NBER WORKING PAPER SERIES

A POSITIVE THEORY OF SOCIAL SECURITY

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Working Paper No. 3272

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
February 1990

I wish to thank Torsten Persson for several discussions on the topic of this paper, Tom Harris and Pablo Sanguinetti for excellent research assistance, and the NSF and the Center for Pacific Rim Studies for financial support. This paper is part of NBER's research program in Financial Markets and Monetary Economics. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

NBER Working Paper #3272
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A POSITIVE THEORY OF SOCIAL SECURITY

ABSTRACT

In many countries, social security is a large fraction of the government budget. Why is it, given that at any moment in time the number of recipients of social security benefits is smaller than the number of contributors? More generally, what determines the size of social security? To answer these questions, this paper studies an overlapping generations model in which all individuals currently alive vote on social security. There is no commitment to preserve the legislation inherited from the past. Voters are weakly altruistic and there is heterogeneity within each generation. The paper shows that 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. Both predictions of the theory are supported by the empirical evidence in cross-country data.

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I. INTRODUCTION

In many countries, social security is a large fraction of the government budget. Table 1 contains different measures of the size of social security programs for a large number of developing and industrialized countries in the late 1970s and early 1980s. In many cases, and for most industrialized countries, social security expenditures account for over a third of total government spending. Yet, it is difficult to explain why a social security system exists, let alone why it is so large. At any given moment in time, the number of recipients of social security benefits is smaller than the number of contributors. So, why does a large majority of the citizens support a system that redistributes towards a minority?

The literature provides two answers to this question. The first stresses 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 on the average tax payer must be relatively small. 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 revoting. If the current majority can commit the future majorities to preserve 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 revoting is clearly counterfactual. Society cannot precommit its future decisions on social security legislation. And in practice, the legislation has been changed repeatedly over time.[4]

This paper suggests an alternative explanation of 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 U.S., this fact is extensively documented by Boskin et al (1987) and by Ferrara and Lott (1985)). 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.

The first part of this paper studies 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 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. The second part of the paper explores these two empirical implications. I compare the size of the social security programs of the countries listed in Table 1, by means of simple cross-country regressions. I find that indeed the cross-country differences of Table 1 are 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 paper outline is as follows. Section 2 describes the model. Section 3 characterizes the economic equilibrium. The voters preferences are described in Section 4. Section 5 characterizes the political equilibrium. The empirical evidence is explored in Section 6. Finally, Section 7 concludes the paper.

2. The Model

The economy is populated by overlapping generations. Each generation lives two periods; hence, in every period two generations are alive. Members of the old generations are called "parents"; members of the young generations 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 i^{th} household. The preferences of the i^{th} kid born in period t are represented by:

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

where c_t^i is consumption of the i^{th} 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 i^{th} 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 i^{th} household are:

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

where d_t^i is the consumption of the i^{th} 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 i^{th} 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 $[\underline{e},\bar{e}]$ inside the unit circle, zero mean and negative median. The aggregate endowment w_t is drawn at random from a known distribution with support $[\underline{w},\bar{w}]$. The variables w_t and e_t^i are mutually uncorrelated, and their period t realizations are known to everybody 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 i^{th} kid in period t is:

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

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 of negative.

In the second period of his life, each individual receives an endowment a from nature and a non-negative lump-sum social security benefit g_t from the government, plus any gift from its kids. Hence, the budget constraint of the i^{th} parent in period t is:

$$a + g_t + R_{t-1}\, s_{t-1}^i + f_t^i(1+n) \geq d_t^i + b_t^i \tag{4}$$

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, $f_t^i, b_t^i \geq 0$, 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:

$$\int s_t^i \, dF_t(s_t^i) = 0 \tag{5}$$

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_t^i 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% of the voters to any other policy in a pairwise comparison.[7]

3. 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);

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

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:

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

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:

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

4. 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 will mean a social security tax rate, τ_t. The government budget constraint then determines g_t residually.

