THE EFFECTS OF SOCIAL SECURITY REFORM ON SAVING, INVESTMENT, AND THE LEVEL AND DISTRIBUTION OF WORKER WELL-BEING

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The Effects of Social Security Reform on Saving, Investment, and the Level and Distribution of Worker Well-Being

by

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Abstract

All observers agree that Social Security reform is needed restore the program's solvency. This paper examines the impact of alternative reforms on Social Security finances, on the wider U.S. economy, and on workers who contribute to and receive benefits from the program. In one reform we consider, Social Security benefits are eventually reduced about one-third so that benefits can be financed with the present 12.4 percent payroll tax rate. Workers are required to contribute an additional 2 percent of their wages to a new defined-contribution pension. We embed Social Security's finances in a neoclassical growth model and show how additions to Social Security and defined-contribution pension reserves, if they are saved, can increase the future growth of productivity and wages and reduce the rate of return on capital. These economy-wide impacts in turn affect the lifetime wages and pensions of workers born in successive generations. They have differing effects on workers depending on workers' relative earnings and the trend in their earnings over their careers. Our model includes a microsimulation component to measure these effects on individual workers. Our findings suggest that scaling back traditional Social Security and replacing part or all of it with defined-contribution pensions can potentially increase national saving over a very lengthy horizon, thus lifting the domestic capital stock and wages. The potential benefits are larger for high-wage workers than for average- and low-wage workers. Because of the potential impact of this reform on the U.S. capital-labor ratio, real capital returns might be adversely affected by this reform, reducing the rate of return workers will obtain in their defined-contribution pension accounts. Our results also imply that generations which will retire before about 2035 would enjoy higher lifetime pensions and net incomes under a policy that maintains Social Security benefits with tax hikes. That is, generations that will retire over the next 30 or 40 years would be better off under a policy that preserves Social Security through tax hikes than under a policy that scales back benefits and partially replaces them with benefits from a new defined-contribution system.

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1. Introduction and Summary

THE AMERICAN SOCIAL SECURITY SYSTEM does not have enough resources to pay for all benefits promised under current law. The imbalance between resources and promised benefits has brought repeated calls to supplement or replace the program with a new system based on individual retirement accounts. In addition to or instead of contributing to Social Security, workers would be required to build up retirement savings in individually owned and directed private accounts. Workers would be free to decide how their contributions are invested, at least within broad limits. They would then withdraw funds from their accounts when they reached the retirement age. To assure that retired workers do not out-live their retirement savings, some or all of the funds in workers' accounts would be converted into annuities when they retire.

Supporters of this kind of reform point to three potential advantages of individual accounts over traditional Social Security. If workers were permitted to invest their retirement savings as they choose, many would obtain welfare gains by investing in portfolios tailored to their individual taste for financial market risk. Workers enrolled in a collective retirement system such as Social Security are obliged to accept the portfolio choices of that system. Even more important, advocates of individual accounts argue that workers would receive larger pensions and the overall economy would grow faster under their preferred retirement system. Pensions would be larger, it is claimed, because savings in individual accounts can obtain the market rate of return on capital. In contrast, contributions to a pay-as-you-go defined-benefit pension system can ultimately deliver a return that is ultimately defined by the economy-wide growth of taxable wages, a rate that is now significantly less than the return on capital. Finally, proponents of individual accounts believe the economy will grow faster under their preferred system because advance funding of pensions in individual accounts must boost saving more than pay-as-you-go financing of Social Security benefits.

Critics of individual accounts are skeptical of these arguments. Many are also concerned that such accounts would reduce the nation's commitment to protect the incomes of low-income retirees and would expose low- and middle-income workers to excessive financial market risk.

In this paper we develop a macroeconomic and micro-level model of the U.S. economy to evaluate the effects of alternative Social Security reforms on economic growth and workers' well-being. The macroeconomic model can be used to assess the impacts of various reforms on saving, investment, and economic growth. Furthermore, using actual lifetime earnings information for Social-Security-covered workers born between 1931 and 1960, we construct standardized earnings profiles for a handful of representative American workers. Our stylized earnings profiles are constructed to reflect the experiences of a wide range of future workers, who differ from one another both in terms of their relative lifetime earnings and the pattern of earnings growth over their careers. With information on the lifetime pattern of individual earnings, we can predict the pension benefits to which workers' will become entitled under alternative reforms. This permits us to calculate lifetime net incomes, pension replacement rates, and internal rates of return on pension contributions under a variety of alternative reforms, including proposals to scale back Social Security benefits and replace them with pensions earned in defined-contribution retirement accounts. Equally important, the microeconomic component of the model allows us to compare the effects of alternative reforms on workers who have low, average, and high lifetime earnings. We can assess the comparative effect of individual retirement accounts on high- and low-wage workers to see whether the expected gains for high-wage workers are matched by those received by low-wage workers.

We do not consider the utility gains that workers could obtain if they were free to invest their retirement savings as they choose, nor do we evaluate the welfare consequences that would result from the change in financial risks surrounding workers' retirement incomes. Instead, we examine the impact of reform on aggregate pension fund saving and the consequences of this saving on the U.S. capital stock and foreign investment holdings, on productivity and real wages, and on the rate of return earned by U.S. savers. All of these effects can be analyzed in the framework of the standard neoclassical growth model that we developed for this exercise. The impacts of reform on saving, investment, and growth in turn affect the lifetime wages and pensions earned by different generations and classes of workers. The impacts will vary

depending on the details of reform and the career path of a worker's predicted earnings, and they are examined within the microsimulation component of the model.

We focus on three alternative reforms that would make the Social Security system solvent in the long run. In the first, Social Security benefits are maintained at their current level and payroll taxes are periodically raised whenever Trust Fund reserves reach a dangerously low level. The long-term goal of the reform is to assure the solvency of the Trust Fund by attempting to hold enough reserves to finance at least one year's benefit payments. In the second reform, Social Security payroll taxes are increased by 2 percentage points in 2000, well in advance of the year taxes would have to rise to prevent the Trust Fund from reaching a dangerously low level. Under this reform, too, the current Social Security benefit formula is preserved, but the Trust Fund accumulates much more reserves than it does under the first reform. In the third reform, the Social Security tax rate is maintained at the current level and benefits are reduced whenever necessary to keep the Trust Fund from falling below one year's benefit payments. However, future Social Security benefits are supplemented with pensions financed out of new defined-contribution retirement accounts. The pension is financed with a new 2-percent contribution out of Social-Security-taxable earnings, and savings in these accounts are invested in a portfolio consisting of 70 percent corporate equities and 30 percent U.S. government bonds.

These reforms are evaluated first within a static analysis where the changes in the Social Security trust fund balance have not effect on saving, capital formation and future incomes; and second within a dynamic framework where the accumulation of retirement saving alters the future course of capital formation and economic growth. The basic macroeconomic growth model is outlined in section 2. The framework for the distributional analysis with its focus on a small set of representative age-earnings profiles is presented in section 3. With these earnings profiles and survival probabilities, we can calculate the future pension under the existing Social Security formula and a variety of reform proposals, including individual accounts. The microeconomic portion of the model also computes replacement rates and internal rates of return. The microeconomic simulation model is used in section 4 to evaluate the three reforms in a static context of no feedback effects from induced changes in the aggregate economy.

Finally, a full dynamic simulation in which the pension reforms lead to changes in national saving is presented in sections 5 through 7. Section 5 considers the implications of reform when the increment to national saving is invested domestically. Section 6 incorporates an additional reform of allowing a portion the trust fund reserves to be invested in equities. Section 7 reports on the results of a simulation in which the increment to national saving is invested abroad.

Some of our main findings can be summarized briefly:

- To maintain the existing benefit formula under the current assumptions of the Social Security Trustees (static analysis), payroll taxes must rise 5.5 percentage points (44 percent) by 2075, with the largest portion of the increases coming between 2020 and 2030.

- If the payroll tax is increased by 2 percentage points in 2000, the remaining part of the necessary tax increase can be deferred until much later in the century. This follows from the fact that an immediate tax increase generates a bigger expansion in the peak Trust Fund accumulation, allowing a much larger percentage of future Social Security benefits to be financed out of interest earnings on the Trust Fund. The ultimate size of the needed tax increase is the same, however, regardless of whether payroll taxes are first hiked in 2000 or 2020.

- If the existing payroll tax rate is not increased, benefits must be cut more than one-quarter by 2035 and almost one-third by 2075.

- Under our third option, level real pensions financed out of a 2-percent defined-contribution account would replace *part* of the lost Social Security benefits for low-wage workers and *all* of lost Social Security benefits for high-wage workers. In fact, high-wage workers would ultimately receive DC pensions that are larger than the losses in Social Security benefits they sustain if Social Security benefits are cut by an equal proportional amount for all workers. However, low-wage workers would receive DC pensions that are smaller than the reduction in Social Security benefits. The largest net losses in retirement income would occur for low-wage workers who earn most of their labor income late in their career.

- The internal rate of return on Social Security contributions will fall in the future for all classes of workers, even in the absence of any change in the tax rate or benefit formula; but the reforms we consider will further reduce those returns. Even taking account of the returns workers obtain on contributions to their DC pension accounts, the combined returns under the third reform are lower than with current law.

- The *slowest* decline in internal real returns occurs under the reform plan that defers tax increases until they are absolutely needed to prevent the Trust Fund from falling to zero. The *fastest* decline in returns occurs under the plan that adjusts benefits to keep Social

Security solvent and introduces a new DC pension plan. The decline is fastest under this plan because workers who retire in the near future are subject to the benefit cuts; yet until the DC pension is fully mature, it provides relatively small pensions.

- In the distant future, the plan that combines lower Social Security pensions with a new DC pension offers the highest rate of return to most contributors, although not to low-wage and some average-wage workers.

- An important reason that the plan providing smaller Social Security benefits and new DC pensions initially offers such poor returns is that workers are required to purchase level real annuities when they retire. We assume that workers cannot purchase such annuities unless the company that offers the annuities invests in a very safe asset – and obtains the riskless rate of return. Thus, even though workers earn the equity rate of return on their DC savings when they are at work, they must accept a lower rate of return after they retire. Because improved longevity lengthens the expected duration of life after retirement, later generations must accept this low return for progressively larger fractions of their life

The findings described so far are based on accepting all of the economic and demographic assumptions of the Social Security Trustees. If instead we assume that additions to the reserves of the Social Security and DC pension systems increase national saving, the outlook changes significantly. Higher saving boosts future national income. If invested in the United States, extra saving increases the rate of capital formation, worker productivity, and real wages but reduces the rate of return on U.S. business capital. The conclusions we describe below follow from assuming that Social Security reform affects national saving by the annual amount of change in the Trust Fund and DC pension reserves.

- The most sustained and largest change in annual saving occurs under the plan that reduces Social Security benefits and establishes a new DC pension system. Even at the end of the twenty-first century, this plan adds almost one-half percentage point annually to the share of national income that is saved. Because the other two plans ultimately finance Social Security pensions with a pay-as-you-go tax rate, they eventually contribute only modestly to saving. Only in the first half of the century, when the Trust Fund grows rapidly, do the other plans add noticeably to the overall saving rate.

- Because the Social-Security-benefit-cut / DC-pension plan adds most to saving, it also adds most to national income growth. If the extra saving is invested domestically, the plan eventually boosts average pre- and post-tax wages more than the other plans.

- Perhaps surprisingly, retirement incomes are ultimately lower under the third plan than under the other two, particularly for average- and below-average wage workers. This is partly because of the large required cuts in Social Security benefits, but it is also the effect of a depressed rate of return when additions to saving are invested domestically.

A lower rate of return sharply reduces the benefits workers obtain under DC pensions. When additions to saving are invested solely in the United States, the induced change in the market rate of return depresses the rate of return that workers under the Social-Security-benefit-cut / DC-pension plan receive on their pension contributions. Ironically, the plan ultimately delivers the *lowest* rate of return of any of the plans we consider, even though it delivers the highest lifetime income for most workers who retire after 2060.

- The reform plan that boosts payroll taxes in 2000 and periodically in later years to protect the current Social Security formula does the best job of improving lifetime incomes of workers who retire before about 2035. By boosting saving in the near term, the plan raises economy-wide wages and Social Security pensions. Since workers' Social Security pensions do not depend on directly on capital market rate of return, their retirement incomes are improved rather than hurt by capital deepening.

- The improvement in well-being of workers who retire before 2035 under the plans that raise taxes in order to preserve Social Security benefits is achieved in part at the expense of later generations. Workers who retire in 2030, for example, obtain higher net wages as a result of capital deepening. The improvement in their real wages causes their Social Security benefits to increase. To finance the improvement in benefits, the Trust Fund is eventually run down, reducing national saving below what it would otherwise be. The earlier increases in national saving boost this generation's gross and net wages while it is at work, and the later reductions in saving help protect its real pensions when it is old. Generations that retire in later years cannot obtain such a favorable combination of increased wages and improved retirement benefits. They must pay higher payroll tax rates while at work to protect the solvency of Social Security (and the real benefits flowing to workers who are already retired).

- Somewhat surprisingly, a policy of investing the additions to pension fund reserves offers modest improvements to the financial position of Social Security. The rise in wages raises tax receipts in the short run, but they are followed by a delayed, but proportionate increase in benefit payments. Meanwhile, the capital deepening reduces the interest on the trust fund balance. The result is little or no change in the timing of the tax increases or benefit cuts.

- The outlook for Social Security would look more favorable – and the increase in the Trust Fund would be much larger – if Social Security reserves were invested in equities as well as in Treasury bonds. If 30 percent of reserves were invested in equities, for example, an increase in the payroll tax above 14.4 percent could be postponed 16 years (from 2055 to 2071). If 70 percent of reserves were invested in equities, the increase in tax rates could be postponed 53 years (from 2055 to 2108).

- The larger accumulation of Social Security reserves under the policy of investing in equities would lift national saving much more than would a policy of investing reserves exclusively in Treasury bonds. The resulting increases in investment and national income would be even larger than those achieved under a policy of reduced Social

Security benefits and new DC pensions. If all of the increase in saving were domestically invested, wages would rise and the return earned on capital investment would fall.

- The outlook under all the reform plans is dramatically altered if a substantial share of the increase in national saving can be invested in other countries. In the context of a large global economy, an increase in U.S. saving would lead to a smaller decline in the rate of return on capital. While this scenario is less favorable to U.S. workers, who enjoy smaller improvements in wages and Social Security pensions, it more advantageous for U.S. savers, who do not suffer such a large drop in the rate of return. If American workers are required to become savers, as contributors to new DC pension plans, they benefit from higher returns on their pension contributions. Thus, the option of investing increased saving overseas is more important to workers if they participate in DC pensions than if they receive most of their retirement income from Social Security.

- Finally, the analysis clearly indicates the problems of relying on single measures such as the rate of return on contributions or the pension replacement rate to evaluate the various reform proposals. It is often the case that a policy that offers the highest benefits to Americans as a whole implies a low rate of return on pension contributions.

2. Macroeconomic Simulation Model

Social Security reform can affect national saving and hence the growth of aggregate output. In addition, it can affect the level and distribution of pension contributions and benefits. To assess these two effects of reform we have developed a forecasting model containing both an aggregate growth model and a microsimulation model.

The macroeconomic model. We evaluate the macroeconomic effects of reform using a small simulation growth model calibrated to match the 75-year economic and demographic forecasts of the Social Security Trustees.[1] At the core of the model is a Cobb-Douglas production function for the nonfarm business sector. Under the assumptions of this model, capital (*K*) and labor (*L*) are combined in period *t* to produce total output (*Y*),

$$(1) \quad Y_t = A(t) K_t^{\alpha} L_t^{1-\alpha},$$

and where *A(t)* is an efficiency parameter that rises from year to year as a result of technical progress. Capital's share is set at 0.28 on the basis of historical data from the national income and product accounts. Labor supply is assumed fixed at the future annual levels specified in Social Security Trustees' intermediate projections. The capital stock is calculated from information published by the Department of Commerce and projected as the cumulative sum of investment, *I*, with a constant geometric rate of depreciation, δ:

$$(2) \quad K_t = (1 - \delta) K_{t-1} + I_t .$$

The compensation rate for labor, *w*, and the gross rate of return on capital, *r*, are determined by the marginal conditions --

$$(3) \quad w = \partial Y / \partial L = (1-\alpha)(Y/L),$$

$$(4) \quad r = \partial Y / \partial K = \alpha (Y/K).$$

The rate of interest on government bonds and the equity rate of return are both tied to movements in *r* by equating a weighted average of the bond and equity yield with the rate of

[1] The structure of the model is very similar to the one developed in Aaron, Bosworth, and Burtless (1989).

return on capital for nonfinancial corporations.[2] We assume a 75-25 split between debt and equity. In addition, the rate of return is scaled down to reflect the after-tax return reported for nonfinancial corporations.[3]

$$(5)\quad .75\, r_e + .25\, r_b \;=\; .75\,(1-\tau)\, r,$$

where τ equals the corporate tax rate. At the margin, we assume that the financial market rates move proportionately with a smoothed measure of the after-tax rate of return on capital.

At least initially, overall rates of net saving in the government (S_g) and private (S_p) sectors are set exogenously. For the public sector, we distinguish between net saving in the Social Security system and in other budgetary accounts. In addition, in some of the following analyses we examine the impact of net saving in new defined-contribution pension accounts (S_{dc}). For convenience, we treat the net saving in these accounts as part of saving in the government sector, but they could equally well be viewed as an element of private saving.

Investment is divided between domestic (I_D) and foreign investment (I_F), and the domestic investment is further disaggregated among government, housing, inventories, short-lived computer equipment, and other business capital. Thus,

$$(6)\quad I_D + I_F \equiv S_g + S_p + S_{dc} + Dep,$$

where *Dep* represents capital depreciation. If the United States were a closed economy, I_F would be zero by definition. Annual additions to the U.S. capital stock could be calculated simply from knowledge of *S*. In an open economy, I_F can be positive or negative depending on whether the nation runs a current account surplus or deficit. In the following analysis we use two

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[2] The data for nonfinancial corporations are taken from Board of Governors of the Federal Reserve, *Flow of Funds Accounts of the United States*, table B102.

[3] Profits as reported in the national accounts and used in our model refer to earnings from domestic operations, but the stock market valuations of U.S. companies also reflect their overseas operations. We should emphasize that it is difficult to find a link in the historical data between changes in the rate of return on real capital and the financial market rate of return. For a discussion, see Poterba (1998) and Howe and Pigott (1992).

alternative and extreme assumptions about the impact of a *change* in net national saving from the baseline amount assumed in our model. Under one assumption, all of an increment to national saving flows into domestic capital; under the alternative assumption, the increment to saving is entirely invested abroad. It is important to note that the change in the saving rate is modeled in net terms so that it is not dissipated over time by an increase in depreciation charges.

Under our baseline assumptions about future saving and investment, the growth of the business capital stock parallels that of output, yielding a constant return to capital. The result is a domestic rate of investment that declines moderately as labor force growth slows in the future, reducing the demand for capital. In order for the rate of return to remain unchanged, the net national saving rate in our baseline model of the economy must drift down from about 5 percent in the 1990s to about 3 percent in 2020 and thereafter.[4]

The properties of the model can be illustrated by considering a simple change in net national saving from the path assumed under our baseline assumptions. Table 1 shows the impact of an increase in the net saving rate equal to one percent of net national product (NNP) that begins in the year 2000 and is maintained throughout the 75-year simulation period. In this simulation we assume that all of the extra saving is invested domestically; none is invested overseas. At the margin, the additional saving flows mainly into the business sector. The amount of capital services that enters into the production function rises by about one percent in the first year and steadily builds up to a 25-percent increase after 25 years and a 68-percent increase after 75 years. Since there are diminishing returns, the increases in GDP are smaller. Real GDP is 5 percent larger than in the baseline after 25 years and 12 percent larger by 2075. Much of the increase in gross output must be devoted to offsetting the higher rate of depreciation on a larger capital stock. Thus, the gain to NNP – gross national product minus capital depreciation – is just 3 percent in 2025 and 7 percent in 2075. The increased saving implies a lower level of consumption in the first 10 years, but real consumption is 1.5 percent above the baseline by 2025 and 5 percent higher in 2075. The most striking feature of the macroeconomic

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[4] In the intermediate projections of the Trustees' Report, the growth of the labor force slows from an annual rate of 1.5 percent between 1975 and 2000 to 0.1 percent from 2050 to 2075. Real GDP growth declines from an annual rate of 2.7 percent to 1.2 percent between the same two periods. The slowing of labor force growth requires a decline in the rate of domestic investment and saving if the real rate of interest is to remain the same, as assumed in the Trustees' projections.

response to higher saving is the sharp decline in the return to capital. The rate of return declines one-fifth after 25 years and nearly one-half after 75 years. This decline follows directly from the substantial rise in the ratio of the capital inputs to output. The drop in returns implies a very large redistribution of income from capital to labor. The real wage increases 15 percent above its baseline level by 2075.

Social Security finances. Our model of the economy includes a set of equations predicting future revenues and outlays of the Social Security system. Social Security revenues consist of payroll taxes, the income taxes levied on OASDI benefit payments, and the interest earnings of the Trust Fund. The tax rates and number of beneficiaries are determined exogenously and match the intermediate projections of the OASDI Trustees. The average OASDI benefit payment is a weighted average of the benefit paid to each surviving cohort of pensioners. For each cohort the average real benefit is a function of the economy-wide average wage when the cohort reaches age 60. The cohort weights are set exogenously to match the population projections of the Social Security Trustees, but our predictions of average real benefits received by each cohort reflect past changes in the average real wage, which is determined within the model (see equation 3 above). The Trust Fund reserve is simply the cumulative sum of past revenues (including interest earnings) less program outlays.

While our baseline predictions of future taxes, benefit payments, and Trust Fund reserves match the projections of the OASDI Trustees, those projections are themselves unrealistic. They are based on the implicit but dubious assumption that large future deficits of the OASDI program will be financed indefinitely out of other accounts of the federal government. We assume this means future Social Security deficits will be matched by offsetting surpluses in the non-OASDI accounts in order to achieve a constant saving rate in the government sector equal to zero percent of NNP. (In other words, we assume in our baseline projections that starting in 1999 the overall deficit of the government will be negligible over the forecast period.) Our choice of a baseline government saving rate has only minor implications for our evaluation of alternative policy changes.

The effect of an increase in the aggregate saving rate on Social Security finances is illustrated in Table 1. As noted above, a higher saving rate increases the pace of real wage growth. An increase in the level of real wages gives rise to a nearly equivalent percentage rise in

tax revenues and, with a substantial lag, to a proportionate increase in real benefits (see lower panel of Table 1). Because the rise in taxes precedes the growth in benefit payments, the Trust Fund balance is improved. Even though interest rates are reduced as the rate of return on capital declines, the larger Trust Fund reserve produces a large and growing increase in OASDI interest revenues. After 50 years, the gain in interest income is more important than the addition to payroll taxes as a source of additional OASDI revenues. The relative importance of rising interest income grows rapidly thereafter. Clearly, higher national saving and faster economic growth have beneficial consequences on Social Security finances.

3. Distributional Analysis

To analyze the impact of reform on individual workers and on cohorts of workers who retire in future years, it is necessary to describe what these workers will earn at successive ages during their careers. The distributional analysis in this paper is based on a set of stylized age-earnings profiles representing a range of career earnings experiences. The specific earnings profiles we examine were derived from our statistical analysis of data from the 1990-1993 Survey of Income and Program Participation (SIPP) panels matched to Social Security earnings records (SSER). The SSER records contain information on Social-Security-covered earnings by calendar year for the period from 1951 through 1996.[5] Our estimates of the stylized age-earnings profiles are based on the experiences of workers born between 1931 and 1940. The careers of most workers in these birth cohorts were substantially completed by 1996, which is the last year for which we have actual data from the Social Security administrative records. We have nearly complete career earnings information for this sample, and we can thus reliably classify workers by their observed earnings. The sample includes all workers with at least one year of Social-Security-covered earnings.

