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Long-Run Effects of Social Security Reform Proposals on Lifetime Progressivity

Julia Lynn Coronado, Don Fullerton,
and Thomas Glass

5.1 Introduction

Most observers agree that the U.S. Social Security system must be reformed. Although the original "pay-as-you-go" (PAYGO) system was converted to a partially funded system in 1983, promised future benefits still exceed expected future taxes—especially by the time the baby boom population bulge is finished retiring. When converted into 1995 dollars, the "intermediate" projected deficit for the year 2075 is $480 billion, or just less than 4 percent of projected gross domestic product (GDP; U.S. Social Security Administration 1998).

In addition to serving as a mandatory retirement saving program, Social Security is a program of social insurance with many redistributive elements. The program redistributes income not only from current working generations to the retired, but also between families of a given generation in different circumstances. The benefits formula is highly progressive in that it provides a greater replacement rate for workers with lower lifetime earnings. Benefits well in excess of taxes paid are also provided to spouses who do not work, to survivors of deceased workers, and to women in general (because they tend to live longer than men). Any reform will alter

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redistribution under the program, and many proposals give careful consideration to this issue. In general, the current system is considered to be progressive, and most proposals seek to maintain or enhance that degree of progressivity.

In this chapter, we estimate the implied changes to the progressivity of the current system from four specific reform proposals. We focus on the retirement portion of the program and the redistribution between the rich and poor of a given generation, giving special attention to how we classify economic well-being. We take a steady-state approach in that we assume people work and retire under a given system. Thus, we do not address intergenerational redistribution or the issue of transition costs from the present system to any given new system. To define who is rich or poor, we use an estimate of *lifetime potential* income—the present value of the total value of one's time. We also pool the resources of husbands and wives. A spouse of a high earner who chooses to stay at home is therefore not misclassified as "poor" under our methodology. We use a large data set of almost 2,000 individuals and classify them into five lifetime income groups. We calculate the present value of the Social Security taxes paid and benefits received for each individual. The difference is divided by lifetime potential income to provide a lifetime "net tax rate." If this net tax rate rises across the five income groups, the system (or reform) is deemed progressive.

We evaluate how four specific reform proposals would alter redistribution from rich to poor. The proposals were chosen to represent the broad spectrum of possible approaches to reforming Social Security. One set of reforms would either privatize the system or switch to a system based entirely on mandatory individual accounts with benefits that depend on contributions (e.g., Feldstein and Samwick 1998). Transition costs aside, such a plan does not redistribute, but provides benefits equal to the present value of one's own contributions. In our model, the net tax rate under such a system is zero, and the redistributive consequences of this type of reform are the same as the "repeal" of Social Security. Second, we evaluate the proposal of the National Commission on Retirement Policy (NCRP; 1999). This plan redirects 2 percentage points of the payroll tax into defined contribution individual accounts, and it dramatically cuts other benefits to balance the Social Security budget at that reduced tax rate. Third, we look at the plan of Aaron and Reischauer (1998), which suggests smaller specific changes without fundamentally altering the nature of Social Security. In order to close the long-run imbalances, this plan relies heavily on higher returns generated by investing the trust fund in private financial markets. Fourth, we calculate effects of the Moynihan (1999) plan that depletes the current Social Security trust fund through lower tax rates now and then switches to true PAYGO financing.

The model used in this chapter was developed elsewhere to evaluate the progressivity of the current Social Security system (Coronado, Fullerton, and Glass 2000). In that analysis, we found that the current system redistributes little, if anything, from rich to poor. In the current chapter, we find that each of the proposed reforms is a somewhat regressive change to the current system.

The next two subsections describe our model and review the existing literature on the redistributive effects of Social Security. Section 5.2 provides more detail on the model, and section 5.3 provides more detail on the four reforms. Section 5.4 discusses our basic results, and section 5.5 discusses the sensitivity of those results to alternative assumptions. Section 5.6 concludes.

5.1.1 Overview of the Model

We assume that all working years and retirement years come under a single Social Security system. Thus, we assess long-run redistributive effects of the current system and of several reforms. Within this steady-state context, we take account of the ways in which Social Security redistributes across groups defined by income, gender, and marital status. That is, while we report only the redistributions between lifetime income quintiles, we account for heterogeneity within each such quintile. Thus we capture the fact that different income groups have different proportions of individuals who are single or married, male or female, and employed continuously or sporadically, and who have different mortality rates.