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

$$
\begin{aligned}
J_t^i = \frac{1}{1-\delta\gamma}\{&U(w_t(1-\tau_t)) + \gamma w_t\tau_t + R_t w_t(1-\tau_t)e_t^i + \\
&+ \frac{\gamma}{1+n} R_{t-1}w_{t-1}(1-\tau_{t-1})e_{t-1}^i + (1+n)E_t\, w_{t+1}\tau_{t+1} + \mu + \delta(1+n)J_{t+1}^i\}
\end{aligned}
\tag{11}
$$

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

where $\mu = \frac{\gamma a}{1+n} + a$. Despite being 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 in 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 i^{th} kid and parent welfare at time t. Differentiating (11) with respect to τ_t and simplifying:

$$J^i_{\tau_t} = \frac{w_t}{1-\delta\gamma}\left[\gamma - R_t - \frac{(1-\delta\gamma r_t)}{1-\delta\gamma} R_t e^i_t\right] \tag{12}$$

$$H^i_{\tau_t} = (1+n)\ [w_t+\delta J^i_{\tau_t}] \tag{13}$$

where $J^i_{\tau_t}$ and $H^i_{\tau_t}$ denote the partial derivatives of J^i_t and H^i_t with respect to τ_t respectively, and $r_t = -U_{cc}(c_t)c_t/U_c(c_t)$ is the coefficient of relative risk aversion of $U(\cdot)$. Throughout the rest of the paper I will assume that $r_t < 1/\delta\gamma$ for any c_t.

For the average voter (i.e., if $e^i_t = 0$), equation (12) can be shown to imply $J_{\tau_t} < 0$ and $H_{\tau_t} > 0$ for any $1 \geq \tau_t \geq 0$.[8] This is not surprising. For the average voter, the social security program only redistributes across generations, with no intragenerational 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 $e^i_t \neq 0$), the policy also has intragenerational effects, since it redistributes from rich to poor households. Specifically, if the i^{th} kid is richer than the average (if $e^i_t > 0$), then he will be even more opposed to the social security system; while his parent will be less strongly in favor (or may even oppose it, if e^i_t is sufficiently large). And conversely, a poor kid may support the social security system, while his parent will be even more strongly in favor 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 is the kids' income, the smaller is the preferred social security tax, for both kids and parents.[9] But the parents always prefer a larger 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]

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

Equation (14) enables us to match each kid with a parent who votes exactly like him. As expected, the p^{th} parent is wealthier than the k^{th} 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 left hand side 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]

5. 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 right hand side 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]

$$e^{mk} - \frac{(1-\delta\gamma)(\gamma-U_c(c*))}{U_c(c*)+\delta\gamma c*U_{cc}(c*)} = E^k(c*)$$

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

The political equilibrium is characterized by the condition:

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

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 left hand side 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 transfers through the social security system. Whether or not this happens thus depends on the parameter values as well as on the realization of aggregate output, w_t.[15]

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 labor income among tax payers -- 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 $dc^*/dn > 0$.[16] 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 labor income among the kids. The more unequal is the distribution of labor 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 above, equations (12) and (13)). Thus, the size of the social security system is larger in societies with a greater income inequality. The next section tests these two predictions of the theory.

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, like in the political equilibrium. Thus, the ex ante optimal policy can be implemented under majority rule, even in the absence of commitments.[17] On the second dimension (the average allocation of consumption between young and old), the normative comparison is ambiguous. Here we need a stronger 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.

6. 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, throughout 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.

6.1 The Data

For reasons of data availability, I aggregate together social security and welfare expenditures.[18] Table 1 displays three different measures of the size of the social security programs of various countries. The first column measures real expenditures in social security and welfare per person over 65 years of age. The other two columns measure social security plus welfare expenditures in proportion to GNP and to total government spending respectively. Each ratio is the average for the period 1978-82 (or whatever fraction of it is available). The data appendix describes the sources more in detail. The sample of countries is determined by data availability, taking also into account the variables listed below.

