Pareto Improving Social Security Reform

by
Douglas H. Joines
Department of Finance and Business Economics
Marshall School of Business
University of Southern California
Los Angeles, CA 90089-1427 USA

January 24, 2005

Preliminary Draft
Please Do Not Quote

Abstract

The last two decades have witnessed the complete or parital privatization of public pension systems in several countries, and many proposals have been made to privatize the U.S. Social Security system either completely or partially. The motivation behind such proposals is that privatization will lead to substantial long-run welfare gains due to an increase in the economy's steady-state capital stock. This buildup of capital requires lower consumption or greater work effort during the short run, however, so that transition generations might suffer welfare losses. Previous analyses of the transition to privatized social security using large-scale, computable, overlapping generations models have generally confirmed both large long-run welfare gains and substantial welfare losses during the transition. This paper uses such a model to explore the characteristics that a reform proposal must have if it is to avoid welfare losses in the short run. Using reasonable parameter values, it claims that a Pareto-improving transition to privatized social security is feasible.

Can Social Security Privatization Be Pareto Improving?

1. Introduction

The last two decades have witnessed the complete or partial privatization of public pension systems in several countries, and many proposals have been made to privatize the U.S. Social Security system either completely or partially. The principal motivation behind such proposals is that privatization of the U.S. system would lead to substantial long-run welfare gains due to an increase in the economy's capital stock. Like government debt, unfunded social security promises currently living individuals an income stream to be financed by future taxes, some of which will fall on individuals not yet born. In a model populated by pure life-cycle consumers or those with sufficiently weak altruism toward future generations, the promises entailed by either government debt or unfunded social security reduce private saving and depress the steady-state capital stock.[1]

The depressing effect of unfunded social security on the capital stock could be avoided either by eliminating social security entirely or by moving to a funded system. Funding, in turn, can be accomplished either by replacing the unfunded system with a system of mandatory private retirement accounts or by maintaining a centralized system but having the government accumulate sufficient assets to pay all benefits promised to current participants. In principle, any of these reforms would result in a long-run increase in the capital stock. Complete elimination of the system might nevertheless be undesirable because of moral hazard issues of the sort considered by Diamond (1977). Because government control of a large portfolio of private assets might entail a different range of problems, most proposals for U.S. Social Security reform have focused on a system of mandatory private accounts.

The overall welfare effects of funding the system remain unclear, whatever the means chosen to achieve it. While funding would result in a larger capital stock, it would also require

[1] The equivalence between unfunded social security and public debt has been noted by Miller and Upton (1974, chapter 8), Feldstein (1974, 1976), and Barro (1974, 1976). Earlier discussions of the burden of the public debt are contained in Modigliani (1961) and Diamond (1965).

lower consumption during the transition to the new steady state, so that transition generations might suffer welfare losses.

Several previous analyses of the transition to funded social security using large-scale, computable, overlapping generations models have confirmed both large long-run welfare gains and substantial welfare losses during the transition. Huang, İmrohoroğlu, and Sargent (1997) model both a fully funded, centralized system and complete elimination of social security. They find that both transitions result in substantial short-run welfare losses before the eventual long-run gains are realized. Kotlikoff, Smetters, and Walliser (1999) consider various methods of handling the transition to a fully funded system. They find that all result in short-run welfare losses that reach a maximum for the hardest-hit cohorts of between two and four percent of consumption of a composite of market goods and leisure. Nishiyama (2002) models a proposal similar to one contained in the report of the President's Commission on Social Security in 2001. This proposal calls for a system of individual accounts that would partially replace the current unfunded system. Like the earlier studies, he finds substantial short-run welfare losses followed by long-run gains. On the other hand, Feldstein and Samwick (1998), who do not use such an explicit model, calculate much smaller transition costs.

The natural question arises as to whether it is possible to manage the transition to a fully or partially privatized social security system in such a way that no cohort has lower welfare than under the current system. It is not at all obvious that such Pareto-improving reforms are possible. To see why, consider the following simple example. Suppose that in a two-period overlapping generations model the government at date $t = 0$ makes an aggregate transfer of D_0 to the old generation. How should this transfer be financed, both intertemporally and intratemporally? A plausible and arguably equitable intertemporal allocation would be to spread the burden of the initial transfer uniformly across all future generations. This could be accomplished by issuing an initial amount of government debt equal to D_0 and letting this debt grow at the economy's aggregate growth rate, g, so as to maintain a constant debt-GDP ratio over time. If the real interest rate is r ($> g$), then this policy would require collecting incremental tax revenue of $(r - g)D_t$ every period to cover debt-service payments, which would remain constant over time as a fraction of income. Intratemporally, it would be efficient to collect the revenue for debt-service payments through lump-sum taxes if these were available. In the absence of lump-sum taxes, distorting taxes would be required instead.

Now consider financing the initial transfer by setting up an unfunded social security system.[2] Such a system would impose a payroll tax that would collect D_0 from the initial young and the same fraction of the earnings of each future generation. The initial young would collect social security benefits of $D_1 = (1 + g)D_0$ during retirement, which is less than the amount $(1 + r)D_0$ that they would have received had their payroll taxes been invested in assets. Thus, the transfer imposes a cost of $(r - g)D_0$ on the first generation of workers, and this cost remains constant as a fraction of earnings from one cohort to the next. The resulting intertemporal pattern of cash flows is the same as under the "fair" intertemporal allocation implemented through government debt.

Unfunded social security collects $(r - g)D_t$ from each cohort to service the debt implicit in the system. This implicit debt service can be viewed as a tax on each cohort's "assets" in the system. Unlike most taxes on income from capital, however, this implicit tax does not distort the margin between consumption and saving since, conditional on earnings, each worker's contributions to the system are mandatory. The marginal rate of return to saving is still the after-tax rate of return on assets. Any distortions are to the margin between consumption and leisure. These distortions could arise for a variety of reasons. First, additional contributions during working years might lead to a less than one-for-one increase in the present value of benefits received during old age. This would be the case if benefits increase less than proportionately with lifetime contributions (as is the case in the U.S. system) or if the implicit return of g on contributions is less than the after-tax discount rate. Second, if the system is overly generous and consumers face binding borrowing constraints (rendering simple present value calculations inappropriate), then an incremental dollar of income during working years might yield a larger increase in lifetime utility than would an increase in future benefits equal to one dollar in present value (Hubbard and Judd, 1987).

Despite these labor market distortions, the U.S. Social Security payroll tax nevertheless possesses certain efficiency properties compared with the income tax (Barro and Sahasakul, 1986). First, it is a tax on labor income rather than income from capital, and heavy taxation of

[2] This is a reasonable characterization of the evolution of U.S. Social Security. Although the original intent was to establish a funded system (Miron and Weil, 1998), funding was for various reasons continually deferred. As a consequence, cohorts alive at the time the system began operation in the late 1930s received positive net transfers, while cohorts born later made net contributions. See Figure 4 in Geanakoplos, Mitchell, and Zeldes (1999).

income from capital might be inefficient (Chamley, 1981; Judd, 1987). Second, the payroll tax is a flat-rate tax on earnings below a cutoff amount, after which the marginal tax rate is zero. Thus, it is in effect a lump-sum tax for high-income workers. Finally, the existence of even a partial linkage between current contributions and future benefits mitigates the distortion of the labor supply decision.

