Volume Title: Tax Policy and the Economy, Volume 10

Volume Author/Editor: James M. Poterba, editor

Volume Publisher: MIT Press

Volume ISBN: 0-262-16161-3

Volume URL: http://www.nber.org/books/pote96-1

Conference Date: November 7, 1995

Publication Date: January 1996

Chapter Title: Privatization of Social Security: How It Works and Why It Matters

Chapter Author: Laurence J. Kotlikoff

Chapter URL: http://www.nber.org/chapters/c10897

Chapter pages in book: (p. 1 - 32)

PRIVATIZATION OF SOCIAL SECURITY: HOW IT WORKS AND WHY IT MATTERS

Laurence J. Kotlikoff
Boston University and NBER

EXECUTIVE SUMMARY

This paper uses the Auerbach–Kotlikoff dynamic life-cycle model (AK model) to examine the macroeconomic and efficiency effects of privatizing social security. It also uses a simple privatization proposal, the Personal Security System, as a framework to discuss a number of other issues associated with privatizing social security, including transition rules and changes in the overall degree of progressivity.

According to the AK model's simulations, privatizing social security can generate very major long-run increases in output and living standards. These gains come largely, but not exclusively, at the expense of existing generations. Indeed, the pure efficiency gains from privatization can be substantial. The term efficiency gains refers here to the welfare improvement available to future generations after existing generations have been fully compensated for their losses from privatization. The precise size of the efficiency gain depends on the existing tax structure, the linkage between benefits and taxes under the existing social security system, and the choice of the tax instrument used to finance benefits during the transition.

Laurence J. Kotlikoff is Professor of Economics at Boston University and a Research Associate of the NBER. I thank Jan Walliser for excellent research assistance and Peter Diamond, Henry Aaron, and Jan Walliser for very helpful comments.

When the initial tax structure features a progressive income tax, when the existing system's benefit–tax linkage is low, when consumption taxation is used to finance social security benefits during the transition, and when existing generations are fully compensated for their privatization losses, there is a 4.5 percent simulated welfare gain to future generations from privatization. However, if these circumstances do not hold, the efficiency gains from privatization are likely to be smaller, possibly even negative. For example, when the initial tax structure is a proportional income tax, when the benefit–tax linkage is perceived to be dollar for dollar, when the income tax rate is increased to finance social security benefits during the privatization transition, and when current generations are fully compensated, there is a 3.1 percent welfare loss to future generations.

The illustrative Personal Security System shows that there are simple ways to privatize the retirement portion of the U.S. Social Security System and to credit workers for their past social security contributions. It also suggests that privatizing social security could provide more survivor protection than the current system as well as eliminate much of the current system's seemingly capricious redistribution between two-earner and single-earner couples. But the proposal's analysis also suggests that these benefits from privatization must be set against a possible reduction in progressivity and a likely reduction in the amount of longevity insurance available to the elderly through annuities.

1. INTRODUCTION

Privatization of social security is spreading around the world. Chile's highly publicized and successful privatization was the first in a growing list that includes, or will soon include, privatizations in Argentina, Australia, Bolivia, Columbia, Mexico, Peru, and the United Kingdom. Will the United States join this club? Should it, on economic grounds? If it does join, what form might its privatization take?

This paper does not predict whether social security will be privatized in the United States, nor what form such privatization might take. Instead, it lays out the macroeconomic issues involved in privatizing Social Security, uses the Auerbach–Kotlikoff dynamic fiscal policy model (AK model) to simulate the macroeconomic and efficiency effects of privatization, and shows, by means of an actual proposal, that the U.S. system could be privatized in a simple and straightforward manner. The proposal considered is entitled the Personal Security System. Its analysis will help to clarify some of the microeconomic issues involved in privatizing social security.

This is not the first paper to consider many of these issues, nor is it the first to simulate social security privatizations. Feldstein (1995) uses a partial equilibrium framework, and Arrau (1990) and Arrau and Schmidt-Hebbel (1993) use a version of the AK model to make a number of the points argued here. The AK model used by Arrau (1990) and Arrau and Schmidt-Hebbel (1993) takes labor supply as exogenous. This is a significant shortcoming, since the efficiency gains from privatizing social security arise, in large part, from eliminating social security's distortion of labor supply decisions. Raffelhueschen (1993) does include variable labor supply in his simulation analysis of privatizing social security, and his qualitative conclusions are quite similar to those reached here. But Raffelhueschen's model contains only two periods, which limits the applicability of his quantitative findings. Like this study, Imrohoroglu, Huang, and Sargent (1995) use a multiperiod life-cycle model to simulate the effects of privatizing social security. Although their model is more elaborate than that used here, it does not include variable labor supply, which precludes separating efficiency gains from intergenerational redistribution. Nonetheless, their general findings concerning noncompensated social security privatization transitions accord with those presented here.

2. PRIVATIZATION OF SOCIAL SECURITY AND THE MACROECONOMY

Most industrialized economies and a good many developing countries have spent the postwar period dramatically expanding their pay-as-you-go social security programs. Although this expansion has reduced poverty rates among the elderly, it has also redistributed tremendous sums from young and future generations, as a group, to contemporaneous older generations, as a group.

The mechanism underlying the redistribution to the initial elderly is clear. Generations that are retired or close to retirement at the time that pay-as-you-go social security benefits are increased receive windfalls. The mechanism underlying the redistribution away from younger and future generations is less clear, at least to the general public. The public understands that expanding pay-as-you-go social security means higher payroll taxes for current and future young workers, but it also sees the higher benefits these generations will, themselves, receive when they retire. What the public misses is that the present value of the social security benefits that these generations will receive is far less than the present value of the taxes they will pay once one discounts these flows at prevailing pretax returns to domestic and foreign capital. Stated differ-

ently, the public misses the fact that the implicit rate of return paid on social security contributions in a mature system is far less than the return available on investments in the international economy.

The public also misses the major macroeconomic effects of these programs, which are to raise the consumption of the elderly, lower national savings and investment, and, as a result, raise real interest rates and reduce real wage rates relative to what they would otherwise have been. These general equilibrium feedback effects exacerbate the redistribution from young and future generations to the initial old (see Auerbach and Kotlikoff, 1987). This is not just a theoretical possibility. As Gokhale, Kotlikoff, and Sabelhaus (1996) show, the dramatic postwar decline in U.S. savings has coincided with a dramatic increase in the absolute and relative consumption of the elderly, which, in turn, can be traced to the U.S. government's postwar intergenerational redistribution.

2.1 Demographic Strains

The fiscal burdening of young and future generations through pay-as-you-go social security can occur just as well in settings with stable and unstable demographics. But a baby boom followed by a baby bust of the kind recently experienced by most developed economies places added stress on the social security chain letter. Indeed, the United States, Japan, Germany, Italy, France, and a host of other countries now face the unpleasant prospect of either dramatically raising their payroll tax rates over the next few decades or dramatically reducing their social security benefits. It is this impending demographic/social security crunch, rather than a real appreciation of the intrinsic problem with running unfunded social security programs, that is leading politicians to consider privatizing social security.

Many politicians appear to believe that privatizing social security represents a painless way out of their country's demographic dilemmas. This will not necessarily be the case. When potential efficiency gains from privatizing social security are ignored, fiscal policy is, generationally speaking, a zero-sum game. Consequently, if privatization is used to mitigate the prospective increase in the fiscal burden on future generations, it is likely to do so at the price of a higher fiscal burden on current generations.[1]

2.2 Zero-Sum Generational Accounting

Equation (1) makes this last point clear. Equation (1) is the government's intertemporal budget constraint:

[1] This statement takes as given the government's projected path of purchases of goods and services.

$$N_{-100} + N_{-99} + \cdots + N_0 + N_1 + N_2 + \cdots + N_\infty = G_0 + D_0. \quad (1)$$

where N_t represents all net taxes (taxes paid minus transfer payments received) to be paid in current and future years by the generation born in year t, where the present year is indexed as 0. N_{-100} is the remaining net taxes to be paid by those born 100 years ago; N_{-99} is the net taxes to be paid by those born 99 years ago; N_0 represents the net taxes to be paid by current newborns (those born in year 0); and N_1, N_2, and N_∞ are the net taxes to be paid by those who will be born in years 1, 2, and the indefinite future, respectively. All the net tax terms are measured as actuarial present values.

The term G_0 represents the present value, as of year 0, of the government's current and future purchases of goods and services; and D_0 represents the government's official net debt (its official liabilities less official assets) in year 0. The discount rate used to form the N_t values as well as the value of G_0 is the economy-wide marginal product of capital. This budget constraint tells us that net tax payments of current and future generations must collectively cover the government's bills, given by $G_0 + D_0$. It also tells us that if the size of the government's bills is held constant, any reduction in the net tax payments of one generation requires an increase in the net tax payments of one or more other generations.

From the perspective of equation (1), introducing pay-as-you-go social security lowers the N_t values of those above a certain age, say 40, but raises the N_t values of those below that age as well as those not yet born. This reflects the fact that the N_t values include the present value of future social security contributions minus the present value of future social security benefits. In our example, since the social security benefits received by generations under age 40 are smaller, when discounted at the internationally available pretax return to capital, than are their tax contributions, pay-as-you-go social security raises their N_t values.

