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SIMULATING THE PRIVATIZATION OF SOCIAL SECURITY IN GENERAL EQUILIBRIUM

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ABSTRACT

This paper studies the macroeconomic and efficiency effects of privatizing social security. It does so by simulating alternative privatization schemes using the Auerbach-Kotlikoff Dynamic Life-Cycle Model. The simulations indicate three things. First, privatizing social security can generate very major long-run increases in output and living standards. Second, although the long-run gains from privatization are larger if privatization redistributes resources from initial to future generations, the pure efficiency gains from privatization are also substantial. Efficiency gains refers to the welfare improvement available to future generations after existing generations have been fully compensated for their losses from privatization. The precise size of the efficiency gain depends on the existing tax structure, the linkage between benefits and taxes under the existing social security system, and the method chosen to finance benefits during the transition. Third, at least in the long run, privatizing social security is likely to be progressive in that it improves the well-being of the lifetime poor relative to that of the lifetime rich.

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I. Introduction

Privatization of social security is one of the hottest policy issues currently under discussion in the United States. Much of this interest seems motivated by a desire to find a way out of the U.S. Social Security System's long-run financing problem. But there is also a growing awareness among Americans of Chile's success in privatizing social security and the fact that countries all over the world are trying to replicate it. Chile's privatization coincided with a spectacular take-off of its economy and has led some observers to suggest that privatizing social security was the key to Chile's economic growth. The truth here is hard to know. The Chilean economy benefited from a number of concomitant economic reforms. It also benefited from a stable government and from improvements in external economic conditions. Given the potential for exaggerating the impact on Chile of privatizing social security, it's important to take a hard-nosed look at what economic analysis tells us privatization can and can't do.

This paper does this. It draws and builds on Kotlikoff (1996a, 1996b, and 1996c) in trying to identify the economic arguments for and against privatization. One of the main, although certainly not novel, points in these papers is that, absent efficiency improvements, welfare improvements accruing to particular generations as the result of privatization come at the expense of welfare losses to other generations. Moreover, absent efficiency gains or intergenerational redistribution, making some members of a generation better off requires making other members worse off. Policy makers should, presumably, be interested in identifying and immediately enacting any reforms that constitute Pareto improvements. Hence, understanding the potential pure efficiency gains from privatization is important. But policy makers also routinely trade off the welfare of

one generation against another. Consequently, they also need to understand the potential role of privatization in redistributing resources across and within generations.

This paper uses the Auerbach-Kotlikoff Dynamic Fiscal Policy Model to simulate the macroeconomic and efficiency effects of privatization. In so doing, it adds to a growing literature on the subject. Feldstein (1995) use a partial equilibrium framework and Arrau (1990) and Arrau and Schmidt-Hebbel (1993) use a version of the AK Model to make a number of the points argued here. The AK Model used by Arrau and Arrau and Schmidt Hebbel takes labor supply as exogenous. This is a significant shortcoming since the efficiency gains from privatizing social security arise, in large part, from eliminating social security's distortion of labor supply decisions. Raffelhueschen (1993) does include variable labor supply in his simulation analysis of privatizing social security, and his qualitative conclusions are quite similar to those reached here. But Raffelhueschen's model contains only two periods which limits the applicability of his quantitative findings. Like this study, Imrohoroglu, Huang, and Sargent (1995) use a multi-period life cycle model to simulate the effects of privatizing social security. Although their model is more elaborate than the one used here, it does not include variable labor supply which precludes separating efficiency gains from intergenerational redistribution. Nonetheless, their general findings concerning non-compensated social security privatization transitions accord with those presented here.

The paper proceeds in Section II by discussing the potential macroeconomic and efficiency effects of pay-as-you-go social security. Section III describes the AK Model and its parameterization for this study. Sections IV and V report results for a one-income

class and multi-income class versions of the AK model. The final section, VI, summarizes and concludes the paper.

II. Social Security's Privatization and the Macro Economy

Social Security and Saving

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

The mechanism underlying the redistribution to the initial elderly is clear. Generations, which are retired or close to retirement at the time pay-as-you-go social security benefits are increased, receive windfalls. Initial young as well as all future generations are then left contributing to a retirement system whose rate of return is dictated by the total earnings of subsequent contributors and, thus, the economy's rate of growth of labor earnings. In the U.S., this growth rate appears to be about one third the rate of return available from investing in the market.[1]

This intergenerational redistribution, which produces a very big windfall to the initial elderly and imposes a smaller, but still substantial, loss to all subsequent generations, has a major macroeconomic fallout. It raises the current consumption of the elderly by more than it reduces the current consumption of the current young as well as that of future

[1] In a setting in which the growth rate of earnings as well as the market return on capital are risky, the comparison between the return paid by social security and that paid by the market requires appropriately

generations, whose current consumption is obviously zero. Consequently, the policy lowers national saving. The consumption of the elderly rises by more than that of the young for two reasons: First, the elderly have higher propensities to consume out of remaining lifetime resources than do the young.[2] Why? Because the elderly are closer to the ends of their lives and have, therefore, fewer years over which to spend each dollar of remaining lifetime resources. Second, as mentioned, the windfalls to the current elderly are paid for not only by the current young, but also by future generations. So the resource loss to the initial young is smaller than the resource gain to the initial elderly.

Figure 1, based on data developed in Gokhale, Kotlikoff, and Sabelhaus (1996), documents the differences by age in propensities to consume. It shows that propensities to consume of American cohorts are roughly constant through age 60 and then rise dramatically. Figures 2 and 3 use the same data to show how relative age-consumption and age-resource profiles for American cohorts have changed since the early 1960s. Note that the very substantial increase in the resources of the elderly relative to the young has coincided with an equally substantial increase in their relative consumption. The secular increase in the relative resources of the elderly reflects many factors. But the predominant factor is direct government redistribution to the elderly through social security, Medicare, and Medicaid.

As Figure 4 shows, U.S. intergenerational redistribution has led to precisely what the life cycle model predicts -- a decline in the rate of U.S. saving. The greater than two-thirds decline in the rate of U.S. saving since the 1950s and 60s has meant a much lower

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adjusting for risk. It seems unlikely, however, that such adjustment would make pay-as-you-go social security a better investment than investing in the market.

rate of U.S. domestic investment. This, in turn, has raised real interest rates and reduced labor productivity and real wage growth substantially below what would otherwise have been the case (see Figure 5). Thus, these general equilibrium feedback effects have exacerbated the direct redistribution from young and future generations to the initial old through pay-as-you-go social security.[3]

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

The Saving, Investment, and Growth Effects of Privatization

If privatization ends up placing a larger fiscal burden on initial older generations, it will lower the fiscal burden not only of the initial young, but also of all future generations. In this case, the initial elderly, with their high propensities to consume, will reduce their consumption by more than the initial young will raise their consumption. Thus, the net

[2] The term "resources" refers to the present value of all remaining lifetime non-asset income (net of taxes and gross of transfer payments received) plus current net wealth.

impact will be a rise in national saving, investment, and, at least in the short run, real wage growth.

The Personal Security System described in Kotlikoff (1996) provides an example of how privatization may produce *income effects* that are conducive to more national saving. In this scheme, social security benefits are phased out over a 45-year period. Since payroll contributions to social security are immediately privatized (i.e., the contributions are made to and invested within private accounts), an alternative fiscal instrument is needed to finance social security benefits during the transition. The Personal Security System uses a consumption tax, specifically a federal retail sales tax, to pay for transitional benefits. Since the elderly account for a larger share of consumption than they do of social security payroll contributions, this policy imposes a larger fiscal burden on them.

In addition to altering national saving via income effects, privatization may also change saving incentives in a way which either encourages or discourages current consumption. Suppose, for example, that income-tax finance is used to pay for interest on debt issued in the course of privatizing social security. The higher effective rate of capital income taxation that results from higher income tax rates raises the price of consuming in the future relative to the present and provides the young and old alike an incentive to substitute current for future consumption, i.e., to save less.[4] Indeed, such positive *substitution effects* on current consumption could outweigh the negative income effects on

[3] See Auerbach and Kotlikoff (1987) for a simulation analysis showing how alternative government policies affect the welfare of current and future generations.

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

current consumption arising under particular privatization schemes, producing, on balance, a decline in national saving.

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

Are there Efficiency Gains from Privatizing Social Security?

Economic efficiency concerns the structure of economic incentives, such as the incentive to consume now rather than latter or the incentive to work rather than enjoy leisure. Since privatization of social security will generally alter economic incentives, the possibility arises that privatization could make the economy more efficient – that it could improve the structure of incentives and, in the process, make some generations better off without making others worse off.

The most important incentive affected by social security is the incentive to work. By financing social security benefits via payroll taxation, social security reduces this incentive, although the degree to which it does so depends on the nature of its marginal linkage between social security benefits and contributions. This linkage can be positive, negative, or zero. Zero linkage occurs when social security benefits are determined, at the margin, independent of contributions or when workers incorrectly perceive that contributing more to social security will not raise their future social security benefits. In the U.S., misconception of the true nature of benefit-tax linkage seems plausible given the complex nature of the U.S. social security benefit formula.

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

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

Although providing 100 percent or greater marginal benefit-tax linkage to some contributors is certainly feasible, providing such linkage to all contributors may be politically impossible because of equity considerations. Ignoring other fiscal instruments, providing such high marginal benefit-tax linkage on each dollar contributed to social security requires imposing a large inframarginal tax. Since this large inframarginal tax would be independent of labor earnings, low wage earners would face a higher average tax from social security than would high wage earners, making the system regressive.

The Potential Efficiency Gain from Eliminating the U.S. Social Security Payroll Tax

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

Distortions of economic decisions rise with the square of the total effective marginal tax on the decision, so the contribution of the payroll tax to distorting labor supply depends upon the size of marginal income taxes as well as other effective marginal labor taxes. In the United States, workers who earn less than social security's covered earnings ceiling (currently $62,500) are subject to the full 15.3 percent marginal social security payroll tax.[5] Most of these workers are likely to be in the 15 percent federal marginal income tax bracket. They are also likely to face a 5 percent state marginal

income tax and state sales taxes as well as federal excise taxes which together effectively tax their labor earnings at about 5 percent.

In combination, these non social security marginal taxes total 25 percent. The 15.3 percent U.S. social security payroll tax rate raises the total effective marginal tax rate on labor supply from 25 percent to 39 percent once one takes into account the fact that half of the payroll tax contribution (the employer's contribution) is deductible from the federal income tax. Now .25 squared equals .0625, and .39 squared equals .1521. Since the distortion of labor supply is proportional to the square of the total effective marginal labor tax rate, the U.S. social security payroll tax may be raising labor supply distortions of low income workers by 143 (([.1521/.0621]-1)*100) percent even though it raises the total effective marginal labor tax rate by only 56 (([.39/.25]-1)*100) percent.[6]

The Linkage at the Margin of Benefits to Earnings[7]

This analysis may overstate social security's actual distortion of labor supply and the efficiency gains from privatization because of marginal-benefit tax linkage under the current system. In the United States, marginal benefit-tax linkage varies enormously across the population. Many secondary earners in two-earner couples and all non working spouses in single-earner couples collect dependent retirement and survivor benefits based

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[5] The 15.3 payroll tax rate includes the Medicare (HI) tax.

[6] For low-income workers covered by the earned income tax credit, the payroll tax's marginal distortion is even larger. Such workers lose 20 cents of their earned income tax credit for every dollar that they earn. Hence, their total effective marginal labor tax rate is 45 percent absent the social security payroll tax and 59 percent with the payroll tax. For such workers, the payroll tax raises their total effective marginal tax rate by 31 percent, but their labor supply distortion by .3481 by 72 percent. Compared to workers who face the earned income tax credit, the incremental distortion from the payroll tax (which is proportional to the difference between .3481 and .2025) is 62.5 percent larger than the incremental distortion for workers who don't face the earned income tax credit (which is proportional to the difference between .1521 and .0625).

solely on their spouse's earnings histories. Consequently, they receive zero additional benefits in exchange for their marginal payroll tax contributions to social security.[8] The same is true for workers under age 21 since their earnings are not included in the calculation of average indexed monthly earnings for purposes of determining retirement benefits. On the other hand, benefit-tax linkage for many primary earners in two-earner couples is significant.

Table 1 presents net marginal tax rates on social security contributions for six different household types taking into account benefit-tax linkage. These data were provided by Andrew Samick based on a benefit-calculating program developed in Feldstein and Samwick (1992).[9] The calculations assume a 6 percent real rate of discount, a 1.2 percent rate of real wage growth, and a 3.5 percent rate of inflation and consider the net rate of social security benefit taxation arising from a permanent increase in monthly earnings by $1. The table considers only the old age and survivors (OASI) components of social security, and its net tax rates should be compared with the 11.2 percent OASI payroll tax. Negative values refer to subsidies.

The table shows three things. First, it confirms that marginal OASI net tax rates differ greatly across different Americans. For example, at age 50, the table's low-earner, single-earner husband faces a 12 percent social security subsidy, whereas a high earner (in the 15 percent benefit bracket), single male age 50 faces a 10 percent marginal tax. Second, OASI net tax rates decline, often substantially, over the life cycle. Consider again the low-earner, single-earner husband. His net tax rate falls from 2 percent to -23 percent

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[7] This section draws on Kotlikoff (1996c).
[8] This discussion abstracts from disability benefits.

between ages 25 and 60. The reason for the decline in net tax rates with age is that the closer one gets to collecting marginal benefits arising from additional labor earnings, the less severe is the discounting of those benefits.

Third, as one goes from low- to high-earner households who are earning less than social security's covered earnings ceiling, net marginal tax rates rise substantially. For example, there is a 15 percentage point spread between the 5 percent subsidy facing 50 year-old low earning, single males and the 10 percent tax facing 50 year-old high earning, single males. On the other hand, once one passes the covered earnings ceiling, the marginal OASI net tax drops to zero. Workers earning more than social security's covered earnings ceiling face zero marginal OASI payroll taxation and also receive no marginal social security benefits.[10]

Do workers whose benefits are linked at the margin to additional earnings understand the linkage? We don't know. However, we do know that correctly assessing the linkage is very difficult. Doing so requires knowledge of intricate OASI benefit provisions and the ability to make sophisticated actuarial calculations. Since very few workers have such knowledge or actuarial background, the vast majority are, presumably, guessing about the degree to which their benefits are linked at the margin to their additional earnings. If they are over-assessing the degree of linkage, the present social security system may be less distortionary than it appears. On the other hand, if they are under-assessing the degree of linkage, the opposite will be true. In this case, privatizing

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[9] Boskin, et. al. (1987) is an earlier study of the marginal net rate of social security taxation which reaches similar conclusions.

[10] For this large group of workers, social security does, however, represent a substantial infra-marginal tax. Indeed, it is this large infra-marginal tax on high earners that is used to provide low earners, as a

social security can be beneficial by simply making clear that the true rate of marginal taxation of labor supply is less than the perceived rate.

Other Efficiency Issues Raised by Social Security's Privatization

In addition to its impact on effective marginal tax rates on labor supply, privatization may also alter other effective marginal tax rates. For example, if privatization is accomplished by using income tax finance to pay, over time, the accrued benefits owed to current retirees and workers, there will be a temporary increase in effective marginal capital income taxation. If effective marginal capital income taxation is already quite high due to, say, a high corporate income tax, privatization could well reduce economic efficiency. Thus, there is no guarantee that privatizing social security will improve economic efficiency. It all depends on the type of social security system being privatized, the nature of other fiscal distortions, and the manner in which privatization takes place.

An entirely different efficiency issue raised by social security's privatization is its impact on the availability to the elderly of longevity insurance (insurance against outliving one's resources). Social security provides this insurance by paying retirees benefits for as long as they live. Social security overcomes the adverse selection problem faced by private insurers in trying to sell annuities by simply forcing everyone into its insurance pool; i.e., it effectively forces everyone to buy its annuities. The government has a second important advantage vis-a-vis private insurers, namely the ability to provide inflation-indexed benefits. The U.S. government appears poised to assist private insurers in selling

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group, with low or negative marginal OASI net tax rates and average rates of return on their contributions

indexed annuities by following the example of England and other several other countries in issuing indexed debt. Insurance companies will be able to purchase this debt to hedge their exposure in selling indexed annuities to the public.