Age-earnings profiles. Figure 1 shows the average age-earnings profile for all members of this sample and the profiles for men and women separately. We measure earnings at each age in relation to that year's economy-wide average wage as estimated by the Social Security Administration. For example, Figure 1 shows that men earned 50 percent of the economy-wide wage when they were 22 years old and earned 138 percent of the average wage when they were 40. (These estimates include as zeroes the earnings of men who had no Social-Security-covered wages at the indicated ages.) The age-earnings profiles displayed in Figure 1 generally mirror the hump-shaped pattern of earnings observed in cross-sectional surveys of earners. There is a clear pattern of rising earnings until workers reach middle age and then a gradual decline through

[5] These records do not contain information about *all* labor earnings, but only on earnings up to the taxable wage ceiling. In order to adjust for this censoring of earnings, we created, for all individuals with covered earnings at the taxable maximum, estimates of "expected earnings" above the taxable maximum but below a hypothetical ceiling that is equal to the 1990-96 average taxable maximum (about 2.5 times the economy-wide average wage). Thus, the revised historical earnings series reflects a consistent degree of censoring for all years from 1951 through 1996. The stylized earnings estimates used in this paper reflect earnings that would be subject to Social Security payroll taxes under current law. See Bosworth et al. (1999).

the retirement age. The matched SIPP-SSER data suggest that men born between 1931 and 1940 saw their earnings reach a peak comparatively early in their work life, around ages 38-42, while women's earnings reached a peak considerably later, between ages 50-55. Not surprisingly, both the peak and average level of men's earnings are substantially higher than those of women. Our empirical analysis suggests, however, that the male-female lifetime earnings gap narrowed significantly for cohorts born after 1940.

Our classification of workers' earnings patterns focuses on two characteristics of the time path of their earnings: (1) The average earnings *level*, which is simply the career average of the worker's relative earnings; and (2) The *trend* in earnings, which captures the direction and magnitude of change in relative earnings between early and later decades of the worker's career. Individuals are classified into nine categories based on the level of their relative earnings (low, middle, or high) and the trend in their earnings (declining, level, or rising).[6] For purposes of calculating workers' retirement benefits under the current Social Security formula, it is enough to know the level of their lifetime wages (specifically, the highest 35 years of indexed earnings). On the other hand, the trend or time path of earnings has a major impact on benefits under a defined-contribution (DC) pension plan. Contributions into a DC account in the early years of a worker's career earn investment returns over a longer period, providing a larger pension per dollar contributed than contributions made late in the career.

In order to classify workers according to the trend in their earnings, we divide each worker's 30-year career between ages 32 and 61 into three 10-year subperiods -- ages 32-41, 42-51, and 52-61. For each of these subperiods we calculate the worker's "average relative earnings." (Our classification ignores a worker's earnings for ages before age 32, because nearly all workers have low but sharply rising earnings early in their careers. Many workers have very low earnings while they are in their twenties because they are still in school.) The 10-year average wage is the unweighted average of the worker's relative earnings in each of the ten years of a subperiod.

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[6] The original analysis was done as part of a larger study that also considered earnings in other age cohorts and evaluated more complicated classification schemes for categorizing age-earnings profiles.

We define the trend of a worker's lifetime earnings as follows. Suppose a worker's "average relative earnings" in the three 10-year subperiods are labeled A, B, and C, where A represents average earnings between 32 and 41, B represents average earnings between 42 and 51, and C represents average earnings between 52 and 61. The *trend* is computed as:

(7) $t = (C-A) / (C+A);$

After measuring *t* for a worker, we classified the worker in one of three trend groups using the following scheme:

(8) "Declining": $t < -1/9$
"Level": $-1/9 < t < 1/9$
"Rising": $t > 1/9$.[7]

This classification scheme produced three groups of workers of unequal size. Workers with declining and rising earnings patterns are more common than workers with comparatively flat earnings profiles (see below).

The average earnings *level* is simply the 30-year average of the worker's relative earnings between ages 32 and 61. We divided workers into three equal-sized level groups according to the average of their lifetime Social-Security-covered annual earnings. The cutoffs for the earnings level categories were 0.37 and 1.04 of the average wage. Workers with lifetime wages less than 0.37 times the economy-wide average wage were classified as "low" earners; workers with wages greater than 1.04 times the economy-wide wage were classified as "high" earners. Remaining workers were classified as "average" earners. It may seem surprising that the cutoff point for a "high" earnings worker is so close to the economy-wide average wage. The economy-wide wage for a given year is calculated by the Social Security Administration is based on sources other than the earnings records. It excludes individuals who did not work during the year, and the underlying earnings are not truncated at the taxable ceiling. In contrast, our tabulations include the zero earnings amounts of workers who are temporarily jobless or working outside of Social Security covered employment.

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[7] Our methodology is adapted from work by Herman Grundman and Barry Bye of the Social Security Administration. Their methodology is described Committee on Finance, U.S. Senate, and the Committee on Ways and Means, U.S. House of Representatives (1976).

The characteristic hump-shaped pattern of lifetime earnings displayed in Figure 1 masks a remarkable degree of diversity in the underlying experiences of individual workers. This diversity is highlighted in Figure 2, which shows the average age-earnings profiles of the nine classes of workers just defined. The charts at the top of the figure show earnings profiles of workers with low lifetime earnings; the charts in the middle show profiles of workers with average earnings; and the charts at the bottom show profiles of high-wage workers. Note that the scales of the *y*-axes in the graphs have been adjusted to permit easier inspection of details of the earnings profiles. We show the percentage distribution of workers across earnings classes at the bottom of the figure (for the entire sample) and in Table 2 (for men and women separately). These tabulations show that men have significantly higher career earnings than women, although men are much more likely to have a pattern of declining earnings over their work life. The main explanation for the big earnings gap between men and women is the difference in their frequency distributions across the earnings classes. Fifty-nine percent of men are in the "high" earnings categories, whereas 54 percent of women are in the "low" earnings categories. For the most part, the age profiles of earnings *within* an earnings class are quite similar for men and women in the class. Only in two of the lowest earnings profiles do we see noticeable differences between earnings patterns for men and for women.[8] In order to simplify the exposition of this paper, we therefore decided to collapse the separate male and female earnings profiles into the nine profiles displayed in Figure 2.[9]

In part the diversity of the earnings patterns in Figure 2 is the result of differential patterns of labor force withdrawal over workers' careers. There are wide differences in the frequency of nonemployment across the nine earnings profiles. For the low-earnings groups, the proportion of workers with zero earnings at a specific age ranged from a low of 20 percent to over 80 percent between the ages of 22 to 61. The average rate of nonemployment over a 40-year career was above 50 percent in the low-earnings groups. In contrast, the high-wage earners

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[8] In both the "low and declining" and "low and level" categories, men have noticeably higher earnings early in their careers. Additional details are provided in Toder et al. (1999), Chapter 8, and Bosworth et al. (1999).

[9] The analysis obviously can be extended to consider 18 earnings profiles – 9 for women and 9 for men. In addition, it can also be extended to consider more complicated classification schemes, such as those considered in Toder et al. (1999). These extensions would lengthen the paper without shedding extra light on the main issues we consider here, however.

are notable for the stability of their employment rates. The employment rate in the high-wage groups was typically over 90 percent at any given age. Rates of nonemployment were much higher among women than among men, but the rates of nonparticipation were very similar within each earnings category.

The tabulations we have described reflect the experiences of workers born between 1931 and 1940. We have also tabulated the career earnings of workers born between 1921 and 1930 as well as the actual and predicted career earnings of workers born from 1941 to 1960.[10] The frequency distributions of workers across earnings categories are displayed in Table 2. For workers born in 1921-1930, both the shapes of the profiles and the frequency distribution of workers among the earnings classes are virtually identical to those for the 1931-1940 cohort. Our earnings forecasts for the 1941-1960 cohorts imply that there will be large offsetting shifts in the distributions of men and women across the nine stylized earnings categories. They imply, for example, that there will be a sharp increase in the proportion of women in the top third of the lifetime earnings distribution. The proportion is predicted to rise from 10 percent of female earners in the 1931-1940 birth cohort to 22 percent of women in the 1951-1960 cohort. This improvement for women is exactly counterbalanced by a declining percentage of men in the highest earnings category. That percentage falls from 59 percent of men in the 1931-1940 cohort to 47 percent of men in the 1951-1960 cohort. Our forecast also implies there will be a significant falloff in the proportion of workers who have a rising trend in their lifetime earnings. This latter result is especially pronounced among men. On the whole, however, the frequency distributions when we combine the male and female working populations change only modestly for the worker cohorts born after 1930.

In the remainder of this paper we base our individual-level analysis on the nine stylized age-earnings profiles which combine the profiles for men and women in the 1931-1940 birth cohorts (see Figure 2). The within-group variations in the earnings profiles across gender and age cohorts are too small to have major effects on our main conclusions. In addition, we sometimes perform our calculations using a composite age-earnings profile that combines the

[10] We make predictions of the prevalence of the different earnings patterns in younger cohorts by using forecasts of future earnings for workers in those cohorts. We then apply the same methodology used to

other nine profiles into a single profile (see the composite earnings profile for both sexes displayed in Figure 1). Our analysis focuses on workers' earnings between ages 22 and 61. Earnings before age 22 and after age 61 are ignored.

While our analysis is based on only a small number of stylized profiles, when properly weighted the profiles are representative of the actual distribution of earnings profiles observed in the American labor force. Most other distributional analyses are based on a much less representative sample of earnings patterns. For example, the Social Security Administration traditionally focuses on three or four illustrative workers who are assumed to have steady relative earnings throughout their careers. A recent Social Security Advisory Council assessed the potential impacts of alternative reform plans using calculations for four representative workers.[11] The workers were assumed to have lifetime earnings patterns corresponding to four levels of stable relative wages. The lowest wage worker earned roughly the minimum wage throughout his or her career; the second worker consistently earned wages corresponding to the economy-wide average wage; the third earned two-thirds of the maximum taxable wage; and the fourth received the maximum taxable wage throughout his or her career. Our use of profiles that are related directly to the bottom, middle, and top thirds of the lifetime earnings distribution provides a more accurate representation of the distributional consequences of policy reform.[12] In addition, for workers in defined-contribution retirement plans, differences in the trend of lifetime earnings can produce important differences in pension entitlements.

Future mortality. To estimate the value of retirement benefits it is necessary to know how long pensioners will live as well as how much they earn in each year they are at work. In the distributional analysis that follows we focus on those workers who survive until age 62, when they are assumed to claim a pension. After age 62 we use the Social Security Trustees' intermediate mortality assumptions to predict future survival rates. Because we focus on

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classify workers in the 1931-1940 birth cohorts to classify workers born between 1941 and 1960. For details about our earnings prediction methods see Bosworth et al. (1999).

[11] See Advisory Council on Social Security (1997), especially pp. 35 and 165-230.

[12] For a detailed comparison of our earnings profiles and those used in traditional Social Security distributional analysis as well as an assessment of the implications for policy evaluation, see Bosworth et al. (1999).

composite earnings patterns for both men and women, our survival probabilities also reflect the combined probabilities for men and women. Our calculations disregard the fact that survival probabilities may be higher for high-wage than for low-wage workers. Instead we assume that a common life table applies to all workers in a cohort, regardless of earnings pattern. Because of future improvements in longevity predicted under the Trustees' assumptions, the life table changes from one birth cohort to the next. Under the Trustees' assumptions, for example, people born in 1931 will have a 50 percent chance of surviving until age 77. In contrast, people born in 2013 (who will turn 62 in 2075) will have a 68 percent chance of surviving until age 77 and a 50 percent chance of surviving until age 84. The predicted improvement in life spans substantially increases the cost of pensions if the retirement age remains unchanged. All of our calculations take longevity improvements into account.

Value of pensions. Using our assumptions about the profile of lifetime earnings and future survival probabilities, it is straightforward to calculate the exact amount of future pensions under the existing Social Security formula and a variety of reformed formulas. Analysts have traditionally assessed the value of pensions in two different ways. The first is based on the concept of a pension "replacement rate." The replacement rate is simply the percentage of a worker's typical earnings that are replaced by the annual pension benefit. The Social Security Administration usually measures the replacement rate as the initial Old-Age pension divided by the worker's final wage. This measure makes sense under the maintained assumption that the worker has steady relative earnings throughout his career. It seems arbitrary when relative earnings vary widely over a career, as is the case for the great majority of workers. Our measure of the replacement rate is the real average pension during a worker's retirement divided by the real average wage over the worker's 40-year career.[13] Under current law, the average real pension during a worker's retirement is equal to the initial pension when the worker first claims a pension. Since Social Security pensions are annually adjusted in line with changes in the consumer price index, the real pension remains constant throughout retirement.

A second standard measure of the value of Social Security pensions is the internal real rate of return on contributions. To calculate the internal rate of return we must estimate each

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[13] We subtract the employee's Old-Age Insurance contributions from his gross wage in order to approximate the *net* real wage while the worker is employed.

worker's annual real contributions and expected annual real benefits. Our calculations pertain only to the Old-Age Insurance (OAI) pension. We ignore Disability Insurance and Survivors Insurance contributions and benefits in this paper. To calculate workers' annual OAI contributions, we have estimated the percentage of the OASDI payroll tax that is earmarked for Old-Age pensions. We assume, as most analysts do, that workers' contributions include both the employee and employer shares of the OAI tax. Workers' annual retirement benefits are assumed to begin at age 62, the earliest entitlement age for OAI pensions and the most common age at which benefits are claimed. Under our baseline assumptions, the initial real Social Security benefit remains unchanged until the worker dies.

Table 3 shows the replacement rates and internal rates of return available to workers who retire in 1995, 2015, and 2035. These indicators of Social Security's value are calculated for the nine earnings profiles described earlier and for the composite earnings profile that represents the weighted average of the other nine profiles. For each earnings profile, we have also calculated the level of the worker's lifetime wage in relationship to the average lifetime wage of every worker retiring in the same year (see the first column in the table). This calculation shows that high-wage workers typically earn about 10 times as much as low-wage workers and more than twice as much as middle-wage earners.

We calculated replacement rates and internal rates of return for 1995, 2015, and 2035, years that span the retirement of the Baby Boom generation. The oldest Baby Boomers will reach the early retirement age in 2006, while the youngest will turn 62 in 2026. Over this period the normal retirement age in Social Security will be increased gradually from 65 to 67. The increase in the normal retirement age reduces the early retirement pension available at age 62. Instead of receiving 80 percent of the full retirement pension (or PIA), 62-year-old pensioners will receive just 70 of a full pension when the two-year increase in the normal retirement age is fully implemented. Workers reaching 62 in 1995 face a normal retirement age of 65; workers turning 62 in 2015 face a normal retirement age of 66; and workers attaining 62 in 2035 face a normal retirement age of 67. Other things equal, we should expect the higher retirement age to reduce replacement rates and internal rates of return.

Although the tabulations in Table 3 show that the internal rate of return will shrink over time, they do not show the anticipated pattern of decline in replacement rates. The fall in the

internal rate of return is easily explained. Workers in later birth cohorts will pay substantially higher Social Security taxes over their careers. Workers who retired in 1995 faced a combined OASDI payroll tax of just 7.65 percent when they were 30 years old; workers who will retire in 2035 face a combined payroll tax of 12.4 percent at the same age. The increase in the payroll tax rate, which is inevitable when a pay-as-you-go pension program matures, pushes down the real return that workers can obtain on their contributions. Perhaps surprisingly, the replacement rate does not systematically decline for younger cohorts, in spite of the hike in the normal retirement age. The main reason is that the Social Security Trustees' projections assume future real earnings will rise faster and more steadily than has been the norm since 1973. In the quarter century after 1973, the economy-wide real wage barely increased at all. Under the Trustees' intermediate assumptions, average real wages after 2000 will increase about one percent a year. Under the Social Security benefit formula, this will push up real pensions claimed at the normal retirement age one percent a year. Thus, even though the increase in the normal retirement age will reduce the value of pensions claimed at age 62, the faster assumed growth in average wages will cause the normal-retirement-age pension to climb approximately enough to compensate workers for the higher normal retirement age. Replacement rates will decline only slightly between 1995 and 2035, and stabilize thereafter.[14]

The results clearly show the redistributive effects of the Social Security benefit formula, which provides low-wage workers much better pensions (relative to contributions) than those given to middle- and high-wage workers. Note that workers with rising earnings patterns tend to enjoy higher rates of return than workers with declining or level patterns. This follows from the fact that workers with increasing wages over their careers pay the bulk of their lifetime taxes toward the end of their careers, close to the time they begin to collect Social Security benefits.[15]

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[14] The replacement rate under current law is shown in more detail later in Figures 5 and 6.

[15] The advantage for workers with increasing career earnings is less pronounced for workers in the high-wage group who retired in 1995. This is because of the impact of the taxable wage ceiling on the early payroll tax contributions of high-wage workers. The taxable wage ceiling was very low in relation to average wages during the late 1950s and 1960s, a fact that was particularly advantageous for workers who had high wages during that era. This group would include high-career-earnings workers who retired in 1995 and had a pattern of level or declining lifetime earnings.

The baseline calculations substantially overstate future returns that workers can anticipate under Social Security. They are based on projections that unrealistically assume the Social Security Trust Fund will be able to borrow unlimited funds from the federal Treasury. It seems more likely that future Social Security benefits will have to be cut or payroll taxes increased in order to keep the program solvent. Either of those options will reduce future retirees' returns.

4. A Static Analysis of the Policy Alternatives

Most policymakers recognize that the Social Security system does not have enough resources to pay for all benefits promised under current law. The Trustees' intermediate assumptions imply the system will run out funds to pay for pensions around 2030. When that occurs, benefits must be reduced, payroll taxes increased, or funds borrowed from the rest of the government. The Trustees' long-term projections implicitly assume funds will be borrowed from the rest of government. No tax increases or benefit reductions except those prescribed by current law are included in the forecast. In this section, we evaluate the effects of several policy options that would restore the system's solvency, but the analysis is static in that we do not take account of the potential feedback effects through the impact of the policy changes on saving, capital formation, future wages, and tax revenues.

Three options to preserve solvency. In this section we consider three reform options that would keep the Social Security system solvent without borrowing funds from the U.S. Treasury. The first two involve tax increases, while the third assumes benefits will be scaled back and a new system of individual retirement accounts introduced.

Under the first option, Social Security payroll taxes are increased whenever the Trust Fund falls dangerously low. In particular, we begin to increase the combined employer-employee tax rate when the Trust Fund first falls below 200 percent of the previous year's OASDI outlays. (This occurs around 2020 in our baseline simulation.) Taxes continue to be increased until the Trust Fund is stabilized at about 100 percent of annual outlays.[16] In essence,

[16] After some experimentation, we increased the payroll tax by about 0.4 percentage points a year in order to keep the Trust Fund from falling below zero. The rate of annual tax increase was boosted whenever the Trust Fund fell below 100 percent of the previous year's outlays. We eliminated the

the payroll tax is modified periodically to keep Social Security a pay-as-you-go program with a reserve fund equal to 100 percent of the previous year's outlays. Since the current payroll tax in 2000 is substantially higher than the pay-as-you-go tax rate, the Social Security system accumulates a large and growing Trust Fund during the first decade after 2000. That Trust Fund accumulation is quickly used up after the Baby Boom generation starts retiring in 2010.

Our second approach to maintaining solvency incorporates a large initial increase in the tax rate in 2000, prefunding a larger portion of future retirement costs, and then raising the tax periodically in later years to maintain solvency. We assume the combined employer-employee payroll tax is increased from 12.4 percent to 14.4 percent in 2000, with additional increases in years after 2000 whenever the Trust Fund falls below 100 percent of the previous year's OASDI outlays. The extra accumulation caused by a 2-percentage-point increase in the payroll tax generates an enormous increase in the interest earnings of the Trust Fund, allowing a far higher percentage of future benefit payments to be financed out of interest earnings rather than additional tax increases. Eventually, however, even the 2-point rise in the payroll tax is not enough to keep the program solvent, and additional tax increases are needed.

Under our third approach to reform, Social Security benefit payments are periodically reduced to keep the system solvent, but the loss of retirement income is partially offset by introducing a new system of individual retirement accounts. As with option one, benefit cuts begin when the Trust Fund falls below 200 percent of the previous year's benefit payments, which occurs around 2020. Benefits are reduced by about 1.75 percent a year until the Trust Fund stabilizes with a reserve equal to about 100 percent of the previous year's outlays. After 2035 additional small benefit cuts are periodically needed to keep the system solvent.[17] Under the Trustees' intermediate assumptions, the benefit cut option requires a reduction in Social Security pensions equal to 25 percent of those promised under current law by 2035.

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possibility that payroll tax rates could ever decline after they had once been raised, so the Trust Fund can occasionally increase above 100 percent of previous year's outlays.

[17] The benefit cuts are imposed equally on all Social Security beneficiaries including those already on the roles. As with the tax increases, we assume that the benefit cuts are not reversed even if prior reductions generate temporary increases in the trust fund.

We assume this benefit reduction would be made up in part by the introduction of a new individual retirement account. Workers who are 56 years of age or younger in 2000 would be required to contribute 2 percent of their Social-Security-covered wages to these new accounts.[18] Although workers might be permitted to invest their contributions in a variety of funds, for purposes of this exercise we assume they maintain investment portfolios that are invested 70 percent in equities and 30 percent in Treasury bonds. At the age of 62 workers are assumed to retire and convert their retirement accumulations into a single-life annuity. We further assume the annuity is fixed in real terms and ceases upon the death of the retired worker. To calculate the real annuity payment, we use the intermediate mortality projections of the Social Security Actuary and assume that the insurance company selling the annuity expects to earn the real interest rate on U.S. government bonds. The insurance company is assumed to incur no administrative costs and to make no profit on the sale of annuities. While this is clearly unrealistic and understates likely annuity prices (and thus overstates annuity payments), it approximates a system in which the federal government offers to sell fair annuities to all retiring workers.

Note that our assumption about the investment strategy of the insurance company implies that workers must accept the riskless rate of real return on their retirement savings once they have reached the retirement age and converted their savings to an annuity. Many proponents of individual retirement accounts reject this assumption, because they do not believe workers should be forced to purchase annuities with their individual account savings. To address this concern, we investigate the implications of assuming that retired workers purchase variable rather than fixed annuities. Since an insurance company that sells variable annuities does not promise to pay a level real annuity, it can invest its funds in riskier assets than Treasury bonds. To keep the simulations simple, we assume the insurance company selling variable annuities expects to invest in the same portfolio of stocks and bonds that the worker purchased during his active career (70 percent equities / 30 percent bonds). It is an open question whether workers would be permitted to purchase variable annuities with their individual-retirement-account

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[18] To treat the DC contributions consistently with contributions to Social Security, we assume that one-half of the contribution is made by workers – and thus must be subtracted from the gross wage to determine the worker's *net* annual earnings – and one-half is made by employers.

savings. One argument against permitting such purchases is that a sequence of poor stock market returns would seriously erode the real value of retired workers' annuities, forcing some of them into poverty and onto public assistance. To prevent this from occurring, the government might require workers to purchase level real annuities.