Now suppose the objective of privatizing social security is to lower the fiscal burden on all future generations, that is, to lower the N_t values for all generations born after year 0. Also suppose that privatization does not entail a decline in the government's future purchases, which would lower G_0. Then the government's budget constraint insists that the N_t values of one or more currently living generations will have to increase.

To make this concrete, suppose that the government privatizes social security by (1) allowing workers to make their social security contributions to private pensions, (2) making up for the loss in social security revenue by raising consumption taxes, and (3) gradually cutting benefits of new retirees. Since retired elderly pay consumption taxes, but do not make social security contributions, this method of privatizing social secu-

rity raises the N_t values of those who are old at the time of the privatization. The consumption tax increase as well as the cuts in social security benefits are also likely to raise the N_t values of initial younger generations. The net impact of this is a reduction in the N_t values of those not yet born. If, instead of raising consumption taxes, the government makes up for its lost revenue through official borrowing, but uses, say, the income tax to cover interest payments on this additional official debt, the result will be similar. In this case, the N_t values of the initial elderly will rise because they pay a larger share of income taxes than they do of social security payroll taxes.

2.3 *The Effects of Privatization on Savings, Investment, and Economic Growth*

According to the life-cycle model, changes in the N_t values will affect savings, investment, and economic growth. The reason is that older generations have a larger propensity to consume than do younger ones, and younger ones, in turn, have higher a propensity to consume than do future generations, whose current propensity to consume is zero. By lowering the N_t values of initial young and future generations and raising those of initial older generations, privatizing social security produces *income effects* that lower aggregate consumption and, thereby, raise aggregate saving, investment, and, at least temporarily, economic growth.

But privatizing social security may also change saving incentives in a way that discourages saving. Take, for example, the case that income tax finance is used to pay for interest on debt issued to privatize social security. The higher effective rate of capital income taxation that results from higher income tax rates raises the price of consuming in the future relative to the present and provides the young and old alike with an incentive to substitute current for future consumption (i.e., to save less).[2] Such *substitution effects* on current consumption may outweigh privatization's income effects, producing a net increase in consumption and a concomitant decline in national savings, investment, and, at least temporarily, economic growth.

Since the savings, investment, and economic growth effects of privatizing social security are theoretically ambiguous, depending on how privatization is conducted, simulation analysis is needed to understand the net macroeconomic impact of privatization. Before turning to such analysis, let us consider other issues involved in privatizing social security.

[2] Changes in the relative of price of current and future consumption may also produce income effects, unless households are compensated for such relative price changes.

2.4 Are There Efficiency Gains from Privatizing Social Security?

Our discussion of the zero-sum nature of privatizing social security is abstracted from the issue of economic efficiency. Economic efficiency concerns the structure of economic incentives, such as the incentive to consume now rather than later and the incentive to work rather than take leisure. Since privatization of social security will generally alter economic incentives, the possibility arises that privatization could make the economy more efficient. In technical terms, improving the economy's efficiency means being able to make some people better off without hurting others. In our context, it means making some generations better off through privatization without leaving others worse off.

Whether or not privatizing social security improves efficiency depends on the nature of the pre-privatization linkage, at the margin, between social security benefits and contributions. This linkage could, of course, be zero. Zero linkage occurs when social security benefits are determined independent of past contributions or when workers incorrectly perceive that their additional social security contributions will not raise their future social security benefits. In the United States, misconception of the true nature of benefit–tax linkage seems plausible given the complex nature of our social security benefit calculation.

In a "pay-as-you-go" system with zero actual or perceived linkage, workers will consider 100 percent of their payroll tax contribution to be a marginal tax on their labor supply. Nonetheless, in a pay-as-you go program with stable growth, workers will on average receive some return on their contributions to social security, a return that is governed by the rate of growth of the economy. So, on average, social security contributions are not just a tax.

This point notwithstanding, there is no necessary relationship between the average and marginal returns to social security contributions. To see this, suppose that the social security payroll tax rate is 15 percent. If benefits are provided as a lump sum independent of past contributions, the marginal return from an extra dollar of contributions is zero, and social security adds 15 percentage points to the total effective marginal tax rate on labor supply. If, on the other hand, the government provides, in present value, $2 for every dollar contributed to social security above some contribution level, then social security will represent a marginal subsidy to the labor supply—one that reduces the total effective marginal tax rate on labor supply by 15 percentage points.[3]

The smaller is a social security system's marginal benefit–tax linkage,

[3] This assumes that all workers contribute above this contribution level.

the larger are the chances that privatizing social security can support an efficiency gain. To see this, consider a pre-privatization situation in which social security benefits are provided to workers independent of their past contributions, so that the marginal linkage is zero, and workers view all their payroll tax contributions as a marginal tax on their labor supply. Also assume that privatization is effected by paying only those social security benefits owed to existing retirees as well as those benefits that current workers have accrued as of the date of the privatization. In this case, the payroll tax will, over time, disappear as a smaller and smaller number of original retirees and workers with accrued benefits remain alive. As the payroll tax rate falls, the total effective tax on labor supply will fall as well. Since the government's distortion of labor supply is reduced over time, this method of privatizing social security has the potential of improving economic efficiency.

Note that lowering effective marginal tax rates on labor supply can also be accomplished under the existing social security system by simply tightening the link between benefits received and contributions paid; that is, the fact that social security is financed at the macrolevel on a pay-as-you-go basis does not preclude establishing a tight and transparent linkage between social security benefits and contributions—a linkage that, at the margin, can, as mentioned, even entail an effective subsidy to labor supply.[4]

Privatizing social security can also reduce economic efficiency. To see this, take the case that social security subsidizes labor supply at the margin and thereby reduces the total effective marginal labor income tax rate. In this case, privatizing social security in the manner just described will eliminate this marginal subsidy, raising the effective marginal tax on labor supply and reducing economic efficiency.

In addition to its impact on effective marginal tax rates on labor supply, privatization may also alter other effective marginal tax rates. For example, if privatization is accomplished by using income tax finance to pay, over time, the accrued benefits owed to current retirees and workers with no subsequent benefit accrual, there will be a temporary increase in effective marginal capital income taxation. If effective marginal capital income taxation is already quite high due to, say, a high corporate income tax, privatization could well reduce economic efficiency.

Thus, there is no guarantee that privatizing social security will improve economic efficiency. It all depends on the type of social security

[4] For an analysis of the efficiency gains from tightening the linkage between social security benefits and contributions, see Chapter 10 in Auerbach and Kotlikoff (1987).

system being privatized, the nature of other fiscal distortions, and the manner in which privatization takes place.

3. ILLUSTRATING SOCIAL SECURITY PRIVATIZATION EFFECTS WITH THE AUERBACH–KOTLIKOFF MODEL

The Auerbach–Kotlikoff (AK) model can provide some sense of the potential saving, investment, and growth effects of privatizing social security.[5] The AK model calculates the time path of all economic variables in its economy over a 150-year period. The model has 55 overlapping generations. Each adult agent in the model lives for 55 years (from age 20 to age 75).

There are three sectors: households, firms, and the government. Households (adult agents) decide how much to work and how much to save based on the after-tax wages and after-tax rates of return they can earn in the present and the future on their labor supply and savings, respectively. The work decision involves not only deciding how much to work in those years that one is working, but also when to retire. The AK model's consumption and leisure preferences that underlie these decisions were chosen in light of evidence on actual labor supply and saving behavior.

As agents age in the model, they experience a realistic profile of increases in wages. This age–wage profile is separate from the general level of wages, the time path of which is determined in solving the model. Fiscal policies affect households by altering their after-tax wages, their after-tax rates of return, and, in the case of consumption taxes, their after-tax prices of goods and services. The model is equipped to deal with income taxes, wage taxes, capital income taxes, and consumption taxes. It is also able to handle progressive as well as proportional tax rates. Finally, and most important for this study, the model includes a pay-as-you-go social security system in which the perceived linkage between taxes and benefits can be set at any desired value.

All agents are assumed to have the same preferences, so differences in behavior across agents arise solely from differences in economic opportunities. Since all agents within an age cohort are assumed to be identical, differences in economic opportunities are present only across cohorts. In this study, the model's population growth rate is set at a constant 1

[5] For a detailed description of the AK model, see Auerbach and Kotlikoff (1987).

percent rate, with the population of each new cohort being 1 percent larger than that of the previous cohort.

The AK model's production sector is characterized by perfectly competitive firms that hire labor and capital to maximize their profits. The production relationships that underlie firms' hiring decisions and their production of output are based on empirical findings for the United States. The government sector consists of a Treasury that collects resources from the private sector to finance government consumption and an unfunded, "pay-as-you-go" Social Security system that levies payroll taxes to pay for contemporaneous retiree benefit payments. There is no money in the model, and, thus, no monetary policy. There is, however, government debt, and the model can handle deficit-financed reductions in payroll and other taxes. It can also handle gradual phaseins of one tax for the other. Finally, the model contains a Lump-Sum Redistribution Authority (LSRA), a hypothetical governmental agency that can use lump-sum taxes and transfers to redistribute among generations alive at a point in time as well as those who will be born in the future. The LSRA can be used (switched on) to study the pure economic efficiency effects of particular policy changes.

Although the model handles a great number of complex processes, it leaves out large portions of reality. The model's agents are heterogeneous only with respect to their age. There are no welfare recipients or millionaires whose saving and work behavior might differ dramatically from that of the model's agents. The model does not include saving for purposes other than retirement, such as bequests. Nor does the model incorporate uncertainty either with respect to individual or macroeconomic outcomes. These and other omissions suggest viewing the model's results cautiously.