Research is now underway to assess the potential efficiency costs of eliminating compulsory purchase of annuities through social security which would potentially leave the elderly with much less longevity insurance. These costs may be substantial because, as demonstrated in Kotlikoff and Spivak (1981), the value of longevity insurance can be very high even for households with moderate degrees of risk aversion. On the other hand, Kotlikoff and Spivak also show that extended families, for whom information problems are surely less severe, can insure their members against longevity risk to a surprising degree. The fact, recently documented by Hayashi, Altonji, and Kotlikoff (1996), that extended families don't self insure doesn't preclude their choosing to do so in response to the privatization of social security. Anecdotal as well as hard evidence on extended family living arrangements suggests that self insurance by extended families was much greater in the United States prior to the expansion of social security. In any case, until this important issue is resolved, it will be impossible to assess the net efficiency gains from privatizing social security.[11]

III. Using the Auerbach-Kotlikoff Model to Study Social Security's Privatization

The Auerbach-Kotlikoff Model

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that exceed the economy's growth rate.

[11] Note that in a privatized system, the government could limit the degree of adverse selection by a) compelling each cohort to annuitize all of its accumulated privatized account balances, say, at age 65 and b) prohibiting insurance companies from restricting the sale of its annuities to individuals with particular characteristics.

The Auerbach-Kotlikoff Model (henceforth, the AK model) can provide some sense of the potential saving, investment, and growth effects of privatizing social security.[12] The AK model calculates the time-path of all economic variables in its economy over a 150 year period. The model has 55 overlapping generations. Each adult agent in the model lives for 55 years (from age 20 to age 75).

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

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

[12] For a detailed description of the AK Model see Auerbach and Kotlikoff (1987).

The model's base-case population growth rate is set at a constant 1 percent rate, with the population of each new cohort being 1 percent larger than that of the previous cohort. All agents are assumed to have the same preferences, so differences in behavior across agents arise solely from differences in economic opportunities. Until Section V, all agents in the within an age cohort are assumed to be identical, i.e., differences in economic opportunities are present only across cohorts. Section V considers a heterogeneous-agent version of the model, developed by Kent Smetters and Jan Walliser. This modified model considers twelve earnings groups within each cohort. Each earnings groups experiences the same longitudinal growth in earnings, but has a different level of earnings. This modified model facilitates the study of the effect of privitization on the intragenerational distribution of economic resources and welfare.

The AK Model's output is produced by perfectly competitive firms that hire labor and capital to maximize their profits. These firms produce subject to a CES production function, which, for purposes of this study, is restricted to the Cobb-Douglas form. The government sector consists of a treasury that collects resources from the private sector to finance government consumption and an unfunded, "pay-as-you-go" Social Security system which levies payroll taxes to pay for contemporaneous retiree benefit payments. There is no money in the model, and thus, no monetary policy. There is, however, government debt, and the model can handle deficit-financed reductions in payroll and other taxes. It can also handle gradual phase-ins of one tax for the other. Finally, the model contains a Lump Sum Redistribution Authority -- a hypothetical governmental agency which can use lump sum taxes and transfers to redistribute among generations alive at a point in time as well as those who will be born in the future. The LSRA can be

used (switched on) to study the pure economic efficiency effects of particular policy changes.

Although the model handles a great number of complex processes, it leaves out certain portions of reality, some small and some large. For one thing, there are no liquidity constraints. Leaving out liquidity constraints greatly facilitates the simulation of social security's privatization. The reason is that one can model the act of privatizing social security contributions as equivalent to simply eliminating the payroll tax. This reflects the fact that agents in the model cannot be forced to save. Any attempt to do so simply leads them to borrow against their future wealth. This applies to forcing agents to invest their social security contributions in private accounts. Doing so would produce the same net saving as not doing so. This said, it's worth pointing out that in the particular economies simulated here, agents do not actually seek to borrow. So s liquidity constraint (specifically, a co straint against negative net wealth), even were it added to the model, would not be binding.

The version of the model used here ignores saving for purposes other than retirement, such as bequests. The model also ignores uncertainty with respect to either individual or macroeconomic outcomes. These and other omissions suggest viewing the model's results cautiously.

Modeling Social Security's Privatization

As just mentioned, in the AK model, privatizing social security contributions just requires setting the model's social security payroll tax rate to zero.[13] Hence, there is no need to add a formal private pension system to the model. Beyond eliminating the payroll tax, privatizing social security benefits within the model involves three key decisions: how fast to phase out benefits, whether to issue explicit government debt for a period of time to make up for some or all of the loss in payroll tax revenue, and what tax instrument to use, during the benefit phase-out period, to pay for benefits that aren't financed by explicit borrowing and to meet, during and after the benefit phase-out period, interest on new debt issued as part of the privatization.[14]

The AK Model Used to Study Social Security's Privatization

As reported in Table 2, the pre-privatization economy features a progressive income tax (with an average marginal tax rate of 33 percent) that finances government consumption equal to 22 percent of output, a 12 percent social security payroll tax, zero linkage between social security benefits and taxes, zero initial official government debt, a 1 percent population growth rate, zero technological change, a Cobb-Douglas production

[13] Again, this can be thought of forcing agents to make their contributions to private pension accounts but permitting them to reduce their other saving and, indeed, borrow against these accounts if they so desire.

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

function, and a CES utility function in consumption and leisure with intertemporal and intratemporal elasticities of substitution of .25 and .8, respectively, and a time preference rate of 1.5 percent.

Our baseline economy has a 2.5 percent rate of national saving and a ratio of social security outlays to output of .089.[15] The pre-tax interest rate (the marginal product of capital) is 10.3 percent. At the micro level, consumption more than doubles between ages 21 and 75, which is consistent with the findings in Figure 2. Social security benefits constitute between 55 and 60 percent of consumption for agents over 65. Labor supply at age 65 is about 70 percent lower than labor supply at age 21; it is virtually zero after age 71.

The simulation phases out social security benefits in a linear manner over a 45-year period. This phase-out period starts 11 years after the payroll tax is eliminated, thus permitting all beneficiaries at the time of the reform to collect all their benefits. Social security benefits during the transition are financed by either a proportional consumption tax, a progressive income tax, a payroll tax, or initial deficit finance coupled with subsequent increases in either proportional consumption tax rates or progressive income tax rates. For each case, I present results in which the welfare (utility) of initial generations is allowed to change in response to the privatization as well as results in which the welfare of initial generations is held constant. In the latter simulations, the LSRA redistributes in a lump-sum manner so as to a) leave all generations alive at the time of the

[15] Note that this is higher than the 1994 5.2 percent NNP share of social security spending. It also exceeds the respective 7.5 percent for combined spending on Medicare and social security. This difference arises from the stylized assumption of constant 1 percent population growth. The current US population, in contrast, reflects high birth rates in the 50s and 60s and payroll taxes are levied on a relatively larger working population.

transition with precisely the same utility they would have enjoyed absent privatization and b) equalize the utility of all generations born after the policy is initiated. Finally, I consider alternative degrees of benefit-tax linkage.

IV. Simulation Findings

Simulating A Cold-Turkey Privatization

To place subsequent privatization results in perspective, I first simulate the macroeconomic and efficiency effects of an immediate and complete elimination of social security benefits and taxes. Although such a privatization is unlikely to ever be undertaken, simulating it clarifies the maximum damage that could be done to initial older generations from privatization as well as the maximum efficiency gains available from privatization after initial older generations are fully compensated for their loss of benefits.

Figure 6 shows that this policy would have a major impact on the macro economy as well as the intergenerational distribution of welfare. The top panel in the figure provides an index of the policy's induced changes (relative to initial steady-state values) in the capital stock (K), output (Y), labor supply (L), the real wage (w), and the real interest rate (r). The first rows of Tables 3 to 7 (Run 1) record the values graphed in the figures. As indicated, the "cold-turkey" elimination of social security leads to a 57 percent long-run increase in the economy's capital stock relative to its initial steady-state value. The long-run increases in labor supply, output and the real wage are 6 percent, 17 percent and 10 percent, respectively. The long-run reduction in the real interest rate is 25 percent, and the long-run increase in welfare (the increase in utility of those alive in the long run) is 10.79 percent. This percentage change in remaining lifetime utility is measured as the

percentage increase in remaining lifetime consumption and leisure at each age needed in the initial steady state to produce the same level of utility for the generation in question as it enjoys under privatization.

Although Figure 6 and the tables point to a very major long run gain to the economy and its future inhabitants from a "cold-turkey" transition, they also show that these gains come at a cost of major utility losses to initial older generations. For example, the oldest members of society – those born 54 years before the reform – suffer a 26 percent reduction in remaining lifetime welfare.

To investigate how much of the improvement in the welfare of future generations reflects efficiency improvements as opposed to simply redistribution away from initial generations, I repeated the "cold-turkey" simulation but instructed the LSRA to compensate all initial generations to prevent any loss in their utility levels. The results are shown in Figure 7 and reported as Run 2 in the tables. The long-run increase in the capital stock in this case is lower -- 36 percent, rather than 57 percent – but 36 percent is still remarkably large. It is large enough to raise long-run output by 14 percent, raise the long-run real wage by 6 percent, lower the long-run real interest rate by 16 percent, and raise the utility levels of all those born after the reform by 7.23 percent. As excess burden calculations go, this is a very large efficiency gain.

The efficiency gains are measured here as the percentage increase in full lifetime income (the present value of expenditures on consumption and leisure). Since every generation born after the reform begins enjoys this efficiency gain, it represents an ongoing flow to the economy. This flow can readily be expressed as percentage of initial GDP by simply multiplying the reported efficiency gain by the ratio of the steady state present value of

full income to GDP. The latter turns out to be .53 for all runs except the high growth economy. In other words, the welfare gains expressed as a percent of GDP are about half as large as the welfare gains expressed as a percent of discounted lifetime full income.

To check the sensitivity of the results to the assumed growth rate, I next repeated (in Runs 3 and 4) both simulations assuming a 3 percent population growth rate. The payroll tax is held constant in this analysis. Consequently, the replacement rate is twice as high as with 1 percent population growth. Accordingly, income and consumption levels are much smaller in the initial steady state. 'Cold turkey' privatization of social security without LSRA leads to a larger percentage increase in capital stock, income, and wages than with 1 percent population growth. The long run welfare gain is 10.7 percent. With LSRA turned on the high benefit level requires large transfers to the old who would otherwise lose up to 41 percent of their life time utility. Therefore the capital stock grows more slowly. Overall, the efficiency gain is 5.64 percent in the high growth case compared to the 7.23 percent with 1 percent growth.

Runs 5 to 8 let us consider the extent to which the results in Runs 1 and 2 depend on the degree of marginal benefit-tax linkage in the initial social security system. Runs 5 and 6 consider 10 percent marginal linkage, whereas Runs 7 and 8 consider 30 percent marginal linkage. Thus, in these sets of simulations, the total effective marginal tax rate on labor supply includes either 90 percent or 70 percent of the social security payroll tax rate. As a comparison of Runs 5 and 7 with Run 1 indicates, macroeconomic effects of the no LSRA simulations are fairly similar to those without benefit-tax linkage. For example, with 30 percent benefit-tax linkage, there is a 52 percent long-run increase in the capital stock compared with 57 percent with zero linkage. The LSRA runs (Runs 6 and 8) are more interesting. As shown in Table 6, the efficiency gain from social security's

privatization is 6.32 percent with 10 percent linkage and 4.65 percent with 30 percent linkage. These figures are smaller than the 7.23 percent efficiency gain found in Run 2 when the economy features zero initial linkage. They indicate that even a small degree of benefit-tax linkage can make a substantial impact on social security's distortion of labor supply.

Progressive Income-Tax or Wage-Tax Finance of Transition Benefits

The next simulations, shown in Figures 8 and 9, consider privatizing social security, but raising progressive income tax rates to pay for transitional benefits. In the uncompensated (no LSRA) transition (Run 9), the long-run position of the economy is exactly the same as in the corresponding cold-turkey transition. But the economy's short-term transition is quite different. The induced capital accumulation occurs much more slowly, and initial older generations suffer much smaller reductions in their levels of remaining lifetime utility. In the compensated transition (Run 10), the efficiency gain is 1.65 percent compared with 7.23 percent in the cold-turkey run. Although this is a very big difference, a 1.65 percent efficiency gain is non trivial.

The fact that the efficiency gain is positive may, itself, be surprising. Intuitively, raising progressive income tax rates to pay for social security benefits during the transition temporarily adds extra distortions to the fiscal structure at the same time it eliminates a permanent distortion from payroll taxation. These extra distortions involve both the labor-leisure decisions and intertemporal consumption decisions. Now, one might think that a tax structure with permanently low tax rates would be more efficient than one which collects, in present value, the same amount of revenue, but does so with higher marginal

tax rates in the short run than in the long run. This intuition follows from the fact that tax distortions rise with the square of the tax rate, so that smoothing tax rates over time provides a way of mitigating dead weight loss.

This intuition is correct as far as it goes. But switching from payroll tax to income-tax finance of social security benefits in the short run has four additional features that need to be considered. First, the switch equalizes the marginal tax rates affecting labor-leisure and intertemporal consumption choices, so it smooths tax rates over economic choices.[16] Second, the capital income tax component of the progressive income tax has a lump sum tax element to it. In the short run, capital income is given, so taxing it via a higher rate of capital income taxation represents an implicit lump sum tax. Third, the decline over time in progressive income tax rates as social security benefits are phased out acts like a negative capital income tax rate, which offsets the distortion caused by the capital income tax component of the progressive income tax which is financing government purchases. Fourth, if, as assumed in these simulations, social security benefits are provided independent of tax contributions, one could reduce the distortion of labor supply by linking benefits to marginal contributions. For example, one could provide a rate of return equal to the economy's growth rate on each dollar paid to social security. This marginal-benefit tax linkage would lower the effective rate of marginal payroll taxation. Although the current social security privatization simulations eliminate social security benefits over time, rather than marginally link them to contributions, the result, in the long run, is quite similar because this needless additional distortion is eliminated.

[16] In the initial steady state, the tax rate on the labor -leisure margin exceeds that on the intertemporal consumption margin because the payroll tax only taxes labor income.

Runs 11 and 12 phase out benefits in the same manner as Runs 9 and 10 but pay for them with a payroll tax rather than a progressive income tax. As Table 3 shows, compared to income-tax finance, payroll-tax (wage-tax) finance of transition benefits speeds up capital accumulation in the early phase of the transition. This reflects the greater saving disincentives associated with temporarily high capital income taxes.

The pattern of welfare gains and losses also differ. With income-tax finance, there are a bigger welfare losses to initial elderly cohorts in the non LSRA runs (Runs 9 and 11), but also bigger gains to initial younger cohorts as well as those born shortly after the reform. Given these differences, which financing mechanism is more efficient? The answer, given in the LSRA Runs 10 and 12, is progressive income-tax finance. There is a 1.65 percent efficiency gain with progressive tax finance compared with a 1.08 percent gain with payroll-tax finance.

Consumption Tax Finance of Transition Benefits

The next two simulations use a proportional consumption tax to finance transitional benefits. As Figures 10 and 11 and Runs 13 and 14 indicate, consumption-tax finance produces much more favorable short-run macroeconomic effects in both the compensated and the uncompensated runs. For example, in the uncompensated run, the capital stock is 12 percent bigger in the tenth year of the reform than when the reform begins. With progressive income tax finance, the tenth year capital stock is actually smaller, by .6 percent. After 25 years, the capital stock is 26 percent larger in the uncompensated consumption tax transition, but only 5 percent larger in the uncompensated income tax transition. Since in both, the uncompensated consumption and

income tax runs, the capital stock ultimately ends up 57 percent higher than its initial value, virtually all of the crowding in of capital in the income tax finance run occurs more than a quarter century from the time the social security reform is initiated.