We use twenty-two years of wage rates from the Panel Study of Income Dynamics (PSID) to estimate wage rate profiles for different kinds of individuals (household heads, full-time secondary workers, and part-time secondary workers). The estimated coefficients are used to project each individual's wage rates before and after the sample period, so that each individual has a complete wage profile from age twenty-two to sixty-six (extended through age sixty-nine for plans with retirement at age seventy). The wage rate for each year is multiplied by a total time endowment to calculate potential earnings, and the present value of this endowment is used to categorize individuals into quintiles from rich to poor. Lifetime resources for husbands and wives are pooled so that they are always classified in the same quintile.

Next, for each quintile, actual earnings are used to estimate earnings profiles. We estimate Tobit earnings regressions and again use the coefficients to project out-of-sample earnings for each individual, so that each member of our sample has a complete lifetime earnings history. We then derive income-differentiated mortality rates, and we use those mortality probabilities with constructed earnings histories to calculate each individual's expected lifetime Social Security taxes and benefits. Finally, we add over the individuals in each quintile to determine the net impact of Social Security on each group under the current system and proposed reforms.

Using actual earnings data is one of the important innovations of our model. As noted below, previous studies use stylized groups, or smoothly estimated profiles for each group. In contrast, the use of actual earnings data allows us to incorporate differential effects of human capital investment, illnesses, child rearing, and other events that affect earnings and may lead individuals to enter and exit the labor force. We also give special attention to differential mortality rates by gender, race, and lifetime income.

Distributional effects of the current system also represent the effects of a major reform, namely, the repeal of Social Security or complete privatization. In addition, we calculate effects of three specific reforms, and we compare the progressivity of those reforms to a proportional cut in all benefits (with a comparable overall net tax rate). For each plan, we plot the net tax rate as a function of income. We compare the slopes of these curves because of our interest in long-run redistributions between rich and poor, but we ignore the levels of these curves because our model does not capture redistributions between current generations and long-run future generations.

5.1.2 Overview of Existing Literature

The Social Security system takes taxes from both a high-wage person and a low-wage person during working years, and it provides benefits to both individuals when retired. We wish to measure how much of this money is transferred between individuals, rather than merely transferred from the working years to the retirement years of the same person.

Initial tax incidence studies like Pechman and Okner (1974) used groupings based on annual income. This type of study would find that the Social Security system is progressive, but it aggregates unlike individuals. The low-annual-income group may include both the working poor and those who have retired from a high-earning career. Some later studies like that of Auerbach and Kotlikoff (1987) include lifetime profiles and lifetime decision making in order to determine how Social Security redistributes between young and old. However, this study does not distinguish between different lifetime income groups of the *same* cohort.[1]

Although much work has focused on intergenerational effects of the Social Security system, Aaron (1977) initiates a growing literature on intragenerational redistribution. Some researchers use arbitrary levels of income for different groups. For example, of the studies by Hurd and Shoven (1985) and Boskin et al. (1987), each uses three groups (e.g., median income, half the median, and five times the median).[2] The approach of using

1. Nelissen (1998) finds substantial differences between annual incidence and lifetime incidence for social security in the Netherlands.

2. Panis and Lillard (1996) set the low group at full-time minimum wage earnings, the middle group at social security's average earnings, and the high group at the social security

arbitrarily set income levels has tremendous computational appeal. However, the calculation of Social Security benefits depends not only on the level of lifetime earnings. Recent years often receive more weight, and some years with zero earnings can be dropped from the calculation. Thus, the benefits received by each group depend on the shape of the earnings profile and the variance from one year to the next. For these reasons, we estimate a nonlinear profile separately for each group. We retain actual earnings data from the sample period and use actual and constructed years of data with zero earnings. Each group has different proportions of individuals with different numbers of zero-earnings years that can be dropped from the benefit calculations (as in Williams 1998).

Some studies have used actual Social Security records to examine issues of redistribution (Burkhauser and Warlick 1981); Hurd and Shoven 1985; and Liebman, chap. 1, this volume). Duggan, Gillingham, and Greenlees (1993) use records for more than 32,000 workers from the Continuous Work History Sample of Social Security records. While using Social Security records would better identify Social Security earnings histories, two important elements are missing from the available extracts. First, the observed amount of earnings is generally capped at the annual Social Security wage cap, yet only data with wage rates above the cap can fully capture the regressivity of Social Security taxes that exempt higher wages.[3] Second, and equally important, records for individuals are not linked with records of spouses.

