify the median voters. Recall that each parent has $(1+n)$ kids, and that e^i is distributed according to the function $G(\cdot)$. The median voters are a kid with endowments e_t^{mk} and the parent of a kid with endowment e_t^{mp} such that e_t^{mk} and e_t^{mp} satisfy (14) and are defined implicitly by:

$$(1+n)G(e_t^{mk}) + G(e_t^{mp}) = 1 + \frac{n}{2}. \tag{15}$$

The first term on the LHS of (15) is the number of kids poorer than the median voter kid (who thus prefer higher social security taxes); the second term is the number of parents poorer than the median voter parent. If (15) is satisfied, an equal number of voters lies on the opposite side of e^{mk} and e^{mp}. Let e^m be the median value of e^i. Since $G(\cdot)$ is increasing and $e_t^{mk} < e_t^{mp}$ by (14), we have $e_t^{mk} < e^m < e_t^{mp}$: the income of the median voter kid is below the median income, whereas the opposite is true of the median voter parent.[12]

V. Political Equilibrium

The equilibrium policy is the value of τ_t preferred by the median voters. Consider first an interior optimum for the median voters. It is convenient to express the equilibrium in terms of the kids' consumption, rather than in terms of the policy. Let c^* be the kids' consumption in the political equilibrium. Then, c^* is found by setting the RHS of (12) and (13) equal to zero, for $e^i = e^{mk}$ and $e^i = e^{mp}$, respectively. Doing that and using (10) we obtain that c^* must satisfy:[13]

[12] Recall though that e_t^{mp} is the endowment of the kid of the median voter parent.

[13] Since e^{mk} and e^{pk} satisfy (14), the same value of c^* enters both expressions of (16). Moreover, since $e^{mk} < e^m$ and $e^m < 0$ (by hypothesis), we have $e^{mk} < 0$. By (7), (9) and (16), we then also have $e^{mp} > 0$.

$$e^{mk} = \frac{(1-\delta\gamma)(\gamma - U_c(c^*))}{U_c(c^*) + c^* U_{cc}(c^*)} \equiv E^k(c^*)$$
$$e^{mp} = \frac{(1-\delta\gamma)(1 - \delta U_c(c^*))}{\delta[U_c(c^*) + c^* U_{cc}(c^*)]} \equiv E^p(c^*). \tag{16}$$

The political equilibrium is characterized by the condition:

$$(1+n)G[E^k(c^*)] + G[E^p(c^*)] = 1 + \frac{n}{2}. \tag{17}$$

The function $G(\cdot)$ is strictly increasing. Differentiating (16) with respect to c^* and invoking the second-order conditions, it can be shown that $E^k(c^*)$ and $E^p(c^*)$ are also strictly increasing.[14] Hence, equation (17) identifies a unique equilibrium value c^*. The equilibrium policy, τ_t^*, is then defined by:

$$\tau_t^* = 1 - \frac{c^*}{w_t}. \tag{18}$$

Thus, if the political equilibrium is at the median voters' interior optimum, the kids' consumption is constant and does not depend on the aggregate endowment. The equilibrium social security tax moves in the same direction as w_t, and fully insures the kids against any aggregate shock. All aggregate risk is borne by the parents' generation.

Under what conditions does the political equilibrium involve a positive amount of social security transfers? This is equivalent to asking: when are the median voters not at the corner $\tau_t^* = 0$? The answer is easily obtained from (17) and (18). Since the LHS of (17) is strictly increasing in $c*$, the median voters are *not* at the corner $\tau_t^* = 0$ if and only if:

$$(1+n)G[E^k(w_t)] + G[E^p(w_t)] > 1 + \frac{n}{2}. \tag{19}$$

Whenever (19) is satisfied, the equilibrium involves a positive amount of

[14] Alternatively, the sign of $E_c^k(c^*)$ and $E_c^p(c^*)$ can be determined as follows. Let τ_t^k and c_t^k be the tax rate and kids' consumption preferred by the kth kid. Set the RHS of (12) equal to zero, for $e_t^i = e_t^k$. By the implicit function theorem and the second-order conditions, it can be shown that $d\tau_t^k/de_t^k < 0$ at an interior optimum. Hence,

$$\frac{dc_t^k}{de_t^k} = \frac{dc_t^k}{d\tau_t^k}\frac{d\tau_t^k}{de_t^k} = -w_t\frac{d\tau_t^k}{de_t^k} > 0.$$

Finally, note that $E_c^k(c^*) = (dc^k/de^k)^{-1}$ for $e^k = e^{mk}$. The same procedure can be used to show that $E_c^p(c^*) > 0$.

transfers through the social security system. Whether or not this occurs thus depends on the parameter values as well as on the realization of aggregate output, w_t.

