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Privatizing Social Security in the United States — Comparing the Options*

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This paper uses a new version of the Auerbach–Kotlikoff model to consider alternative ways to privatize the U.S. Social Security System. The new model incorporates intra- and intergenerational heterogeneity and is closely calibrated to U.S. fiscal institutions. Three privatization issues are considered: financing the transition, participation rules, and progressivity. As shown, Social Security's privatization can substantially raise long-run living standards. But these gains come at the cost of welfare losses to transition generations and take a long time to materialize. The long-run poor have much to gain from privatization even absent an explicit redistribution mechanism. Finally, privatizations that give initial workers the option of remaining in the current system have particularly low transition costs and particularly favorable macroeconomic consequences. *Journal of Economic Literature* Classification Numbers: D9, E6.

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I. INTRODUCTION

Public debate about privatizing the U.S. Social Security System has intensified in recent years. Unfortunately, this debate has been remarkably unconstrained by the lessons of economic science. Advocates of reform have tended to portray privatization as a costless panacea, while opponents have suggested it will hurt the elderly, particularly the elderly poor. This paper finds the truth where one might expect: in the middle. Although privatization offers significant long-run gains, it does so at some nontrivial short-run costs. The precise size of the gains and the speed of their arrival depend critically on the precise manner in which privatization occurs.

This paper studies Social Security's privatization using a substantially enhanced version of the Auerbach–Kotlikoff (1987) perfect foresight dynamic simulation model. The new model, developed by Kotlikoff *et al.* (1999, 1997, 1998a, 1998b) and Altig *et al.* (1997), incorporates intra- as well as intergenerational heterogeneity and is closely calibrated to U.S. fiscal institutions. Three dimensions of Social Security's privatization are considered here: the method of financing the transition, the rules governing participation in the new retirement system, and the method of making the new system progressive.

The alternative transition taxes are the payroll tax, the income tax, and the consumption tax. Participation in the new system is mandatory for all new workers, but may be either compulsory or voluntary for existing workers. Progressivity in the new retirement system is introduced via a flat (basic) benefit or through the government's matching, on a progressive basis, of contributions made to private retirement accounts. Simulations are conducted assuming that the economy is either closed or fully open to international capital flows and that workers do or do not fully appreciate the extent of the marginal benefit–tax linkage provided by the current system.

This study's key findings are as follows.

Long-run macroeconomic performance. Fully privatizing Social Security without increasing the long-run stock of explicit government debt produces major long-run increases in the capital stock, labor supply, national income, and real wages. Privatizations that introduce new unfunded liabilities in the form of a flat, pay-as-you-go-financed benefit culminate in markedly smaller economic gains.

Short-run macroeconomic performance. The type of transition finance, the choice of participating in the new system, and the extent of government contribution matching are key determinants of short-run macroeconomic performance.

Speed of the transition in closed economics. Privatizations of Social Security take a very long time to improve closed economies. This is true even in the case of consumption-tax finance, which generates the quickest macroeconomic effects by eliciting a significant consumption sacrifice from middle- and upper-income initial retirees. In contrast, income-tax finance *reduces* the capital stock, labor supply, and national income during the first 25 years of the transition due to temporarily large increases in marginal tax rates.

Opting out. Giving workers the option to opt out of the old Social Security system improves short-run macroeconomic performance. Why? Because workers who opt out are forced to forgo all of their accrued Social Security benefits. This obviates the need to pay these benefits during the transition.

Progressivity. Matching workers' contributions to their private accounts on a progressive basis generates larger short-run gains than does using a pay-as-you-go-financed flat benefit when the transition is financed with a consumption tax, but not when it is financed using a wage or an income tax.

Long-run welfare effects. All income classes alive in the long run can benefit from Social Security's privatization. This is true even for privatizations that involve no progressive elements. Progressive contribution matching leads to a more progressive distribution of the long-run gains. But the same is not true of privatizing, but maintaining a flat Social Security benefit. In this case, the long-run poor are actually worse off. The benefits to the long-run poor of the flat benefit is outweighed by the lower real wages that eventuate from this provision.

Short-run welfare effects. Wage-tax finance of the transition reduces the welfare of initial retirees by substantially less than does either consumption- or income-tax finance. The reason is simple: retirees pay consumption taxes and income taxes on their capital income, but not wage taxes. Initial retirees are also better off under privatizations with an opting out provision since the government continues to collect some revenue from payroll taxes. Although good for the initial elderly, voluntarism generates larger welfare losses for the initial middle-aged agents across the entire income distribution. These agents choose to remain in the old system and, therefore, pay both the existing payroll tax and the new income or consumption tax used to finance the transition.

Open economy simulations. Treating the United States as a small open economy almost doubles the long-run total (domestic plus international) wealth holdings of the economy and raises the long-run per-capita factor

income from domestic and foreign sources by about 16%. The economy also converges much more rapidly to its long-run position. Moreover, the open-economy simulations generate smaller welfare losses to the early transitional generations, but at the cost of smaller gains to generations born in the long run. The reason is that in the open-economy simulations, domestic wages are policy-invariant.

Literature Review

The literature dealing with Social Security's privatization is rapidly growing. It includes Feldstein (1975), Seidman (1983), Arrau and Schmidt-Hebbel (1993), Feldstein (1995), Gustman and Steinmeier (1995), Kotlikoff (1996), Samwick (1996), Kotlikoff *et al.* (1997), Altig and Gokhale (1997), Feldstein and Samwick (1997), Huang *et al.* (1997), and Imrohoroglu *et al.* (1995, 1998). Some of these papers employ partial-equilibrium models, but most are general-equilibrium studies.

Our own work on privatization appears in Kotlikoff *et al.* (1997a, 1997b, 1998a, 1998b]). Each of those papers considers a particular aspect of privatization. In Kotlikoff *et al.* (1997a, 1997b) all workers are immediately enrolled in a new privatized system, although the benefits they accrued under the old system are recognized and paid to them in retirement. These accrued benefits are financed by wage, income, or consumption taxation. Kotlikoff *et al.* (1998a, 1998b) permit voluntary participation by workers in the new system, albeit at the price of the complete loss of those benefits they accrued under the old system. General revenues are used to offset the loss of payroll taxes in financing transition benefits. Kotlikoff *et al.* (1998b) add to the policy mix two alternative redistribution mechanisms: a flat benefit and a progressive matching by the government of contributions to individual accounts.

This paper reviews the lessons of our prior research. It also examines additional privatization options and the sensitivity of our previous findings to the openness of the economy. Space considerations limit our presentation to key results; the mathematical description of the model and the solution methodology can be found in Kotlikoff *et al.* (1998a).

II. THE MODEL

Our model is a substantially enhanced version of that developed by Auerbach and Kotlikoff (1987). Like their approach, our model features 55 overlapping generations. But unlike their approach, our model follows Fullerton and Rogers' (1993) approach in including intragenerational heterogeneity. In particular, it posits 12 lifetime income groups, each with

its own age–wage profile estimated with PSID data. Groups 1 and 12 constitute the bottom and top 2% of lifetime wage earners, and groups 2 and 11 the remaining 8% of the top and bottom deciles. All other groups constitute 10% of the population. For example, group 3 is the second decile of lifetime-wage income, group 4 is the third decile, and so on up to group 10.

The new model is also much more closely calibrated to the U.S. Social Security System. It includes the statutory progressive bend-point formula used by the Social Security Administration to calculate retirement benefits as a function of average wage-indexed preretirement wage income. Each worker's replacement rate is calculated with a sixth-order polynomial that replicates the statutory replacement rate function based on the bend-point formula to a very close approximation (Fig. 1). Statutory payroll tax rates are calculated endogenously to meet the pay-as-you-go financing con-

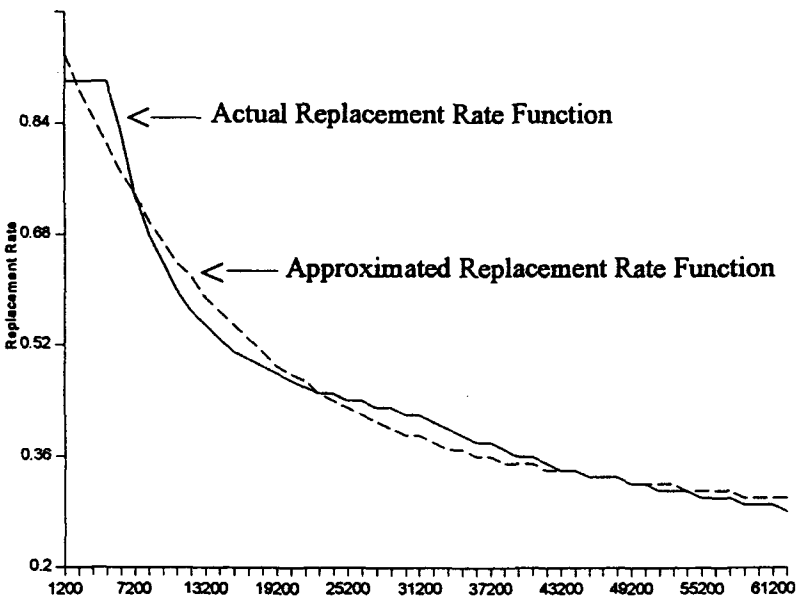

FIG. 1. The U.S. replacement rate as a function of average indexed yearly earnings, $R(\cdot)$, for a single person retiring in 1996: actual and polynomial approximated. Actual replacement rate is computed using the statutory formula for a person turning age 62 in 1996. The monthly benefit equals 90% of first \$437 of covered average indexed monthly earnings (*AIME*) plus 32% of the next \$2,198 plus 15% above \$2,635. *AIME* converted to average indexed yearly earnings (*AIYE*) by multiplying times 12. Replacement rate for single worker with retired spouse equals $1.5 \cdot R(\cdot)$. Predicted $R(AIYE) = 0.9927 - 4.37\text{E-}05 \cdot AIYE + 1.2\text{E-}09 \cdot AIYE^2 - 1.9\text{E-}14 \cdot AIYE^3 + 1.5\text{E-}19 \cdot AIYE^4 - 6.1\text{E-}25 \cdot AIYE^5 + 9.8E\text{-}31 \cdot AIYE^6$. The regression $R^2 = 0.99$.

straint. The model also includes a simple treatment of the Medicare and Disability Insurance programs.

The new model incorporates the key features of the U.S. federal, state, and local hybrid income-tax system. This is important because the tax system plays a pivotal role in privatizing Social Security. Since the current U.S. income-tax base covers only 57% of national income, the model includes an array of tax-base reductions whose inclusion permits us to use actual tax schedules to calculate taxes. These tax-base reductions produce two kinks in the consumer's budget constraint. The first kink is associated with the statutory nonrefundable deductions of the federal income tax. The second kink arises from Social Security's payroll tax ceiling. The U.S. tax system also features accelerated depreciation, excise taxes, and consumption-tax treatment of pension fringe benefits and other features—all of which are included in our model.

We entertain two informational assumptions about the Social Security tax–benefit linkage perceived by consumers: full perception and no perception. Figure 2 presents the *net* marginal payroll tax rate (the payroll tax paid minus the present value of benefits received on an additional dollar of wages) by lifetime income class and age if people perfectly perceive how benefits change at the margin with additional earnings. The net payroll tax

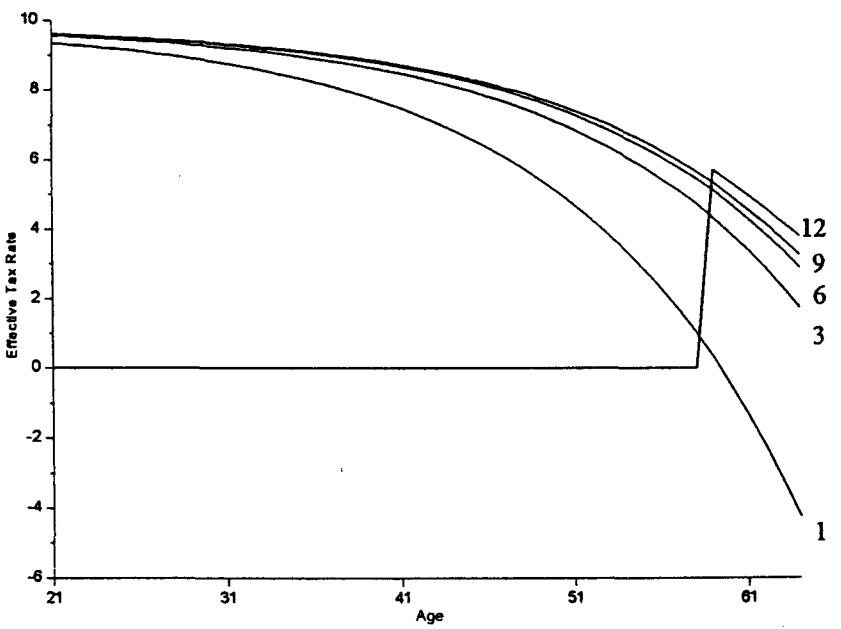

FIG. 2. Effective marginal social security tax rates by age and income class.

rate simply equals the statutory rate when consumers fail to perceive any link between taxes and benefits. Modeling the case of no perceived linkage seems important to us. While everyone faces the same statutory tax rate up to the covered earnings ceiling, Fig. 2 shows that the net tax rate varies significantly across lifetime income classes and over the life cycle within each lifetime income class. Moreover, given the complexity of social security's benefit provisions, it is highly unlikely that people understand the true marginal net tax they face.

The model's key parameter values are shown in Table I. Given these values, the model generates a pretax interest rate of 9.3%, a net national saving rate of 5.3%, and a ratio of capital to national income of 2.6. Consumption accounts for 73.4% of national income, net investment for 5.2%, and government purchases of goods and services for 21.4%. These figures are very close to their respective 1996 NIPA values. The post-tax interest rate equals 0.08 and is calculated following Auerbach (1996). Summary statistics for the initial economy are provided in Table II.

Limitations

Although the model incorporates many complex features, it abstracts in important ways from reality and the exact numerical results should be interpreted cautiously. It incorporates neither aggregate nor individual uncertainty. In ignoring lifespan uncertainty, the model implicitly assumes that adverse selection in the private annuities market either is unimportant or is effectively dealt with via mandated annuitization. Moreover, the model does not include liquidity constraints that could influence the economy's response to privatization.

III. SIMULATIONS

This section describes the results of 19 simulations (*runs*) of Social Security's privatization.