Fullerton and Rogers (1993) also estimate profiles separately for twelve different lifetime income groups and use them to calculate the incidence of various taxes, but they do not look at Social Security benefits. More recently, Altig et al. (1997) employ the same twelve lifetime income groups in their model of tax incidence, and Kotlikoff, Smetters, and Walliser (1998) use that model to look at Social Security. These computational general equilibrium models can calculate the effects of Social Security reforms on factor returns in each period, but each of the twelve groups is assumed to contain homogeneous individuals. Since everyone in a group must work the average amount for that group, these general equilibrium models cannot incorporate heterogeneity, such as the existence of a fraction in each group that has zero earnings.

For these reasons, we do not attempt to build a general equilibrium model. The point of this chapter is to make use of actual data on diverse individuals within each lifetime income group. We can thus use the fact that each group has a different proportion of individuals with zero-

tax wage cap. Similar procedures are followed by Myers and Schobel (1983), Steuerle and Bakija (1994), and Garrett (1995).

3. The true earnings can be estimated, however. For example, Fox (1982) uses information on the time of year that an individual reaches the wage cap to infer the full annual earnings.

earnings years, of individuals who qualify for spousal benefits, and of individuals who receive fewer benefits because they die earlier. In this way, we can look at distributional impacts of specific elements of the Social Security system.[4]

The literature on distributional impacts of specific elements of the Social Security system is sparse. Flowers and Horwitz (1993) examine the spousal benefit, whereby low-earner spouses can draw the greater of their own computed benefit or one-half of the higher-earning spouse's benefit. They demonstrate that the spousal benefit calculation is progressive when compared to an own-benefit calculation. This result is driven by their finding that higher-income families consist of spouses with more-equal earnings and that lower-income couples have more disparate earnings. Our data imply the opposite: more-equal earnings among couples with low wages. Also, Panis and Lillard (1996) use a low-medium-high income structure to examine three basic reforms: the increase of the retirement age, the increase of payroll taxes, and the decrease of benefits. The effects of these reforms on progressivity are not clear.

Starting with Aaron (1977), some have introduced differential mortality into the analysis. Rofman (1993) uses a data set that matches demographic information from the Current Population Survey with Social Security information on earnings, benefits, and mortality. However, Duleep (1986) reports that mortality information is severely underreported in the Social Security records, especially for working-age individuals and minorities. Garrett (1995) uses mortality estimates from a literature search, while Panis and Lillard (1996) extract mortality information from the PSID. Since high-income people live longer, several studies show that accounting for income-differentiated mortality seriously dampens the progressivity of Social Security (e.g., Steuerle and Bakija 1994; Duggan, Gillingham, and Greenlees 1995; and Panis and Lillard 1996).

Finally, Caldwell et al. (1999) use a large microsimulation model to construct lifetime earnings for many heterogeneous individuals. This model starts with the 1960 Census Public-Use Microdata Sample and uses estimated transition probabilities to "grow" the sample in one-year intervals. For each person, they simulate the next year's income and work status. Thus, as in our study, they capture differences in race, gender, the number of zero-earnings years, differential mortality, and wage rates above the cap. They focus primarily on intergenerational redistributions, finding that, although early generations received a good rate of return, postwar generations receive smaller and even negative rates of return.

4. By concentrating on dollar flows, however, we miss the effect of this social insurance program on the utility of risk-averse individuals (see Geanakopolos, Mitchell, and Zeldes 1998). The benefits of risk reduction may be larger for low- or high-income individuals. Lee, McClellan, and Skinner (1999) calculate such effects for Medicare.

5.2 Lifetime Earnings Profiles and Net Benefits from Social Security

In this section we describe the data and methodology used to obtain lifetime earnings profiles, to estimate mortality probabilities that differ by lifetime income, and to calculate net taxes from Social Security. A more detailed description is provided in the appendix. We use the PSID for the years 1968 to 1989, which gives us twenty-two years of actual earnings data for a sample of the population.[5] We select a sample consisting of 1,086 heads and 700 wives that is 66 percent of the representative cross-section. The use of a reduced sample suggests the possibility of bias in our econometric estimates and our conclusions about the progressivity of Social Security. However, we do not believe our results are biased, for reasons discussed in the appendix.

The PSID provides only twenty-two years of actual data. In order to obtain complete profiles of earnings from age twenty-two through age sixty-six for each of our sample members, we want to be able to generate out-of-sample earning observations.[6] We do this by estimating earnings regressions and using the estimated coefficients to generate the needed observations. However, as Fullerton and Rogers (1993) demonstrated using data from the PSID, earnings profiles can have significantly different shapes for different lifetime income groups. We therefore estimate separate earnings regressions for different lifetime income classes.

Our model is somewhat stylized in that we ignore inheritances and transfers. Our measure of annual income is based on wages, which are zero for a retired person. Lifetime income is the present value of that annual income. Note that capital income from life-cycle saving is *not* part of lifetime income. If the present value of consumption must equal the present value of labor income, then capital income merely reflects rearrangements in the timing of consumption.