By (16)–(18), the equilibrium size of the social security system depends on two central features of society: (i) the proportion of young people in the population, n; and (ii) the distribution of labour income among taxpayers—the function $G(\cdot)$. Consider first a change in the proportion of young people in the population, n. Applying the implicit function theorem to (17), it can be shown that $\mathrm{d}c^*/\mathrm{d}n > 0$.[15] Hence, by (18), the social security tax rate is negatively related to n. Intuitively, if there are more kids in the population, a larger fraction of the voters will be opposed to the social security system; hence the equilibrium size of τ_t^* is smaller.

Next, consider the effect of changing the distribution of labour income among the kids. The more unequal is the distribution of labour income, the lower are e^{mk} and e^{pk} (since the cumulative distribution $G(\cdot)$ would rise more rapidly for low values of e). Hence, the median voters correspond to poorer individuals, who in turn prefer a larger social security system (see equations (12) and (13)). Thus, the size of the social security system is larger in societies with greater income inequality. These two predictions of the theory are tested in the next section.

I close this section by comparing this equilibrium against a normative benchmark. There are two relevant dimensions. First, how is aggregate risk shared among generations? Second, how is consumption allocated on average between the young and old generations? On the first dimension, the political equilibrium exactly mimics the *ex ante* optimal policy of intergenerational risk sharing; see Gordon and Varian (1988). Since the parents are risk neutral, the optimal policy shifts all aggregate risk onto the parents, as in the political equilibrium. Thus, the *ex ante* optimal policy can be implemented under majority rule, even in the absence of commitments.[16] On the second dimension (the average allocation of consumption between young and old), the normative comparison is ambiguous. Here we need a stronger

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[15] By the implicit function theorem,

$$\frac{\mathrm{d}c^*}{\mathrm{d}n} = -\frac{G[E^k(c^*)] - \frac{1}{2}}{g(E^k(c^*))e_c^k + g(E^p(c^*))E_c^p}.$$

The denominator is positive. Since E^k is smaller than the median e^i, $G[E^k(c^*)] < \frac{1}{2}$. Hence, $\mathrm{d}c^*/\mathrm{d}n > 0$.

[16] Note that a similar finding would also hold if the parents were risk averse. In this case, the political equilibrium would be more difficult to characterize, but it would have the feature that aggregate shocks are borne by both generations currently alive. Naturally, the political equilibrium would exactly implement the *ex ante* optimal risk sharing only for particular parameter values.

criterion than Pareto efficiency. Since there is heterogeneity between rich and poor and young and old, the nature of the optimal allocation of consumption depends on the weights given to different individuals. Depending on how these weights are chosen, the equilibrium allocation of c^* to every kid may be too large or too small compared to the optimum.

VI. The Empirical Evidence

The theory has predictions for both time-series and cross-country data. But the time-series predictions (that social security tax rates are positively correlated with aggregate income) are not robust to minor changes in the model. In particular, increasing the risk aversion of the old compared to that of the young reverses the time-series predictions. For this reason, in the remainder of the paper I test the predictions of the theory by comparing the size of the social security programs of a large number of developing and industrialized countries.