The better short-run macroeconomic performance in the no-LSRA consumption tax run comes at the price of larger welfare losses to initial older generations. For example, the oldest generation at the time of the reform suffers a 4.7 percent welfare loss with consumption tax finance but only a -.4 percent loss under income-tax finance. The question begged by this result, of course, is whether consumption-tax finance is more efficient than income-tax finance; i.e. whether there is still an advantage to consumption-tax finance once initial generations have been fully compensated for the additional fiscal burden arising under consumption taxation.

The answer is a strong yes. The efficiency gain available with consumption-tax finance is a quite substantial 4.33 percent. This is almost two-thirds of the maximum efficiency gain achievable from privatizing social security and 2.5 times the efficiency gain available under income-tax finance! As discussed in Chamley (1981) and Auerbach and Kotlikoff (1987), consumption taxation is more efficient than income or wage taxation because it incorporates a lump sum tax on existing wealth.

How much of this efficiency gain could be achieved by just financing existing social security benefits through a consumption tax? A run which substitutes the payroll by a consumption tax and keeps benefits in place while compensating living generations gives the answer: The efficiency gain is 3.44 percent compared to 4.33 percent if benefits are phased out over time. Note, however, that, in the absence of compensation, the long-run gains from simply switching to consumption-tax finance of social security are much smaller than those arising

when one also phases out social security benefits over time. For example, the capital stock increases only by 17.5 percent, compared to 56.7 percent when benefits are phases out. And the long-run welfare gain is only 4.05 percent, compared to 10.79 percent .

Sensitivity Analysis

To what extend does the choice of parameter values influence the above findings? Table 9 addresses this question. It shows efficiency gains from privatizing social security with income- or consumption-tax finance for combinations of intratemporal substitution elasticities ranging from .50 to 1.20 and intertermporal elasticities of substitution raning from .15 to .50. The qualitative results are the same for all of the combinations indicted. Future generations' welfare increases between .7 and 2.7 percent with income-tax finance and between 3.5 and 5.1 percent with consumption tax finance. Since -- as discussed before -- efficiency gains largely arise from eliminating the payroll-tax's distortion of labor supply decisions, the intratemporal elasticity of substitution between leisure and consumption has a larger influence on the magnitude of efficiency gains than does the intertemporal elasticity of substitution.

The Importance of the Initial Debt Position

Thus far, I've assumed no government debt in the initial steady state. To check if this matters, I repeated Runs 9 and 10 as well as 13 and 14 with an initial 50 percent debt-to-GDP ratio. Recall that Runs 9 and 10 incorporate progressive income-tax finance of social security benefits, whereas Runs 13 and 14 incorporate consumption-tax finance. Runs 9 and 13 are non LSRA, and Runs 10 and 14 are LSRA. In all cases, the welfare gains are larger with initial

debt than without. Welfare increases by 11.5 percent compared to 10.8 percent in runs 9 and 13. Efficiency gains from privatization are 1.91 percent in the income-tax finance case and 4.72 in the consumption-tax finance case, an increase of .15 and .29 percentage points.

The reason for these differences is straightforward. During the transition, capital accumulation reduces interest rates which also reduces the fiscal burden of debt service. This permits a reduction in tax rates. This, again, induces more capital accumulation and labor supply. In fact, repeating Run 9 with initial debt leads to a 61.7 percent higher long-run capital stock and a 7.21 percent higher long-run labor supply. The concomitant numbers without debt are 56.7 percent and 6.28 percent. Similar results apply to the other runs. Thus, the calculations presented so far can be understood as lower bounds for an economy with initial debt.

Using Debt Finance in the Short Run

An alternative to immediately raising either income or consumption tax rates to pay for transition benefits is to borrow for a while. The next set of simulations consider a post-reform period of borrowing which lasts for five years. Figures 12 and 13 and Runs 15 and 16 consider raising progressive income tax rates after the five-year issuance of debt to both pay interest on the accumulated debt and to pay for social security benefits during the remainder of the transition. Figures 14 and 15 and Runs 17 and 18 repeat this analysis, but use a proportional consumption tax to pay for social security benefits after the five-year period of deficit finance is completed.

Consider first the uncompensated runs. With income-tax finance, capital is first crowded in, then crowded out, then crowded in. As discussed in Auerbach and Kotlikoff

(1987), short-run crowding in can arise in the presence of deficit finance as workers take advantage of temporarily low marginal tax rates to increase their labor supply. This leads them to both earn and save more. Once income taxes are raised (indeed, raised above their initial values) to pay interest on past accumulated debt as well as for ongoing spending, workers reduce their labor supply below their initial values. In Run 17, the crowding-in/crowding-out/crowding-in effects of deficit finance alter the basic short-run pattern of capital accumulation observed in no-deficit, income-tax finance (Run 9). The deficit finance also reduces the amount of long-run crowding in of capital, with the long-run capital stock now only 40 percent, rather than 57 percent larger than in the initial steady state.

In contrast to the income-tax cum temporary deficit results, the consumption-tax cum temporary deficit displays smaller crowding-in in the very short run. The principal reason is that the prospect of a near-term (after year 5) increase in consumption tax rates acts just like a temporarily high rate of capital income taxation, leading households to substitute current for future consumption. The smaller short-run crowding-in under consumption-tax finance necessitates more debt accumulation in the consumption-tax run than in the income-tax run. This higher debt-to-output ratio expalins why long-rin capital formation is slightly smaller under consumption-tax finance than income-tax finance.

The use of short-term deficit finance during the transition leaves the economy with permanently higher marginal tax rates. It also particularly distorts the choices of how much to work and how much to save right before and right after the period of deficit finance. Hence, it is not surprising that the LSRA runs produce smaller efficiency gains from privatization with deficit finance than without it. In the income-tax runs, the

efficiency gain is 1.27 percent with deficit finance compared to 1.65 percent without. In the consumption-tax runs, the efficiency gain is 2.98 percent with deficit finance compared to 4.33 percent without it.

Privatizing from a Position of Partial Benefit-Tax Linkage

The remaining 8 sets of simulations, runs 19-26 , also phase out social security benefits over a 55-year period, but do so assuming either 10 percent or 30 percent marginal benefit-tax linkage. As Tables 3 through 8 indicate, the crowding in associated with privatization is smaller the higher the degree of benefit-tac-linkage. For example, with 30 percent linkage, the long-run increase in capital in the no-LSRA income and consumption tax runs is 52 percent, compared with 57 percent with no linkage. These differences and those of other macro variables aren't large. But the differences in efficiency gains with and without partial linkage are substantial. Run 20 in Table 8 indicates only a .66 percent gain under income-tax finance when linkage is 10 percent compared to a 1.65 percent gain with zero linkage. And Run 22, which features income-tax finance with 30 percent linkage actually shows a 1.22 percent efficiency loss. In the case of consumption-tax finance, the efficiency gain is 4.33 percent with zero linkage, 3.4 percent with 10 percent linkage, and 1.64 percent with 30 percent linkage. These efficiency gains are 61 percent, 55 percent, and 37 percent of the corresponding maximum efficiency gains reported in Runs 2, 6, and 8 of Table 6 from replacing social security with lump sum net taxes.

V. Incorporating Intra-cohort Heterogeneity

The multi-income version of the AK Model developed by Kent Smetters and Jan Walliser posits twelve earnings classes within each cohort. Each of these earnings classes experiences the same longitudinal age-earnings profile, but each has its own wage level. Thus, the classes can be thought of as differing in their endowments of human capital. The bottom decile of wage earners is divided into classes 1 and 2. Class 1 contains 2 percent of the distribution, and class 2 contains 8 percent of the distribution. Classes 3-10 contain 10 percent each of the distribution, and class 11 and 12 contain the highest decile, with class 12 containing 2 percent of the distribution and class 11 containing 8 percent. The initial steady-state wage rates for the twelve classes are 1, 1.7, 2.2, 2.7, 3.1, 3.5, 3.8, 4.2, 4.7, 5.5, 7.2, and 10.2, respectively.

Tables 10-15 use the multi-income model to consider two alternative privatization policies. One uses a consumption tax to finance transition benefits, the other uses the progressive income tax. Both simulations are uncompensated. The corresponding one-income class runs with which to compare these results are listed in Tables 3-8 as Runs 13 and 9.

Such comparisons indicate that changes in macroeconomic variables in the multi-income class model are very close to those in the one-income class model. Take, for example, year-5 and year-150 increases in the capital stock under consumption-tax finance. They are 5.75 and 55.64 percent, respectively, in the multi-income class run, and 5.54 percent and 56.67 percent, respectively, in the one-income class model. Or consider the year-5 and year 150 increases in output in the progressive-tax run. They are 1.23 percent and 17.14 percent, respectively, in the multi-income class run, and 1.10 and 17.11,

respectively, in the one-income class model. Intra-cohort earnings heterogeneity does not, then, alter this paper's central finding that privatizing social security can produce very major long-run improvements in the state of the economy.

Table 15 indicates that the welfare gains and losses associated with uncompensated transitions to privatized social security can differ significantly across members of a cohort and that these differences can flip signs over time. Take Run 27, which incorporates consumption-tax finance. In this run, all members of the oldest cohort at the time of the reform, those age 54, end up worse off. But the poorer elderly suffer a relatively larger welfare loss. For example, class-1 54 year-olds suffer a 4.58 percent reduction in remaining lifetime utility whereas the class-12 54 year-olds experience only a 3.67 percent utility loss.

These differences reflect two factors. First, the reform induces a significant and immediate increase in labor supply (see Table 11) which raises the year-1 interest rate from 9.4 percent to 9.8 percent. This benefits the rich elderly more than the poor elderly because a bigger share of their old-age consumption is financed by their assets (as opposed to their social security benefits). Second, the increase in labor supply means more income which means a larger income-tax base. This permits the government to cut its income tax rates which is relatively more important to the rich elderly who start out in quite high marginal tax brackets.

Interestingly, the distribution of long-run utility gains in Run 27 is quite different from that of the distribution of the short-run gains. As Table 15 points out, all income-groups benefit in the long run, but the welfare gains to poorer income groups exceed those to richer ones. For example, members of the class-1 cohort alive in the long run enjoy a

10.13 percent increase in lifetime utility compared to an 8.12 percent increase for members of the class-12 cohort alive in the long run. What explains this? The answer is that for lower income classes, social security's implicit tax associated with its pay-as-you-go finance represents a larger share of its lifetime resources than it does for the higher income classes. Hence, eliminating pay-as-you-go social security provides lower income classes with a larger percentage welfare gain than it provides higher income classes.

Comparing the top and bottom halves of Table 15 shows that the short-run distribution of welfare gains from privatizing social security is critically dependent on the method used to finance the transition. The bottom half of the table, Run 28, considers progressive income-tax finance of transition benefits. Since this is disadvantageous to the richer agents as well as less efficient overall compared to consumption-tax finance, it's not surprising that initial elderly and young members of income-class 12 are worse off in this run compared to Run 27. It's also not surprising that, for example, the richest 54 year-olds suffer a bigger welfare loss than do the poorest 54 year olds.

VI. Conclusion

The privatizing of social security is spreading from South America. It could well spread to the U.S. as politicians grapple with ways of addressing the fiscal/demographic debacle facing the country. This paper's simulations of the AK Model show that privatizing social security is likely to generate major long-run increases in output and living standards. But unless privatization includes compensation to initial generations, these long-run gains will come, in large part, at their expense. This said, the pure efficiency gains from privatization can be substantial. Their precise size depends on the

existing tax structure, the linkage between benefits and taxes under the existing social security system, and the choice of the tax instrument used to finance benefits during the transition. When the initial tax structure features a progressive income tax, when benefit-tax linkage is low, when consumption taxation is used to finance social security benefits during the transition, and when existing generations are fully compensated for their privatization losses, there is a 4.3 percent welfare gain to future generations. But if these circumstances don't hold, the efficiency gains from privatization are likely to be smaller, possibly even negative. Indeed, with income-tax finance of transitional benefits, 30 percent linkage, and full compensation paid to initial generations, future generations suffer a 1.2 percent welfare decline.

There are two lessons to be drawn from our multi-income class analysis. First, policies that equalize the intra-cohort distribution of utility in the long run may fail to do so in the short run. Second, in the long run, privatization of social security, since it eliminates an implicit tax that places a relatively high proportional burden on the lifetime poor, is likely to improve the wellbeing of the lifetime poor relative to the lifetime rich; i.e., as a long-run proposition, privatizing social security is progressive.

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Table 1

Net Marginal OASI Tax Rate on $1 Rise in Monthly Wages

(percent)

	Case					
AGE IN 1995	A	B	C	D	E	F
25	5	10	2	10	11	0
30	3	10	-0	10	11	0
35	1	10	-2	9	11	0
40	-1	10	-6	9	11	0
45	-3	10	-9	9	11	0
50	-5	10	-12	9	11	0
55	-8	9	-16	8	11	0
60	-12	9	-23	8	11	0

Case

A Single Female, 90 Percent Benefit Bracket, Faces no Federal Income Tax

B Single Male, 15 Percent Benefit Bracket, Faces 85 Percent Benefit Taxation at a 33 Percent Rate

C Husband in Single-Earner Couple, 90 Percent Social Security Benefit Bracket, Faces no Federal Income Tax

D Husband in Single-Earner Couple, 15 Percent Social Security Benefit Bracket, Faces Federal Income Taxation of 85 Percent of Benefits at a 33 Percent Rate

E Secondary Earner Collecting Benefits Based Solely on Spouse's Earnings Record

F Very High Earner (Earning Above Social Security's Earnings Ceiling)

Source: Calculations by Andrew Samwick

Table 2

Baseline Parameter Values and Spending and Tax Rates

Parameter	Value
Intratemporal Elasticity of Substitution	.800
Intertemporal Elasticity of Substitution	.250
Weight on Leisure	1.500
Pure Rate of Time Preference	.015
Elasticity of Substitution between Labor and Capital	1.000
Population Growth Rate	.010
Output Share of Government Consumption	.224
Average Income Tax Rate	.224
Average Marginal Income Tax Rate	.328
Payroll Tax Rate	.122

Table 3

Percentage Change in Capital Stock Relative to Steady State

Run	Tax Financing Soc. Sec. Benefits	Years Benefits Phased Out	LSRA	B-T-L	Years of Deficit Finance	Year of Transition 5	10	25	150
1	Yprog	0	no	0	0	16.11	31.68	50.28	56.67
2	Yprog	0	yes	0	0	5.71	11.85	25.16	35.24
3	Yprog*	0	no	0	0	10.04	19.30	30.20	33.60
4	Yprog*	0	yes	0	0	2.84	5.56	10.62	13.64
5	Yprog	0	no	.1	0	15.75	30.96	49.03	55.19
6	Yprog	0	yes	.1	0	5.01	10.35	21.89	31.75
7	Yprog	0	no	.3	0	15.07	29.60	46.74	52.49
8	Yprog	0	yes	.3	0	3.72	7.63	16.09	24.19
9	Yprog	55	no	0	0	-.52	-.57	4.96	56.67
10	Yprog	55	yes	0	0	-1.72	-3.54	-4.90	8.82
11	W	55	no	0	0	.79	1.68	7.52	56.67
12	W	55	yes	0	0	.01	-.45	-1.56	7.01
13	C	55	no	0	0	5.54	11.54	25.60	56.67
14	C	55	yes	0	0	2.98	6.27	13.64	20.28
15	Yprog	55	no	0	5	4.32	1.43	-4.16	40.43
16	Yprog	55	yes	0	5	3.98	0.70	-7.81	4.15
17	C	55	no	0	5	2.02	4.25	12.04	39.31
18	C	55	yes	0	5	1.27	2.21	5.64	10.70
19	Yprog	55	no	.1	0	-.92	-1.34	3.74	55.19
20	Yprog	55	yes	.1	0	-2.38	-4.92	-7.56	5.41
21	Yprog	55	no	.3	0	-1.68	-2.82	1.47	52.49
22	Yprog	55	yes	.3	0	-3.60	-7.45	-12.45	-1.59
23	C	55	no	.1	0	5.17	10.82	24.41	55.19
24	C	55	yes	.1	0	2.31	4.84	10.67	16.20
25	C	55	no	.3	0	4.48	9.49	22.22	52.49
26	C	55	yes	.3	0	1.05	2.24	5.33	8.90

