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Is Altruism Important for Understanding the Long-Run Effects of Social Security?*

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This paper quantifies the effects of social security on capital accumulation and wealth distribution in a life-cycle framework with altruistic individuals. The main findings of this paper are that the current U.S. social security system has a significant impact on capital accumulation and wealth distribution. I find that social security crowds out 8% of the capital stock of an economy without social security. This effect is driven by the distortions of labor supply due to the taxation of labor income rather than by the intergenerational redistribution of income imposed by the social security system. In contrast to previous analysis, I found that social security does not affect the savings rate of the economy. Another interesting finding is that even though the current U.S. social security system is progressive in its benefits, it may lead to a more dispersed distribution of wealth. *Journal of Economic Literature* Classification Numbers: D31, D58, E2, E6, H55, J22, J26.

Key Words: social security; altruism; capital accumulation; labor market distortions; wealth distribution.

1. INTRODUCTION

The effects of the current U.S. social security system on capital formation have been the focus of great attention among economists. Using a life-cycle framework, Auerbach and Kotlikoff (1987) find that the capital stock in the U.S. economy could be 24% higher if the social security

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system were eliminated. The seminal work of Barro (1974) shows that in a dynastic framework, however, an unfunded social security system has no effects on capital accumulation if each generation is linked to the next through bequests.

This paper quantifies the steady state effects of social security on capital accumulation in a framework that embraces as special cases both the life-cycle and the dynastic frameworks. All quantitative analyses of social security have used the overlapping generations model. This paper incorporates altruism into this framework to assess the extent to which the findings in the literature are affected by the assumption of nonaltruistic preferences. The answer will not be trivial as Barro (1974) suggests, since at the steady state of this model not every household will be linked by bequests. This property of the model is consistent with the fact that bequests in the U.S. economy are concentrated in the upper wealth groups. See, for example, Hurd and Shoven (1985), Hurd (1987), and Juster and Laitner (1996).

Social security plays an insurance role that has not been analyzed so far. This paper emphasizes the idea that altruistic individuals may benefit from a progressive social security system because it provides insurance against the possibility of a low income shock affects descendants. The analysis of this insurance role is of interest since the U.S. social security system is progressive in its benefits. This study looks at how this intragenerational redistribution of income affects the distribution of wealth in the economy.

The results of this paper show that the current U.S. social security system has a significant impact on capital accumulation. Social security crowds out 8% of the capital stock of an economy without social security. This effect, though important, is significantly smaller than the one obtained in a life-cycle framework. In this setting a social security system transfers income from individuals with high marginal propensity to save (young agents) to individuals with low marginal propensity to save (old agents). Therefore, social security has a significant negative effect on saving rates and capital accumulation. In a model with altruism, old individuals save for bequests and thus do not necessarily have a lower marginal propensity to save than younger individuals. In fact, I find that social security has no important effects on the savings rate of an economy with altruistic households. The decrease of the capital stock is explained by a negative income effect triggered by the reduction of labor due to social security taxation. Indeed, if labor were supplied inelastically, social security would only crowd out 2% of the capital stock.

Surprisingly, social security leads to a more dispersed distribution of asset holdings, even though the system is progressive in its benefits. Indeed, I find that the Gini coefficient of the distribution of assets increases from 0.46 to 0.58 with social security. Social security substitutes for life-cycle savings; consequently, the bequest motive becomes more important relative to the life-cycle motive in savings decisions. Since bequests are concentrated among the upper wealth groups, the distribution of assets becomes more concentrated. In fact, the share of assets of the richest 20% of households increases from 47 to 53%, while the share of assets of the poorest 40% of households decreases from 10 to 1.4%.

The model in this paper has four key features. First, it is an overlapping generations model. This way, the intergenerational transfers implemented by a social security system can be modeled. Second, individuals are altruistic. Altruism is modeled as two-sided; that is, individuals care about their predecessors and descendants. For the specification of preferences, I have followed Laitner (1992) in order to prevent parents and children from behaving strategically, as they may do in multiperiod overlapping generations models with altruism. Third, there is an idiosyncratic shock that affects the lifetime labor productivity of individuals. This shock evolves according to a stochastic process across generations of individuals within a dynasty. Fourth, negative bequests are now allowed. These four key features entail that in steady state equilibrium some households receive positive bequests while other households do not [see Laitner (1992)].

Many economists have quantified the long-run effects of social security on capital accumulation using the life-cycle framework. Among the most relevant contributions are Hubbard and Judd (1987), Auerbach and Kotlikoff (1987), and İmrohoroğlu *et al*. (1995). Barro (1974) has shown that these findings may be very sensitive to the consideration of altruistic preferences. Other economists, for instance Laitner (1988) and Altig and Davis (1993), have also explored the effects of social security in the presence of altruism. The present paper contributes to the literature by performing the first quantitative analysis of social security in a framework where individuals have altruistic preferences.

Previous quantitative analyses have focused on the beneficial role of social security in economies where annuity markets are absent [see, for instance, İmrohoroğlu *et al*. (1995)]. The present paper, however, abstracts from uncertain lifetimes and studies an insurance role of social security that has not been emphasized before: A progressive social security system provides insurance against the risk of having children of low labor productivity.