The first measure of the size of the social security program (scaled to the size of population over 65) is the closest equivalent of the variable g in the previous theoretical model. However, it could be measured with error, because the conversion from nominal to real international prices may be imprecise (see the data appendix), and because the size of the population over 65 could reflect measurement errors. For this reason, I also consider the size of social security in proportion to GNP and to total government

spending. This last variable (in proportion to government spending) is particularly meaningful, even though it has no theoretical counterpart in the previous model. Across countries, the size of the social security program is strongly positively correlated with the overall size of government. This is to be expected, since the size of government depends on factors neglected in the theoretical analysis (such as the availability of tax bases and the general political preferences of the citizens) which also determine the size of the social security program.
Hence, it may also be appropriate to test the predictions of the model when social security is measured in relation to total government spending.

Table 1 underscores how different is the size of social security in different countries, both per capita and in proportion to GNP and to the size of government. Most of the industrialized countries (marked with an asterisk) have relatively large social security programs; but this is also true of some of the developing countries, particularly when social security is scaled to total government 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 tax payers 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 ratio of the pre-tax income received by the top 20% of the population over the pre-tax income received by the bottom 40% of the population ("incratio"). Thus, the larger is the variable incratio, the more concentrated is the distribution of income. For a number of countries, only the distribution of post-tax income is available. A dummy variable ("post tax") has been set equal to 1 (0) if the variable "incratio" refers to post-tax (pre-tax) income. In the empirical analysis this dummy variable is interacted with the variable incratio, to isolate the countries for which the distribution of income is measured before taxes in conformity with the theory.

6.2 The Cross-Country Regressions

To test the predictions of the theory, I estimate by OLS the following regression:

$$y = \beta_0 + \beta_1 \text{ prop65} + \beta_2 \text{ incratio} + \beta_3 x + u \qquad (20)$$

where y is the size of social security as measured by one of the three variables listed in Table 1, u is the error term and x is a vector of additional explanatory variables neglected by our theory but which may nevertheless contribute to explain 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: $\beta_1 = \beta_2 = 0$.

I try different specifications of the vector x of additional explanatory variables. In the most comprehensive specification, x includes a dummy variable taking a value of 1 for industrialized countries and zero otherwise, the post-tax dummy interacted with the variable incratio, and two additional variables that may be related to the cost of administering the social security system, namely the percentage of the population living in urban areas ("urbanization"), and per capita income (as a general proxy for the stage of development).

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

The estimated coefficients for alternative specifications, for different sample of countries, and for alternative measurements of the dependent variable are reported in Tables 3 and 4. Table 3 contains the most parsimonious specification: besides the variables dictated by the model, only the post-tax dummy and the dummy for industrialized countries are included as explanatory variables. The regression fit is remarkably good, considering the large variance in the dependent variables, except when the sample only consists of the industrialized countries; this may be because in the latter case we have too few observations. The estimated coefficients of the variables of interest (prop65 and incratio) always have the correct sign. If we neglect the sample of only the industrialized countries, which is probably meaningless given the extremely poor fit, the estimated coefficient of the variable prop65 is always highly significant.[19] The variable incratio is also significant for several regressions, particularly when social security is measured in proportion to total government spending.

Table 4 contains the estimated coefficients when the other explanatory variables (urbanization and/or per capita income) are added to the regression. Even though these additional variables are generally significant, the same results of Table 3 are obtained: the variable prop65 always has a positive and highly significant estimated coefficient. And the variable incratio always has a positive estimated coefficient, which is also statistically significant when social security is measured in proportion to total government spending. The same kind of result is obtained when alternative combinations of the dependent variables and of the explanatory variables are tried, and in particular when social security is measured in relation to GNP.

To further assess the robustness of the estimates I tried alternative specifications besides those reported in Tables 3 and 4. First, I interacted the industrialized dummy variable with the two variables of interest, prop65 and incratio, to allow for differences in the slope coefficients between the two sample of countries. These new variables were generally insignificant, and the other estimated coefficients generally remained as reported in Tables 3 and 4. Second, I replaced urbanization and/or per capita income in Table 4 with the share of the agricultural sector in GDP. Again, the coefficients of interest did not change. Finally, I created a new dummy variable that distinguishes between democratic and non-democratic regimes. Strictly speaking, the theoretical model only applies to democratic systems. But the new dummy variable was always insignificant both when interacted with the coefficients of interest and when included as an additional variable, and the other estimated coefficients were not affected by it.