3.1 Modeling the Privatization of Social Security

In the AK model, privatizing social security contributions is simple. It just requires setting the model's social security payroll tax rate to zero. Since agents in the model are free to dissave (borrow) as well as to save (lend/invest), forcing them to contribute to private pensions will make no difference to their total savings and consumption; that is, forced private pension savings will simply crowd out voluntary private savings dollar for dollar. Hence, there is no need to add a formal private pension system to the model.

Privatizing social security benefits within the model involves three key decisions: (1) how fast to phase out benefits; (2) whether to issue explicit government debt for a period of time to make up for some or all of the loss in payroll tax revenue; and (3) what tax instrument to use, during the benefit phaseout period, to pay for benefits that are not financed by

explicit borrowing and to meet, during and after the benefit phaseout period, interest on new debt issued as part of the privatization.

These three decisions are illustrated in Chile's privatization of social security. Chile's privatization honored benefit commitments to existing retirees. It also provided existing workers with *recognition bonds*—explicit IOUs that would come due when they reached retirement age. These recognition bonds compensated the workers for the elimination of their claims to future social security benefits, claims that they had accrued as a result of past contributions. Because the timing of the payment of principal and interest on the recognition bonds is similar to the timing of the payment of the accrued social security benefits that these workers would otherwise have received, the Chilean reform can be viewed as paying off all accrued benefits under the old system but disallowing any further accrual of social security benefits. Consequently, it amounts to a particular benefit phaseout policy. Chile used deficit finance to cover some of the losses in revenue arising from the discontinuation of the payroll tax. This deficit finance took the form of running smaller surpluses than would otherwise have been the case. Finally, Chile used its income tax to make up the rest of the lost payroll tax revenue and, implicitly, to meet interest payments on its additional borrowing.

3.2 *The AK Model Used to Study Privatization of Social Security*

The AK model's steady state from which privatizations of social security are simulated features a 20 percent income tax, a pay-as-you-go social security system with a 12 percent payroll tax rate, a marginal benefit–tax linkage of zero, zero initial explicit debt, a 1 percent population growth rate, zero technological change, and a Cobb–Douglas production function. Social security benefits equal 75 percent of the average level of wages earned between ages 1 and 45 (real world ages of 20 and 65). The intertemporal and intratemporal elasticities of substitution in the Consumer Expenditure Survey (CES) utility function are set at the conservative values of 0.25 and 0.8, respectively. Households have a pure rate of time preference of 1.5 percent per year, and the initial steady-state interest rate is 9.1 percent. The base-case simulation begins in year 1 and involves (1) an immediate elimination of the payroll tax, (2) a 45-year phaseout of security benefits starting in year 11, and (3) the use of income tax finance to make up for the loss in payroll tax revenues in meeting social security benefit payments.

Delaying the benefit phaseout for 10 years ensures that all retirees collecting benefits at the time of the reform (all those 46 to 55 years old) receive all the benefits they had been promised. Spending 45 years phasing out social security benefits ensures that all workers alive at the time of the reform receive some social security benefits when they retire. The

phaseout of benefits is linear over the 45-year period, but more rapid or slower phaseouts can be considered. In terms of the Chilean privatization, the rapidity of the benefit phaseout captures the choice of discount rate, survival rates, and other factors used in determining the size of recognition bonds given to existing workers.

The reduction in the payroll tax burden facing future generations combines with the increase in the real wage to raise the utility of those born in the long run by 9.7 percent. This is a very significant long-run welfare improvement, but it comes at a price. As the lower panel in Figure 1 shows, initial generations are made worse off; 30-year olds suffer the largest percent reduction in their remaining utility, 2.0 percent.

3.3 *Can Privatization Improve Economic Efficiency?*

The utility changes in Figure 1 beg the question of whether, in the course of privatizing social security, initial generations can be compensated by future generations, leaving them no worse off and future generations better off. Such an outcome, referred to as a *Pareto improvement*, is clearly more efficient than the initial steady-state status quo.

Figure 2 answers this question in the affirmative. It shows the results of running the base-case privatization simulation but with the LSRA instructed to redistribute across generations in a nondistorting manner to (1) leave each initial generation at its preprivatization level of utility, and (2) leave each generation born after the reform with the same level of utility. It is important to note that the LSRA's activities are fully incorporated into the model; that is, the model's agents take into account the lump-sum net taxes (which may be negative) that they must pay to the LSRA. Moreover, the requisite size of these generation-specific net transfers are calculated simultaneously with all the other variables in the model in solving for the economy's dynamic general equilibrium.

3.4 *Base-Case Results*

The results of the base case and other nine simulations considered in this section are presented in Tables 1 to 5. For each simulation, there is also a figure with two panels. The top panel shows how indices of the capital stock, output, the wage, and the interest rate change during the privatization transition. The lower panel shows the impact of privatization on generations alive at the time of the reform and thereafter. The horizontal axis in the lower panel indicates the year in which the various generations were born, and the vertical axis provides an index of the generation's utility levels. A value of 1.06 means that the genera-

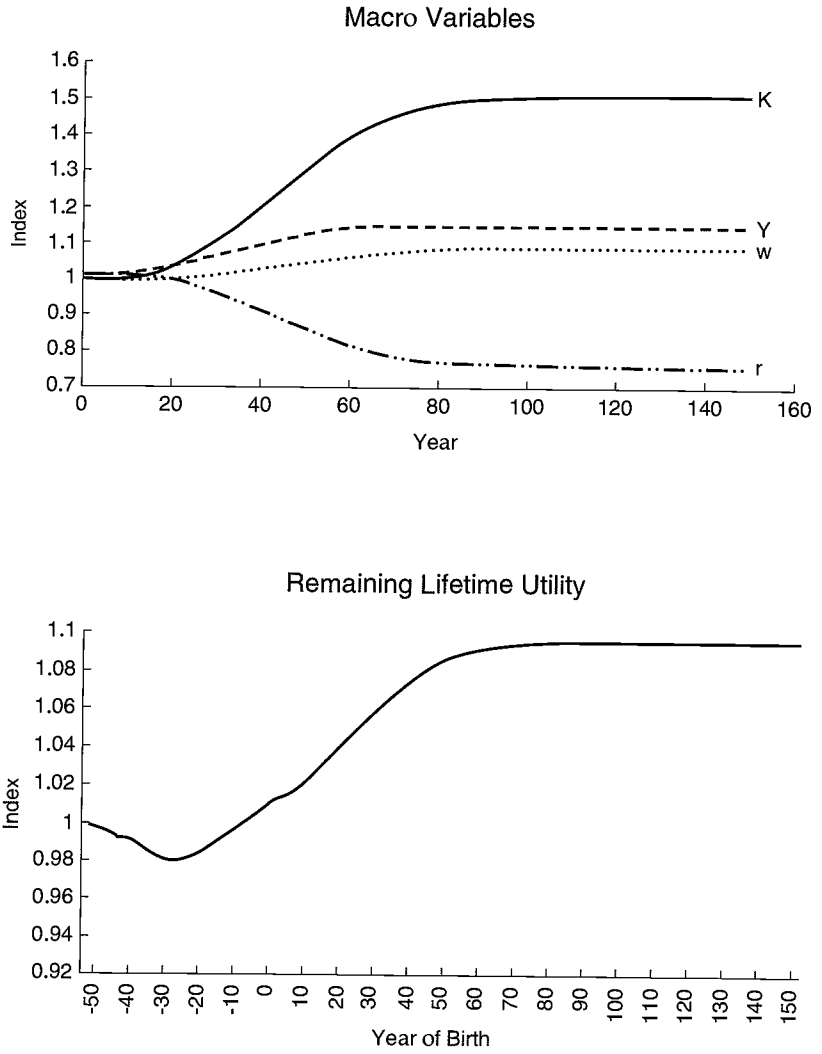

FIGURE 1. ***Proportional income tax financing of benefits.***

tion's remaining lifetime utility under privatization is 6 percent higher than it would have been in the initial steady state. To be precise, the percent change in utility is measured as a wealth equivalent, specifically, as the percent change in initial steady-state remaining lifetime resources needed to achieve the level of utility experienced as a result of privatizing social security.