Privatization of social security involves altering either the intertemporal or intratemporal properties (or both) of the mechanism used to of finance the transfer to the initial elderly. In particular, a reduction in the payroll tax means that the inflows to a pay-as-you-go system are no longer sufficient to pay promised benefits. This revenue shortfall implies transition costs that can be borne either by current participants in the system in the form of benefit reductions or by some cohorts (possibly the same ones) in the form of increases in other taxes. Given the efficiency properties noted above, the Social Security payroll tax might constitute as close a substitute for a lump-sum tax as is feasible. If so, then any reform that uses more distorting income taxes would tend to increase the welfare costs of the transfer to the initial elderly. If the transition costs of privatization are financed entirely by a permanent increase in the steady-state debt-GDP ratio, then privatization has no first-order effect on the intertemporal allocation of the burden of the intial transfer. If the transition costs are financed exclusively through such an explicit debt issue, then one would expect little or no change in the steady-state capital intensity, and utilization of more highly distorting income taxes to cover the resulting explicit debt-service payments might well leave individuals worse off than under pay-as-you-go social security. Alternatively, financing a portion of the transition costs by higher taxes during the transition might might permit steady-state welfare gains but leave the transition cohorts worse off. In other words, it is an open question whether Pareto improvements are possible as a result of social security privatization.

This paper employs a 65-period overlapping generations model populated by pure life-cycle consumers (described in section 2) to explore the possibility of Pareto-improving social security privatization. To provide the clearest illustration of the general issues involved, the model is first applied to an economy in which all individuals are identical at birth and both the population growth rate and the age distribution of the population are stationary (section 4 and 5). This economy begins in a steady state with an unfunded social security system much like that currently existing in the United States (characterized numerically in section 3) and moves to a new steady state with a smaller system. This set of experiments indicates that Pareto-improving reforms are possible.

The next set of experiments (not yet completed) considers the more complicated situation in which the demographics evolve much as they have in the United States since World War II but in which all individuals are still identical at birth. The third set of experiments (also not completed) considers distributional issues by assuming that individuals fall at birth into one of the 12 skill types modeled by Kotlikoff, Smetters, and Walliser (1999).

2. The Model

This paper employs a variant of the discrete-time, overlapping generations model of İmrohoroğlu, İmrohoroğlu, and Joines (2003). The current model differs from that one in only three important respects. First, individuals in the earlier model faced idiosyncratic earnings risk which is absent in the current model. Second, individuals in the earlier model could supply positive labor hours up through the last period of life, whereas the current model has a mandatory retirement age. This is assumed to be the age at which individuals first become eligible to collect social security benefits in the initial steady state, and it remains unchanged by any social security reform. Finally, all individuals in this paper have time-consistent preferences.

Demographics

At each date t, a new cohort is born that is n percent larger than the previous cohort. Age is denoted by j, and $j = 1$ in the first period of life. Cohorts are indexed by i, which is equal to the calendar date corresponding to the first period of life. The relation between date, cohort, and age is given by $t = i + j - 1$. In general, a variable needs to be subscripted by only two of these three indices. Variables that change over the life cycle but are stationary from one cohort to the next are indexed only by age. Aggregates describing the entire economy, including market-clearing factor prices, are indexed only by time.

Among these startionary variables are those describing the demographic evolution of the economy. Individuals face long but random lives and some live through age J, the maximum possible life span. Life-span uncertainty is described by y_j, the conditional probability of surviving from age j-1 to j. Both n and y_j are assumed to be time-invariant. Under this stationarity assumption, the cohort shares are also time-invariant and are given by

$$m_j = y_j m_{j-1}/(1+n) \text{ where } \sum_{j=1}^{J} m_j = 1.$$

The unconditional probability of surviving to age j is given by $p_j = \sum_{h=1}^{j} y_h$, where $p_1 = y_1 = 1$.

Individual Preferences and Budget Constraints

Preferences are standard. An individual of cohort i maximizes the utility derived from lifetime sequences of consumption $\{c_{ij}\}$ and work effort $\{\ell_{ij}\}$, and the lifetime utility function is given by

$$U_i = \sum_{j=1}^{J} b^{j-1} p_j \frac{[c_{ij}^{s}(1-\ell_{ij})^{1-s}]^{1-g}}{1-g},$$

where b is the subjective discount factor.

Individuals choose c_{ij}, ℓ_{ij}, and a_{ij}, their holdings of "ordinary" assets at the end of age j, to maximize lifetime utility subject to a sequence of one-period budget constraints

$$c_{ij} + a_{ij} = (1+r_{i+j-1})a_{i,j-1} + w_{i+j-1}e_j\ell_{ij} + B_{ij} + P_{ij} - T_{ij}^{*} + x_{i+j-1}$$

as well as the constraints[3]

[3] Given the form of the utility function, the nonnegativity constraint on consumption is never binding. The zero constraint on labor is also redundant if the efficiency index e_j is calibrated to equal zero for $j \geq j^{*}$.

$$
\begin{aligned}
&c_{ij} \geq 0, \quad && j = 1,2,\ldots,J \\
&\ell_{ij} \geq 0, \quad && j = 1,2,\ldots,j^* - 1 \\
&\ell_{ij} = 0, \quad && j = j^*, j^* + 1,\ldots,J \\
&a_{ij} \geq 0, \quad && j = 1,2,\ldots,J \\
&a_{i0} = 0. &&
\end{aligned}
$$

Here j_j is a time-invariant but age-specific labor efficiency index. The market-clearing wage rate and rate of return at date t are denoted by w_t and r_t, respectively. The other time-specific variable is j_t, a lump-sum transfer payment received by all individuals alive at date t. B_{ij} denotes the social security benefit received by members of cohort i, and P_{ij} denotes a pension from mandatory individual retirement accounts. Both variables are constant for ages $j \geq j^*$ and are zero before that. T_{ij}^* denotes "taxes" paid by a member of cohort i at age j and is the sum of explicit taxes

$$T_{ij} = t_{i+j-1}^{c} c_{ij} + t_{i+j-1}^{a} r_{i+j-1} a_{j} + t_{i+j-1}^{\ell} w_{i+j-1} e_{j} \ell_{ij} + t_{i+j-1}^{s} \max(w_{i+j-1} e_{j} \ell_{ij}, \overline{w}_{i+j-1})$$

and mandatory contributions to individual retirement accounts. Here t_t^c, t_t^a, and t_t^ℓ denote flat-rate taxes on consumption, income from ordinary assets, and labor income, respectively. Note that these tax rates may vary over time but are the same for all cohorts at any date. Social security contributions are the product of a flat contribution rate t_t^s and the larger of an individual's earnings and a time-specific amount of wage income denoted $\overline{w}_t$. The four terms on the right-hand side of the revenue equation are denoted by T_t^c, T_t^a, T_t^ℓ, and T_t^s, respectively.