The Data

The closest observable counterpart to the average social security tax rate—the variable in the model—is the ratio of social security contributions to GNP. This ratio is displayed in the first column of Table 1 for a number of

Table 1. *Social security contributions and expenditures*[a]

Country	Contributions		Expenditures	
	% of GNP	% of govt revenues	% of GNP	% of govt spending
South Africa	–	1.21	–	–
Jamaica	–	3.66	–	–
Madagascar	–	9.94	–	–
Ecuador	–	–	–	1.07
Niger	–	4.19	–	1.89
Nigeria	–	–	–	2.48
Sierra Leone	–	–	–	3.28
Morocco	–	5.08	–	5.15
Senegal	–	3.75	–	5.58
Peru	–	–	0.03	0.17
Philippines	–	–	0.27	2.11
Sudan	–	–	0.28	1.72
Bolivia	–	–	0.31	2.79
Tanzania	–	–	0.34	1.17
Pakistan	–	–	0.48	2.65
El Salvador	–	–	0.64	3.80
Zambia	–	–	0.78	2.30
Fiji	–	–	0.80	2.97

Table 1. *(continued)*

	Contributions		Expenditures	
Country	% of GNP	% of govt revenues	% of GNP	% of govt spending
Côte d'Ivoire	1.32	5.47	0.97	3.05
Burma	–	–	0.98	6.21
Malaysia	0.12	0.46	1.10	3.81
Korea	0.19	1.05	1.13	6.46
Venezuela	1.21	4.32	1.75	6.76
Trinidad & Tobago	0.65	1.64	1.87	5.92
Costa Rica	4.66	25.89	1.95	8.86
Tunisia	3.04	9.51	2.83	8.54
Mexico	2.26	15.11	3.03	16.01
Colombia	1.40	10.43	3.03	20.06
Panama	6.04	23.11	3.30	9.58
Barbados	2.72	9.68	4.57	14.98
Sri Lanka	–	–	5.95	16.01
Argentina	3.67	22.34	6.29	32.38
Australia*	–	–	7.00	27.94
Brazil	6.60	27.80	7.03	35.25
United States*	5.77	28.40	7.53	33.96
Finland*	2.67	9.47	7.74	27.00
United Kingdom*	6.74	17.08	9.43	25.48
Greece*	8.10	26.98	10.21	28.35
Chile	4.15	12.79	10.39	33.96
Italy*	11.47	34.55	12.61	30.11
Norway*	10.07	23.47	12.90	33.89
Israel*	5.12	8.32	14.59	20.31
Germany, Fed.*	15.22	53.32	14.99	49.58
Denmark*	–	–	16.46	42.29
France*	16.64	42.57	17.56	44.12
Sweden*	12.34	33.40	19.48	47.89
Netherlands*	18.34	36.67	19.95	37.09

Sources: International Monetary Fund, GFS and IFS.
[a]In the first two columns, the numerator is 100 $*$ social security contributions, and the denominator is indicated above. In the other two columns, the numerator is 100 $*$ social security plus welfare expenditures, and the denominator is indicated above. All the ratios are averaged over the period 1978–1982.
*indicates an industrialized country.

countries. Since the sample includes very heterogeneous countries, which certainly also differ in the availability of observable tax bases, the second column of Table 1 reports a different measure of the size of social security: the ratio of social security contributions to total government revenue. This second variable, although not literally related to the model, is perhaps more meaningful than the first. The reason is that its variation across countries is less likely to be affected by the difficulties of administering tax collections or general political attitudes towards the size of government, which are difficult to control for.

Data on social security contributions are missing for many countries. On the other hand, a larger group of countries report comparable data on social security and welfare spending.[17] Moreover, if the social security system is unbalanced and financed with general government revenues, social security expenditures as a fraction of GNP are perhaps a better measure of the variable in the model. This measure is displayed in the third column of Table 1. Finally, and for the same reasons discussed above, the last column of Table 1 also reports social security and welfare spending as a fraction of total government spending.

All the variables in Table 1 are averaged over the period 1978–1982 (or whatever fraction of it is available). The data sources are described in more detail in the Appendix. The sample of countries is determined by data availability, also taking into account the variables described below.

Table 1 underscores the extent to which the size of social security differs across countries. Most of the industrialized countries (indicated by an asterisk) have relatively large social security programmes; but this is also true of some of the developing countries, particularly when social security is scaled to total government revenue or spending. Can these differences be explained by the theory formulated in the previous sections?