5.2.1 Lifetime Income

We want to estimate a separate earnings regression for each lifetime income class, and we want a measure of lifetime income that accurately reflects economic well-being. To begin, we calculate an annual wage rate for each member of our sample by dividing annual earnings by hours

5. While data are currently available through 1992, our model was constructed several years ago when data were available only through 1989.

6. We assume that people work until the future normal retirement age of sixty-seven, claim social security benefits at that point, and do not work after retirement. While the majority of people retiring in the past decade have claimed early retirement, they receive a reduction in benefits that is supposed to be actuarily fair. However, early retirees have less education and are more likely to be retiring from blue-collar jobs, indicating that they have lower lifetime incomes (U.S. Congressional Budget Office 1999).

worked. To construct a wage rate for every year of each sample member's working life, we first use all positive wage observations to estimate log wage profiles.[7] We estimate separate log wage regressions for heads, full-time working wives, and part-time working wives. The results of these regressions can be found in the second main section of the appendix. We regress the log of the wage rate on an individual fixed effect and other variables like age, age squared, and age cubed. Because we have a fixed effect for each individual, we cannot use variables that do not vary over time (like race or gender). However, we do include age *interacted* with education, race, and gender. Using the resulting fixed effects and coefficients, we then fill in missing observations during the sample period and observations outside the sample period. The appendix details how we assign a wage rate to women who have no earnings histories. Nonworking wives do engage in household production, and assigning them a zero wage may incorrectly place them in a low lifetime income group for the distributional analysis. Thus, for each individual, we have a wage rate for every year of entire economic life from age twenty-two to sixty-six.

We then use this wage rate and multiply it in each year by 4,000 hours to represent the year's labor endowment. This product represents the potential earnings of the individual and therefore serves as a measure of his or her material well-being.[8] Using this endowment allows us to abstract from the actual labor-leisure choice, since someone who chooses to work less and consume more leisure might be just as well off as someone who decides to work more and consume less leisure. Using potential income also avoids the distortion introduced by the fact that home production does not show up in the data under hours worked. The wage rate is a measure of earning power that reflects experience, talent, and education.[9]

Once we have a complete wage profile for each of our heads and wives for ages twenty-two to sixty-six, we calculate individual gross lifetime income as

$$\text{LI} = \sum_{t=1}^{45} \frac{w_t \times 4{,}000}{(1 + r)^{t-1}}, \tag{1}$$

where t indexes the forty-five years in the individual's economic lifetime relevant for Social Security, ages twenty-two to sixty-six, and where the individual could work a maximum of eighty hours per week for fifty weeks

7. This estimation of a whole life's wage profile takes advantage of the fact that some individuals are in the sample during the early part of their working lives and others are in the sample for the latter part.

8. For sensitivity analysis, we show net tax rates with two other measures of income: the present value of actual earnings, and the present value of potential earnings, where leisure is valued at the average wage rate for the sample instead of the individual's wage rate.

9. On the other hand, our model may overstate the value of time at home to the extent that it represents sick days or unemployment.

per year. Through most of our analysis, we use a value of 2 percent for r, the real discount rate. Later, we see the effect of changing the discount rate.

As couples generally pool their resources, it would be inappropriate to place husbands and wives individually into separate lifetime income groups. The low-wage wife of a high-wage husband is not "poor." We therefore combine the lifetime income of the husband and wife, and divide by two to obtain individual lifetime income for each of them. We can now deal with each member of our sample as an individual and categorize them into five lifetime income groups. The 1st quintile has the lowest income, the 5th quintile the highest income.

5.2.2 Earnings Profiles

Once we have classified people into lifetime income groups based on what we feel to be an appropriate measure of economic well-being, we estimate regressions for actual earnings. For each quintile, using our data from the PSID, the third main section of the appendix describes how we estimate separate earnings regressions for heads, habitually working wives, and occasional working wives, for a total of fifteen regressions. We use both positive and zero earnings observations in a Tobit framework.

Because the Tobit framework is nonlinear, we do not include fixed effects, as their inclusion would imply inconsistent parameter estimates. The exclusion of fixed effects also means we can use variables in these earnings regressions that do not vary over time, such as education, race, and gender. For each regression for the heads, we begin with independent variables for age, age squared, age cubed, education, education squared, the product of age and education, a dummy for whether the head is female, age interacted with the female dummy, and a dummy for whether the head is white. We then eliminate the variables that were insignificant. We follow a similar procedure for habitually working wives and occasionally working wives.