Benchmark Simulations

Runs 1 through 6 are our benchmark simulations. In these runs, participation in the new system is mandatory and privatization involves (a) requiring workers to contribute to private accounts, (b) paying retirees and workers Social Security benefits in retirement that roughly equal those they have accrued at the time of the reform, and (c) financing these accrued Social Security benefits.

In our model, privatizing Social Security contributions simply requires setting the model's Social Security payroll tax rate to zero; i.e., there is no

TABLE I
Benchmark Parameter Definitions and Values

Symbol	Definition	Value
	Preferences	
α	Utility weight on leisure	1.00
δ	Rate of time preference	0.015
γ	Intertemporal substitution elasticity	0.25
μ^j	Utility weight placed on bequests by income class j	[a]
ρ	Intratemporal substitution elasticity	0.80
Human Capital		
ε_s^j	Productivity of agent in income class j at age s	[b]
Demographics		
n	Population growth	0.01
N	Number of children per adult $(1 + n)^{20}$	1.22
ϕ^j	Fraction of agents of income class j	[c]
Technology		
λ	Technological change	0.01
b	Adjustment costs	0.00
θ	Net capital share	0.25
Debt, Taxes, Deductions in Initial Steady State		
—	Debt service as fraction of national income	0.0350
—	Disability tax rate	0.0185
—	Medicare tax rate	0.0290
—	Progressive Social Security (OAI) replacement rate	[d]
—	Social Security marginal tax–benefit linkage	0.25
—	Payroll tax ceiling	$62,700
$T^{C'}$	Proportional consumption tax	0.113
$T^{K'}$	Proportional capital income tax	0.20
$T^W(\cdot)$	Kinked progressive wage tax with standard deduction	[e]
$T^{Y'}$	State proportional income tax less evasion adjustment	0.011
—	Itemized deductions proportional wage base reduction	0.0755[f]
—	Fringe benefits proportional wage base reduction	0.1129[f]
z	Expensing[g]	0.20

[a] Calibrated endogenously in the initial state to match the level of bequests—as a fraction of mean national income—in Fullerton and Rogers (1993, Table 3-8), calibrated to 1996 dollars.

[b] See Appendix for estimation procedure.

[c] $\phi^1 = 0.02$, $\phi^2 = 0.08$, $\phi^i = 0.10$ $(3 \leq i \leq 10)$, $\phi^{11} = 0.08$, $\phi^{12} = 0.02$.

[d] The statutory progressive bendpoint formula for 1996, scaled up by a factor of 2 to account for the fact that other non-DI benefits (mainly spousal and survivors benefits) account for 50% of all benefits paid (see 1996 OASDI Trustees Report, Table II.C7).

[e] The 1996 statutory tax function for a single individual with a deduction equal to $9661 ($4,000 standard deduction, $2550 personal exemption and $2550 · N exemption for dependents).

[f] Total proportional base reduction above the standard deduction therefore equals 0.18845.

[g] Deductions for new investment above economic depreciation and adjustment costs.

TABLE II
Key Endogenous Equilibrium Values for the Initial Steady State and the Corresponding Empirical Values

Model		Empirical estimate and calculation	
Concept	Value	Estimate	calculation (using NIPA unless indicated)
Composition of National Income (as a Percent case)			
Personal consumption	0.734	0.720	Personal consumption expenditures − housing services
Net saving rate	0.053	0.056	(National saving − capital consumption allowance)/NI
Government consumption	0.214	0.212	Consumption expenditures + gross investment for federal (defense and nondefense) and state and local − consumption of fixed capital
Tax Rates and Government Revenue			
Average marginal wage tax[a]	0.214	0.217	Auerbach (1996) based on the NBER TAXSIM model
Government revenue	0.239	0.239	Total receipts − contributions for social insurance − property taxes (state and local)
Social Security (OAI) tax[b]	0.100	0.100	1996 tax rate is 10.52, which includes trust fund contributions equal to about 0.5 to 0.7
Capital–Output Ratio and Before-Tax Interest Rate			
Capital–income ratio	2.564	2.660	1993 current-cost net stock of fixed reproducible wealth n the SCF − government-owned fixed capital/1993 NI
Before-tax rate of return[c]	0.097	0.093	The average from 1960–94 of the sum of interest, dividends, retained earnings and all corporate taxes to the replacement value of capital stock (Rippe, 1995)

[a]This does not include the payroll tax.

[b]The combined OASDI-HI payroll tax therefore equals 0.147, which is close to the actual value of 0.153 and exactly equal to the correct value for the payroll tax after subtracting 0.006 for contribution to the trust fund.

[c]The social marginal rate of return (i.e., before corporate taxes).

need to add a formal private pension system to the model. Since the agents in our model are not liquidity constrained, forcing them to contribute to private accounts will not affect their net saving or labor supply decisions because they are free to borrow against their mandated retirement accounts. This said, it is worth noting that in the particular economies simulated here, only the poorest 10% of agents actually seek to borrow against their future Social Security. So were we to add a liquidity con-

straint (specifically, a constraint against having negative net wealth), it would not materially alter our findings.

To capture the second feature of privatization, namely giving retirees and workers their full accrued Social Security benefits, we phase out Social Security benefits starting 10 years after the privatization reform occurs. The 10-year delay reflects the need to give current retirees the same benefits they would otherwise have received. In the model, Social Security benefits are received for 10 years from 45 to 55 (real age 65 to real age 75). Starting in the 11th year of the reform, we phase out Social Security benefits by 2.2 percent (of the baseline benefits) per year for 45 years. This linear reduction, although still progressive, is designed to protect the approximate value of accrued liabilities for existing workers. As Feldstein (1997) notes, our general methodology in this first approach is similar to the popular "recognition bond" approach used throughout many Latin American countries—except, in these benchmark cases, participation is mandatory.

We use three alternative tax bases to pay for Social Security benefits during the transition: a proportional payroll tax levied on Social Security's taxable wage base, an increase in the existing progressive income tax, and a proportional consumption tax. In run 1, Social Security's existing wage tax base is used to pay off the recognition bonds. This run assumes that workers perceive the correct net payroll tax rate in the current system at each age in their life cycles. Run 2 is the same as run 1 except workers do not perceive the correct net payroll tax rate; they instead assume they face the full *statutory* payroll tax rate. Runs 3 and 4 are similar except they assume that accrued benefits are paid off with the existing progressive income tax base. This is done by increasing the two components of the income tax, the progressive wage tax and the proportional capital income tax, so that the average wage tax and the average capital income tax change proportionally. Runs 5 and 6 assume that a proportional consumption tax is used to pay accrued benefits.

The transition to a privatized system alters the income-tax base due to growth in the capital stock and labor income. Since we maintain a constant level of government purchases per effective worker in each transition, we adjust income-tax rates along the transition path even in those simulations in which income taxes are not used to pay the benefits accrued under Social Security.

Making Participation in the New System Voluntary

A privatization plan that mandates participation in the new system may be less likely to be implemented than one that gives people the choice to simply opt out of Social Security. Indeed, most actual privatizations have

given people the choice. This was true, for example, in Chile, Argentina, and other major reforms in Latin America; only new workers were forced into the new system. In the United Kingdom, even new workers are allowed to choose between the traditional public pension system and private accounts. Allowing for choice leads those agents whose present value of future Social Security taxes exceeds the present value of future benefits (including benefits already accrued) to opt out of the existing system.

Providing for free choice with respect to leaving Social Security involves three elements: (a) eliminating both future payroll taxation and all future benefit claims for those who opt out of the system, (b) collecting payroll taxes and paying benefits to those who do not opt out, and (c) using general revenue to finance the gap between payroll taxes collected and benefits received. In runs 7 through 10, agents who stay in Social Security face the same payroll tax rate and receive the same benefits under current law. Runs 11 and 12 consider a slight twist: people who stay in Social Security now face only half of the previous payroll tax rate along with the same benefits as before. Naturally, this modification entices more people to stay with Social Security, but it also puts a greater overall strain on general revenue.

Runs 7 and 8 finance the gap between payroll taxes and Social Security benefits with the income base. In run 7, workers correct perceive the existing tax–benefit linkage; in run 8, they do not. Runs 9 and 10 make the same respective assumptions about the perception of benefit–tax linkage as runs 7 and 8, but finance Social Security with a new consumption taxes. Run 11 has income-tax transition finance and full perception of the net tax rate, but sets the payroll tax rate to half the present value for those who remain in Social Security. Run 12 is identical to run 11, but has consumption tax finance.

The solid lines in the top panel of Fig. 3 show those generations by income class who participate in the new privatized system—that is, opt out of Social Security—for the income-tax finance case. (The consumption tax-finance case produces a similar picture.) In all six runs, the decision for each worker to opt out depends on future factor prices, and this dependence is taken into account in solving the model's perfect foresight transition path. Notice that all agents younger than 25 years of (real-life) age opt out, as do all future agents. The participation lines are not continued past transitional year 50 to enhance the figure's resolution. The effects of selection can be seen both inter- and intragenerationally. Most older people stay with Social Security because they have accrued large enough benefits that it is unprofitable to switch. Intragenerationally, a poor agent is less likely to opt out of Social Security than a richer agent of

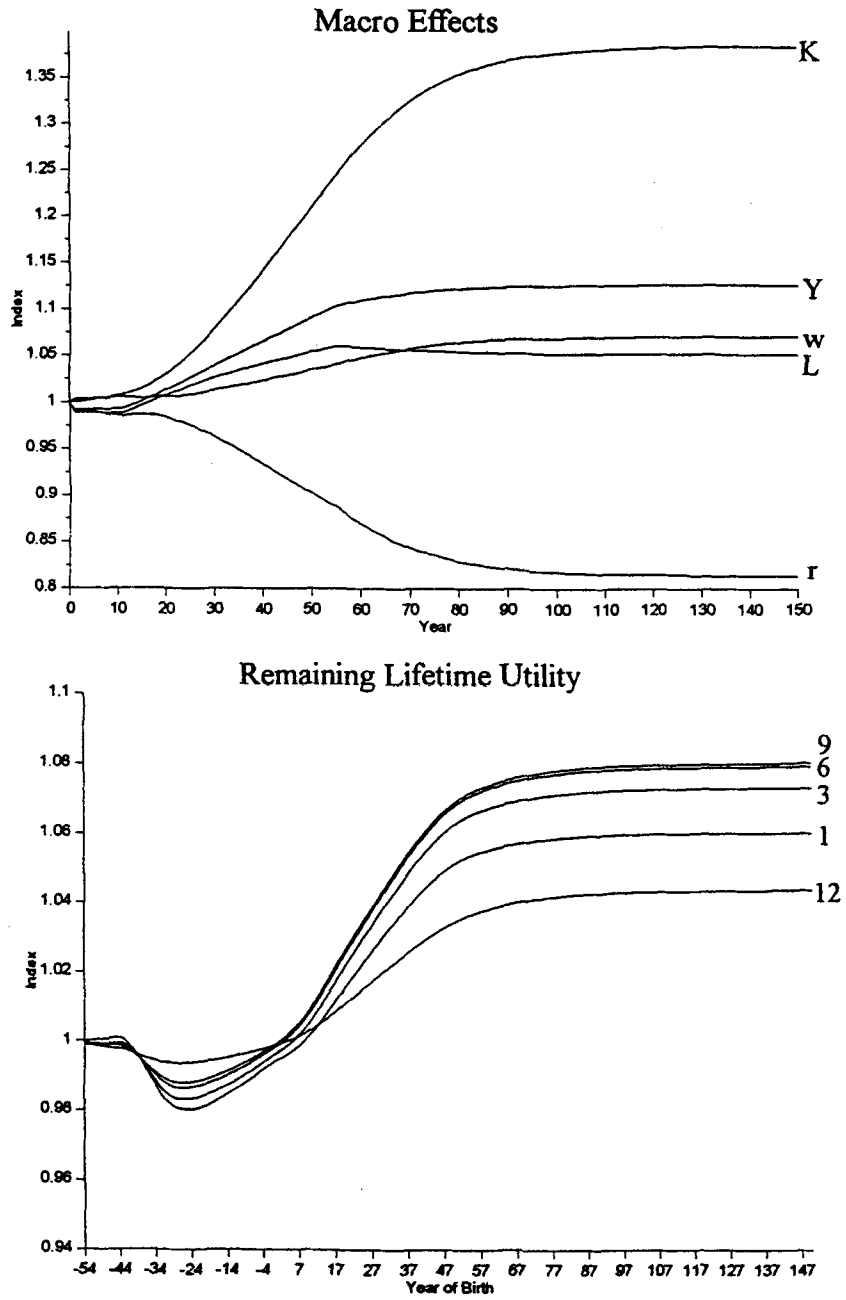

FIG. 3. Who opts out of social security? Income tax finance of transition with tax–benefit linkage and new payroll tax equal to present law value (top) and one-half present law value (bottom). Solid line denotes generations that opt out.

the same age. This reflects the progressive formula used in the calculation of Social Security's benefits.

Flat Benefit vs Progressive Matching of Contributions

Actual social security privatizations have typically included some progressive feature as part of the reform. In the United States, progressive elements are features of many reform proposals. For example, the Personal Security Account Plan of the Social Security Advisory Council includes a new, pay-as-you-go-financed flat minimum benefit. Other plans, including that by Kotlikoff and Sachs (1997), suggest the government match, on a progressive basis, contributions to mandatory private saving accounts.

Runs 13 through 15 analyze privatization coupled with a pay-as-you-go-financed flat benefit. This benefit, like the accrued benefits of the old system, is financed by a wage tax, an income tax, or a consumption tax. These runs assume full perception of the tax-benefit linkage. We investigate this policy by (a) providing a wage-indexed flat minimum annual benefit that equals $6000 and (b) paying a weighted average of the old Old Age and Survivors Insurance (OASI) and the new flat minimum benefit during the transition.

Runs 16 through 18 consider a progressive contribution match. The government's match is calculated as a function of labor income and falls steadily as a percentage of earnings, starting at about 5 percent for the poorest. In absolute terms, it increases from about $470 at annual earnings of $10,000 to around $840 for annual earnings of $21,000 and remains constant thereafter. On a lifetime basis, the match provides a transfer to the poor whose long-run value exceeds the flat minimum benefit by 30 percent. Workers fully incorporate in their labor supply and saving decisions the marginal subsidy associated with the progressive contribution match. Both runs 16 and 17 finance the match with income taxes, whereas run 18 finances the match with consumption taxes. OASI benefits are phased out as above and financed with a payroll tax (run 16), an income tax (run 17), or a consumption tax (run 18).