Mandatory contributions to individual retirement accounts are given by $t_{i+j-1}^{p} \max(w_{i+j-1} e_{j} \ell_{ij}, \overline{w}_{i+j-1})$. Note that the upper limit on the contribution base is assumed to be the same for social security and mandatory private accounts. These contributions are not deductible from taxable earnings and returns on assets held in retirement accounts are not taxed. Upon retirement, the account balance is used to purchase an actuarially fair annuity that makes a fixed periodic payment of B_i until the individual dies. These annuity payments are not subject to income taxation, although any consumption they finance is taxed at the ordinary consumption tax rate.

While the parameters governing contributions to the social security system are assumed to be constant across cohorts at a given date, the benefit formula may vary from one cohort to the next.[4] In the initial steady state, the benefit at the initial retirement age j^* is a concave, piecewise linear function of average "covered" indexed earnings up through age $j^* - 1$, where the indexing adjusts the earnings at age j for aggregate wage growth between age j and retirement and covered earnings at each age are the larger of actual earnings and $\overline{w}_{i+j-1}$. The kink points in the benefit formula are calibrated to match those recently applicable in the U.S. system and are assumed to be unchanged by any reforms of the system. The replacement rates along the three segments are 90 percent, 32 percent, and 15 percent, also in line with recent U.S. practice. The size of the social security system is measured by the contribution rate t^s, and the three replacement rates are all adjusted upward or downward by the same proportion so that the system's budget balances period-by-period in the initial and terminal steady states.

<u>Government</u>

Government in this economy has three functions. First, it makes purchases of goods and services equal to G_t per period. G_t is the amount corresponding to the balanced growth path starting in the initial steady state and is unaffected by any subsequent changes to the social security system. Second, the government makes a lump-sum transfer payment (which in principle could be negative) of j_t to each person alive at time t. This transfer payment is also fixed at the amount implied by the balanced growth path starting in the initial steady state and is unchanged thereafter.[5] Government finances these expenditures by imposing flat-rate taxes on

---

[4] This assumption is in line with historical experience in the U.S. system, where amendments enacted over time have incorporated differential changes in various rules governing benefits for different cohorts.

[5] Allowing the transfer payment to change amounts to assuming that the government has access to lump-sum taxes, an assumption ruled out below when considering financing the transition to a new steady state after reform of the social security system.

consumption, labor income, and income from ordinary assets. In addition, the government is assumed to receive the ordinary assets of all individuals who die before the maximum age J and as well as the assets held in mandatory retirement accounts of individuals who die before the retirement age j^*. Individuals beyond retirement age no longer hold retirement accounts, as the balances have been used to purchase actuarially fair annuities. In the event of premature death, the assets used to finance these annuities go to the surviving annuity holders.

The government's third function is to operate a pay-as-you-go social security system financed by a flat-rate payroll tax on earnings up to $\overline{w}_t$ each period and paying retirement benefits according to the formula described above. In the steady state, aggregate social security contributions equal aggregate benefits in each period. During the transition from one steady state to another, the system is permitted to run a surplus or deficit, with the difference between contributions and benefits being made up from the general government budget.

The government's one-period budget constraint is given by

$$D_t = (1+r_t)D_{t-1} + G_t + B_t + j_t - T_t^c - T_t^a - T_t^{\ell} - T_t^s - x_t$$

where B_t denotes aggregate social security benefits and D_t is end-of-period government debt. Along a balanced growth path the debt grows at rate g, the rate of growth of aggregate output. In addition, aggregate social security contributions and benefits are equal so that, omitting time subscripts, the steady-state budget constraint becomes

$$T^c + T^a + T^{\ell} = \left(\frac{r-g}{1+g}\right)D + \overline{G} + \bar{j} - x.$$

In the initial steady state, the government sets all tax rates, the social security benefit level, and its level of purchases. The lump-sum transfer j is determined as a residual required to balance the budget. In any subsequent steady state, purchases and transfers are set to the levels $\overline{G}$ and $\bar{j}$ determined in the initial steady state.

Production

Output is given by an aggregate Cobb-Douglas production function

$$Y_t = A_t K_t^a L_t^{1-a} .$$

where K_t and L_t denote aggregate capital and labor, respectively, and A_t is total factor productivity, which is assumed to grow at a constant, exogenously given rate. Factor markets are assumed to be competitive, implying that factor prices are given by

$$w_t = (1 - a) A_t K_t^a L_t^{-a}$$
$$r_t = a A_t K_t^{a-1} L_t^{1-a} - d,$$

where d is the depreciation rate of capital.

Experiments

The economy begins in an initial steady state in which there are no mandatory retirement accounts, i.e., $t^p = 0,$ but with an unfunded social security system characterized by a contribution rate $t_0^s \geq 0.$ At the end of period $t = 0$ the government unexpectedly announces a policy change to take effect in the subsequent period. In each experiment, the social security contribution rate is immediately set to a new, lower long-run level t_∞^s, which is zero in the case of complete privatization of the system and positive in the case of partial privatization. In addition, a system of mandatory individual accounts is established along the lines described above.

This policy change will eventually lead to a new steady state which can be characterized fairly simply and to a transition which can take a wider range of possible forms. In the new steady state, the replacement rates along all segments of the social security benefit formula are adjusted downward in the same proportion so that aggregate contributions once again equal aggretate benefits. The debt-GDP ratio may be different in the new steady state than in the old.

In addition, at least one tax rate (other than the social security contribution rate) will generally have to differ from that in the initial steady state. This is fairly clear from the steady-state government budget constraint for the case in which the new level of debt differs from the old, but it is true more generally because of endogenous responses of consumption, work effort, and asset holdings that affect the amount of revenue collected at the original tax rates. For simplicity, attention will be restricted to new steady states in which only one of the tax rates differs from its initial value. These assumptions imply that the new steady state can be characterized by the new values of the debt-GDP ratio, the contribution rates for social security and individual accounts, and one of the other tax rates. The first three of these are set exogenously by the government and the last is determined endogenously so as to satisfy the government budget constraint.