Changes in taxes, benefits, and reserves. In Figure 3 we show the timing of the tax increases or benefit reductions that are implied by the three policy reforms just described under the 'static' assumption that the macroeconomic variables, such as GNP, wages, and interest rates remain at their baseline values. The top panel shows the tax increases needed to keep Social Security solvent under the Trustees' intermediate assumptions. The line labeled "Policy option #1" shows the tax rates required to maintain Social Security solvency when tax rates are increased as needed to keep the Trust Fund from falling much below the previous year's OASDI outlays. Under this option the combined payroll tax must be raised from 12.4 percent to 16.7 percent – more than a third – between 2020 and 2035. The 16.7 percent rate is high enough to keep the Trust Fund from falling below the previous year's outlays until shortly after 2060, when the tax must once again be increased to keep the program solvent.[19] By 2075 the tax rate required under this option is 18 percent.

The line labeled "Option #2" shows the annual tax rate schedule when payroll taxes are boosted 2 percentage points in 2000 and then raised in later years whenever the Trust Fund threatens to fall below the previous year's outlays. Because the Trust Fund reaches a much higher peak under this alternative, interest earnings on the Fund allow later tax hikes to be postponed in comparison with when they are needed under the first policy. Between 2026 and 2061 the tax rate under option #2 is actually lower than it is under option #1. By 2062, however, population aging has increased the required tax rate even under option #2. After 2062 the tax rates required under this option are the same as those needed under the first policy option.

The explanation for the long-run equality of tax rates under the two policy options is straightforward. Even with a substantial tax hike in 2000, the build-up in the Trust Fund is not

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[19] The 16.7 percent payroll tax rate is high enough to generate growing Trust Fund surpluses in years immediately after 2035. Since it is unlikely policymakers would actually reduce payroll tax rates under such circumstances, however, we imposed the requirement that payroll tax rates be nondecreasing. Eventually, of course, the Trust Fund surpluses disappear and a higher tax is needed to maintain solvency.

nearly large enough to pay for Social Security's ultimate benefit promises. The pay-as-you-go tax rate in year *y*, say, t_y, must ultimately be high enough to pay for at least one year's benefit payments out of the current year's payroll tax revenues:

$$(9) \quad t_y = \left(\frac{Average\ \ Benefit_y}{Average\ \ Wage_y} \right) \times \left(\frac{Number\ \ of\ \ Pensioners_y}{Number\ \ of\ \ Active\ \ Workers_y} \right)$$

The ratio of the average Social Security benefit to the average covered wage in the long run is determined by the benefit formula and the rate of growth of real wages. When real wages and the labor force grow steadily, the ratio of the average benefit to the average wage is ultimately a constant term. With a steadily growing population and rising longevity, however, the ratio of pensioners to active workers must increase over time, even in the very long run. Unless the tax rate in 2000 is set high enough to produce a Trust Fund accumulation that generates large and ever increasing interest earnings, the Trust Fund must eventually begin to fall. When the Trust Fund falls to 100 percent of the previous year's outlays, the tax rate must be adjusted to reflect the pay-as-you-go tax identity in equation (9) above. Obviously, the implied tax rate after the Trust Fund has stabilized will be essentially the same, regardless of when the payroll tax was first increased.

The lower panel in Figure 3 shows the schedule of benefit reductions needed to keep Social Security solvent under the assumption that the payroll tax is maintained at 12.4 percent. Benefit reductions begin in 2020 and continue through 2036, in which year pensions are just 73.5 percent of benefits promised under current law. This benefit cut is enough to keep the Trust Fund from falling below the previous year's OASDI outlays over the period from 2036 through 2067, but starting in 2068 additional benefit cuts are needed to keep the program solvent. By 2075 pension levels are slightly less than 69 percent of the pensions promised under current law. Benefits must be trimmed another 0.1 percentage points (or 0.15 percent) a year after 2075 in order to keep the Trust Fund from falling below the previous year's outlays.

The implications of the three policy options for the size of the Social Security Trust Fund are displayed in Figure 4. The Trust Fund is measured as a percentage of contemporaneous GDP in the chart. The predicted size of the Trust Fund under current law is shown as the lower heavy

line in both the top and bottom panels. Under the Trustees' intermediate assumptions the Trust Fund reaches a peak level – about 12.9 percent of GDP – between 2010 and 2020 but is predicted to fall to zero around 2030. Assuming the OASDI system must pay the government bond interest rate in order to borrow funds from the rest of government, total Trust Fund debt will amount to slightly more than GDP by 2075.

In contrast, the Trust Fund never falls below zero under the other three policy alternatives. Under the two policy options where tax increases or benefit cuts are delayed until 2020, the predicted Trust Fund is the same as under current law through 2020. In years after 2020 the Trust Fund fluctuates but eventually stabilizes. By 2075 the Fund equals 6.6 percent of GDP under the tax-increase option and 4.5 percent of GDP under the benefit-cut option, approximately the level of OASDI outlays as a percentage of GDP in 2075 under the two options. Under the second policy option, payroll taxes are increased 2 percentage points in 2000, swelling OASDI revenues and increasing the peak accumulation in the Trust Fund. At its high point around 2025, the Trust Fund under this option reaches almost 29 percent of GDP, more than twice the peak accumulation under current law and under the other two policy alternatives. Note, however, that the Trust Fund under this alternative must eventually decline. By 2061 the Trust Fund is essentially the same size as it would be if tax increases were postponed until after 2020.

Replacement rates. If tax rates are increased to maintain Trust Fund solvency, future retirees will receive all Social Security benefits promised under current law. Social Security replacement rates will remain the same as they are in the baseline (see Table 3). On the other hand, any policy reform, like option 3, that changes the benefit formula in order to maintain solvency must reduce Social Security replacement rates. [20] The top and bottom panels in Figure 5 show future replacement rates for low-wage workers who have declining and rising earnings profiles, respectively. The top line in each panel shows the Social Security replacement rate under current law. The bottom line shows the Social Security replacement rate when benefits are

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[20] To compute the replacement rate, we calculated the weighted average real pension received by a retired worker through retirement and divided by the average real wage between ages 22 and 61. The average pension is computed taking account of the probability a worker will survive through each year of age after 62. Benefit reductions that begin 20 years after a worker retires thus have a small negative effect on the average replacement rate during retirement.

periodically adjusted to maintain Trust Fund solvency. Workers who retire after 1996 must accept a benefit cut under this policy option. Workers who retire in 2000, for example, receive pensions that are about 2 percent smaller than benefits promised under current law. This may seem surprising, since benefit cuts do not begin until 2020 (see lower panel of Figure 3). People who retire in 2000 will be affected by the benefit cuts in 2020, however, because their pensions starting at age 82 will be lower than what is promised under current law. The low-wage, declining-trend earner retiring in 2015 suffers a 10-percentage-point (12½ percent) reduction in replacement rate. For the same type of worker who retires in 2035, the reduction is 22 percentage points (26 percent). A similar worker who retires in 2075 must accept a 27-percentage-point (32 percent) reduction in replacement rate compared with the rate that is promised under current law.

Some of the loss of Social Security benefits is offset by the new defined-contribution pension. Since the program begins with workers who are 56 years old or younger in 2000, the initial annuities are paid to workers retiring in 2006. However, the program reaches maturity only in 2040 when new retirees will have paid into the accounts for a full worklife. The solid middle line in Figure 5 shows workers' combined replacement rate from both the Social Security pension and the defined-contribution annuity. For low-wage workers with declining earnings, the DC annuity comes close to replacing lost Social Security pensions by 2040, before declines to about 70 percent by 2075. The annuity replaces only about half of lost benefits for workers with a rising wage profile. The DC pension is more helpful for workers with a declining wage profile, because the bulk of the their contributions are made early in their careers when their savings have longer to generate investment earnings.

For workers with high lifetime earnings, the relative advantage enjoyed by those with a declining-wage profile is also apparent; but more importantly, the DC annuity replaces *all* of the lost Social Security benefits (See Figure 6). In fact, when a new DC pension is combined with a Social Security benefit cut, high-wage workers obtain combined Social Security and DC pensions that are higher than the Social Security pensions they are promised under current law. The tabulations displayed in Figures 5 and 6 thus imply that defined-contribution accounts would be more helpful for high-wage than for low-wage earners in preserving or improving upon current replacement rates. This should not be surprising, because low-wage earners obtain

excellent returns on their Social Security contributions. When their returns are reduced by a proportional cut in OASDI pensions, they must earn exceptional returns on their DC contributions to make up the difference. In comparison, high-wage workers obtain low returns on their Social Security contributions. It is therefore easier for a DC account yielding normal returns to offset the loss of Social Security benefits for workers with high lifetime earnings. If an important policy goal is to keep replacements rates high for low-wage workers, these findings imply that cuts in regular Social Security benefits must be proportionately smaller for low-wage earners than for average- and high-wage earners.

The build-up of annuity benefits from DC accounts is displayed in Figure 7. The lines in each panel show replacement rates from the defined-contribution plan for workers who have declining, level, and rising wage profiles. Initially, the DC annuity is most helpful for workers who have rising relative earnings over their careers. Since they earn a higher proportion of their lifetime wages in the years immediately before retirement, they initially receive higher DC pensions than workers whose wages were earned earlier. When the new pension plan is fully mature in 2040, however, workers with declining wage profiles fare better than workers with level or rising career earnings. The chart shows a gradual decline in DC replacement rates after 2040 for *all* types of workers. This decline is explained by lengthening life spans. Under our assumptions about future wages and interest rates, all workers who retire after 2040 will accumulate essentially the same ratio of DC savings to lifetime wages at the time they reach retirement age. Gradual improvements in longevity will require that retirement savings be converted into annuities that last progressively longer for each successive cohort. Because we assume the retirement age remains unchanged, the annual DC pension must shrink.

Internal rates of return. Internal rates of return under the three reform plans are displayed in Table 4. The top panel shows returns on Social Security tax contributions when the payroll tax is periodically adjusted to preserve Trust Fund solvency. Estimates on the left show the trend in returns if the tax increase is delayed until 2020, when the Trust Fund first falls below 2 times the previous year's OASDI outlays. Those on the right show returns if the combined tax rate is increased to 14.4 percent in 2000 and taxes are periodically increased in later years whenever the Trust Fund threatens to fall below the previous year's outlays. The bottom panel shows combined returns on Social Security taxes and contributions to the DC pension accounts

under the reform option that cuts OASDI benefits to keep the Trust Fund solvent. The estimates on the left show internal returns when workers are forced to purchase a level annuity; those on the right show returns when workers are permitted to buy variable annuities. For each reform option we show the internal rates of return for all the lifetime earnings profiles.

The table shows returns for workers retiring in 1995, 2015, 2035, and 2075. Over the twenty-first century, real returns decline under all reform plans for all categories of workers. Workers who retire in 1995 enjoy the highest returns; workers who retire in 2075 obtain the worst returns except under the plan that provides DC variable annuities. The fastest initial decline occurs under the reform plan that adjusts Social Security benefits to maintain solvency and provides level DC pensions. The slowest decline occurs when taxes are adjusted to maintain solvency and the first tax increase is delayed until 2020. It should be obvious why the latter plan requires such a modest sacrifice on the part of workers who retire up through 2035. Under that plan all workers receive the same Social Security pensions promised under current law. Only workers with earnings after 2020 pay additional taxes. Since many workers have a declining wage profile, they will not pay much extra taxes, even if they retire in the first one or two decades after 2020. It is interesting, however, that the rate of return under the delayed-tax-increase option eventually falls below the return under the immediate-tax-increase plan. For the composite worker who retires in 2075, the real return under the first policy option is just 2.3 percent whereas the return under the second option is 2.6 percent. The second option offers better returns by 2075 because workers who retire in that year face a lower payroll tax during most of their career than do workers under the first policy option (see top panel in Figure 3). Eventually, of course, returns under the two plans would be identical because tax rates under the two plans converge.

The main difference between the two plans should be apparent. If the payroll tax is boosted in 2000, the cohorts retiring between 2001 and 2046 are forced to make a larger contribution toward paying for the liabilities of the Social Security system, reducing the contributions needed from cohorts retiring after 2046. This shrinks the real returns of workers retiring between 2001 and 2046 while boosting the returns of workers retiring after 2046. The aging of the U.S. population must push down the returns workers can obtain under a pay-as-you-

go system, but an early tax increase that partially finances future benefits can affect the rate of decline in real returns.

An even more interesting comparison is between the second and third policy options. Under the second option, taxes are boosted in 2000 to pay for part of future benefits under the existing Social Security formula. Under the third option, the same hike in contributions is imposed in order to give workers a new kind of pension – a defined-contribution investment account. From 2000 until 2053 the required contribution rates under the two policies are identical – 14.4 percent of taxable earnings. Yet up through 2035 the second policy option almost always delivers equal or better returns than the option that provides workers with level DC annuities. The only workers who clearly fare better under the level annuity plan are high-wage workers who retire after about 2030. Most other workers obtain better returns under the plan that maintains Social Security benefits with a tax hike in 2000 and additional tax increases after 2053. Eventually, of course, the required tax rate hikes under the second option must push returns below those obtainable under the level DC policy option for the great majority of workers. It is surprising how long this takes, however. Retiring workers with the composite earnings profile do not obtain noticeably higher returns under the level DC plan until almost 2075. In other words, most cohorts born before 2012 would be better off if the present Social Security benefit package were maintained with a 2-percent tax increase than if a 2-percent increase in contributions were invested in a DC pension account. Cohorts born in later years would be better off if the retirement system shifted toward DC accounts.

The advantage of the existing system for currently active workers and for workers who will be born over the next few years stems from the fact that lifetime returns under a DC system are more modest than usually advertised. We assume that workers will invest their contributions in a portfolio that consists of 70 percent equities and 30 percent bonds. Since the equity return averages 7.3 percent and the bond return averages 2.3 percent, workers earn a real return of 5.8 percent during the accumulation phase of their careers.[21] This is indeed a very good return, one that compares favorably to returns obtainable under Social Security (see Table 3). When their DC savings are converted into level annuities, however, workers are essentially forced to accept

[21] These projected returns are close to returns assumed by other analysts. If anything, the assumed return on bonds is higher than average bond return over the past century. See Burtless (1999).

the riskless rate of return, which is just 2.3 percent. The lifetime return on DC contributions is a weighted average of the returns workers receive during the accumulation and decumulation phases of their careers. Workers who make most of their contributions when they are in their 20s and 30s obtain somewhat better lifetime returns than workers who make most of their contributions after they are 40, but their lifetime returns still fall considerably short of 5.8 percent because much of their life is spent in retirement when their savings earn the riskless rate of return.

Workers' returns look better if DC account savings are used to purchase a variable annuity instead of a level annuity (see the right-hand columns in the lower panel of Table 4). Under a variable annuity pension, workers can earn high real returns throughout their lives because they are not forced to invest their savings in a riskless asset at age 62. Even with a variable annuity, however, most retiring workers are not clearly better off under a DC plan until about 2030. Low-wage earners are not better off until after 2075. Workers with low lifetime earnings would be better off under the existing Social Security system, even if taxes must be substantially raised to preserve benefits (compare the top and bottom panels in Table 4). Of course, the situation of low-wage workers would improve under a DC plan if benefit cuts in the traditional Social Security program were targeted on workers with higher lifetime earnings. In the analysis in this paper we focus on proportional benefit cuts for all classes of workers.

Advocates of individual account plans may be shocked by the modest lifetime returns we project for plans containing a new DC pension. Even under a variable annuity plan, the combined DC and Social Security return averages less than 3½ percent for workers who retire after 2015. This is well below the 5.8 percent rate of return that workers are assumed to receive on contributions to their DC pensions and even further below the 7.3 percent return workers obtain on their equity investments. The explanation for the poor overall return is that returns on Social Security contributions are far below the returns workers obtain in their DC accounts. Because Social Security pensions must be reduced under the third reform plan, the return on overall contributions to the pension system (i.e., to Social Security plus the new DC pension) falls even further.

The basic reason for the poor return on Social Security contributions is that they include an implicit tax to pay for the unfunded liability of the system. Workers who retired under the

program before 1980 received benefits well in excess of the benefits they would have received if Social Security offered normal returns on contributions (see Leimer, 1994, and Geanokoplos, Mitchell, and Zeldes, 1998). This excess of benefit payments relative to their contributions was financed through payroll taxes on later generations of workers, who in turn were promised future pensions based on their contributions. The contributions of each cohort retiring after 1980 can be thought of as including two components: a contribution that pays for future Social Security pensions to that cohort and a tax that helps pay for the "excess" pensions paid to earlier cohorts. On the first part of their contribution, workers obtain a normal rate of return. The second part of their contribution yields a -100 percent return; it is a pure tax on labor earnings. When Social Security benefits are reduced below the amount promised under current law, contributors receive even lower returns on their Social Security contributions. They are forced to pay a higher implicit tax to finance the unfunded liability of the system.[22] The burden of this tax is reflected in our estimate of the long-run returns that workers receive under a system that combines a smaller Social Security program with a new DC pension plan. Advocates of individual accounts often overlook this tax. They focus only on the return that workers can obtain on deposits into their DC accounts. Unless the nation abrogates its promise to pay already-accrued Social Security pensions, future workers will be obliged to pay a tax for unfunded Social Security liabilities, regardless of whether a new DC pension system is introduced. The question facing policymakers is how to distribute that tax across living and unborn generations and across wage earners within each generation.

[22] Under an ongoing pay-as-you-go system, the major portion of the unfunded liability is continually passed forward to the 'last' generation which will receive no benefit. However, if the system is phased back, each generation that accepts a benefit cut pays a portion of the unfunded liability.

5. Dynamic Analysis

Our analysis of policy reform up to this point has been based on the assumption that national saving and thus future incomes are unaffected by reform. The trends in public and private saving were assumed to remain the same as those projected in our baseline simulation. This overlooks one of the most important potential effects of reform. Changes in pension policy can affect public or private saving, boosting national saving and investment. In fact, a major goal of many proponents of reform is to increase national saving. We can evaluate the effects of pension fund accumulation and higher national saving using the assumptions of our macroeconomic model. Instead of assuming that net national saving remains unchanged, as we did in the previous section, we assume that additions to the reserves of the pension system contribute to higher national saving, over and above the baseline.

Effects on the aggregate economy. We implement this idea by calculating the combined reserves of the Social Security system and the new DC pension system and then determining the year-to-year change in real reserves. If we assume government dissaving *outside* the pension system is 0 percent of NNP starting in the year 2000, net public and private saving under this assumption is

$$(6') \quad I_D + I_F = S_{OASDI} + S_{dc} + S_{NonOASDI} + S_p + Dep,$$

$$= S_{OASDI} + S_{dc} + S_p + Dep,$$

where S_{OASDI} is the net addition to real OASDI Trust Fund reserves, $S_{NonOASDI}$ is net government saving outside the OASDI accounts, and S_{dc} is the net addition to real reserves of the new defined-contribution pension accounts.[23] We continue to assume that private saving, S_p, follows the same path (as a percentage of NNP) as it did under our baseline assumptions. If the real value of reserves in the Trust Fund and DC accounts increases from one year to the next, the change in reserves pushes the national saving rate above the rate assumed in our baseline

[23] The change in reserves is measured in inflation-adjusted dollars. If R_t is the level of nominal reserves at the end of year t and Δp is the change in the price level between t-1 and t, then the change in real reserves is $R_t - R_{t-1}\,(1+\Delta p)$.

projections; if real reserves shrink from one year to the next, the national saving rate falls below the rate assumed in our baseline. Thus, deviations in the rate of national saving from its baseline path after 1999 are driven entirely by changes in the pension system reserves.

The response of public and private saving to a build-up in pension fund reserves may be more complicated than this, of course. Many critics of a large Trust Fund build-up believe that the availability of large Social Security reserves will tempt the Congress to run larger deficits in other government accounts, either through general tax reductions or higher public spending. This would mean that non-OASDI saving, $S_{NonOASDI}$, would not be zero and in fact could become substantially negative. Private savers might respond to higher government saving by saving less in their private accounts. They might also respond to growing reserves in a new DC account system by reducing their own private pension or nonpension saving. Either kind of effect on private saving would reduce S_p below our assumed path, offsetting some or all of the impact of saving in the pension system. While some political or private saving offset to a build-up of pension savings is possible, we think it is useful to trace out the effects of a dollar-for-dollar impact of additional pension reserves on national saving. At a minimum, this exercise shows the potential impact of a policy of higher national saving on future wages, pensions, and national income – assuming the net reserves of the pensions system are actually saved. Alternative assumptions would simple scale back the results of the dynamic analysis to be closer to those obtained from the static analysis.

Figure 8 shows the annual changes in pension reserves, measured as a percent of NNP in the baseline projections. They represent the increment to national saving that would result from implementing our assumption, but they do not yet incorporate any feedback effects form changes in the aggregate economy. The top panel shows the net additions to reserves under all three reform options. The smallest increment occurs under the first policy option, which delays payroll tax increases until about 2020. Reserves initially grow much faster under the second policy option, which boosts the payroll tax rate 2 percentage points in 2000, but the period of buildup is followed by a long period of decumulation. Between 2030 and 2060, additions to reserves are higher under the policy that delays taking any action until 2020. After 2062 there is virtually no difference between the two policies because the tax rate and the size of the Trust Fund (measured as a percent of NNP) are essentially the same. Note that under both tax-increase

options there are lengthy periods when pension reserves are falling. Under the first policy option the decline occurs between 2015 and 2028; under the second option it occurs between 2030 and 2062. The Trust Fund can decline for much longer under the second option than the first and still remain positive because the peak of reserves is much larger in relation to annual OASDI pension payments.

The biggest and most sustained increase in pension reserves occurs under the third option, which involves the creation of a new system of individual retirement accounts. In 2075 this policy results in the accumulation of extra reserves amounting to 0.5 percent of NNP a year. The lower panel provides further details about reserve accumulation under the third policy option. The lowest line in that panel shows saving and dissaving within the OASDI Trust Fund as benefits are periodically trimmed to maintain solvency. The ups and downs of the Trust Fund are generally similar to those under the first policy option, which periodically adjusts payroll tax rates to maintain solvency. Another line in the lower panel shows the accumulation of reserves in the new DC pension accounts. To calculate the required accumulation of reserves in these pension accounts we assume that workers do not have access to funds in their accounts until they reach retirement age. Steady but comparatively small disbursements from the fund are made for workers who die before reaching age 62.[24] Large outlays from the fund do not begin until retiring cohorts have spent a substantial part of their careers under the new pension plan. Between 2000 and 2020, the annual increment in DC reserves almost doubles, rising from 0.8 percent to 1.6 percent of NNP. After 2020 annual annuity payments grow faster than new contributions plus investment earnings of the fund, so annual increases in the fund begin to shrink measured as a percentage of NNP. When the new pension program is fully mature after 2060, the pension reserve grows about 0.5 percent of NNP each year.

Table 5 shows the impact of the policy reforms on the aggregate economy, assuming the additions to real pension reserves actually add to national saving starting in 2000. Under all three policy options there is an immediate increase in national saving beginning in 2000 because under current law the trust fund will continue to grow until about 2015. This shift in fiscal

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[24] We assume that the heirs of deceased workers receive and consume the accumulation in the DC account over a 5-year period. However, the results vary little when we modify this assumption. If heirs

policy is responsible for an increase in saving amounting to 0.7 percent of NNP in 2000. The top panel shows the impact of the first policy option on the economy. Under this option, the first tax increase occurs around 2020. Until that year the only change in policy is the shift of the government surplus to reflect the annual changes in pension fund reserves. This policy initially boosts public (and national) saving and capital investment, reducing aggregate consumption and the rate of return on capital. After 2015, however, the growing size of the retired population causes the OASDI Trust Fund to start shrinking, pushing the overall government budget into deficit and reducing public saving below its baseline level. Because of the past beneficial impacts of the policy on the size of the capital stock, national income and consumption remain higher than they were under the baseline assumptions, but the gains are comparatively modest.