Sensitivity Analysis: The Open Economy (Run 19)

Runs 1–18 assume a closed economy. This assumption seems like a reasonable benchmark: although the United States produces about 30% of the world's output, capital flows appear to be relatively immobile (Feldstein and Horioka, 1980; Gordon and Bovenberg, 1996). But for the sake of comparison, run 19 considers the other extreme: simulating the benchmark privatization plan with wage tax financing when the United States is modeled as a small open economy.

IV. SIMULATION FINDINGS

The benefits and costs of privatization cannot be assessed with a single metric. Privatization significantly affects short-run and long-run macroeconomic variables and materially alters the intra- and intergenerational distribution of resources. Hence, it is important to consider the entire gambit of privatization effects.

Long-Run Macroeconomic Performance

Tables III–VII present the macroeconomic effects of our 19 runs for selected years of the economy's transition path. Year 150 represents the new (final) steady state. The macroeconomic effects are also plotted in the top panels of Figs. 4–6 for the benchmark runs, Figs. 7 and 8 for the opting out runs, Figs. 9 and 10 for the opting out runs with the new payroll tax at one-half the present law value, Figs. 11–13 for the privatization cum flat benefit runs, Figs. 14–16 for the privatization cum progressive contribution match runs, and Fig. 17 for the open economy run.

The capital stock. Table III shows that all of the benchmark and opting out runs generate the same very large increase in the long-run (year 150) capital stock once pay-as-you-go financing is entirely eliminated and replaced with funded private accounts. All of the benchmark runs that assume full perception of tax–benefit linkage culminate in a 39% long-run increase in the capital stock. The long-run increase is the same for each of these three runs because the transition tax is only temporary; i.e., the three experiments differ only in the transition. The long-run increase is the same for opting out runs with full perception of the tax–benefit linkage because everyone in the new steady state chooses to opt out of Social Security—even the lifetime poor. Their choice reflects the fact that the after-tax return to investing in capital substantially exceeds Social Security's internal rate of return even for the lifetime poor who receive the highest replacement rate.

The benchmark runs that assume no perceived tax–benefit linkage each lead to a 40% long-run increase in the capital stock. The slightly larger increase here is due to the improvement in perception of the tax–benefit linkage that accompanies privatization. The same size long-run gains materialize for the opting out runs without tax–benefit linkage, where, again, everyone in the final steady state chooses to opt out of Social Security.

In contrast to these results, the long-run gains in the capital stock are more than halved if the privatization reform is "made progressive" by including in the reform, as Chile and other countries have done, a flat, pay-as-you-go-financed benefit. Financing the payment of accrued benefits

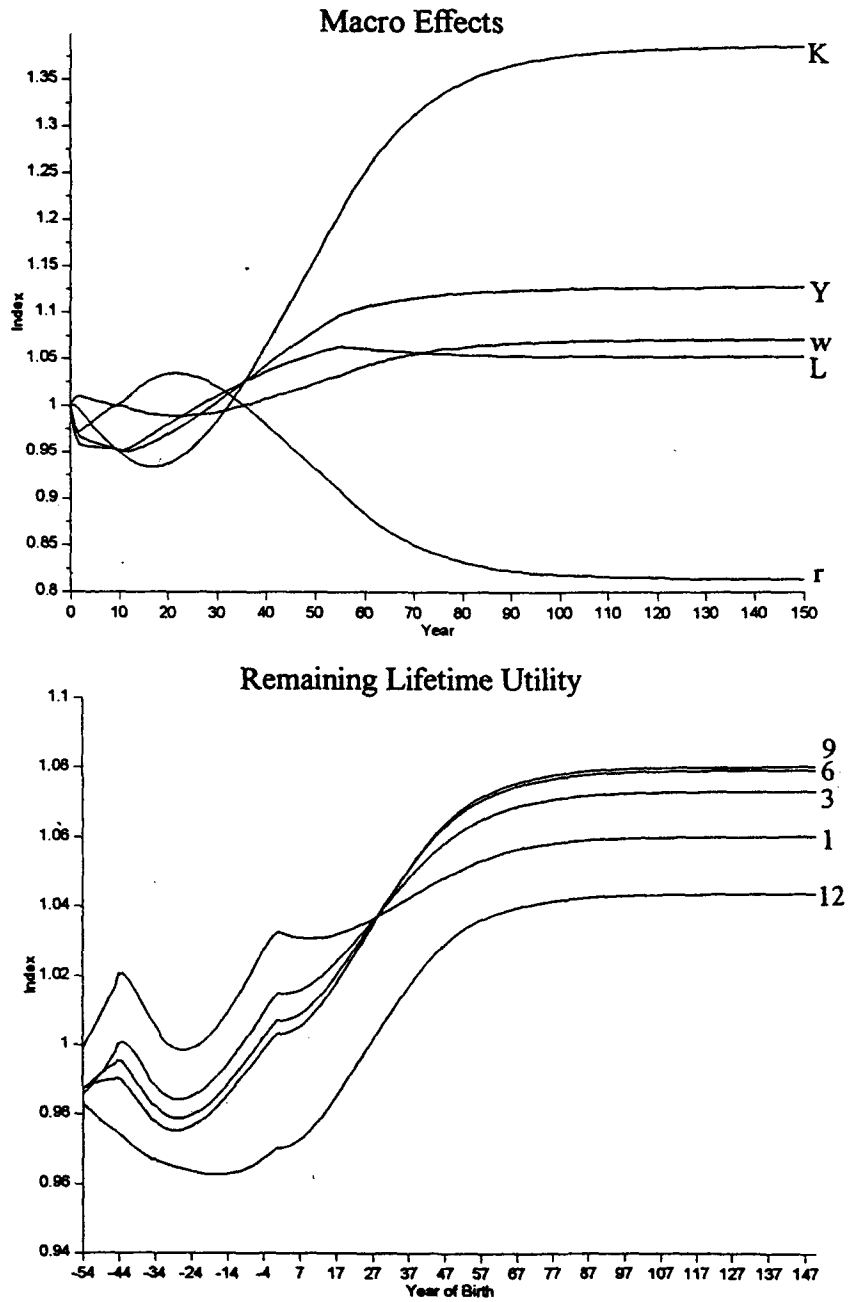

FIG. 4. Payroll-tax finance of transition with tax–benefit linkage. Benchmark: recognition bonds.

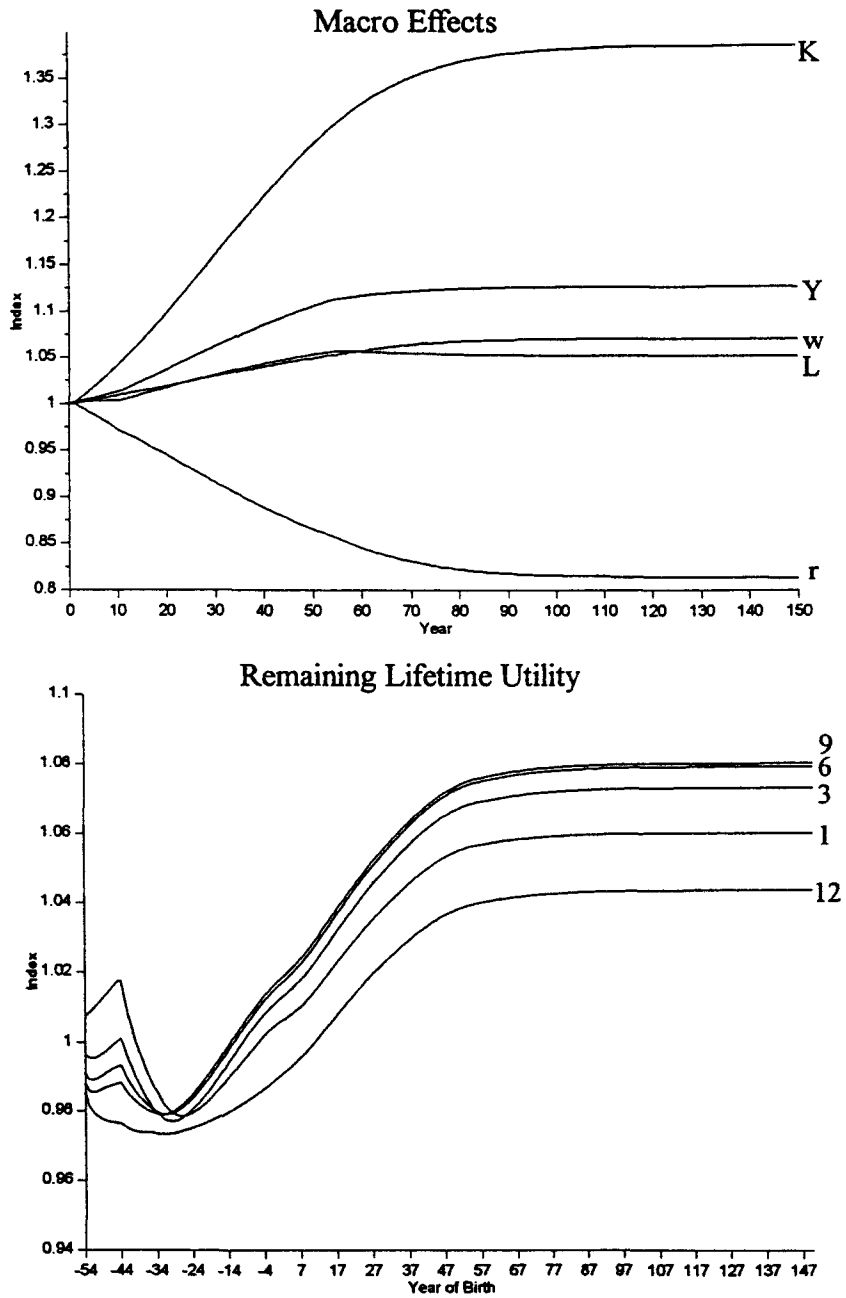

FIG. 5. Income-tax finance of transition with tax–benefit linkage. Benchmark: recognition bonds.

during the transition as well as the flat benefit with a wage tax (run 13) produces a 19% increase in the capital stock, while using an income tax or a consumption tax produces a 12 or 23% increase, respectively. The final steady states are not the same for each of the three runs because the new tax finances the flat benefit as well as the transition. Run 14 leads to a smaller increase than does run 13 due to an increase in tax progressivity and the higher taxation of capital income. Run 15 generates the largest long-run increase of the flat benefit experiments due to the initial wealth levy that arises with consumption taxation and, relative to income-tax financing, its better saving incentives.

Why do each of the flat benefit experiments generate a smaller increase in the capital stock relative to their counterparts without a flat benefit? There are two reasons. First, the continuing unfunded liability of paying the flat benefit, which amounts to about half of the unfunded liability of the current Social Security system, reduces the impact of privatization on

Income Tax Finance of Transition with Tax-Benefit Linkage and New Payroll Tax Equal to Present Law Value (Solid line denotes generations that opt out)

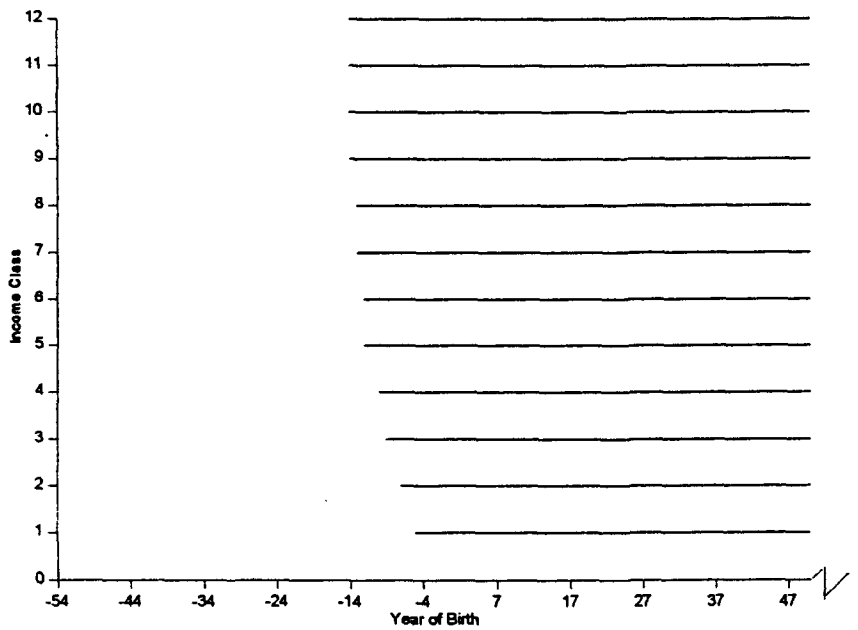

FIG. 6. Consumption-tax finance of transition with tax–benefit linkage. Benchmark: recognition bonds.

Income Tax Finance of Transition with Tax-Benefit Linkage and New Payroll Tax Equal to One-Half Present Law Value (Solid line denotes generations that opt out)

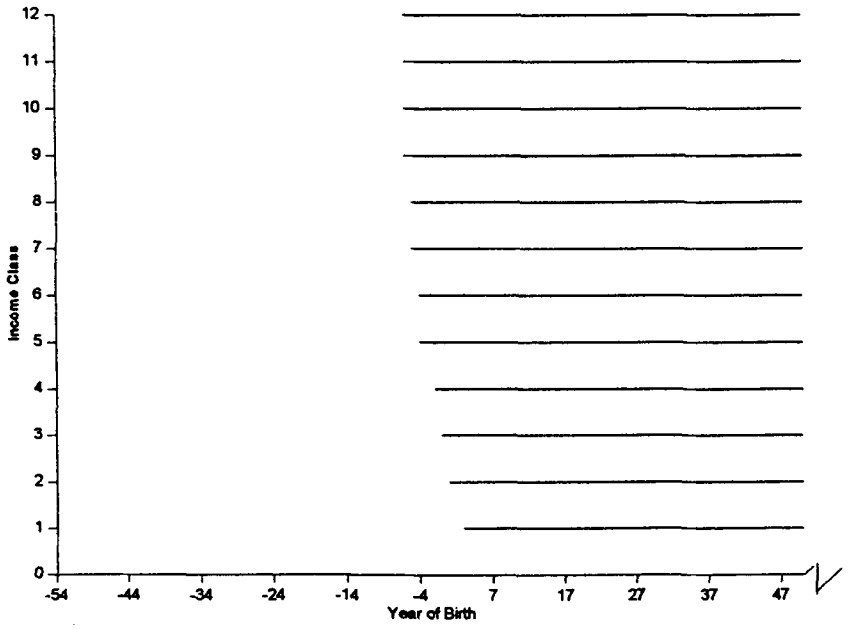

FIGURE 6—*Continued*

saving and capital accumulation. Second, the tax that finances the flat minimum benefit is highly distortionary since the flat benefit is the same independent of how much workers pay in taxes to finance the benefit.

