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Dean R. Leimer and Peter A. Petri

Division of Economic Research

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COHORT-SPECIFIC EFFECTS OF SOCIAL SECURITY POLICY

Dean R. Leimer and Peter A. Petri*

1. Introduction

The future of social security is clouded by projections of large deficits in the early part of the next century, and by serious questions about its potentially negative impact on capital formation. The literature on the latter issue is now substantial, if still inconclusive.[1] But even if the hypothesis of a savings effect is accepted, it does not easily translate into a prescription for future policy. Most significantly, implications derived from comparing balanced growth equilibria with and without social security[2] fail to address the complex transitional issues raised by changes in the program. Social security has sizeable obligations to workers who contributed and made savings decisions in the anticipation of future benefits, and the assessment of future options must explicitly account for impacts on these as well as future participants. To this end, our paper develops cohort-specific, general-equilibrium comparisons of concrete policy alternatives.

The long term context of social security is illustrated in Figure 1, a diagram based on the most recent projections of the system's actuaries[3]. Under an intermediate set of economic and demographic assumptions, legislated expenditures will significantly exceed legislated taxes roughly thirty years from now, even if the sharp payroll tax increases now scheduled are in fact implemented. The single most important factor behind these results is the large <u>relative</u> size of the group that is expected to retire in the early part of the next century: cohorts born between the late

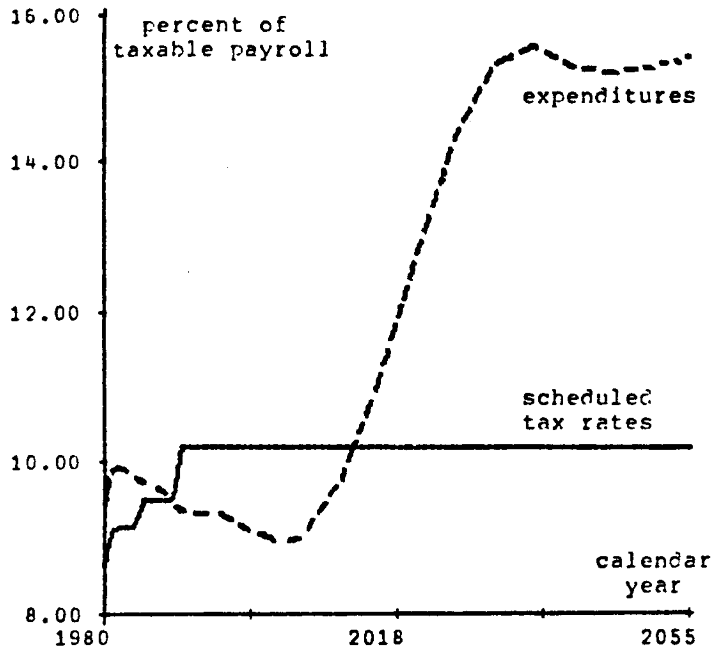

Figure 1. Estimated OASI Expenditures and Scheduled Tax Rates

1940's and the early 1960's (the "baby boom") were roughly 30 percent larger than current and expected future birth cohorts. The impact of the baby boom is likely to be reinforced by declines in mortality; recent improvements have been dramatic, particularly at older ages[4].

Several different paths of tax increases and/or benefit reductions could "balance" social security over the next 75 years. The important issue is how individual cohorts of participants -- including those now alive and some yet to be born -- would fare under different policies. To make the question managable, this study abstracts from the distribution of benefits <u>within</u> cohorts, and addresses only the intergenerational welfare consequences of policy. Its principal analytical tool is a new simulation model of the social security system and the economy. This model tracks a series of cohorts through time, and includes simplified descriptions of long-term demographic and economic change, a detailed representation of social security, and some important, recently-hypothesized linkages between social security and the economy. In particular, the model assumes that social security affects saving in the context of a life cycle saving approach. The model's general-equilibrium results provide useful insights on the tradeoffs involved in solving the long-range financing problem.

Section 2 of this paper describes the model in some detail, Section 3 defines alternative long run policy options, and Section 4 presents the time-series results of the simulations. Sections 5 and 6 then examine the results from the viewpoint of individual cohorts, using both partial- and general-equilibrium approaches. Section 7 evaluates the options with illustrative intergenerational welfare criteria. Some conclusions are drawn in Section 8.

2. Model

The analysis of the lifetime income streams of current and future workers requires very long projection horizons, and perhaps the most unusual feature of the model is the 75 year plus length of its simulation period. Obviously, the model is not intended to achieve forecast precision over that interval but rather to identify the differential impacts of policy alternatives.

To clarify the nature of the simulations, it is useful to classify the sources of uncertainty involved. In the present application, the effect of basic economic uncertainties, e.g., about the rate of future productivity growth, is considerably smaller than the effect of demographic uncertainties, e.g., about future fertility. Certain indexing features built into the present social security tax and benefit structures limit their sensitivity to wage and price changes over time. Also, we are interested mainly in the relative impacts of different policies, e.g. in the relationship between output levels under different policies, rather than the absolute level of future output. While these results depend critically on the economic relationships embedded in the model, they are much less sensitive to the underlying growth assumptions.

In contrast, the model's results are very sensitive to the underlying fertility assumptions. Post-war total fertility rates have varied remarkably, and different, reasonable assumptions about future fertility lead to widely divergent projections of the relative burden of social security. This sensitivity reflects the fact that system finances are closely tied to the ratio of retirement age to working age populations. In addition, aggregate economic activity is affected by changes in the age/sex composition of the population because of differences in the labor force participation, productivity, and savings characteristics of those groups. Thus the results reported below are especially sensitive to the demographic assumptions used.

The model is quite simple, and elaborates only those relationships which influence the determination of social security taxes and benefits or which are especially sensitive to demographic change and the influence of social security. In contrast to the actuarial projections which rely on exogenous assumptions concerning the timepaths of economic influences,[5] the model endogenously determines key economic variables such as output and investment. It differs from other long run economic simulation models[6] in the detailed treatment of current social security transfers, anticipated social security wealth, and the demographic determinants of saving. These variables generate important feedbacks on investment and growth. At present, however, two other, relevant aspects of behavior, fertility and labor force participation, are still treated exogenously. This necessarily limits the range of social security policies which can be considered, and we exclude options, such as raising the retirement age, which might have large additional impacts on labor force participation. Unless specifically indicated to the contrary, the values of exogenous parameters are based on the long-range projections of social security actuaries.[7]

Table 1 lists the model's equations. Some detail is omitted for the sake of clarity. The model's four main modules deal with demography, production and distribution, social security, and saving and investment. With the exception of the determination of social security wealth (to be described below), the system is recursive; its equations are solved sequentially in each simulation year. The inputs needed by particular equations are generated either by an "up-stream" equation, or by the previous period's calculations.