Under the second reform option, the combined payroll tax rate is hiked 2 percentage points in 2000 and is then raised periodically in later years to keep the Trust Fund from falling to dangerously low levels. By sharply increasing Social Security revenues and Trust Fund reserves, this policy produces a much larger boost in national saving in the years immediately after 2000. In 2000 the policy boosts saving by 1.7 percent of NNP (see the right-hand column in the middle panel of Table 5), and saving remains higher until 2030. Naturally, this policy requires a much larger consumption sacrifice in early years of the twenty-first century, but it also generates much bigger gains in national income and wages after the first decade. The gains begin to shrink after 2030, however, as the trust fund declines toward its pay-as-you-go level. By the end of the projection period, however, the differences between the first and second options for output, consumption, and wages narrow considerably. The narrowing follows from the fact that the two policies are based on the same long-run rule of a trust fund equal to 100 percent of OASDI outlays, leading to almost identical increments to net national saving (see Figure 8).[25]

The third policy option produces a smaller Social Security system and a new defined-contribution pension system. It also generates the largest and most sustained increases in

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received and spent deceased workers' accumulations over 1-year or 10-year periods, the impacts on the pattern of reserve accumulation would be slight.

[25] NNP and wages will always be slightly higher under the second policy than the first because the build-up in saving over the first three-quarters of the twenty-first century is larger under the second policy. This creates a slightly larger economy, though in the long run the saving rate and rate of growth of the economy are the same under both policies.

national saving. However, the initial increment to saving is nearly identical to that for option 2; and the two begin to depart only after 2020 as the trust fund under both options declines toward pay-as-you-go and the DC plan grows in importance (Figure 8).[26] The result in later years is a larger capital stock, higher gross incomes, and better wages but substantially lower returns on capital.

The benefits to future generations of investing the retirement account saving are most clearly illustrated in Figure 9, which compares to the increment to future consumption under the three policy options. In all three plans consumption is initially reduced by the higher contributions to the retirement plans. But the additions to capital in the dynamic analysis generate large increases in future incomes – and, after the first decade, substantial net gains to consumption. In the first two options, the increase in saving is only temporary, but it still results in a permanent increase in the capital stock and a modest consumption gain, one to two percent of NNP. The largest sustained rise in saving occurs under the third policy option, but the increase in consumption is not significantly above that of the second option until well into the second half of the century.

Effects on the pension system. As shown in Table 6, all three policies boost OASDI tax revenues in comparison with the baseline. The first two policies accomplish this both directly (through tax rate increases) and indirectly (through increased saving and faster economic growth). The third policy increases tax revenues only through its impact on the size of the economy and taxable wage base; the OASDI tax rate is left unchanged. Social Security benefit payments increase under the first two policies as an indirect result of increases in the real wage levels. OASDI payments decline under the third policy option, which reduces benefit levels to keep the program solvent. The reduction in benefits is considerably smaller than the required adjustment in the Social Security benefit formula, however. In order to keep Social Security solvent in 2075, for example, the basic formula linking pensions to past wages must be scaled back 31 percent. Real benefit levels are only 22½ percent lower than in the baseline, however. The difference is explained by the fact that real wage levels, which determine Social Security pensions, are higher under the third policy option than they are in the baseline. In addition,

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[26] Recall that workers who are within five years of the early retirement age when the DC plan is introduced are not obliged to participate in the plan.

relative to the baseline, all three policies dramatically increase the size of the Trust Fund and the percentage of future Social Security pensions that can be financed out of interest earnings on the Fund. This is hardly surprising, since the Trust Fund under current law is expected to fall below zero around 2030

The last two columns in Table 6 show the contributions of Trust Fund accumulation and growth in DC pension reserves to national saving. A comparison of these projections shows plainly that the main difference between the three policies after 2050 is the continued sizable growth in the DC pension reserves. Because all three policies ultimately achieve solvency in the Social Security Trust Fund by periodically increasing tax rates or reducing benefits in order to maintain pay-as-you-go financing, accumulations in the Trust Fund contribute very modestly to national saving after about 2050. The DC pension accounts, in contrast, continue to add to national saving through the indefinite future.

The inclusion of dynamic effects of increased pension saving on the aggregate economy has a surprisingly small long-term effect on the financial condition of the trust funds. This point is highlighted in Figure 10 by comparing the timing of the tax increases needed to maintain the pay-as-you-go reserve in the dynamic and static simulations for the second policy option, and the timing of the benefit cuts for the third option. Despite the higher level of wages and tax revenues induced by added saving, there is only a miniscule delay in the timing of the tax rate and benefit changes. While the increase in wages raises the system's tax receipts, it also leads to a delayed, but proportionate, rise in benefit payments. In addition, the expansion of domestic capital formation drives down interest rates, dampening the trust fund's interest earnings. The somewhat surprising conclusion is that a policy of increased saving is good for future generations in expanding their consumption possibilities, but it cannot do much to resolve the financial problems of the pension system, as reflected in the magnitude and timing of tax rate increases and benefits reductions.

Finally, we should point out that the additions to national saving need not be tied to a policy that creates new DC pensions. The same savings could be generated within the existing

Social Security system by a suitable sequence of tax increases or benefit reductions.[27] For example, as mentioned earlier, the additions to pension system reserves under the second and third policy options are very similar from 2000 through 2019. And, as can be seen in Table 5, the two policies also lead to similar increases in national income, gross wages, and consumption during the first part of the twenty-first century. They could generate similar changes in saving during the remainder of the century if Social Security did not revert to a pay-as-you-go financing policy.

Effects on individual earners. The changes in real wages and market rates of return caused by an increase in national saving obviously affect workers' welfare. The net impact on workers' well-being is complicated because the increase in national saving is obtained in the short run by reducing workers' or pensioners' consumption. This sacrifice leads to capital deepening, faster productivity growth, and higher real wages, but it may also reduce the rate of return workers obtain on their retirement saving. The lower rate of return has direct consequences on workers who invest in defined-contribution pension plans. They receive less in retirement benefits per dollar invested in the plan than they would receive if the rate of return remained unchanged. Even workers whose retirement incomes consist entirely of Social Security benefits can be affected by lower capital returns. If the Trust Fund earns a lower return on its holdings, benefits must be reduced or payroll taxes increased more frequently than would otherwise be the case.

The effects of alternative reforms on the lifetime earnings, pensions, and net incomes of successive worker cohorts are displayed in Figure 11. The calculations are based on the earnings and pensions of workers who are assumed to have the composite lifetime earnings profile. That is, the assumed earnings profile is the weighted average of the nine stylized earnings profiles illustrated in Figure 2. The top panel in the figure shows the net lifetime earnings of successive worker cohorts relative to the baseline earnings of workers in the same cohorts. This calculation

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[27] In Aaron, Bosworth, and Burtless (1989) we outlined such a policy. We proposed that payroll taxes be raised or benefits lowered by enough to maintain actuarial balance over a 75-year planning horizon. Whenever the 75-year forecast for Social Security solvency shows that the expected revenues would pay for less than 95 percent of expected benefit payments, we suggested that a combination of tax increases or benefit cuts be implemented within five years to restore the system to long-term balance. Under this strategy, the Social Security Trust Fund would always grow in relation to national income, generating indefinite gains in national saving if the annual increases in the Fund were actually saved.

takes account of the additional payroll taxes or DC pension contributions workers are required to make under each of the three reforms. We subtract the worker's portion of the required contribution for Social Security Old-Age Insurance benefits and the worker's share of mandatory contributions for the new DC pension from the worker's gross wage in order to measure "net" lifetime earnings.[28] Policy options #1 and #2 require payroll tax increases, which directly reduce the net earnings of future workers relative to what they earn in the baseline. On the other hand, the increased tax rates boost government saving, capital investment, and worker productivity, raising the pre-tax wages. This effect is clearly much more important under the second policy option, which involves a 2-percent increase in the combined payroll tax starting in 2000. For workers retiring in 2050 under the second policy reform, net lifetime earnings are increased 7 percent in comparison with what they would be under our baseline assumptions. In years after 2050 the impact on lifetime earnings is smaller, because policy option #2 has a modest and shrinking effect on the national saving rate and hence on the level of productivity and average wages.

The biggest long-term impact on lifetime wages occurs under the third policy option, which as noted earlier produces the largest sustained increase in national saving. For workers retiring in 2075, net lifetime earnings under the third option are almost 12 percent higher than they are under our baseline assumptions.

The middle panel in Figure 11 shows the impact of the three reforms on real pensions received by workers retiring in successive cohorts. The first policy option yields modest pension improvements, with pension gains peaking for workers who retire around 2065. The benefit gains are significantly larger under the second reform plan, and they reach a peak for workers retiring between 2025 and 2030. Those workers receive Social Security benefits that are about 9 percent larger than in the baseline. Note that the maximum gain in Social Security pensions is achieved around the same time the economy-wide real wage gain reaches a peak under the policy (Table 5). Real Social Security benefits for a cohort are largely determined by the economy-wide real wage level when the cohort attains age 60. If the reform boosts economy-wide wages

[28] We make no adjustment for the part of gross wages that are used to pay for Survivors and Disability Insurance and Hospital Insurance benefits. The reason is simple. None of our calculations take account of the benefits workers receive under these programs.

at that age, workers automatically obtain better pensions throughout their retirement – assuming that Social Security pensions are fully indexed to the price level during the cohort's retirement.[29]

We display the pension impact of the third policy option using two different measures. The lowest line in the middle panel of the figure shows the level of workers' Social Security pensions relative to the baseline pension. A higher line in the same panel shows the impact of the third reform plan on lifetime pensions if we compare the *sum* of Social Security and DC pensions with the Social Security pension workers receive under our baseline assumptions. Note that the Social Security pension falls dramatically under the third policy. When the DC pension is included, workers' lifetime pensions initially fall (for workers retiring before 2006) and then improve (for workers retiring between 2006 and 2040). The peak gain in combined Social Security and DC pensions is achieved for workers who retire in 2040, when the first cohort of workers with 40 years of coverage under the new system retires.

The gain in lifetime pensions begins to shrink after 2040, and by 2060 lifetime pensions are lower under the third policy option than they are under options #1 or #2. After 2070 the combined value of Social Security and DC pensions is actually lower than the value of Social Security pensions in the baseline. The lower lifetime pension at the end of the projection period is a natural consequence of the reduction in the rate of return on capital (see the second column from the right in Table 5). Because workers who retire in 2075 earn a dramatically lower rate of return on their DC pension contributions and at the same time must accept lower Social Security pensions, they are left with lower lifetime pensions than workers under either of the reform alternatives.

An important implication of this analysis is that replacement rates and internal rates of return on pension contributions are ultimately lower under the third policy option than under either of the other two. The replacement rate is lower because in the long run the third policy option delivers lower pensions to retiring workers while generating significant increases in their productivity and wages while they are at work. In comparison with the other two policies, the

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[29] It may seem surprising that the maximum gain in pensions under policy #2 is achieved for workers retiring around 2027 while the maximum lifetime earnings gain is attained for workers retiring around 2050. But as just noted, real Social Security benefits are largely determined by the economy-wide real wage when workers are 60 years old, whereas the gain in lifetime earnings reflects a weighted average of the changes in the economy-wide wage over the prior 40 years.

policy that keeps the Social Security system solvent by lowering pensions shifts a greater percentage of workers' spendable income to their pre-retirement years, *away* from their retirement years.

This particular result of our simulations points up a weakness of focussing exclusively on the rate of return workers obtain on their retirement contributions. Even though the composite worker eventually obtains a better lifetime income under the third policy option than under the other two, the third option delivers lower real returns on pension contributions for every generation that retires in the twenty-first century. If the choice of retirement policy were solely determined by the rate of return on contributions, the policy of reducing Social Security benefits in order to make room for a new DC pension would appear worse than the other two.

These findings about the effect of reform on retirement incomes are largely driven by our assumption that additions to pension reserves add to national saving and are invested exclusively in the United States. The extra saving increases the U.S. capital stock, output, and real wages above what is predicted in the baseline, but it lowers the rate of return on capital. It may seem odd that the policy option that does the most to boost national saving eventually does the least to improve workers' retirement income. But if all of the added saving is invested domestically and if workers' pensions are tied closely to the rate of return that can be obtained in the capital market, the increase in national saving can hurt the pensions workers obtain in retirement even as it improves workers' wages while they are employed.

The bottom panel in Figure 11 combines the results displayed in the two upper panels. We calculate the sum of net lifetime earnings and pensions and compare this amount with the sum of lifetime earnings and pensions under our baseline assumptions. After 2005 all three reform options produce improvements in the lifetime incomes of retiring workers. At first, the largest improvement occurs under the second policy option which boosts Social Security payroll taxes in 2000 and then adjusts the tax rate periodically in order to keep the Trust Fund solvent. For workers retiring after 2035, however, the largest gain in lifetime income is achieved under the third policy option, which combines periodic reductions in Social Security benefits with a new DC pension program. At the end of the projection period in 2075, retiring workers under the third policy option receive lifetime incomes that are about 8 percent larger than workers

receive under our baseline assumptions. In contrast, the gains are just ½ percent and 2 percent, respectively, under the first and second policy options.

Estimates of the change in lifetime earnings, pensions, and net incomes for different types of workers are displayed in Table 7. In general these results mirror those presented in Figure 11. Workers retiring before 2035 except those with the highest average wages are better off under a reform plan that boosts Social Security tax rates to preserve benefit levels. Eventually, however, all but the lowest wage workers achieve net lifetime income gains under the policy that trims Social Security benefits to keep the Trust Fund solvent and establishes new defined-contribution retirement accounts. However, the third policy option reduces the retirement incomes of all workers with average- and below-average earnings, with particularly large reductions in the case of workers who have a rising lifetime earnings profile.

Three implications from this analysis stand out. First, a policy of sustained high saving ultimately delivers sizable improvements in workers' lifetime incomes. Second, the gains can be meaningful even for workers who will retire within the next two decades. Finally, the sacrifices required to achieve the increase in saving can be spread in a way that does not force any generation to accept a sizable reduction in its *lifetime* net income. Of course, Figure 11 does not show all the consumption sacrifices each generation is required to make, nor does it show how spendable income is re-arranged across the lifetime of a given cohort.

Part of the increase in national saving that occurs in 2000 is achieved through a change in fiscal policy rather than a change in pension policy. Instead of running a balanced budget in its overall accounts, the new policy requires the federal government to run an overall surplus equal to the change in Trust Fund reserves. To achieve this surplus the government must increase non-OASDI taxes or reduce non-OASDI spending. These changes cut the spendable incomes of taxpayers or reduce the flow of government services provided to Americans. The impacts of the changes in non-OASDI policy that are needed to achieve budget balance are ignored in the tabulations.[30]

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[30] By the same token, however, we also ignore the *improvements* in non-OASDI accounts that occur after 2015 as a result of the fact that Social Security no longer is running a large and growing deficit after the policy reforms. In order to pay promised Social Security benefits in the baseline forecast, we assumed the non-OASDI portion of the budget ran large and growing surpluses after 2015. These surpluses could

Interestingly, even a policy that imposes tax increases starting in 2000 does not lower the lifetime net incomes of the worker cohorts who are required to pay the extra taxes. Their lifetime gross wages and pensions are increased by enough as a result of the extra saving to boost their lifetime net incomes. The only policy that reduces the lifetime incomes of any individual cohort is the one that periodically reduces Social Security benefits to keep the Trust Fund solvent. While the policy benefits workers who participate in the new DC pension, workers who retire before 2006, but are still alive when the benefit cuts begin in 2020, will receive smaller Social Security pensions. Yet, they do not obtain much if any gain from higher economy-wide wages.

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only be achieved with increased non-OASDI taxes or lower non-OASDI spending, sacrifices that are not needed if the Social Security system is running a surplus.

6. The Effect of Alternative Trust Fund Investment Policies

We have assumed so far that all of the reserves of the Social Security Trust Fund are invested in U.S. government bonds. Treasury bonds are widely considered the safest investment, but they have historically yielded a lower return than investments in U.S. corporate equities (see Burtless, 1999, and Diamond, 1999). One reason that accumulations in DC pension accounts contribute more to pension saving than do accumulations in the Social Security Trust Fund is that deposits in DC accounts are credited with a higher annual return than the investments held in the Trust Fund. If the Social Security Trust Fund were invested in assets that earned the same rate of return as investments in DC accounts, the growth of the Trust Fund would be faster and the potential contribution of Social Security to national saving would be bigger.

This point can be illustrated in a variety of ways. Figure 12 shows the impact of higher Trust Fund returns on the timing of payroll tax increases needed to keep Social Security solvent. The solid dark line toward the bottom of the figure shows the combined employee-employer tax rate under current law. Under current law, the tax will be 12.4 percent over the projection period. The higher lines reflect the sequence of tax rates needed to maintain solvency under alternative Trust Fund investment strategies. Under all four investment strategies we assume the same solvency rules as in our second option: the payroll tax is hiked by 2 percentage points in 2000 and then periodically increase the tax in later years when assets in the Trust Fund fall below 100 percent of the previous year's OASDI outlays. The initial tax increase plays a critical role because if the trust fund remained small, as under a strict pay-as-you-go system, variations in the rate of return would be of little consequence. In each case we assume that annual additions to the Trust Fund reserve add to national saving and that additions to saving are invested domestically in the United States.

The investment strategy that requires the earliest tax increase is the one we have examined in previous sections. Under that investment strategy, all Trust Fund reserves are invested in government bonds; none are invested in equities. This conservative investment strategy requires that payroll taxes be increased in 2055. If 30 percent of Trust Fund reserves are invested in equities, the tax increase could be postponed until 2071. If half of reserves are invested in equities, the tax hike would not be needed until 2088. And if the Trust Fund investment strategy were the same as the one we have assumed for DC pension accounts (30

percent bonds and 70 percent equities), the first tax increase after 2000 could be delayed more than a century.

Even the investment strategy expected to yield the highest rate of return on Trust Fund reserves does not generate enough investment earnings to eliminate tax increases indefinitely. In fact, by 2125 the necessary Social Security tax hike is almost identical under all four investment strategies. The tax rate is virtually the same because after 2000 we postpone any tax increase until the system has reverted to a pay-as-you-go basis. The tax rate can be slightly lower when Trust Fund reserves are invested to obtain a higher return, but the difference is small.

Table 8 shows the impact of three of the investment strategies on the overall economy. The top panel in the table shows the effect of investing all Trust Fund reserves in government bonds. (The results in this panel duplicate those displayed in the middle panel of Table 5.) We compare this policy with investment policies in which, respectively, 30 percent and 70 percent of reserves are held in corporate stocks. In the first year of the investment policy change, the change in investment portfolio has virtually no impact on the amount of saving or, indeed, on any other economic aggregate. Even though new Trust Fund investments are earning a higher rate of return, we assume that old Trust Fund bond holdings are not invested in equities until they mature. By 2025 the higher Trust Fund return boosts pension fund saving considerably (see the right-hand column in Table 8). Whereas Trust Fund accumulation in 2025 adds only 0.4 percent of NNP to saving when reserves are invested solely in government bonds, the accumulation adds 1.0 percent of NNP to national saving when 30 percent of reserves are invested in equities and adds 2.1 percent of NNP to national saving when 70 percent of reserves are invested in equities. By 2075 the additional saving adds 90 percent to the flow of capital services and almost 9 percent to the size of NNP under the most aggressive investment strategy. In comparison, capital services are only 13 percent higher and NNP is only 2 percent larger than in the baseline under the most conservative Trust Fund investment strategy. A large increase in national saving exacts a heavy toll on the rate of return on capital, corporate equities, and government bonds. By 2075 the rate of return falls more than half under the most aggressive investment strategy, while it falls only about 12 percent under the most conservative strategy.

The substantial fall in the rate of return hurts the investment returns of the Trust Fund, but it does not reduce Social Security pensions. This contrasts with the outcome when higher

contributions to the pension system are invested in DC pension accounts. Table 9 shows the effects of the Trust Fund portfolio allocation on Social Security program operations. Note that in 2075 OASDI benefit payments are 5 percent higher when the Trust Fund is invested exclusively in bonds, 9½ percent higher when 30 percent of reserves are invested in stocks, and 18½ percent higher when 70 percent of reserves are invested in stocks. The improvements in pension benefits under these policy options stand in marked contrast to the fall in pensions that occurs when additional contributions to the pension system are invested in DC pension accounts (see the bottom panel of Table 6 and middle panel of Figure 11).

The difference is explained by the significant difference in the "formula" that links contributions and benefits under the two reforms. If the Social Security benefit formula is protected with periodic increases in the payroll tax rate, retired workers will continue to receive inflation-adjusted pensions that are linked to the economy-wide real wage level when they are 60 years old. When additional national saving increases real wages, workers receive larger Social Security pensions. In percentage terms, the improvement in their pension is approximately the same as the gain in real wages that occurs when they reach age 60. In contrast, under the third policy option, Social Security benefits are periodically trimmed whenever necessary to keep the Trust Fund from falling below zero. Additional pension contributions under this policy are invested in DC pension accounts. An increase in national saving increases workers' wages and contributions, but it reduces the return workers obtain on their deposits into DC pension accounts. The net effect of lower Social Security pensions and large but declining DC pensions is to reduce the retirement incomes workers receive under the third policy option.[31]

It is important note, however, that the improvement in retirement income under the Social-Security-tax-increase policy is achieved in part at the expense of generations that will be born in the distant future. The right-hand column in Table 9 shows that even under the most aggressive Trust Fund investment strategy the Social Security system is subtracting from rather than adding to national saving by 2075. Though the Trust Fund is vastly larger by 2075 than it was under the baseline assumptions, it is predicted to shrink – and thus to lower government and national saving – for a half century after 2075. This means that the economy will ultimately be

[31] Of course, Social Security pensions would not have to fall as much under the third policy option if part of Trust Fund reserves were invested in stocks and thus obtained a better rate of return.

smaller (and wages lower) than would be case under the third policy option, which restricts the rate of contributions workers are required to make to finance pensions but adds to national saving even in the distant future. In essence, the workers who retire in 2075 under a policy of Social Security tax increases and aggressive Trust Fund investment obtain the benefit of increased national saving while they are young and reduced national saving when they are old. The increases in national saving boost their gross and net wages while they are at work, and the later reductions in saving help maintain their real pensions when they are old. Generations that retire in later years cannot obtain such a favorable combination of increased wages and improved retirement benefits. They must pay higher payroll tax rates while at work to protect the solvency of Social Security (and the real benefits flowing to retired workers). Because we assume that Social Security eventually reverts to pay-as-you-go financing, higher taxes after 2075 will never produce large increases in the government or national saving rate.

Another implication of this analysis is worth noting. The improved fortune of Social Security when Trust Fund reserves are aggressively invested is not without cost. The rate of return on domestically invested saving declines, and it declines by successively larger amounts as the percentage of Trust Fund reserves held in equities increases. This reduces the flow of income received by other owners of U.S. capital, and it may be regarded as an implicit tax on private capital income. It is certainly the case that under an aggressive Trust Fund investment strategy a smaller percentage of capital income flows to private owners of capital; a growing percentage of capital income is diverted to pay for Social Security benefits. Social Security contributors are better off as a result of this diversion, but other owners of U.S. capital are worse off. The same redistribution of capital income occurs when workers are required to contribute 2 percent of their wages to DC pension accounts. The new pension accounts will own a growing percentage of private capital. To the extent that additions to the accounts boost national saving, they reduce the return obtained by other owners of capital. If the reduction in returns is as large as predicted in the bottom panels of Tables 5 and 8, it is reasonable to ask whether other private savers will continue to save as much as assumed in our baseline model.