According to the preceding model, the size of social security is related to the relative proportions of taxpayers and retirees among voters, and to the distribution of income. I measure the former by the proportion of individuals over 65 years of age in the total population ("*prop65*"), and the latter by the fraction of pre-tax income received by the top 5 percent of the population (*Top5*). Other measures of income distribution are also used, as described below.

The Cross-country Regressions

To test the predictions of the theory, I estimated the following regression:

$$y = \beta_0 + \beta_1 prop65 + \beta_2 top5 + \beta_3 \mathbf{x} + u \tag{20}$$

where y is the size of social security as measured by one of the variables listed in Table 1, u is the error term and $\mathbf{x}$ is a vector of additional explanatory variables neglected by our theory, but which may nevertheless contribute to explaining international differences in the size of social security. Our theory predicts that β_1 and β_2 are positive. Hence, the null hypothesis to be tested is: H_0: $\beta_1 = \beta_2 = 0$.

The vector $\mathbf{x}$ of additional explanatory variables includes a dummy

[17] The breakdown of social security and welfare is missing for most countries. But when available, welfare is generally a small proportion of social security plus welfare.

variable taking a value of 1 for industrialized countries and 0 otherwise (industrial), and real per capita income (per capita income), as a general proxy for the stage of development. Below I also report the results of including other variables in **x**, such as the size of the agricultural sector or of the urban population, which may be related to the cost of administering tax collections.

Table 2 contains the summary statistics and the correlation matrix among the variables mentioned above. Note that all the measures of social security are highly positively correlated with each other.

The estimated coefficients for alternative specifications, for different samples of countries, and for alternative measurements of the dependent variable are reported in Tables 3 and 4. Table 3 refers to all countries, while Table 4 splits the sample into industrial and developing countries.

Consider Table 3 first. Since there is evidence that the absolute size of the estimated residuals is correlated to per capita income, the coefficients were estimated by weighted least squares, with per capita income as weight. The unweighted estimates are very similar. For all measures of the dependent variable and all sample sizes, the regression fit is extremely good, considering the large variance in the dependent variable. The estimated coefficients of the variables of interest (*top5* and *prop65*) are always of the correct sign and are generally significantly different from zero.

Table 2. *Summary statistics*

Variables	Mean	Std. Dev.
S.S. Contrib. (% of GNP)	6.02	5.25
S.S. Contrib. (% of govt. revenue)	16.51	13.88
S.S. Exp. (% of GNP)	6.07	6.12
S.S. Exp. (% of govt. spending)	16.25	15.23
Prop65	0.07	0.05
Top5	26.63	8.92
Per capita income	4,114	3,675

Partial correlation matrix

	S.S. cont. (% rev.)	S.S. exp. (% GNP)	S.S. exp. (% sp.)	*Prop65*	*Top5*	P.C. income
S.S. cont (% GNP)	0.90	0.89	0.80	0.71	0.03	0.64
S.S. cont (% rev.)		0.72	0.83	0.64	0.07	0.62
S.S. exp (% GNP)			0.91	0.86	−0.36	0.80
S.S. exp (% sp.)				0.84	−0.29	0.83
Prop65					−0.43	0.89
Top5						−0.48

Table 3. *All countries*[a] *(1978–1982)*

Dependent variable	S.S. cont. (% GNP)	S.S. cont. (% rev.)	S.S. exp. (% GNP)	S.S. exp. (% sp.)	S.S. cont. (% GNP)	S.S. exp. (% sp.)
Explanatory variables						
Intercept	−8.814 (−2.427)	−26.99 (−3.108)	−3.603 (−1.247)	−11.971 (−2.040)	−10.828 (−2.610)	−16.161 (−2.691)
Prop65	36.259 (1.120)	118.286 (1.513)	70.071 (2.654)	214.312 (3.943)	73.541 (2.503)	204.885 (4.231)
Top5	0.362 (3.219)	1.147 (4.415)	0.118 (1.341)	0.502 (2.760)	0.343 (2.789)	0.533 (2.974)
P.C. income	–	–	–	–	0.37E(−3) (0.911)	1.33E(−3) (2.032)
Industrial	6.786 (2.111)	16.516 (2.130)	4.940 (1.848)	8.490 (1.540)	– –	– –
$\overline{R}^2$	0.586	0.632	0.655	0.731	0.517	0.743
S.E.	280.970	683.879	253.850	524.008	303.397	512.401
No. obs.	25	28	38	40	25	40

[a]All regressions were estimated by weighted least squares, with P.C. income as the weight; *t*-statistics in parentheses.