* 3% population growth
LSRA: Lump Sum Redistribution Authority
B-T-L: Benefit-Tax-Linkage
Yprog: Progressive Income Tax
C: Proportional Consumption Tax
W: Payroll Tax

Table 4

Percentage Change in Aggregate Labor Supply Relative to Steady State

Run	Tax Financing Soc. Sec. Benefits	Years Benefits Phased Out	LSRA	B-T-L	Years of Deficit Finance	Year of Transition 5	10	25	150
1	Yprog	0	no	0	0	13.89	11.08	7.26	6.28
2	Yprog	0	yes	0	0	10.74	10.08	8.63	7.36
3	Yprog*	0	no	0	0	7.68	6.15	4.05	3.58
4	Yprog*	0	yes	0	0	5.37	5.07	4.46	4.14
5	Yprog	0	no	.1	0	12.69	9.94	6.22	5.28
6	Yprog	0	yes	.1	0	9.42	8.85	7.56	6.56
7	Yprog	0	no	.3	0	10.42	7.80	4.25	3.37
8	Yprog	0	yes	.3	0	6.97	6.54	5.55	5.00
9	Yprog	55	no	0	0	1.64	1.67	5.00	6.28
10	Yprog	55	yes	0	0	1.05	1.22	4.83	8.28
11	W	55	no	0	0	.43	.14	3.87	6.28
12	W	55	yes	0	0	-.13	-.49	3.35	8.49
13	C	55	no	0	0	5.13	4.48	4.97	6.28
14	C	55	yes	0	0	4.38	4.06	4.91	7.61
15	Yprog	55	no	0	5	8.58	-2.53	2.11	5.18
16	Yprog	55	yes	0	5	8.19	-2.73	1.82	6.42
17	C	55	no	0	5	7.15	1.51	2.98	6.05
18	C	55	yes	0	5	6.67	1.18	2.72	6.04
19	Yprog	55	no	.1	0	.43	.53	4.00	5.88
20	Yprog	55	yes	.1	0	-.20	.06	3.90	7.59
21	Yprog	55	no	.3	0	-1.83	-1.61	2.09	3.37
22	Yprog	55	yes	.3	0	-2.59	-2.16	2.15	6.04
23	C	55	no	.1	0	3.95	3.36	3.96	5.28
24	C	55	yes	.1	0	3.14	2.89	3.93	6.80
25	C	55	no	.3	0	1.73	1.26	2.02	3.37
26	C	55	yes	.3	0	.77	.68	2.07	5.21

* 3% population growth
LSRA: Lump Sum Redistribution Authority
B-T-L: Benefit-Tax-Linkage
Yprog: Progressive Income Tax
C: Proportional Consumption Tax
W: Payroll Tax

Table 5

Percentage Change in Output Stock Relative to Steady State

Run	Tax Financing Soc. Sec. Benefits	Years Benefits Phased Out	LSRA	B-T-L	Years of Deficit Finance	Year of Transition 5	10	25	150
1	Yprog	0	no	0	0	14.44	15.91	16.70	17.11
2	Yprog	0	yes	0	0	9.46	10.52	12.54	13.95
3	Yprog*	0	no	0	0	8.27	9.29	10.05	10.39
4	Yprog*	0	yes	0	0	4.73	5.19	5.96	6.44
5	Yprog	0	no	.1	0	13.45	14.86	15.47	16.00
6	Yprog	0	yes	.1	0	8.30	9.22	10.97	12.36
7	Yprog	0	no	.3	0	11.56	12.88	13.55	13.92
8	Yprog	0	yes	.3	0	6.15	6.81	8.09	9.58
9	Yprog	55	no	0	0	1.10	1.11	5.00	17.11
10	Yprog	55	yes	0	0	0.35	0.01	2.31	8.42
11	W	55	no	0	0	.52	.53	4.78	17.11
12	W	55	yes	0	0	-.09	-.48	2.10	8.11
13	C	55	no	0	0	5.23	6.20	9.79	17.11
14	C	55	yes	0	0	4.03	4.61	7.03	10.65
15	Yprog	55	no	0	5	7.50	-1.55	0.50	13.06
16	Yprog	55	yes	0	5	7.12	-1.89	-0.68	5.84
17	C	55	no	0	5	5.85	2.18	5.18	12.77
18	C	55	yes	0	5	5.30	1.44	3.44	7.06
19	Yprog	55	no	.1	0	.09	.06	3.93	16.00
20	Yprog	55	yes	.1	0	-.75	-1.21	.91	7.04
21	Yprog	55	no	.3	0	-1.79	-1.92	1.93	13.92
22	Yprog	55	yes	.3	0	-2.84	-3.51	-1.71	4.08
23	C	55	no	.1	0	4.25	5.18	8.73	16.00
24	C	55	yes	.1	0	2.93	3.38	5.57	9.08
25	C	55	no	.3	0	2.41	3.26	6.73	13.92
26	C	55	yes	.3	0	.84	1.07	2.88	6.13

* 3% population growth
LSRA: Lump Sum Redistribution Authority
B-T-L: Benefit-Tax-Linkage
Yprog: Progressive Income Tax
C: Proportional Consumption Tax
W: Payroll Tax

Table 6

Percentage Change in Wage Relative to Steady State

Run	Tax Financing Soc. Sec. Benefits	Years Benefits Phased Out	LSRA	B-T-L	Years of Deficit Finance	Year of Transition 5	10	25	150
1	Yprog	0	no	0	0	.48	4.35	8.80	10.19
2	Yprog	0	yes	0	0	-1.16	.40	3.60	6.14
3	Yprog*	0	no	0	0	.54	2.96	5.77	6.57
4	Yprog*	0	yes	0	0	-.61	.11	1.44	2.21
5	Yprog	55	no	0	0	-.54	-.56	.00	10.19
6	Yprog	55	yes	0	0	-.70	-1.20	-2.41	.11
7	Yprog	55	no	.1	0	-.34	-.47	-.06	10.19
8	Yprog	55	yes	.1	0	-.56	-1.27	-2.88	-.51
9	Yprog	0	no	.3	0	1.04	4.71	8.92	10.21
10	Yprog	0	yes	.3	0	-.76	.25	2.41	4.26
11	W	55	no	0	0	.09	.38	.87	10.19
12	W	55	yes	0	0	.03	.01	-1.21	-.34
13	C	55	no	0	0	-.25	1.65	4.59	10.19
14	C	55	yes	0	0	-.34	.52	2.02	2.81
15	Yprog	55	no	0	5	-1.00	1.00	-1.57	7.49
16	Yprog	55	yes	0	5	-.99	.87	-2.46	-.54
17	C	55	no	0	5	-1.22	.67	2.13	7.30
18	C	55	yes	0	5	-1.29	.25	.70	1.11
19	Yprog	55	no	.1	0	-.34	-.47	-.06	10.19
20	Yprog	55	yes	.1	0	-.56	-1.27	-2.88	.51
21	Yprog	55	no	.3	0	.03	-.31	-.15	10.21
22	Yprog	55	yes	.3	0	-.26	-1.38	-3.79	-1.85
23	C	55	no	.1	0	.29	1.76	4.59	10.19
24	C	55	yes	.1	0	-.20	.47	1.58	2.12
25	C	55	no	.3	0	.66	1.97	4.62	10.21
26	C	55	yes	.3	0	.07	.38	.78	0.85

* 3% population growth
LSRA: Lump Sum Redistribution Authority
B-T-L: Benefit-Tax-Linkage
Yprog: Progressive Income Tax
C: Proportional Consumption Tax
W: Payroll Tax

Table 7

Percentage Change in Interest Rate Relative to Steady State

Run	Tax Financing Soc. Sec. Benefits	Years Benefits Phased Out	LSRA	B-T-L	Years of Deficit Finance	Year of Transition 5	10	25	150
1	Yprog	0	no	0	0	-1.44	-11.98	-22.35	-25.25
2	Yprog	0	yes	0	0	3.55	-1.19	-10.08	-16.36
3	Yprog*	0	no	0	0	-1.61	-8.39	-15.48	-17.38
4	Yprog*	0	yes	0	0	1.85	-.35	-4.21	-6.34
5	Yprog	0	no	.1	0	-1.99	-12.30	-22.43	-25.26
6	Yprog	0	yes	.1	0	3.14	-1.02	-8.95	-14.71
7	Yprog	0	no	.3	0	-3.04	-12.90	-22.61	-25.30
8	Yprog	0	yes	.3	0	2.34	-.77	-6.88	-11.77
9	Yprog	55	no	0	0	1.62	1.69	.00	-25.25
10	Yprog	55	yes	0	0	2.12	3.69	7.59	-.33
11	W	55	no	0	0	-.60	-1.13	-2.55	-25.25
12	W	55	yes	0	0	-.09	-.02	3.73	1.03
13	C	55	no	0	0	-2.22	-4.78	-12.59	-25.25
14	C	55	yes	0	0	1.03	-1.55	-5.81	-7.98
15	Yprog	55	no	0	5	3.05	-2.40	4.87	-19.49
16	Yprog	55	yes	0	5	3.03	-2.56	7.75	1.65
17	C	55	no	0	5	3.75	-1.98	-6.13	-19.06
18	C	55	yes	0	5	4.00	-.75	-2.07	-3.27
19	Yprog	55	no	.1	0	1.02	1.43	.19	-25.26
20	Yprog	55	yes	.1	0	1.68	3.92	9.17	1.55
21	Yprog	55	no	.3	0	-.11	.93	.45	-25.30
22	Yprog	55	yes	.3	0	.80	4.27	12.28	5.75
23	C	55	no	.1	0	-.87	-5.10	-12.60	-25.26
24	C	55	yes	.1	0	.62	-1.39	-4.59	-6.11
25	C	55	no	.3	0	-1.98	-5.69	-12.67	-25.30
26	C	55	yes	.3	0	-.20	-1.13	-2.32	-2.59

* 3% growth
LSRA: Lump Sum Redistribution Authority
B-T-L: Benefit-Tax-Linkage
Yprog: Progressive Income Tax
C: Proportional Consumption Tax
W: Payroll Tax

Table 8 Percentage Change in Remaining Lifetime Utility

Run	Tax Financing Soc. Sec. Benefits	Years Benefits Phased Out	LSRA	B-T-L	Years of Deficit Finance	Year of Birth -54	-25	-10	0	10	25	150
1	Yprog	0	no	0	0	-25.60	.43	6.09	8.70	10.04	10.59	10.79
2	Yprog	0	yes	0	0	.00	.00	.00	7.23	7.23	7.23	7.23
3	Yprog*	0	no	0	0	-23.54	-1.83	2.27	4.07	4.92	5.27	5.39
4	Yprog*	0	yes	0	0	.00	.00	.00	2.45	2.45	2.45	2.45
5	Yprog	0	no	.1	0	-25.70	.18	5.85	8.48	9.79	10.32	10.79
6	Yprog	0	yes	.1	0	.00	.00	.00	6.32	6.32	6.32	6.32
7	Yprog	0	no	.3	0	-25.8	-.27	5.41	8.08	9.33	9.84	10.79
8	Yprog	0	yes	.3	0	.00	.00	.00	4.65	4.65	4.65	4.65
9	Yprog	55	no	0	0	-.14	-1.67	.04	1.52	2.78	5.82	10.79
10	Yprog	55	yes	0	0	.00	.00	.00	1.65	1.65	1.65	1.65
11	W	55	no	0	0	.00	-1.18	-.44	.33	1.86	5.35	10.79
12	W	55	yes	0	0	.00	.00	.00	1.08	1.08	1.08	1.08
13	C	55	no	0	0	-4.71	-1.19	1.81	3.55	5.07	7.57	10.79
14	C	55	yes	0	0	.00	.00	.00	4.33	4.33	4.33	4.33
15	Yprog	55	no	0	5	.10	-.91	.18	1.26	.55	3.18	8.67
16	Yprog	55	yes	0	5	.00	.00	.00	1.27	1.27	1.27	1.27
17	C	55	no	0	5	.10	-1.01	1.26	2.66	2.63	5.03	8.52
18	C	55	yes	0	5	.00	.00	.00	2.98	2.98	2.98	2.98
19	Yprog	55	no	.1	0	-.17	-1.95	-.23	1.24	2.48	5.53	10.79
20	Yprog	55	yes	.1	0	.00	.00	.00	.66	.66	.66	.66
21	Yprog	55	no	.3	0	-.22	-2.46	-.77	.73	1.95	5.02	10.79
22	Yprog	55	yes	.3	0	.00	.00	.00	-1.22	-1.22	-1.22	-1.22
23	C	55	no	.1	0	-4.76	-1.46	1.55	3.30	4.80	7.30	10.79
24	C	55	yes	.1	0	.00	.00	.00	3.40	3.40	3.40	3.40
25	C	55	no	.3	0	-4.87	-1.94	1.06	2.85	4.30	6.80	10.79
26	C	55	yes	.3	0	.00	.00	.00	1.64	1.64	1.64	1.64

*3% growth, LSRA Lump Sum Redistribution Authority, B-T-L Benefit-Tax-Linkage, Yprog: Progressive Income Tax,Cprop Cons Tax, W Payroll Tax

Table 9

Sensitivity Analysis

Efficiency Gains with Income Tax-Finance

(percent)

Intratemporal Elasticity of Substitution	Intertemporal Elasticity of Substitution		
	.15	.25	.50
.50	not converged	.65	1.08
.80	1.65	1.67	1.96
1.20	2.46	2.44	2.70

Efficiency Gains with Consumption-Tax Finance

(percent)

Intratemporal Elasticity of Substitution	Intertemporal Elasticity of Substitution		
	.15	.25	.50
.50	not converged	3.67	3.53
.80	4.78	4.33	4.22
1.20	5.05	4.75	4.72

Table 10

Percentage Change in Capital Stock Relative to Steady State with Multiple Income Classes

Run	Tax Financing Soc. Sec. Benefits	Years Benefits Phased Out	LSRA	B-T-L	Years of Deficit Finance	Year of Transition 5	10	25	150
27	C	55	no	0	0	5.75	11.85	26.06	55.64
28	Yprog	55	no	0	0	-0.50	-0.56	5.09	55.64

LSRA: Lump Sum Redistribution Authority
B-T-L: Benefit-Tax-Linkage
C : Consumption Tax
Yprog: Progressive Income Tax

Table 11

Percentage Change in Labor Supply Relative to Steady State with Multiple Income Classes

Run	Tax Financing Soc. Sec. Benefits	Years Benefits Phased Out	LSRA	B-T-L	Years of Deficit Finance	Year of Transition 5	10	25	150
27	C	55	no	0	0	5.64	4.86	5.34	6.55
28	Yprog	55	no	0	0	1.82	1.84	5.49	6.55

LSRA: Lump Sum Redistribution Authority
B-T-L: Benefit-Tax-Linkage
C: Consumption Tax
Yprog: Progressive Income Tax

Table 12

Percentage Change in Output Relative to Steady State with Multiple Income Classes

Run	Tax Financing Soc. Sec. Benefits	Years Benefits Phased Out	LSRA	B-T-L	Years of Deficit Finance	Year of Transition 5	10	25	150
27	C	55	no	0	0	5.67	6.57	10.17	17.14
28	Yprog	55	no	0	0	1.23	1.24	5.39	17.14

LSRA: Lump Sum Redistribution Authority
B-T-L: Benefit-Tax-Linkage
C : Consumption Tax
Yprog: Progressive Income Tax

Table 13

Percentage Change in Wages Relative to Steady State with Multiple Income Classes

Run	Tax Financing Soc. Sec. Benefits	Years Benefits Phased Out	LSRA	B-T-L	Years of Deficit Finance	Year of Transition 5	10	25	150
27	C	0	no	0	0	0.03	1.63	4.59	9.93
28	Yprog	55	no	0	0	-0.57	-0.60	-0.09	9.93

LSRA: Lump Sum Redistribution Authority
B-T-L: Benefit-Tax-Linkage
C : Consumption Tax
Yprog: Progressive Income Tax

Table 14

Percentage Change in Interest Rates Relative to Steady State with Multiple Income Classes