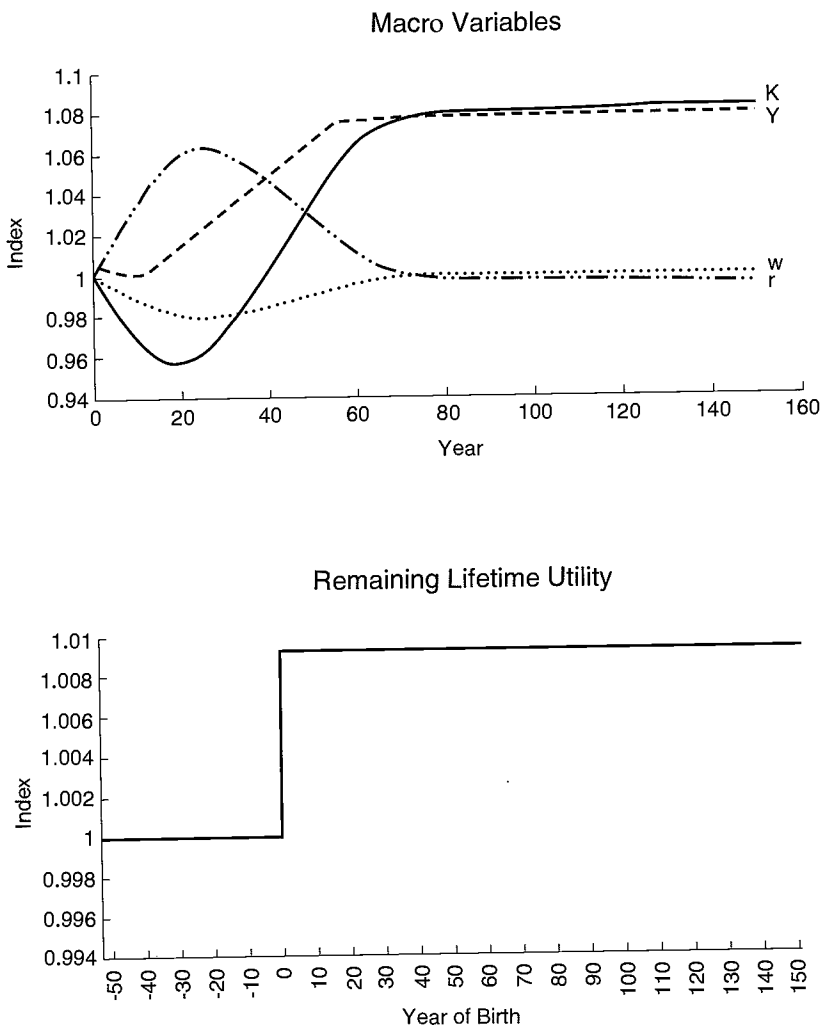

FIGURE 2. ***Proportional income tax financing of benefits: welfare of living generations constant.***

As Figure 1 shows, privatizing social security in the base-case manner is highly beneficial to the economy over the long run. Compared with the initial steady state, the long-run capital stock, output, and wage are 52.2, 15.9, and 9.5 percent larger, respectively. The long-run interest rate is 23.9 percent smaller. The income tax rate, which was 20.0 percent in the initial steady state, rises immediately to 28.8 percent but declines

TABLE 1
Percent Change in Capital Stock Relative to Steady State

Tax financing govt. spending	Tax financing soc. sec. benefits	LSRA	TBL	Deficits for first 5 years	Year of transition 5	10	25	150
Yprop	Yprop	No	No	No	−0.32	−0.02	6.59	52.19
Yprop	Yprop	Yes	No	No	−1.54	−3.11	−3.71	8.46
Yprop	Yprop	No	Yes	No	−2.89	−4.92	−0.90	43.18
Yprop	Yprop	Yes	Yes	No	−5.21	−10.43	−16.83	−8.88
Yprop	Yprop	No	No	Yes	2.93	−0.32	−2.86	35.40
Yprop	C	Yes	No	No	1.91	3.92	8.65	12.92
Yprog	C	No	No	No	5.54	11.54	25.60	56.67
Yprog	C	Yes	No	No	3.13	6.51	14.07	21.44

govt., government; soc. sec., social security; LSRA, lump sum redistribution authority; TBL, tax–benefit linkage; Yprop, proportional income tax; Yprog, progressive income tax; C, proportional consumption tax.

TABLE 2
Percent Change in Output Relative to Steady State

Tax financing govt. spending	Tax financing soc. sec. benefits	LSRA	TBL	Deficits for first 5 years	Year of transition 5	10	25	150
Yprop	Yprop	No	No	No	0.96	1.19	5.02	15.86
Yprop	Yprop	Yes	No	No	0.30	0.11	2.37	8.07
Yprop	Yprop	No	Yes	No	−5.98	−6.05	−2.41	8.08
Yprop	Yprop	Yes	Yes	No	−7.14	−7.85	−6.36	−1.34
Yprop	Yprop	No	No	Yes	6.67	−1.33	0.90	11.81
Yprop	C	Yes	No	No	2.78	3.18	5.38	8.92
Yprog	C	No	No	No	5.23	6.20	9.79	17.11
Yprog	C	Yes	No	No	4.21	4.80	7.25	11.05

govt., government; soc. sec., social security; LSRA, lump sum redistribution authority; TBL, tax–benefit linkage; Yprop, proportional income tax; Yprog, progressive income tax; C, proportional consumption tax.

over time, ultimately ending up lower than it started, at a value of 17.3 percent.

The message of Figure 2 is that almost all of the long-run economic gains in Figure 1 from privatizing social security are due to the policy's redistribution from initial generations to future ones. When compensation is provided to initial generations, the long-run gain in utility is not

TABLE 3
Percent Change in Wage Relative to Steady State

Tax financing govt. spending	Tax financing soc. soc. benefits	LSRA	TBL	Deficits for first 5 years	Year of transition			
					5	*10*	*25*	*150*
Yprop	Yprop	No	No	No	−0.43	−0.40	0.50	9.52
Yprop	Yprop	Yes	No	No	−0.62	−1.08	−2.02	0.12
Yprop	Yprop	No	Yes	No	1.08	0.40	0.51	9.83
Yprop	Yprop	Yes	Yes	No	0.69	−0.94	−3.88	−2.61
Yprop	Yprop	No	No	Yes	−1.18	0.50	−1.26	6.59
Yprop	C	Yes	No	No	−0.28	0.24	1.02	1.20
Yprog	C	No	No	No	−0.25	1.65	4.59	10.19
Yprog	C	Yes	No	No	−0.35	0.54	2.08	3.02

govt., government; soc. sec., social security; LSRA, lump sum redistribution authority; TBL, tax–benefit linkage; Yprop, proportional income tax; Yprog, progressive income tax; C, proportional consumption tax.

TABLE 4
Percentage Change in Interest Rate Relative to Steady State

Tax financing govt. spending	Tax financing soc. sec. benefits	LSRA	TBL	Deficits for first 5 years	Year of Transition			
					5	*10*	*25*	*150*
Yprop	Yprop	No	No	No	1.29	1.20	−1 .48	−23.87
Yprop	Yprop	Yes	No	No	1.87	3.33	6.32	− 0.36
Yprop	Yprop	No	Yes	No	−3.17	−1.19	−1.50	−24.50
Yprop	Yprop	Yes	Yes	No	−2.05	2.88	12.59	8.26
Yprop	Yprop	No	No	Yes	3.64	−1.65	3.87	−17.42
Yprop	C	Yes	No	No	0.85	−0.71	−3.00	−3.55
Yprog	C	No	No	No	−2.22	−4.78	−12.59	−25.25
Yprog	C	Yes	No	No	1.04	−1.60	−5.98	−8.55

govt., government; soc. sec., social security; LSRA, lump sum redistribution authority; TBL, tax–benefit linkage; Yprop, proportional income tax; Yprog, progressive income tax; C, proportional consumption tax.

9.7 percent, but only 0.9 percent. In addition, the respective long-run increases in the capital stock, output, and wage are 8.5, 8.1, and 0.1 percent, respectively, much smaller than the corresponding 52.2, 15.9, and 9.5 percent increases shown in Figure 1. Although the efficiency gain is small compared with the long-run utility gain in Figure 1, it is certainly not trivial. Nor is it small compared with the efficiency gains

TABLE 5

Percent Change in Remaining Lifetime Utility

Tax financing govt. spending	Tax financing soc. sec. benefits	LSRA	TBL	Deficits for first 5 years	Year of birth						
					−54	*−25*	*−10*	*0*	*10*	*25*	*150*
Yprop	Yprop	No	No	No	−0.12	−1.84	−0.17	1.19	2.38	5.17	9.67
Yprop	Yprop	Yes	No	No	0	0	0	0.93	0.93	0.93	0.93
Yprop	Yprop	No	Yes	No	−0.24	−3.06	−1.26	0.31	1.39	4.29	8.89
Yprop	Yprop	Yes	Yes	No	0	0	0	−3.14	−3.14	−3.14	− 3.14
Yprop	Yprop	No	No	Yes	0.09	−0.90	0.12	0.99	0.13	2.55	7.43
Yprop	C	Yes	No	No	0	0	0	2.09	2.09	2.09	2.09
Yprog	C	No	No	No	−4.71	−1.19	1.81	3.55	5.07	7.57	10.79
Yprog	C	Yes	No	No	0	0	0	4.45	4.45	4.45	4.45

govt., government; soc. sec., social security; LSRA, lump sum redistribution authority; TBI, tax–benefit linkage; Yprop, proportional income tax; Yprog, progressive income tax; C, proportional consumption tax.