Economists have also been concerned with the effects of social security on the distribution of wealth. Abel (1985) has shown that in a life-cycle framework with accidental bequests social security decreases the concentration of wealth. The present paper adds to the literature by showing that even a progressive social security system can lead to a higher dispersion in the distribution of wealth when altruism is incorporated into the analysis.

Section 2 presents the model economy. Section 3 describes the calibration of the benchmark economy and reports the results of the numerical experiments. Section 4 concludes. An Appendix contains a description of the computational method used in the numerical experiments.

2. THE MODEL

The economy is populated by $2T$ overlapping generations of individuals. Since there is no population growth, all cohorts have the same size, which is normalized to one. An individual becomes a father at age $T+1$. Thus, an individual's life overlaps during the first T periods with the life of his father and during the last T periods with the life of his son. Notice that while in the economy a new generation is born every period, in a family line a new generation is born only every T periods. This assumption implies that an individual belonging to the generation j of his family line belongs to the generation jT of the economy.

2.1. *Endowments*

Individuals are endowed with one unit of time that they can allocate to leisure or work. They are born with a labor ability which can be high or low: $z \in Z = \{H, L\}$. Labor ability determines an individual's lifetime profile of efficiency units of labor, which is denoted by $\{\epsilon_z(1), \dots, \epsilon_z(2T)\}$. If $z = H$, an individual has a high labor productivity and if $z = L$, an individual has a low labor productivity. The endowment of efficiency units of labor becomes zero when an individual reaches the retirement age R.

Labor abilities are correlated intergenerationally. They follow a two-state first-order Markov chain with a stationary distribution μ. The transition probability matrix for the labor ability state is given by the matrix

$$\Pi(z', z) = [\pi_{ij}]; \qquad i, j \in \{H, L\},$$

where $\pi_{ij} = \Pr\{z' = j | z = i\}$, z' is the labor ability of the new individual born in the dynasty, and z is the labor ability of his father. It is important to note that there are no insurance markets in the economy.

2.2. *Social Security*

The social security system provides pension benefits to retired individuals and taxes labor income. The tax rate is set so that the budget of the social security system is balanced each period. I assume that the benefits that individuals receive are related to their average lifetime earnings according to a linear function. As will become evident later, this linearity in the benefit formula will greatly simplify the computational problem. In order to capture the progressivity of the social security system, I will choose a different benefit formula for high and low labor ability individuals (see Section 3.1).

2.3. *Technology*

There are firms in this economy that use capital, K, and effective labor, N, to produce a single good according to the production function

$$Y = K^{\alpha}N^{1-\alpha},$$

where $\alpha \in (0, 1)$ is the capital share of output. Capital depreciates at a constant rate $\delta \in (0, 1)$. Firms maximize profits hiring capital and labor services so that marginal products equal inputs' prices; that is,

$$\begin{aligned} r &= \alpha K^{\alpha-1}N^{1-\alpha} - \delta \\ \omega &= (1-\alpha)K^{\alpha}N^{-\alpha}. \end{aligned} \tag{1}$$

2.4. *Altruistic Preferences*

Individuals derive utility from their lifetime consumption and leisure, and from the well-being of their predecessors and descendants. As was mentioned above, the formalization of preferences follows Laitner (1992). This author formulates a two-sided altruism model in which strategical behavior of father and son does not arise because their decisions maximize the same objective function. Because of this commonality of interests during the T periods when their lives overlap, father and son constitute a single decision unit by pooling their resources and jointly solving a maximization problem. I call this decision unit "a household." In this definition of household I omit women because I am assuming assortative mating as analyzed in Laitner (1991).

By a "dynasty" I mean a sequence of households that belong to the same family line. A household lasts T periods. It begins with a $(T+1)$-periods-old male, the "father," and with a 1-period-old male, the "son." After T periods, the father dies and the son becomes the father in the next-generation household of the dynasty. During the household's life span, the father's consumption and leisure are $\{c_f(t, j), l_f(t, j)\}_{t=1}^{T}$, and the son's consumption and leisure are $\{c_s(t, j+1), l_s(t, j+1)\}_{t=1}^{T}$, where the second argument of these functions indicates the individual's generation in the dynasty. The expected utility of a dynasty that starts with the father of generation 0 and a son of generation 1 is

$$E_0 \sum_{j=0}^{\infty} \beta^{jT} \sum_{t=1}^{T} \beta^{t-1} \Big\{ u\big(c_f(t,j), l_f(t,j)\big) + u\big(c_s(t,j+1), l_s(t,j+1)\big) \Big\}. \tag{2}$$

Note that since individuals derive utility from the well-being of their living predecessors and all their descendents, the above utility function includes the well-being of individuals belonging to generations $j = 0, 1, \dots, \infty$. The utility of individuals is defined in expected terms because the labor ability of future members of the dynasty is unknown.

2.5. *The Maximization Problem of a Household*

Writing the maximization problem of a household in the terms of dynamic programming language simplifies its computation. In order to express the household problem in these terms, I will divide it into two stages. In the first stage, newly created households maximize the discounted sum of utilities over the T periods that households last. In this problem households take as given both the initial wealth and the final wealth that they will leave to the next household. In the second stage, households decide the optimal amount of wealth that they will transfer to the next household in the dynasty.