Achieving progressivity via a progressive contribution match rather than a flat benefit produces a long-run increase in the capital stock that is similar in magnitude to that arising in the benchmark and opting out experiments. Runs 16 and 17, which finance the transition with a wage tax and an income tax, respectively, generate a 35% increase, while consumption-tax finance (run 18) produces a 40% increase. The capital stock increase is identical for both wage and income-tax financing because they differ only with respect to paying off Social Security benefits; i.e., both use an income tax to finance the contribution match.

Aggregate labor supply. Table IV shows that, in the long run, aggregate labor supply increases by 5.5% to 7% in the benchmark and opting out runs. The 5.5% increase occurs in those runs in which Social Security's

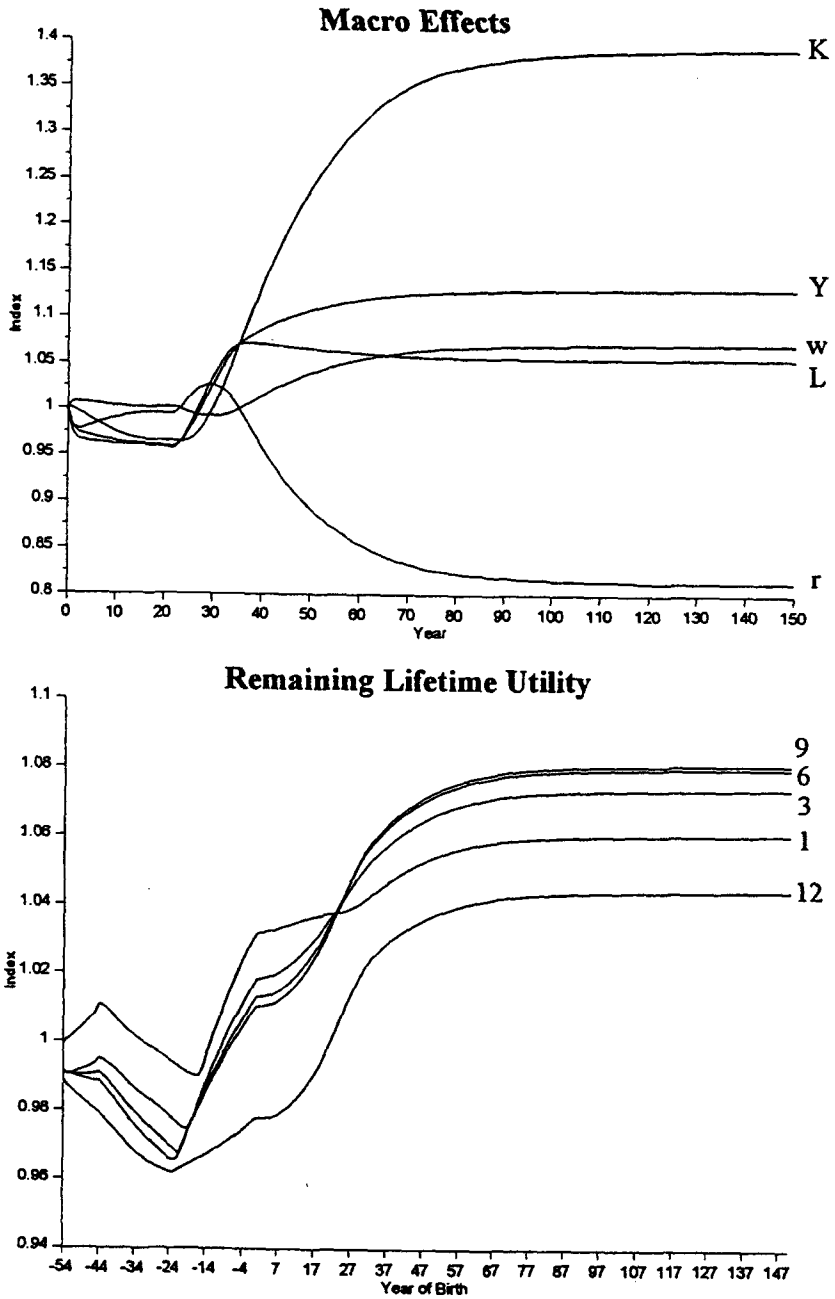

FIG. 7. Income-tax finance of transition with tax–benefit linkage. Opting out with new payroll tax equal to present law value.

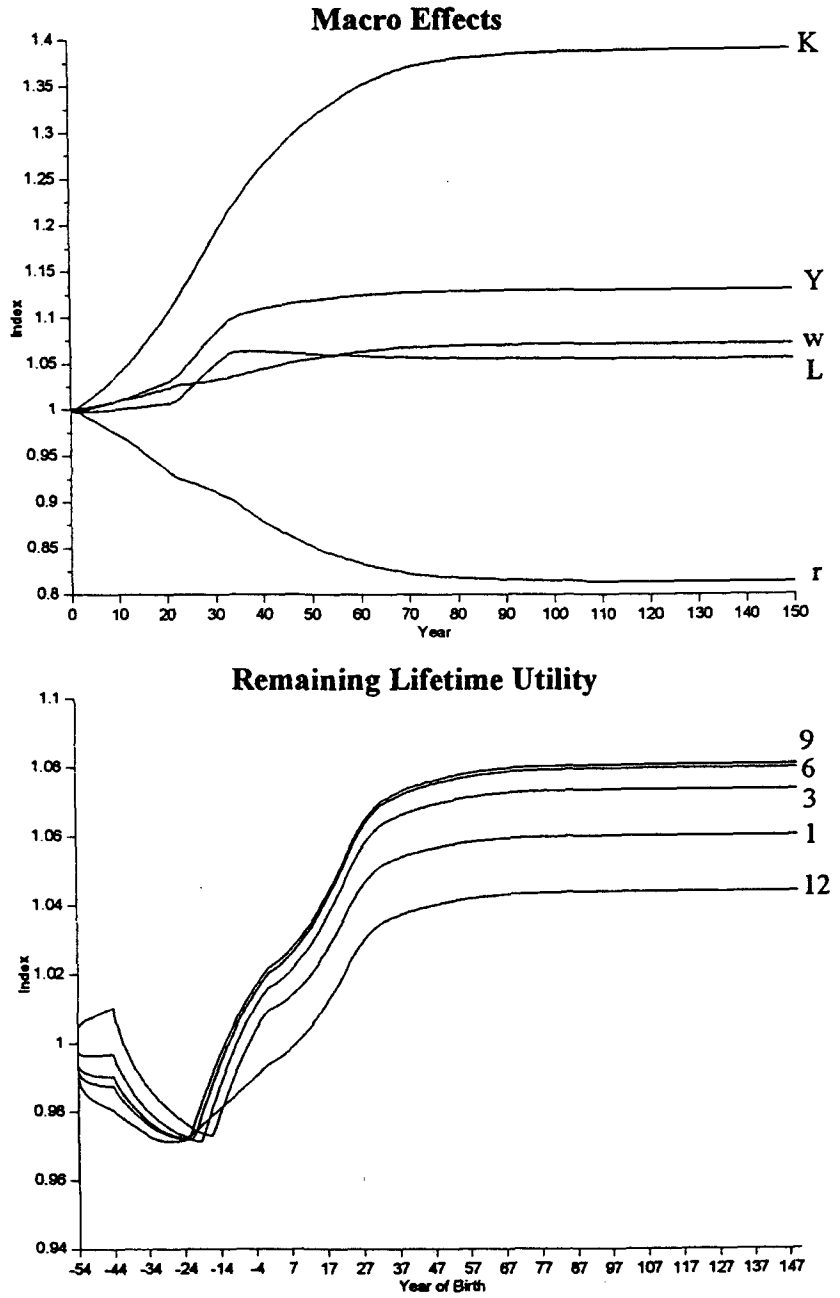

FIG. 8. Consumption-tax finance of transition with tax–benefit linkage. Opting out with new payroll tax equal to present law value.

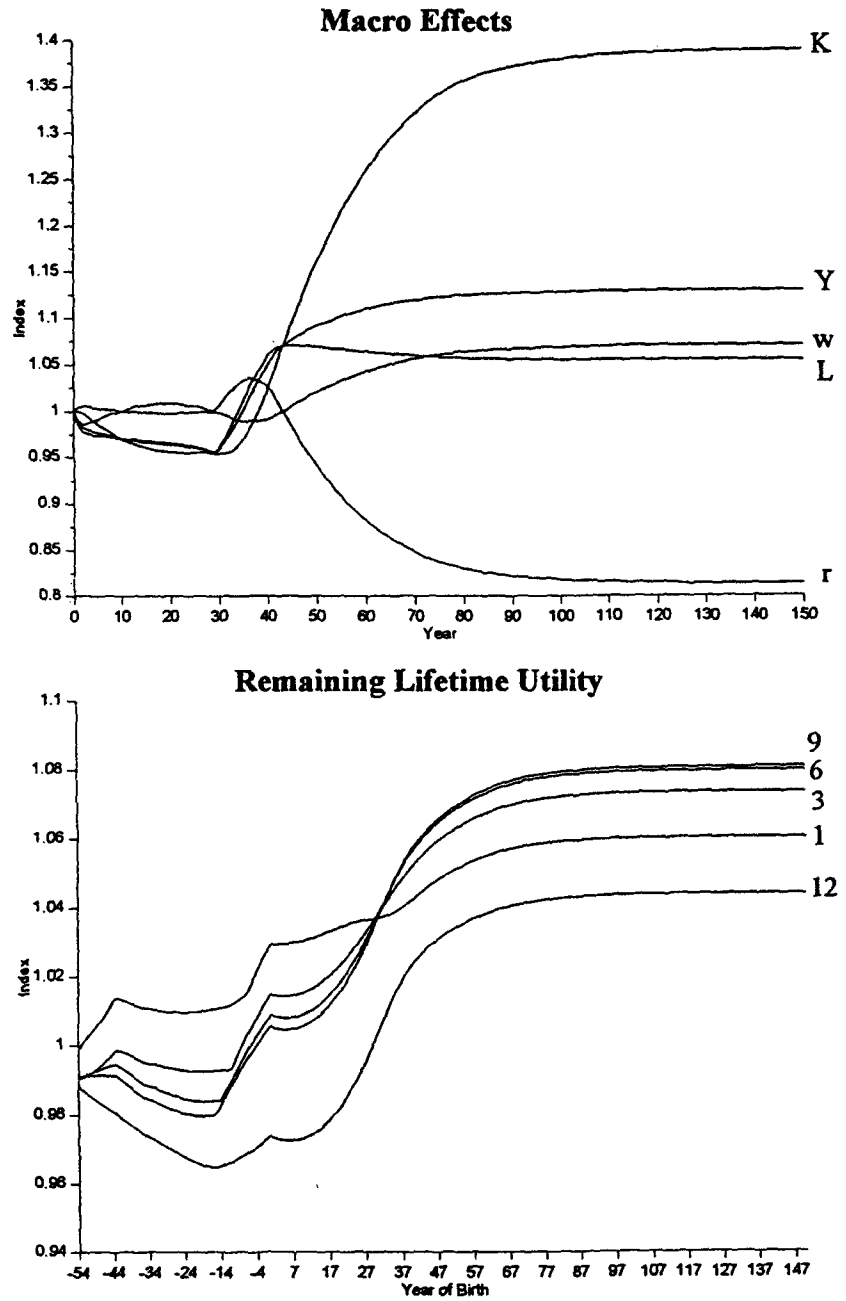

FIG. 9. Income-tax finance of transition with tax–benefit linkage. Opting out with new payroll tax equal to one-half of present law value.

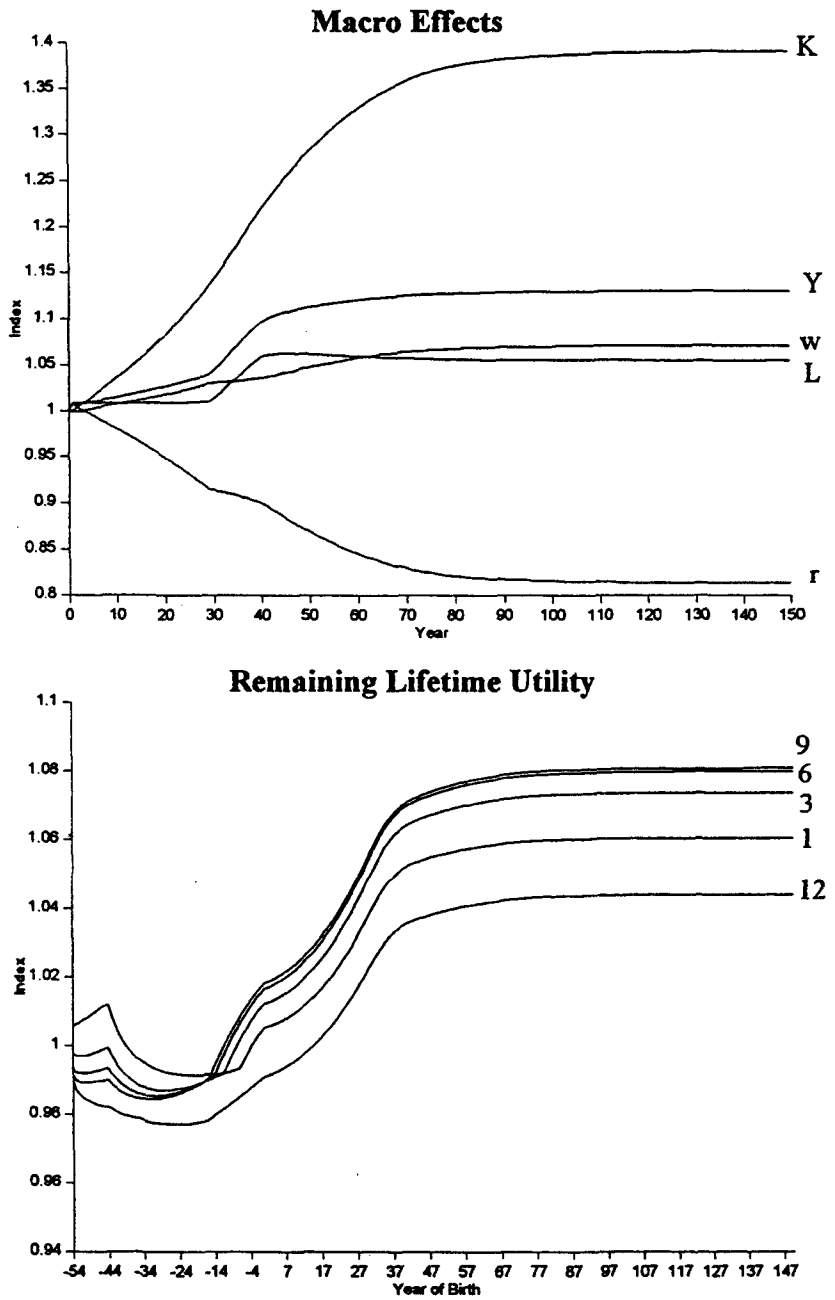

FIG. 10. Consumption-tax finance of transition with tax–benefit linkage. Opting out with new payroll tax equal to one-half of present law value.