7. Investing Increased Saving Overseas

When additions to pension saving boost national saving, the destination of the extra saving is crucial in determining the effect of reformed pension policy on future wages, capital returns, and aggregate income. If the additional saving is invested exclusively in the United States, as we assume in earlier sections, the resulting increase in the capital stock will improve productivity and real wages but depress capital returns. An alternative view is that some of the extra saving will flow overseas where it can obtain a better rate of return. Faced with a sharp decline in the rate of return on their domestic investments, it seems reasonable to believe U.S. savers will look abroad for more attractive investment possibilities. Whether such opportunities are plentiful enough or attractive enough to absorb *all* of the additional saving that results from U.S. pension reform is an open question (see Bosworth and Burtless, 1997, esp. pp. 263-67). In this section we assume that foreign investment opportunities are plentiful enough to absorb sizable increases in U.S. saving.

We can use our model of the aggregate economy and simple assumptions about the exchange rate mechanism to analyze the implications of pension reform if the resulting increase in saving is invested overseas. To perform this analysis we assume that enough of the increase in saving is invested abroad to leave the rate of return on domestic business capital unchanged from the rate of return predicted under our baseline assumptions.[32] In addition, we assume U.S. overseas investments earn a before-tax rate of return equal to that in our baseline simulation for capital in the domestic nonfarm business sector. In other words, foreign investments are not subject to diminishing returns.

For U.S. savers to acquire overseas assets faster than foreign savers acquire assets in the United States, the required transfer of resources must be financed by increased net exports of U.S. goods and services. This will require some reduction in the relative price of American products, that is, a depreciation of the dollar. In later years, of course, the exchange rate should recover as the inflows of earnings on overseas capital investments come to equal and later to

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[32] Additions to saving, whether invested domestically or overseas, must boost U.S. national income. Because Americans are wealthier as a result of the extra income, they will devote part of their increased income to better housing, and their government will invest more in public capital. Private business capital remains at its baseline value.

exceed the annual capital outflows to other countries. To reflect this pattern of exchange rate movements, we assume that a change in the resource balance equal to 1 percent of national income is associated with a 5 percent appreciation of the currency. We measure the annual resource transfer as the change in net foreign investment minus the inflow of capital income – that is, as the change relative to the baseline in the balance of trade in goods and services.[33]

Table 10 shows the effects of the three alternative reform options on the overall economy when net additions to pension fund reserves add to national saving and increases in national saving are invested overseas. Under these assumptions, none of the plans produce an increase in investment in the business sector or an increased flow of capital services (see column 1). All three plans nonetheless yield a noticeable increase in saving measured as a percent of NNP (see the right-hand column). Our assumptions also imply the rate of return on domestic business capital will be the same as in the baseline projection. The increase in national income is less than when the capital is invested domestically because the corporate taxes are paid to foreign governments and Americans receive only the after-tax return.

Real consumption must initially decline under all three plans, for an increased percentage of national income is saved through larger government budget surpluses and, under the third plan, through accumulation of sizable reserves in new DC accounts. The effects of increased saving on aggregate consumption are eventually reversed when the flow of income from overseas assets exceeds the increase in savings arising from the higher saving rate. Under both the first and second plans, the government's contribution to national saving eventually turns negative, and when that happens real consumption rises above the baseline level both because national income is higher than in the baseline and because the saving rate is slightly lower. The government's saving rate is only temporarily negative under both the first and second reform plans, but the period of government dissaving lasts long enough to eliminate most of the gain in overseas assets. As in our earlier simulations, we find that the third plan produces the largest and most sustained increase in national saving and ultimately produces the biggest increase in national income.

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[33] See Bosworth and Burtless (1997) for a further discussion of the empirical parameters.

All three plans cause a temporary fall in the U.S. exchange rate. This effect is larger in the second and third plans because they cause the biggest initial jump in overseas investment. The adverse move of the exchange rate depresses real wages, because workers must use more of their product wage to buy the foreign goods and services that remain in their consumption basket. Eventually the flow of income from foreign investments reverses the exchange rate effect, and workers benefit from a real appreciation of the dollar. Their real wages improve compared with the baseline projection.

Despite the gains from exchange rate appreciation, the increase in real wages is much smaller than the increase that would result from equivalent investments in the U.S. business capital stock (compare the wage gains for 2075 in Tables 5 and 10). If additional saving were invested in the United States, American workers would obtain higher real wages as a result of their higher productivity. If the additional saving flows overseas, their productivity remains unchanged but their consumption possibilities improve as goods and services produced overseas become cheaper. Most of the benefits of the additional overseas investments flow to U.S. owners of those investments and foreign workers, however. When American workers are forced to become owners of capital, as they are under the third reform plan, they benefit from the flow of income from overseas investments. Their DC accounts yield a higher rate of return when additions to saving can be invested abroad than when those additions must be invested in the U.S. business sector.

Table 11 shows the impacts of overseas investment on the pension system itself under the three reform plans. The effects of the reforms are very similar to those that would occur if the accumulation of reserves in the Trust Fund and DC pension accounts produced *no* increase in national saving, the static analysis. The main differences arise from the fact that overseas investment of higher national saving causes a swing in the real exchange rate. This accelerates cost-of-living increases in Social Security in some periods and reduces such adjustments in other periods. Under the first reform plan, for example, the real value of OASDI taxes and benefits initially falls slightly as a result of the depreciation in the dollar. The effect on benefits soon shrinks, because Social Security pensions are annually adjusted in line with changes in the consumer price index. Workers who obtain new benefits after an acceleration in price inflation, however, receive permanently reduced benefits, decreasing real Social Security benefit outlays in

comparison with what they would be with slower inflation and faster real wage growth. When the U.S. dollar appreciates against other world currencies, this effect is reversed. New Social Security benefit awards are higher in real terms than they would be without the additional overseas investments. All of these impacts are quite small, however, because the predicted movements in the real exchange rate are small.[34]

Figure 13 shows the impact of the three reform plans on net lifetime earnings, pension benefits, and net incomes when additions to reserves are invested abroad. As in Figure 11, our calculations were performed for workers in successive cohorts who have the composite lifetime earnings profile. In comparison with the results in Figure 11, those in Figure 13 show very modest effects of the reform plans on workers' net lifetime wages and incomes. All three plans reduce the real (after-tax) lifetime earnings of workers who retire immediately after 2000. The effect is very slight for the first reform plan, which of course has the smallest impact on the lifetime retirement contributions of workers retiring between 2000 and 2030. For workers retiring in 2075, however, the first reform option reduces net lifetime earnings by 1½ percent, approximately the extra share of their lifetime wages that are needed to pay for Social Security Old-Age pensions if the current benefit formula is to be maintained. As before, the biggest initial impact of any of the reform options is produced by the plan that periodically reduces Social Security benefits and introduces a new DC pension plan. This plan directly reduces workers' net wages by imposing a 2-percent mandatory contribution for DC pensions, and it indirectly depresses real wages by causing a depreciation of the dollar. These effects are compounded for workers retiring before 2030 by the loss of Social Security benefits (see the middle panel of Figure 13). Eventually, however, the third plan produces higher retirement benefits and lifetime net incomes than the other two plans. In comparison with the baseline projection, real retirement benefits are 4 percent higher and net lifetime income is 1 percent

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[34] One finding in Table 11 may seem odd. OASDI taxes under the third reform plan are predicted to be lower than in the baseline simulation, even though real gross wage rates are predicted to rise as a result of the long-term improvement in the U.S. exchange rate (see the bottom panel of Table 10). Part of OASDI tax revenues are obtained by imposing federal income taxes on Social Security benefits, however. Because Social Security benefits are dramatically reduced under the third reform plan, we predict that income tax revenues would also fall under that option. While it is true that these lost federal tax revenues could be made up by taxes on the new DC pensions, we do not assume such revenues would be automatically dedicated to the Social Security Trust Fund.

higher under the plan that periodically trims Social Security benefits and replaces them with DC pensions. Much of the improvement in net lifetime income occurs late in workers' lives and is the result of good capital market returns on contributions to DC pensions.

The implications of the three reform plans for net lifetime wages, pensions, and real income of workers with different earnings profiles are displayed in Table 12. The results in this table highlight the importance of traditional Social Security benefits for workers with low lifetime wages. Even though the third reform plan eventually boosts real lifetime wages more than the other two plans, it forces all low-wage workers and some average-wage workers to accept big cuts in retirement income. For low-wage workers who retire in 2075, the loss of retirement benefits amounts to 7.5 percent to 14.6 percent of retirement income in the baseline projection, forcing these workers to accept a reduction in net lifetime income equal to 2.4 percent to 4.3 percent of income in the baseline forecast. High-earnings workers, especially those who earn most of their wages early in their careers, do much better under the third reform plan. High-wage workers who retire in 2075 enjoy pension increases amounting to 6.0 percent to 16.6 of expected pensions under the baseline assumptions and lifetime earnings improvements equal to 1.3 percent to 3.0 percent of their net earnings in the baseline forecast.

The other two plans are more successful in preserving retirement benefits for low-wage workers. They are also more successful in allocating lifetime earnings sacrifices relatively equitably across the different earnings classes. In contrast with the third reform plan, however, the first two plans cannot avoid imposing modest cuts in the net lifetime incomes available to all classes of workers. The income cuts are the direct result of the higher lifetime taxes that must be levied to maintain the present Social Security formula. Unless the added saving generated by these taxes is invested in U.S. business capital, American workers benefit only modestly from the saving. Their ultimate earnings gains when extra saving flows overseas are too small to offset the effect of the higher Social Security tax rate. Thus, most workers who retire in the second half of the twenty-first century receive lower lifetime incomes than implied under our baseline assumptions.

The results in Table 12 contrast sharply with those presented in Table 7, which reflects workers' gains when additions to saving are invested domestically. When the saving is invested domestically, the productivity of U.S. workers is enhanced and they earn higher wages. While

their DC pensions are enhanced by the higher rate of return associated with investing abroad, that is not enough to offset the loss of wage income. The option of investing abroad is associated with lower lifetime income for all nine earnings profiles and all three reform plans.

8. Conclusion

In assessing the economic and distributional effects of Social Security reform, it is plainly important to determine whether reform will give rise to changes in aggregate saving and, if so, whether the additions to saving will be invested domestically or overseas. When reform boosts national saving, our findings suggest that the direct and indirect effects of the extra saving can strengthen Social Security finances and eventually improve the consumption possibilities of American workers. Their consumption possibilities are improved the most when most of the extra saving generated by reform is invested in the United States, where it can raise the capital-labor ratio and real wages.

The distribution of income and pension improvements across workers is sensitive to the details of reform. In general, reforms that maintain the existing structure of benefits are helpful in the short- and intermediate-term to low-wage workers, no matter what we assume about where the extra saving is invested. Because low-wage workers are disproportionately favored under the current benefit formula, reforms that scale back traditional benefits tend to threaten the lifetime incomes and retirement incomes of such workers. If the extra saving generated by reform is invested in the United States, however, even low-wage workers can eventually benefit from greatly improved real wages.

The assumptions we examine in this study are extreme. It is unlikely that reform will boost national saving by one dollar for each dollar of additional accumulation in the pension reserve. Part of any addition to the Trust Fund or to new DC pension accounts is likely to be offset by a reduction in other public or private saving. It is also unlikely that an induced change in U.S. national saving would be entirely invested in the United States or entirely invested overseas. The extreme assumptions we evaluate here probably bracket the truth. Under all the assumptions we examine it seems clear that a consumption sacrifice in the near term can produce net consumption gains for some or all workers in the long-term. If the extra saving is invested domestically, low-, average-, and high-wage workers will capture a larger percentage of the

consumption gains. If the additions to saving are invested overseas, the U.S. benefits will be captured by the people who own the new investments – including U.S. workers if they choose to or are forced to become investors.

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Table 1. Economic Effects of a Permanent Rise in the National Saving Rate, Invested Domestically

Percent change in comparison with baseline

	Effects on aggregate economy						
Year	Wealth	Capital services	GNP	NNP	Consumption	Wage rate	Return on capital
2000	0.5	0.9	0.0	0.0	-1.3	0.0	-0.4
2025	12.9	25.5	4.8	2.9	1.5	6.3	-19.1
2050	25.8	48.1	9.0	5.2	3.5	11.3	-34.0
2075	38.3	67.6	12.4	6.6	4.7	15.3	-45.5

	Effects on the OASDI program			
Year	OASDI Taxes	OASDI benefits	Interest receipts a/	Assets in Trust Fund a/
2000	0.0	0.0	0.0	0.0
2025	6.1	2.7	2.7	3.0
2050	11.1	7.2	14.5	9.5
2075	15.0	11.6	47.2	26.9

Note: National saving rate increased by one percent of NNP.

a/ The change in interest receipts is measured as a percent of non-interest OASDI income; the change in the Trust Fund is expressed as a percent of NNP.

Table 2. Frequency Distributions of Workers by Earnings Class, Cohorts Born 1921-1960

Level of earnings	Trend in earnings	Men born in --				Women born in --			
		1921-30	1931-40	1941-50	1951-60	1921-30	1931-40	1941-50	1951-60
		Distribution by Income Level and Trend							
Low	**Declining**	8	10	13	18	23	25	19	12
	Level	1	0	1	2	5	5	4	9
	Increasing	4	4	3	1	26	24	22	21
Middle	**Declining**	15	19	20	29	10	9	9	7
	Level	4	3	4	3	5	5	9	21
	Increasing	8	4	4	1	24	22	18	8
High	**Declining**	17	25	19	21	1	1	2	1
	Level	26	24	31	26	2	3	9	19
	Increasing	18	10	5	0	3	6	8	2
	Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
		Distribution by Average Earnings Level							
Low		13	14	17	20	54	54	45	42
Middle	**(All trends)**	26	26	28	33	39	36	36	36
High		61	59	55	47	7	10	19	22
	Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
		Distribution by Trend Pattern							
(All levels)	**Declining**	40	54	52	67	34	35	30	21
	Level	31	28	36	31	13	13	22	49
	Increasing	29	18	12	2	53	52	49	30
	Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

Source: Authors' tabulations of matched SIPP-SSER files (1990-1993 SIPP panels).

Table 3. Replacement Rates and Internal Rates of Return by Earnings Profile, 1995-2035

Level of earnings	Trend in earnings	Lifetime relative earnings a/	Replacement rate (%)			Internal real rate of return (%)		
			1995	2015	2035	1995	2015	2035
Low	Declining	0.21	81	83	83	6.2	4.9	4.7
	Level	0.17	74	74	72	6.5	5.2	4.9
	Increasing	0.19	79	77	74	7.3	6.0	5.6
Middle	Declining	0.89	43	44	43	4.5	3.4	3.2
	Level	0.87	42	43	41	4.7	3.7	3.5
	Increasing	0.73	45	45	43	5.4	4.5	4.2
High	Declining	1.94	31	32	31	4.1	2.6	2.4
	Level	2.15	29	30	29	3.7	2.5	2.3
	Increasing	1.82	32	33	31	3.8	3.0	2.8
All earnings profiles		*1.00*	*40*	*40*	*39*	*4.4*	*3.5*	*3.3*

a/ Lifetime relative earnings are measured here as the worker's average relative earnings over a career divided by the average relative earnings of every worker in the same birth cohort.

Source: Authors' tabulations (see text).

Table 4. Internal Rates of Return under Social Security Reform Plans, by Earnings Profile, 1995-2035

Percent

Level of earnings	Trend in earnings	Option #1: Delayed tax increase				Option #2: Immediate 2% tax increase			
		1995	2015	2035	2075	1995	2015	2035	2075
Low	Declining	6.2	4.9	4.7	3.9	6.2	4.9	4.4	4.2
	Level	6.5	5.2	4.8	4.0	6.5	5.1	4.6	4.3
	Increasing	7.3	6.0	5.4	4.6	7.3	5.8	5.3	4.9
Middle	Declining	4.5	3.4	3.2	2.4	4.5	3.3	2.8	2.7
	Level	4.7	3.7	3.3	2.5	4.7	3.5	3.0	2.8
	Increasing	5.4	4.6	3.9	3.1	5.4	4.2	3.7	3.2
High	Declining	4.1	2.6	2.3	1.5	4.1	2.5	2.0	1.8
	Level	3.7	2.5	2.1	1.3	3.7	2.3	1.8	1.6
	Increasing	3.8	3.0	2.5	1.7	3.8	2.8	2.3	1.9
All earnings profiles		*4.4*	*3.5*	*3.1*	*2.3*	*4.4*	*3.3*	*2.8*	*2.6*

Level of earnings	Trend in earnings	Option #3: Benefit cut and level DC annuity				Option #3: Benefit cut and variable DC annuity			
		1995	2015	2035	2075	1995	2015	2035	2075
Low	Declining	6.2	4.7	4.0	3.8	6.2	4.7	4.3	4.2
	Level	6.5	4.9	4.1	3.9	6.5	5.0	4.4	4.3
	Increasing	7.3	5.6	4.6	4.4	7.3	5.7	4.8	4.7
Middle	Declining	4.4	3.1	2.8	2.8	4.4	3.2	3.3	3.4
	Level	4.6	3.4	2.9	2.8	4.6	3.5	3.4	3.4
	Increasing	5.4	4.1	3.3	3.1	5.4	4.3	3.7	3.7
High	Declining	4.1	2.3	2.2	2.2	4.1	2.5	2.9	3.0
	Level	3.7	2.2	2.1	2.0	3.7	2.5	2.8	2.9
	Increasing	3.8	2.7	2.3	2.2	3.8	3.0	3.0	3.0
All earnings profiles		*4.4*	*3.2*	*2.8*	*2.7*	*4.4*	*3.3*	*3.3*	*3.3*

Source: Authors' tabulations (see text).

Table 5. Effects on the Economy of Alternative Social Security Reforms when Additions to Pension Reserves Are Invested in the U.S.

Percent change in comparison with baseline unless otherwise noted

Year	Capital services	GNP	NNP	Consumption	Wage rate	Return on capital	Net addition to saving a/
Option # 1: Pay-as-you-go tax increases							
2000	0.7	0.0	0.0	-0.9	0.0	-0.3	0.7
2025	1.9	0.7	0.7	1.7	0.7	-1.1	-0.7
2050	7.8	1.5	0.9	0.3	2.0	-7.0	0.4
2075	8.3	2.0	1.4	1.6	2.3	-7.5	-0.2
Option # 2: 2% OASDI tax increase in 2000							
2000	1.5	-0.2	-0.2	-2.1	0.0	-0.6	1.7
2025	35.7	6.9	4.3	3.7	8.8	-25.2	0.4
2050	22.3	5.1	3.5	4.4	6.0	-17.5	-0.7
2075	13.3	3.0	1.9	1.7	3.5	-11.8	0.1
Option # 3: Pay-as-you-go benefit cut + 2% DC pension							
2000	1.4	-0.1	-0.2	-2.0	0.0	-0.6	1.5
2025	37.9	7.2	4.5	3.7	9.3	-26.4	0.5
2050	54.3	10.2	5.9	4.7	12.7	-37.2	0.7
2075	55.4	10.7	6.1	5.3	13.0	-39.2	0.4

a/ Net addition to saving is measured as a percent of contemporaneous NNP.

Table 6. Effects on the Pension System of Alternative Social Security Reforms when Additions to Pension Reserves Are Invested in the U.S.

Percent change in comparison with baseline unless otherwise noted

Option # 1: Pay-as-you-go tax increases

Year	OASDI Taxes	OASDI benefits	Interest receipts a/	Assets in OASDI Trust Fund a/	Net addition to saving from Trust Fund b/	Net addition to saving from DC accounts b/
2000	0.0	0.0	0.0	0.0	0.7	n.a.
2025	10.1	1.3	1.7	1.9	-0.7	n.a.
2050	37.4	1.0	58.8	53.6	0.4	n.a.
2075	38.6	2.1	143.6	124.5	-0.2	n.a.

Option # 2: 2% OASDI tax increase in 2000

Year	OASDI Taxes	OASDI benefits	Interest receipts a/	Assets in OASDI Trust Fund a/	Net annual addition to Trust Fund b/	Net annual saving in DC accounts b/
2000	15.8	0.0	0.7	0.9	1.7	n.a.
2025	25.4	4.4	30.3	31.5	0.4	n.a.
2050	22.1	6.9	66.0	60.9	-0.7	n.a.
2075	49.0	4.9	141.7	123.1	0.1	n.a.

Option # 3: Pay-as-you-go benefit cut and 2% DC pension

Year	OASDI Taxes	OASDI benefits	Interest receipts a/	Assets in OASDI Trust Fund a/	Net annual addition to Trust Fund b/	Net annual saving in DC accounts b/
2000	0.0	0.0	0.0	0.0	0.7	0.8
2025	8.9	1.0	4.5	5.3	-0.7	1.2
2050	10.8	-17.3	53.9	49.9	0.2	0.5
2075	10.5	-22.7	138.4	120.7	0.1	0.3

n.a. = Not applicable.

a/ The change in OASDI interest receipts is measured as a percent of non-interest OASDI income in the baseline simulation; the change in the Trust Fund is measured as a percent of NNP in the baseline simulation.

b/ Net additions to the OASDI Trust Fund and to DC pension accounts are measured as a percent of contemporaneous NNP.

Table 7. Change in Lifetime Earnings, Pensions, and Net Income under Alternative Pension Reforms, by Lifetime Earnings Profile and Retiree Cohort, When Additions to Savings Are Invested Domestically

Percent change in comparison with baseline

Year of retirement	Earnings profile: Low wage 1	2	3	Average wage 4	5	6	High wage 7	8	9	Composite
Policy option #1: Delayed tax increase										
Lifetime earnings										
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	0.5	1.0	1.3	0.7	1.1	1.4	0.9	1.1	1.3	1.0
2050	0.7	0.2	0.0	0.3	0.0	-0.2	0.1	0.0	-0.1	0.0
2075	0.1	0.5	0.6	0.4	0.6	0.8	0.5	0.6	0.7	0.6
Lifetime pension										
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
2050	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
2075	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Lifetime income a/										
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	0.5	0.9	1.2	0.7	1.0	1.3	0.9	1.0	1.2	1.0
2050	1.1	0.7	0.6	0.6	0.4	0.2	0.4	0.3	0.2	0.4
2075	0.9	1.0	1.2	0.8	1.0	1.1	0.8	0.9	1.0	0.9
Policy option #2: 2% tax increase										
Lifetime earnings										
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	1.1	2.8	4.5	1.9	3.3	4.6	2.5	3.3	4.0	3.1
2050	7.0	6.9	6.5	7.2	7.1	6.8	7.2	7.1	7.0	7.1
2075	5.2	3.9	3.0	4.4	3.5	2.7	4.0	3.5	3.0	3.6
Lifetime pension										
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
2050	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
2075	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Lifetime income a/										
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	3.5	4.6	5.8	3.2	4.3	5.4	3.4	4.0	4.7	4.1
2050	6.7	6.6	6.3	7.0	6.8	6.6	7.0	6.9	6.8	6.8
2075	4.6	3.8	3.2	4.2	3.5	2.9	3.9	3.5	3.1	3.6
Policy option #3: Reduced S.S. + DC pension										
Lifetime earnings										
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	0.9	2.7	4.4	1.7	3.1	4.5	2.3	3.1	3.9	2.9
2050	7.5	8.4	9.1	8.1	8.9	9.5	8.5	8.9	9.3	8.8
2075	11.0	11.3	11.4	11.3	11.5	11.6	11.4	11.5	11.6	11.4
Lifetime pension										
2000	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
2025	-5.4	-3.0	-3.4	2.9	4.9	4.8	9.6	11.5	10.6	5.3
2050	-1.8	-2.8	-5.4	8.9	5.9	1.3	16.4	16.2	10.5	7.8
2075	-10.5	-11.1	-13.3	-0.9	-3.2	-6.9	5.9	6.0	1.2	-1.6
Lifetime income a/										
2000	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2	-0.2	-0.1	-0.2	-0.2
2025	-1.1	1.1	2.1	1.9	3.4	4.5	3.4	4.3	4.9	3.4
2050	4.4	5.0	4.7	8.3	8.3	7.8	9.7	9.9	9.4	8.6
2075	3.7	4.3	3.6	8.7	8.5	7.7	10.5	10.6	9.9	8.9

Note: Earnings profiles 1, 4, and 7 show declining earnings over a career; profiles 2, 5, and 8 have level earnings; and profiles 3, 6, and 9 have rising earnings. Additions to Trust Fund reserves add to national saving and are invested in the United States.

a/ Lifetime income is the sum of lifetime earnings and lifetime pensions from the reformed pension system (see text).