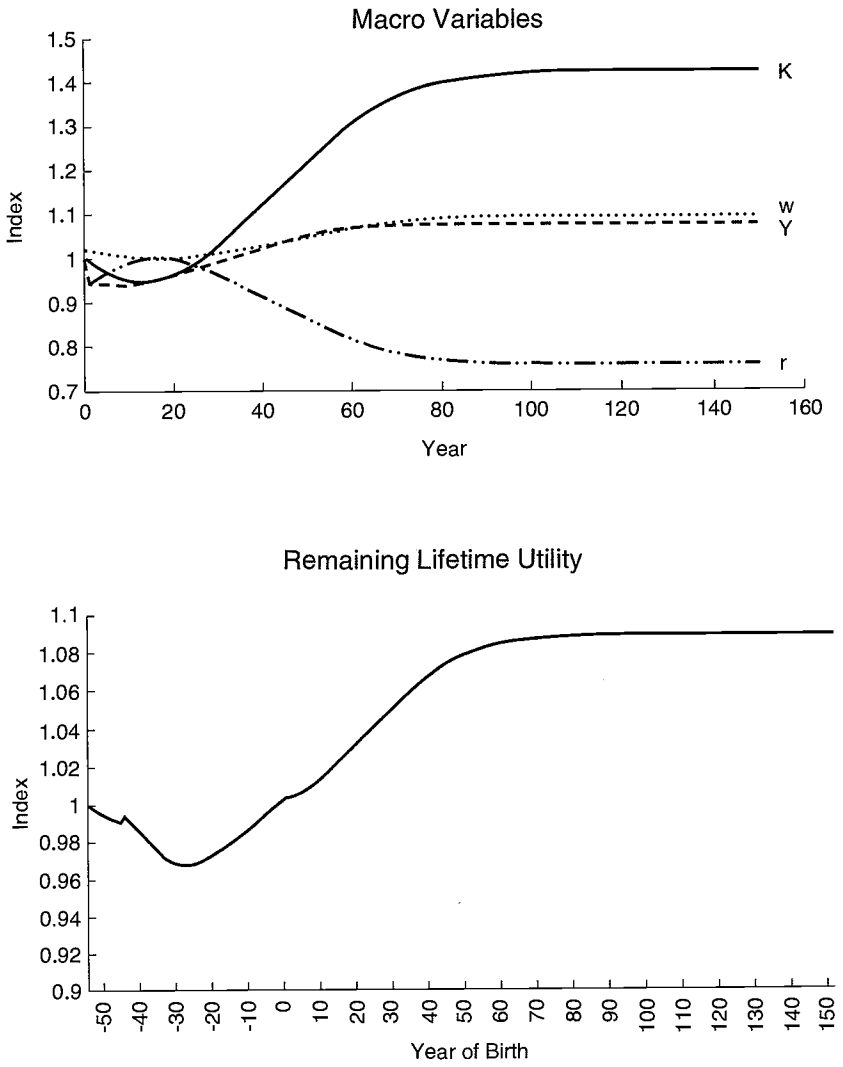

FIGURE 3. ***Proportional income tax financing of benefits: perfect tax–benefit linkage.***

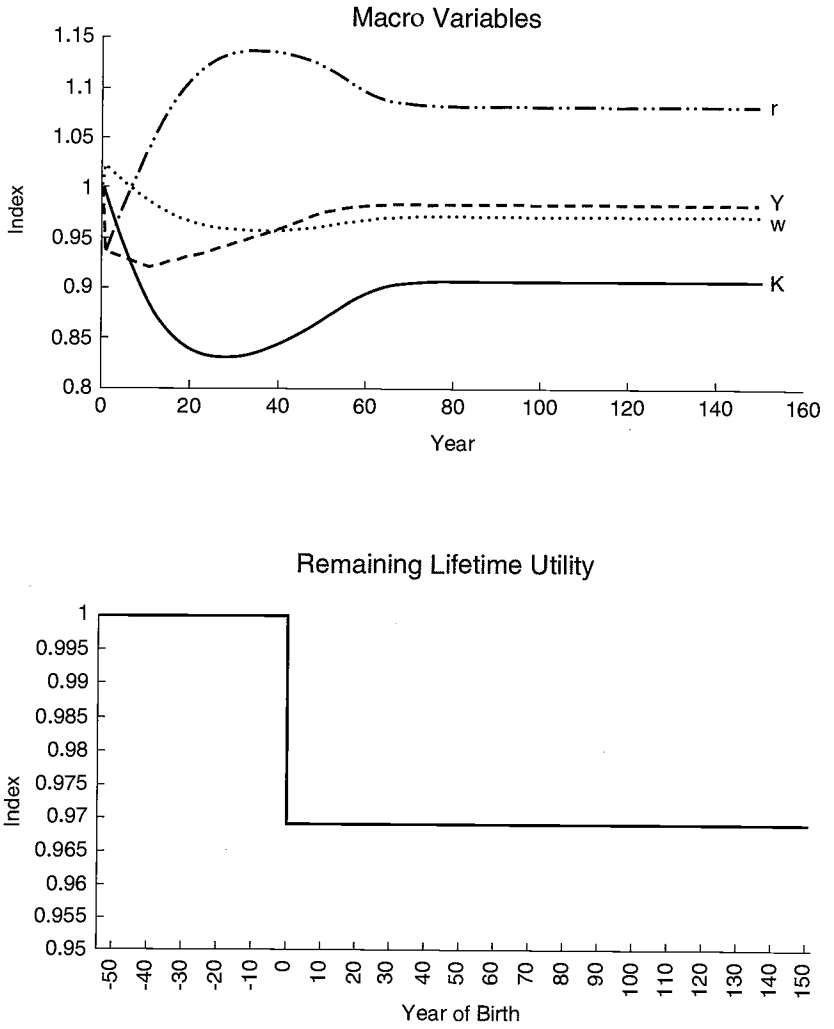

FIGURE 4. ***Proportional income tax financing of benefits: perfect tax–benefit linkage and welfare of living generations constant.***

available from other fiscal reforms, such as switching from income to consumption taxation.

What is the source of the efficiency gain? Is it related to the fact that in the base-case steady state, the pay-as-you-go social security system features zero marginal benefit–tax linkage? Figures 3 and 4 answer this question. They repeat the simulations of Figures 1 and 2 but starting from a steady state in which each dollar contributed to social security is

viewed as providing future benefits with the present value of $1.[6] Figure 3, like Figure 1, shows that absent the LSRA's compensation of initial generations, privatization has very significant positive long-run effects on the economy. But as Figure 4 makes clear, once one compensates initial generations, future generations actually end up worse off; that is, Figure 4 indicates that privatizing from a situation of full benefit–tax linkage is inefficient. Indeed, keeping all initial generations at their preprivatization level of utility and producing a uniform level of utility for future generations (those born after the reform) entails a quite substantial 3.1 percent reduction in the utility levels of these future generations. Interestingly, the long-run values of the capital stock, output, and real wage are all smaller as a result of privatizing social security coupled with the LSRA compensation policy.

Intuitively, privatization adds, at least temporarily, an additional distortion to the fiscal structure, namely that arising from the use of general revenue finance—in this case, income taxation—to finance benefits during the benefit phaseout period. The temporarily higher income tax rates distort both labor supply and intertemporal consumption decisions. Given this fact, the only way that privatization can improve economic efficiency is if the temporary income tax distortion replaces a permanent social security tax distortion. But since privatization in Figure 4 phases out a nondistortionary social security system, it must be inefficient.

3.5 Using Debt Finance During the Privatization Transition

An alternative to raising income tax rates immediately is to borrow. Figure 5 considers a simulation in which the government borrows to meet all social security benefits for the first 5 years of privatization. Thereafter, the government raises the income tax rate to maintain a constant ratio of debt per capita. Note that this policy features short-run crowding-out but long-run crowding-in of the capital stock. The 5-year borrowing policy mitigates much of the utility losses to initial generations, leaving future generations with a 7 percent higher level of welfare. Waiting for 10 years to stabilize the debt goes too far in helping initial generations and, consequently, ends up making certain future generations significantly worse off. For example, the generation born 8 years after the reform suffers a 3 percent utility loss from the policy. The moral here is that short-term deficit finance can help protect initial generations from adverse effects of privatization, but it is easy to go overboard.

[6] Again, we know that pay-as-you-go social security cannot on average and in the long run pay benefits whose present values equal tax contributions, assuming as we do that the marginal product of capital exceeds the economy's growth rate. But this does not preclude social security's paying, at the margin, a present dollar in benefits for each dollar contributed.

