Investing in Equities:
Can it Help Social Security?

Michael Dotsey

S ocial Security is in trouble. A recent report by the U.S. General Account-
ing Office (1997) indicates that absent any changes to the current system,
payments to beneficiaries will exceed revenues from payroll taxes in
2012, and by 2029 the Social Security Trust Fund will be depleted. That Social
Security is in trouble is not really news. The system has a long history of being
underfinanced, and the current difficulties are not historically large. Recently,
the 1994–1996 Advisory Council on Social Security issued its report with var-
ious recommendations for putting the system on firm financial footing. From
an economic perspective, making the Social Security System sound is not a
difficult task. There exist a multitude of ways for doing so, but most involve
either increases in taxes, reductions in benefits, or both. Thus, any plan inher-
ently involves difficult political decisions. However, one part of the solution
that is included in each of the three separate plans that were presented to the
Commissioner of Social Security was the recommendation that some portion
of the current trust fund be invested in the stock market. By taking advantage
of the higher returns earned by equities, this recommendation seemingly would
reduce the increases in taxes or the reduction in benefits that would be needed
to return the Social Security System to financial viability.

In this article I address the economic merits of this recommendation. My
analysis suggests that the ownership of the capital stock has very few conse-
quences for the government's budget. The economic opportunities available to
society are not increased by a transfer of capital from the private sector to the
government. In short, there is no free lunch.

1.   A BRIEF HISTORY

The Inception of Social Security

Social Security was created in 1935 as an intergenerational transfer program from workers to retirees. Its design also provided for income redistribution among the elderly, because replacement rates (the ratio of the benefit paid in the first year of retirement to taxable earnings in the preceding year) are higher for low-income workers than for high-income workers. Social Security is a pay-as-you-go system. In years when the revenue from Social Security taxes exceeds outlays, the U.S. Treasury uses the proceeds to finance other expenditures, thereby reducing the level of government debt from what it otherwise would have been. There exists the accounting fiction of a trust fund, but from an economic perspective no such fund exists. The lower level of government debt makes it more likely that future claims will be honored, but there is no dedicated set of securities belonging to the Social Security Administration that has the same legal standing as a government bond issued to a private citizen. Because it is a pay-as-you-go system, there is the potential that, for a variety of reasons, promised payments could become increasingly difficult to honor. This is what has happened repeatedly to the Social Security System.

Despite its problems, the Social Security System has been remarkably successful in terms of its growth and its economic importance. At the time of its creation, the old age and survivors insurance (OASI) part of the program was fairly small, with benefits equaling 0.03 percent of GDP in 1940. By 1950 that percentage had risen to only 0.33 percent of GDP, but by 1996 it had risen to over 4 percent of GDP. In terms of taxable payrolls, benefits were 10.7 percent in 1994, which is very close to the 10 percent envisioned in the 1939 Act (see Miron and Weil [1997]) and represented roughly 19 percent of all federal outlays. Over time, the fraction of the labor force covered by Social Security has risen from 63.7 percent in 1940 to 97.6 percent in 1993.

Social Security has also played a major role in reducing the percent of those over 65 who live below the poverty line. In 1959, 35.2 percent of the elderly were characterized as poor. By 1994, that figure had dropped to 11.7 percent. The increase in Social Security benefits is in large part responsible for this decline. Expressed in terms of 1995 dollars, the average monthly benefit in 1950 was $269.30, in 1960 it was $381.38, and in 1995 it was $719.80. Also, the number of beneficiaries has risen substantially from 222,488 in 1940 to 37.5 million in 1995. In terms of percentages of the population over 65, only 7 percent received benefits in 1940, whereas 91.3 percent received benefits in 1995. More importantly from the standpoint of helping the poor, Social Security currently provides over 90 percent of income for half the seniors below the poverty line and 50 percent of income for two-thirds of all beneficiaries.

As the preceding figures show, the scope and amount of coverage has increased greatly since the inception of Social Security. The original act

promised benefits only to those who contributed, but in 1939 benefits were extended to spouses and surviving widows. Over time, various changes have expanded the scope of Social Security, with perhaps the most important extension resulting from the 1950 Act that brought 10 million new workers into the system. Also, various changes in computing benefits, coupled with high inflation and growth in wages, served to increase benefits, which consequently grew much faster than the economy.

Initially a 2 percent tax rate, equally divided between employer and employee, was levied on income up to $3,000. The first benefits to contributing retirees were not to be paid until 1942, but the 1939 Act moved that date forward to 1940. Further, no benefits were to be paid in any month that a retiree earned more than $15. To put that figure in perspective, the average annual wage in 1937 was $979. This feature of the system indicates that Social Security was in part envisioned as insurance against destitution. However, under the assumption of no inflation and no wage growth, the replacement rate for a worker earning $1,000 for 45 years, and retiring at age 65 in 2002, would have been 0.60 under the initial act. That means that this hypothetical worker would have received $600 a year in perpetuity, implying that the initial act also possessed features that went far beyond mere insurance. A 60-year-old worker earning the same salary ($1,000) and retiring in 1942 would have received benefits of $200 a year. With the extension of benefit eligibility, the 1939 Act also reduced the replacement rate to 0.43. Thus, our hypothetical worker would receive only $430 upon retirement, while his spouse would receive $215.

Under the 1939 Act, the combined tax rates on employer and employee were 2 percent and were scheduled to rise to 6 percent by 1949 and remain fixed thereafter. Full benefits would not begin until 1991, when workers with a full history of contributions would be retiring. According to projections at the time, the internal real rate of return for those retirees would be 3.9 percent, not much above the 3 percent rate of return that was projected on the accumulated trust fund. Or, in more relevant terms, the internal rate of return would not be too far above the economy's growth rate and benefits could be paid by issuing government debt without increasing the debt-to-GDP ratio. Thus the initial planning attempted to create a sustainable system.