The description of the transition is somewhat more complicated than that of the terminal steady state. The reduction in the social security payroll tax rate is assumed to apply to all workers in period 1, thus immediately reducing the aggregate contributions used to pay benefits. Members of cohorts $J-2$ to $j^{*}-2$ are alive and retired in period 1. They have been promised social security benefits determined by their earnings history under the old policy regime, and it is assumed that the government continues to pay them benefits at least as large as those promised. Members of cohort 1 and later work only under the new policy regime. Upon retirement, they will collect an annuity P financed by their contributions to individual retirement accounts. In the case of partial social security privatiazation they will also collect social security benefits. As under the original regime, these benefits are determined as a piecewise linear function of average indexed earnings over the working career. Under the new regime, the replacement rate along each segment of the benefit schedule is assumed to be roughly equal to t_{∞}^{s}/t_{0}^{s} times the original replacement rate.[6]

By the time they retire, members of cohorts $j^{*}-3$ to 0 will have worked one or more periods under each of the two policy regimes. Work under the new regime entitles them to an

---

[6] Under partial privatization the adjustment in the replacement rates is only approximately equal to the ratio of the tax rates because the change in regime in general results in an endogenous change in hours and earnings. The flat-rate payroll tax implies that aggregate social security contributions are always proportional to aggregate covered earnings. Because of of the concavity of the benefit formula, however, this strict proportionality does not hold for benefits, thus necessitating a further adjustment of the replacement rates if aggregate benefits are to equal aggregate contributions in the new steady state.

annuity that can be determined in a straightforward manner from their contributions to individual retirement accounts. A "baseline" social security benefit can be defined for each of these cohorts by multiplying each of the replacement rates in the original benefit formula by the ratio of average indexed contributions over the worker's career to the average indexed contributions the worker would have made (for a given lifetime earnings history) if the payroll tax rate had not been lowered. Here the indexing is for aggregate wage growth between the period the contribution is made and retirement, just as with the indexing of earnings. The baseline benefit schedule is adjusted downward from one cohort to the next because each cohort has spent one less period contributing at the initial, higher rate t_0^s than the previous cohort did. It is assumed that the benefit paid to members of cohorts $j^* - 3$ to 0 is at least equal to this baseline benefit.

These assumptions imply that the social security system runs a deficit during the transition to the new steady state. The government can finance these transition costs by increasing general tax revenues and/or issuing additional public debt. The government chooses a debt-GDP ratio for the new steady state that may be higher than the initial ratio. In most experiments it is assumed to adjust one of the tax rates along the transition path so as to hit this terminal debt ratio. The chosen tax rate is assumed to remain unchanged until period t_1, at which point it jumps (generally upward). The tax rate reaches its terminal steady-state value in period t_2. The size of the jump at t_1 is determined by the terminal debt-GDP ratio. The adjustment between periods t_1 and t_2 is assumed to be linear, and additional time beyond t_2 is required for the economy to reach its final steady state.

3. Calibration and Initial Steady State

The model is calibrated so that the initial steady state matches certain long-run features of the U.S. economy. The capital share parameter in the production function is set to 0.31 and the depreciation rate to 0.044. One model period is taken to be a year. The annual growth rate of per capita output is 1.65 percent and the rate of growth of population is 1.20 percent. Age-specific survival probabilities are taken from U.S. Life Tables. The initial period of a model individual's life is assumed to correspond to a real-time age of 21, and the maximum possible life span J is

85, corresponding to a real-time age of 105. Mandatory retirement is assumed to occur at model age 45.

In the initial steady state, government purchases are set to 0.18 and the tax rates on consumption, labor income, and income from ordinary assets are set to 5.5 percent, 20 percent, and 40 percent, respectively. The initial social security contribution rate is 10 percent and the debt-GDP ratio is 0.40.

Given these technology and policy parameters, the preference parameter s is set to match labor input, while g is set to 2.0. The subjective discount factor b and the initial level of total factor productivity are set to give a capital stock of 2.52 and a value of 1.0 for output.[7]

Figure 1 shows consumption, assets, and labor as functions of age in the initial steady state. The age-consumption profile has the same general shape as those identified from U.S. data. In particular, consumption exhibits a discontinuous drop at retirement similar to that documented in a variety of studies of U.S. data and by Banks, Blundell, and Tanner (1998) for British data.

4. Comparing Terminal Steady States

Given that the goal of social security reform is long-run utility gains, it is worth comparing the properties of the steady states associated with various alternative reforms before analyzing the transitions in more detail. As noted above, these new steady states can be characterized by values of the debt-GDP ratio, the contribution rates to social security and individual retirement accounts, and one of the general tax rates. It can be seen from the steady-state government budget constraint that, assuming the economy is dynamically efficient, an increase in the debt-GDP ratio will require an increase in tax revenue to meet the higher debt-service payments. Even without an increase in the public debt, reforms of the sort considered here generally require an increase in the consumption or income tax rates. This is because these reforms, which set up a system of mandatory, tax-exempt individual retirement accounts, tend to

[7] See İmrohoroğlu, İmrohoroğlu, and Joines (1999) for a further justification of these parameter values.

cause individuals to reduce their holdings of ordinary, taxable assests (İmrohoroğlu, İmrohoroğlu, and Joines, 1998) . Thus, some tax rate must be raised to replace the lost revenue.

The first result of simulating such a complete or partial privatization of social security is that it is not desirable to impose a higher tax rate on income from ordinary assets in the new steady state. In fact, it may be impossible to raise this tax rate sufficiently to generate the required revenue. For example, Figure 2 shows steady-state Laffer curves for two privatization experiments, one with $t_{\infty}^{p} = 0.02$ and $t_{\infty}^{s} = 0.08$ (partial privatization) and another with $t_{\infty}^{p} = 0.06$ and $t_{\infty}^{s} = 0.00$ (full privatizaton). The vertical axis shows combined revenue from the taxes on consumption, labor income, and ordinary assets as a function of the asset tax rate, holding constant the other two tax rates. The figure indicates that the revenue-maximizing tax rate is actually lower than the value of 40 percent assumed in the initial steady state.

A second general result is that raising the additional revenue required in the terminal steady state through the consumption tax yields higher utility than increasing the labor income tax. Figure 3 shows the utility gain in the terminal steady state at various terminal debt-GDP ratios for a particular privatization experiment in which $t_{\infty}^{p} = 0.06$ and $t_{\infty}^{s} = 0.04$. The utility gain is expressed as a percentage increase in consumption at all ages along the initial balanced growth path. Regardless of whether the consumption tax or the labor income tax is used to generate the required additional revenue, a higher debt-GDP ratio leads to a smaller capital stock and implies a higher tax ratre, thus resulting in lower welfare in the new steady state. At any debt-GDP ratio, use of the consumption tax results in higher utility than does raising the labor income tax. Consequently, attention will be confined to privatization experiments where only the consumption tax rate is increased in the new steady state.

Figure 4 compares the utility gains in the new steady state resulting from three different privatization experiments, two of which require that $t_{\infty}^{p} + t_{\infty}^{s} = t_{0}^{s} = 0.10$. A debt-GDP ratio of 0.4 in the terminal steady state, which is equal to that in the initial steady state, implies that all transition costs are financed by higher tax revenue along the transition path. The figure indicates that a small, partial privatization with $t_{\infty}^{p} = 0.02$ and $t_{\infty}^{s} = 0.08$ lowers welfare in the new steady state even if none of the transition costs are financed by issuing new public debt. Assets held in individual retirement accounts ultimately equal 40 percent of total assets that would have been accumulated along the initial balanced growth path. Ordinary assets fall by a slightly greater amount, so that total assets are about 0.5 percent lower than initially. Government revenue from the asset tax falls by about 40 percent, requiring an increase in the consumption tax rate from 5.5 percent to 12.8 percent. In the absence of a substantial increase in the capital stock, the distortions caused by the higher consumption tax rate reduce welfare.