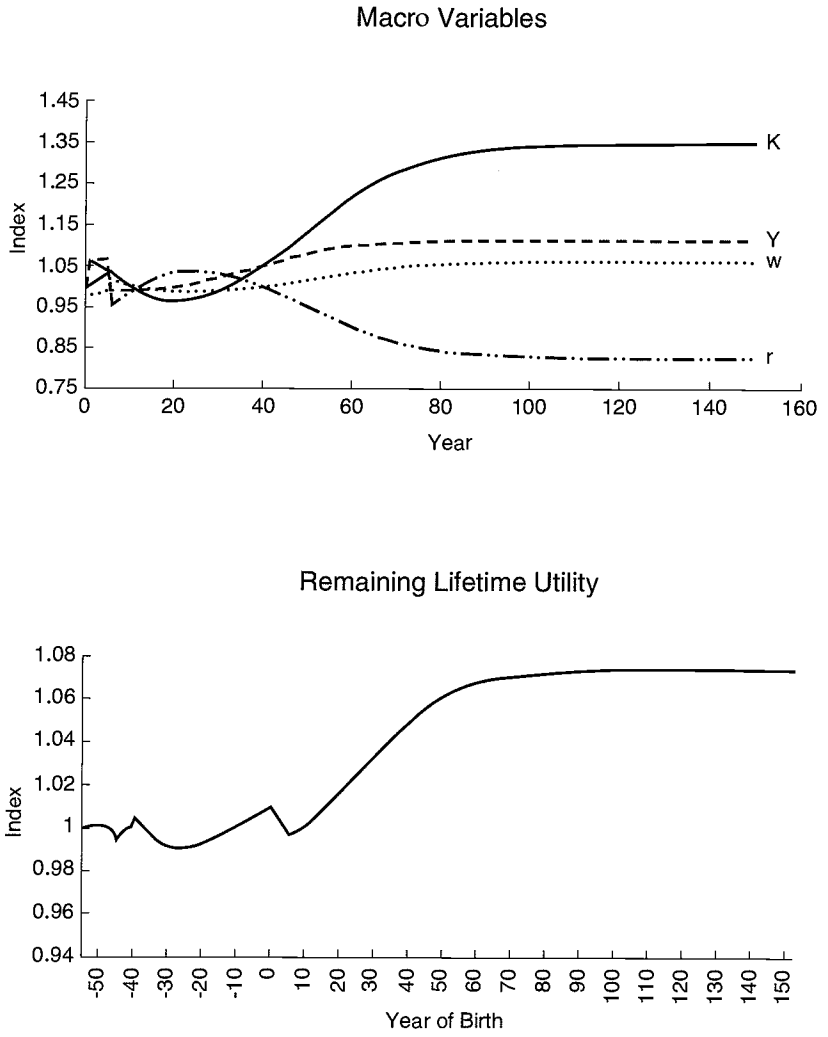

FIGURE 5. ***Proportional income tax financing of benefits: 5-year debt finance.***

3.6 Using Consumption Taxes to Finance Benefits During the Transition

Figure 6 shows that the choice of tax base used to finance social security benefits during the transition can alter macro-outcomes and the efficiency gains from reform. Figure 6 repeats the LSRA privatization experiment of

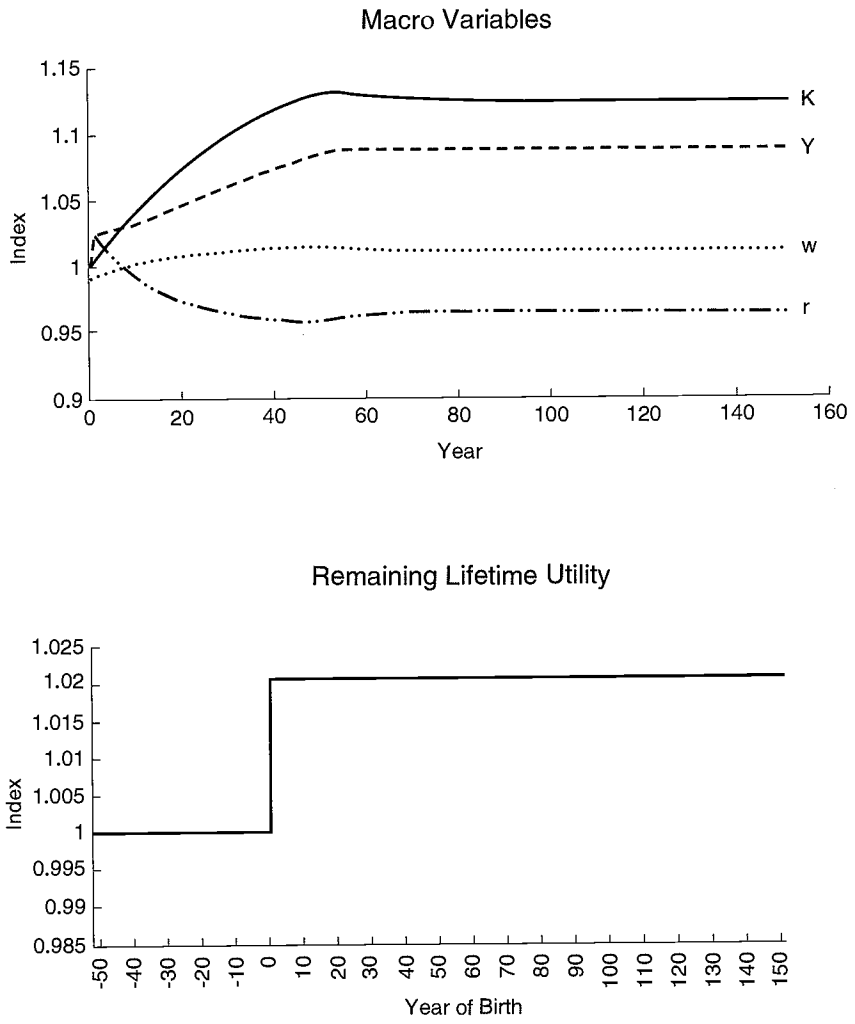

FIGURE 6. ***Proportional consumption tax financing of benefits: proportional income tax financing of general revenues and welfare of living generations constant.***

Figure 2 with one exception. It uses consumption taxation to pay for social security benefits during the phaseout of those benefits. Using consumption taxes to finance social security benefits leads to more crowding in of the capital stock. The intuition for this result is that in using consumption taxation to help finance the transition, a larger burden of paying for re-

maining social security benefits is shifted onto older generations who have a larger propensity to consume. Figure 6 also shows a larger efficiency gain than does Figure 2. Future generations are made better off by 2.1 percent rather than by 0.9 percent. This is what one would expect given that consumption taxation is more efficient than income taxation. As discussed in Auerbach and Kotlikoff (1987), consumption taxation is significantly more efficient than income taxation because it embeds a one-time nondistortionary wealth tax. In the simulation under consideration, the consumption tax is also used only temporarily—until all benefits are phased out—and during the phaseout period, the consumption tax rate steadily declines. The temporary nature of the consumption tax and the fact that its rate falls over time may also improve economic efficiency. The reason is that it provides the model's households with an incentive to delay consuming until the consumption tax rate is reduced. This incentive to delay consuming somewhat offsets the incentive to consume earlier rather than later, arising from the capital income tax component of the income tax.

3.7 Privatizing Starting with Progressive Income or Proportional Consumption Taxation

The privatization of social security can also start from steady states featuring other than a proportional income tax regime. If, for example, one starts with a progressive income tax, with an average marginal rate of 32.9 percent, and adjusts all marginal tax rates during the transition by the same percentage, one ends up with results similar to those depicted in Figures 1 and 2. The same is true if one starts with a proportional consumption tax and adjusts the consumption tax rate over the transition to cover remaining social security benefits.

The simulations underlying Figures 7 and 8 also start with a progressive income tax but use a consumption tax to finance transitional benefits. Figure 8 indicates much greater potential efficiency gains than does Figure 6. In this case, the efficiency gain is a substantial 4.5 percent. As with the comparison between Figures 2 and 4, the size of the gain in Figure 8 depends critically on the assumption of a zero social security benefit–tax linkage. Rerunning the Figure 8 simulation under the assumption of a full benefit–tax linkage produces an efficiency loss of 3.2 percent!

4. PRIVATIZING SOCIAL SECURITY IN THE UNITED STATES: AN EXAMPLE

In the Fall 1994 final report of the Entitlements Commission, Senators Danforth and Kerry proposed a limited privatization of social security.

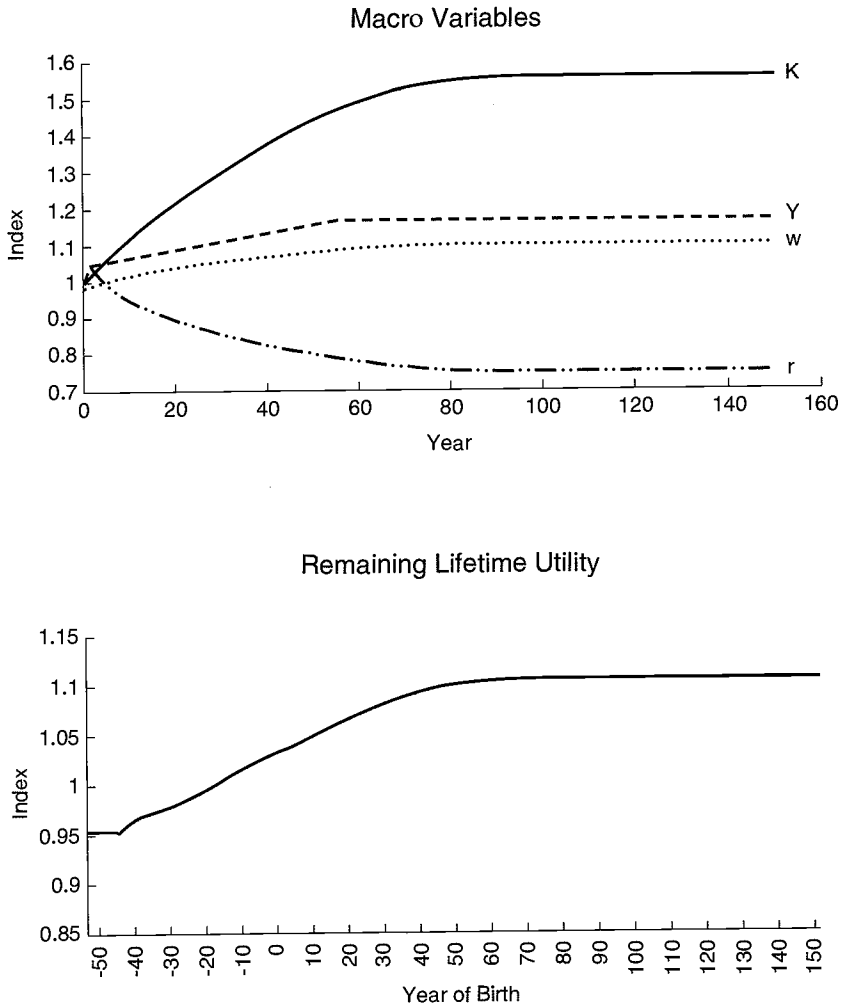

FIGURE 7. ***Proportional consumption tax financing of benefits: progressive income tax financing of general revenues.***