Table 4. *Industrial and developing countries*[a] *(1978–1982)*

	Industrial countries			Developing countries		
Dependent variable	S.S. cont. (% GNP)	S.S. cont. (% rev.)	S.S. exp. (% sp.)	S.S. exp. (% GNP)	S.S. cont. (% rev.)	S.S. exp. (% sp.)
Explanatory variables						
Intercept	−3.648 (−0.426)	−19.687 (−1.086)	−3.439 (−0.298)	−2.839 (−1.302)	−10.387 (−1.101)	−10.092 (−1.230)
Prop65	30.372 (0.508)	111.754 (0.883)	197.553 (2.372)	19.640 (0.887)	70.693 (0.706)	317.987 (3.073)
Top5	0.471 (2.004)	1.598 (3.214)	0.578 (1.675)	0.170 (2.795)	0.635 (2.458)	0.211 (1.032)
$\overline{R}^2$	0.228	0.523	0.439	0.314	0.206	0.225
S.E.	4.460	9.436	6.859	1.727	8.209	8.985
No. obs.	11	11	13	14	17	27

[a]Estimation method: ordinary least squares; *t*-statistics in parentheses.

Similar results are obtained in Table 4, when the regressions were estimated separately for industrialized and developing countries.[18] Note, however, that now the variable *prop65* loses significance in both samples when the dependent variable is measured as contributions (rather than expenditures). This could be due to the small number of observations within each sample. Very similar results (not reported in the tables) are obtained when per capita income is included in the regressions as an additional explanatory variable, or when social security is measured as expenditures as a percentage of GNP.

Sensitivity Analysis

To further assess the robustness of the estimates, I tried alternative specifications besides those reported in Table 3, as well as alternative measures of the data. First, I replaced per capita income in Table 3 with the share of the agricultural sector in GDP and with a measure of urbanization. The coefficients of interest did not change even though the size of the urban population had a significant estimated coefficient in some specifications.

Second, I created a new dummy variable that distinguishes between democratic and non-democratic regimes. The new dummy variable was always insignificant when included as an additional variable, and the other estimated coefficients were generally not affected by it.

Third, I replaced the measure of income inequality, *top5*, by two other measures of income distribution: the Gini coefficient and the fraction of income received by the third quintile in the population (which includes median income). The Gini coefficient is a measure of inequality, and the expected sign of its coefficient is positive as for *top5*; the third quintile is a measure of equality, and its expected sign in the regression is thus negative. The estimated coefficients of these variables always had the expected sign in all regressions, even though their *t*-statistics were generally slightly lower than for the variable *top5* (perhaps because they vary less in the sample).

Fourth, the same specification was estimated for more recent measures of all variables except income inequality. Thus the same variables listed in Table 3 were collected for the period 1988–1992 and the average was taken for each country over this same period (or whatever subperiod over which data where available). Income inequality is still measured by the same variable and with the same source used in Table 3. The number of countries for which data could be collected is somewhat smaller than for the regressions reported in Table 3. The new estimates are reported in Table 5 (the names of the variables are kept the same, even though they refer to

[18]Table 4 reports the unweighted estimates. Estimating with weighted least squares again makes little difference.

Table 5. *All countries*[a] *(1988–1992)*

Dependent variable	S.S. cont. (% GNP)	S.S. cont. (% rev.)	S.S. exp. (% GNP)	S.S. exp. (% sp.)	S.S. cont. (% GNP)	S.S. exp. (% sp.)
Explanatory variables						
Intercept	−10.939	−24.36	−7.038	−11.678	−13.686	−16.063
	(−2.041)	(−1.884)	(−1.922)	(−1.695)	(−2.338)	(−2.190)
Prop65	61.849	50.649	100.835	249.513	57.211	205.678
	(1.031)	(0.350)	(3.079)	(4.050)	(1.341)	(3.742)
Top5	0.418	1.296	0.188	0.537	0.447	0.640
	(2.342)	(3.094)	(1.526)	(2.320)	(2.507)	(2.775)
P.C. income	–	–	–	–	0.46E(−3)	0.80E(−3)
					(0.953)	(1.411)
Industrial	3.451	17.564	2.922	2.285	–	–
	(0.541)	(1.087)	(0.868)	(0.361)	–	–
$\bar{R}^2$	0.407	0.415	0.635	0.698	0.431	0.720
S.E.	482.997	1164.900	359.262	675.845	473.124	650.189
No. obs.	19	20	27	27	19	27