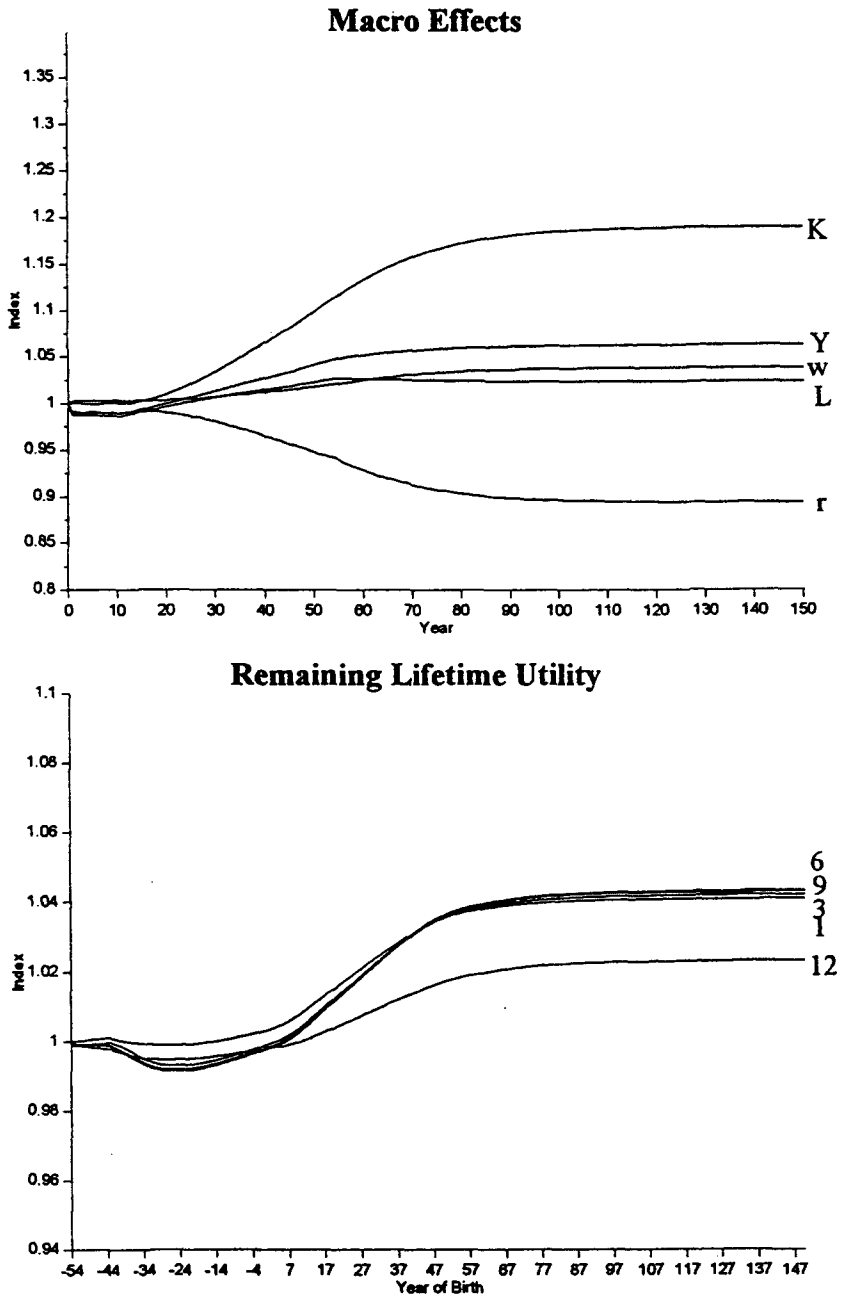

FIG. 11. Flat minimum benefit with payroll-tax finance.

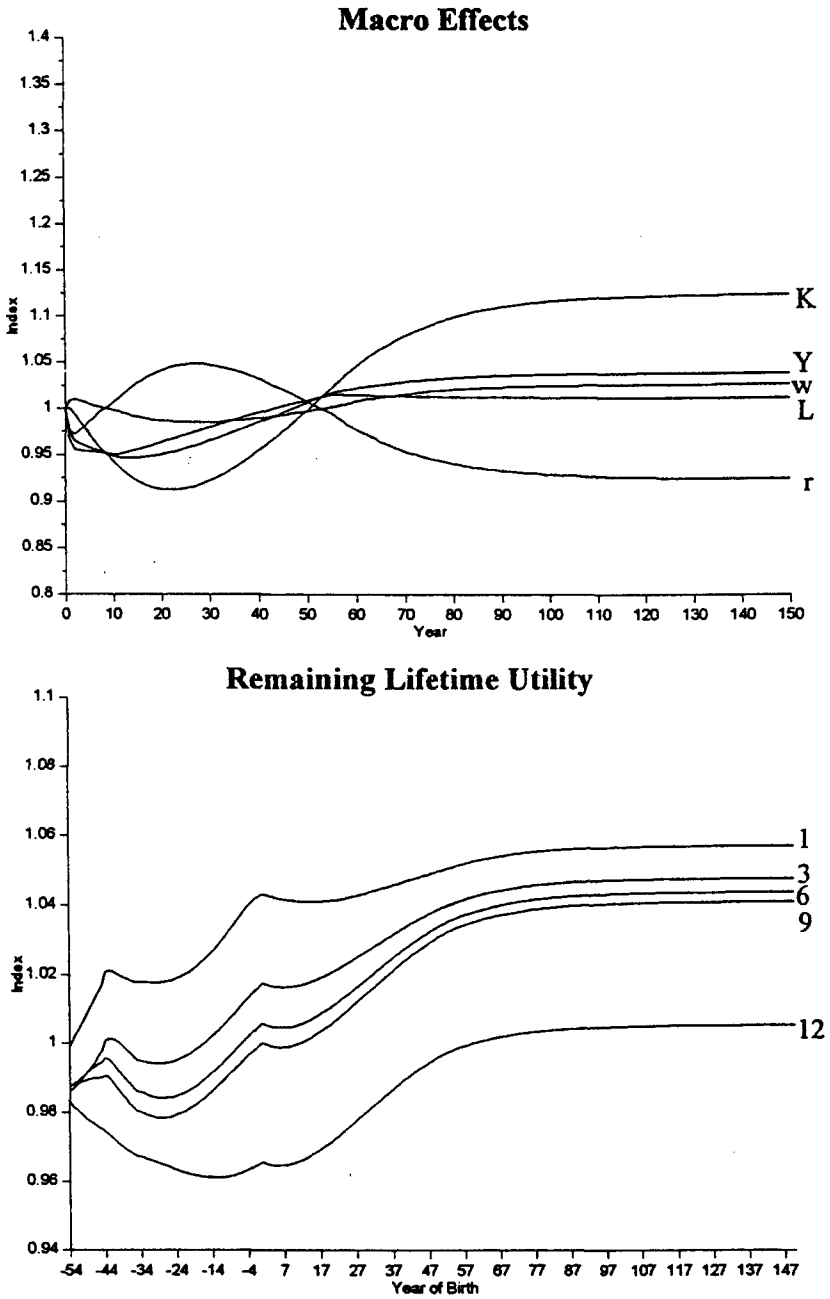

FIG. 12. Flat minimum benefit with income-tax finance.

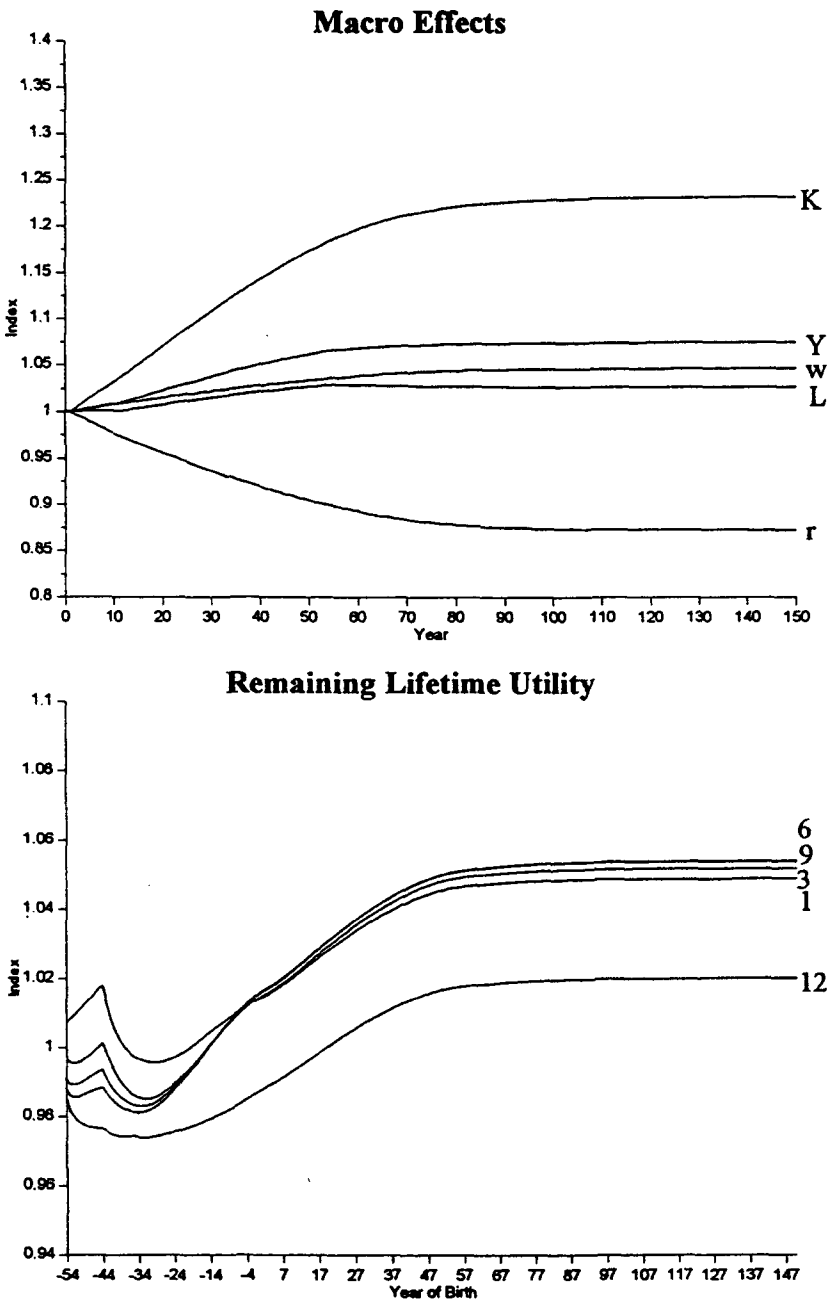

FIG. 13. Flat minimum benefit with consumption-tax finance.

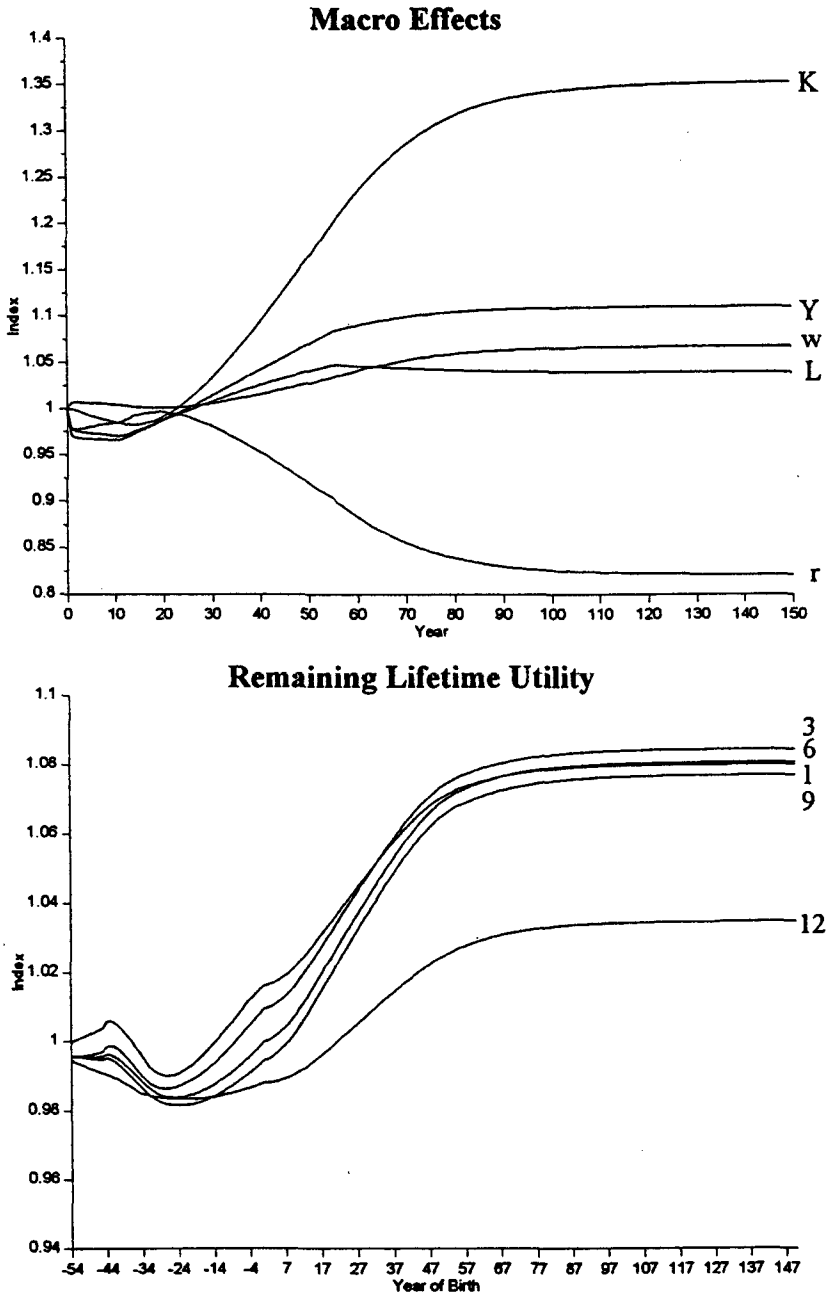

FIG. 14. Progressive match with payroll-tax finance.