Their scheme involves using 1.5 percentage points of each worker's social security payroll tax contribution to fund a personal retirement account for the worker. The proposal applies to all workers 50 years old and under. Like 401(k) and Keogh plans, workers would control the investment of moneys in their accounts. Earnings on the accounts would be taxable when funds were withdrawn. Withdrawals would be permitted only in

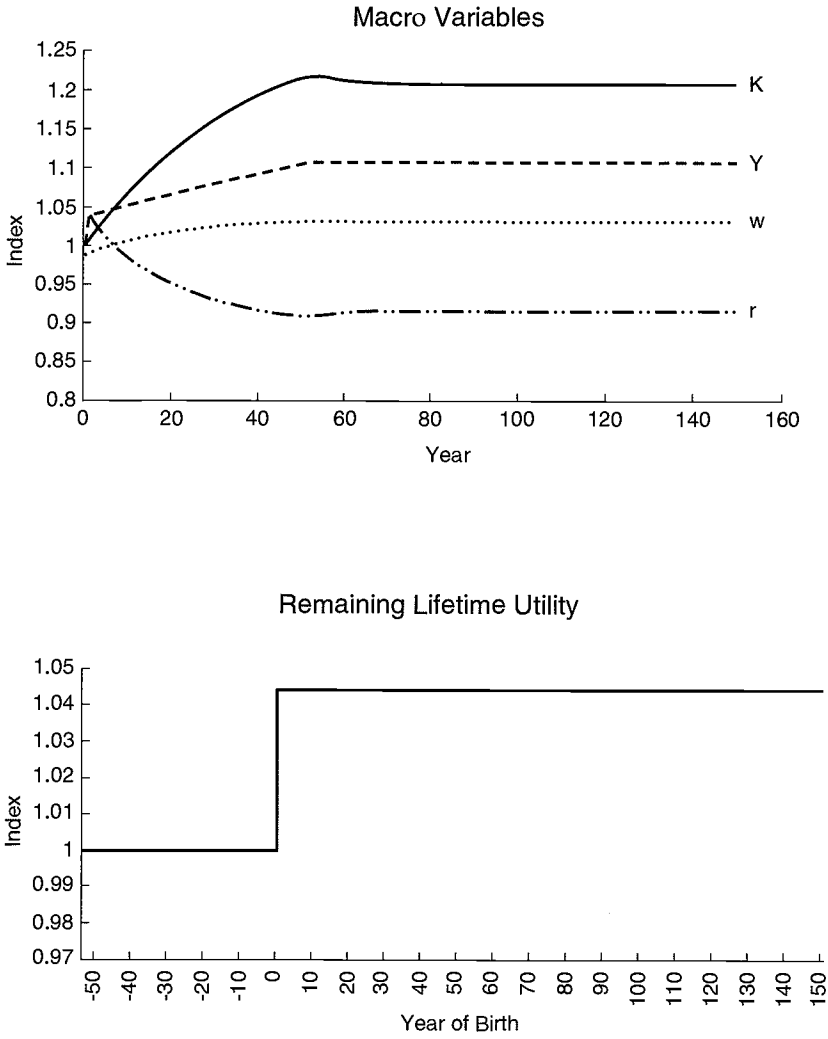

FIGURE 8. ***Proportional consumption tax financing of benefits: progressive income tax financing of general revenues and welfare of living generations constant.***

the case of disability or retirement. Unlike 401(k) and Keogh plans, contributions would not be deductible. The Danforth–Kerry social security privatization proposal leaves social security benefits unchanged, although other proposals in their report reduce these benefits.

Since the combined employer–employee Old Age, Survivor, and Disability Insurance (OASDI) payroll tax rate exceeds 12 percent, the Danforth–Kerry proposal envisions privatizing only about one eighth of current social security taxes and zero percent of social security benefits. As such, the proposal's goals are rather modest. Indeed, the most significant feature of the Danforth–Kerry proposal is not in its details, but in the fact that prominent members of Congress are now taking privatizing social security seriously. This fact opens the door for a broad public debate about the merits and demerits of the System and how it might best be privatized.

4.1 Illustration of Social Security Privatization

In offering such a modest proposal and one that left social security benefits unchanged, Senators Danforth and Kerry avoided the potentially tricky issue of how to credit past contributions and how to privatize survivor and disability insurance benefits. This section illustrates a simple method for privatizing social security—the Personal Security System—that deals with these issues.[7] The objective here is not to advocate privatizing social security but simply to illustrate that certain types of privatization are easily accomplished. Having an explicit proposal to consider also helps focus attention on particular issues that arise in considering privatization.

4.2 The Personal Security System

The Personal Security System is a straightforward method of crediting past contributions and uses social security's own benefit schedule. It also separates the survivor and disability insurance programs from the Old Age Insurance (OAI) part of social security and leaves them within social security. The Personal Security System privatizes the total (employer plus employee) contribution to OAI by investing it in personal retirement accounts (PRAs) for all workers below age 62. The OAI component of total OASDI contributions refers here to the ratio of social security retirement benefits to total OASDI benefits. This ratio would remain fixed through time at its current value of 0.68. Hence, 68 percent of current and future projected total contributions to social security would be allocated to the funding of PRAs.

The OAI contribution for married workers would be divided into equal shares and invested in two PRAs, one for each spouse. Withdrawals from PRAs would be permitted only in the event of disability or the

[7] A version of this social security privatization proposal was developed as part of a Data Resources, Inc. project on which I worked with Dr. Cynthia Latta of Data Resources, Inc.

attainment of age 62, which is the youngest age at which social security retirement benefits can now be received. Contributions to PRAs would not be subject to federal income taxes, thus maintaining the current federal income tax treatment of employer contributions. Withdrawals from PRAs would be subject to federal income taxation. Hence, PRAs would receive the same tax and regulatory treatment as current 401(k) and Keogh plans. Indeed, employers with existing 401(k) plans could make PRA contributions on behalf of their employees to those accounts as well as to new 401(k) accounts that they would establish for the spouses of their workers. Self-employed workers with Keogh accounts could make their PRA contributions to their existing Keogh accounts as well as to new accounts that they would establish for their spouses. The PRAs would afford the same protection to surviving spouses in the event of the death of the account owner as is provided with respect to current 401(k) and Keogh accounts.

Employers as well as employees would still contribute to social security for survivor and disability insurance. The proposal leaves social security survivor and disability benefits unchanged; that is, these benefits continue to be calculated on the basis of workers' social security-covered earnings histories.

Each worker under age 62 at the time of the reform would receive social security retirement (OAI) benefits to the extent that he or she had contributed to the system before the reform. The benefit would still be calculated using social security's benefit formula, but the earnings record used in the calculation would have entries of zero for years after the reform was initiated.[8]

For example, the average monthly earnings of a worker who is 35 at the time of the reform and began covered employment at age 25 will be based on his or her covered earnings between ages 25 and 35, with the worker's covered earnings record after age 35 filled in with zeros. Dependent OAI benefits for spouses of retired workers would continue to be based on the retired worker's postreform social security retirement benefit.

4.3 Financing the Transition

The reform would obviously reduce contributions to the Social Security System that are now being used to make current benefit payments and to build up a significant reserve in the Social Security Trust Fund. This

[8] Gustman and Steinmeier (1995) propose an alternative method of calculating benefits during the transition to a fully privatized social security system. Their method provides workers with a benefit equal to the social security benefit they would otherwise receive, multiplied by the fraction of benefit computation years the worker spent participating under the current system.

shortfall in revenues would be borrowed by the Treasury. Interest payments on this borrowing would be paid through general revenue finance. Although the government's explicit debt would increase as a result of the reform, its implicit social security liability would decline. As previously described, the macroeconomic impact of the proposal would depend on the type of general revenue finance used to pay for interest on the additional explicit debt issued during the transition.

4.4 Discussion

This proposal leaves social security survivor and disability benefits unchanged. In so doing, it avoids the highly complex problem of determining the amounts of life and disability insurance that different households with very different ages, incomes, health status, and other characteristics should be forced to purchase from the private market. It also avoids having to confront issues of adverse selection and moral hazard that plague private market provision of insurance, particularly disability insurance.

The proposal would be easy to implement. It piggybacks on existing 401(k) and Keogh regulation, thereby avoiding the need for new regulations covering PRAs. In addition, the Social Security Administration can modify its calculation of benefits for those participating in the Personal Security System by simply changing a few lines of computer code in the software that it currently uses to compute benefits.

The proposal's phasing out of social security retirement and dependent benefits based on past contributions is gradual. Consequently, there will be no "notch-baby" problems in which one age group can claim to be treated unfairly relative to generations either slightly younger or older. The benefit phaseout uses social security's own mechanism for adjusting benefits for shorter work histories. As a result, the phaseout of benefits is likely to be viewed as fair.