Note that wealth is composed of asset holdings and the present value of social security claims that individuals have accumulated. Pension wealth and asset holdings differ in their liquidity since the pension wealth cannot be consumed until an individual retires from the labor market. I assume that individuals can borrow against the present value of the social security claims accumulated (pension wealth). This assumption greatly simplifies the computation of the solution of the household problem. Since households can borrow against their pension wealth, their decision problem depends only on the sum of assets holdings and pension wealth rather than on each of them individually.

The pension an individual receives depends on his average lifetime earnings according to a linear function $b_z(\cdot)$, being an individual's lifetime earnings the index

$$m = \sum_{t=1}^{T} \frac{\omega\big(n_s(t)\epsilon_z(t) + n_f(t)\epsilon_z(t+T)\big)}{R-1},$$

where $n_s(t)$ and $n_f(t)$ are the fractions of time allocated to work by an individual while he was a son and while he was a father, respectively. The linearity of the benefit formula leads to

$$b_z(m) = \sum_{t=1}^{T} \frac{b_z\big(\omega n_s(t)\epsilon_z(t)\big)}{R-1} + \sum_{t=1}^{R-1-T} \frac{b_z\big(\omega n_f(t)\epsilon_z(t+T)\big)}{R-1}.$$

The first part of the above expression is the social security claims that an individual accumulates while he is a son; the second part represents the social security claims that he accumulates while he is a father.

The budget constraint of the household's problem entails that the sum of the present value of the consumption by both father and son and the present value of the final wealth is restricted by the sum of initial wealth, the present value of after tax labor income, and the present value of the social security claims that father and son accumulate in the current household, that is,

$$\begin{aligned}
&\sum_{t=1}^{T} \frac{c_f(t) + c_s(t)}{(1+r)^{t-1}} + \frac{a'}{(1+r)^{T-1}} \\
&\quad = (1+r)a + \omega(1-\tau)\sum_{t=1}^{T} \frac{n_s(t)\epsilon_{z'}(t) + n_f(t)\epsilon_z(t+T)}{(1+r)^{t-1}} \\
&\qquad + \sum_{j=R}^{2T} \frac{1}{(1+r)^{j-(T+1)}} \left(\sum_{t=1}^{R-1-T} \frac{b_z\big(\omega n_f(t)\epsilon_z(t+T)\big)}{R-1} \right) \\
&\qquad + \sum_{j=R}^{2T} \frac{1}{(1+r)^{j-1}} \left(\sum_{t=1}^{T} \frac{b_{z'}\big(\omega n_s(t)\epsilon_{z'}(t)\big)}{R-1} \right),
\end{aligned} \tag{3}$$

where a is the initial wealth, a' is the final wealth, τ is the social security tax, t denotes the age of the household, and j indicates the age of individuals during retirement.

In the first stage of the maximization problem, newly formed households take as given the initial amount of wealth, the final amount of wealth to be transferred to the next household, and the abilities of father and son. This optimization problem defines an indirect utility function $F(\cdot)$,

$$F(a, a', z, z') \equiv \max_{\{c_f(t), l_f(t), n_f(t), c_s(t), l_s(t), n_s(t)\}_{t=1}^{T}} \sum_{t=1}^{T} \beta^{t-1}\Big[u\big(c_f(t), l_f(t)\big) + u\big(c_s(t), l_s(t)\big)\Big], \tag{4}$$

subject to

$$\text{Eq. (3)}, \qquad n_s(t) + l_s(t) = 1 \quad \text{and} \quad n_f(t) + l_f(t) = 1, \qquad \forall t.$$

Note that the first stage of the maximization problem of a household is a deterministic optimization problem because the abilities of both father and son are known.

In the second stage, households decide the sum of asset holdings and pension wealth that they will leave to the next household in the dynasty. This decision problem is represented with the functional equation

$$v(a, z, z') = \max_{a' \geq 0} \{ F(a, a', z, z') + \beta^T [\pi_{z'H} v(a', z', H) + \pi_{z'L} v(a', z', L)] \}. \quad (5)$$

The nonnegativity constraint in the above maximization problem implies that negative transfers of wealth between households are now allowed. This is a standard assumption in models with altruistic preferences [for instance, see Barro (1974)]. The solution of the above functional equation is characterized by an optimal policy function of final wealth $a' = h(a, z, z')$.

2.6. *Distribution of Households*

The space of possible states of a household is discretized by requiring the initial assets of a household to fall in a finite grid G. Therefore, the space of possible states is $G \times Z \times Z$. There is an invariant distribution of households, X, which is defined on the σ-algebra of subsets of $G \times Z \times Z$. The law of motion of this distribution is consistent with the household's optimization behavior and with the stochastic process of the ability shock.

2.7. *Steady State*

A steady state for a given social security arrangement (b_z, τ) consists of the indirect utility functions F and v; policy functions $(c_f, c_s, l_f, l_s, n_f, n_s, h)$; aggregate capital, labor, and consumption (K, N, C); prices (ω, r); and distribution of households X, such that policies $(c_f, c_s, l_f, l_s, n_f, n_s, h)$ are optimal, prices are competitively determined, markets clear, the distribution X remains invariant, and social security's budget is balanced in each period. The formal definition of steady state can be found in Fuster (1997, Appendix).