[a] All regressions were estimated by weighted least squares, with P.C. income as the weight; *t*-statistics in parentheses.

different periods). The results (and particularly the estimated coefficient of income inequality) are remarkably stable.

I conclude from these regressions that we cannot reject the predictions of the theory: social security is larger in countries with a more unequal distribution of pre-tax income and in countries with a greater proportion of elderly people in the population.

Finally, a central question is whether the earlier results are robust to errors in measuring the two explanatory variables of interest, *prop65* and *top5*. To answer it, I computed consistent bounds on their coefficients. Under the conventional hypothesis of the error in variables literature (namely the measurement error is not systematically related to any included regressor), even if these two variables are measured with error, their true maximum likelihood coefficients lie within these bounds.

Our procedure exploits the results of Klepper and Leamer (1984). Consider the first column in Table 3. First, I estimated the coefficients of *prop65* and *top5* by unweighted OLS and by alternatively interchanging each of them with the dependent variable (social security contributions as a percentage of GNP). I thus obtained three estimates for each coefficient, one of which corresponds to that reported in Table 3. For both variables, the signs of the three coefficients are the same across the three estimators. As shown by Klepper and Leamer (1984), I can then conclude that the true maximum likelihood coefficients lie within the convex hull of these three estimates. I then repeated the same procedure for the remaining five columns of Table 3. I find that for both variables, the three estimates always lie in the same orthant. Hence, I can compute the consistent bounds on the coefficients of *prop65* and *top5* for all the regressors reported in Table 3.

These bounds are reported in Table 6. The lower bounds always happen to coincide with the unweighted OLS estimator. Hence, if present, the measurement error tends to bias the results against the theory. I infer from this table that the findings of the preceding subsection are robust to the possibility of measurement error in income inequality and in the proportion of the population over 65 years of age.

VII. Concluding Remarks

This paper started with a question: why do a majority of voters support a social security system that redistributes income towards a minority of the population? To answer this question, I formulated a positive theory of social security that relies on a simple central idea. Social security redistributes both across and within generations. For this reason, it is supported by the recipients of social security benefits, as well as by the poorest taxpayers. When this idea is formalized in a simple overlapping-generations model, two positive implications are obtained. The size of the social security program is larger (i) the greater the proportion of retired individuals in the population; and (ii) the greater the inequality of pre-tax income. Both implications are strongly supported by the empirical evidence on cross-country data.

But the ideas studied in this paper lead to a second, deeper, question. Why

Table 6. *Errors in variables bounds*[a]

	Prop65		*Top5*	
Equation	Lower	Upper	Lower	Upper
(1)	33.800	558.660	0.268	40.080
(2)	115.990	1,414.430	0.905	2.400
(3)	70.110	383.000	0.027	5.263
(4)	272.816	874.126	0.243	4.437
(5)	64.577	308.070	0.254	1.072
(6)	199.223	877.193	0.284	3.640

[a]The equation numbers refer to the columns of Table 3.

is it that in many countries, most of the intra-generational redistribution occurs through the social security system? Outside this system there are not many purely redistributive programs; in most countries welfare expenditures are small compared to the size of social security. So, why do we observe that inter- and intra-generational redistributive policies are intertwined through a single policy instrument? The model analysed in this paper cannot answer this question. Specifically, suppose that in our overlapping-generations model we add one more instrument that enables the government to transfer a lump sum also to every young individual. This additional instrument breaks the link between inter- and intra-generational redistribution. Hence, in equilibrium all the kids would vote against any positive transfer to the parents, and the tax proceeds would only be redistributed among the kids; the equilibrium would then resemble that of Meltzer and Richard (1981), in which a majority of the voters favor a policy that taxes and redistributes. So, why is this extra instrument not used more systematically?