Run	Tax Financing Soc. Sec. Benefits	Years Benefits Phased Out	LSRA	B-T-L	Years of Deficit Finance	Year of Transition 5	10	25	150
27	C	55	no	0	0	-0.08	-4.72	-12.60	-24.73
28	Yprog	55	no	0	0	1.73	1.81	1.00	-24.73

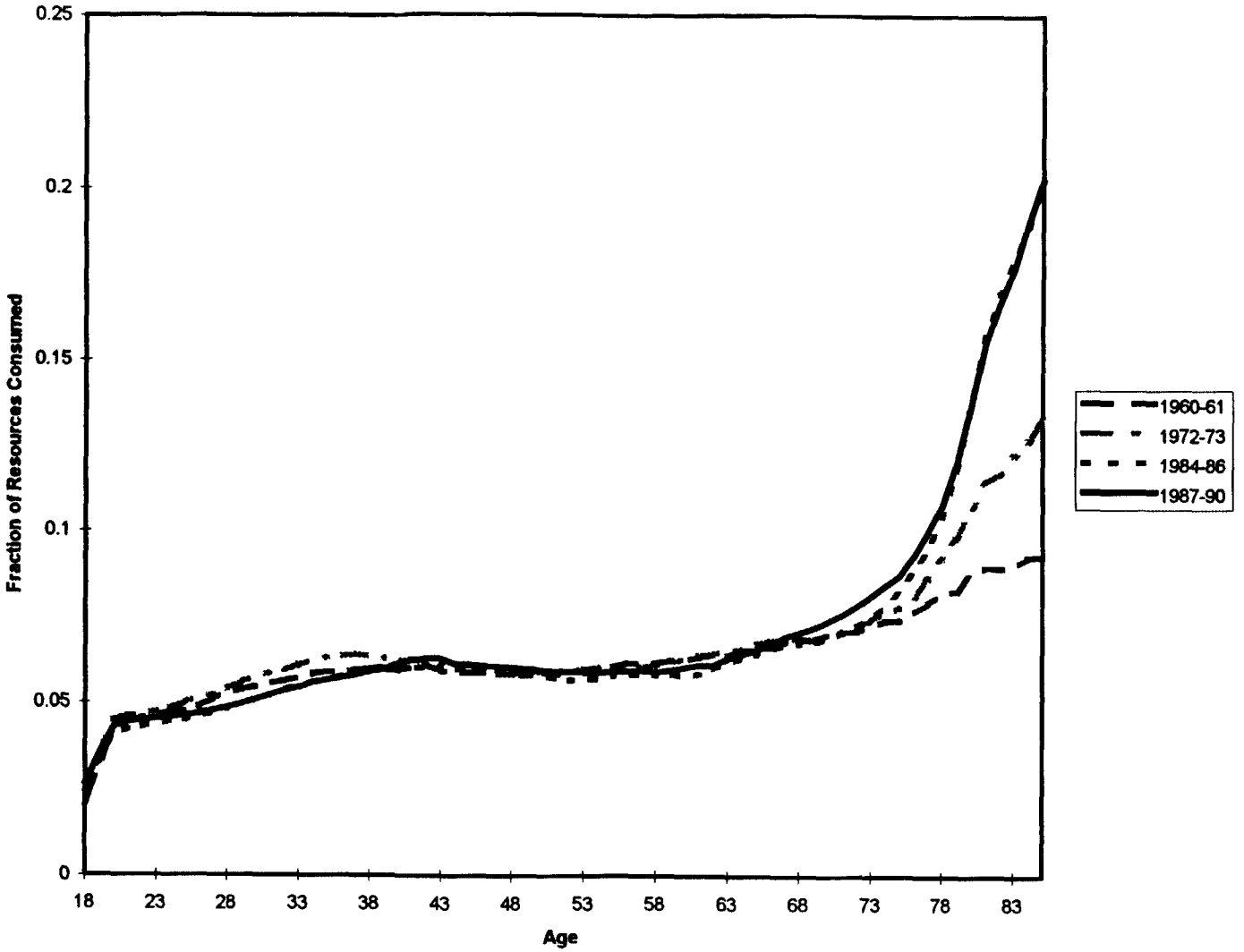
LSRA: Lump Sum Redistribution Authority
B-T-L: Benefit-Tax-Linkage
C : Consumption Tax
Yprog: Progressive Income Tax

Table 15

Percentage Change in Remaining Lifetime Utilities for Selected Income Classes

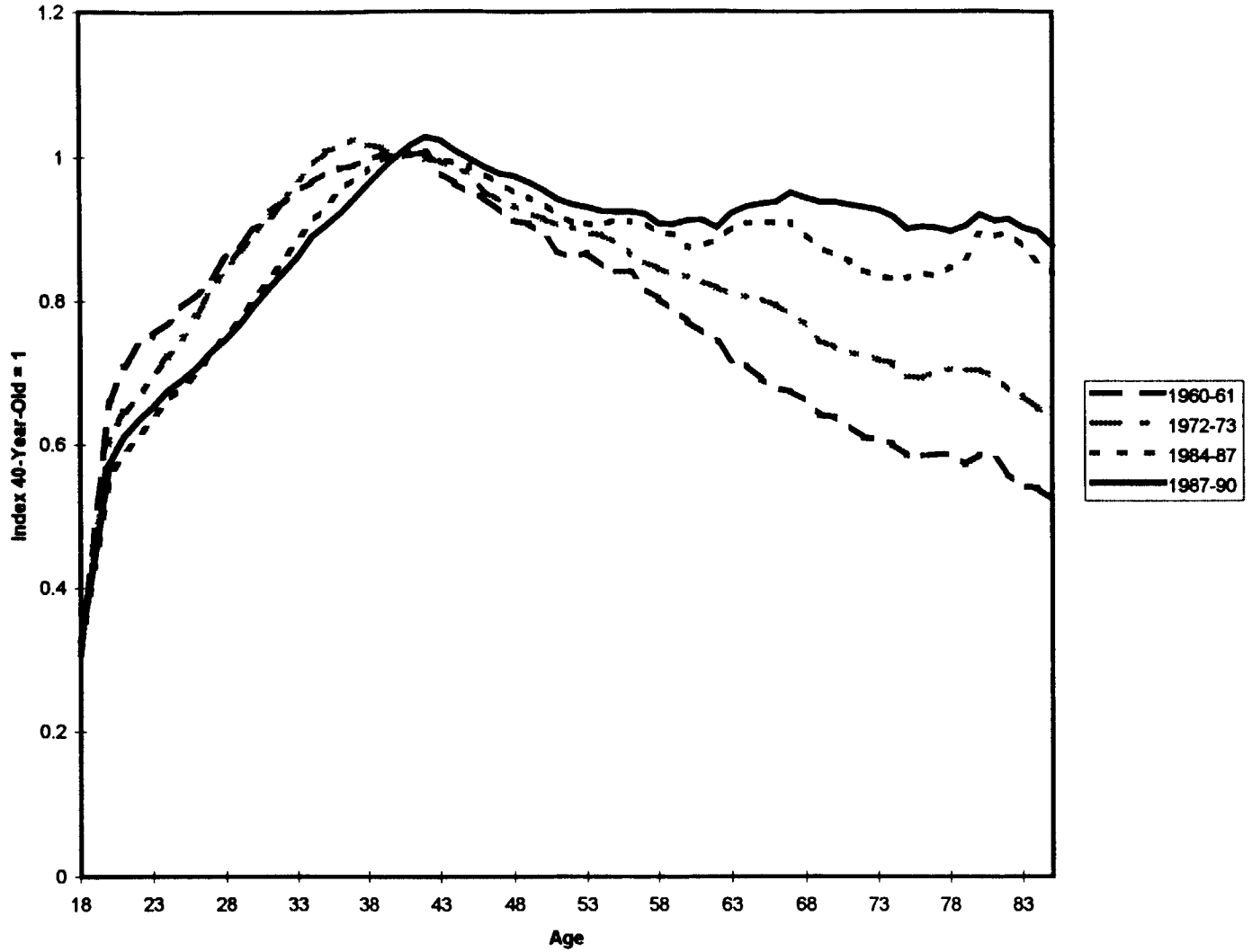
Run	Class	Years of Birth -54	-25	-10	0	10	25	150
27	1	-4.58	-1.79	1.17	2.91	4.29	6.78	10.13
	3	-4.17	-1.61	1.17	2.81	4.03	6.27	9.22
	6	-4.01	-1.39	1.27	2.83	3.97	6.08	8.82
	9	-3.89	-1.16	1.38	2.87	3.96	6.00	8.59
	12	-3.67	-0.23	1.88	3.10	4.03	5.89	8.12
28	1	-0.14	-1.70	0.00	1.32	2.29	5.08	10.13
	3	-0.11	-1.64	-0.10	1.18	2.10	4.70	9.22
	6	-0.13	-1.52	0.00	1.13	2.04	4.57	8.82
	9	-0.09	-1.50	-0.11	1.11	2.02	4.53	8.59
	12	-0.19	-1.19	0.00	1.10	2.04	4.52	8.12

Figure 1: Average Propensities to Consume out of Total Resources (r=6%)



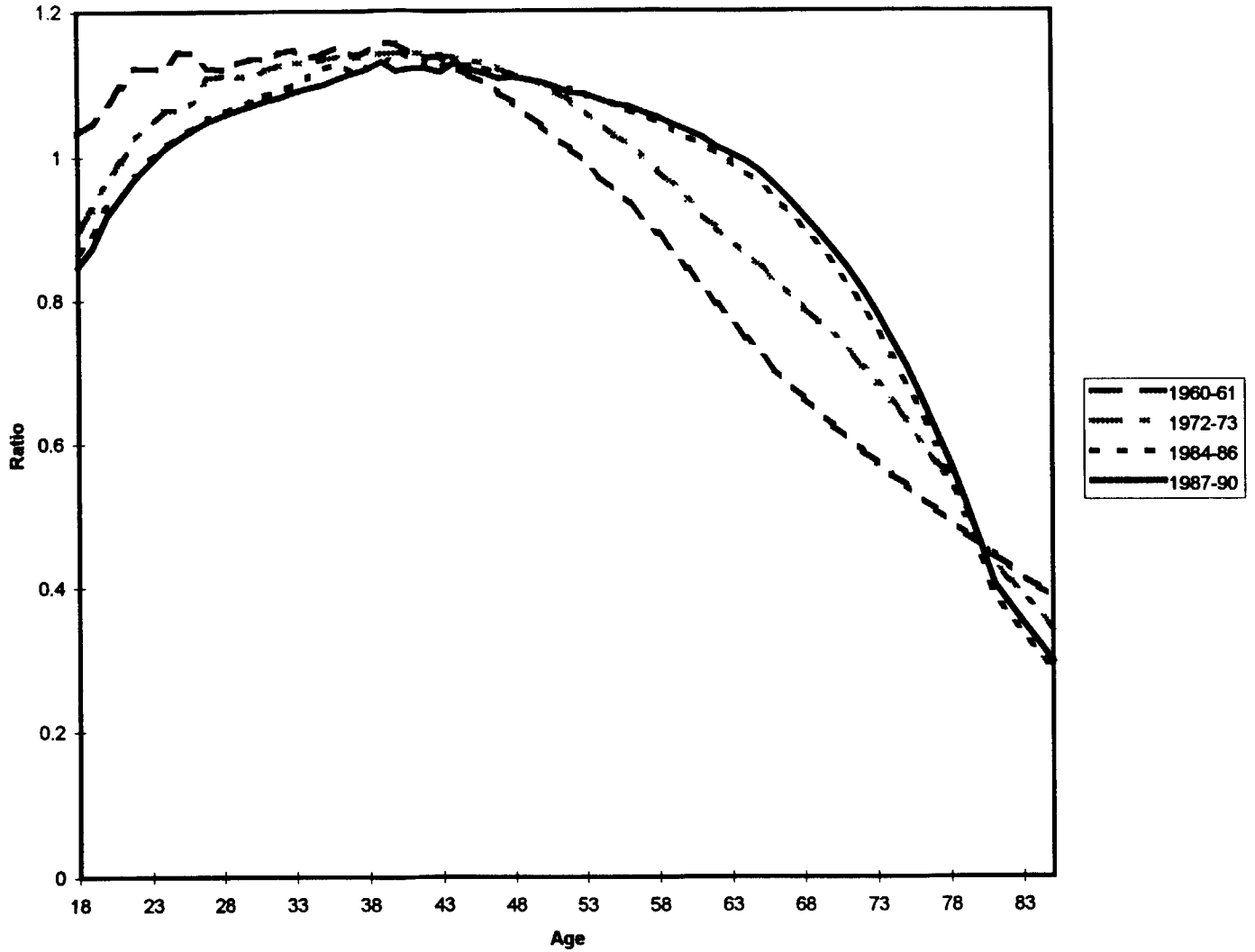
Source: Authors' calculations.

Figure 2: Relative Consumption Profiles



Source: Authors' calculations based on the Consumer Expenditure Survey.

Figure 3: Cohort Resources Per Capita / Per Capita Resources



Source: Authors' calculations.