3. LONG-RUN EFFECTS OF SOCIAL SECURITY

In this section, I quantify the effects of social security on capital accumulation and wealth distribution. In order to motivate the numerical analysis that follows, I discuss here the extent to which social security affects the economy.[1] Social security substitutes for life-cycle savings because it redistributes income from working period to retirement periods. It also affects the bequest decision, and thus also has important consequences for capital accumulation and the distribution of wealth.

In this framework, social security plays an insurance role that has not yet been emphasized. Because altruism is two-sided and there is an uninsurable shock on the earnings of children, individuals face the risk of having a son who cannot afford to support them during retirement. In such an economy a progressive social security system plays the role of insurance because it reduces the variability of a household's earnings during retirement. Consequently, social security substitutes for precautionary savings. The progressivity of social security may lead to significant labor supply distortions. This may affect savings due to a negative income effect.

Social security affects intervivos transfers and bequests. In order to understand these effects, let us consider a simple case of this model in which individuals live for two time periods (a household lasts for one period, i.e., $T = 1$), and social security benefits are independent of past earnings and are financed by lump-sum taxes. In this economy, social security redistributes income within a household from the son to the father. This mandatory transfer can be offset by an intervivos transfer from the father to the son. As a result, consumption, savings, and bequests remain the same and only intervivos transfers are affected by social security. Consider now the case where individuals live for four periods (a household lasts two periods, i.e., $T = 2$) and are retired the last period of their life. Social security redistributes income across households of different ages, from young to old households (that is, from age 1 to age 2 households). Therefore, social security affects the profile of earnings of a dynasty, reducing the earnings of young households and increasing the earnings of old households. Since the utility function is concave, dynasties prefer a smooth consumption profile and would like to offset the redistribution forced by social security. The redistribution is offset by an increase of the bequest (or the wealth) left to the next young household in the dynasty.

[1] In this environment Ricardian neutrality fails because in each period some households end up being constrained since the steady state interest rate is lower than the discount rate of utility.

Social security affects the distribution of wealth in a nontrivial way. On the one hand, the progressivity of social security induces an equalizing effect. On the other hand, since households leave a higher bequest with social security than without it, the range of the distribution of bequests increases. This may lead to a more spread distribution of bequests and wealth.

In the next subsections I quantify the long-run effects of the U.S. social security system on capital accumulation and the distribution of wealth. To quantify these effects, I first calibrate the model economy such that its steady state equilibrium is consistent with some stylized facts of the U.S. economy. Then, I compute the steady state of an economy with and without social security and compare capital accumulation and wealth distribution across both steady states. I pay special attention to the role played by the assumptions of elastic labor supply and altruisitic preferences in generating the results.

3.1. *Calibration*

The artificial economy is calibrated to match selected observations of the U.S. postwar economy. Following Auerbach and Kotlikoff (1987), I assume that individuals start their economic lives at age 20, retire at age 65, and die at age 80. For computational reasons a model period is 5 years. This implies $R = 10$ and $T = 6$.

Technology and Utility. The capital share of production, α, the depreciation rate, δ, and the discount factor, β, are chosen to match a capital share of GNP of 0.36 [Prescot (1986)], a capital−output ratio of 3, and a rate of return of capital equal to 0.045. Therefore, I obtain $\alpha = 0.36$, $\delta = 0.075$, and, $\beta = 0.955$, the last two being expressed in annual terms. Note that I have to search numerically for β until the equilibrium interest rate is close to 0.045.

The utility function displays a unitary elasticity of substitution between consumption and leisure. This assumption is consistent with the fact that hours of work per household have been constant during the last four decades in spite of a large rise in the real wage rate [see, for example, Kydland and Prescott (1996)]. The utility function is assumed to be

$$u(c,l) = \frac{1}{1-\sigma}\left(c^{1-\gamma}l^{\gamma}\right)^{1-\sigma},$$

where $\frac{1}{\sigma}$ is the intertemporal elasticity of substitution and γ represents the intensity of preferences for leisure relative to consumption. There is an ample range of estimated values for the intertemporal elasticity of substitution. Auerbach and Kotlikoff (1987) cite empirical studies that provide

TABLE I
List of Parameters

	Population
$2T = 12$	Lifetime of individuals (60 years)
$R = 10$	Retirement age (45 years)
	Utility
$\gamma = 0.6$	Intensity of preferences for leisure
$\sigma = 4$	Coefficient of relative risk aversion
$\beta = 0.955$	Annual discount factor of utility
	Production
$\alpha = 0.36$	Capital share of GNP
$\delta = 0.075$	Annual depreciation rate
$\epsilon_z(\cdot)$ (see Table II)	Efficiency index
$\mu(H) = 0.28$	Measure of individuals with high ability
$\pi_{zz'}$	Transition probability matrix of abilities
$\pi_{LL} = .0833$ and $\pi_{HH} = 0.57$	

estimations of σ in the range of 1 to 10. I have followed the social security analysis by Auerbach and Kotlikoff (1987), who choose $\sigma = 4$. The parameter γ is chosen so that individuals allocate 40% of their discretionary time to work. This implies $\gamma = 0.6$. (See Table I.)