Figure 4 also shows the utility gains resulting from privatizations involving a 6-percent contribution rate to private accounts. These reforms are large enough to lead to substantial increases in the capital stock, resulting in substantial utility gains in the case where none of the transition costs are financed with public debt. Furthermore, utility would increase in the new steady state even with a fourfold increase in the debt-GDP ratio. The utility gain is larger if social security is eliminated entirely than if the two contribution rates are constrained to sum to the original social security contribution rate of 0.10. One reason for this is apparent in Figure 5, which shows the age-consumption profiles associated with these two privatization experiments as well as the profile for the initial balanced growth path. Because assets held in retirement accounts earn a return substantially above that on a worker’s implicit assets in the unfunded social security system, individual accounts with a 6-percent contribution rate yield retirement income roughly equal to that provided by social security with a 10-percent contribution rate (the initial situation). Private accounts lead to higher lifetime utility, however, because they require a smaller sacrifice of consumption during working years. Retaining unfunded social security on a reduced scale leads to substantially higher retirement income than provided by the original system and results in a sharp upward jump in consumption at retirement. Individuals would like to borrow against this retirement income but cannot do so. The resulting allocation of consumption over the life cycle is so skewed toward old age that it yields lower lifetime utilitly than complete elimination of social security. In addition, elimination of social security leads to a 25-percent increase in the capital stock, compared with a 22-percent increase if a small social security system is retained.

Having established that complete or partial privatization of social security can increase welfare in the new steady state, we now turn to the question of the effects on cohorts alive during the transition.

5. Transition Effects

Figure 6 shows the transition to the new steady state for the complete privatization experiment in which $t_{\infty}^{p} = 0.06$, $t_{\infty}^{s} = 0.00$, and the terminal debt-GDP ratio is 1.0. The top panel shows the consumption tax rate, which jumps upward from 5.5 percent to 19.0 percent at time $t_1 = 1$ and then decreases to its new steady-state value of 16.56 percent at $t_2 = 100$. The reduction in the payroll tax rate causes an immediate substitution away from leisure and toward consumption of market goods. Aggregate labor jumps upward by more than 10 percent before settling at a new value about 8 percent higher than in the initial steady state. Consumption jumps upward by about 6 percent. The net effect is an increases in saving, which causes the capital stock to increase gradually to a value about 21 percent higher than in the initial steady state. Output is about 12.4 percent higher in the new steady state, and consumption is about 13.3 percent higher.

In the absence of any other change in taxes or transfers, the increase in the consumption tax rate at time t_1 would lower the welfare of retirees and workers close to retirement, all of whom will collect benefits accrued under the old pension system. In order to prevent such welfare losses, the government is assumed to increase the pension benefits paid to transition generations above the level accrued under the old system given their lifetime contributions. The top panel of Figure 7 shows the benefits accrued by each transition cohort under the old system as well as the benefits actually paid. These benefits begin at age 45 for cohorts not yet retired at time t_1 and at time t_1 for those already retired, and they are expressed as a ratio to the benefits accrued that would have been paid under the old system. Cohorts already retired at the time of the policy reform receive and immediate 30-percent increase in benefits.

The bottom panel of Figure 7 shows the effect of the pension reform on the lifetime utility of various cohorts. The effect on utility is expressed as a percentage change in consumption at all remaining ages, with positive numbers denoting welfare gains. The pension reform described above either raises or holds constant the lifetime utility of all cohorts alive at the time of the reform. The welfare gain in the new steady state is about 5.8 percent of consumption. The welfare gains increase smoothly and monotonically from one cohort to the next for cohorts born after time 0. The pattern of welfare gains for cohorts alive at the time of the reform is an artifact of the pattern of benefits shown in the top panel and could be smoothed out by refining these benefit payments.

[Additional results to be reported.]

6. Additional Experiments and Conclusions

[Experiments using U.S. rather than stationary demographics and considering distributional effects.   To be written.]

References

Banks, James, Richard Blundell, and Sarah Tanner (1998). "Is There a Retirement Savings Puzzle?", *American Economic Review* 88 (September): 769-788.

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

________ (1976). "Reply to Feldstein and Buchanan", *Journal of Political Economy* 82 (April): 343-350.

________ and Chaipat Sahasakul (1986). "Average Marginal Tax Rates from Social Security and the Individual Income Tax", *Journal of Business* 59 (October): 555-566.

Chamley, Christophe (1981). "The Welfare Cost of Capital Income Taxation in a Growing Economy", *Journal of Political Economy* 89 (June): 468-496.

Diamond, Peter A. (1965). "National Debt in a Neoclassical Growth Model", *American Economic Review* 55 (December): 1126-1150.

________ (1977). "A Framework for Social Security Analysis", *Journal of Public Economics* 8 (December): 275-298.

Feldstein, Martin S. (1974). "Social Security, Induced Retirement, and Aggregate Capital Accumulation", *Journal of Political Economy* 82 (September-October): 905-926.

________ (1976). "Perceived Wealth in Bonds and Social Security: A Comment", *Journal of Political Economy* 84 (April): 331-336.

________ and Andrew Samwick (1998). "The Transition Path in Privatizing Social Security", in Martin Feldstein, ed., *Privatizing Social Security*, University of Chicago Press.

Geanakoplos, John, Olivia S. Mitchell, and Stephen P. Zeldes (1999). "Social Security Money's Worth", in Olivia S. Mitchell, Robert J. Myers, and Howard Young, eds., *Prospects for Social Security Reform*, University of Pennsylvania Press.

Huang, He, Selahattin İmrohoroğlu, and Thomas J. Sargent (1997). "Two Computations to Fund Social Security", *Macroeconomic Dynamics* 1: 7-44.

Hubbard, Glenn R., and Kenneth L. Judd (1987). "Social Security and Individual Welfare: Precautionary Saving, Borrowing Constraints, and the Payroll Tax", *American Economic Review* 77 (September): 630-646.

İmrohoroğlu, Ayse, Selahattin İmrohoroğlu, and Douglas H. Joines (1998). "The Effect of Tax-Favored Retirement Accounts on Capital Accumulation", *American Economic Review* 88 (September): 749-768.

________ (1999). "Social Security in an Overlapping Generations Economy with Land", *Review of Economic Dynamics* 2 (July) :

________ (2003). "Time-Inconsistent Preferences and Social Security", *Quarterly Journal of Economics* 118 (May): 745-784.