Source: Authors' tabulations.

Table 8. Effects on the Economy of Alternative Trust Fund Investment Policies a/

Percent change in comparison with baseline unless otherwise noted

Year	Capital services	GNP	NNP	Consumption	Wage rate	Return on capital	Net addition to saving b/
Option # 2 with Trust Fund invested in government bonds							
2000	1.5	0.0	0.0	-2.1	0.0	-0.6	1.7
2025	35.7	6.9	4.3	3.7	8.8	-25.2	0.4
2050	22.3	5.1	3.5	4.4	6.0	-17.5	-0.7
2075	13.3	3.0	1.9	1.7	3.5	-11.8	0.1
Option # 2 with Trust Fund 70% in bonds and 30% in equities							
2000	1.5	0.0	0.0	-2.1	0.0	-0.6	1.7
2025	45.2	8.3	5.0	3.6	10.8	-30.5	1.0
2050	46.5	9.2	5.6	5.4	11.2	-32.7	0.0
2075	23.2	5.4	3.8	4.5	6.2	-18.5	-0.7
Option # 2 with Trust Fund 30% in bonds and 70% in equities							
2000	1.6	0.0	0.0	-2.2	0.0	-0.7	1.7
2025	62.3	10.7	6.0	3.1	14.0	-39.0	2.1
2050	92.2	15.7	8.3	6.1	19.8	-53.7	1.3
2075	90.4	16.2	8.6	8.2	19.7	-54.9	-0.1

a/ The effects of alternative Trust Fund investment policies are examined under policy option # 2, in which the payroll tax rate is increased 2 percentage points in 2000 and periodically in later years when Trust Fund reserves fall dangerously low.

b/ Net addition to saving is measured as a percent of contemporaneous NNP.

Table 9. Effects on the Pension System of Alternative Trust Fund Investment Policies a/

Percent change in comparison with baseline unless otherwise noted

Year	OASDI Taxes	OASDI benefits	Interest receipts b/	Assets in OASDI Trust Fund b/	Net addition to saving from the Trust Fund c/
Option # 2 with Trust Fund invested entirely in government bonds					
2000	15.8	0.0	0.7	0.9	1.7
2025	25.4	4.4	30.3	31.5	0.4
2050	22.1	6.9	66.0	60.9	-0.7
2075	49.0	4.9	141.7	123.1	0.1
Option # 2 with Trust Fund 70% in bonds and 30% in equities					
2000	15.8	0.0	0.8	0.9	1.7
2025	27.6	5.0	44.8	39.7	1.0
2050	28.1	9.6	91.2	81.1	0.0
2075	37.5	9.4	149.3	127.8	-0.7
Option # 2 with Trust Fund 30% in bonds and 70% in equities					
2000	15.8	0.0	1.0	1.0	1.7
2025	31.2	5.9	72.2	54.5	2.1
2050	37.7	14.2	137.7	118.7	1.3
2075	37.7	18.6	214.0	182.1	-0.1

a/ The effects of alternative Trust Fund investment policies are examined under policy option # 2, in which the payroll tax rate is increased 2 percentage points in 2000 and periodically in later years when Trust Fund reserves fall dangerously low.

b/ The change in OASDI interest receipts is measured as a percent of non-interest OASDI income in the baseline simulation; the change in the Trust Fund is measured as a percent of NNP in the baseline simulation.

c/ Net additions to the OASDI Trust Fund and to DC pension accounts are measured as a percent of contemporaneous NNP.

Table 10. Effects on the Economy of Alternative Social Security Reforms when Additions to Pension Reserves Are Invested Abroad

Percent change in comparison with baseline unless otherwise noted

Year	Capital services	GNP	NNP	Consumption	Wage rate	Exchange rate	Net addition to saving a/
Option # 1: Pay-as-you-go tax increases							
2000	0.0	0.0	0.0	-0.8	-0.3	-3.1	0.7
2025	0.0	0.2	0.2	0.7	0.2	2.0	-0.4
2050	0.0	0.4	0.4	0.2	0.1	0.6	0.2
2075	0.0	0.4	0.5	0.4	0.1	1.2	0.1
Option # 2: 2% OASDI tax increase in 2000							
2000	0.0	0.0	0.0	-1.9	-0.7	-7.1	1.6
2025	0.0	2.2	2.5	2.2	0.8	7.5	0.3
2050	0.0	1.3	1.5	2.2	0.7	6.9	-0.6
2075	0.0	0.5	0.6	0.5	0.2	1.6	0.1
Option # 3: Pay-as-you-go benefit cut and 2% DC pension							
2000	0.0	0.0	0.0	-1.7	-0.7	-6.6	1.5
2025	0.0	2.6	2.9	1.8	0.6	5.9	1.0
2050	0.0	4.7	5.3	4.1	1.3	13.0	1.0
2075	0.0	5.3	6.0	5.4	1.6	16.2	0.5

a/ Net addition to saving is measured as a percent of contemporaneous NNP.

Table 11. Effects on the Pension System of Alternative Social Security Reforms when Additions to Pension Reserves Are Invested Abroad

Percent change in comparison with baseline unless otherwise noted

Year	OASDI Taxes	OASDI benefits	Interest receipts a/	Assets in OASDI Trust Fund a/	Net annual addition to Trust Fund b/	Net annual saving in DC accounts b/
Option # 1: Pay-as-you-go tax increases						
2000	-0.3	-0.3	12.2	0.0	0.7	n.a.
2025	14.1	0.1	8.4	1.8	-0.4	n.a.
2050	33.0	0.1	10.3	51.6	0.2	n.a.
2075	42.0	0.1	9.0	122.7	0.1	n.a.
Option # 2: 2% OASDI tax increase in 2000						
2000	15.0	-0.7	13.1	0.9	1.6	n.a.
2025	16.2	0.2	36.8	26.6	0.3	n.a.
2050	16.0	0.6	19.9	58.8	-0.6	n.a.
2075	42.4	0.4	9.7	122.8	0.1	n.a.
Option # 3: Pay-as-you-go benefit cut and 2% DC pension						
2000	-0.7	-0.7	12.4	0.0	0.6	0.8
2025	-0.1	-10.0	9.7	2.5	-0.5	1.5
2050	-0.4	-25.3	7.8	49.4	0.2	0.8
2075	-0.6	-30.1	6.0	120.2	0.1	0.5

n.a. = Not applicable.

a/ The change in OASDI interest receipts is measured as a percent of non-interest OASDI income; the change in the Trust Fund is measured as a percent of NNP in the baseline simulation.

b/ Net additions to the OASDI Trust Fund and to DC pension accounts are measured as a percent of contemporaneous NNP.

Table 12. Change in Lifetime Earnings, Pensions, and Net Income under Alternative Pension Reforms, by Lifetime Earnings Profile and Retiree Cohort, when Additions to Saving Are Invested Abroad

Percent change in comparison with baseline

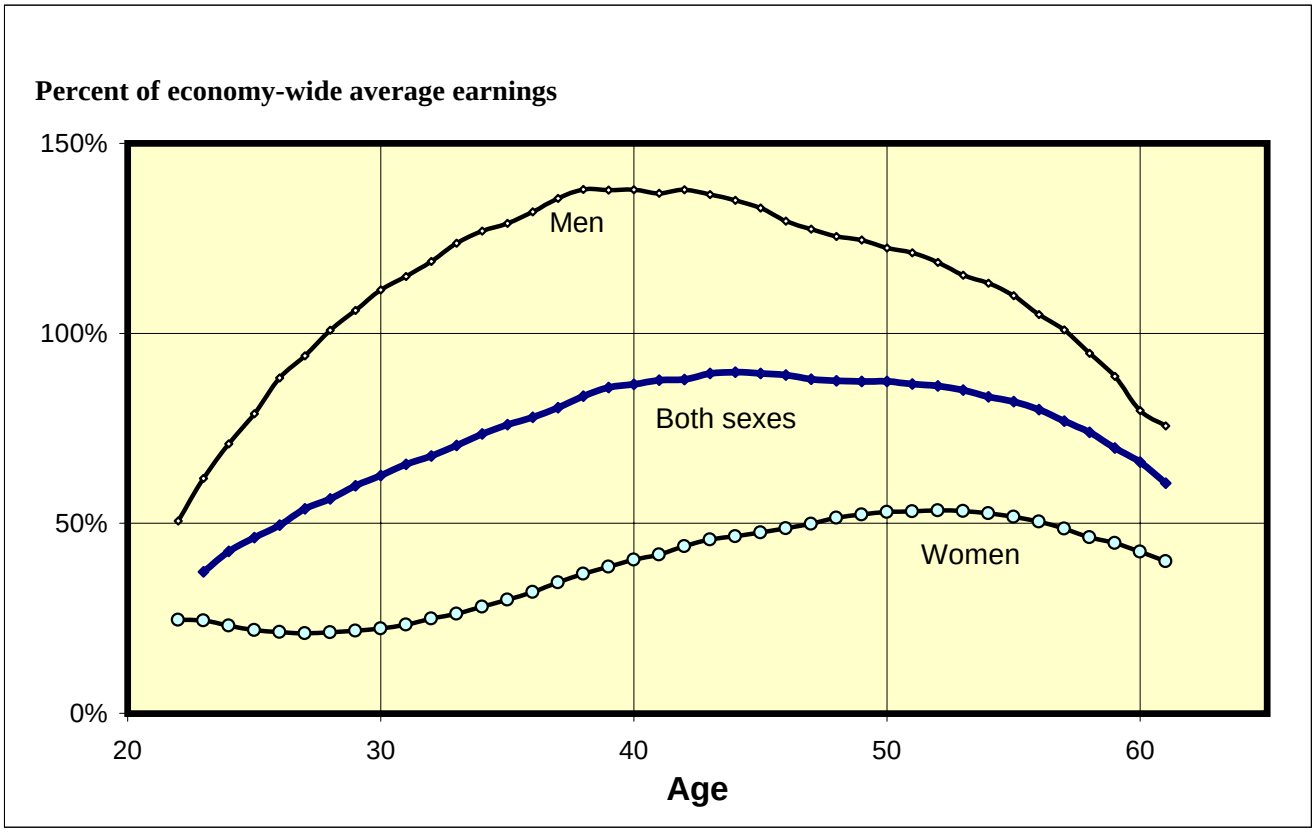
Year of retirement	Earnings profile: Low wage 1	2	3	Average wage 4	5	6	High wage 7	8	9	Composite
Policy option #1: Delayed tax increase										
Lifetime earnings										
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	0.0	0.0	0.2	0.0	0.1	0.1	0.0	0.1	0.1	0.1
2050	-0.4	-0.9	-1.1	-0.7	-1.0	-1.2	-0.8	-1.0	-1.1	-0.9
2075	-1.5	-1.5	-1.6	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5
Lifetime pension										
2000	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
2025	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2050	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2075	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Lifetime income a/										
2000	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	-0.1
2025	0.0	0.1	0.2	0.0	0.1	0.1	0.0	0.1	0.1	0.1
2050	-0.2	-0.6	-0.8	-0.5	-0.8	-1.0	-0.7	-0.8	-0.9	-0.7
2075	-0.9	-1.0	-1.0	-1.1	-1.2	-1.2	-1.2	-1.3	-1.3	-1.2
Policy option #2: 2% tax increase										
Lifetime earnings										
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	-0.4	-0.4	-0.3	-0.5	-0.5	-0.4	-0.5	-0.5	-0.5	-0.5
2050	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2075	-0.2	-0.7	-1.1	-0.4	-0.8	-1.1	-0.6	-0.8	-0.9	-0.7
Lifetime pension										
2000	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
2025	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
2050	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
2075	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Lifetime income a/										
2000	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
2025	0.0	-0.1	0.0	-0.3	-0.3	-0.2	-0.3	-0.3	-0.3	-0.3
2050	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1
2075	-0.1	-0.4	-0.7	-0.3	-0.6	-0.8	-0.5	-0.6	-0.8	-0.6
Policy option #3: Reduced S.S. + DC pension										
Lifetime earnings										
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	-0.6	-0.7	-0.7	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
2050	-0.6	-0.4	-0.3	-0.5	-0.3	-0.2	-0.4	-0.3	-0.3	-0.4
2075	0.2	0.3	0.4	0.3	0.4	0.5	0.3	0.4	0.4	0.4
Lifetime pension										
2000	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8
2025	-14.8	-12.2	-13.0	-5.1	-3.1	-3.7	2.6	4.5	3.1	-2.6
2050	-1.6	-4.3	-9.0	13.4	7.1	-1.0	23.3	21.7	12.2	10.2
2075	-7.5	-10.1	-14.6	7.1	1.0	-6.8	16.6	15.1	6.0	3.9
Lifetime income a/										
2000	-0.8	-0.8	-0.8	-0.5	-0.5	-0.5	-0.4	-0.4	-0.4	-0.5
2025	-5.0	-4.0	-4.3	-1.6	-1.2	-1.4	-0.3	-0.1	-0.2	-1.1
2050	-0.9	-1.6	-3.0	2.4	1.1	-0.4	3.3	2.9	1.7	1.6
2075	-2.4	-2.9	-4.3	1.7	0.5	-1.1	3.0	2.6	1.3	1.1

Note: Earnings profiles 1, 4, and 7 show declining earnings over a career; profiles 2, 5, and 8 have level earnings; and profiles 3, 6, and 9 have rising earnings. Additions to Trust Fund reserves add to national saving and are invested abroad.

a/ Lifetime income is the sum of lifetime earnings and lifetime pensions from the reformed pension system (see text).

Source: Authors' tabulations.

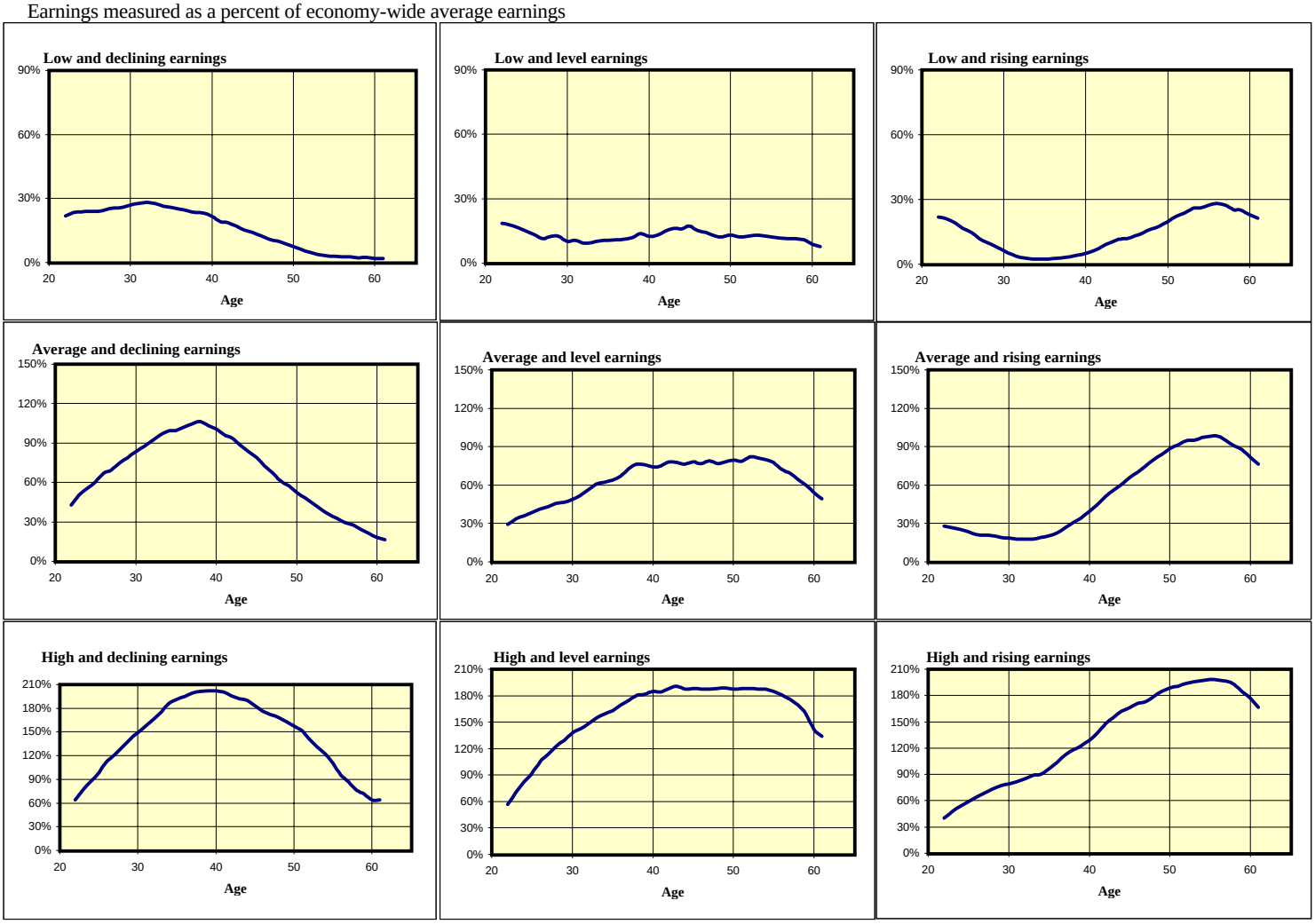
Figure 1. Aggregate Age-Earnings Profiles, 1931-40 Birth Cohort



Source: Authors' tabulations of matched SIPP-SSER files (1990-1993 SIPP panels).

Figure 2. Age-Earnings Profiles of Nine Classes of Workers, 1931-1940 Birth Cohorts

Earnings measured as a percent of economy-wide average earnings

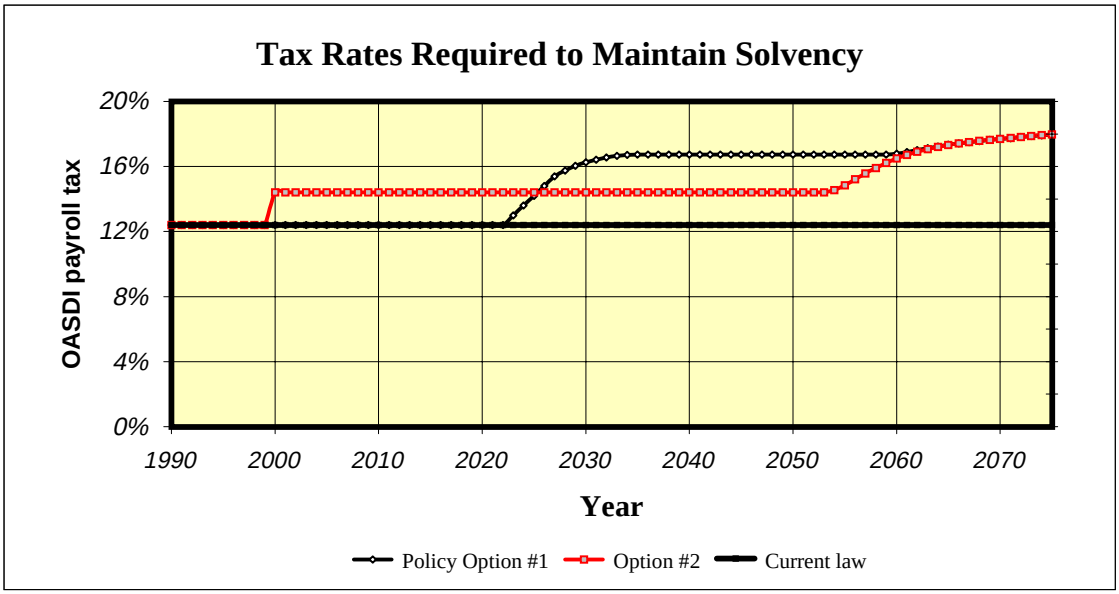


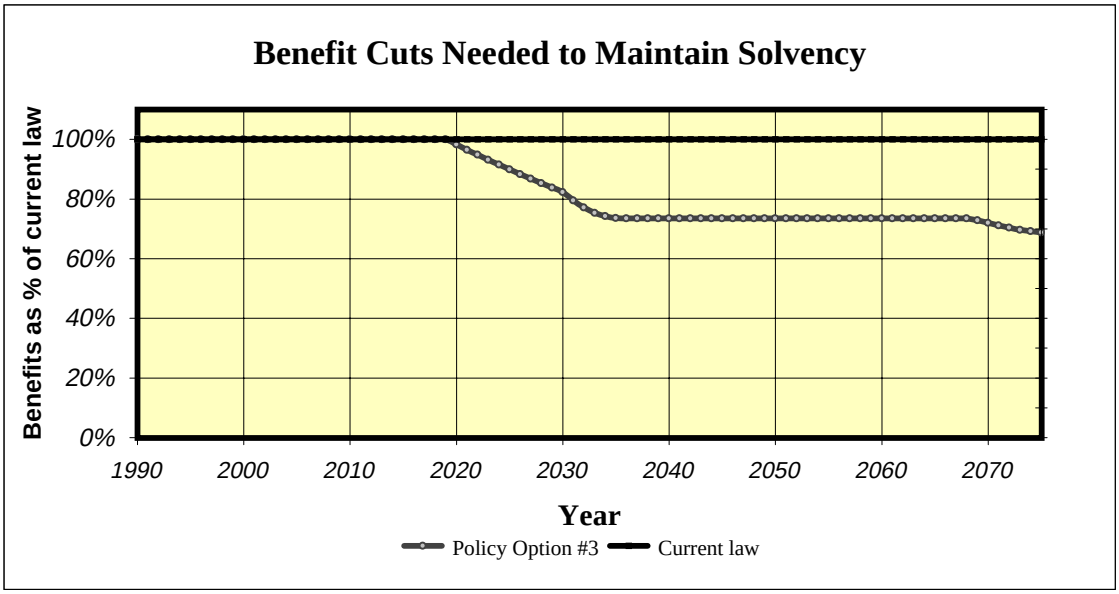
Source: Authors' tabulations of matched SIPP-SSER files (1990-1993 SIPP panels).