We next use the estimated coefficients from our earnings regressions to simulate earnings observations for the out-of-sample years for all individuals in our sample.[10] We do not use these coefficients to fill in zero earnings observations during the sample period, because we are interested in actual earnings, and years spent out of the labor force are relevant for calculating the costs and benefits of Social Security. In fact, we also simulate a representative number of zero earnings years for the out-of-sample portions of each earnings profile.

5.2.3 Income-Differentiated Mortality

It is a stylized fact that people with higher lifetime incomes tend to live longer, a fact that can dampen the progressivity of the benefit structure of

10. These imputations are independent of each other and are not serially correlated.

the Social Security system. We derive a set of mortality probabilities that vary by race, gender, and our measure of potential lifetime income, so that we can examine the impact of differential mortality on redistribution. Standard mortality tables extend only to age eighty-five and are differentiated only by sex and race. As the fourth part of the appendix describes, we extend these data in three ways. First, we extend the tables to age ninety-nine. Second, since individuals with low incomes have higher mortality rates than the population as a whole, we modify the standard tables by using available information on mortality differentiated by annual income. Third, we then use that information to construct mortality tables that are differentiated among our lifetime income quintiles. In later sections, we use these tables to compute expected present values of Social Security taxes and benefits.

Standard mortality tables are provided in *Vital Statistics of the United States* (U.S. Department of Health and Human Services 1993).[11] For 100,000 individuals alive at age zero, the table shows the number surviving at each age from one through eighty-five. Based on standard mortality tables, a hypothetical twenty-two-year-old white male has probabilities of survival to age twenty-three of 99.83 percent, survival to age sixty-five of 75.82 percent, and survival to age eighty-five of 22.34 percent. We multiply the tax that would be due or the benefit that would be received at each age by the probability of attaining that age, and then calculate the present value of these expected cash flows.

The National Center for Health Statistics obtains death certificates from all U.S. states and constructs four "current life tables" (for white males, white females, nonwhite males, and nonwhite females). Since 31 percent of the population is still alive at age eighty-five, the fourth section of the appendix describes how we extend the tables through age ninety-nine. These expanded mortality tables allow us to weight tax payments and benefits by the probability of being alive in each year from age twenty-two to ninety-nine.

Many studies have noted that mortality rates for the poor are higher than average. *A Mortality Study of 1.3 Million Persons* (Rogot et al. 1992) provides a rich source of data on this phenomenon. They show the observed number of deaths for each annual income class of each race, gender, and ten-year age group. For each such cell, we divide observed deaths (O) by the expected deaths (E) that would occur if all income classes of that group had the same mortality rate. We then apply that O/E ratio to each cell in the extended mortality tables. Among white males aged twenty-five

11. An alternative source of data for our analysis of a hypothetical future cohort would be projected mortality tables from the Social Security Administration (SSA), which incorporate projected increases in life expectancies. Using the SSA's probabilities would decrease the net tax rate for everyone, as people live longer and draw benefits longer, but it would have no effect on our adjustments for mortality probabilities that differ by lifetime potential income and so would not substantively alter our conclusions on redistribution.

to thirty-four, for example, those in the poorest annual income group die at a rate that is 168 percent of the average, while those in the richest annual income group die at rate that is only 61 percent of the average. For non-white females of the same age, the poor die at a rate that is 186 percent of the average, while the rich die at a rate equal to 44 percent of the average.

Although we have the annual household income of each individual in our sample for each year, we do not use only the corresponding annual income group's *O*/*E* ratio for that person in that year to weight mortality probability. Using annual income would imply that an individual with a steeply hump-shaped earnings profile would have a probability of dying that falls dramatically during high annual income years and then rises again during low annual income years. We do not believe that the same individual's probability of death changes that rapidly with annual income, jumping over other individuals in the same age cohort whose annual incomes are not so volatile. Instead, the probability of dying is more likely affected by the individual's *lifetime* income. To address this issue, our procedure described in the fourth section of the appendix is based on the relative ranking of each individual's lifetime income. Basically, a person in a particular percentile of the lifetime income distribution is assigned the *O*/*E* ratio of a person in the same percentile of the annual income distribution.[12]

5.2.4 Social Security Taxes Paid

We next compute the value of Social Security taxes for each person in each year, following the provisions of the Social Security Administration. This tax is commonly called the FICA (Federal Insurance Contributions Act) tax. It is collected on earned income and consists of three portions: Old Age and Survivors Insurance (OASI), Disability Insurance (DI), and Hospitalization Insurance (HI, also known as Medicare). The proceeds from these taxes are deposited into three separate trust funds, and benefits are paid from the appropriate fund. The program has become almost universal—95 percent of all employment in the United States is covered.[13]

The tax is deducted from employees' pay at a rate of 7.65 percent of wages, but employers match those deductions for a total tax of 15.3 percent. Self-employed individuals pay the entire 15.3 percent tax annually with their income tax returns. Both the employee and employer shares of the tax are collected on wages up to an annual maximum amount of taxable earnings—the Social Security wage cap ($76,200 for the year 2000).