A History of Problems

Over its history the Social Security System probably has never been sound. The chief reason is that Congress tended to make benefits more generous than originally intended and refused to raise tax rates as fast as the 1939 Act prescribed. Tax rates did not reach 6 percent until 1960. Also, economic factors such as usage growth interacted with the methodology for calculating benefits, increased the level of benefits in unintended ways during the 1970s, and placed the system under tremendous strain. Corrections to the methodology were not

made quickly enough, and tax rates were not raised sufficiently, so that the system almost defaulted in the early 1980s. Demographic changes also conspired to make the system less sound than it would have been under stable population growth. Thus, under current law someone just entering the labor force will earn a rate of return on Social Security contributions that is probably negative, while the rate of return for those that have already retired is significantly higher than was intended.

The 1950 Act, which brought in 10 million new workers, also calculated their benefits in a way that provided them with large transfers. Expansion in scope need not have been detrimental to the soundness of the system, but these workers received benefits that were based on their wage history after 1950 rather than on their entire wage history. Thus, individuals from this group who retired soon after 1950 received full benefits and a large transfer from the existing system. Basically for this group the link between the replacement rate and the number of years of paying into the system was cut, and these new retirees received the same benefits as those who had been in the system since its inception. To accommodate this change, average benefits were slightly reduced.

Perhaps the most severe problem for the system was created by the 1972 Act, which for the first time included automatic price adjustments. Previously, such adjustments were made on an ad hoc basis. However, the adjustment procedure ended up overcompensating workers and made replacement rates unstable (for an excellent discussion see Munnell [1977]). The cost-of-living adjustment for retirees did not present a problem. Rather, the calculated replacement rates for newly retired workers were overstated. In essence these workers received an increase in their benefits that accounted not only for inflation but for wage growth as well. Because wages tend to rise with inflation, new retirees received a double counting. The amount of initial benefits also increased with the disparity between real wage growth and inflation. In this manner, the economic climate at the time, along with the unsound method of computing initial benefits, placed great stress on the system, with replacement rates rising from 47.9 percent in 1970 to 66.7 percent in 1980. As a result, the individual that retired in the 1970s received the largest net transfer of any cohort under Social Security.

The mistakes in the 1972 Act led to the rescue package of 1977, which constituted the largest peace-time tax increase in U.S. history. The rescue package also stopped initial benefits from rising faster than wage growth. The system was pronounced sound for the rest of the century and well into the next one. Unfortunately, the pronouncement was wrong. By 1981, there was a high probability that the system would not be able to meet its promised benefits. A commission was appointed to deal with the problem. Its lack of complete success is in part why Social Security restructuring is currently receiving so much attention. The 1983 Act did raise the schedule of tax rates and the annual

maximum on taxable earnings. It also effectively reduced benefits by taxing some portion of Social Security payments. Finally, it gradually raised the age to 67 at which full benefits were paid for the cohort born in 1960. Combined, these changes averted a problem of failing to honor legislated benefits but failed to solve the problem of long-term insolvency.

The Current Problem

The Social Security System as currently constituted is not actuarially sound. In this regard, the important date is 2012, because that is when expenditures will exceed receipts. At that point the federal government will have to raise taxes, reduce government spending, or increase its borrowing in order to make the promised payments to retirees. Beyond that date, the revenue shortfall will increase and the necessary adjustments will be more dramatic. It is estimated that the revenue shortfall will be $57 billion in 2015 and grow to $232 billion in 2020. Put in perspective, current total OASI payments are approximately $308 billion dollars. This deficit will occur in part because there will be an estimated 50.4 million beneficiaries in 2015, up from 37.5 million in 1995.

As mentioned earlier, the system's current troubles are a consequence of increasing benefits, due both to the increased number of retirees and the more generous benefits that each retiree receives. One way to gauge the increase in the level of benefits is to compare them with average wages. For example, in 1953 the maximum benefit was equivalent to 30.5 percent of the average wage. By 1981 the corresponding figure was greater than 50 percent, and in 1995 it equaled 60.5 percent (Marcks 1997). Unquestionably, retirees' benefits have been rising relative to the tax base that can support those benefits.

The problem is also one of demographics. In 1945 there were 42 workers per retiree. In 1995 that number had shrunk to 3.3, and it is projected that in 2030 there will only be 2 workers per retiree. Furthermore, the life expectancy of individuals has increased since the inception of the system, meaning that a greater fraction of contributors have become beneficiaries. Also, the length of retirement has increased. In 1940 a 65-year-old male and female had a life expectancy of 12 and 13 years, respectively. By 2015 the comparable numbers will be 16 and 20 years.

These demographic features imply that maintaining the current level of benefits requires a significant increase in taxes. The *Report of the 1994–1996 Advisory Council on Social Security* (Department of Health and Human Services 1997) indicates that taxes would have to be raised immediately by 2.13 percent to attain 75-year balance.[1] These calculations explicitly take into ac-

---

[1] It should be noted that 75-year balance and actuarial soundness are not the same thing, because the problems of the system tend to worsen in the future. Thus 75-year soundness today implies 75-year unsoundness tomorrow.

count interest payments and payments on principal from the fictitious trust fund. To make these payments, the government would have to increase the level of the debt, reduce spending, or increase tax revenue from other sources.[2] Thus, total tax payments could be substantially higher if all forms of taxes are considered. Waiting to adjust tax rates will only make the problem worse.

2. THE STOCK MARKET TO THE RESCUE?

Over the period 1926 to 1993, the real return on the Standard & Poor's 500 averaged 9 percent, while the real yield on intermediate-term U.S. government bonds averaged only 2.2 percent. This difference in yields is large. For example, earning 9 percent implies that your investment doubles approximately every eight years as compared to every 35 years with a 2.2 percent return. Furthermore, in every 22-year period since 1926, equities have outperformed bonds. These considerations have spurred many observers to argue that investing at least some portion of the Social Security Trust Fund in equities can avert the financial difficulties facing the system.