DEMOGRAPHIC MODULE. Population is projected by sex and age given exogenous projections of mortality, fertility, and immigration. The total fertility rate is assumed to increase gradually to 2.1 for cohorts of women born after 1970, mortality rates are projected to continue to fall, and net immigration by sex and age is held constant at 1977 levels. For all but newborns, equation (1) derives the current population from the population in the previous period less deaths and plus net immigration. The population of newborns surviving through year end is determined by equation

Table 1

MODEL EQUATIONS:

(1) $N_{s,a} = N_{s,a-1,t-1}\,(1-m_{s,a-1,t-1}) + M_{s,a}$ for $a>0$

(2) $N_{s,o} = \lambda_s\,(1-m_{s,*}) \sum_a f_a\, N_{2,a} + M_{s,o}$ for $a=0$

(3) $E_{s,a} = N_{s,a}\, p_{s,a}\,(1-u_{s,a})$

(4) $L = \sum_s \sum_a E_{s,a}\, \pi_{s,a}$

(5) $K = K_{t-1} + I_{t-1}$

(6) $Y = z\, L^{\alpha}\, K^{(1-\alpha)}$

(7) $w_{s,a} = (\alpha Y/L)\, \pi_{s,a}$

(8) $r = ((1-\alpha)\, Y / K) - \delta$

(9) $R_{s,a,j} = n_{s,j,t-(a-j)}\, h_{s,t-a}\, N_{s,a}$ for $a \geq j$

(10) $b_{s,a,j} = \begin{cases} b_{s,a-1,j,t-1} & \text{for } a>j \\ Q_{s,j}\, \bar{w}_{s,a} & \text{for } a=j \end{cases}$

(11) $B_a = \sum_s \sum_j R_{s,a,j}\, b_{s,a,j}$ for $a \geq j$

(12) $D_a = d_a \sum_a B_a$

(13) $T_a = v \sum_s w_{s,a}\, E_{s,a}$

(14) $g_a = B_a + D_a - T_a$

(15) $F = F_{t-1}\,(1+\xi r) - \sum_a g_a$

(16) $W_a = W(\ldots)$

(17) $S_a = \sigma_a \left(\sum_s w_{s,a}\, E_{s,a} \right) + (1-\Psi) \left[g_a - (W_a/e_a) \right]$

(18) $I = \theta\,(Y-\delta K) + (F-F_{t-1}) + \sum_a S_a$

NOTE: Greek notation is used exclusively for parameters which are not time or cohort specific. The time subscript on the remaining variables is generallly omitted except in the case of lagged variables, where the form of the subscript indicates the nature of the lag; a time subscript of "o" refers to the variable's base year value.

NOTATION KEY:

α :labor's share of output
δ :depreciation rate of capital
θ :ratio of public net investment plus net foreign investment to net output
λ :share of births by sex
ξ :ratio of rate of return earned on trust fund assets to net profit rate
π :relative productivity of workers by sex and age
σ :net saving rate by age
Ψ :share of social security transfers offset by private transfers
a :subscript denoting age in years
b :individual retirement benefit by sex, age, and age at retirement
B :total retirement benefits disaggregated by age
c :subscript denoting birth year of cohort
d :ratio of dependent's and survivor's benefits disaggregated by age to total retirement benefits
D :total dependent's and survivor's benefits disaggregated by age
e :discounted life expectancy in years by age
E :employment by sex and age
f :age-specific fertility rate
F :OASI trust fund assets
g :net social security transfers disaggregated by age
h :proportion of the cohort born in year t-a to eventually achieve fully-insured status by sex
I :net investment
j :subscript denoting age at retirement
K :capital stock
L :effective labor input
m :probability of death within one year by sex and age, where age is the age last birthday at the beginning of the year (an age subscript "*" refers to the probability that a birth within the year will die before the end of the year)
M :net immigration by sex and age
n :proportion of the fully-insured population of sex s and current age a who retired at age j in year t-(a-j)
N :population by sex and age
p :labor force participation rate by sex and age
Q :social security replacement rate (ratio of the benefit award to a measure of the worker's prior "wage-indexed" earnings) by sex and age at retirement
r :profit rate net of depreciation
R :number of retirees by sex, age, and age at retirement
s :subscript denoting sex (1=male, 2=female)
S :net private saving disaggregated by age
t :subscript denoting time
T :OASI tax payments disaggregated by age
u :unemployment rate by sex and age
v :ratio of OASI tax payments to total labor income
w :individual earnings by sex and age
$\bar{w}$:individual "wage-indexed" earnings average (similar in construct to the social security AIME measure) by sex and age
W :net social security wealth disaggregated by age
Y :gross output
z :production function scale variable reflecting current level of technical progress

(2) from the female population of child-bearing age, current age-specific fertility rates, and the mortality experience of newborns. Newborns are allocated by sex in fixed proportions, and net immigration of newborns is added.

PRODUCTION/DISTRIBUTION MODULE. Equations (3)-(8) provide a stylized, neoclassical description of the growth and distribution of output. Production is Cobb-Douglas: there are two inputs, labor and capital services, and one output, used for both consumption and capital formation. All quantities are measured in 1977 dollars, and the distribution equations are based on a marginal productivity approach.

Equation (3) derives current employment by sex and age from the corresponding population projections. The participation rates used reflect a 20 percent increase in the labor force participation of women, and a 1 percent decline in that of men over the 1977-2010 period. Unemployment rates are assumed constant at 1977 levels. Equation (4) translates employment by sex and age into "effective" labor input using age- and sex-specific productivity weights.[8] The capital stock at the beginning of each period is determined by equation (5) as the sum of the previous period capital stock and net investment during the previous period. Equation (6) represents the Cobb-Douglas production technology with Hicks-neutral technological progress at an annual rate of 1.25 percent. Age- and sex-specific wage rates are obtained in equation (7) by multiplying the returns to an effective labor unit (total labor income divided by total effective labor input) by the relevant age- and sex-specific productivity coefficient. Equation (8) obtains the net profit rate as the marginal product of capital less depreciation.

SOCIAL SECURITY MODULE. Equations (9)-(15) simulate the level and age distribution of OASI benefits and tax payments, and the status of OASI trust fund balances. While a detailed description of the OASI benefit structure is beyond the scope of this paper, several features merit emphasis. The retirement benefit award is based on a worker's average earnings over a certain number of years. In computing this average, past earnings are "wage-indexed", that is, adjusted for subsequent changes in the national average wage.[9] A basic retirement benefit is then computed as a function of the worker's earnings average. The benefit formula is progressive: the basic benefit increases with the earnings average, but less than proportionally. The actual retirement benefit award is reduced from the basic benefit for early retirement (prior to age 65) or adjusted upward for retirement after age 65. The benefit formula itself is adjusted automatically over time to reflect changes in the national average wage. Once the benefit award at retirement is determined, annual price adjustments keep its real value constant over the retirement period.

These characteristics of OASI benefit computations define the basic structure of the social security module. The number of retirees by sex, age, and age at retirement is determined in equation (9) as the product of the appropriate populations ($N_{s,a}$), sex- and cohort-specific eligibility ratios ($h_{s,t-a}$), and projected "retiring" rates which are sex-, age at retirement-, and year-specific ($n_{s,j,t-a+j}$).[10] Benefit levels are determined in equation (10). In the first line, the benefits of previously retired workers ($a>j$) are assumed to equal their previous period benefits in real terms. In the second line, benefits of new retirees ($a=j$) are calculated as the product of their "wage-indexed" earnings average and a constant "replacement rate" which depends on sex and age at retirement.

This representation assumes that the relative sizes of new benefit awards by sex and age at retirement remain constant over time, but that the absolute level of new benefits keeps pace with changes in average earnings.[11]

Equation (11) aggregates retirement benefits by age for subsequent use. Equation (12) estimates dependent's and survivor's benefits by age of recipient as proportions of total retirement benefits. These age-specific proportions assume a constant age distribution of dependent's and survivor's benefits but incorporate SSA-projected changes in the overall ratio of dependent's and survivor's benefits to retirement benefits. All benefits are subject to across the board percentage changes under certain scenarios, as described in Section 3 below.