12. Thus, even if two retirees have the same low annual income, the one with higher lifetime income is assumed to have a lower mortality probability.

13. Coverage may be excluded for the following: federal civilian workers hired before 1984 who have not elected to be covered; railroad workers who are covered under a similar but separate program; certain employees of state and local government who are covered by their state's retirement programs; household workers and farm workers with certain low annual incomes; persons with income from self employment of less than $400 annually; and persons who work in the underground, cash, or barter economy, who may illegally escape the tax.

This cap is adjusted automatically each year with the average earnings level of individuals covered by the system, thereby accounting for both real wage growth and inflation.

Since an objective of our research is to measure each worker's net Social Security tax burden, the question arises: How much of the total FICA tax does the worker bear? Using only the statutory incidence (the worker's half) would yield much lower burdens than using the combined employer and employee portions. Hamermesh and Rees (1993, 212) review empirical work on payroll tax incidence and conclude that the worker bears most of the employer's share of the tax through reduced wages. We therefore base our estimates on the combined employer and employee tax.[14]

Our focus is the retirement portion of the Social Security system, not the DI or HI portions. Of the total 15.3 percent tax rate, 2.9 percent is for Medicare (HI), leaving 12.4 percent for Old Age, Survivors and Disability Insurance (OASDI). This is the rate cited and modified by certain reform proposals, even though 1.8 percent goes to DI. The remaining 10.6 percent is for OASI, and this is the tax in our model.[15] The OASI portion of the tax is paid directly to the OASI Trust Fund, which is used to pay all retirement benefits. We ignore the DI and HI portions of the tax, as well as benefits paid from the DI and HI Trust Funds. In essence, we assume that no one becomes disabled prior to retirement. If sample members have few earnings observations because they became disabled, they are treated as any other workers with many years out of the labor force.

Our sample from the PSID includes observed and constructed earnings for each individual from age twenty-two until retirement. To obtain steady-state taxes and benefits under current law, however, we look at a hypothetical future cohort with a birth year of 1990. We therefore take N_{oij}, the "observed" nominal earnings of individual i in year j, and we convert it to the corresponding future individual's nominal earnings, N_{fij}, using the ratio of projected average earnings in the future year (AE_{fj}) to observed average earnings in the PSID sample year (AE_{oj}):

$$N_{fij} = N_{oij} \frac{\mathrm{AE}_{fj}}{\mathrm{AE}_{oj}}. \tag{2}$$

14. Panis and Lillard (1996) point out that because the employer's portion of the payroll tax is deductible against the employer's income tax, the net cost to the employer is lower than the full amount of the payroll tax paid. Like Panis and Lillard, however, and for comparability with other studies, we treat the entire payroll tax as the employee's cost of social security coverage. In effect, we look at the social security system only, without any income tax. The combined incidence is not equal to the sum of the parts, but we cannot say whether the income tax affects the incidence of social security, or social security affects the incidence of the income tax.

15. These allocation percentages are for the year 2000 and beyond. Congress "temporarily" increased the portion going to DI for the years 1994 to 1996, followed by a reduction for 1997–1999. The 1997 allocation is OASI = 10.7 percent, DI = 1.7 percent, and HI = 2.9 percent.

Since 1951, the Social Security Administration has computed average earnings, the average annual earnings of all workers covered under the Social Security Act. We project this average earnings into the future using assumptions about future real wage growth and inflation.[16]

In our study, we calculate the present value at age twenty-two of mortality-adjusted Social Security taxes and benefits through age ninety-nine. Again, we assume that each person works and retires under a given system. The probability P_{ij} of individual i being alive at age j is conditional on being alive at age twenty-two, and it is computed from the constructed tables (for each age-race-sex-income cell) as the number in cell i alive at age j divided by the number in cell i alive at age twenty-two. We then calculate $E(\mathrm{SST}_{ij})$, the expected Social Security tax of person i in year j, as

$$(3) \qquad E(\mathrm{SST}_{ij}) = \left[T \times \min(N_{ij}, \mathrm{CAP}_j)\right] \times P_{ij},$$

where T is the combined OASI tax rate (which is constant with unchanged law), CAP_j is the maximum nominal earnings subject to the OASI tax (which increases with inflation), and P_{ij} is the probability that person i is alive at age j. These amounts are used to compute the present value of Social Security taxes paid.