In one sense the proposition is true. Increasing the yield on the trust fund can make the Social Security System more viable in isolation. However, it can only do so by making the rest of the government worse off. On net, an individual taxpayer will be little affected by this investment policy. In order for the government, or some part of it, to take an equity position, the government as a whole must issue more bonds. This swap of paper claims with the public affects the allocations and the risk characteristics of the respective portfolios but quantitatively does not have any appreciable effect on the government's overall budget. The economy cannot produce any more goods, and although the consumption profile of the representative household may be somewhat altered, the effects of this alteration are small. Since taxpayers are the ultimate receivers of any government earnings or losses, it matters little who owns the capital stock.

A number of economists recognize this fairly simple notion. Federal Reserve Board Chairman Alan Greenspan expressed the idea cogently in his recent Remarks at the Abraham Lincoln Award Ceremony of the Union League of Philadelphia (1996, p. 8), "Bonds and equities are merely the paper claims to income earning assets, and the value of the income stream is not determined by short-run changes in the supply and demand for securities. Rather, equity prices

---

[2] If the payments promised by Social Security are equivalent to payments promised on government bonds, then increasing the level of the measured debt to pay off these claims does not affect the overall indebtedness of the U.S. government. This action just transfers a promise into an explicit security. Treating the promised Social Security benefits in a similar way to any other government IOU implies that the true level of the government debt is closer to $17 trillion instead of the $5 trillion currently calculated.

must, in the long run, reflect the underlying earnings of the corporations on which the equities are a claim, as well as society's need to be compensated for postponing consumption into the future and its perception and attitudes toward risk as a consequence of uncertainty about the future. Indeed, the total market value of debt plus equities is, to a first approximation, likely to be unaffected by a shift in the balance of paper claims." These sentiments are also reflected in the views of Herbert Stein (1997, p. A18), ". . . privatizing the Social Security funds would not add to national saving, private investment, or the national income and would not allow the system to earn more income without anyone earning less."

Others, however, have argued to the contrary and have made the purchase of equities by the trust fund seem like a free lunch. For example, editorial commentary in *Barron's Online* by Thomas G. Donlan (1997) states that "Unless the system invests in private enterprise and those investments continue to earn historically high returns the Baby Boom generation will pay for its own retirement." Investing in equities is a major component of all three plans presented by the 1994–1996 Advisory Council on Social Security (Department of Health and Human Services 1997).

The Trust Fund

The Social Security System is but one part of the government. It is the largest part, with transfers amounting to 22 percent of government expenditures in 1995. The system's trust fund is really a myth. Social Security receives contributions or taxes from workers and their employers and pays out benefits to retirees, their dependents, and those on disability. Excesses in receipts over expenditures are handed over to the U.S. Treasury to be used in financing other governmental activities. Employing an accounting fiction, the Social Security System treats these transfers as investment in government securities and adds them to an imaginary portfolio that also collects fictitious interest payments. From the perspective of the government's total budget, this practice implies that the Treasury issues fewer bonds to the public than it would if there were no surplus received from Social Security. Unlike Treasury bills issued to the public, however, the IOUs from the Treasury to Social Security are not counted as government debt.

What would happen if the Social Security System invested in equities? The system would currently turn over less surplus to the Treasury, and the Treasury would have to issue more bonds to the public. Again, from the perspective of the government as a whole, this transaction amounts to a trade of bonds for equities with the public. Can such a trade benefit the public? Since equities are a claim on firms, government ownership of stock amounts to government ownership of some portion of the country's capital stock. So the preceding question can be rephrased. Does it matter who owns the capital stock? The analysis presented below attempts to shed light on that question. It turns out

that the policy of government investment in equities has either only minor or no effects on the government's budget and the saving rate of the economy. Whether the government's financing decisions have any economic effect depends on its ability to transfer risk across individuals. In the models considered in Section 3, that ability is absent, and hence government portfolio decisions are irrelevant. The overlapping generations model of Section 4 allows some scope for more efficient risk-sharing and the government's portfolio decision does affect economic behavior. Quantitatively, this effect turns out to be small.

3.   A MODEL WITH INFINITELY LIVED AGENTS

In this section I use a model populated by infinitely lived agents (or more generally, the dynastic families possessing bequest motives as in Barro [1974]) to explore whether government investment in private capital affects the amount of tax revenue needed to support a given stream of transfer payments. Answering this question is analogous to answering the question of whether investment by the Social Security Administration in the stock market would have any impact on the financing of a given stream of Social Security payments. I analyze this question in a sequence of models that highlight the key issue, namely that equity premium considerations are unimportant and it is only the transferring of risk across generations that has any effect on economic outcomes.[3] The model with infinitely lived agents clearly makes the point that when there is no possibility of transferring risk among agents, because all agents are essentially the same, the existence of an equity premium does not in any way allow government ownership of capital to influence economic outcomes.

To begin, I shall consider a world in which all transfers and taxes are lump sum. Private agents own some portion of the capital stock and the government owns the rest. The government may also issue debt. It finances transfer payments and the interest payments on debt through its earnings on capital and through taxes. I will show that in such a world the behavior of individuals is unaffected by the portion of the capital stock owned by the government. Essentially, any distribution of ownership of the capital stock is consistent with the initial path of transfers and taxes and has no effect on the consumption or saving decisions of individuals. In other words, the government's portfolio decision is irrelevant. I shall then extend this model to include distortionary taxes and show that the results are unchanged.

The Model with Lump Sum Taxes

This model economy is populated by people who live forever or, more generally, by the dynastic families in Barro (1974). Output is stochastic and is

---

[3] For a detailed analysis of these issues, see Bohn (1997a, b).

produced via a standard neoclassical production function using capital and labor. The government finances lump sum transfers through lump sum taxes, the issuance of debt, and the return from its ownership of capital.