Labor Productivity. The profiles of efficiency units of labor for high- and low-ability individuals, $\epsilon_z(\cdot)$, are calibrated to the profiles of efficiency units of labor of college-graduate and non-college-graduate males, respectively. These indices are taken from Cubeddu (1996), who constructed indices of labor efficiency units for four categories of individuals by gender and education. They are calculated using data on wages and following the methodology developed by Hansen (1991). I consider the two male categories reported by Cubeddu (1996) and normalize the indices to average one. Table II presents these indices.

I choose values for the transition probabilities to match the following two observations: First, the proportion of full-time male workers that were college graduates in 1991 was 28% [see Bureau of the Census (1991, p. 145)]. Second, the correlation between the permanent component of income of parents and children is 0.4 according to estimations by Zimmerman (1992) and Solon (1992). These observations imply for this model that $\pi_{HH} = 0.57$ and $\pi_{LL} = 0.83$.

Social Security. Social security pensions depend on the average earnings of individuals over their 35 years of highest earnings. This relation is nonlinear since the marginal replacement rate of social security decreases

TABLE II
Profiles of Efficiency Units of Labor

Age	College	Noncollege
20−24	0.73	0.45
25−29	1.00	0.70
30−34	1.21	0.84
35−39	1.35	0.90
40−44	1.46	0.94
45−49	1.54	0.97
50−54	1.61	0.98
55−59	1.66	0.99
60−64	1.68	0.95
> 65	0.00	0.00

with an individual's earnings (see Fig. 1). The marginal replacement rate is the benefit that the last dollar of earnings entitles. For each dollar of earnings below 20% of the average earnings in the economy, the social security benefit is 90 cents. For each dollar of earnings between 20 and 125% of the average earnings in the economy, the social security benefit is 32 cents. Each additional dollar of earnings up to 246% of the average

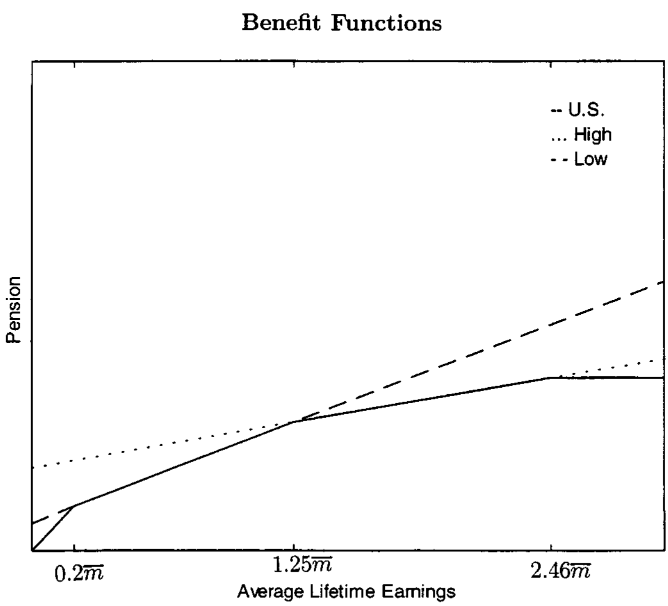

FIG. 1. Benefit functions.

earnings in the economy receives 15 cents of benefit. Above that level of earning the marginal replacement rate is zero.

In order to capture the progressivity of social security, I use different benefit formulas for individuals of low labor ability and of high labor ability, which are, respectively,

$$b_L(m) = 0.32(m - 0.2\overline{m}) + 0.9 \cdot 0.2\overline{m},$$

$$b_H(m) = 0.15(m - 1.25\overline{m}) + 0.32(1.25\overline{m} - 0.2\overline{m}) + 0.9 \cdot 0.2\overline{m},$$

where m represents the average lifetime earnings of an individual and $\overline{m}$ denotes the average earnings in the economy.

Figure 1 represents the benefit functions used in this paper as well as the one for the U.S. economy ($b_{\text{U.S.}}$). The functions $b_L(\cdot)$ and $b_H(\cdot)$ satisfy the following properties: (1) $b_i(\cdot) \geq b_{\text{U.S.}}(\cdot)$ for $i = L, H$; and (2) $b_L(m) = b_{\text{U.S.}}(m)$ for $m \in [0.20\overline{m}, 1.25\overline{m}]$ and $b_H(m) = b_{\text{U.S.}}(m)$ for $m \in [1.25\overline{m}, 2.46\overline{m}]$. These properties guarantee that when low labor ability individuals have earnings belonging to the interval $[0.20\overline{m}, 1.25\overline{m}]$, the solution of the household maximization problem coincides with the one obtained if we had used the U.S. benefit formula. A similar conclusion applies for high labor ability individuals when their average lifetime earnings belong to the interval $[1.25\overline{m}, 2.46\overline{m}]$. In the numerical experiments the first condition is satisfied by all individuals of low labor ability, and the second condition is satisfied by all individuals of high labor ability.[2]

3.2. *Findings*

Social security has significant effects on capital accumulation and wealth distribution. The results of this experiment show that the actual U.S. social security crowds out 8% of the capital stock compared to an economy without social security. However, the capital−labor ratio and, therefore, the savings rate of the economy are not significantly affected by social security. Another interesting finding is that the distribution of assets becomes more dispersed with social security, even though the system is progressive in its benefits.