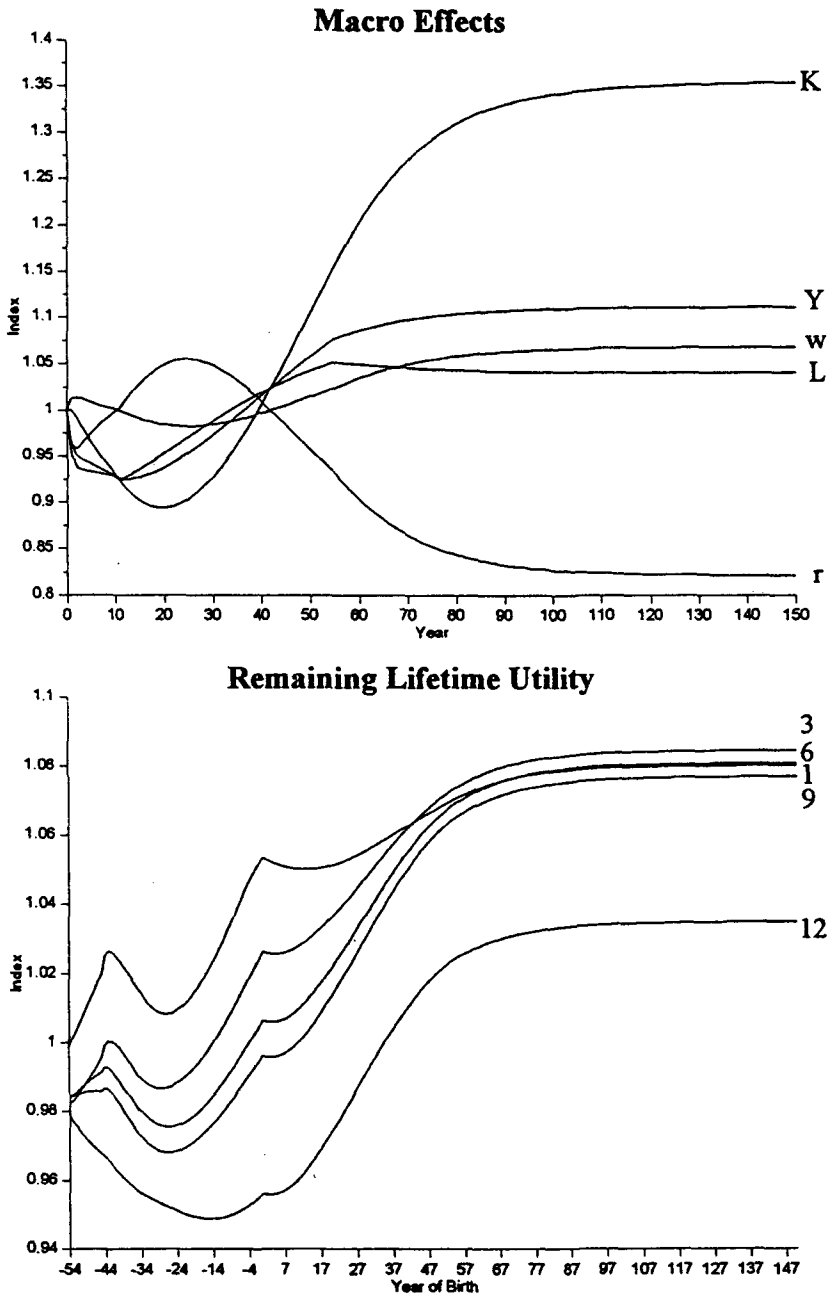

FIG. 15. Progressive match with income-tax finance.

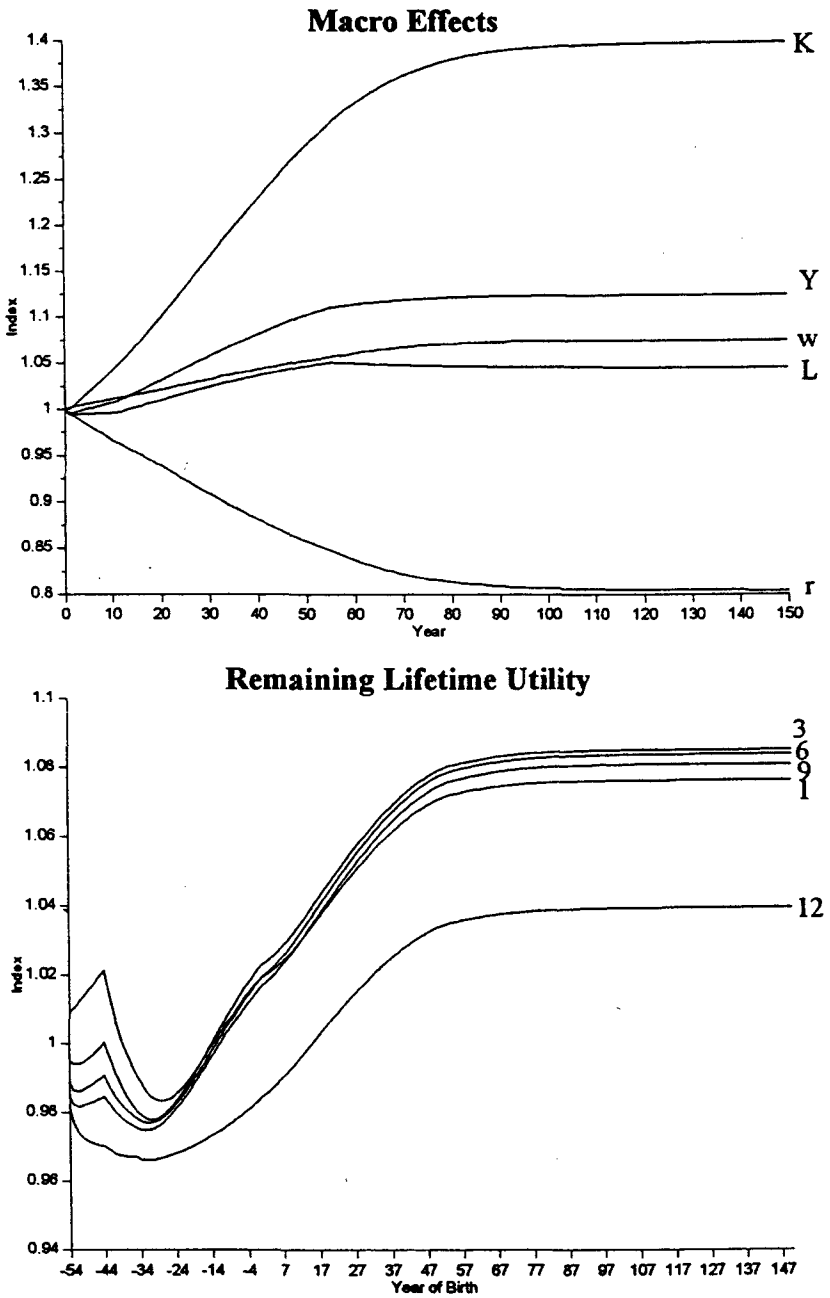

FIG. 16. Progressive match with consumption-tax finance.

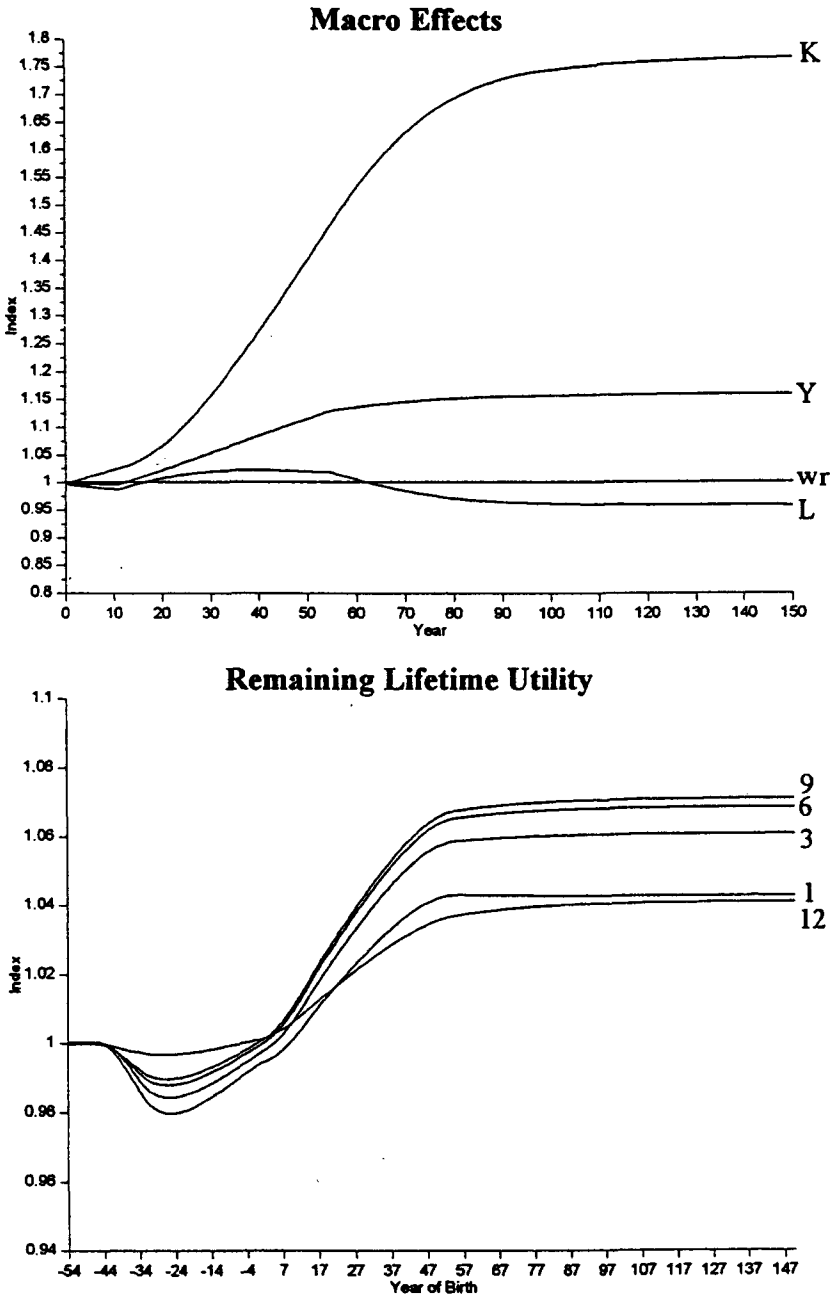

FIG. 17. Open economy with payroll-tax finance.

TABLE III
Percentage Change in Capital Stock Relative to Steady State

Run	Experiment	Finance of social security benefits	Tax–benefit linkage	New social security tax rate	Year of transition 5	10	25	150
1	—	W	Yes	n/a	0.0	0.1	5.2	39.0
2	—	W	No	n/a	0.5	1.1	6.1	39.8
3	—	Y	Yes	n/a	−2.4	−5.0	−4.6	39.0
4	—	Y	No	n/a	−2.2	−4.3	−3.5	39.8
5	—	C	Yes	n/a	1.8	4.1	12.8	39.0
6	—	C	No	n/a	2.1	4.7	13.6	39.8
7	Opting out	Y	Yes	PL	−1.2	−2.5	−3.4	39.0
8	Opting out	Y	No	PL	−1.4	−3.1	−4.0	39.8
9	Opting out	C	Yes	PL	1.5	3.8	14.2	39.0
10	Opting out	C	No	PL	1.4	3.4	14.1	39.8
11	Opting out	Y	Yes	PL/2	−1.4	−3.0	−4.5	39.0
12	Opting out	C	Yes	PL/2	1.5	3.5	11.0	39.0
13	Flat benefit	W	Yes	n/a	0.0	0.0	2.0	19.0
14	Flat benefit	Y	Yes	n/a	−2.8	−5.7	−8.7	12.4
15	Flat benefit	C	Yes	n/a	1.4	3.2	8.9	23.2
16	Progressive match	W	Yes	n/a	−0.7	−1.4	0.9	35.4
17	Progressive match	Y	Yes	n/a	−3.4	−7.1	−9.7	35.4
18	Progressive match	C	Yes	n/a	1.8	4.1	13.0	39.8
19	Open economy	W	Yes	n/a	−0.8	−1.3	1.5	−4.3

Note. C: Consumption tax.
n/a: Nonapplicable. For forced privatization, payroll tax is endogenous for payroll-tax financing and zero for income-tax and consumption-tax financing.
PL: Present law payroll-tax rate.
PL/2: Present law payroll-tax rate divided by 2.
W: Payroll tax.
Y: Income tax.

benefit–tax linkage is fully perceived. The increase is 7% in those runs in which the tax–benefit linkage is not perceived, reflecting the larger distortion of Social Security's current payroll tax. The progressive match leads to a slightly smaller—4 to 4.5%—increase, depending on the tax base chosen to finance the matching contribution. The matching policy provides a subsidy to low earners on their labor supply, but the tax used to finance the match reduces the labor supply incentives of all workers.