Individual Decisions

To start the analysis, consider the problem of the individual agent who wishes to maximize lifetime well-being or utility subject to a budget constraint. The individual owns some capital that earns $\rho(s_t)$ in state s at time t. That is, the return to capital is stochastic and, while one observes the actual return in any given period, future returns are uncertain and depend on the state of the economy in that period. Individuals also receive transfer payments from the government $Tr(s_t)$ and pay taxes $T(s_t)$. These transfers and taxes may, but need not, depend on the state of the economy. Individuals also own government bonds, $b(s_t)$, that pay $r(s_t)$ units of consumption in all states in period $t + 1$. Finally, given a capital stock at the beginning of period t, agents choose how much capital to bring into the next period, $k(s_t)$, and how much to consume this period, $c(s_t)$.

Formally, the representative agent maximizes discounted expected lifetime utility

$$\max \sum_{t, S^t} \beta^t u[c(s^t)] \pi(s^t)$$

subject to per-period budget constraints in each possible state s_t.

$$c(s^t) + b^d(s^t) + k(s^t) \leq w(s^t)n + \rho(s^t)k(s^{t-1}) + [1 + r(s^{t-1})]b(s^{t-1}) + Tr(s^t) - T(s^t),$$

where w is the real wage rate, n is exogenous labor supply, and ρ is the rate of return on capital. For simplicity, I assume that capital fully depreciates each period. Thus, agents are maximizing their utility, taking into account expectations of all possible future events. In the notation above, s_t is the realization of one of finitely many states of the economy at time t. s^t represents a particular history of realizations up to time t. That is, $s^t = (s_0, s_1, \ldots s_t)$ is a particular history of events up to time t. The set S^t represents all the possible histories that can occur. Each event occurs with probability $\pi(s_t)$ and each history occurs with probability $\pi(s^t)$. Each agent rents out labor and capital to firms in competitive rental markets and earns the appropriate marginal product of each factor.

The first-order conditions for optimal bond and capital accumulation are

$$u'[c(s^t)] = \beta \sum_{s^{t+1}} \pi(s^{t+1})u'[c(s^{t+1})][1 + r(s^t)] \tag{1a}$$

and

$$u'[c(s^t)] = \beta \sum_{s^{t+1}} \pi(s^{t+1})u'[c(s^{t+1})]\rho(s^{t+1}). \tag{1b}$$

These conditions imply that agents accumulate assets so that they are just indifferent between consuming an extra unit of consumption in any particular state s_t or investing in either another bond or an extra unit of capital and consuming the proceeds of that investment next period. Also, since a government bond returns the same amount in each state at $t + 1$, it is less risky than holding capital whose return is uncertain. The interest on a government bond will, therefore, generally be less than the expected return on capital. That is, capital will on average earn a premium over bonds with the amount of the premium depending on the agent's aversion to risk and the underlying riskiness of the return on capital. It is this feature of bonds and capital that initially seems to suggest that the government, by issuing bonds and owning some more capital, can reduce the tax burden associated with any stream of transfer payments. However, as the first-order conditions make clear, both of these choices have the same value when adjusted for risk, namely the current marginal utility of consumption. Thus, there is no free lunch.

The Government

Each period the government makes some transfers, collects some taxes, and adjusts its portfolio by either issuing or repurchasing some government bonds or buying or selling some capital, x (or claims to the capital, which amount to the same thing). In each state, the government's net holding of assets obeys

$$b^s(s^t) - x(s^t) = b(s^{t-1})[1 + r(s^{t-1})] + Tr(s^t) - T(s^t) - \rho(s^t)x(s^{t-1}). \quad (2)$$

It is clear from this expression that, all other things equal, an increase in the capital stock held by the government at time $t - 1$ reduces the taxes that are necessary to maintain the same net asset position. The experiment we are interested in, however, is not what happens if someone donates an extra unit of capital to the government but what happens when the government increases its holdings of capital by issuing additional debt.

Market Clearing

For any allocation of consumption, bonds, and capital to be an equilibrium, it must be consistent with the resource constraints of the economy and with supply equaling demand. In particular, for each state the following equations hold:

$$c(s^t) + k(s^t) + x(s^t) = A(s_t)[k(s^{t-1}) + x(s^{t-1})]^\alpha n^{1-\alpha} \quad (3)$$

and

$$b^s(s^t) = b^d(s^t). \quad (4)$$

Equation (3) indicates that the amount consumed and invested must equal the output produced in the current period, and equation (4) requires that the supply

of bonds issued by the government must be equal to the demand for these bonds by the public.

Solution

The consumption decision of agents will now be shown to be independent of portfolio decisions of the government. Alternatively, agents do not care who owns the capital stock since they are indifferent between holding an extra unit of government debt or an extra unit of capital. In particular, consumption in any state is given by

$$c(s^t) = (1 - \beta)A(s_t)K(s^{t-1}),\qquad(5)$$

where K is the aggregate capital stock equal to $k + x$. The accumulation of private capital is then expressed as

$$k(s^t) = \beta A(s_t)K(s^{t-1}) - x(s^{t-1}).\qquad(6)$$

As long as government capital does not exceed $\beta A(s_t)K(s^{t-1})$, the above solutions satisfy the first-order conditions of agents and do not violate the economy's overall resource constraint. Thus, for any supportable path of taxes and transfer payments, individuals are indifferent as to who owns the capital stock.

The Model with Distortionary Taxes

Next consider the case where the government raises revenue through distortionary taxation. In this setting it is not so easy to represent analytically the solution to the decision problem of agents. However, by looking at the individual's first-order conditions and budget constraints along with the budget constraint and transversality condition of the government, one sees that the proportion of the capital stock owned by the government is irrelevant.