Social Security and Capital Accumulation. Social security crowds out 8% of the capital stock relative to an economy without social security. This crowding out effect, though significant, is smaller than the one found in life-cycle analyses. For instance, the life-cycle analyses by Auerbach and Kotlikoff (1987) and by İmrohoroğlu *et al*. (1995) found that the U.S. social security crowds out more than 20% of the capital stock relative to an

[2] If $\hat{x} = \arg\max\{f(x)s \text{ to } x \in A\}$, and $\hat{x} \in B \subseteq A$, then it is true that $\hat{x} = \arg\max\{f(x)s \text{ to } x \in B\}$.

TABLE III
Benchmark Economy: Aggregate Effects of Social Security

τ	K	N	C	$\delta K/Y$	ω
0.0	100	100	100	21.6%	100
0.15	92	93.8	93.5	21.3%	99.2

Note. $K/Y = 3.1$; $r = 0.043$; $\tau = 0.15$; hours = 39% at benchmark.

economy without social security. In a standard life-cycle model, social security redistributes income from young individuals, who have a high marginal propensity to save, to old individuals, who have a low marginal propensity to save. This intergenerational redistribution leads to a significant decrease in the savings rate of the economy and, hence, to a large negative effect on capital accumulation. Yet, in a model with altruism, old households save for bequests and thus they do not necessarily have a lower marginal propensity to save than younger households. In fact, old households would like to compensate the tax burden of future generations by increasing their bequests. The increase of bequests explains why the savings rate of the economy is not significantly affected by social security. As a consequence, the impact on the capital−labor ratio is small (see Table III).

Social security also has significant negative effects on labor supply. The social security tax rate, net of the present value of pension entitlements per dollar of labor income, is positive. Then, social security is on net a tax on labor income and discourages labor supply. Table III shows that aggregate labor is 6.2% lower in the benchmark economy than in the economy without social security. The reduction in labor supply is more important for young individuals than for old individuals since the social security tax rate net of marginal benefits decreases with an individual's age. On average, the youngest member of a household (son) reduces his labor supply by 8% while the oldest member of a household (father) reduces his labor supply by 4%.

Distributional Effects of Social Security. Even though social security implies less dispersion of income, it induces more dispersion of asset holdings. Indeed, the Gini coefficient of the distribution of income decreases with social security from 0.16 to 0.11, while the Gini coefficient of the distribution of assets increases from 0.46 to 0.58. Table IV reports data on the distribution of asset holdings (defined as wealth minus pension wealth) across households. It is striking that the share of assets of the poorest 40% of households decreases from 10 to 1.4% with social security.

TABLE IV
Distribution of Asset Holdings: Fraction of Assets Held by Each Asset Holdings Group (%)

τ	Gini	Bottom 40%	Top 20%	10%	5%	1%
0.0	0.46	10	47.3	27.9	15.7	3.9
0.15	0.58	1.4	53.3	31.6	17.7	4.3

To understand this observation, note that poor households save mainly for smoothing consumption along the life-cycle. Since social security substitutes for life-cycle savings, the share of assets of the poorest households drops dramatically. In contrast to the negative effect that social security induces on the share of assets held by the poorest households, the share of assets of the richest 20% of households increases from 47 to 53%. This increase is caused by an increase in bequests which is important among wealthy households. The increase in bequests is reflected in the assets owned by newly created households, which rises from 30 to 40% of output.

Tables V and VI illustrate how social security affects households of different ability types. Even though the aggregate capital stock decreases with social security, Table V shows that average initial asset holdings increases for all household types. This observation is explained by the increase in bequests induced by social security. Table V also shows that, for all household types, the average present value of after tax labor income and pension payments decreases with social security. This finding is driven by the decrease of working hours and by the low return of social security relative to capital. (Notice that factor prices do not differ significantly across steady states.)

TABLE V
Effects of Social Security on Households' Wealth: Change Relative to the Economy without Social Security (%)

	Household type			
	HH	HL	LH	LL
Initial assets	11	11	31	31
Present value after tax labor income and pension	−12	−11	−14	−12
Lifetime resources	−9	−7	−8	−5

TABLE VI
Effects of Social Security on Distribution of Consumption: Change Relative to the Economy without Social Security (%)

	Household type			
	HH	HL	LH	LL
Average present value consumption	−10	−9	−9	−7
Coefficient variation present value consumption	44	45	33	35

I define the lifetime resources of a household as the sum of initial assets and the present value of income, that is,

$$(1+r)\tilde{a} + \omega(1-\tau)\sum_{t=1}^{T}\frac{\left(n_f(t)\epsilon_z(t+T) + n_s(t)\epsilon_{z'}(t)\right)}{(1+r)^{t-1}} + \sum_{t=R-T}^{T}\frac{b_z(m)}{(1+r)^{t-1}},$$

where $\tilde{a}$ denotes the initial asset holdings (capital) of the household. Table V reports that the average lifetime resources decreases with social security for all household types. Consequently, it is not surprising that average consumption decreases for all household types (see Table VI). Moreover, the increase in the dispersion of assets within each household type induced by social security is associated with a higher dispersion of consumption, as measured by the coefficient of variation, for all household types.