Equation (13) derives OASI tax payments as the product of an effective tax ratio and age- and sex-specific earnings as generated by equation (7). The effective tax ratio is essentially a weighted average of the three OASI tax rates (employer, employee, and self-employment), with weights representing the proportions of total earnings which are subject to the three types of tax liability.[12] Projections of the effective tax rate reflect both scheduled changes in tax rates and projected changes in the proportions of earnings subject to each kind of tax. Under the various scenarios considered, future tax rates are either given by presently legislated rates or are generated endogenously under alternative program assumptions.

Net OASI transfers by age are calculated in equation (14) for use in the savings/investment module and in the calculation of cohort-specific welfare measures (see Section 5). Equation (15) updates the OASI trust fund balance from the prior year balance by adding interest income and subtracting aggregate net transfers. A proportional relationship is assumed between the net profit rate as determined in the production/distribution module and the rate of return earned on trust fund assets.

SAVING/INVESTMENT MODULE. Net investment is projected as a sum of private, public, foreign, and social security investments. The private saving component takes account of age-specific saving differences and is affected in varying degrees by current net social security transfers and changes in social security wealth. As indicated in equation (18), the public investment and net foreign investment components are assumed proportional to net output; net changes in OASI trust fund assets are assumed to have a separate, full impact on real investment.

A life cycle approach underlies the determination of net private saving in the model. The first term of equation (17) determines net private saving in the absence of social security. It is built on the assumption that the current earnings of a given age group provide a satisfactory proxy for both current wealth (the wealth accumulated primarily from past earnings) and future wealth (the wealth equivalent of expected future earnings.) In this case, life cycle theory permits saving to be expressed as a fixed proportion of earnings in each age group. Age-specific saving/earnings ratios in the absence of social security were derived from consumer expenditure data by purging the observed saving ratios of the base year social security effect as estimated below.[13]

The effects of social security on saving are captured in the second term of equation (17), essentially in the spirit of Feldstein (1974). Individuals are assumed to treat "social security wealth," the discounted value of present and future social security benefits less contributions, as a substitute for private wealth, and to spread the consumption of this wealth evenly across their remaining lifetime. The "potential" savings effect of social security is calculated by subtracting the consumption induced by social security wealth (W_a divided by the discounted life expectancy[14] e_a) from current net social security income (g_a, the age group's benefits less contributions). The quantity (g_a-W_a/e_a) is generally negative for younger age groups and near zero for older groups.

In contrast to the Feldstein position, Barro (1974) has argued that social security taxes and benefits trigger opposite changes in private transfers (such as bequests and children's support of parents). To reflect this possibility, an actual savings effect is obtained in the model by multiplying the potential effect, (g_a-W_a/e_a), with the term $(1-\psi)$, where ψ represents the share of social security transfers which are offset by changes in private transfers. Thus $\psi=0$ represents an extreme Feldstein position, and $\psi=1$ an extreme Barro position.

How large is the offset in private transfers likely to be? Presently available empirical estimates do not provide a definitive answer.

Estimates based on time series data suggest values for ψ ranging from 0.7 to over 1.0.[15] In contrast, estimates based on cross-section data typically suggest much lower values for ψ, ranging from less than zero to about 0.5.[16] In the absence of more definitive estimates, we have adopted an intermediate value of 0.5 in the simulations described below. Thus, we implicitly assume that about one-half of the potential impact of social security on saving is not realized because of offsetting changes in private transfers.

It is also possible, of course, that the actual effect of social security on saving is less than its potential effect because people use social security wealth to retire early, rather than to decrease saving. Since we cannot yet simulate this "induced retirement effect", some aspects of the simulations, including especially labor force projections, will be inaccurate if the effect is strong. Some other results, however, including the welfare implications analyzed in Sections 6 and 7, are not very sensitive to whether the saving offset is due to changes in private transfers or to the retirement effect.[17]

Construction of the social security wealth variable requires assumptions concerning how individuals perceive future taxes and benefits. As such, the appropriate construction of this variable is not obvious. With the exception of an important experiment described below, we assume that individuals possess "perfect foresight" of their future social security taxes and benefits. This assumption is implemented by explicitly discounting, in each period and for each age group, all subsequent benefits and taxes as projected by the model itself. Since social security wealth affects the projection trajectory, and vice versa, several iterations of the projection run are typically needed to establish consistent "actual" and "perceived" trajectories for social security taxes, benefits, and wealth.

3. Policy Alternatives

There is no shortage of policy proposals for dealing with the projected deficits of social security. Suggestions have ranged from changing the system's revenue base and funding structure, and from adjusting its indexing formulas, to the taxation of social security payments, and the reduction or elimination of various types of benefits[18]. Typically, these plans boil down to combinations of long term tax increases and benefit reductions, but their intergenerational implications are often overshadowed by int<u>ra</u>generational conflicts. To keep intergenerational issues in focus, we avoid specific proposals and examine four simple, stylized alternatives. These are:

1. Increase taxes, as needed, to maintain solvency under the present benefit structure;
2. Decrease benefits across-the-board, as needed, to limit taxes to presently scheduled levels;
3. Adjust both taxes and benefits, with the burden split equally between the two;
4. Increase taxes, as needed, to establish trust funds equal to five times expenditures by the year 2000, and then maintain the funds at this level relative to expenditures.

The first three alternatives represent variations of pay-as-you-go financing: the trust fund is permitted to fall as low as 43 percent of expenditures (the 1977 base level). A relatively small, temporary trust fund (equal to about 2.5 times expenditures at its peak) is accumulated nevertheless during a period of surpluses anticipated near the end of this century. The fourth alternative envisions a substantially larger trust fund, which is not permitted to decumulate subsequently. This permanent, partial funding alternative requires current workers to contribute more heavily toward the provision of their own social security retirement income. These scenarios do not exhaust the range of feasible alternatives, but they do illustrate such widely divergent possibilities as the maintenance of the present benefit structure, significant reductions in social security's scale, and basic shifts in its funding approach.