I conclude from these regressions that we generally cannot reject the predictions of the theory: social security is larger in countries with a greater proportion of elderly people in the population, and in countries with a more unequal distribution of pretax income. The predictions of the theory are only rejected in the sample of industrialized countries, that contains too few observations.

6.3 Sensitivity Analysis

A central question is whether the previous results are robust to errors in measuring the two explanatory variables of interest, prop65 and incratio. To answer it, I compute consistent bounds on their coefficients. Under the conventional hypothesis of the error in variables literature, even if these two variables are measured with error their true maximum likelihood coefficients lie within these bounds.[20]

Our procedure exploits the results of Klepper and Leamer (1984). Consider first equation (1) in Table 3. First, I estimate the coefficients of prop65 and incratio by alternatively interchanging each of them with the dependent variable (social security per individual over 65). I thus obtain 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 repeat 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 incratio for all the regressors reported in Table 3.

These bounds are reported in Table 5. The lower bounds always happen to coincide with the OLS estimator of Table 3. I infer from this table that the findings of the previous subsection are robust to the possibility of measurement error in income inequality and in the proportion of the population over 65 years of age.

Finally, heteroscedasticity of the residuals is often a problem with cross-sectional data. Indeed, here the White (1980) test on the covariance matrix of the estimated residuals rejects the hypothesis that there is no heteroscedasticity. However, when the covariance matrixes for the regressions of Table 3 are reestimated using White (1980) consistent estimator, the t statistics are not substantially different from those reported in Table 3 and the two variables of interest generally remain significant. In addition, when the regressions in Table 3 are reestimated by weighing each observation with per capita income, the results are generally unchanged, even though the regression fit tends to deteriorate.

7. Concluding Remarks

This paper started with a question: why does a majority of the 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 the social security benefits, as well as by the poorest tax payers. 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 is the proportion of retired individuals in the population; and (ii) the greater is 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 is it that in many countries most of the intragenerational 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 intragenerational redistributive policies are intertwined together through a single policy instrument? The model analyzed in this paper cannot answer this question. Specifically, suppose that in the previous 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 intragenerational 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 favors a policy that taxes and redistributes. So, why isn't this extra instrument 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 tax payers 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? 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. Further exploring this issue, and more generally the question of how coalition formation influences policymaking, is a difficult but exciting task for future research.

Footnotes

[1]This explanation is proposed for instance in Patton (1978). Stuart and Hansson (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 two interesting papers by Loewy (1988, 1989).

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

[3]This point has been explored in several papers. See for instance Browning (1975) and more recently Broadway and Wildasin (1989a,b) and Cukierman and Meltzer (1989).

[4]Some recent interesting papers (Kotlikoff, Persson and Svensson (1988), and Sjoblom (1985)) argue that "reputation" can substitute for commitment. Succinctly, if a young generation reneges on a social security program, it is punished by the succeeding generation who 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 (1989).

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

[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.

[7]Meltzer and Richards (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.

[8]If $e^i_t = 0$, (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 $1 \geq \tau_t \geq 0$.

[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 setting the right hand sides of (12) and (13) equal to zero and simplifying.

[12]Recall though that e^{mp}_t 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 $e^{mp} > 0$.

[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 k^{th} kid. Set the right hand side 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 $E_c^p(c*) > 0$.

[15]For instance, if $U(c) = \ell n(c)$ and the distribution $G(\cdot)$ is uniform over the interval $[-e,e]$, condition (1a) reduces to:

$$w_t > \frac{\delta[2(1+e)+n]}{1 + \delta\gamma(1+n)} \qquad \text{(F.1)}$$

which is more easily satisfied if w_t is large and δ is small. Note that, even though a logarithmic utility function violates (8), condition (F.1) is still consistent with zero private transfers for appropriate values of w_t and z_t.