Individual Decisions

With distortionary taxes on both labor and interest income, the representative agent maximizes lifetime utility subject to the following per-period budget constraint,

$$c(s^t) + b^d(s^t) + k(s^t) \leq \rho(s^t)[1 - \tau(s^t)]k(s^{t-1}) + w(s^t)n[1 - \tau(s^t)]\qquad(7)$$
$$\{1 + r(s^{t-1})[1 - \tau(s^t)]\}b(s^{t-1}) + Tr(s^t).$$

Unlike the previous budget constraint, the government now taxes wages and the return on capital and bonds at the rate τ. The first-order necessary conditions for optimal bond holdings and investment are

$$u'[c(s^t)] = \beta \sum_{s^{t+1}} \pi(s^{t+1})u'[c(s^{t+1})]\{1 + r(s^t)[1 - \tau(s^{t+1})]\}\qquad(8a)$$

and

$$u'[c(s^t)] = \beta \sum_{s^{t+1}} \pi(s^{t+1}) u'[c(s^{t+1})]\{\rho(s^{t+1})[1 - \tau(s^{t+1})]\}. \qquad (8b)$$

The consumer's accumulation of assets must also satisfy the transversality condition,

$$\lim_{j \to \infty} \sum_{j,s^{t+j}_{t+1} \in S^{t+j}_{t+1}} p(s^{t+j}_{t+1})[k(s^{t+j}_t) + b(s^{t+j}_t)] = 0, \qquad (9)$$

where $p(s^{t+j}_t) = \beta^j \pi(s^{t+j}_t)\{u'[c(s^{t+j}_t)]/u'[c(s^t)]\}$ is the price of a contingent claim. In the above expression s^{t+j}_t indicates a particular history of states from t to $t+j$ and S^{t+j}_t is the set of all possible histories.

Government

The government's budget constraint is given by

$$b^s(s^t) - x(s^t) = b(s^{t-1})\{1 + r(s^{t-1})[1 - \tau(s^t)]\} + Tr(s^t)$$
$$-\rho(s^t)\tau(s^t)k(s^{t-1}) - \tau(s^t)w(s^t)n - \rho(s^t)x(s^t) \qquad (10)$$

and indicates that the government's net liability position depends on its debt, the net interest paid on that debt, its revenues from taxing income earned from capital and labor, as well as the revenue it earns on its own capital stock.[4] The budget constraint implies that in states where capital has a relatively high rate of return, some debt is retired, while in states where capital's return is low, debt is issued. The government's net asset position must also satisfy the transversality condition

$$\lim_{j \to \infty} \sum_{j,s^{t+j}_{t+1} \in S^{t+j}_{t+1}} p(s^{t+j}_{t+1})[b(s^{t+j}_t) - x(s^{t+j}_t)] = 0. \qquad (11)$$

Equilibrium

Formally, the definition of an equilibrium is given by

---

[4] Using the above budget constraint and the first-order conditions of the representative agent, the government's lifetime budget constraint as of period t can be expressed as

$$\rho(s_t)\tau(s_t)k(s_{t-1}) + \rho(s_t)x(s_{t-1}) - b(s_{t-1}) = \sum_{j,s^{t+j}_t \in S^{t+j}_t} p(s^{t+j}_t)Tr(s^{t+j}_t) +$$
$$\sum_{j,s^{t+j}_{t+1} \in S^{t+j}_{t+1}} p(s^{t+j}_{t+1})\rho(s^{t+j}_t)[k(s^{t+j}_t) + x(s^{t+j}_t)].$$

Notice that only the sum of private and government-owned capital stock enters the right-hand side of equation (11). Therefore, for any sequence of state-contingent prices, only the total capital stock and not its distribution affects the tax policies that are necessary to support a given stream of transfer payments.

Equilibrium: Given the initial conditions $b(s_{t-1}), x(s_{t-1})$, and $k(s_{t-1})$, an equilibrium is a sequence of quantities and prices $\{b(s), k(s), x(s), K(s), c(s), w(s), r(s), \rho(s), \tau(s), Tr(s)\}$ for all histories $s \in S_t^\infty$ satisfying the individual's first-order conditions (8a) and (8b), the individual's budget constraint (7), the government's budget constraint (10), the economy's resource constraint (3), and the transversality conditions of both the individual and the government (9) and (11).

Irrelevance Proposition:[5] Suppose that $\{b(s), k(s), x(s), K(s), c(s), w(s), r(s), \rho(s), \tau(s), Tr(s)\}$ is an equilibrium, then any $\{\bar{b}(s), \bar{k}(s), \bar{x}(s), K(s), c(s), w(s), r(s), \rho(s), \tau(s), Tr(s)\}$ is an equilibrium if $\bar{b}(s), \bar{k}(s), \bar{x}(s)$ satisfy (a) $k(s), \bar{x}(s) \geq 0$ and $\bar{k}(s) + \bar{x}(s) = K(s)$, and (b) $\bar{b}(s)$ is defined recursively by (10).

Proof: The individual's first-order conditions and the economy's resource constraint are satisfied because the real allocations are identical in the two equilibriums. The individual's transversality condition is, therefore, also satisfied. Equilibrium in the goods market and condition (b) imply that the household's budget constraint is also satisfied. Examining the lifetime budget constraint of the government from date t onward, one derives that

$$b(s^{t-1}) - x(s^{t-1}) = \sum_{j=0}^{T} \sum_{s_t^{t+j} \in s_t^{t+j}} p(s_t^{t+j})[Tr(s_t^{t+j}) - w(s_t^{t+j})\tau(s_t^{t+j})n$$

$$-\rho(s_t^{t+j})\tau(s_t^{t+j})K(s_t^{t+j})] \qquad (12)$$

$$+ \sum_{s_t^{t+T+1} \in S_t^{t+T+1}} p(s_t^{t+T+1})[b(s_t^{t+T+1}) - x(s_t^{t+T+1})].$$

Because the first two terms are the same for both equilibriums, the last term must be the same for both equilibriums. Therefore, the transversality condition must hold for the second equilibrium. Hence, different distributions of the capital stock do not affect the aggregate capital stock, consumption, rates of return, tax rates, wages, or transfer payments.

As demonstrated in these models, the ownership of the capital stock has no effect on economic outcomes and is not an avenue that can be used to rescue the Social Security System in an economy where agents are altruistically linked to future generations and, hence, behave as if they were infinitely lived.