4. General Findings

All four plans are examined in the context of the intermediate assumptions already outlined. These assumptions result in a 75-year population growth rate of 0.5 percent (compared with 1.4 percent during the postwar period), implying significant changes in the age structure of the population and, consequently, in social security finances. Tax and benefit responses under the four scenarios are shown in Figures 2 and 3. Figure 2 shows social security taxes (defined as the sum of the OASI employer, employee, and self-employment taxes) expressed as a percentage of payrolls subject to tax. Figure 3 shows the ratio of the benefits projected under each scenario to what benefits would have been under present law. These figures reflect the simple realities of the projected demographic shift: benefit rates will almost certainly have to decline or tax rates increase in the years ahead. Under currently scheduled tax rates and benefit provisions, the revenue gap in 2030, for example, would amount to 34 percent of benefits, or 51 percent of taxes. This gap reflects the required tax-cum-benefit adjustment under each of the scenarios, albeit the

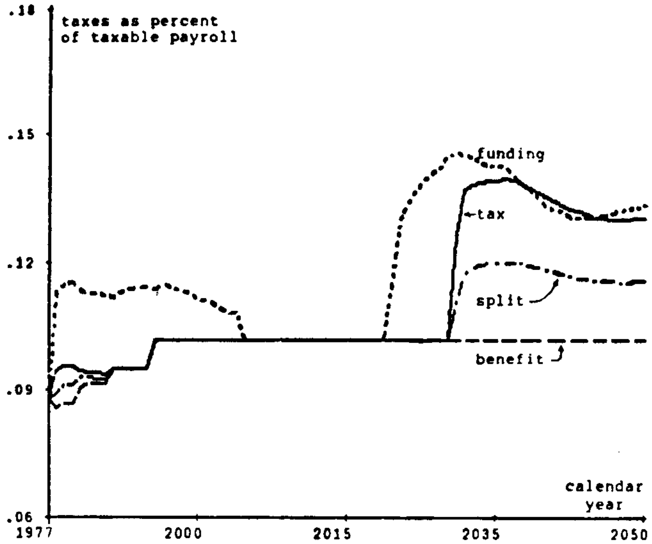

Figure 2. Social Security(OASI) Tax Rates

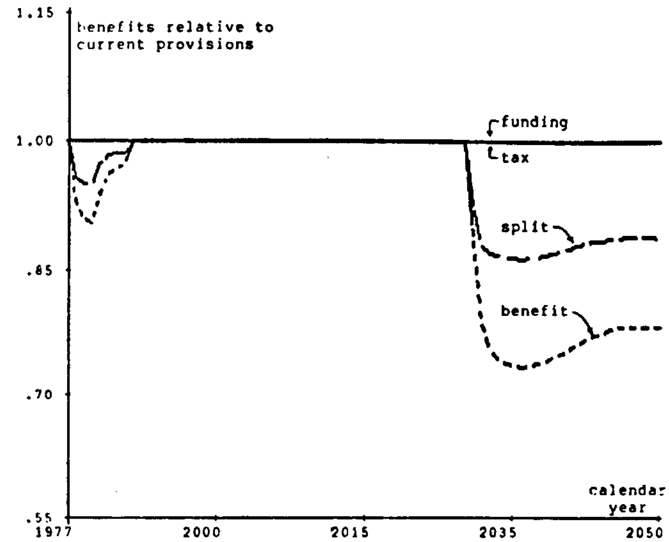

Figure 3. Indexes of Social Security(OASI) Benefits

funding alternative also triggers a large, immediate increase in taxes in order to establish the required intial fund.[19]

There are similarities as well as differences in growth patterns across the four scenarios. In all cases the growth contribution of labor declines significantly over the 75-year period -- the labor force actually shrinks slightly between 2015 and 2025 -- and, despite higher investment (explained below), output growth slows to 2.7-2.8 percent over the 75-year period (compared with 3.4 percent in the postwar period). Since labor force participation rates are projected exogenously, differences in growth paths are due to the investment implications of the alternative policies. As shown in equations (17) and (18), the rate of investment varies with (i) the age composition of the population (a factor not affected by social security policy in our model), (ii) private saving reactions to changes in "net social security wealth," and (iii) the accumulation or decumulation of social security trust funds.

Figure 4 shows that investment/output ratios are projected to rise under all four scenarios. This effect, which is especially large when benefit reductions are used to control the eventual social security deficits, is due to the aging of the population and the higher savings rates observed for units in middle age. Coupled with the slower growth of labor, higher investment rates support a rapid deepening of capital; by 2050, capital/output ratios rise by 44-54 percent, depending on policy. Capital deepening contributes 0.5-0.6 percent to the annual growth rate of output between 1977 and 2050.

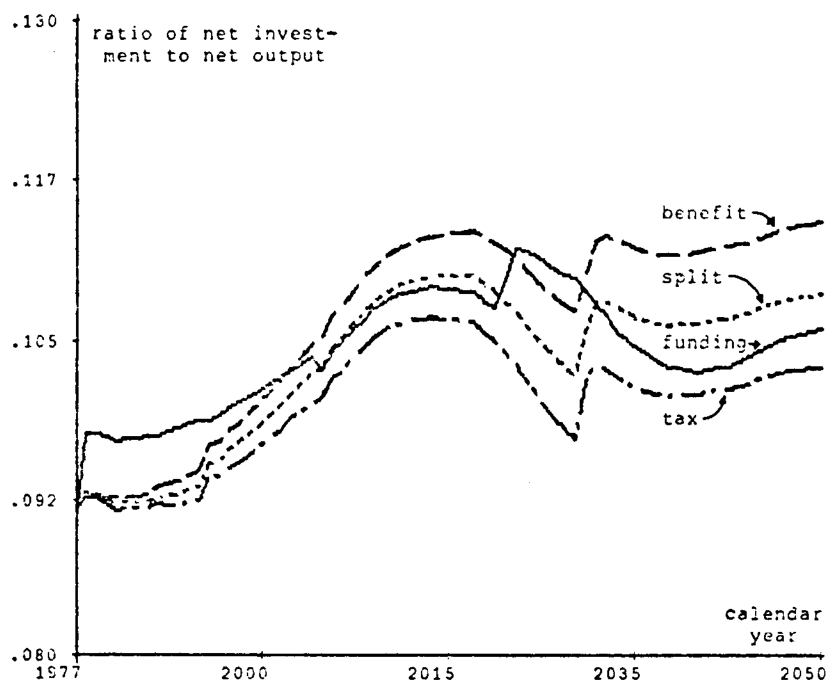

Figure 4. Investment Rates

Initially, funding generates the highest levels of investment, but it is overtaken by the benefit reduction alternative (perfect foresight variant) once the 500 percent trust fund is achieved in 2000. Under benefit reductions, workers begin to anticipate lower benefits with sharply higher savings. Subsequently, the investment rate falls somewhat between 2015 and 2030 in all cases, as the baby boom moves into retirement.

Increases in capital intensity eventually increase returns to labor, and reduce returns to capital, but do so to a different extent under the several policy alternatives. Figure 5 compares capital/labor ratios under the four alternatives, using the mixed tax/benefit policy (Alternative 3) as a base. Scenario-to-scenario wage differences are positively related, and profit rate differences are negatively related to the capital/labor trajectories shown in Figure 5. The timepaths of wages and interest are of interest since they are the main determinants of lifetime welfare; ideally, an individual would like to work when wages are high, and save and retire when profits are high.