[16]By the implicit function theorem,

$$\frac{dc*}{dn} = -\frac{G[E^k(c*)]-1/2}{g(E^k(c*))E_c^k+g(E^p(c*))E_c^p}$$

The denominator is positive. Since E^k is smaller than the median e^i (see the text, p. 10), $G[E^k(c*)] < 1/2$. Hence, $dc*/dn > 0$.

[17]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.

[18]When available, welfare is generally a small proportion of social security plus welfare expenditures. I use data on expenditures rather than on contributions because the latter are available for a much small sample of countries.

[19]It may be argued that when social security is measured by scaling expenditures to the population over 65, we may be introducing some spurious correlation between the dependent variable and the explanatory variable prop65. But if anything, this would bias the coefficient of prop65 downwards, and hence it would make it more difficult to reject the null hypothesis that prop65 has a zero coefficient.

[20]The maintained hypothesis is that the measurement errors are orthogonal to each other and to the unobserved correctly measured regressors.

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Variable Definitions and Data Sources

1. Real social security plus welfare expenditures per individual over 65 years of age is computed as follows: (i) First I compute yearly data on Real GDP at international prices (RGDP), using the population data and the data on real per capita GDP at international prices provided by Summers and Heston (1987). (ii) Then, I compute a GDP price deflator (Q) that converts local currency GDP into real GDP at international prices, by taking the ratio of RGDP to GDP in local currency (Source: International Financial Statistics, International Monetary Fund). (iii) Next, I compute Real Expenditures in social security plus welfare at international prices (RE), by multiplying by Q the local currency data on social security plus welfare expenditures of the central government (Source: Government Finance Statistics, International Monetary Fund). (iv) Then, I take the yearly average of RE over the period 1978-82. (v) Finally, I compute the variable listed in Table 1 by dividing this yearly average by the population over 65 (Source: United Nations Demographic Yearbook -- The population over 65 is available only for one year every five, and not for the same year in every country).

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.

2. Social security plus welfare expenditures in % of GNP and of Total Government Spending. Here take a ratio for every year, and then I average this ratio over the period 1978-82. The numerator in this ratio is the local currency variable used in (iii) above. GNP is taken from the International Financial Statistics (IMF), and total government spending of the central government is taken from the Government Finance Statistics (IMF).

3. Prop65 = Proportion of the total population over 65 years of age. Source: UN Demographic Yearbook. Again, this variable is available every five years, and for different years in different countries.

4. Incratio = Ratio of pre-tax income received by the richest 20% to the pre-tax income received by the poorest 40% of the population. This variable is computed from several different sources: UN (1981), UN (1985), Jodice and Taylor (1983), World Development Report (1987), Jain (1975). This ratio generally refers to a different year for different countries. In a number of countries it refers to post-tax income. In some other countries, it is impossible to know whether it refers to pre or post-tax income. When uncertain, I assumed that it referred to post-tax income. The results are not sensitive to this assumption.

5. Post-Tax = A dummy variable taking a value of 1 if incratio is computed from post-tax income, and 0 otherwise.

6. Industrialized = A dummy variable taking a value of 1 for the countries defined as industrialized by the IMF, and 0 otherwise.