The inclusion of a flat benefit in the reform substantially limits the increase in labor supply. Aggregate labor supply increases by just 2.5% with wage-tax finance, 1% with income-tax finance, and 3% with consumption-tax finance. The reason, as mentioned, is that the pay-as-you-go

TABLE IV
Percentage Change in Labor Supply Relative to Steady State

Run	Experiment	Finance of social security benefits	Benefit–tax linkage	New social security tax rate	Year of transition 5	10	25	150
1	—	W	Yes	n/a	−1.1	−1.1	1.8	5.5
2	—	W	No	n/a	0.3	0.4	3.2	7.0
3	—	Y	Yes	n/a	−4.5	−4.7	0.0	5.5
4	—	Y	No	n/a	−2.9	−3.1	1.1	7.0
5	—	C	Yes	n/a	0.3	0.4	2.4	5.5
6	—	C	No	n/a	1.8	1.9	3.9	7.0
7	Opting out	Y	Yes	PL	−3.6	−3.9	−2.1	5.5
8	Opting out	Y	No	PL	−3.8	−4.0	−0.6	7.0
9	Opting out	C	Yes	PL	−0.2	0.0	2.4	5.5
10	Opting out	C	No	PL	−0.2	0.3	3.9	7.0
11	Opting out	Y	Yes	PL/2	−2.6	−3.0	−3.8	5.5
12	Opting out	C	Yes	PL/2	0.8	0.8	0.9	5.5
13	Flat benefit	W	Yes	n/a	−1.3	−1.4	0.2	2.3
14	Flat benefit	Y	Yes	n/a	−4.7	−4.9	−2.9	1.2
15	Flat benefit	C	Yes	n/a	0.0	0.1	1.1	2.7
16	Prog. match	W	Yes	n/a	−3.2	−3.3	−0.2	4.0
17	Prog. match	Y	Yes	n/a	−6.7	−7.3	−3.0	4.0
18	Prog. match	C	Yes	n/a	−0.5	−0.4	1.7	4.5
19	Open econ.	W	Yes	n/a	−0.8	−1.3	1.5	−4.3

C: Consumption tax.
n/a: Nonapplicable. For forced privatization, payroll tax is endogenous for payroll tax financing and zero for income tax and consumption tax financing.
PL: Present law payroll tax rate.
PL/2: Present law payroll tax rate divided by 2.
W: Payroll tax.
Y: Income tax.

payroll-tax finance of the flat benefit represents a major labor supply disincentive.

National income and factor prices. Table V presents the long-run increase in national income for each simulation. The increases are, of course, largest for those runs with the largest long-run increases in the supplies of capital and labor. Thus, the benchmark and opting out runs generate the largest output increase (between 13 and 14.5%), followed by the progressive match runs (11 to 12.5%). The flat benefit runs performed the worst: long-run output increases between 4 and 7.5% depending on the tax used to finance the flat benefit.

TABLE V
Percentage Change in Income Relative to Steady State

Run	Experiment	Finance of Social Security benefits	Benefit–tax linkage	New Social Security tax rate	Year of transition 5	10	25	150
1	—	W	Yes	n/a	−0.8	−0.7	2.6	13.0
2	—	W	No	n/a	0.4	0.6	3.9	14.4
3	—	Y	Yes	n/a	−4.0	−4.8	−1.5	13.0
4	—	Y	No	n/a	−2.7	−3.4	0.0	14.4
5	—	C	Yes	n/a	0.6	1.3	4.9	13.0
6	—	C	No	n/a	1.9	2.6	6.3	14.4
7	Opting out	Y	Yes	PL	−3.0	−3.5	−2.4	13.0
8	Opting out	Y	No	PL	−3.2	−3.8	−1.4	14.4
9	Opting out	C	Yes	PL	0.2	1.0	5.2	13.0
10	Opting out	C	No	PL	0.2	1.1	6.4	14.4
11	Opting out	Y	Yes	PL/2	−2.3	−3.0	−4.0	13.0
12	Opting out	C	Yes	PL/2	1.0	1.5	3.3	13.0
13	Flat benefit	W	Yes	n/a	−1.0	−1.1	0.6	6.2
14	Flat benefit	Y	Yes	n/a	−4.2	−5.1	−4.4	3.9
15	Flat benefit	C	Yes	n/a	0.4	0.8	3.0	7.5
16	Prog. match	W	Yes	n/a	−2.6	−2.9	0.1	11.1
17	Prog. match	Y	Yes	n/a	−5.9	−7.2	−4.7	11.1
18	Prog. match	C	Yes	n/a	0.0	0.7	4.4	12.4
19	Open econ.	W	Yes	n/a	0.0	−0.4	3.8	16.0

C: Consumption tax.
n/a: Nonapplicable. For forced privatization, payroll tax is endogenous for payroll tax financing and zero for income tax and consumption tax financing.
PL: Present law payroll tax rate.
PL/2: Present law payroll tax rate divided by 2.
W: Payroll tax.
Y: Income tax.

The wage increases and the interest rate decreases in all the closed-economy runs because the capital stock increases more than does aggregate labor supply. As indicated in Table VI, the long-run wage increases by about 7% in the benchmark, opting out, and progressive match runs, but by only 2.5 to 5.5% in the flat benefit runs. Table VII shows that interest rates fall by about 18% for the benchmark, opting out, and progressive match runs, but by only 7.5 to 13% for the flat benefit runs.

Short-Run Macroeconomic Performance

Table III demonstrates that the speed of adjustment of the capital stock to the new steady state depends critically on two general factors: the tax

TABLE VI
Percentage Change in Wages Relative to Steady State

Run	Experiment	Finance of Social Security benefits	Benefit–tax linkage	New Social Security tax rate	Year of transition			
					5	10	25	150
1	—	W	Yes	n/a	0.4	0.5	0.8	7.1
2	—	W	No	n/a	0.1	0.2	0.7	6.9
3	—	Y	Yes	n/a	0.5	0.0	−1.0	7.1
4	—	Y	No	n/a	0.2	−0.3	−1.2	6.9
5	—	C	Yes	n/a	0.4	0.9	2.4	7.1
6	—	C	No	n/a	0.1	0.6	2.3	6.9
7	Opting out	Y	Yes	PL	0.6	0.3	−0.3	7.1
8	Opting out	Y	No	PL	0.6	0.2	−0.9	6.9
9	Opting out	C	Yes	PL	0.4	0.9	2.8	7.1
10	Opting out	C	No	PL	0.4	0.8	2.4	6.9
11	Opting out	Y	Yes	PL/2	0.3	0.0	−0.2	7.1
12	Opting out	C	Yes	PL/2	0.2	0.7	2.4	7.1
13	Flat benefit	W	Yes	n/a	0.3	0.4	0.5	3.9
14	Flat benefit	Y	Yes	n/a	0.5	−0.2	−1.5	2.7
15	Flat benefit	C	Yes	n/a	0.3	0.8	1.9	4.7
16	Prog. match	W	Yes	n/a	0.6	0.5	0.3	6.8
17	Prog. match	Y	Yes	n/a	0.9	0.1	−1.8	6.8
18	Prog. match	C	Yes	n/a	0.6	1.1	2.7	7.5
19	Open econ.	W	Yes	n/a	0.0	0.0	0.0	0.0

C: Consumption tax.
n/a: Nonapplicable. For forced privatization, payroll tax is endogenous for payroll tax financing and zero for income tax and consumption tax financing.
PL: Present law payroll tax rate.
PL/2: Present law payroll tax rate divided by 2.
W: Payroll tax.
Y: Income tax.

base used to finance transition benefits and the form of the privatization experiment. The choice of the tax base is the more important of these two factors. Consider, for example, the benchmark runs with correctly perceived tax–benefit linkage. With payroll-tax financing (run 1) the capital stock is only 5% larger after 25 years—just 13% of its ultimate increase. In the case of income-tax finance (run 3), the capital stock is actually 4.5% smaller 25 years after the transition, notwithstanding the fact that it ultimately ends up 39% larger! With consumption-tax finance (run 5), the transition is much faster, but it is still rather slow. After 25 years the capital stock is 13% larger than its initial value, but this is only one third of its long-run increase.

TABLE VII
Percentage Change in Interest Rates Relative to Steady State

Run	Experiment	Finance of Social Security benefits	Benefit–tax linkage	New Social Security tax rate	Year of transition			
					5	10	25	150
1	—	W	Yes	n/a	−1.0	−1.4	−2.5	−18.6
2	—	W	No	n/a	−0.1	−0.7	−2.0	−18.2
3	—	Y	Yes	n/a	−1.5	0.0	3.2	−18.6
4	—	Y	No	n/a	−0.6	0.9	3.6	−18.2
5	—	C	Yes	n/a	−1.1	−2.7	−6.9	−18.6
6	—	C	No	n/a	−0.2	−2.0	−6.5	−18.2
7	Opting out	Y	Yes	PL	−1.8	−1.0	1.1	−18.6
8	Opting out	Y	No	PL	−1.9	−0.7	2.7	−18.2
9	Opting out	C	Yes	PL	−1.2	−2.7	−7.8	−18.6
10	Opting out	C	No	PL	−1.1	−2.3	−6.8	−18.2
11	Opting out	Y	Yes	PL/2	−0.9	0.0	0.5	−18.6
12	Opting out	C	Yes	PL/2	−0.5	−1.9	−6.8	−18.6
13	Flat benefit	W	Yes	n/a	−0.9	−1.0	−1.4	−10.8
14	Flat benefit	Y	Yes	n/a	−1.4	0.6	4.7	−7.6
15	Flat benefit	C	Yes	n/a	−1.0	−2.2	−5.4	−12.8
16	Prog. match	W	Yes	n/a	−1.9	−1.5	−0.8	−17.9
17	Prog. match	Y	Yes	n/a	−2.6	−0.2	5.4	−17.9
18	Prog. match	C	Yes	n/a	−1.7	−3.4	−7.6	−19.6
19	Open econ.	W	Yes	n/a	0.0	0.0	0.0	0.0

C: Consumption tax.
n/a: Nonapplicable. For forced privatization, payroll tax is endogenous for payroll tax financing and zero for income tax and consumption tax financing.
PL: Present law payroll tax rate.
PL/2: Present law payroll tax divided by 2.
W: Payroll tax.
Y: Income tax.

One reason the transitions take so long is that Social Security benefits are reduced gradually over a 55-year period. A second reason is that capital is a stock, and even substantial changes in annual saving rates take quite a while to materially alter it. This feature of neoclassical economies —that policy-induced economic transitions are very slow—was one of the main messages of Auerbach and Kotlikoff (1987). The third reason the transitions are slow applies in the case of income-tax finance. Using this tax instrument means that in the short run there will be quite high marginal tax rates on labor supply and capital income. This gives households an incentive to substitute current leisure and consumption for future leisure and consumption. Indeed, in the case of income-tax finance, the

short-term disincentive to work leads to a short-term 5% decline in aggregate labor supply!

The method of privatization is also important for short-run outcomes. The benchmark and opting out runs generate the shortest transitions with the opting out runs reaching their long-run values the fastest. Compared with the compulsory participation runs, the opting out runs provide smaller Social Security benefits to existing workers. In the compulsory participation runs, existing workers receive, in retirement, all the Social Security benefits they accrued prior to the reform. In the opting out runs, existing workers who opt out receive no benefits from the old Social Security system in retirement; i.e., the price they face for opting out is foregoing all the benefits they had accrued under the old system.

Overall, the flat benefit runs and progressive match runs perform relatively worse in the short run. Progressive matching with consumption-tax finance (run 18), however, performs just as well as the corresponding benchmark run with consumption-tax finance (run 5). But the progressive match runs perform the worst of all the runs with the other tax bases. Although the flat benefit runs underperform the benchmark and opting out runs, the flat benefit runs outperform the progressive match runs assuming wage- or income-tax financing.

Distributional Impact for Cohorts Born in the Long Run

The long-run welfare effects of the different privatization policies are shown in Table VIII and the bottom panels of Figs. 4–6 (for the benchmark runs), Figs. 7–10 (for the opting out runs), Figs. 11–13 (for the flat add-on benefit runs), and Figs. 14–16 (for the progressive match runs). The welfare effects are measured as an equivalent variation. To be precise, they are measured as the percentage increase in both consumption and leisure in each year of remaining life (the entire lifetime for initial and future newborns) in the preprivatization economy needed to generate the same level of utility the agent enjoys as a result of the privatization reform. "Year of birth" in these tables and figures refers to the year of an agent's birth relative to the year the reform begins. So, for example, the index "-10" refers to a person born 10 years before the reform and whose current age is 11, which corresponds to a real-world age of 32. The index "1" refers to a person born the year the reform begins.

Notice that all households, poor and rich alike, born in the long run gain from privatizing Social Security. Once again, the choice of the tax base used to finance the transition path does not matter for the long run. Moreover, the benchmark and opting out runs generate the same long-run outcomes since everyone born in the long run will choose to opt out of

TABLE VIII
Percentage Change in Remaining Lifetime Utility for Selected Income Classes

Run	Class	Year of birth						
		−54	−25	−10	1	10	25	150
1	1	0.0	−2.0	−1.3	−0.6	0.1	2.2	6.0
	3	−0.1	−1.7	−1.1	−0.4	0.5	3.0	7.4
	6	−0.1	−1.4	−0.8	−0.2	0.8	3.3	8.0
	9	−0.1	−1.2	−0.7	−0.1	0.9	3.5	8.1
	12	−0.1	−0.6	−0.4	−0.1	0.3	1.5	4.4
2	1	−0.2	−1.8	−1.1	−0.5	0.2	2.3	6.0
	3	−0.1	−1.4	−0.7	−0.2	0.7	3.2	7.4
	6	0.0	−1.1	−0.4	0.1	1.1	3.6	8.0
	9	0.0	−0.9	−0.3	0.2	1.2	3.7	8.1
	12	0.0	−0.3	−0.1	0.1	0.5	1.8	4.4
3	1	−0.1	−0.2	1.6	3.2	3.1	3.5	6.0
	3	−1.4	−1.6	0.0	1.4	1.7	3.3	7.4
	6	−1.3	−2.1	−0.7	0.7	1.1	3.2	8.0
	9	−1.2	−2.4	−1.0	0.3	0.8	3.1	8.1
	12	−1.7	−3.6	−3.6	−3.0	−2.5	−0.2	4.4
4	1	−0.1	0.0	1.9	3.3	3.1	3.6	6.0
	3	−1.3	−1.2	0.4	1.7	1.9	3.5	7.4
	6	−1.1	−1.8	−0.2	1.0	1.4	3.5	8.0
	9	−1.1	−2.1	−0.5	0.6	1.1	3.4	8.1
	12	−1.6	−3.2	−3.2	−2.7	−2.1	0.1	4.4
5	1	0.7	−2.1	−0.6	0.5	1.3	3.2	6.0
	3	−0.4	−2.0	0.0	1.2	2.1	4.2	7.4
	6	−0.9	−1.7	0.3	1.6	2.6	4.8	8.0
	9	−1.2	−1.6	0.5	1.7	2.7	4.9	8.1
	12	−1.5	−2.5	−1.8	−1.0	−0.1	1.7	4.4
6	1	0.7	−2.0	−0.3	0.6	1.4	3.4	6.0
	3	−0.3	−1.8	0.4	1.4	2.3	4.4	7.4
	6	−0.8	−1.4	0.8	1.8	2.8	5.0	8.0
	9	−1.1	−1.3	1.0	2.0	3.0	5.1	8.1
	12	−1.3	−2.2	−2.4	−0.8	0.1	1.9	4.4
7	1	−0.1	−0.5	0.7	3.2	3.4	3.8	6.0
	3	−0.9	−2.1	−0.2	1.8	2.2	4.2	7.4
	6	−0.9	−2.9	−0.5	1.3	1.7	4.3	8.0
	9	−0.9	−3.3	−0.7	1.0	1.4	4.2	8.1
	12	−1.1	−3.8	−3.0	−2.2	−1.9	0.9	4.4
8	1	−0.1	−0.6	0.8	3.2	3.4	3.8	6.1
	3	−1.0	−2.1	−0.1	1.9	2.2	4.3	7.5
	6	−0.9	−3.0	−0.4	1.4	1.7	4.4	8.2
	9	−0.9	−3.4	−0.6	1.1	1.5	4.4	8.3
	12	−1.2	−3.7	−2.9	−2.1	−1.8	1.0	4.6