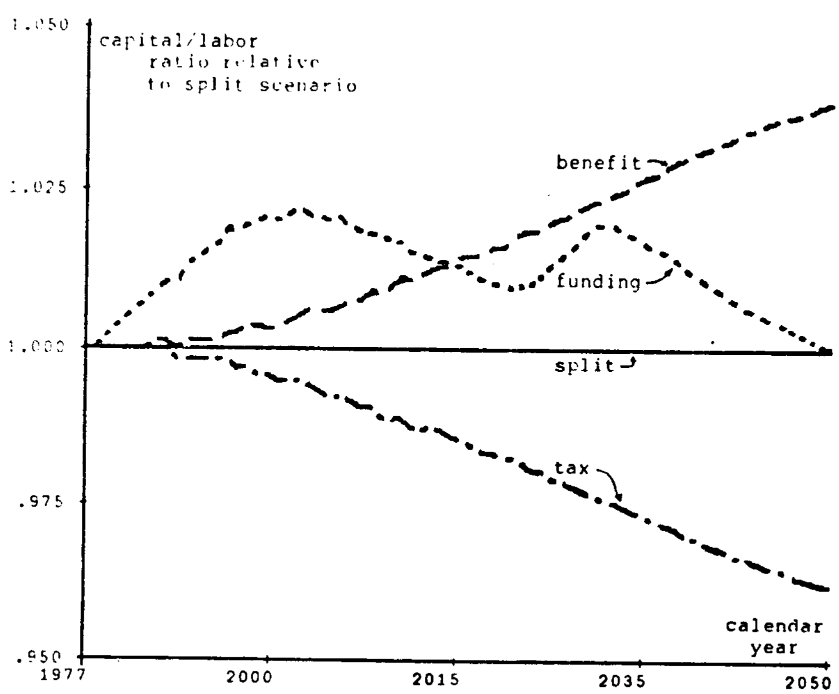

Figure 5. Capital/Labor Ratios Relative to Split Scenario

The timing of the investment response to changes in social security law is sensitive, however, to the expectation assumption used to construct the social security wealth variable. The results described so far assume that individuals correctly foresee both policies and economic changes through the rest of their lives. The importance of this assumption is greatest in the case of benefit reductions, since in this case workers would substantially increase savings at earlier ages. Figure 6 contrasts the "perfect foresight" variant of this policy scenario with another simulation based on the assumption that workers always expect the then current benefit/wage rate ("replacement rate") to be maintained in the future. Since in this case individuals fail to anticipate benefit reductions until they are actually implemented, their savings responses are greatly delayed. In the short-sighted variant, the investment response is

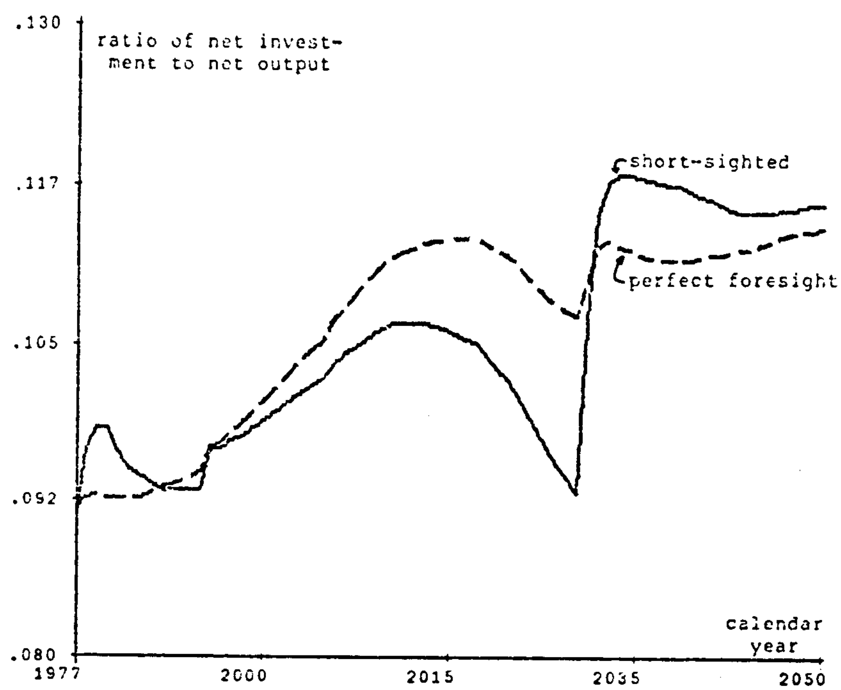

Figure 6. Investment Rates, Benefit Reduction Scenario

much sharper, and comes about 15 years after that in the "perfect foresight" case. We shall return briefly to the welfare implications of this delay in later sections.

5. Narrow Measures of Cohort Effects

Having briefly described the time-series consequences of alternative social security policies, we now examine the lifetime economic positions of people born at different times. Using age-detailed earnings, tax, and benefit results, social security policies are evaluated below in both a narrow sense (valuing only direct program contributions and benefits) and a broad sense (including indirect effects through other components of lifetime wealth). Narrow measures, such as internal rates of return or present values calculated from lifetime streams of social security contributions and benefits, have been traditionally used to evaluate the "profitability" of participation in social security. They also provide a useful background to the broader analysis reported in Section 6, which leads to rather different conclusions about the relative ranking of policies.

Figure 7 illustrates the narrow effects of social security on a particular cohort, in this case people born at the height of the baby boom in 1957. The social security contributions of this cohort appear as negative transfers during working ages, while benefits appear as positive transfers at older ages. The 1957 cohort would gain most from the tax adjustment scenario: it provides high benefits for relatively low taxes by shifting the contribution burden to future workers. The funding and split adjustment options are roughly similar in overall value; of these two, funding offers somewhat higher benefits (by maintaining the current benefit

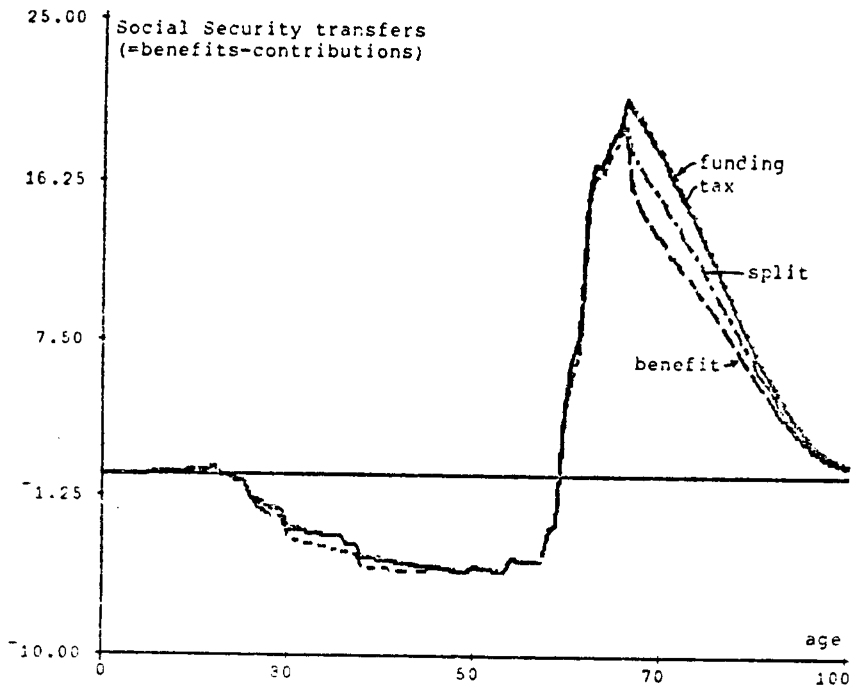

Figure 7. Net Social Security Transfers to 1957 Cohort
(Billions of 1977 dollars)

structure) for somewhat higher contributions. The benefit adjustment option is the least desirable: it substantially reduces retirement income without lowering this cohort's tax burden.