5.2.5 Social Security Benefits

Under the provisions of the Social Security Act, benefits are calculated from a progressive formula based on the individual's average indexed monthly earnings (AIME). Our calculations follow the Social Security Administration's computation of AIME upon the individual's retirement. In particular, earnings prior to age sixty are indexed to average wages in the year the individual attains age sixty. Only earnings at or below the taxable cap in each year are considered. The method of indexing is to multiply the nominal earnings in year j by the ratio of average earnings in the year age sixty was attained to average earnings in year j. Earnings after age sixty are not indexed. A person who works from age twenty-two through age sixty-six (retiring on his or her sixty-seventh birthday) would have a total of forty-five years of earnings. Under the act, only the highest thirty-five years are considered, so the ten lowest years will be dropped. The AIME is the simple average of the indexed earnings in those thirty-five highest-earnings years.[17]

Next, the primary insurance amount (PIA) is calculated as 90 percent

16. We use actual inflation and growth to scale observed PSID years up to 1995. Since amounts in future years are indexed, the subsequent inflation and growth rates are set to zero.

17. The language of the act specifies dropping the *five* lowest years of earnings through age sixty-one. Then, if the worker has years of earnings after age sixty-one that are higher than some earlier years' earnings, the higher earnings from after age sixty-one will replace those lower earnings. The net effect for a worker retiring at age sixty-seven is to drop the ten lowest years.

of AIME up to the first bend point, plus 32 percent of AIME in excess of the first bend point but less than the second bend point, plus 15 percent of AIME in excess of that second bend point. The fact that only capped earnings are used to calculate AIME provides a de facto maximum benefit. In 1995, the bend points were $426 and $2,567. If AIME were $3,200, for example, the PIA would be calculated as follows:

$$\text{PIA} = 0.90 \times (426) + 0.32 \times (2{,}567 - 426) + 0.15 \times (3{,}200 - 2{,}567) = \$1{,}163.47 \,. \tag{4}$$

Like the cap on earnings, the bend points are adjusted annually by the proportional increase in average earnings. We calculate this PIA for each worker in the sample.

A retiree is entitled to a benefit equal to the PIA upon "normal" retirement at age sixty-seven. A worker may still choose to retire as early as age sixty-two, with reduced benefits.[18] In contrast, if a worker elects to delay receipt of benefits to an age as late as seventy, the eventual benefits are permanently increased by 5 percent per year of delay. Our calculations below ignore these provisions for early or late retirement, as we assume workers (and their spouses) always choose the normal retirement age,[19] which for our hypothetical cohort under the current system is sixty-seven.

In addition to retirement benefits for covered workers, the OASI Trust Fund provides certain benefits to the spouse and other dependents of retired or deceased workers. The spouse of a retired worker can receive the greater of the benefit based on the spouse's own earnings, or one-half of the PIA of the retired worker (designated as the "spousal benefit"). The spouse of a deceased worker can receive the higher of the benefit based on the spouse's own earnings, or 100 percent of the benefit to which that worker was entitled. The benefit based on the deceased worker's benefit is called the "survivor benefit." We ignore nonspousal survivor benefits; in aggregate they are relatively minor.[20]

Our calculations of these amounts are detailed in the fifth main section of the appendix. We use each individual's observed and constructed earnings to compute AIME, PIA, the spousal benefit (SpBen), and the survivor

18. This early retirement penalty is a permanent reduction in the PIA of 5/9 percent for each early month (6.67 percent for each early year). For example, workers retiring at age sixty-four when the normal retirement age is sixty-seven would receive a benefit for the rest of their lives that is reduced by 20 percent.

19. This assumption does not affect progressivity unless the chosen date of retirement differs by income. If low-income individuals tend to die earlier, then they might optimally retire earlier, so the availability of this option might be progressive.

20. In 1996, a total of $302.9 billion in benefits was paid from the OASI trust fund. Of that total, $288.1 billion was paid to retired workers or their spouses, and only $14.8 billion (4.9 percent) was paid for the other survivor and miscellaneous benefits (U.S. Social Security Administration 1997, table 4A.5).

benefit for the surviving spouse (SurvBen) in exact accordance with provisions of the act.