Figure 4

The Postwar Decline in U.S. Saving and Investment

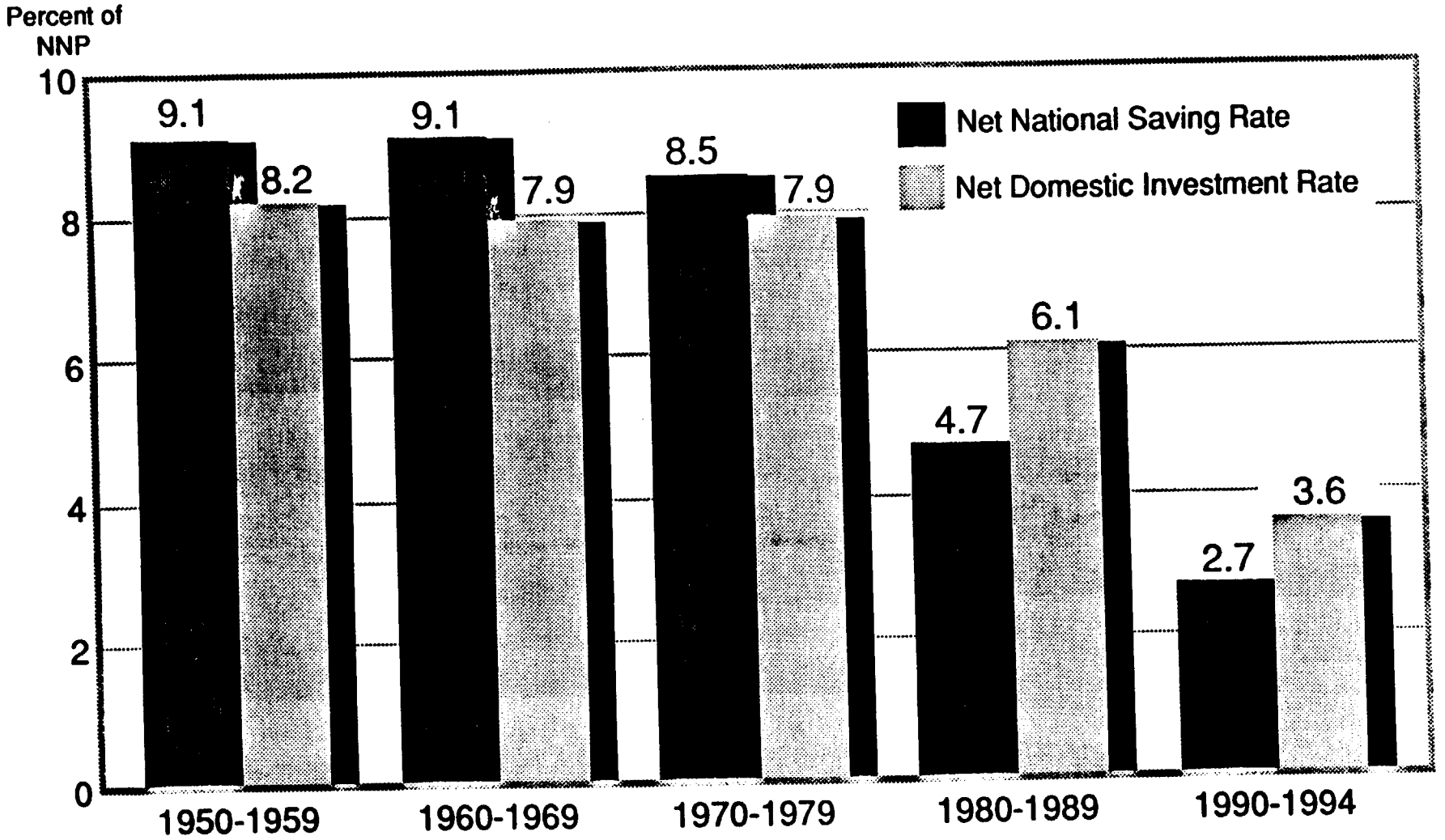


Figure 5

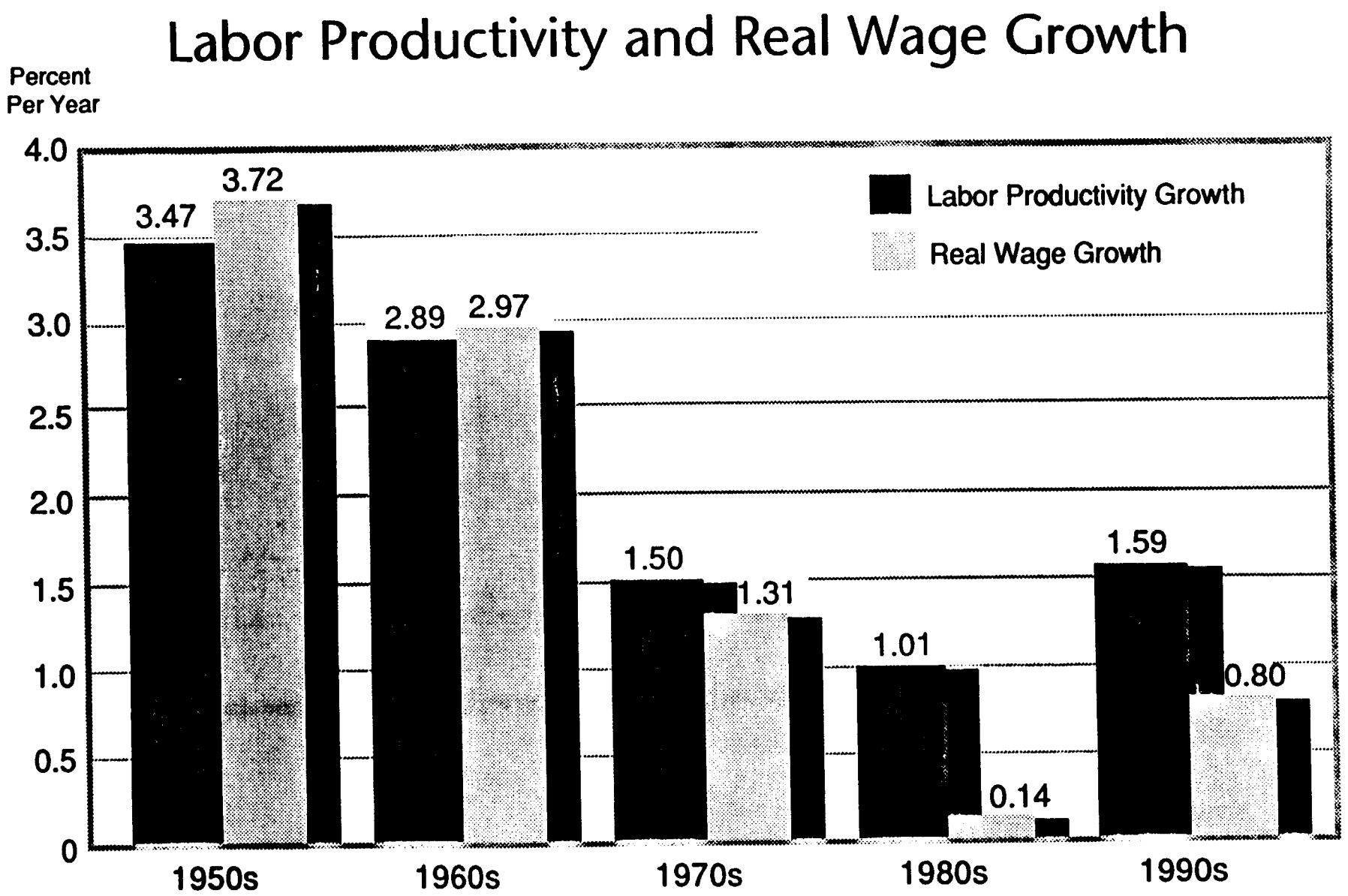
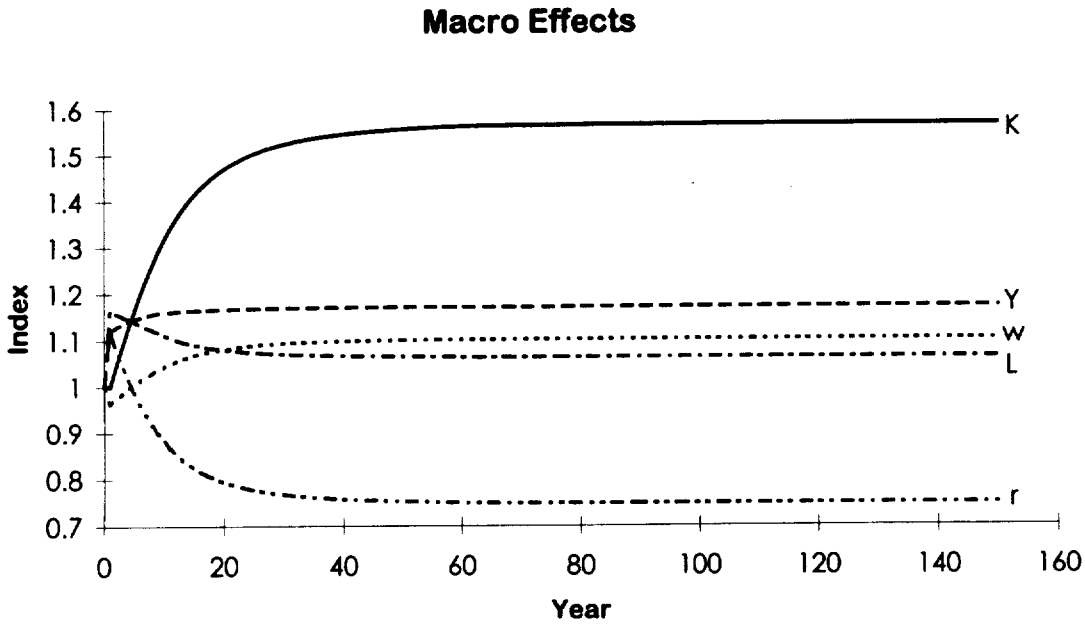

Labor Productivity and Real Wage Growth
Percent
Per Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
3.47
3.72
2.89
2.97
1.50
1.31
1.01
0.14
1.59
0.80
1950s
1960s
1970s
1980s
1990s
Labor Productivity Growth
Real Wage Growth

Figure 6: Progressive Income Tax Finance of Benefits, Benefits Eliminated Immediately



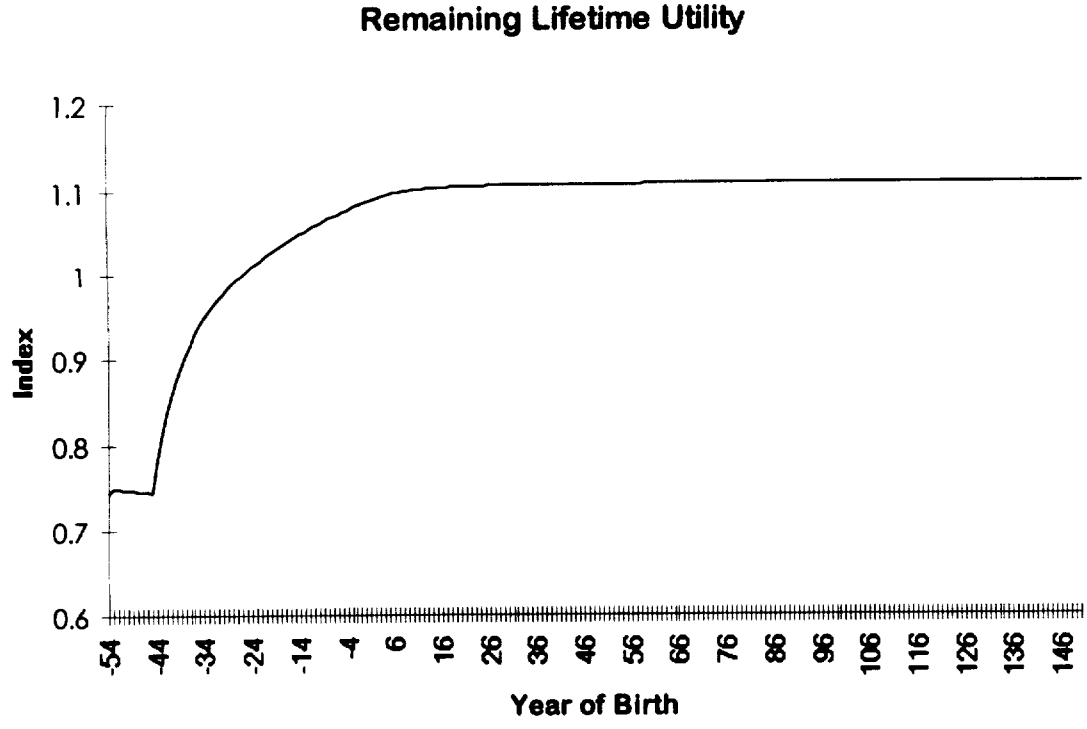
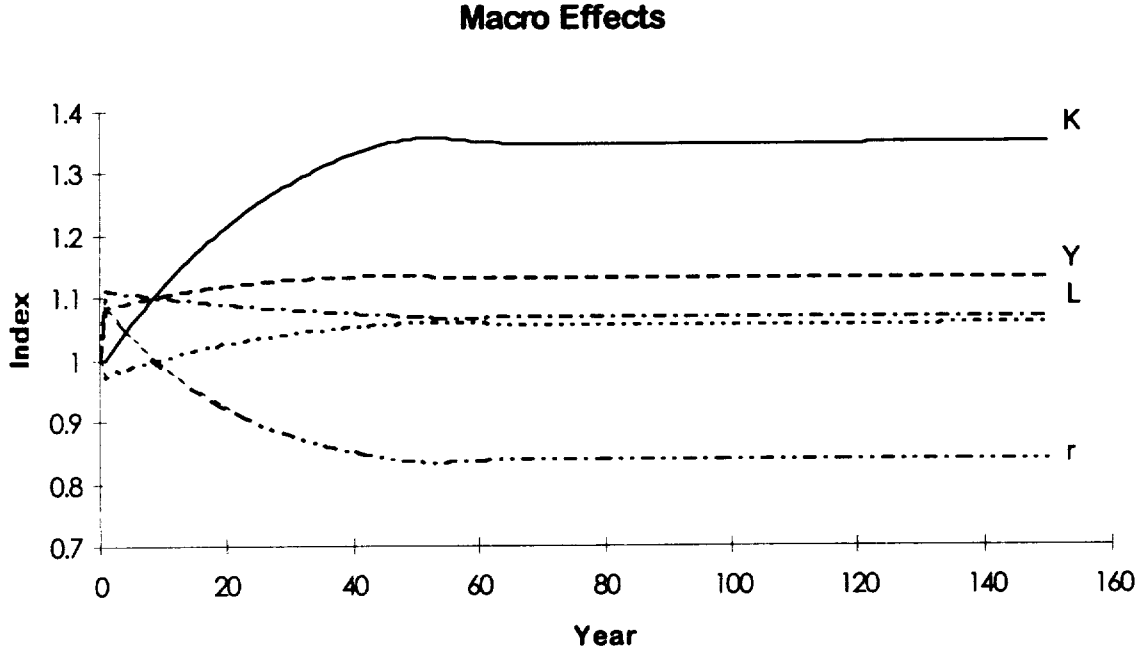


Figure 7: Progressive Income Tax Finance of Benefits, Benefits Eliminated Immediately, Welfare of Living Generations Constant



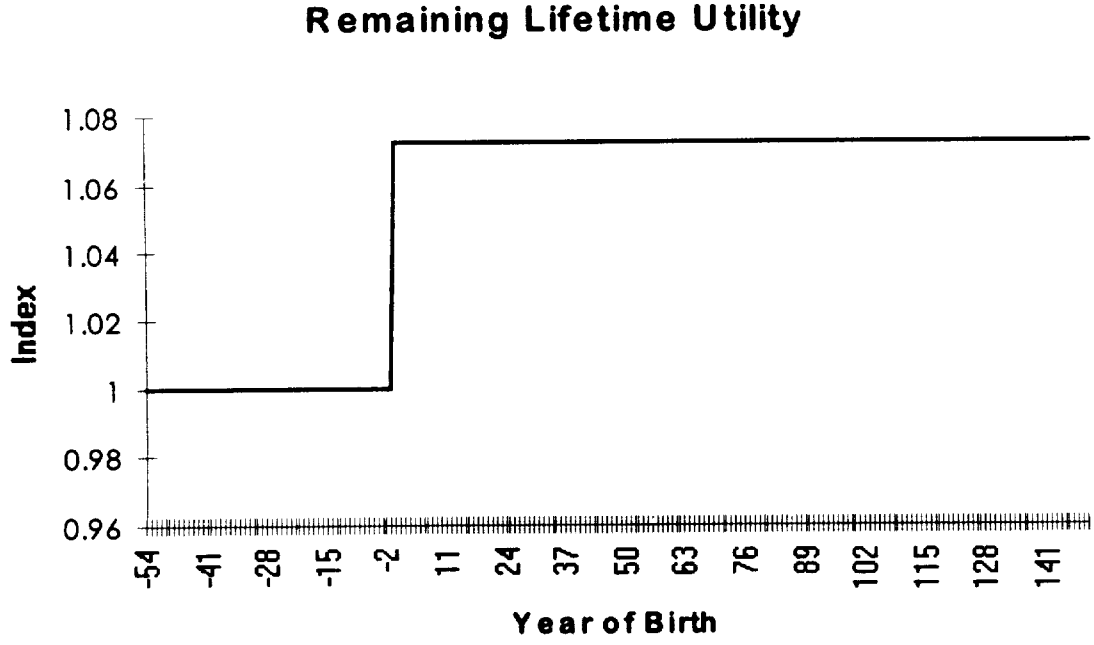
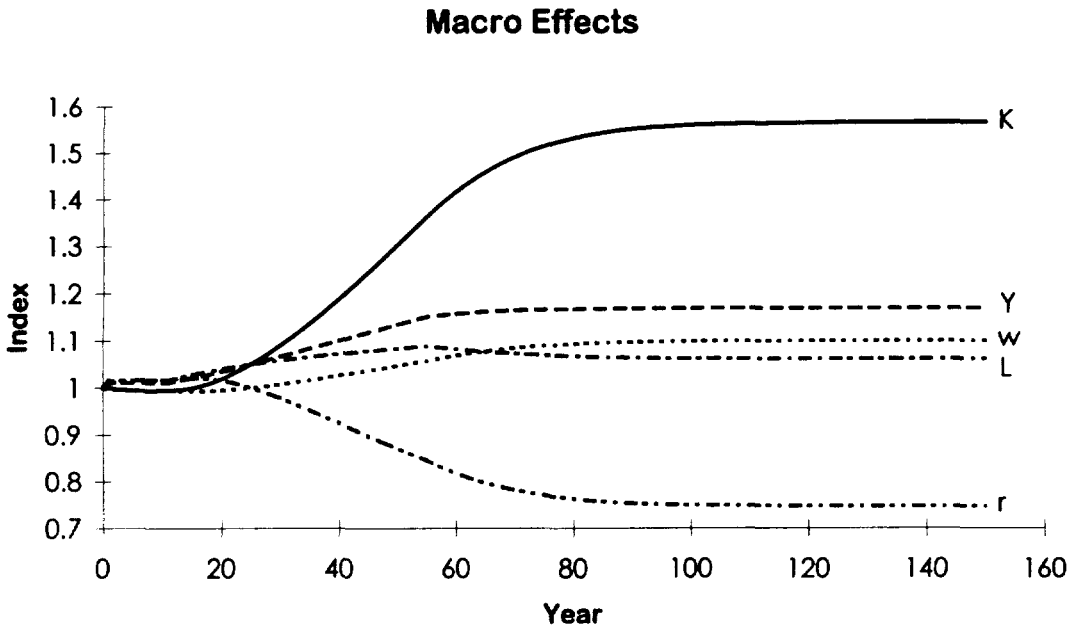