3.3. *The Importance of Labor Distortions*

In this subsection I analyze the role played by labor distortions in generating the results of the previous section. On the one hand, labor distortions are a key factor in generating the significant crowding out effect of social security. On the other hand, they are not important in explaining the distributional effects of social security.

I quantify the effects of social security in a version of the model economy where labor is supplied inelastically. In this exercise I calibrate the model economy to the capital share of income, interest rate, and capital−output ratio used in the previous section. The parameter values used in this exercise are the same values used in the previous exercise with the exception of the elasticity of intertemporal substitution (σ) and the indices of efficiency units of labor (ϵ_z). I pick a value for σ so that the elasticity of intertemporal substitution of consumption is the same as the one used when leisure was valued, that is $\frac{1}{\sigma} = 0.455$. This implies a value

TABLE VII
Inelastic Labor Supply: Aggregate Effects of Social Security (%)

τ	K	Y	C	$\delta K/Y$	ω
0.0	100	100	100	21.5%	100
0.15	98	99.3	99.6	21.3%	99.4

Note. $K/Y = 3.1$; $r = 0.043$; $\tau = 015$ at benchmark.

for σ of 2.2. Since in this section I am considering a model with an inelastic labor supply, I use indices of efficiency units of labor that represent not only differences in productivities, but also differences in working hours. These indices are calculated using data on earnings from the Bureau of the Census (1991). The results that follow are not sensitive to the profile of efficiency units used.

Table VII shows that when labor supply is inelastic, the crowding out effect of social security is small. It is only 2% of the capital stock of an economy without social security. Consequently, the negative effect on aggregate consumption is only 0.4% of aggregate consumption for the economy without social security. Other effects of social security in this framework are similar to the ones obtained in the economy where labor supply is elastic. In particular, the savings rate of the economy and the capital−labor ratio are not affected by the social security system. The fact that the capital−labor ratio is very similar across steady states implies that social security does not have significant effects on wage and interest rates. As in the case of elastic labor supply, social security leads to an increase in wealth inequality. The Gini coefficient of the distribution of asset holdings increases from 0.5 to 0.68 with social security.

Table VIII shows that the average present value of consumption decreases with social security for all types of households except for the one where father and son have low ability. In understanding this observation, the reader should bear in mind that low-ability households are the only

TABLE VIII
Effects of Social Security on Distribution of Consumption in Economy with Inelastic Labor Supply: Change Relative to the Economy without Social Security (%)

	Household type			
	HH	HL	LH	LL
Average present value consumption	−4	−2	−3	0.4
Coefficient variation present value consumption	39	35	37	35

TABLE IX
Effects of Social Security on Households' Wealth in Economy with Inelastic Labor Supply: Change Relative to the Economy without Social Security (%)

	Household type			
	HH	HL	LH	LL
Initial assets	17	17	36	36
Present value after tax labor income and pension	−7	−5	−8	−6
Lifetime resources	−4	−1	−2	2

type that have, on average, higher income in the economy with social security than in the economy without social security (see Table IX). For this household type, the increase in initial capital overturns the decrease of the present value of the tax labor income and pension benefits induced by social security. In contrast, when labor supply is elastic, social security has a large negative effect on hours worked and lifetime resources decrease for all household types.

3.4. *The Importance of Altruism for a Social Security Analysis*

This subsection looks at the importance of altruism in analyzing the effects of social security, and shows that incorporating altruism changes dramatically the impact of social security on capital accumulation and the distribution of wealth.

I quantify the effects of social security in a life-cycle model with nonaltruistic individuals. Individuals only derive utility from their own lifetime consumption of leisure and goods. Although there is uncertainty about the labor abilities of future generations, the household's problem is deterministic because individuals do not care about the well-being of future generations. In all other regards, the model is identical to the economy of Section 2.

This exercise calibrates the life-cycle model so that it resembles the steady state with social security of the altruistic economy. The parameter values are as shown in Tables I and II, except for the discount factor, which is set to 1.01. This value of β is chosen to match an interest rate of 0.045. Notice that, since this is not a dynastic model, the discount factor of utility is not restricted to be lower than one. In fact, in a quantitative life-cycle social security analysis, İmrohoroğlu *et al*. (1995) have used $\beta = 1.011$, which is the value estimated by Hurd (1989).

Table X shows that the main aggregates that characterize the steady state of the life-cycle economy are very similar to the main aggregates of the benchmark economy in Table III. Table X shows that the effects of social security in the life-cycle model differ substantially from those in the

TABLE X
The Life-Cycle Economy: Aggregate Effects of Social Security

τ	K	N	C	$\delta K/Y$	ω
0.0	100	100	100	26%	100
0.15	69	94	89.6	21%	90

Note. $\tau = 0.15$; $K/Y = 3.1$; $r = 0.045$; hours = 40% at benchmark.

dynastic model. In fact, the crowding out effect of social security in the life-cycle model is about four times larger than the crowding out effect of social security in the dynastic economy. Since old individuals do not leave bequests in a life-cycle model, they have a lower marginal propensity to save than young individuals. Therefore, the intergenerational redistribution of income by social security has a strong impact on the savings rate of the economy and, as a consequence, on capital accumulation. Notice that this observation explains why social security has an important crowding out effect on capital regardless of whether labor is supplied elastically or inelastically. In contrast, since in a dynastic framework the savings rate is virtually unaffected by social security, the crowding out effect is significant only when labor is supplied elastically.