4.   A MODEL WITH FINITE LIVED AGENTS

The previous two cases demonstrate that a premium in the return to capital relative to bonds is not sufficient for government portfolio decisions to have any

---

[5] I would like to thank Andreas Hornstein for suggesting and helping me with this particular form of the argument.

real effect on consumer decisions. Changes in portfolio allocations do not affect the lifetime opportunities of the average individual, so they do not have any real consequence. In a model with finite lived agents, however, portfolio decisions generally will affect the economic behavior of consumers—not because capital earns a higher return than bonds but because a change in the portfolio of old agents must affect their consumption decisions. In the last period of life it is the only decision they have left to make. Thus, the government ownership of capital means that the current old agents hold more bonds. This consideration implies that their consumption stream has different risk characteristics than if the government owned no capital. Because the government's ownership of capital can transfer risk between current and future generations, it can change behavior.[6] In the setting of infinitely lived agents, there is no one to whom they can transfer risk. But because we are now considering different generations, there is the potential for risk transfer. How big an effect policies involving portfolio composition may have is an open question. In this section, some rough estimates are formed in a simple two-period overlapping generations model. The results suggest that government ownership of capital may not be the boon that its proponents suggest.

The Individual

In the first period of life, a young individual works a fixed number of hours, n. With his earnings, he pays taxes, saves to finance consumption when old, and purchases goods for current consumption. Saving takes the form of ownership of the capital stock and government bonds. When the individual reaches old age, he receives transfers from the government, rental on the capital stock that then fully depreciates, and after-tax interest plus principal on his government bonds. With this income he purchases consumption goods. In this model economy production is stochastic and transfer payments are fixed. Formally, the individual's problem is

$$\max \ \{u[c^y(s^t)] + \beta \sum_{s^{t+1}} u[c^o(s^{t+1})]\pi(s^{t+1})\}$$

subject to the budget constraints
and

$$c^y(s^t) + k(s^t) + b(s^t) \leq w(s^t)n[1 - \tau(s^t)] + T^y \qquad (13a)$$

$$c^o(s_{t+1}) \leq \rho(s_{t+1})[1 - \tau^k(s_{t+1})]k(s^t) + \qquad (13b)$$
$$\{1 + r(s^t)[1 - \tau^k(s_{t+1})]\}b(s^t) + T^o,$$

---

[6] This idea is discussed in Volume II of the *Report of the 1994–1996 Advisory Council on Social Security* (Department of Health and Human Services 1997). The effects of government financing decisions on intergenerational risk-sharing are formally derived in Bohn (1997a, b), Smetters (1997), and Mariger (1997). Smetters shows that the risk-sharing engendered by the government's purchase of equities is equivalent to options contracts between generations.

where the last constraint must hold for each possible state s_{t+1} drawn from the set S_{t+1}. The superscripts y and o refer to young and old, respectively.

Here, as in the previous examples, s indexes the various possible states that can occur. The above specification assumes that agents know what state they are currently in but are unsure about next period's state. All they know is the probability, π, of any particular state occurring. Specifically, at time t, agents know how productive the economy is, the transfers that are given to both the current old and current young, the current tax rates on labor income, τ, and interest income, τ^k, the current wage rates, and the promised rate of interest on government bonds. They do not, however, know what these variables will be in the future. Thus, they attempt to maximize not only the utility from current consumption but expected utility from future consumption.

The first-order conditions for the problem are

$$u'[c^y(s^t)] = \lambda^y(s^t), \tag{14a}$$

$$\beta\pi(s_{t+1})u'[c^o(s_{t+1})] = \lambda^o(s_{t+1}) \text{ for each } s_{t+1} \in S_{t+1}, \tag{14b}$$

$$u'[c^y(s^t)] = \beta\sum_{s^{t+1}} u'[c^o(s^{t+1})]\pi(s^{t+1})\rho(s^{t+1})[1 - \tau^k(s^{t+1})], \tag{14c}$$

and

$$u'[c^y(s^t)] = \beta\sum_{s^{t+1}}\{1 + r(s^t)[1 - \tau^k(s^{t+1})]\}u'[c^o(s^{t+1})]\pi(s^{t+1}), \tag{14d}$$

where a prime indicates the first derivative and $\lambda^y(s^t)$ and $\lambda^o(s^{t+1})$ are the multipliers associated with the constraints (13a) and (13b). The last two constraints give the efficient consumption-saving decisions of the current young. These conditions state that at an optimum the marginal utility of forgoing one unit of consumption today must be equal to expected marginal utility of additional consumption tomorrow earned from the proceeds of investing in another unit of either capital or bonds. Notice that the last two equations also imply that the certain yield on a bond and the expected after-tax yield on capital must be such that the agent is indifferent between holding a bond or capital. As before, because the return on capital is uncertain, the premium that capital earns over bonds depends on the agent's degree of risk aversion.

Firms

Firms produce output by employing the labor of the young and renting capital from the old and from the government. The production function is constant returns to scale and is given by

$$Y(s^t) = A(s_t)K(s^{t-1})^\alpha n^{1-\alpha}, \tag{15}$$

where Y is aggregate per capita output, and K is the aggregate per capita capital stock. The maximization of profits implies that each factor receives its marginal product, which will depend on the productivity shock $A(s_t)$.

Government

The government issues bonds and purchases capital. It also supplies transfers to the young, T^y, and the old, T^o. These latter transfers may be thought of as Social Security although in reality the old receive more than just OASI payments alone. The government also raises revenue by taxing wage and capital income as well as the interest earned on bonds. Specifically, the government's budget constraint is

$$B(s^t) - x(s^t) = \{1 + r(s^{t-1})[1 - \tau^k(s^t)]\}B(s^{t-1}) - \rho(s^t)x(s^{t-1}) \qquad (16)$$
$$+ T^y + T^o - \tau(s^t)w(s^t)n - \tau^k(s^t)\rho(s^t)k(s^{t-1}),$$

where $B(s)$ is the per capita aggregate supply of government bonds and $x(s)$ is the per capita capital stock owned by the government. The government's net indebtedness $B - x$ is positively influenced by its repayment of existing debt, the interest on that debt, and transfer payments. The government's earnings on its capital stock, as well as the revenue from the taxation of labor, bonds, and the private sector's return on capital, all reduce the government's indebtedness.