Judd, Kenneth L. (1987). "The Welfare Cost of Factor Taxation in a Perfect-Foresight Model", *Journal of Political Economy* 95 (August): 675-709.

Kotlikoff, Laurence J., Kent Smetters, and Jan Walliser (1999). "Privatizing Social Security in the United States – Comparing the Options", *Review of Economic Dynamics* 2 (July) : 532-574.

Miller, Merton H., and Charles W. Upton (1974). *Macroeconomics: A Neoclassical Introduction*, Irwin.

Jeffrey A. Miron and David N. Weil (1998). "The Genesis and Evolution of Social Security", in Bordo, Goldin, and White, eds., *The Defining Moment: The Great Depression and the American Economy in the Twentieth Century*, University of Chicago Press.

Modigliani, Franco (1961). "Long-Run Implications of Alternative Fiscal Policies and the Burden of the National Debt", *Economic Journal* 71 (December): 730-755.

Nishiyama, Shinichi (2002). "Simulating Social Security Reform in a Stochastic OLG Economy with Heterogeneous Agents", manuscript, Congressional Budget Office (November).

Figure 1

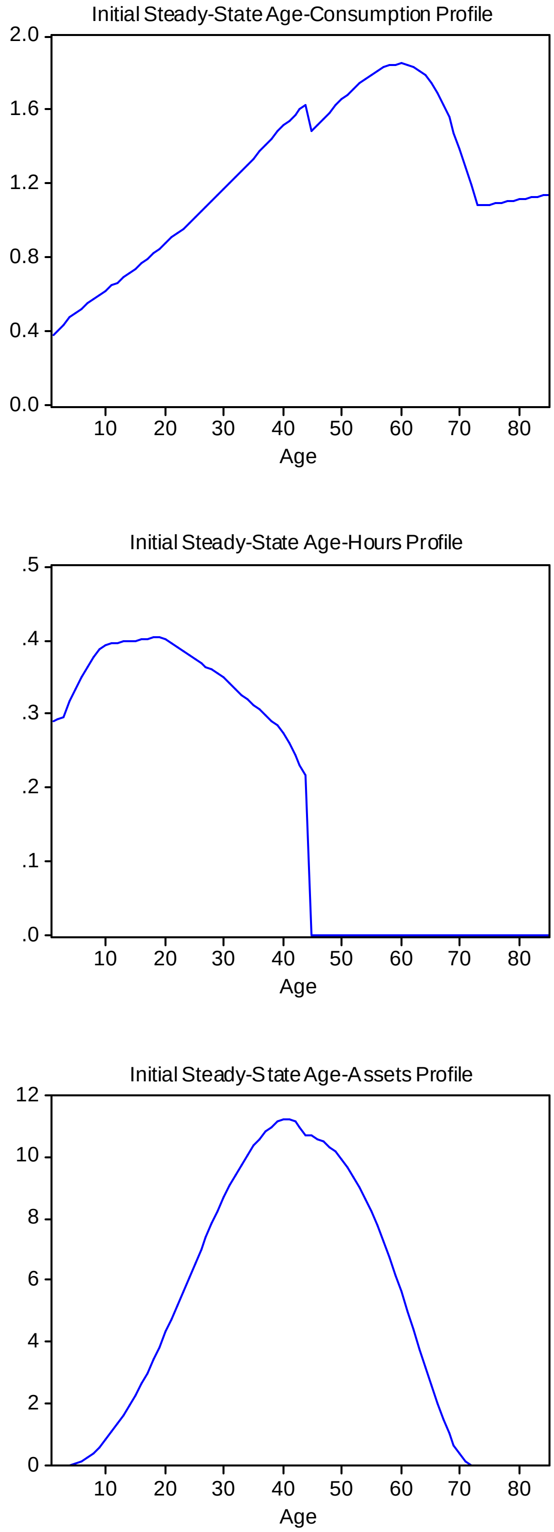

Initial Steady-State Age-Consumption Profile
2.0
1.6
1.2
0.8
0.4
0.0
10 20 30 40 50 60 70 80
Age
Initial Steady-State Age-Hours Profile
.5
.4
.3
.2
.1
.0
10 20 30 40 50 60 70 80
Age
Initial Steady-State Age-Assets Profile
12
10
8
6
4
2
0
10 20 30 40 50 60 70 80
Age