Percent of all workers in each age-earnings class

		Earnings trend --			
		Declining	Level	Rising	*All*
Earnings level --	Low	18%	3%	14%	***35%***
	Average	14%	4%	13%	***31%***
	High	13%	13%	8%	***34%***
	All	***44%***	***20%***	***36%***	***100%***

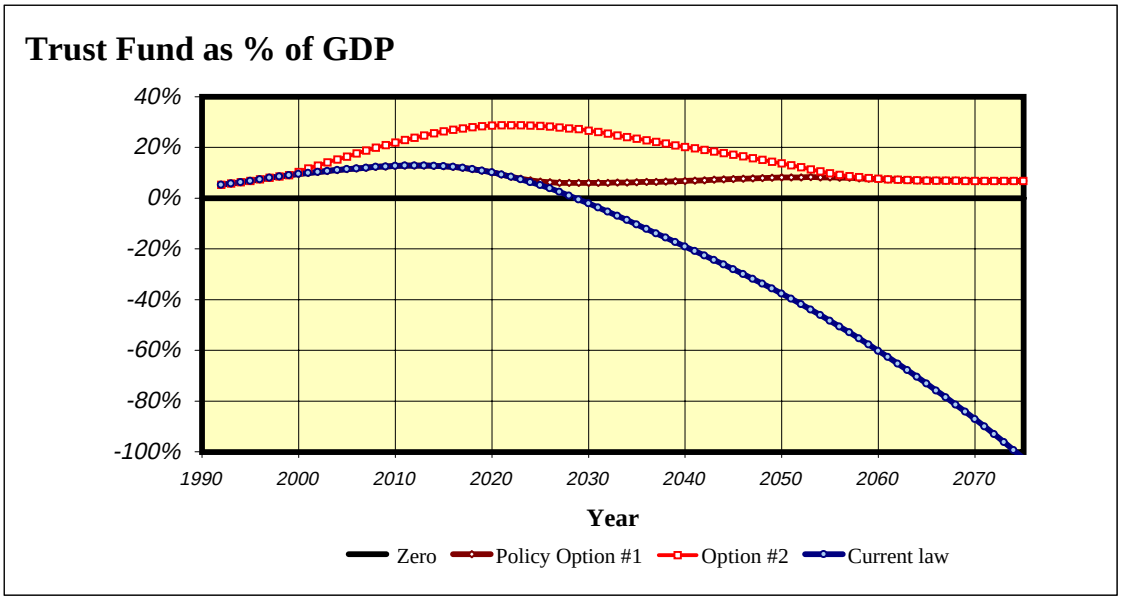
Figure 3. Tax Increases and Benefit Cuts under Three Policies to Maintain Social Security Solvency, 1990-2075

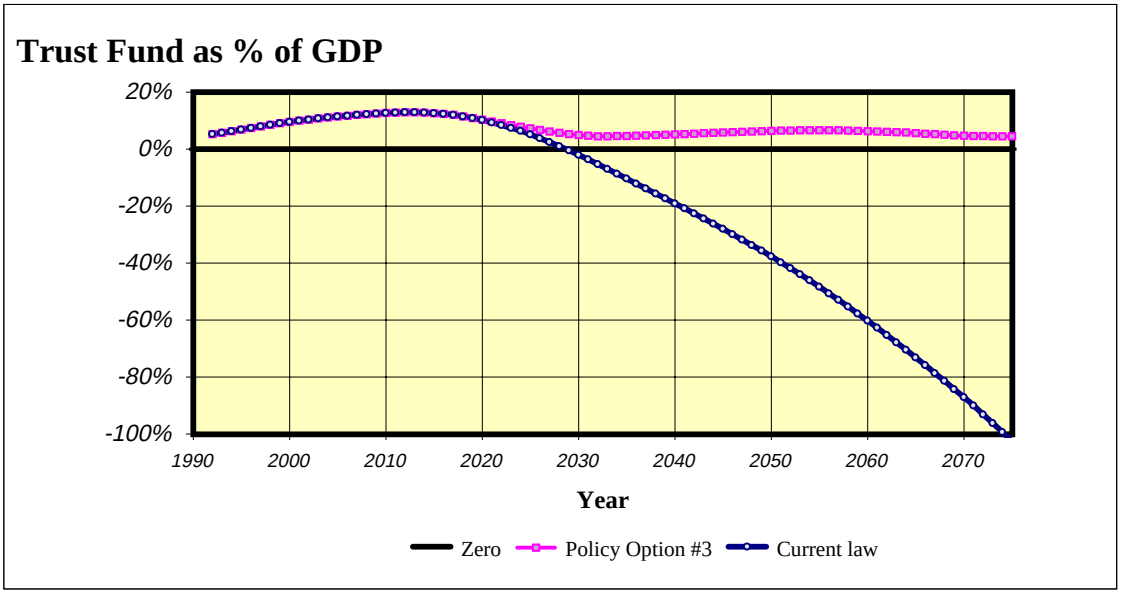




Note: Government dissaving is 0% of NNP after 1999. Additions to Trust Fund reserves do not add to national saving.

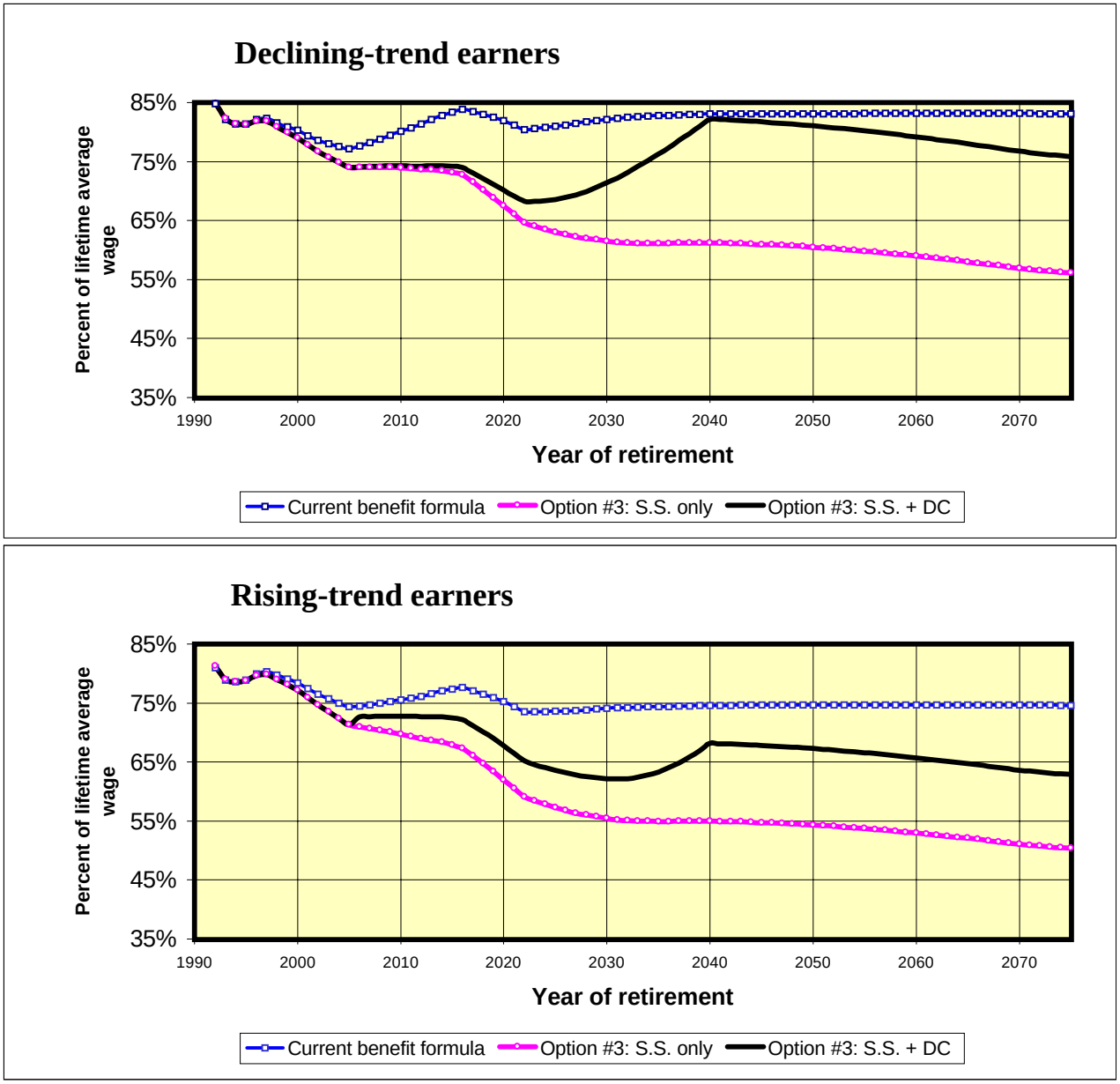
Figure 4. Trust Fund Reserves under Three Policies to Maintain Social Security Solvency, 1992-2075





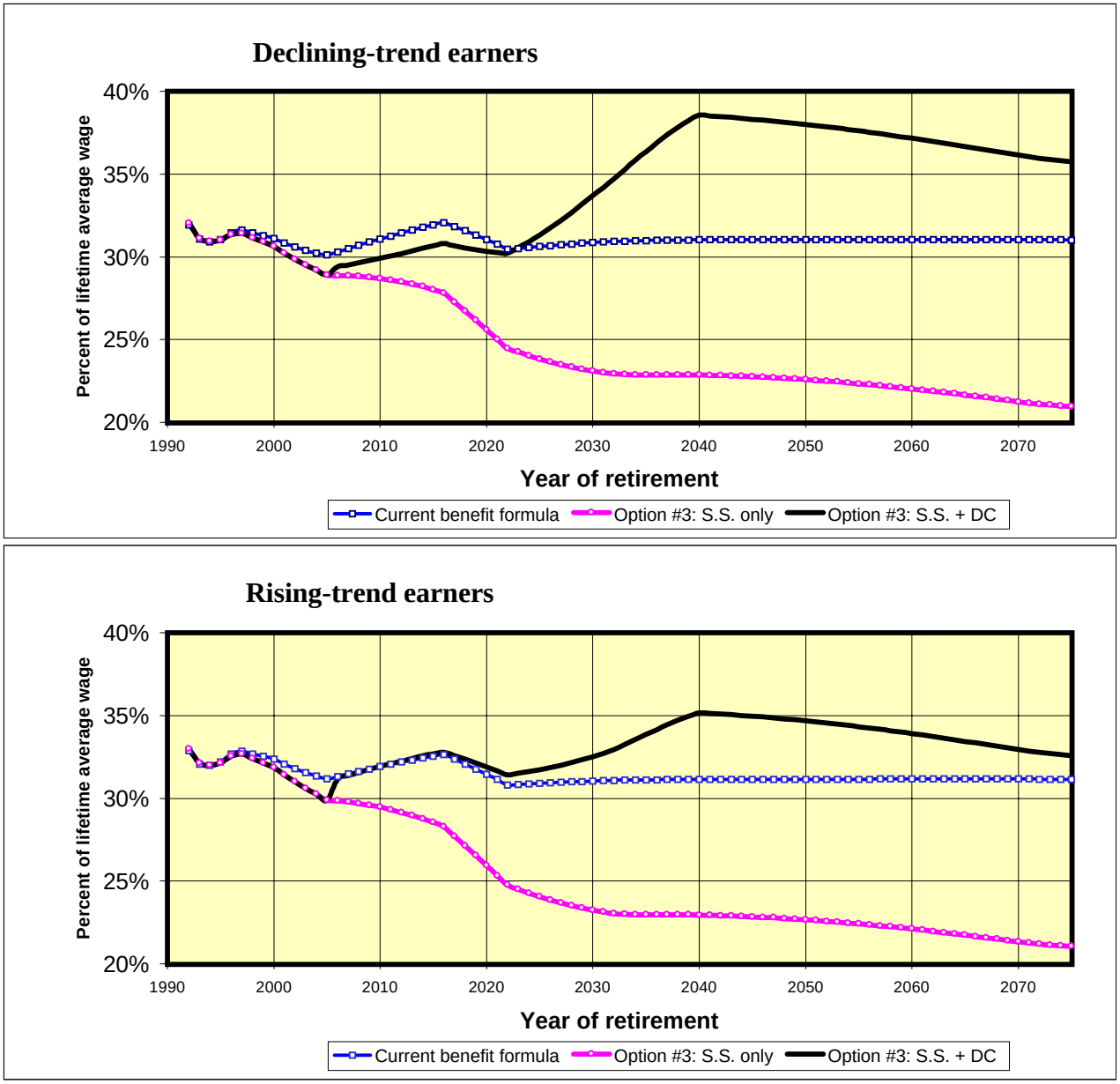
Note: Government dissaving is 0% of NNP after 1999. Additions to Trust Fund reserves do not add to national saving.

Figure 5. Replacement Rates for Low-Wage Workers under Current Law and with Benefit Reductions, 1992-2075



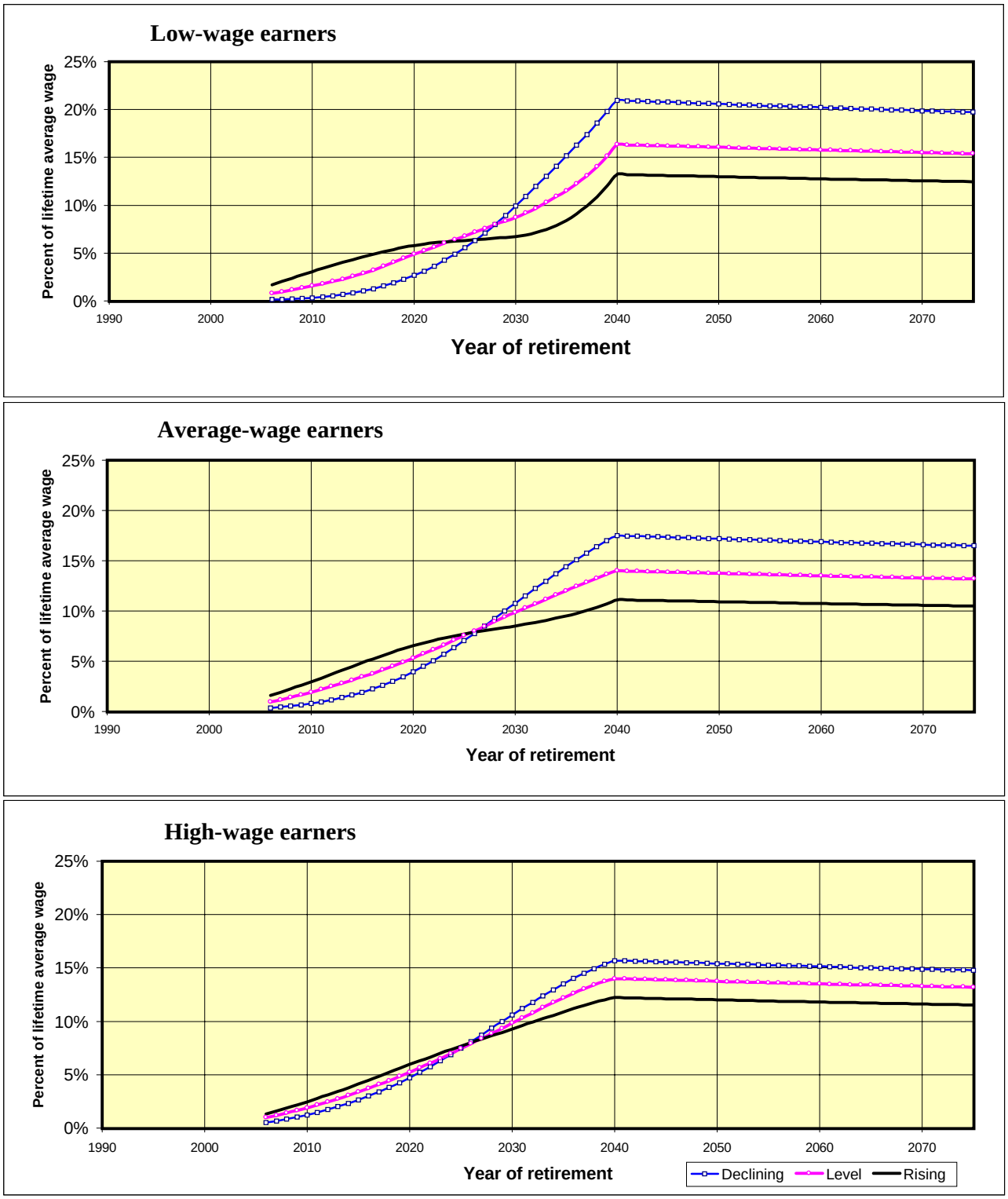
Note: Option #3 requires periodic benefit reductions to keep Social Security solvent. It also provides workers with a defined-contribution (DC) pension. Additions to Trust Fund reserves do not add to national saving.

Figure 6. Replacement Rates for High-Wage Workers under Current Law and with Benefit Reductions, 1992-2075



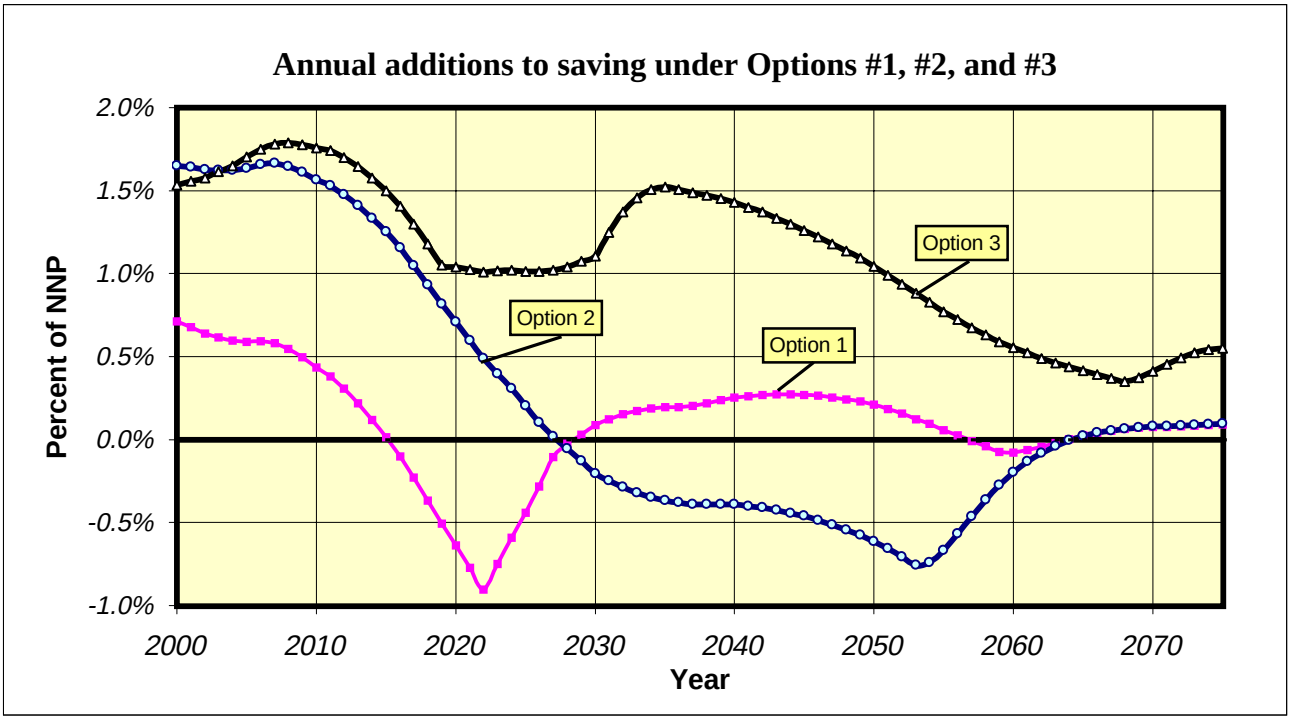
Note: Option #3 requires periodic benefit reductions to keep Social Security solvent. It also provides workers with a defined-contribution (DC) pension. Additions to Trust Fund reserves do not add to national saving.

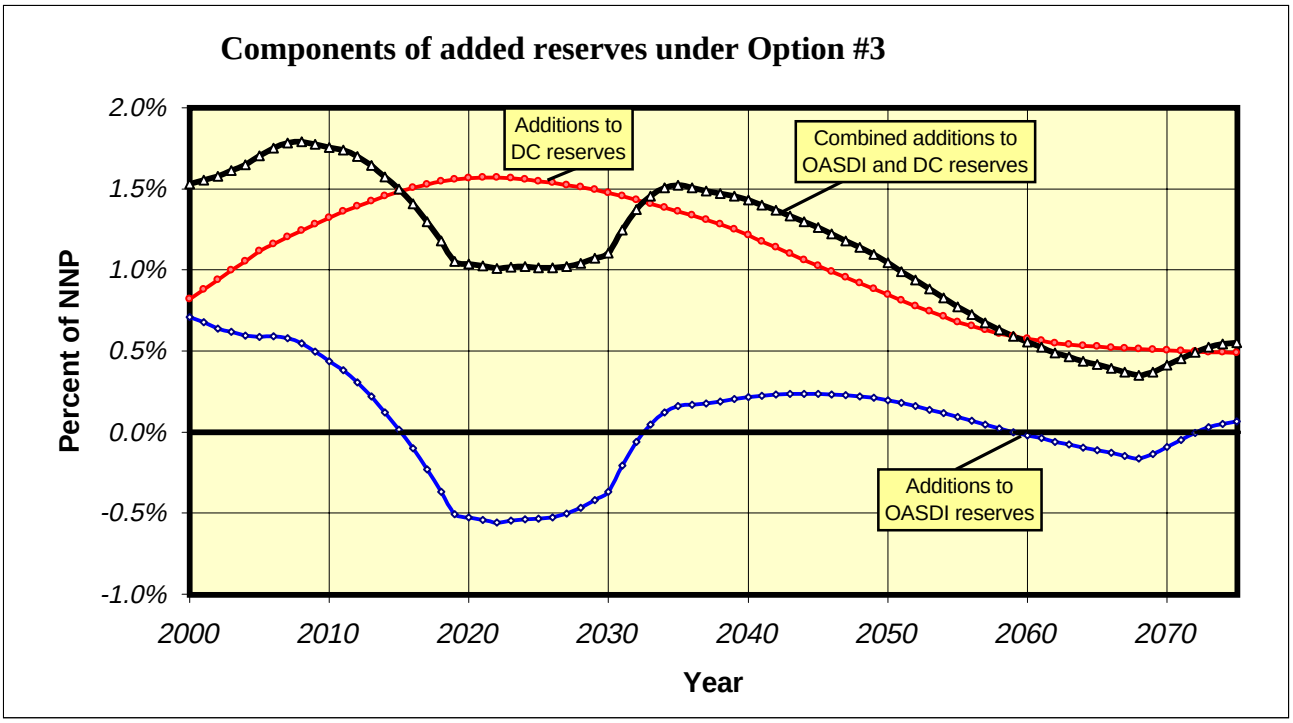
Figure 7. Replacement Rates under Defined-Contribution Pension Plan, 2000-2075



Note: Workers who are 56 years old or younger in 2000 are required to contribute 2 percent of their Social-Security-taxable earnings to a defined-contribution pension. Retirement savings in this account are converted into a level real annutiy when the worker attains age 62. Additions to Trust Fund reserves do not add to national saving.