Figure 8: Progressive Income Tax Finance of Benefits



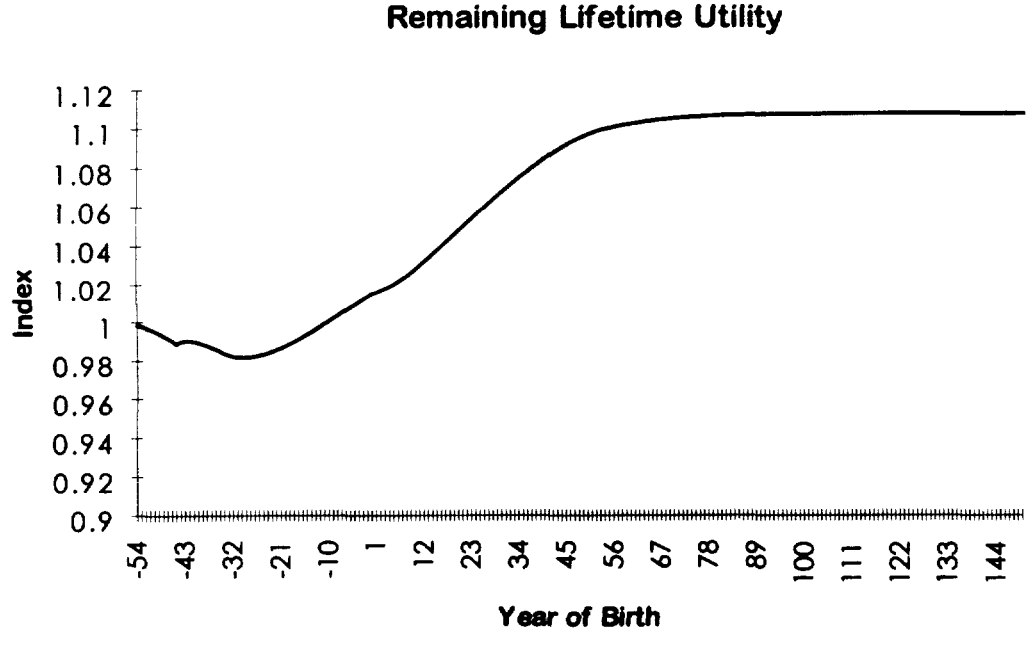
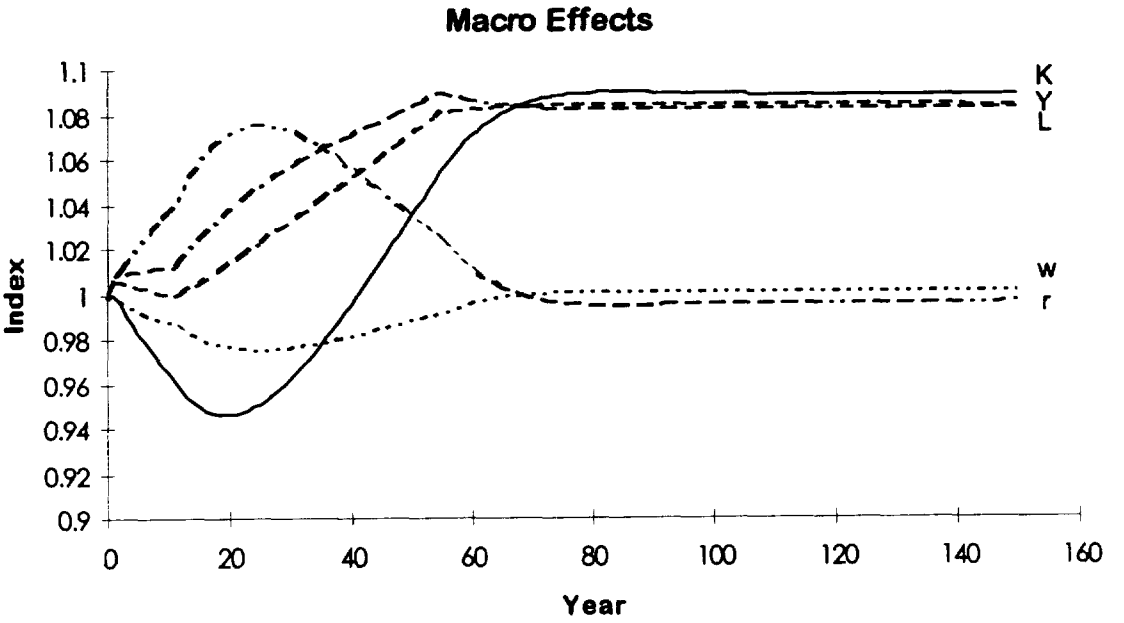


Figure 9: Progressive Income Tax Finance of Benefits, Welfare of Living Generations Constant



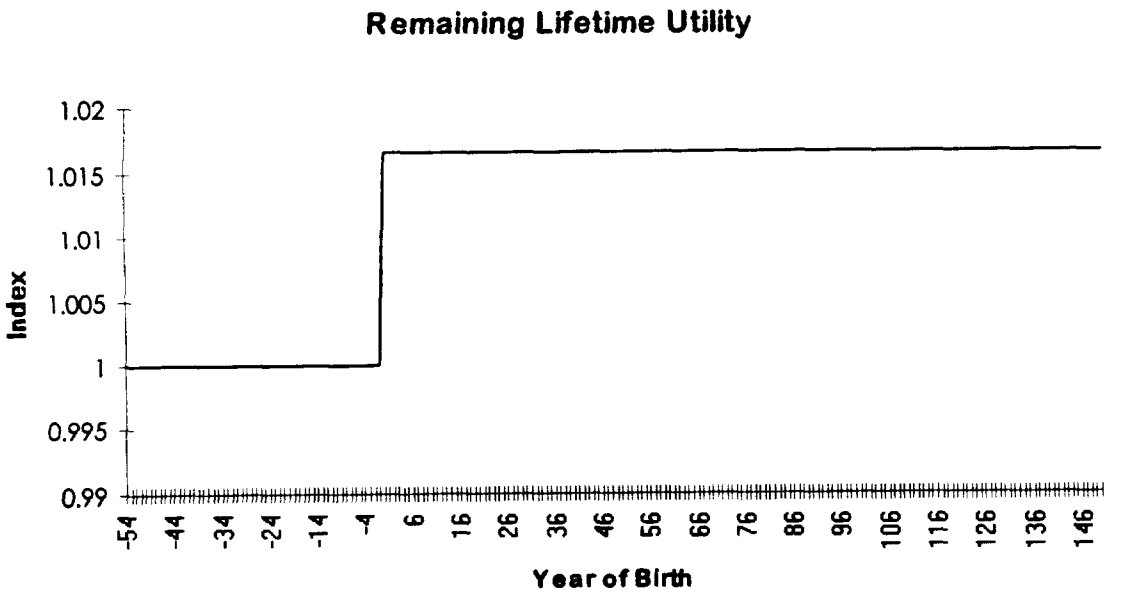
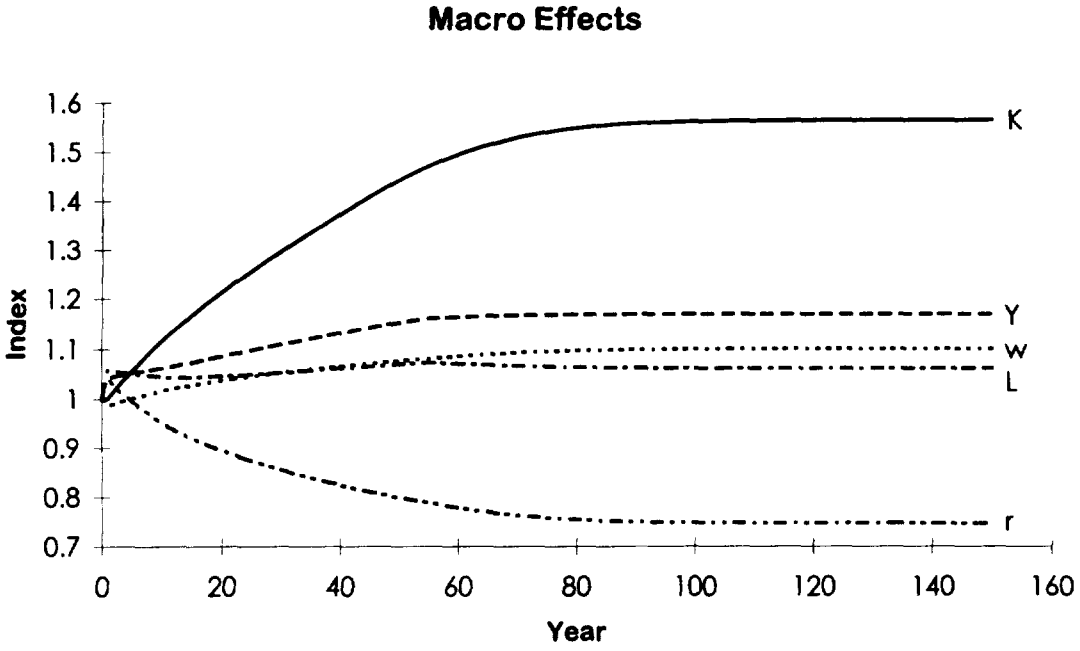


Figure 10: Proportional Consumption Tax Finance of Benefits, Progressive Income Tax Finance of General Revenues



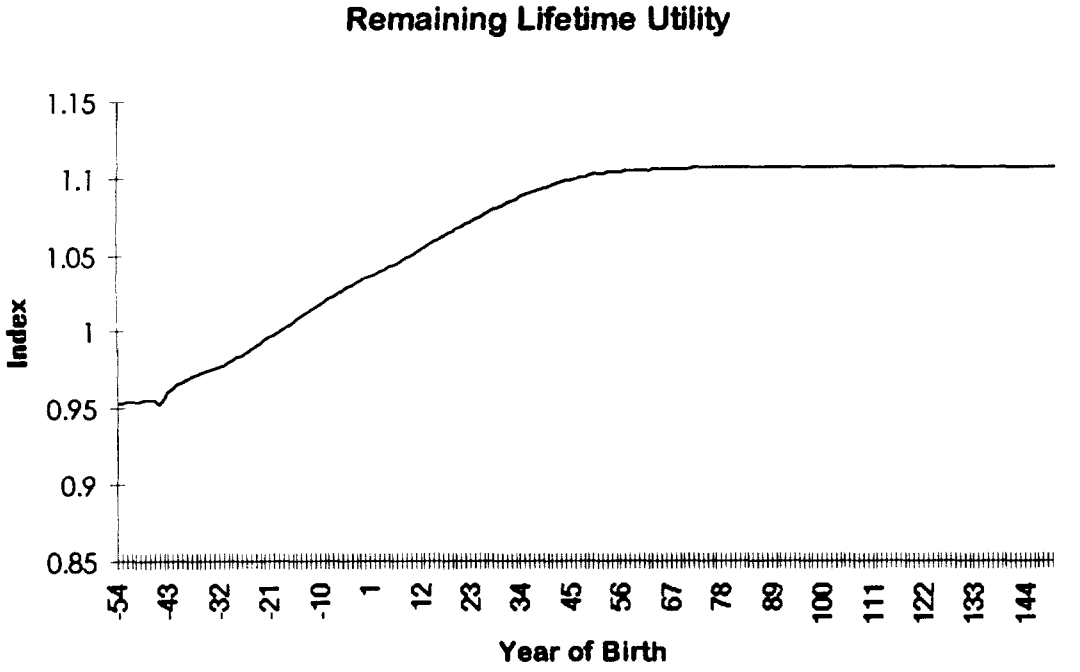
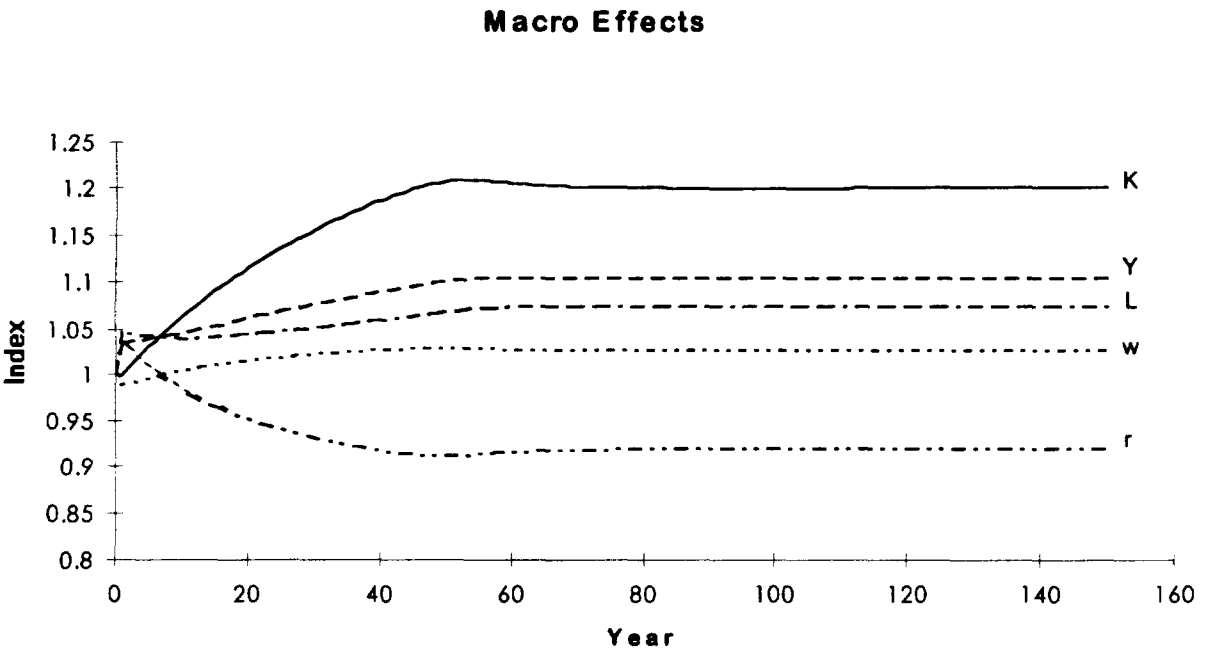


Figure 11: Proportional Consumption Tax Finance of Benefits, Progressive Income Tax Finance of General Revenues, Welfare of Living Generations Constant