Figure 2
Steady-State Laffer Curves

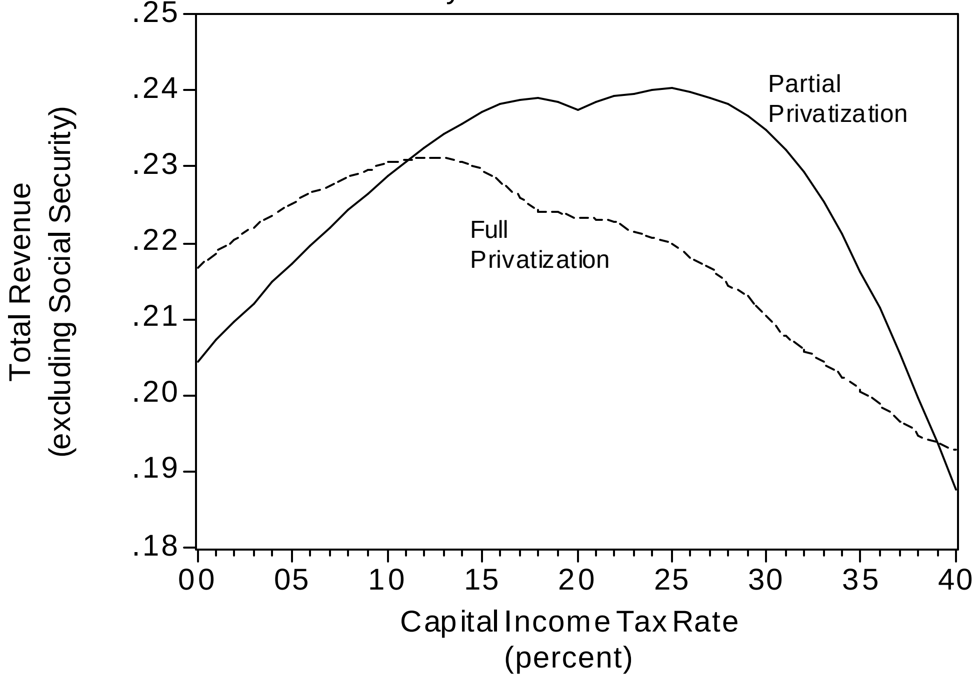


Figure 3
Utility Gain in Terminal Steady State

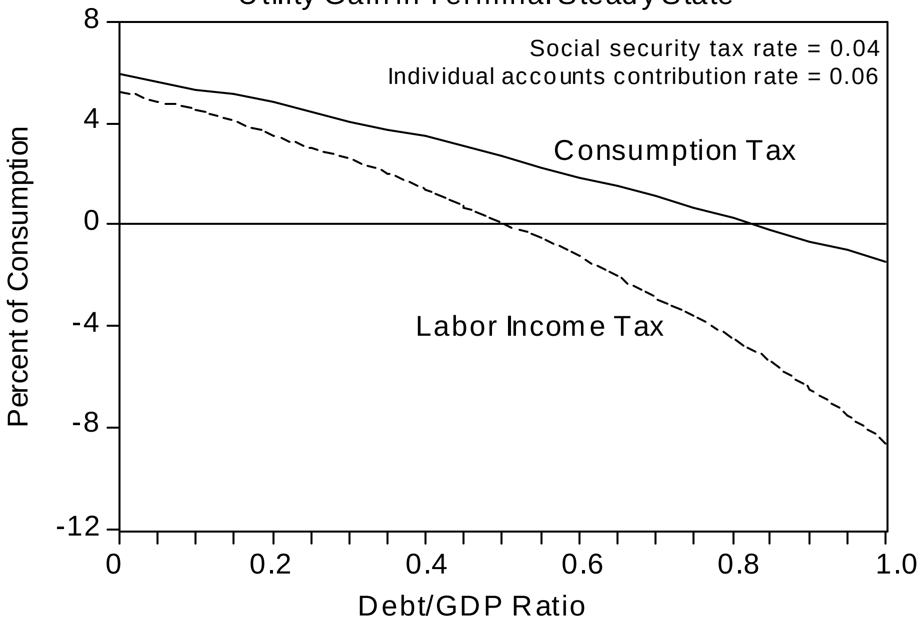


Figure 4
Utility Gain in Terminal Steady State

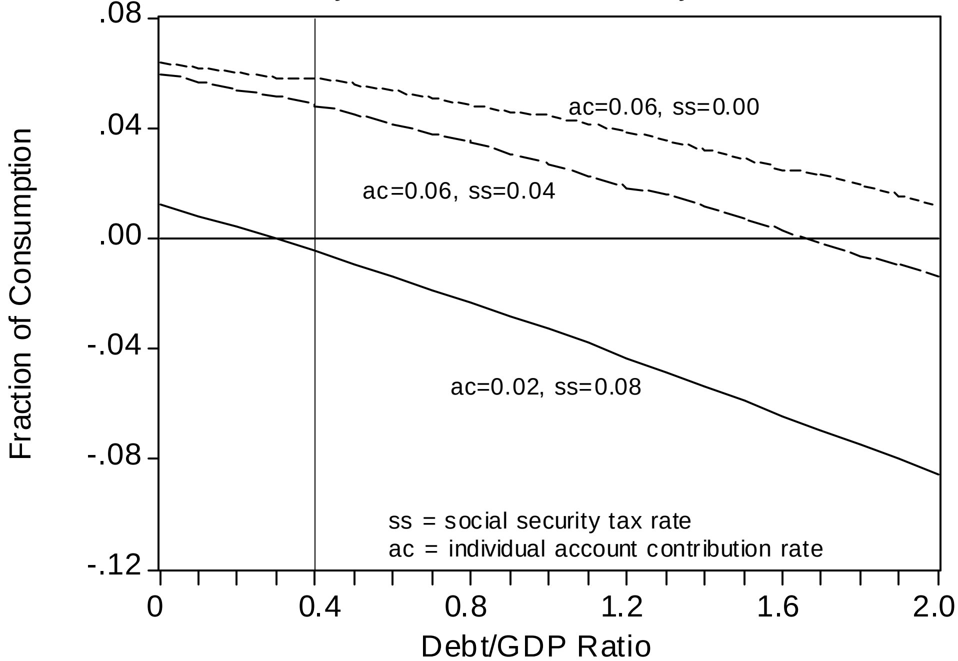


Figure 5
Steady-State Age-Consumption Profiles
(Debt/GDP Ratio = 0.40)

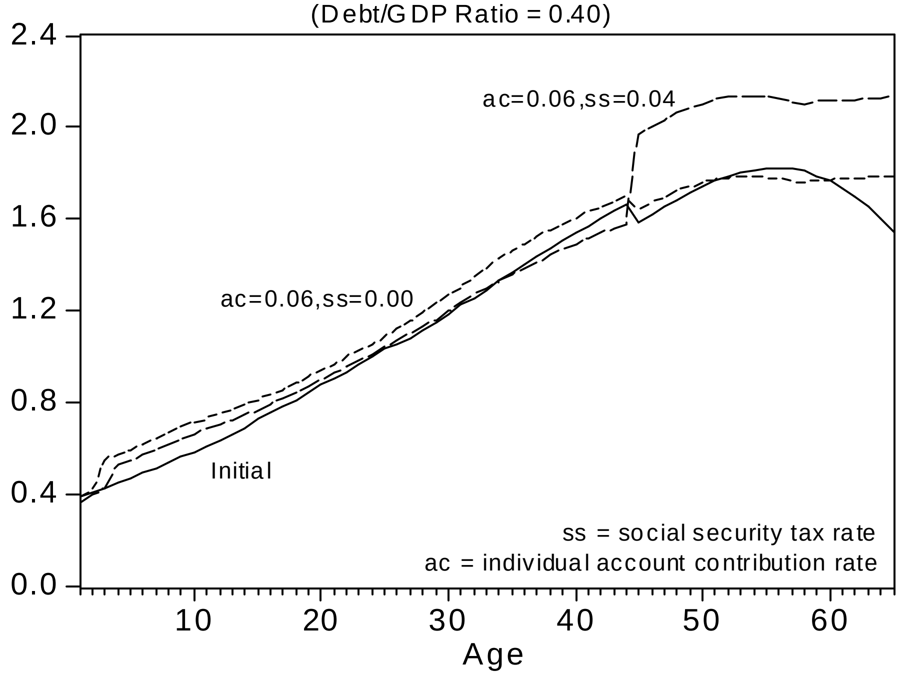
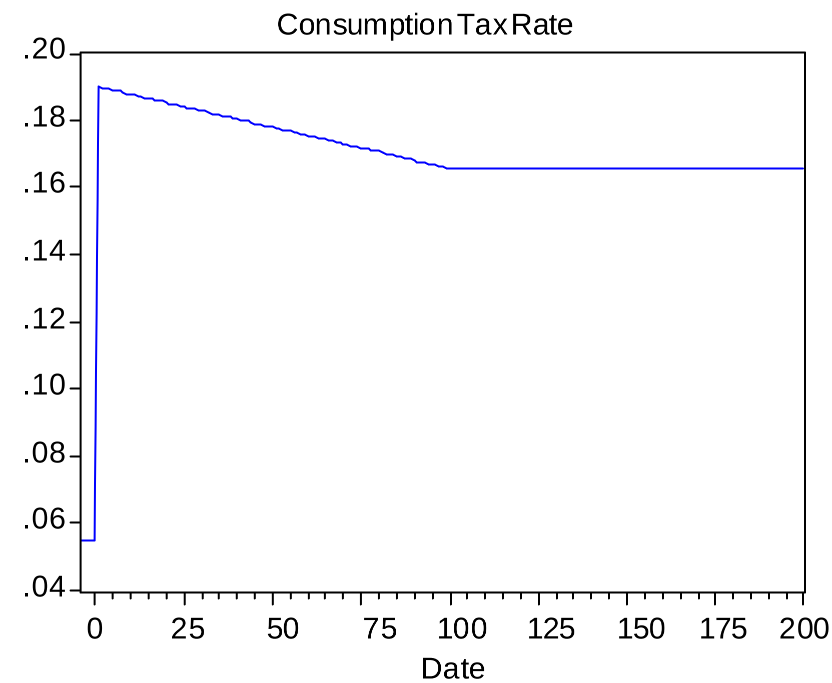