Figure 8 shows internal rates of return based on contribution/benefit streams like those reported in Figure 7. Altogether, it shows 336 such rates, one for each cohort born between 1917 and 2000 under each policy alternative. From the viewpoint of the oldest cohorts, the first three strategies, which do not imply program changes until the early 21st century, are essentially equivalent and preferable to the funding alternative. Then, beginning with cohorts born in the early 1940's, rates of return under the three unfunded alternatives begin to diverge, with the tax adjustment alternative offering the highest rates of return, the split adjustment the next highest, and the benefit adjustment the lowest. Rates of return under the funding alternative remain below all the unfunded

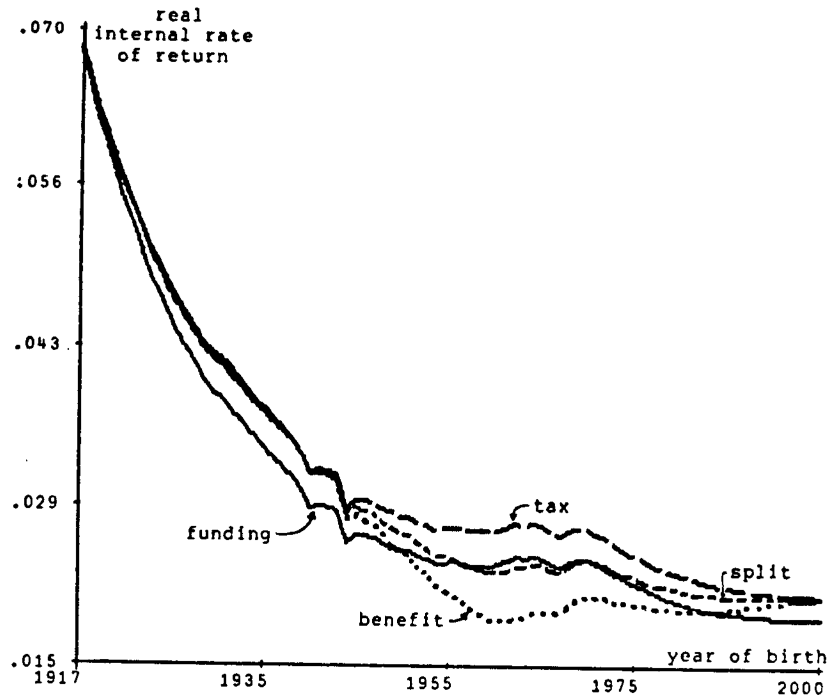

Figure 8. Internal Rates of Return by Cohort

alternatives for cohorts born through the early 1950's, rise relative to those under the benefit adjustment and split adjustment alternatives until exceeding both for cohorts born between 1960 and 1974, and then decline relatively until again falling below all unfunded alternatives for cohorts born after 1987.

Social security rates of return are between 2.0 and 3.0 percent for most cohorts, or roughly equal to the rate of economic growth.[20] Assuming that individual savers generally earn a return equal to somewhat less than one-third of the profit rate (i.e. a rate equivalent to 2.5 percent in 1977), social security performs about as well as a private investment from the viewpoint of an average participant. Typical rates of return are much higher for cohorts who were already near retirement in 1977; they have benefited from the rapid growth of social security benefits and coverage in the past. Note also that the narrow rates of return faced by the youngest cohorts are not much affected by policy; essentially, as each alternative becomes pay-as-you-go and the population age structure begins to stabilize in the long run, the rate of return approaches the general economic growth rate.

6. Broad Measures of Cohort Effects

The narrow measures described so far do not take into account the effects of social security on the other components of lifetime wealth, particularly earnings. Capital accumulation increases wages, and thus also the lifetime earnings of people working with large capital stocks. At the same time, it reduces the returns of capital. Thus policies that "internalize" the retirement costs of a particular generation through private or public capital accumulation also tend to (i) raise the lifetime earnings of other, overlapping generations who work alongside the accumulating assets, and (ii) lower interest rates, thus making it more difficult to finance retirement through savings.

We have used a simple, Cobb-Douglas utility function to combine the effects of earnings and price (interest rate) changes into an index of lifetime welfare:

$$w = \max \prod_{i=o}^{N} c_i^{a_i} \quad \text{s.t.} \quad \sum_{i=o}^{N} p_i \, (e_i - c_i) = 0$$

$$\text{where} \quad p_i = \prod_{t=o}^{i} (1+r_t)^{-1}$$

This function can be solved for the indirect form:

$$w = k \, \Big(\sum_{i=o}^{N} p_i e_i \Big) \; / \; \Big(\prod_{i=o}^{N} p_i^{a_i} \Big)$$

where a = consumption elasticity of lifetime welfare ($\sum_{i=o}^{N} a_i = 1$)
c = consumption
e = earnings
i = subscript, denoting age
k = constant
N = length of lifetime
p = discount factor
r = interest rate
w = lifetime welfare index

Under our assumptions, the parameters a_i represent the share of discounted consumption at age i in total, discounted, lifetime consumption; they are based here on cross-section consumer expenditure data.[21] The first bracketed term of the indirect welfare function is lifetime earnings discounted to age zero, while the second term is akin to a lifetime "price index" -- essentially the weighted geometric mean of the discount factors applicable at various future ages. "Earnings" is defined to include labor earnings, the non-offset part of social security transfers, and an imputation of the investment returns that are obtained socially but not captured privately (i.e. the wedge between private and social returns to capital).[22] Results are presented in Figure 9. This Figure uses the split adjustment scenario as a base, and shows, in percentage terms, how much higher (or lower) cohort per capita welfare would be under the three other scenarios.

The broad results presented in Figure 9 differ from the narrow results in two significant respects. First, the funding option is now no longer the least desirable option for most cohorts; indeed, it is now the most attractive option for nearly 40 percent of the cohorts. Those born in the early part of the baby boom would still gain by passing their retirement expenses to future generations through tax increases. But those born after about 1952 would gain more from working with a larger capital stock than from the backward transfers implicit in the tax-adjustment approach.

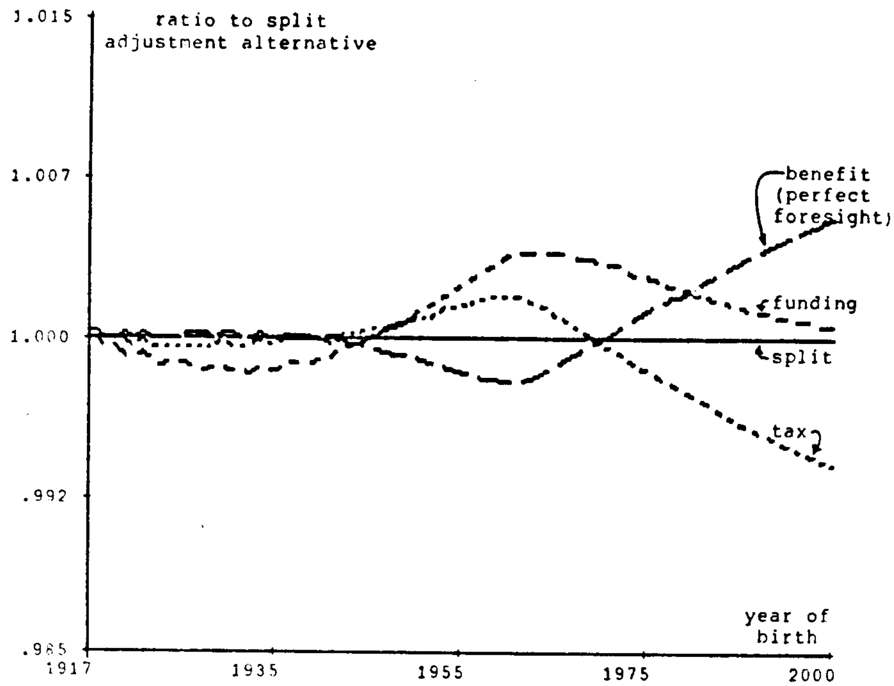

Figure 9. Relative Lifetime Welfare by Cohort

Second, also in contrast to the narrow results, policy choices now matter for the most distant future cohorts. Given broad indicators, these cohorts do particularly well under the benefit adjustment option, since this policy ultimately results in a larger capital stock and consequently higher earnings. A note of caution is needed, however; for reasons already discussed, the impact of the benefit reduction option is sensitive to the expectations assumptions used. Figure 10 substitutes the "short-sighted" assumption for "perfect foresight" in the case of the benefit reduction alternative, and shows much less favorable results for cohorts born before the benefit reductions which occur in the next century. This finding calls attention to an important aspect of policy change: benefit reductions must be announced with a substantial lead, and should be preferably coupled with