TABLE VIII—*Continued*

Run	Class	Year of birth −54	−25	−10	1	10	25	150
9	1	0.5	−2.2	−1.0	0.9	1.6	4.2	6.0
	3	−0.3	−2.7	−0.2	1.6	2.4	5.2	7.4
	6	−0.6	−2.8	0.3	2.0	2.9	5.8	8.0
	9	−0.8	−2.8	0.5	2.2	3.1	5.9	8.1
	12	−1.0	−2.9	−1.6	−0.6	0.1	2.5	4.4
10	1	0.5	−2.3	−0.9	1.0	1.6	4.2	6.1
	3	−0.3	−2.7	−0.1	1.7	2.5	5.4	7.5
	6	−0.6	−2.7	0.4	2.1	3.0	6.0	8.2
	9	−1.5	−2.7	1.1	2.7	3.7	6.3	8.3
	12	−1.0	−2.7	−1.4	−0.5	0.3	2.7	4.6
11	1	−0.1	1.0	1.2	2.9	3.0	3.6	6.0
	3	−0.9	−0.7	−0.4	1.5	1.5	2.9	7.4
	6	−0.9	−1.5	−0.8	0.9	0.9	2.6	8.0
	9	−0.9	−1.9	−1.0	0.6	0.6	2.4	8.1
	12	−1.1	−3.2	−3.3	−2.6	−2.7	−0.9	4.4
12	1	0.5	−0.8	−0.8	0.5	1.0	2.8	6.0
	3	−0.2	−1.3	−0.5	1.2	1.8	3.8	7.4
	6	−0.6	−1.4	0.1	1.7	2.2	4.3	8.0
	9	−0.8	−1.4	0.3	1.8	2.4	4.4	8.1
	12	−1.0	−2.3	−1.7	−0.9	−0.4	1.3	4.4
13	1	0.0	−0.1	0.0	0.3	0.8	1.9	4.0
	3	−0.1	−0.7	−0.4	−0.1	0.4	1.7	4.2
	6	−0.1	−0.8	−0.5	−0.2	0.3	1.7	4.3
	9	−0.1	−0.9	−0.6	−0.2	0.3	1.6	4.3
	12	−0.1	−0.5	−0.4	−0.2	0.0	0.6	2.3
14	1	−0.1	1.8	3.1	4.3	4.1	4.2	5.7
	3	−1.4	−0.5	0.6	1.7	1.7	2.3	4.8
	6	−1.3	−1.6	−0.5	0.6	0.5	1.4	4.4
	9	−1.2	−2.1	−1.0	0.0	−0.1	1.0	4.1
	12	−1.7	−3.6	−3.9	−3.4	−3.5	−3.4	0.5
15	1	0.7	−0.3	0.8	1.4	2.0	3.2	4.9
	3	−0.4	−1.2	0.6	1.5	2.1	3.4	5.2
	6	−0.9	−1.3	0.6	1.6	2.2	3.5	5.4
	9	−1.2	−1.3	0.6	1.6	2.2	3.5	5.4
	12	−1.5	−2.5	−1.9	−1.2	−0.7	0.5	2.0
16	1	0.0	−1.0	0.4	1.6	2.2	4.2	8.0
	3	−0.5	−1.3	−0.2	0.9	1.6	4.0	8.4
	6	−0.4	−1.6	−1.0	0.0	0.9	3.3	8.1
	9	−0.4	−1.8	−1.4	−0.6	0.3	2.9	7.7
	12	−0.5	−1.7	−1.5	−1.2	−0.9	0.3	3.5
17	1	−0.2	0.9	3.2	5.3	5.0	5.3	8.0
	3	−1.8	−1.3	0.7	2.6	2.7	4.2	8.4
	6	−1.6	−2.4	−1.0	0.7	0.9	2.9	8.1
	9	−1.6	−3.2	−1.8	−0.4	−0.1	2.2	7.7
	12	−2.1	−4.9	−5.0	−4.3	−4.1	−1.7	3.5

TABLE VIII—*Continued*

Run	Class	Year of birth −54	−25	−10	1	10	25	150
18	1	0.9	−1.6	0.5	1.9	2.8	4.7	7.6
	3	−0.5	−1.8	0.7	2.3	3.2	5.4	8.5
	6	−1.1	−1.9	0.4	1.9	3.1	5.1	8.4
	9	−1.5	−2.0	0.2	1.7	2.7	4.9	8.1
	12	−1.8	−3.2	−2.4	−1.6	−0.7	1.2	4.0
19	1	0.0	−2.0	−1.2	−0.6	0.1	2.0	4.3
	3	0.0	−1.6	−0.9	−0.3	0.6	3.0	6.1
	6	0.0	−1.2	−0.6	0.0	0.9	3.4	6.8
	9	0.0	−1.0	−0.5	0.0	1.1	3.6	7.1
	12	0.0	−0.3	−0.1	0.1	0.6	1.9	4.1

Social Security. Long-run welfare gains are, different, however, for the flat benefit and progressive match experiments.

For the benchmark and opting out runs, the welfare gains of those born in the long run exceed 4% for each of the income classes. The gains are larger for middle income classes. Class 9, for example, enjoys an 8% welfare gain. The welfare gain for the top income class is 4 percent; for the bottom income class it is 6%. What explains these differences? The answer is that different features of the privatization policy affect income groups differently. First, we are eliminating the progressive Social Security benefit schedule. Second, we are eliminating the regressive (due to the ceiling on taxable earnings) Social Security payroll tax. Third, we are adjusting downward long-run income tax rates due to the expansion of the income-tax base associated with the long-run improvement of the economy. This reduction in income-tax rates benefits income-tax payers, a set of agents that does not include the very poor who pay no income taxes because of income-tax exemptions and deductions. Fourth, eliminating Social Security's payroll tax has a bigger impact on households with higher earnings (but not so high as to exceed the covered earnings ceiling) since they already face a higher marginal income-tax rate. Since the distortion of labor supply rises with the square of the tax rate, those households face a multiple of the labor supply distortion facing low income households. However, those households with earnings above the payroll tax ceiling in the initial steady state (represented by class 12) benefit less from privatization since their labor supply is not affected, at the margin, by the payroll tax.

In the flat benefit runs, the welfare gains of those born in the long run are smaller, on average, and less dispersed. The welfare gain is about 4 to 5% for each income group except the top 2 percent (class 12), whose

welfare increases by only 0.5 to 2%. Although the choice of the tax base used to finance the accrued transition benefits does not matter in the long run, the choice of the tax used to finance the flat benefit does. The income base is the best for the bottom 2% of the income distribution (class 1), but the income and wage base give similar results for the other income classes except the rich, who prefer the wage base. The consumption base is best for all income groups except the bottom 2%. Interestingly, for all choices of the tax bases, all income groups born in the long run are worse off under the flat benefit runs relative to either the benchmark or the opting out run. This is because the benefits of the pay-as-you-go-financed flat benefit to the lifetime poor born in the final steady state are outweighed by the general-equilibrium effects (higher wages and lower interest rates) and higher rate of return to contributions that accompany the elimination of all unfunded liabilities in a closed economy.

The runs with progressive matching produce welfare gains that are, on average, similar to those in the benchmark and opting out runs. But the distribution of the gains is different. For example, the welfare of agents in income class 1 increases by 8% compared with 6% in the benchmark and opting out runs. The gains for those in income class 9, in contrast, decrease from 8 to 7.5%. And the gains decrease from 4.5 to 3.5% for those in income class 12. Financing the progressive match with a consumption tax leads to slightly smaller gains for income class 1 (7.5%) and slightly larger gains for income class 12 (4%).

Distributional Impact for Cohorts Alive in the Short Run

Privatization leads to a reduction in welfare for most income groups alive at the time of privatization or born shortly thereafter. Although the choice of the tax base used to finance the transition and the choice between benchmark and opting out is unimportant in the long run, it can affect those alive at the time of the reform very differently.

Consider the initial elderly. In all of the experiments, wage-tax finance of the transition reduces their welfare by substantially less than either consumption- or income-tax finance. This is because the initial elderly receive essentially no income from wages, but do consume and earn interest income. For example, those age 55 at the time of privatization (real age of 75 and year of birth equal to -54) suffer less than a 0.1% decline in remaining lifetime utility with payroll-tax finance in both the benchmark and flat benefit runs 1 and 13. The losses to the initial elderly are slightly higher in the progressive matching run (run 16) since the match is financed with an income tax. Also note that the welfare loss incurred by the initial elderly is smaller with opting out than in the benchmark runs when the transition is financed with either an income tax

or a consumption tax. This is because the opting out runs continue to collect some payroll taxes in the short run (since some people choose to stay with Social Security), thereby requiring less need to raise income or consumption taxes. It follows that the relatively quick convergence associated with opting out is not incompatible with protecting the welfare of the initial elderly. Third, note that all flat benefit runs result in a smaller welfare loss to the initial elderly and most younger workers alive at the time of the reform than do the corresponding progressive match runs. This is because the larger welfare gains accruing to generations born in the long run in the progressive matching runs require a larger economic sacrifice from those alive in the short run.

Now consider middle-aged workers (e.g., those age 26) at the time of the reform. For a given run, these workers are hurt by roughly the same amount if wage or consumption taxes are used to finance the transition. With the exception of the poorest lifetime income group, middle-aged workers fare the worst with income-tax finance of the transition. Older workers, in contrast, fare the worst with consumption-tax finance.

In the opting out runs, middle-aged and older workers are worse off in the opting out runs than in the benchmark runs if income or consumption taxes finance the transition. This is just the opposite result as arose for the initial retirees. This is because these workers tend to not opt out of Social Security and, therefore, both pay the payroll tax and help finance the transition to the privatized system. Run 11 considers income-tax finance with full perception of the net tax rate and with the payroll tax at one-half the present law value for those who remain in Social Security (benefits remain the same as before). Run 12 uses consumption-tax finance. This modification to opting out now makes middle-aged workers better off relative to the benchmark income and consumption-tax finance runs. Although fewer workers now choose to opt out of Social Security (see the bottom panel in Fig. 3), total payroll revenue declines. This means that a larger amount of revenue must be raised from younger workers (e.g., those born in year -10 through year 25) who pay little or no payroll taxes because they opt out. This modification makes them worse off. The rate of convergence of the capital stock is only a little slower than it is with opting out, but still faster than with compulsory participation.

Now consider young workers born around the time of the reform (e.g., those born in year -10 through year 25). First, as noted above, younger workers prefer the modified opting out program relative to straight opting out. However, notice that the absolute welfare changes for these workers from privatization under the modified opting out program are not much different from the welfare changes for the corresponding benchmark runs. This is because the modified opting out program is effective in allocating more of the distributional burden of privatization to workers born after

year 25 who benefit from privatization (i.e., notice their gains are positive but smaller for the modified opting out program relative to the benchmark runs). Second, except for the very rich, younger workers are actually better off with income-tax than wage-tax finance for most of the experiments. This is because income-tax finance raises substantial revenue from middle-aged workers. But the youngest workers are best off with consumption-tax finance. This is because they have little net worth and, therefore, benefit from the wealth levy on the assets of older workers.

Sensitivity Analysis: The Small Open Economy

In order to create an upper bound on how much open-economy effects could matter, we rerun, as run 19, our first run, but treat the United States as a small open economy. Factor prices—wages and interest rates—are now unaffected by privatization because capital moves in and out of the United States to equalize the after-tax return from investing in the United States with that from investing abroad. While the domestic capital stock rises by the same proportion as labor supply (Table III), the amount of wealth owned worldwide by U.S. citizens increases by over 75% in the long run compared to 39% assuming a closed economy. National income—now including interest earned by U.S. citizens on capital located outside of the United States—increases by over 16% compared to 13% assuming a closed economy. The long-run gains to the capital stock and national income in the open-economy case are larger relative to the closed-economy setting because the return to saving—the interest rate—does not diminish as people save more. In contrast, the interest rate decreases sharply in the closed economy, discouraging additional saving. United States citizens also consume much more leisure in the open-economy case relative to the closed economy. Labor supply falls by 4% in the open-economy case compared to an increase of 5% in the closed-economy case. The increase in income permits more leisure. The long-run utility gains, although slightly smaller, are matched with smaller short-run sacrifices. In sum, our open-economy simulation paints privatization's long-run effects in a better light.

V. CONCLUSIONS

Our simulations deliver the following messages: Privatization of the U.S. Social Security System can raise substantially a nation's living standard. But this prospective gain to those alive in the future comes, for the most part, at the cost of welfare losses to transition generations. Importantly, the poorest members of future society have the most to gain from

privatization even if privatization does not include an explicit redistribution mechanism, such as a flat/basic benefit or a progressive contribution match. The long-run gains from privatization take a fairly long time to materialize. This is particularly true if an income or a wage tax, as opposed to a consumption tax, is used to finance the transition. Finally, privatizations that allow initial workers to remain in the current system have particularly low transition costs and particularly favorable macroeconomic consequences.

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