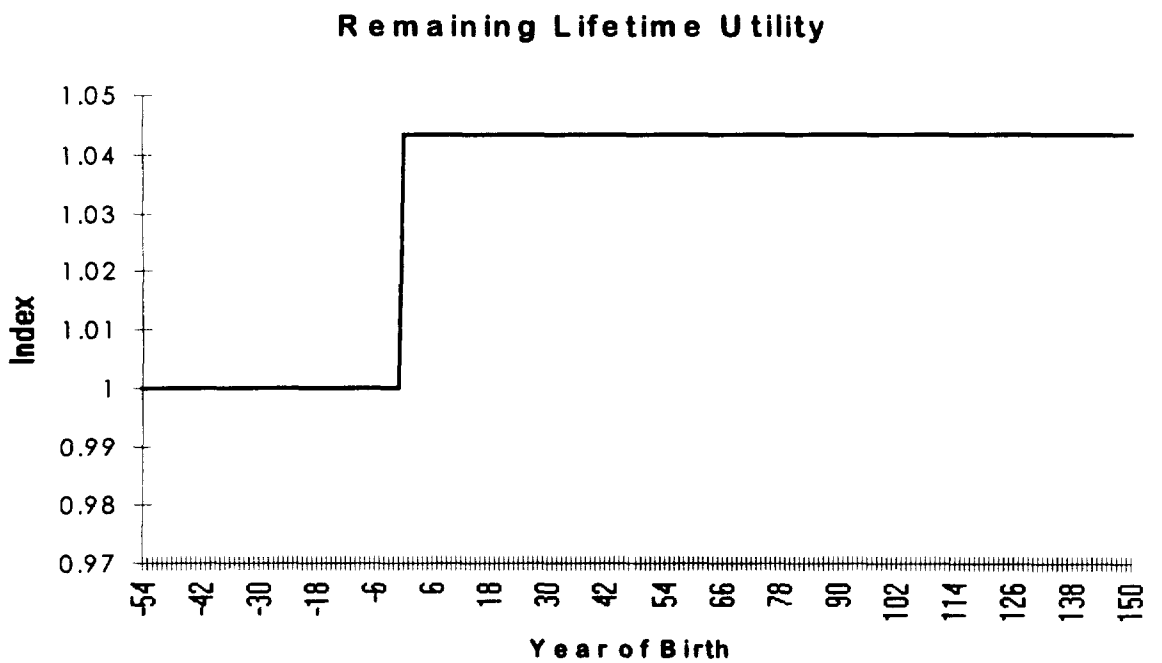
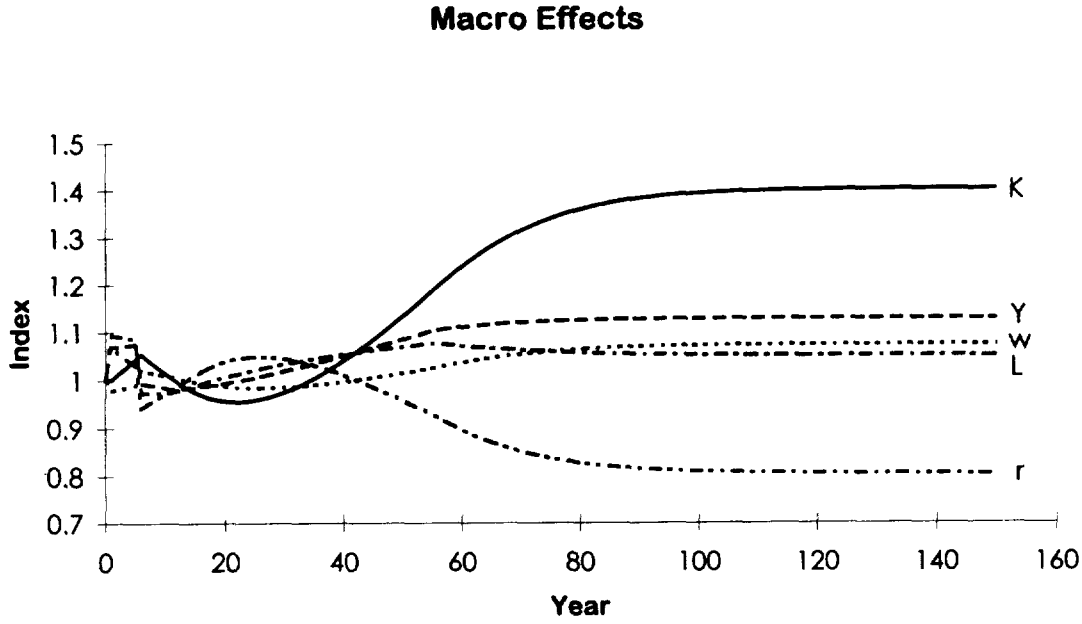


Figure 12: Progressive Income Tax Finance of Benefits, 5 Year Debt Finance



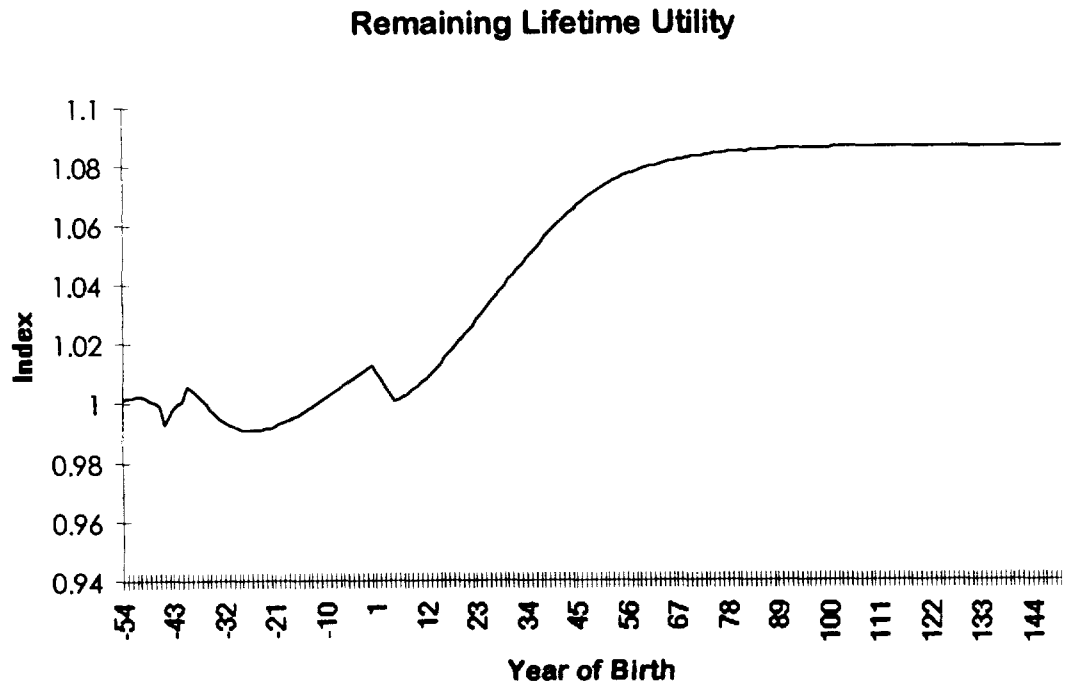
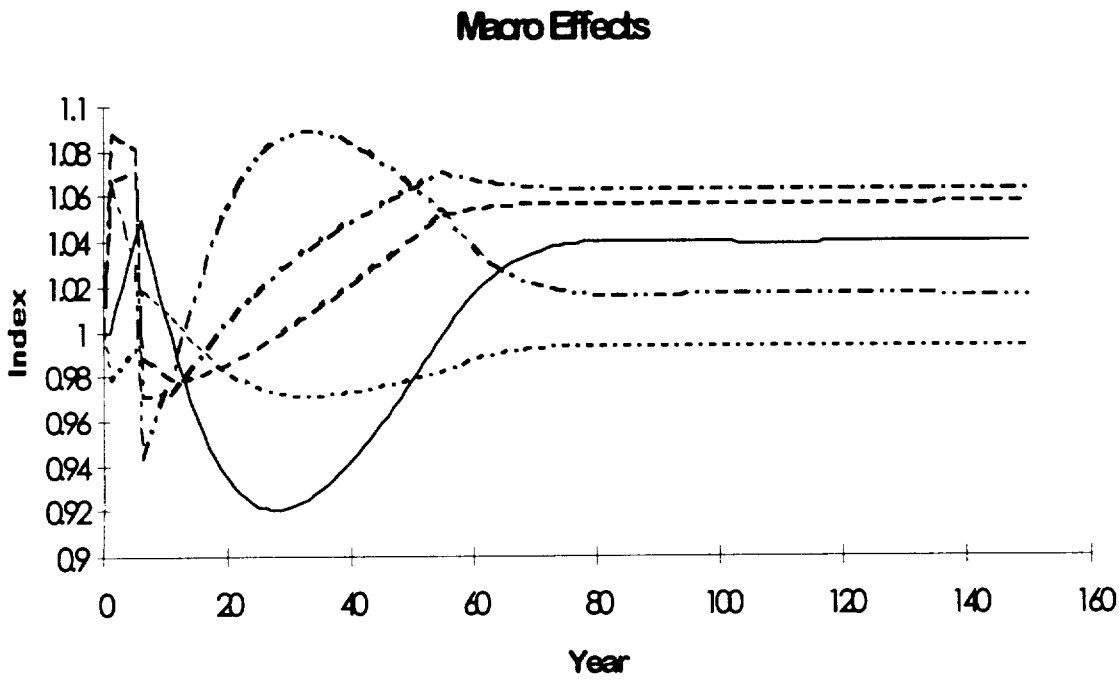


Figure 13: Progressive Income Tax Finance of Benefits,
5 Year Debt Finance
Welfare of Living Generations Constant



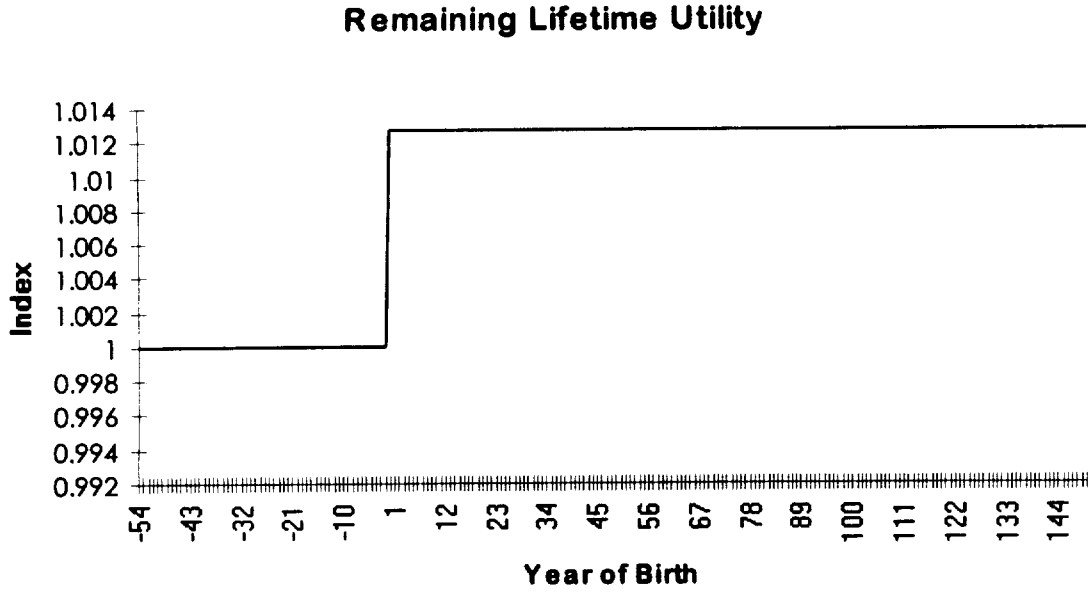
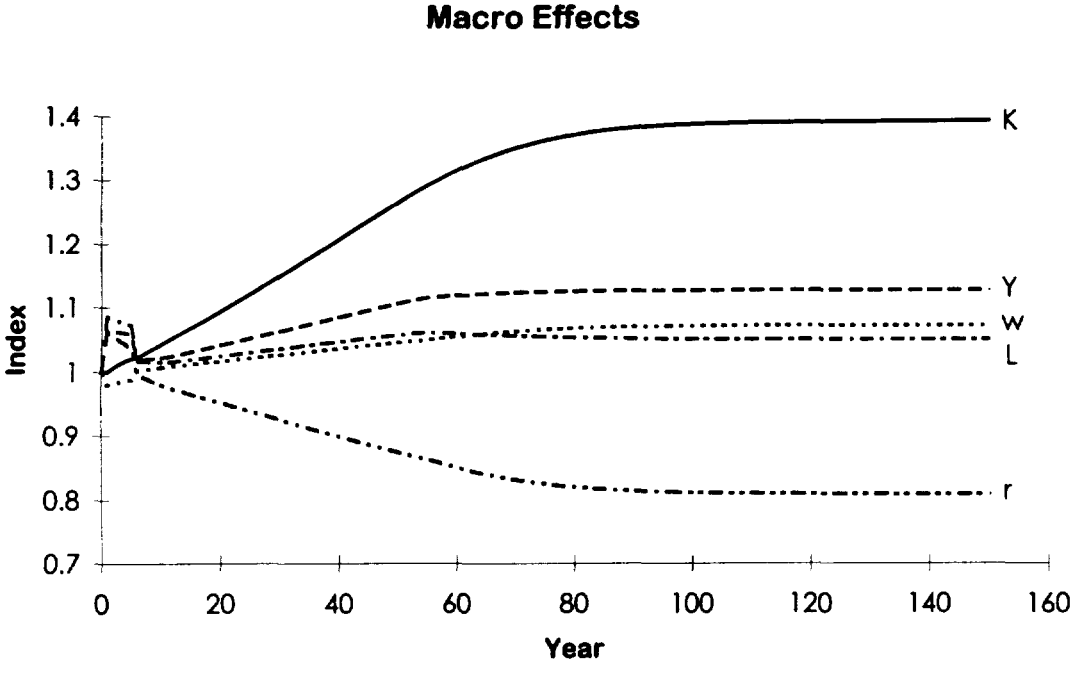


Figure 14: Proportional Consumption Tax Finance of Benefits, Progressive Income Tax Finance of General Revenues, 5 Year Debt Finance



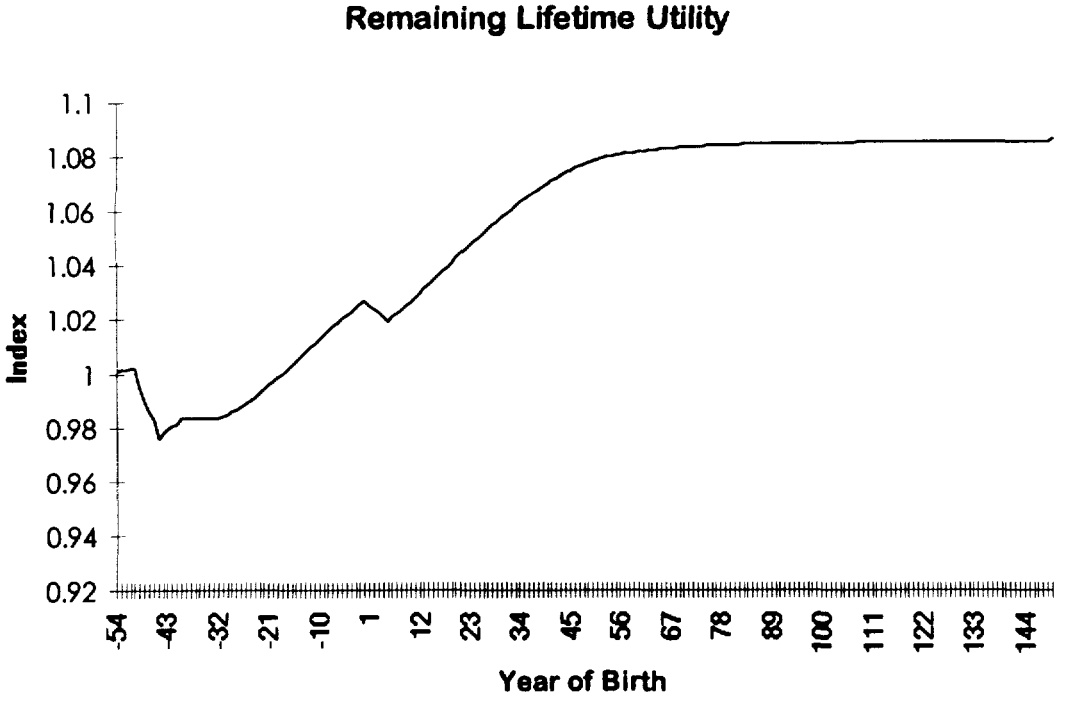


Figure 15: Proportional Consumption Tax Finance of Benefits, Progressive Income Tax Finance of General Revenues, 5 Year Debt Finance, Welfare of Living Generations Constant