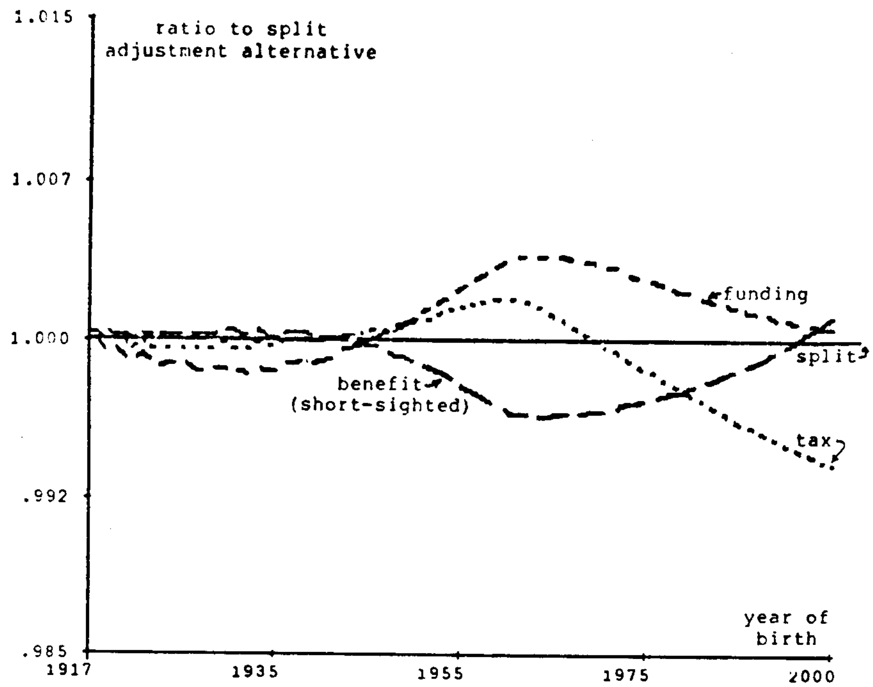

Figure 10. Relative Lifetime Welfare by Cohort, Short-sighted Benefit Scenario

complementary measures that assure the timely accumulation of substitute wealth.

7. Overall Comparisons

Table 2 collects the cohort-by-cohort rankings of the four policy alternatives based on the results obtained so far. It shows that no one policy clearly dominates or is dominated by any of the others: no pair of policies is ordered the same way by all cohorts. To provide some rough, comprehensive comparisons, we now present illustrative calculations with a simple utilitarian, intergenerational welfare function.

Clearly, the utilitarian approach represents just one of several possible ethical perspectives.[23] Even if it is accepted, there are serious conceptual difficulties involved in comparing different generations'

Table 2
RANKINGS OF POLICY ALTERNATIVES BY COHORT WEALTH

Cohort	Adjustment Alternatives: tax N*	tax B**	benefit N	benefit B	split N	split B	funding N	funding B
1920	2	2#	1.5#	2#	1.5#	2#	4	4
1930	3	3	1	1	2	2	4	4
1940	3	2.5#	1	1	2	2.5#	4	4
1950	1	1	3	4	2	3	4	2
1960	1	2	4	4	2.5#	3	2.5#	1
1970	1	2	4	4	3	3	2	1
1980	1	4	4	2	2	3	3	1
1990	1	4	3	1	2	3	4	2
2000	2#	4	2#	1	2#	3	4	2

* Narrow measure. ** Broad measure. # Tie: average rank.

welfare, including the usual, formidable objections to cardinal welfare measurement. Also, the wealth measures developed in this study include neither bequests nor other private intergenerational transfers -- other than those implicitly specified through the partial offsets on social security transfers. Changing longevity introduces further complications: is a cohort's level of well-being more meaningfully measured by lifetime wealth, or by wealth per year of life? Work effort, too, varies across cohorts, partly because of changes in longevity. Should the wealth measure be corrected in some way for differences in effort? While many of these factors do not vary across scenarios, and thus do not significantly affect policy rankings, it is nevertheless clear that the results can do no more than highlight some basic tradeoffs in policy.

The computations were based on the function:

$$U = \sum_i (1+d)^{-i} w_i^b n_i \quad \text{for } i = 1917,\ldots,Y$$

where b = cohort welfare elasticity of social utility
d = social intergenerational discount factor
i = cohort index
n = cohort population
U = social welfare criterion
w = cohort per capita lifetime welfare index
Y = year of birth of last cohort considered

The discount factor (d) and the end of the cohort horizon (Y) govern the relative valuation of the welfare of different generations, and the elasticity parameter (b) defines the sensitivity of social utility to the per capita lifetime welfare of individual cohorts. While the simulations provide complete lifetime earnings and social security data only for cohorts born in 2000 or earlier, crude extrapolations of w_i and n_i for later cohorts have allowed us to extend the analysis also to a longer planning horizon[24]. The cohort discount factor was varied from 0 to 5 percent; the cohort horizon from 2000 to 2050; and the utility elasticity from 0.5 to 1.0. Selected results of these experiments are summarized in Table 3.

Table 3 suggests that funding is preferable to other options if only generations born before the year 2000 are considered. Essentially, this horizon includes the current population and nearly all of its offspring. As Figure 9 indicates, funding is the preferred option of cohorts born between 1953 and 1984. Funding is inferior to tax adjustments from the viewpoint of earlier generations, but very much superior to it from the viewpoint of later generations. Thus, low intergenerational discount rates are necessary to shift the balance against funding. At the same time, the benefit reduction strategy clearly dominates if future cohorts have a large

Table 3
RANKING OF ALTERNATIVES BY WELFARE CRITERION

.....Welfare parameters....			..Adjustment Alternatives..			
cohort horizon	cohort discount	utility elasticity	tax	benefit	split	funding *
2000	0%	1.0*	4	2	3	1
	5%	1.0	4	2	3	1
		0.5	2	4	3	1
2050	0%	1.0	4	1	2	3
	5%	1.0	4	1	3	2

* Except when explicit variation is shown, changes in the utility elasticity did not affect the ranking.

weight in the intergenerational welfare formula -- e.g. the discount rate is low and the horizon is long. This is especially true if benefit reductions are implemented in a world of less than perfect foresight; even with a discount rate of zero, the horizon has to include generations born in 2080 in order to make benefit reductions preferable to funding in this case. Variations of the utility elasticity within the 0.5-1.0 range had no effect on these rankings; changes in the cohort discount rate have a much larger effect on the "importance" of different cohorts in the intergenerational formula than marginal utility effects seem to generate.