7. Urbanization = Urban population as a percent of total population in 1985. Source: World Development Report, 1988.

8. Per Capita Income = Average of real per capita income over the period 1978-82. Source: Summers and Heston (1987).

TABLE 1

Social Security and Welfare Expenditures

Country	Real Expenditures Per Indiv. Over 65	% of GNP	% of Government Spending
Bahamas	-	1.44	7.01
Kenya	10.65	0.04	0.16
Nepal	10.89	0.08	0.53
Peru	17.39	0.03	0.17
Tanzania	31.73	0.34	1.17
Bangladesh	52.75	0.30	2.49
Malawi	65.29	0.44	1.40
Sudan	66.61	0.28	1.72
Burma	103.88	0.98	6.22
Pakistan	111.11	0.48	2.65
Philippines	118.82	0.27	2.11
Bolivia	122.17	0.31	2.79
Botswana	127.71	0.39	0.92
Benin	192.02	1.98	9.45
Guatemala	229.53	0.41	3.64
Thailand	232.48	0.51	2.82
Honduras	239.93	0.81	4.07
Zambia	240.74	0.78	2.30
El Salvador	251.57	0.64	3.80
Singapore	294.09	0.29	1.36
Turkey	311.34	0.64	2.40
Yugoslavia	374.89	0.74	7.67
Fiji	395.23	0.80	2.97
Cote D'Ivoire	477.52	0.97	3.05
Zimbabwe	589.55	2.13	6.47
Korea	597.79	1.13	6.46
Dominican Rep.	709.81	1.18	7.43
Malaysia	956.77	1.10	3.81
Tunisia	1071.38	2.83	8.54
Costa Rica	1133.08	1.95	8.86
Egypt	1220.08	4.62	9.68
Sri Lanka	1518.24	5.95	16.01
Mauritius	1771.31	4.96	17.21
Barbados	1905.77	4.57	14.98
Colombia	1924.58	3.03	20.06
Venezuela	1955.46	1.75	6.76
Trinidad & Tobago	2244.81	1.87	5.92
Argentina	2762.91	6.29	32.38
Panama	2931.54	3.30	9.58
Mexico	3190.69	3.03	16.01
Greece	3248.37	10.21	28.35
Brazil	4690.59	7.03	35.25
Uruguay	4729.14	11.67	48.34
Finland*	4923.67	7.74	27.00

Table 1 (Cont.)

Country	Real Expenditures Per Indiv. Over 65	% of GNP	% of Government Spending
Hungary	5303.32	11.63	21.21
Australia*	5540.88	7.00	27.94
United Kingdom*	5560.88	9.43	25.48
Chile	6304.63	10.39	33.96
Switzerland*	6575.47	9.84	48.64
United States*	6735.89	7.53	33.96
Italy*	6803.21	12.61	30.11
Canada*	7097.77	7.12	33.12
Spain*	7661.42	16.20	58.81
New Zealand*	7797.21	11.40	29.26
Norway*	8972.11	12.90	33.89
Israel	9384.2	14.59	20.31
Sweden*	9407.5	19.48	47.89
Austria*	9782.6	17.50	45.77
Germany, Fed. Rep.*	9828.4	14.99	49.58
Denmark*	10467.6	16.46	42.29
France*	12550.4	17.56	44.12
Belgium*	14229.3	21.71	42.09
Netherlands*	14349.2	19.95	37.09

NOTE: In the first column, the numerator is real expenditures on social security plus welfare, averaged over the 1978-82 period; the denominator is the population over 65, in a year in the period 1980-1987a (which year varies across countries). In the other two columns, the numerator is 100 * social security plus welfare expenditures, and the denominator is indicated above; the ratio is averaged over the 1978-82 period. A * indicates an industrialized country (according to the IMF definition). Sources: International Monetary Fund, GFS and IFS.

TABLE 2

Summary Statistics

Variables	Mean	Std. Dev.
S.S. (per indiv. over 65)	3427.51	3977.56
S.S. (% of GNP)	5.69	6.22
S.S. (% of govt. spending)	17.58	16.66
Prop65	0.07	0.05
Incratio	3.81	1.80
Urbanization	56.97	24.42
Per Capita Income	4206.27	3362.96

Partial Correlation Matrix

	S.S. (Per Indiv. Over 65)	S.S. (% of GDP)	S.S. (% of Govt. Spendng.)	Prop. 65	Incratio	Urbaniz.	P.C. Income
S.S. (per indiv. over 65)	1.00	0.96	0.07	0.83	-0.42	0.70	0.85
S.S. (% of GNP)	0.96	1.00	0.91	0.87	-0.49	0.66	0.77
S.S. (% of govt. spendng.)	0.87	0.91	1.00	0.85	-0.41	0.68	0.79
Prop65	0.83	0.87	0.85	1.00	0.60	0.64	0.88
Incratio	-0.42	-0.46	-0.41	-0.60	1.00	-0.39	-0.49
Urbanization	0.70	0.66	0.68	0.64	-0.39	1.00	0.74
P.C. Income	0.85	0.77	0.79	0.80	0.49	0.74	1.00