Equilibrium

Equilibrium in this model is defined as a sequence of quantities (consumption, capital, and bond allocations), factor prices (wages, interest rates, and rental rates), and taxes and transfers that are consistent with each agent's maximization of expected utility, and the firms' maximization of profits. Equilibrium satisfies the individual's budget constraints (13a) and (13b), the government's budget constraint (16), and the government's transversality condition and results in the clearing of both the bond and goods markets. In particular for each possible history,

$$Y(s^t) = c^o(s^t) + c^y(s^t) + K(s^t) \qquad (17a)$$

and

$$B(s^t) = b(s^t). \qquad (17b)$$

Also, the per capita capital stock must equal its individual components, i.e., $K(s) = k(s) + x(s)$.

   Unlike the case where agents are in effect infinitely lived, a similar irrelevance proposition does not apply. In the overlapping generations model, two separate budget constraints, one for the current old, (13b), and one for the current young, (13a), must hold simultaneously. Notice that the sum of these two budget constraints is the same as the budget constraint for the

infinitely lived agent. Thus any allocation that satisfies the economy's resource constraints and the government's budget constraint will satisfy the sum of the two agents' budget constraints; hence, total consumption will be unchanged. However, this allocation will not generally satisfy each budget constraint separately, and individual consumption will vary with changes in the distribution of capital. The variation in individual consumption implies that rates of return will have to change as well and that the same sequence of tax rates cannot support an identical path of transfer payments.

Analyzing the Effects of Government Ownership of Capital

To analyze the effects of government ownership of capital, I analyze the effect on average tax rates of changes in the proportion of the capital stock owned by the government. In doing so, the pattern of transfer payments and the government's net asset position, $B - x$, are fixed. As a result the experiment does not create any additional government indebtedness and maintains the level of benefits received by the elderly. The results of this experiment are suggestive but not definitive. The model I use is admittedly stylized. Moreover, I do not investigate plausible alternative fiscal policies, including those fixing the net present discounted value of government liabilities rather than fixing them in each and every period. The latter policy would produce a smoother stream of taxes than the one analyzed here but would be computationally much harder to implement. Also, because of the assumption that people live for two periods only, the benefits of risk-sharing are likely to be overemphasized in this framework. Old agents are required to hold all of the capital stock; thus any ownership of capital by the government reduces their exposure to rate-of-return risk. If the model included more periods, old agents could shift some of this burden to agents in their middle ages and thus reduce the risk-sharing benefits that ensue from the government's ownership of capital. The model also excludes other forms of risk-sharing arrangements, such as capital-gains loss-offsets and progressive taxation. Adding these features to the model would further reduce the gains to intergenerational risk-sharing.[7]

The equations used to solve the model include one that specifies the policy of fixing the government's net indebtedness and an equation that specifies the taxation of labor income relative to interest income. Equations 13(a,b), 14(c,d), 15, 16, and the two first-order conditions that determine the marginal product of capital and labor are also employed. Together with a behavioral relationship that specifies the government's purchase of capital, the solution to the model involves solving 11 independent equations in 11 unknowns. The variables solved for are the privately held capital stock, the publicly held capital stock, govern-

---

[7] I wish to thank Douglas Diamond and Kent Smetters for bringing these points to my attention.

ment bond issue, consumption by the young, consumption by the old, output, the interest rate paid on bonds, the rental rate on capital, wages, and the tax rates on labor and interest income, respectively. This system can be reduced to three equations that determine the interest rate, the aggregate capital stock, and the tax rate. In deriving these equations, I assume that the government maintains ownership of a fixed percentage of the capital stock, μ. It is also assumed that utility displays constant relative risk aversion and takes the form $u(c) = \frac{c^{1-\sigma}-1}{1-\sigma}$. Thus, the solution to this three-equation system yields the policy function for $K(s^t) = h_k[K(s^{t-1}), A(s_t), A(s_{t-1})]$, the functions $\tau(s^t) = h_\tau[K(s^{t-1}), A(s_t), A(s_{t-1})]$, and $r(s^t) = h_r[K(s^{t-1}), A(s_t), A(s_{t-1})]$.

To analyze the effects of government investment in capital, two slightly different models are simulated, one in which only labor is taxed, $\tau^k = 0$, and one in which all income is taxed at the same rate, $\tau = \tau^k$. For given values of transfers and net government indebtedness, I then compare tax rates and the aggregate capital stock in model economies in which the government owns 0, 2.5, 5, and 10 percent of the capital stock. The proposal of investing up to 40 percent of the Social Security Trust Fund in equities would result in a much smaller proportion of government ownership of the capital stock than any of the percentages considered. In 1995 the value of the Social Security Trust Fund was approximately $458 billion, while the value of traded equity was greater than $7.7 trillion. Thus, the experiments will, on this dimension, overstate the effects of the current proposal. In essence, I am comparing the equilibrium outcomes of four different economies. Transitional questions are, therefore, not addressed by this experiment.

Calibration

In calibrating the model, I envision a period as corresponding to 25 years. β is set at 0.5, which corresponds to an annual discount factor of roughly 0.973. Labor's share of output, α, is 2/3, and the coefficient of relative risk aversion, σ, is set at 10, implying an average equity premium between 5.7 percent and 7.1 percent. Transfers to the old generation are set to equal 4 percent of steady-state output in the model. When only labor is taxed, such transfers are equal to the actual percentage of output distributed by OASI. The government's indebtedness is 1 percent of output and transfers to the young are roughly 2.5 percent of output, implying a steady-state tax rate on labor of 10.67 percent. This tax rate is close to the current tax rate of 10.52 percent on the OASI portion of the Social Security tax. Thus, the labor-tax-only model is calibrated to approximate the tax rate and the transfers that actually occur. Allowing the government also to tax capital increases the tax base and results in a lower steady-state tax rate and a somewhat higher level of capital and more output. The fraction of output transferred to the old is, therefore, also somewhat lower at 3.65 percent, although the old are receiving the same transfer in both models.