8. Conclusions

Given intermediate assumptions about the economic and demographic variables that affect the future of social security and given current benefit and tax schedules, the social security program appears to be headed for large long-run deficits. This paper reviews the intergenerational consequences of several policy solutions, including adjustments in taxes and benefits, and the transition to a partially funded system.

None of the alternatives considered implies a significant change in benefit rates over the next few decades. Thus, rates of return obtained by cohorts now near retirement do not differ significantly among solutions, and are generally high relative to those projected for younger cohorts. The cohorts most sensitive to policy choices are those born after 1940. Under narrow calculations of the net lifetime benefits obtained from social security -- that is, without taking general equilibrium effects into account -- these cohorts would gain most from a tax adjustment policy. This is especially true for the baby boom cohorts and their immediate "neighbors", since a tax adjustment policy allows them to effectively shift their retirement costs to future workers.

The narrow calculations ignore, however, social security's possible impact on the pace and timing of economic growth. Under the assumptions adopted in this paper, both funding and benefit adjustment strategies lead to increased investment. Under the partial funding scenario considered, investment increases come earlier, and tend to diminish once the trust fund reaches its desired objective. The investment effects of benefit reductions are larger and more durable, but their timing and welfare implications depend crucially on the extent to which the benefit reductions are foreseen.

The higher capital stocks implied by funding and eventually by benefit adjustments tend to increase wages and the lifetime earnings of cohorts who work with these stocks. Since the trust funds under the scenario considered would be highest just when the retirement wave begins, the cohorts obtaining the largest spillover benefits from funding would be those with working careers "centered" on this period (roughly 2020). Given that trust funds are projected as roughly 8 percent of the capital stock at this time, and assuming that capital's share of output is 0.3, funding would increase output by some 2.4 percent relative to a tax adjustment policy. About 0.7 of this increase, or 1.6 percent of output would manifest itself in higher earnings. A policy built on a combination of partial funding and future tax increases seems attractive in light of these findings.

NOTES

* Social Security Administration, and Social Security Administration and Brandeis University. The authors wish to thank John Hagens and Selig Lesnoy for constructive comments on an earlier draft. The views expressed are the authors' and do not necessarily represent the position of the Social Security Administration.

1 Esposito (1978) surveys the conflicting early time series evidence in this area. More recently, Leimer and Lesnoy (1980) reported that a previously undiscovered error in the data invalidated all prior time series estimates. Using a wide range of alternative constructions of the social security wealth variable, they found no empirical support for the hypothesis that social security has reduced saving historically. In a subsequent study, Feldstein (1980) reports that yet another construction does lend support to that hypothesis. The cross-section evidence is also inconclusive. For examples, see Blinder, Gordon, and Wise (1980), Feldstein and Pellechio (1979), and Kotlikoff (1979b).

2 Feldstein (1974), Kotlikoff (1979a).

3 Board of Trustees, Federal Old Age and Survivors Insurance and Disability Insurance Trust Funds (1980).

4 Myers (1978).

5 The general method underlying the actuarial projections is discussed in Bayo, Ritchie, and Faber (1978).

6 For example, see Denton, Spencer, and Feaver (1979).

7 Bayo, Ritchie, and Faber (1978).

8 The age- and sex-specific productivity weights are drawn from cross-section (Current Population Survey) average earnings data for employed workers.

9 Actually, the "wage-indexing" procedure adjusts for changes in average first-quarter earnings for workers in OASI covered employment. A more complete discussion of the benefit structure provisions is given in Snee and Ross (1978).

10 The retirement eligibility and "retiring" rates are derived from the social security actuarial projections under two additional assumptions: (i) workers attain eligibility for retirement benefits by age 62, if at all; and (ii) individuals remain retired once retired.

11 This assumption is unlikely to hold strictly in the future due to changes in the distribution of benefit awards relative to the indexing adjustments in the benefit formula. Since this effect is of secondary importance in the present application, the simulation of such distributional effects is deferred to subsequent revisions of the model.

[12] These proportions are assumed to follow the social security actuarial projections through 1990; thereafter, the employee and employer proportions are projected to be relatively constant, while the proportion for self-employment income is projected to decline by about a fourth through 2050.

[13] The saving propensities in equation (17) are estimated from the 1972-73 Consumer Expenditure Survey.

[14] To account for the declining present value of consumption in distant years, e_a is estimated by the formula: $e_a = \Sigma\ (1+r_i)^{-i}\ (S_{a+i}/S_a)$, where S_a is the probability of survival to age a and r is the individual's discount rate. A value of 2.5 percent was used for r in these simulations.

[15] Leimer and Lesnoy (1980) report coefficients of net social security wealth ranging from -.006 to .012 in consumer expenditure functions estimated for the period 1930-74 using a wide array of alternative social security wealth time series. While none of these coefficient estimates is significantly different than zero, this range implies values of ψ from 1.1 to 0.8. (Our simulations indicate that the discounted life expectancy of the average holder of net social security wealth is about 16 years, implying induced consumption of roughly 6 percent of net social security wealth if there is no offsetting change in private transfers.) More recently, Feldstein (1980) has reported estimated coefficients of social security wealth as high as .018, suggesting a value of about 0.7 for ψ.

[16] For examples, see Blinder, Gordon, and Wise (1980), Feldstein and Pellechio (1979), and Kotlikoff (1979b).

[17] Marginal changes in the lifetime mix of consumption and leisure induced by changes in social security wealth should not affect a comprehensive index of lifetime welfare--at the margin, goods and leisure are likely to be valued at market prices. Nor should the indirect welfare effects of capital formation depend on the cause of the saving offset. From the viewpoint of the welfare calculations presented in Sections 6 and 7, the main difference between the two offset hypotheses is that some portion of the direct social security transfers should be ignored in a Barro-type world but not in a world of strong retirement effects.

[18] For an especially authoritative list, see Advisory Council on Social Security (1979).

[19] The trust funds would amount to 7.5 percent of the economy's total capital stock in the year 2019.

[20] There are simple theoretical reasons for expecting the rate of return to pay-as-you go social security to equal the economy's growth rate, as demonstrated, for example, by Samuelson (1958) and Aaron (1966).

[21] Specifically, the consumption shares are estimated from the 1972-73 Consumer Expenditure Survey.

22 Total net returns to capital differed very little across scenarios, even though the capital stock levels did. Essentially, the additional profits generated by larger stocks were offset by additional depreciation expenses. In a Cobb-Douglas function, this occurs when $K/Y > (1-a)^2/d$, where K/Y is the capital output ratio, a is labor's share, and d is the depreciation rate. With the parameter values used in this study, the critical value of K/Y is about 3.8. The policy rankings were also insensitive to the discount rate used to calculate lifetime wealth, given a rate in the 2.5-3.5 percent range typically used to represent the private discount rate.

23 For alternatives, see Arrow (1973) on a Rawlsian approach, and Browning (1973) for a more libertarian analysis.

24 For each scenario, we simply extrapolated the rate of change of wealth across cohorts born during the 1990-2000 decade to estimate the wealth of still later cohorts.

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