With regard to the distributional effects of social security, this experiment shows that social security leads to a more egalitarian distribution of assets. Indeed, the Gini coefficient of the distribution of asset holdings decreases with social security from 0.49 to 0.44. On the contrary, when individuals are altruistic social security induces a more unequal distribution of wealth.

4. CONCLUSION

This paper shows that altruism may be very important in understanding the effects of social security. I find that, in contrast to life-cycle analyses, social security does not affect the savings rate in a dynastic framework. The social security system affects capital accumulation significantly because it distorts labor supply decisions.

Social security redistributes income intragenerationally and intergenerationally. The role of insurance played by the intragenerational redistribution of income is not significant. On the contrary, the intergenerational redistribution of income increases the dispersion of bequests, which, in turn, makes the concentration of wealth rise.

The model of this paper abstracts from population growth, technological growth, and uncertain lifetimes. Since these features are crucial to matching the actual return of social security in the U.S. economy, they should be taken into account in analyzing the welfare effects of the U.S. social security system or in studying the political support of a social security reform.

APPENDIX: COMPUTATIONAL METHOD

In this Appendix I explain the computational method used in this paper. The initial, and thus the final, wealth of a household is restricted to a discrete set G. The grid of wealth has a dimension equal to 100 being the minimum wealth 0 while the maximum wealth is chosen so that it is never binding in the simulations.

Solving the first stage of the maximization problem of a household: I use a shooting algorithm to solve problem (4) for each $(a, a', z, z') \in G \times G \times Z \times Z$.

1. Use first-order conditions of maximization problem (4) to solve for the sequences of consumption and leisure of father and son as functions of the son's first period consumption.

2. Use a bisection method to solve for the initial consumption of the son that balances the intertemporal budget constraint or Eq. (3). The convergence criteria is $10^{-6}\%$ of the present value of consumption.

Solving the second stage of the maximization problem of a household: I use the value function iteration method to solve for the optimal policy of final wealth $h(a, z, z')$.

1. Using a guess of the value function, obtain the final wealth that solve the Bellman equation (5) for each $(a, z, z') \in G \times Z \times Z$.

2. Use the optimal policy of final wealth, $h_0(a, z, z')$ to obtain a new guess of the value function by iterating on the Bellman equation

$$v_{n+1}(a, z, z') = F(a, h_0(a, z, z'), z, z') + \beta^T\left[\pi_{z'H} v_n(h_0(a, z, z'), z', H) + \pi_{z'L} v_n(h_0(a, z, z'), z', L)\right]$$

until $\|(v_{n+1} - v_n)/v_{n+1}\| < 10^{-9}$, where $\|\cdot\|$ denotes the sup norm.

3. Use the new guess of the value function to obtain a new policy of final wealth like in step 1.

4. Stop if $\|h_{n+1} - h_n\| < 10^{-12}$; otherwise go to step 2.

Computation of the stationary distribution of wealth and abilities across age-1 households: Denote the state of an age-1 household by s, where $s = (s_1, s_2, s_3) = (a, z, z')$. The stationary distribution of states across age-1 households is computed using an iteration method on Eq. (6). Use the optimal policy of final wealth $h(s)$ and the transition probability matrix for the labor ability state $\Pi(z', z)$ to compute a transition matrix for the state of a household $T(s', s)$. This transition matrix gives the probability that the state of the next age-1 household is $s' = (s'_1, s'_2, s'_3)$ conditioned on being $s = (s_1, s_2, s_3)$ the state of today's age-1 household,

$$T(s', s) = \begin{cases} 0 & \text{if } s'_1 \neq h(s_1, s_2, s_3) \text{ or if } s'_2 \neq s_3; \\ \Pr\{z' = s'_3 | z = s_3\} & \text{if } s'_1 = h(s_1, s_2, s_3) \text{ and } s'_2 = s_3. \end{cases}$$

1. Guess a distribution $X_0(s)$ defined on $G \times Z \times Z$.
2. Use the guess of the distribution and the transition matrix T to iterate on

$$X_{n+1}(s') = \sum_{s \in G \times Z \times Z} T(s', s) X_n(s),$$

$$\text{for all } s' \in G \times Z \times Z, \text{ until } \|X_{n+1} - X_n\| < 10^{-11}. \quad (6)$$

Algorithm to compute equilibrium: The algorithm is standard and can be found in Fuster (1997, Appendix). It involves solving for the vector $x = (x_1, x_2, x_3) = (K, N, \tau)$ that clears the goods market and labor market, and balances the budget of the social security system. The convergence criteria is $\sup_{i=1,2,3} \|(x_i^{n+1} - x_i^n)/x_i^n\| < 10^{-4}$.

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