Perhaps, the answer is to be sought in a more complex model of political interaction. In this paper, the voters' preferences are single peaked and the political equilibrium is the policy preferred by the median voters. But in a more general environment, the political equilibrium would reflect the formation of different coalitions. A coalition of poor taxpayers and retirees would presumably support a social security program like that observed in most countries, and described in this model. So, the previous question could be reformulated as follows. Why is it that, in many countries, we observe the formation of this particular coalition of voters?[19] Considering that major reforms to most social security systems are fairly recent and date to the same postwar period, it is likely that the answer to this new question has much to do with particular historical circumstances. Galasso and Conde Ruiz (1999b) have recently addressed this question. They consider an overlapping-generations model combining two redistributive policy tools: a purely intra-generational scheme of redistribution, and a pension scheme that redistributes both within and across generations. In their model, preferences are no longer single peaked, and hence they study a structure-induced equilibrium as defined in Shepsle (1979). They find that both tools are used in equilibrium. But, consistent with the evidence, the intra-generational scheme turns out to be much smaller than the pension system. The reason is that the old constitute a large and homogeneous coalition which supports pensions but not other forms of redistribution. This intuition may also help explain why pensions are financed out of wages, with no explicit or implicit taxes on accumulated wealth (pension benefits are almost never conditional on individual wealth holdings): taxing wealth would break the homogeneity of the

[19]For instance, in Italy, slightly less than half of trade union members are retirees who currently receive pension benefits.

old generation *vis-à-vis* the policy, and reduce the size of a coalition in favor of larger pensions.

Another important policy dimension neglected in this paper is the age of retirement. Why is retirement compulsory in virtually all public pension systems? And what determines retirement age? Recent interesting work by Mulligan and Sala-i-Martin (1999a) and Galasso and Conde Ruiz (1999b) has begun to explore this important question.

Appendix. Variable Definitions and Data Sources

Social Security Contributions in Percent of GNP or of Total Government Revenues

First I take the ratio, and then I compute the average over the period 1978–1982 (or any year within that period for which data are available). *Sources*: Government Finance Statistics and International Financial Statistics, International Monetary Fund. In Table 5 the definition is the same, but the average is taken over the period 1988–1992.

Social Security Expenditures in Percent of GNP or of Total Government Spending

The numerator includes social security and welfare expenditures. The IMF classifies as social security expenditures the "transfer payments designed to compensate for reduction or loss of income or inadequate earning capacity". Health expenditures are not included in social security expenditures. The bulk of social security expenditures generally consists of pensions and retirement benefits. Welfare expenditures are defined by the IMF as "assistance delivered to clients or groups with special needs, such as the young, the old or handicapped". Welfare expenditures are generally much smaller than social security expenditures. *Sources*: Government Finance Statistics and International Financial Statistics, International Monetary Fund. In Table 5 the definition is the same, but the average is taken over the period 1988–1992.

Prop65. Proportion of the total population over 65 years of age. *Source*: UN Demographic Yearbook. This variable is available every five years, and for different years in different countries. The year closest to 1980 was chosen. In Table 5, the source is the World Bank Savings database, and the average is taken over 1988–1992, on yearly data.

Top5. Fraction of pre-tax real income received by the richest 5 percent in the population. It refers to households' income. The data differs across countries, but generally refer to the early 1960s. The other measures of income distribution mentioned in the paper were taken from the same source, namely Paukert (1973).

Industrial. A dummy variable taking a value of 1 for the countries defined as industrialized (see Table 1), and 0 otherwise.

Per Capita Income. Real per capita income in 1985. *Source*: Summers and Heston (1988). In Table 5, this variable is defined as m_rgdpch: real GDP per capita in constant dollars (chain index) in international prices, base 1985, average 1988–1992. *Source*: Penn World Tables (PWT), available on the net.

Other variables used were: Urban population as a percent of total population. *Source*: World Development Report, 1988. And: fraction of the labor force employed in the agricultural sector. *Source*: World Development Report, 1988.

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