Employers' contributions to PRAs are shared equally between the husband and wife. This "earnings sharing" guarantees that nonworking spouses will have retirement income even in the case of divorce. In contrast, the current social security system guarantees OAI dependent benefits for nonworking divorced spouses only if they were married for 10 years before becoming divorced. The proposal also enhances overall survivor protection for spouses. It does so by leaving survivor insurance benefits unchanged but providing, in accordance with 401(k) and Keogh regulations, surviving spouses with a first claim on the PRAs of their decedent husband or wife. In addition, the proposal's earnings sharing reduces the substantial and capricious redistribution from two-earner

couples and single individuals to one-earner couples that occurs under the current system (see Boskin et al., 1987; Steurle and Bakija, 1994).

The proposal provides for individual ownership and investment control of PRA accounts. As a result, workers would most likely view their PRA contributions as equivalent to private saving, which would strengthen the linkage between old-age income and contributions.

Since social security uses a highly progressive benefit schedule based on lifetime earnings, one might question whether the Personal Security System would be as progressive as the existing system. It might, for two reasons. First, unlike social security benefits whose federal income taxation is limited, *all* moneys withdrawn from PRAs would be taxed under the progressive federal income tax. Second, social security benefits are provided in the form of annuities, so those who live longer receive more benefits than those who do not. Since the poor, on average, die at a much younger age than the rich, providing benefits in the form of annuities can be quite regressive (Rogot, Sorlie, and Johnson 1992). Indeed, depending on the rate at which one discounts social security benefits and taxes, social security's regressivity due to longevity differences between the rich and poor can fully offset the progressivity resulting from its benefit formula. These points notwithstanding, the government could easily modify the proposed Personal Security System to make it more progressive by matching individual contributions at a rate that declined with the size of the contribution.

In contrast to social security's annuitized benefits, PRAs would represent a form of net worth. Although households would be free to purchase annuities after age 62 with their PRA accounts, they would not be compelled to do so. Most would probably not annuitize their PRA assets. Why? Because the private annuities market suffers from the same problem of adverse selection as do other insurance markets. In this case, individuals with a longer than average life expectancy are most eager to purchase annuities. Their participation in the market pushes up the price of annuities for those with a normal expected life span (see Friedman and Warshawsky, 1990).[9]

Although reducing social security's annuitization of the poor will redistribute to them, the reduced annuitization of their old-age resources will leave the poor as well as the rich exposed to more longevity risk. Note that longevity risk can be of substantial economic importance (Kotlikoff

[9] There is of course a significant private market in employer-provided defined benefit pensions. By pooling together the longevity risks of large numbers of workers who did not select their employment on the basis of their longevity, employers are able to overcome the adverse selection that plagues the market in individual annuities.

and Spivak, 1981). Although reducing the availability of insurance of any kind, including annuity insurance, is economically inefficient, it would most likely raise our rate of national saving by prompting the elderly to consume less in old age and leave larger unintended bequests (see Auerbach, Kotlikoff, and Weil, 1992, and Auerbach et al., 1995).

Another issue is whether some members of the public would invest their PRA contributions unwisely. Wise investors understand the benefits of a diversified portfolio that includes holding a significant share of one's assets in foreign as well as domestic equities. Given the propensity of many defined contribution plan participants to avoid equities and other assets perceived to be "risky," it is clear that a significant financial educational program would most likely be needed to assist the public in choosing its investment strategies. If improved financial education did not succeed in getting the general public to choose well-balanced portfolios, then the government might limit the choice of investments in the PRA to a single world index fund.

The Personal Security System or similar schemes are likely to entail higher administration costs. Diamond and Valdes-Prieto (1994) report that administration costs of U.S. defined contribution plans are several times higher than those of the Social Security Administration when scaled by the number of participants. Since the Personal Security System proposal leaves social security's administrative responsibilities essentially unchanged, at least for quite some time, the proposal entails higher administrative costs.

A final issue is intergenerational risk sharing. As Merton (1983) shows, pay-as-you-go social security, in combination with other fiscal policies, can be used to pool labor and capital income risks between the young and the old. Pay-as-you-go social security can also be used to pool risk between current and future generations. However, since other fiscal instruments will still be available, such as conventional deficit finance or changes in the tax structure that redistributes across generations, the government's capacity for intergenerational risk sharing is not likely to be greatly affected by the adoption of this proposal.

5. CONCLUSION

The privatizing of social security is spreading from South America. It could well spread to the United States as politicians grapple with ways of addressing the fiscal/demographic debacle facing the country. This paper's simulations of the AK model show that privatizing social security is likely to generate major long-run increases in output and living standards. But unless privatization includes compensation to initial gen-

erations, these long-run gains will come primarily at their expense. This said, the pure efficiency gains from privatization can be substantial. Their precise size depends on the existing tax structure, the linkage between benefits and taxes under the existing social security system, and the choice of the tax instrument used to finance benefits during the transition. When the initial tax structure features a progressive income tax, when benefit–tax linkage is low, when consumption taxation is used to finance social security benefits during the transition, and when existing generations are fully compensated for their privatization losses, there is a 4.5 percent welfare gain to future generations. But if these circumstances do not hold, the efficiency gains from privatization are likely to be smaller, possibly even negative.

The illustrative Personal Security System shows that there are simple ways to privatize the retirement portion of the U.S. Social Security System and to credit workers for their past social security contributions. It also suggests that privatizing social security could provide more survivor protection than the current system as well as eliminate much of the current system's seemingly capricious redistribution between two-earner and single-earner couples. But the proposal's analysis also suggests that these benefits from privatization must be set against a possible reduction in progressivity and a likely reduction in the amount of longevity insurance available to the elderly through annuities.

REFERENCES

Arrau, Patricio (1990). "Social Security Reform: The Capital Accumulation and Intergenerational Distribution Effect." Washington, DC: World Bank.

———, and Klaus Schmidt-Hebbel (1993). "Macroeconomic and Intergenerational Welfare Effects of a Transition from Pay-as-You-Go to Fully Funded Pensions." Washington, DC: World Bank, Policy Research Department, Macroeconomics and Growth Division.

Auerbach, Alan J., and Laurence J. Kotlikoff (1987). *Dynamic Fiscal Policy*. Cambridge, England: Cambridge University Press.

———, Laurence J. Kotlikoff, and David N. Weil (1992). "The Increasing Annuitization of the Elderly." NBER Working Paper no. 4182, October.

———, Jagadeesh Gokhale, Laurence Kotlikoff, John Sabelhaus, and David N. Weil (1995). "The Annuitization of Americans' Resources: A Cohort Analysis." NBER Working Paper no. 5089, April.

Boskin, Michael J., Laurence J. Kotlikoff, Douglas J. Puffert, and John B. Shoven (1987). "Social Security: A Financial Appraisal Across and Within Generations." *National Tax Journal* 40(no. 1, March):19–34.

Diamond, Peter, and Salvador Valdes-Prieto (1994). "Social Security Reform." In *The Chilean Economy: Policy Lessons and Challenges*, Barry Bosworth, Rudiger Dornbusch, and Raul Laben (eds.). Washington, DC: The Brookings Institution.

Feldstein, Martin (1995). "Would Privatizing Social Security Raise Economic Welfare?" Boston: Harvard University, August. Mimeographed.

Friedman, Benjamin, and Mark Wahrshawsky (1990). "The Cost of Annuities: Implications for Saving and Behavior." *The Quarterly Journal of Economics* CV(no. 1, February):135–154.

Gokhale, Jagadeesh, Laurence J. Kotlikoff, and John Sabelhaus (1996). "Understanding the Postwar Decline in U.S. Saving: A Cohort Analysis." Forthcoming in *The Brookings Papers on Economic Activity.*

Gustman, Alan L., and Thomas L. Steinmeier (1995). "Privatizing Social Security." September. Mimeo, Department of Economics, Dartmouth College.

Imrohoroglu, Selahattin, He Huang, and Thomas J. Sargent (1995). "Two Computational Experiments to Privatize Social Security." University of Southern California, March. Mimeographed.

Kotlikoff, Laurence J. (1992). *Generational Accounting.* New York: The Free Press.

———, and Avia Spivak. (1981). "The Family as an Incomplete Annuities Market." *Journal of Political Economy* 89(no. 2, April): 372–391.

Merton, Robert C. (1983). "On the Role of Social Security as a Means for Efficient Risk Sharing in an Economy Where Human Capital Is Not Tradable." In *Financial Aspects of the U.S. Pension System.* Zvi Bodie and John B. Shoven (eds.). Chicago: University of Chicago Press, pp. 325–358.

Raffelhueschen, Bernd (1993). "Funding Social Security Through Pareto-Optimal Conversion Policies." *Journal of Economics/Zeitschrift für Nationalökonomie.* Supplement 7:105–131.

Rogot, Eugene, Paul D. Sorlie, and Norman J. Johnson (1992). "Life Expectancy by Employment Status, Income and Education in the National Longitudinal Mortality Study." *Public Health Reports* 107(no. 4, July/August):457–461.

Steurle, C. Eugene, and Jon M. Bakija (1994). *Retooling Social Security for the 21st Century.* Washington, DC: The Urban Institute Press.

World Bank (1994). *Averting The Old Age Crisis.* Oxford, England: Oxford University Press.