Figure 8. Additions to Pension System Reserves under Three Reform Options, 2000 - 2075

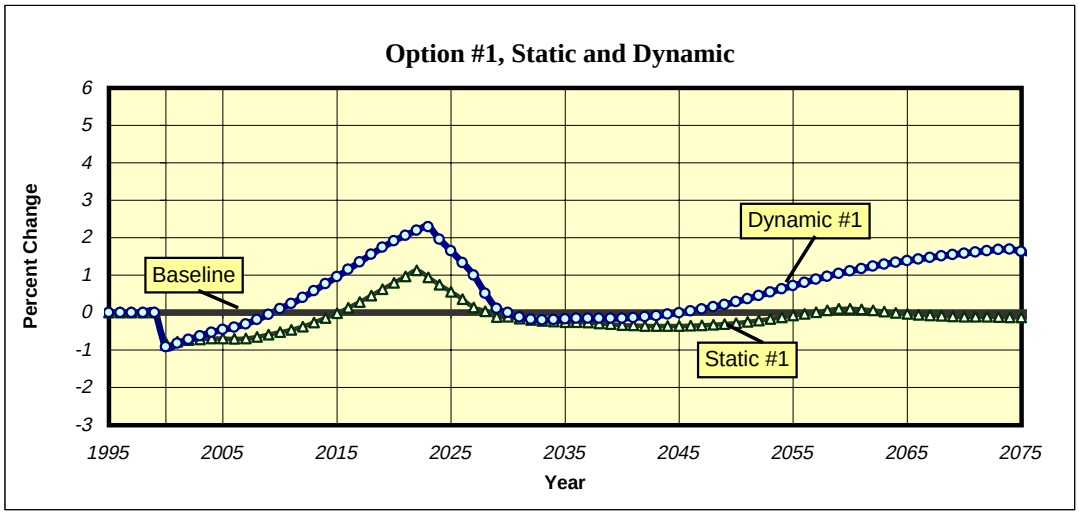


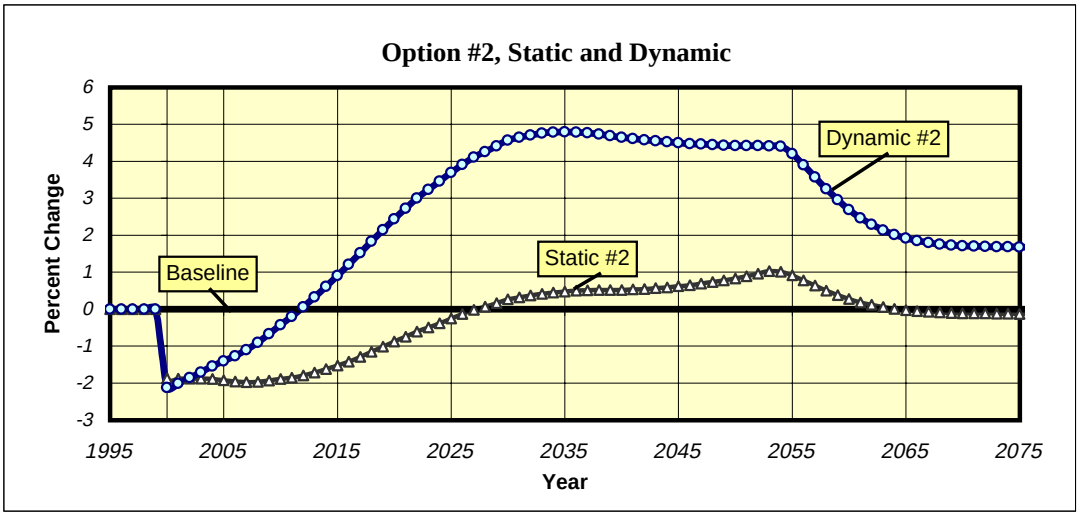


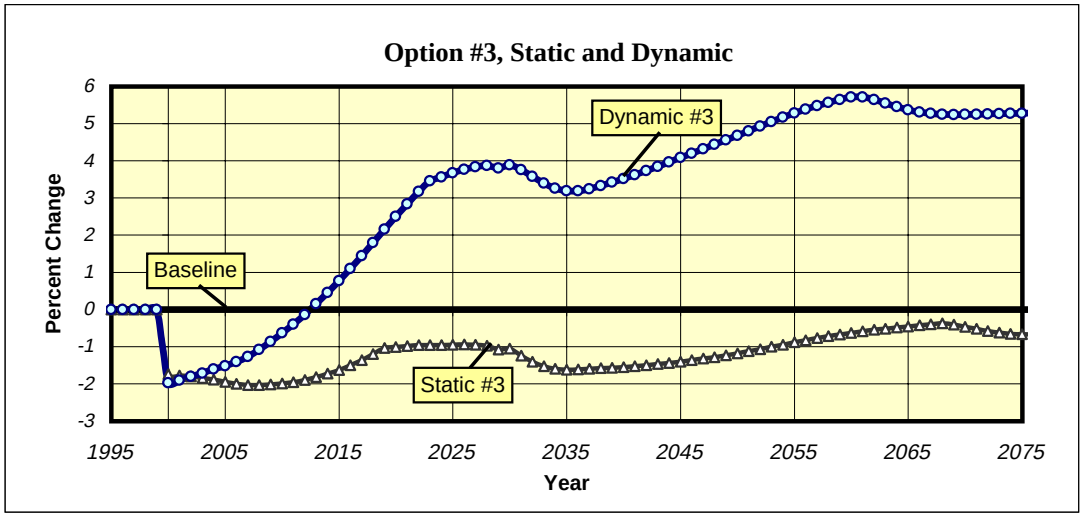
Source: Authors' tabulations (see text).

Note: Additional OASDI savings are calculated here with other macroeconomic assumptions held constant.

Figure 9. Impact of Static versus Dynamic Simulation on Consumption

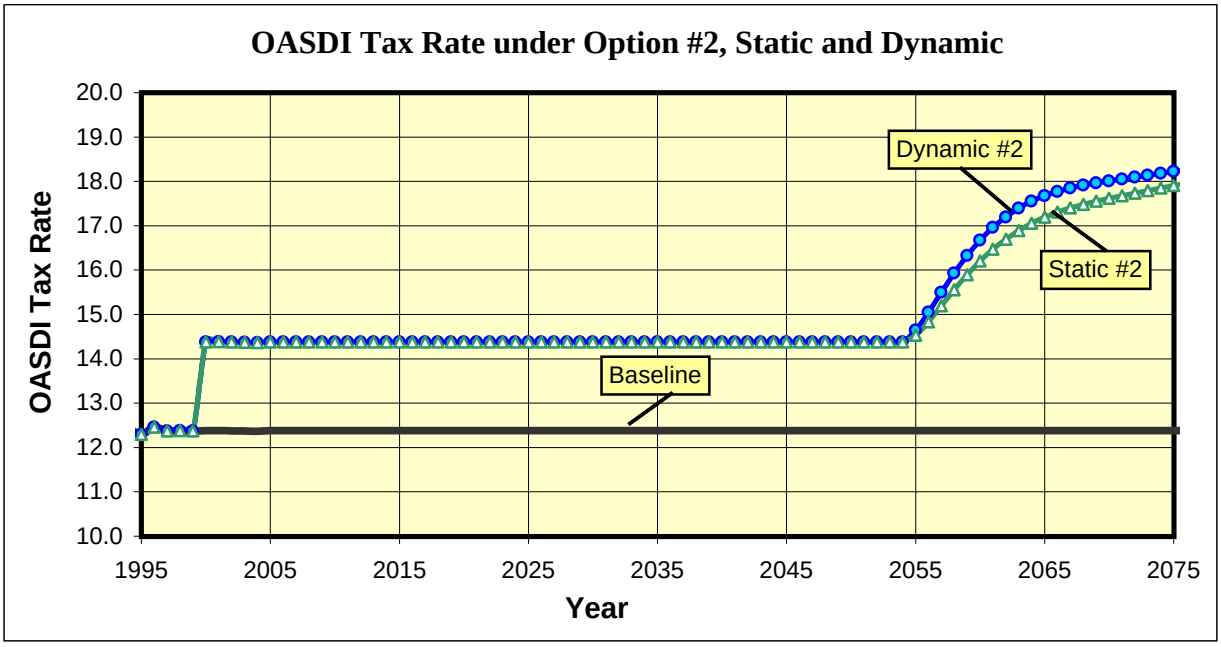


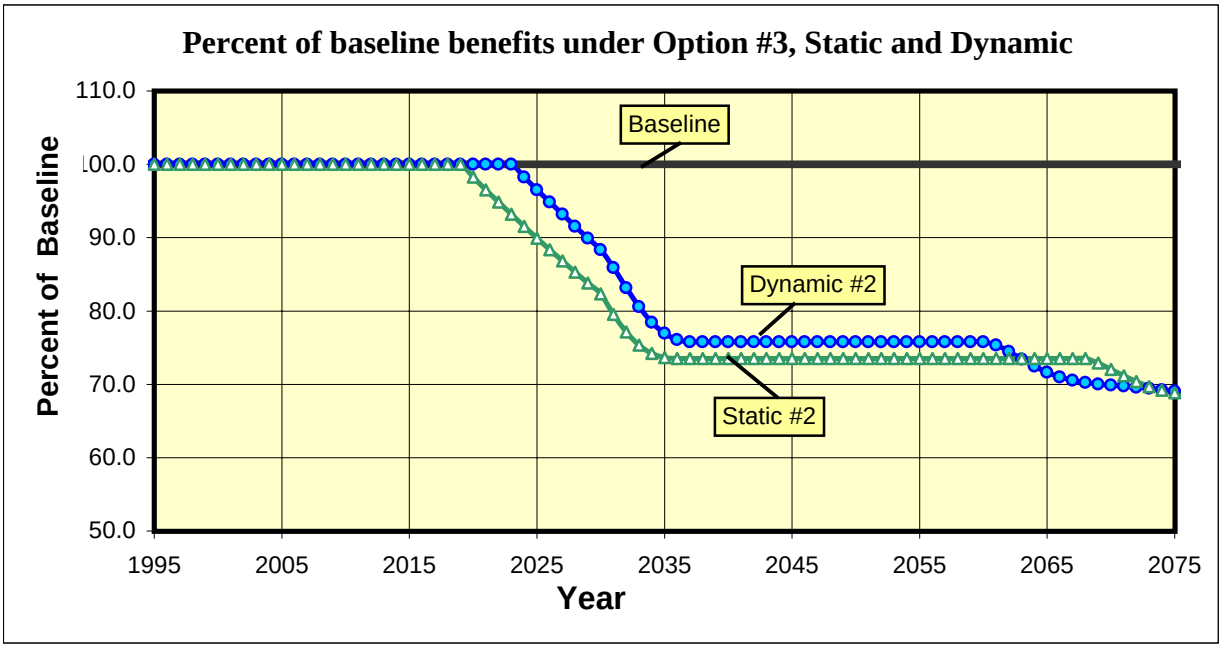




Source: Authors' tabulations.

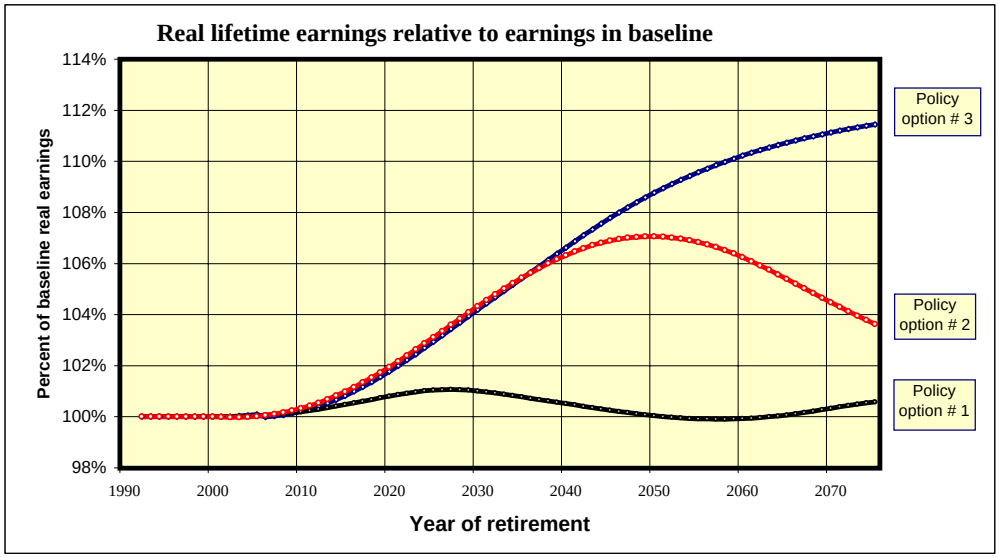
Figure 10. Impact of Static versus Dynamic Simulation on OASDI

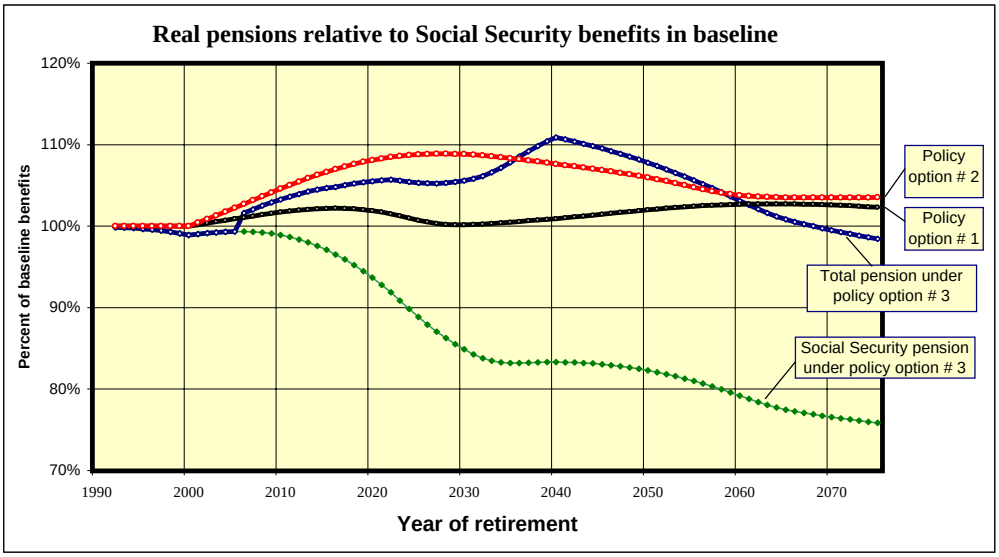


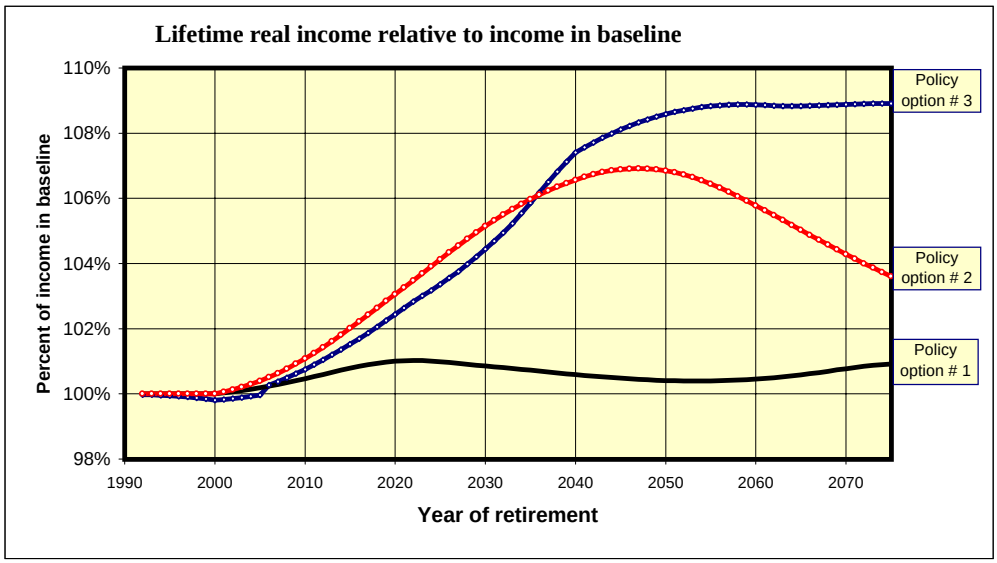


Source: Authors' calculations.

Figure 11. Change in Real Lifetime Earnings, Pensions, and Income under Alternative Social Security Reforms when Additions to Pension Reserves Are Invested in U.S.

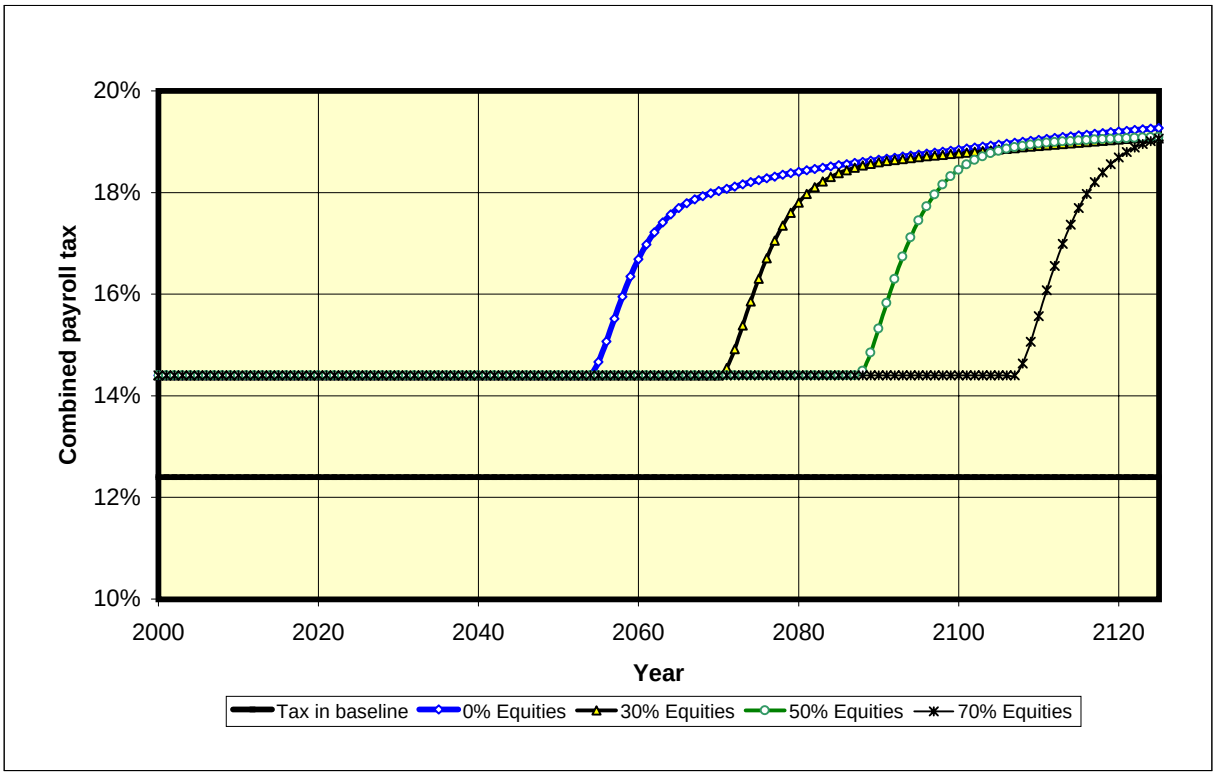






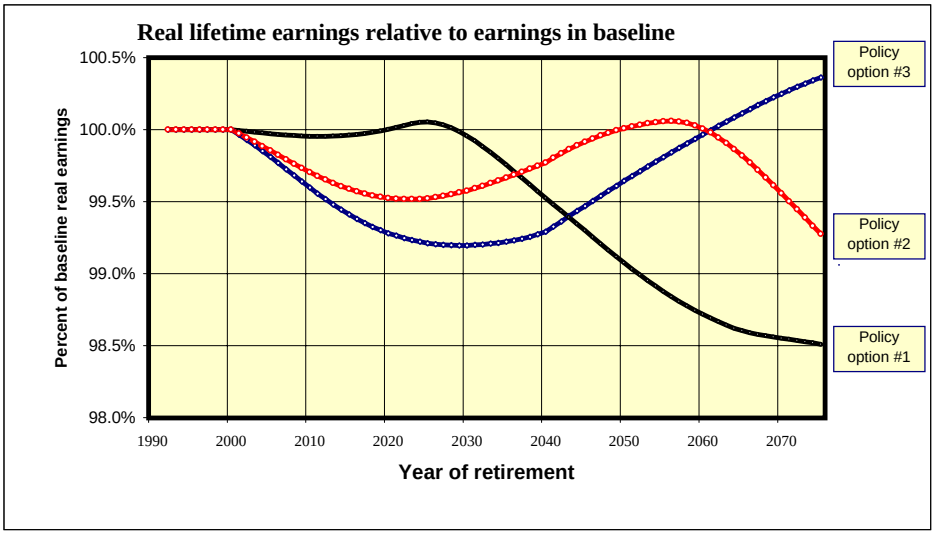
Note: Tabulations refer to workers with the composite -- or weighted population average -- earnings profile. We assume that additions to Trust Fund reserves add to national saving and are invested in the United States.

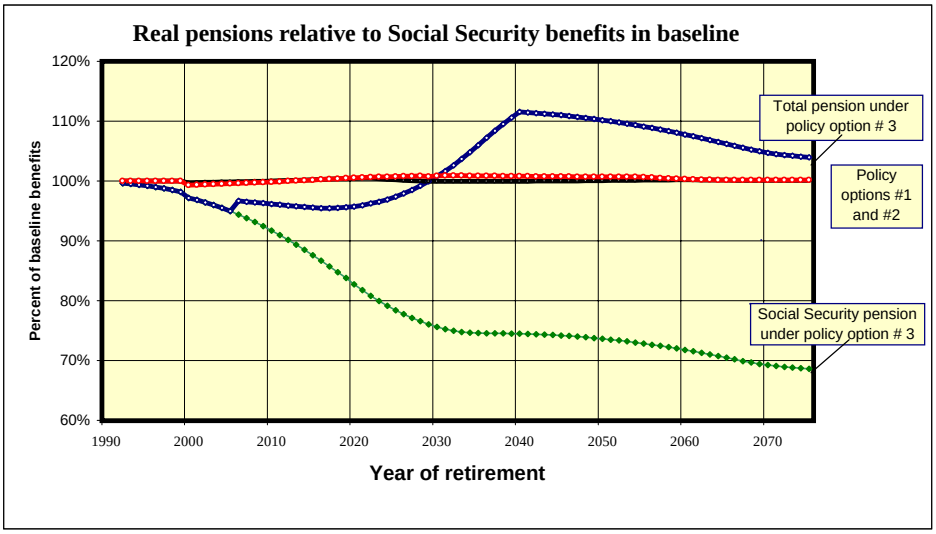
Figure 12. Required Payroll Tax Rates When Trust Fund Reserves Are Invested in Equities

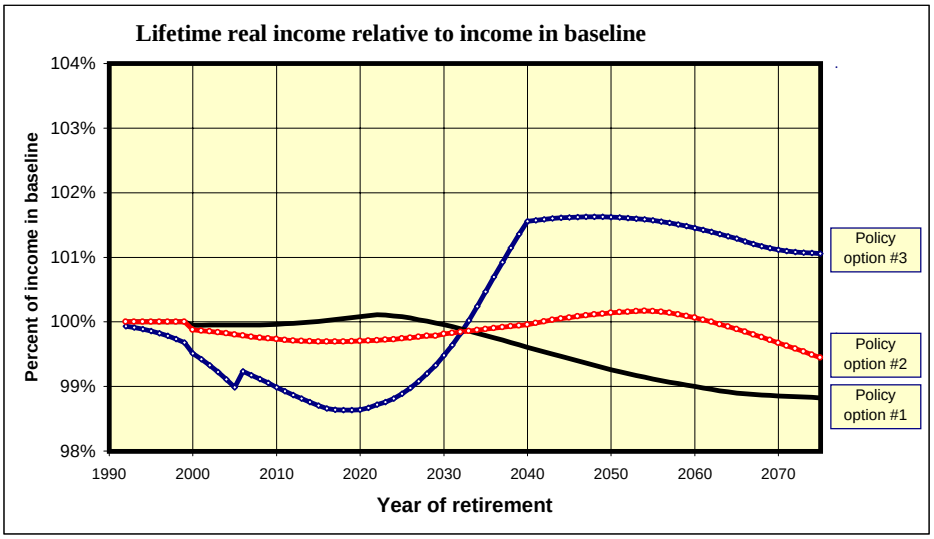


Note: Payroll tax rate is increased 2% in 2000 and then periodically increased when the Trust Fund falls to dangerously low levels. Additions to Trust Fund reserves add to national saving and are invested in the United States.

Figure 13. Change in Real Lifetime Earnings, Pensions, and Income under Alternative Social Security Reforms when Additions to Pension Reserves Are Invested Abroad







Note: Tabulations refer to workers with the composite -- or weighted population average -- earnings profile. Additions to Trust Fund reserves add to national saving and are invested abroad.