Figure 6


Consumption Tax Rate
.20
.18
.16
.14
.12
.10
.08
.06
.04
0
25
50
75
100
125
150
175
200
Date

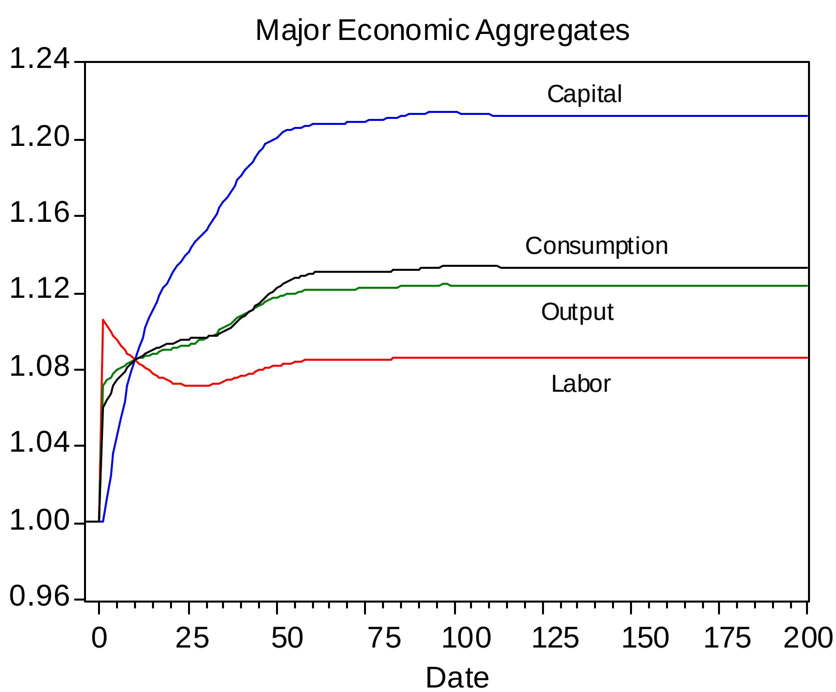
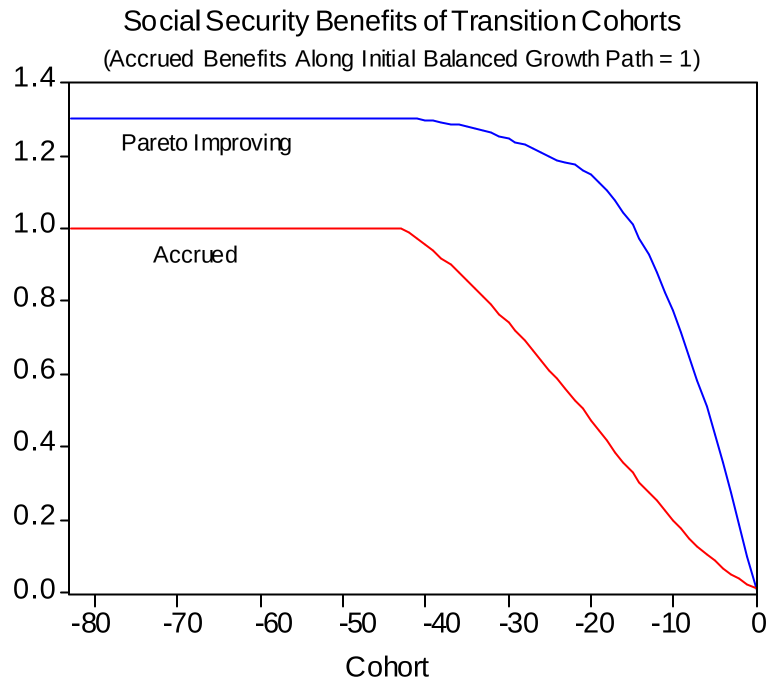
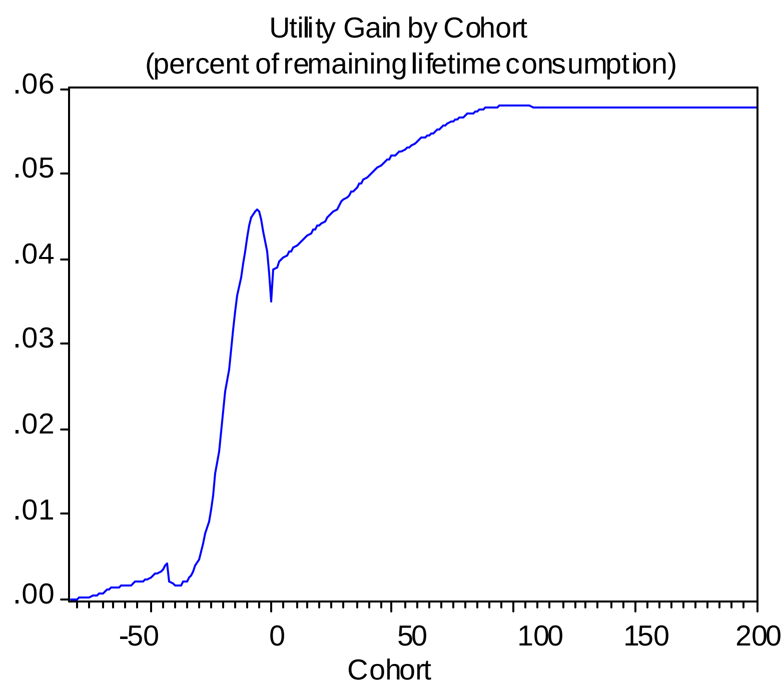

Major Economic Aggregates
1.24
1.20
1.16
1.12
1.08
1.04
1.00
0.96
Capital
Consumption
Output
Labor
0
25
50
75
100
125
150
175
200
Date

Figure 7


Social Security Benefits of Transition Cohorts
(Accrued Benefits Along Initial Balanced Growth Path = 1)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Pareto Improving
Accrued
-80
-70
-60
-50
-40
-30
-20
-10
0
Cohort


Utility Gain by Cohort
(percent of remaining lifetime consumption)
.06
.05
.04
.03
.02
.01
.00
-50
0
50
100
150
200
Cohort