To analyze the effect on the average tax rate of government ownership of capital, I simulate both model economies over four generations or periods 1,000 times and take averages of the tax rates and capital stock that are produced by the simulations. Each simulation is started at capital's nonstochastic steady state, which is invariant to the government's portfolio allocation, and each succeeding capital stock is solved for based on the preceding realized value of capital and the past technology shocks. The tax rates and interest rate that are consistent with this solution are also obtained. The stochastic process for technology is identically and independently distributed with mean 1 and standard deviation of 0.08. The standard deviation was chosen to match the standard deviation of 25-year cumulative deviations from trend over the post–World War II period. This figure would represent the standard deviation of any generation's income from trend income. The standard deviation of this cumulative deviation from trend output was 0.13. I then used a standard deviation that was as close to 0.13 as possible and that still allowed for well-behaved policy functions of the capital stock.[8] Because of the positive comovement of inputs with the technology shock, 0.13 is an upper bound on the variation in the technology shock. For example, Christiano and Eichenbaum (1992) obtain estimates of the relative variability of the technology shock to output anywhere from 48 to 90 percent. Therefore, 0.08 may not be an unreasonable number.

Results

The results of this experiment are reported in Tables 1 and 2. Table 1 includes the results when only labor is taxed, and Table 2 contains the results when both labor and interest income are taxed. For the case when only labor is taxed, one sees that average tax rates fall from 0.1059 to 0.1041 as the government increases its ownership of capital from zero to 10 percent of the aggregate capital stock. At 2.5 percent ownership, the decline in the average tax rate needed to support the level of transfer payments is negligible. It follows that ownership of equities by the Social Security Trust Fund would have little effect on the viability of the Social Security System. Because the decline in tax rates is so small, the capital stock is only marginally higher under the policy of government ownership of capital. In short, this proposed policy has little economic effect. The case where all income is taxed at the same rate is qualitatively similar. Basically, each economy's performance is not influenced by government portfolio decisions.

---

[8] The models investigated above possess two steady states. One steady state, which is unstable, occurs at relatively low values of the capital stock. If the technology shock is too large, the capital stock potentially can enter this unstable region and the policy functions diverge.

**Table 1 Effects of Government Ownership of Capital
           (only labor is taxed)**

Fraction of capital owned	0	2.5	5	10
Average tax rate	0.1059	0.1054	0.1049	0.1041
Standard deviation of tax rate	0.0074	0.0082	0.0089	0.0105
Average capital stock	0.1059	0.1061	0.1063	0.1066
Standard deviation of capital stock	0.0139	0.0141	0.0143	0.0147

**Table 2 Effects of Government Ownership of Capital
           (all income is taxed)**

Fraction of capital owned	0	2.5	5	10
Average tax rate	0.0610	0.0606	0.0603	0.0596
Standard deviation of the tax rate	0.0042	0.0048	0.0053	0.0064
Average capital stock	0.1420	0.1421	0.1422	0.1425
Standard deviation of the capital stock	0.0163	0.0165	0.0166	0.0169

5.   CONCLUSIONS

Current proposals for modifying Social Security have one key feature in common: namely, investing part of the trust fund in equities. Advocates believe that such a reallocation of the trust fund's portfolio will make the system more viable, and maintain the level of benefits without resorting to large increases in taxes. After analyzing the effects of such reallocation in some basic economic models, the results are not encouraging. Even though capital on average earns a higher rate of return than bonds, the government is not able to take much advantage of this differential, because only the ability to shift risk matters. The results in this regard are similar to those found in Bohn (1997a, b), Mariger (1997), and Smetters (1997). Quantitatively, this risk shifting from old to young does not significantly affect the government's budget or the economic behavior of individuals. In short, under the fiscal policies studied above, there is not much to be gained by government ownership of the capital stock. Actuarial soundness of the Social Security System will have to be achieved through other means.

REFERENCES

Barro, Robert J. "Are Government Bonds Net Wealth?" *Journal of Political Economy*, vol. 82 (November/December 1974), pp. 1095–1117.

Bohn, Henning. "Risk Sharing in a Stochastic Overlapping Generations Economy." Manuscript. June 1997a.

──────. "Social Security Reform and Financial Markets." Manuscript. June 1997b.

Christiano, Lawrence J., and Martin Eichenbaum. "Current Real-Business-Cycle Theories and Aggregate Labor-Market Fluctuations," *American Economic Review*, vol. 82 (June 1992), pp. 430–50.

Department of Health and Human Services. *Report of the 1994–1996 Advisory Council on Social Security.* Washington: Government Printing Office, January 1997.

Donlan, Thomas G. "Social Investment: Reform of Social Security Requires Private Investment and More," *Barron's Online* (http://www.barrons.com), January 31, 1997.

Greenspan, Alan. Remarks at the Abraham Lincoln Award Ceremony of the Union League of Philadelphia. December 6, 1996.

Marcks, Ronald H. "Social Security's Most Basic Infirmity," *Wall Street Journal*, January 16, 1997.

Mariger, Randall P. "Social Security Privatization: What It Can and Cannot Accomplish," Finance and Economics Discussion Series, No. 1997–32. Washington: Board of Governors of the Federal Reserve System, Divisions of Research & Statistics and Monetary Affairs, June 1997.

Miron, Jeffrey A., and David N. Weil. "The Genesis and Evolution of Social Security," *NBER* Working Paper 5949. March 1997.

Munnell, Alicia H. *The Future of Social Security.* Washington: Brookings Institution, 1977.

Smetters, Kent. "Investing the Social Security Trust Fund into Equity: An Options Pricing Approach." Washington: Congressional Budget Office, July 1997.

Stein, Herbert. "Social Security and the Single Investor," *Wall Street Journal*, February 5, 1997.

U.S. General Accounting Office. Report to the U.S. Senate Committee on Finance and the House of Representatives Committee on Ways and Means, *Social Security Administration: Significant Challenges Await New Commissioners*. Washington: Government Printing Office, February 1997.