TABLE 3

OLS Estimates of (20)

Sample	All Countries			Developing Only		Indust. Only
Dependent Var.	Per Indiv. Over 65	% of GNP	% of Govt. Spendng.	Per Indiv. Over 65	% of Govt. Spendng.	% of Govt. Spendng.
Explanatory Vars.	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-1655.3 (1185.2)	-3.739* (1.810)	-9.479 (4.905)	-2174.1* (1023.7)	-12.658* (5.144)	12.386 (21.846)
Prop65	46370.3** (11541.4)	109.554** (17.729)	286.271** (48.030)	52364.7** (10417.8)	323.950** (52.624)	183.144 (116.086)
Incratio	269.7 (191.8)	0.326 (0.295)	1.614* (0.710)	323.6* (159.8)	2.018* (0.809)	0.534 (5.194)
Industrialized	3570.9** (1068.3)	1.799 (1.644)	6.137 (4.455)	-	-	-
Post-Tax * Incratio	-113.1 (126.6)	-0.024 (0.193)	-0.505 (0.523)	-113.0 (103.1)	-0.643 (0.517)	0.961 (2.935)
$\bar{R}^2$	.74	.75	.74	.36	.45	-0.03
S.E.	2031.5	3.128	8.473	1597.5	8.091	9.772
N. of Obs.	62	63	63	45	46	17

Note: Estimated standard errors are inside the parenthesis. An asterisk indicates significance at the 5% confidence level. Two asterisks at the 1% level.

TABLE 4

Alternative Specifications of (20)

Sample	All Countries				Developing Only	
Dependent Vars.	Per Indiv. Over 65	Per Indiv. Over 65	Per Indiv. Over 65	% of Govt. Spendng.	Per Indiv. Over 65	% of Govt. Spendng.
Explanatory Vars.						
Intercept	-3055.2* (1239.1)	-3170.7* (1210.7)	-1774.3 (1146.7)	-16.309** (5.170)	-2948.1** (1029.2)	-22.131** (4.814)
Prop65	31813.0* (13417.3)	34763.7** (12078.3)	29556.8* (13440.5)	298.678** (55.982)	35580.6* (13182.2)	389.084** (61.647)
Incratio	237.6 (184.9)	253.0 (181.2)	200.3 (187.9)	1.814* (0.771)	260.5 (149.2)	2.293** (0.698)
Industrialized	2875.6* (1265.0)	3243.1** (1042.5)	2252.1 (1188.2)	10.167 (5.278)	-	-
Post-Tax * Incratio	-72.5 (124.6)	-87.5 (120.4)	-42.4 (126.3)	-0.704 (0.520)	-78.06 (96.76)	-0.923* (0.452)
Per Capita Income	0.117 (0.226)	-	0.428* (0.191)	-0.00186 (0.00094)	0.177 (0.251)	-0.004** (0.001)
Urbanization	39.28* (16.25)	44.09** (13.28)	-	0.223** (0.068)	28.76 (15.50)	0.326** (0.072)
$\bar{R}^2$	.78	.78	.76	.78	.51	.65
S.E.	1904.6	1891.5	1963.3	7.947	1428.1	6.678
No. of Obs.	59	59	62	59	42	42

Note: Estimated standard errors are inside the parenthesis. An asterisk indicates significance at the 5% confidence level. Two asterisks at the 1% level.

TABLE 5

Errors in Variables Bounds

	Prop65		Incratio	
Equation	Lower	Upper	Lower	Upper
(1)	46370	244773	269.7	8041.1
(2)	109.6	503.9	0.3	46.3
(3)	286.3	870.7	1.6	24.5
(4)	52365	153726	323.6	3558.6
(5)	323.9	749.3	2.0	15.6
(6)	183.1	1768.6	0.5	657.3

Note: The equation numbers refer to the columns of Table 3.