5.2.6 Present-Value Net Tax Rates

After we calculate the mortality-adjusted tax and benefit in each year for each individual in each of our lifetime income quintiles, we compute the present value, at age twenty-two, of the benefits to be received minus the taxes paid. We then add over the individuals in each lifetime income quintile. We divide by the present value at age twenty-two of the lifetime endowment (discounted at the same rate) to arrive at an effective net tax rate for each group. A system that takes exactly the same fraction of income for all groups is "proportional," whereas a system that takes a higher fraction of the income of the rich (poor) is deemed progressive (regressive).

The discount rate should reflect a real rate of return that would be available to participants in the system and that would provide for the same certainty as does the Social Security system. The trustees of the Social Security system currently used a rate of 2.8 percent for their long-term estimate of real returns in their 1998 report.[21] Ibbotson Associates (1998) reports on historic rates of return for various portfolio investments. For the period 1935 to 1997, the average inflation rate was 4.0 percent, and the nominal return on intermediate-term U.S. Treasury obligations was 5.4 percent, so the real rate of return was 1.4 percent.

For one choice of discount rate we use 2 percent, which lies between the forecast rate earned by the OASI Trust Fund on its investments (2.8 percent) and the historical average of real returns on government bonds reported by Ibbotson (1.4 percent).[22] To test the sensitivity of results, we also use a discount rate of 4 percent. As shown below, the choice of rate affects not only the absolute size of the present value gains or loss for each group but also the pattern of progressivity.

5.3 Proposed Reforms and their Treatment in our Model

Our evaluation of Social Security reform is limited in many respects. First, because we focus on distributional effects, we ignore behavioral effects such as changes in labor supply or saving. Second, since we cannot

21. In arriving at that rate, they forecast inflation at a long-term rate of 3.5 percent, and a nominal interest rate of 6.3 percent on the special-issue U.S. Treasury obligations that are purchased by the OASI trust fund. Whether to use a before-tax or after-tax discount rate depends on one's assumption about what alternative retirement investments are available.

22. Other studies of social security redistribution have used rates on either side of 2 percent. Myers and Schobel (1983) use 2 percent, Hurd and Shoven (1985) use 3 percent, Boskin et al. (1987) use 3 percent, Duggan, Gillingham, and Greenlees (1993) use 1.2 percent, Steuerle and Bakija (1994) use 2 percent, and Gramlich (1996) uses 2.3 percent. In contrast, Caldwell et al. (1999) use 3, 5, or 7 percent.

evaluate all of the many suggested reform proposals, we focus on only four of the major ones. Third, since most of these proposals are still evolving, we evaluate only versions that were available in written form in early 1999. Fourth, since each such proposal is too complicated to capture fully in our model, we really just evaluate "stylized" versions of these reforms. In particular, since we consider only long-run provisions, we ignore any phase-in of a change in the normal retirement age.[23] Since we assume everybody retires at that normal retirement age, we also ignore the effects of proposed changes in the early retirement age. Additionally, since we have only one "discount rate" in our model, with no consideration of risk, we cannot capture the welfare effects of any plan to switch some of the Social Security trust fund from government bonds to investments in corporate stocks and bonds.

Because we miss some of these ways in which each reform might raise net revenue, especially during the transition, we cannot comment on the extent to which each reform might close the existing Social Security deficit. Each plan extends the solvency of the program to seventy-five years. Some extend solvency indefinitely, while others have large annual cash flow deficits at the end of seventy-five years. Thus each of the plans evaluated is different in present value, and the long-run features that we consider raise different amounts of net revenue for each plan. As a consequence, some of the plans appear in our model to have higher overall net tax rates than others. We emphasize, however, that our goal is to compare the progressivity of these plans and not their overall net tax rates.

As described above, we do capture the major long-run provisions of Social Security that determine taxes and benefits for individuals in different circumstances. We now describe proposed changes to these provisions, as summarized in table 5.1. Column (1) of this table represents the current system. It does not list all features of the current system, only the main ones that would be reformed by one of the plans.

5.3.1 The Feldstein-Samwick Plan

A number of proposals would completely privatize Social Security. The proposal outlined by Feldstein and Samwick (1998) is typical of these plans. It specifies a transition from the current system to one in which the benefits are equivalent to those guaranteed under the current system, but in which these benefits in the long run are funded entirely by mandatory contributions to individual accounts made over a lifetime. The balances in

23. Legislation already enacted will increase the retirement age by two months each year beginning in the year 2000, so that by 2005 the normal retirement age will be sixty-six. Another two month per year increase will begin in 2017, resulting in a normal retirement age of sixty-seven after the year 2021. All of the reform proposals we consider would eliminate the pause from 2005 to 2017 and reach the new higher normal retirement age sooner.

Table 5.1 **Summary of Long-Run Provisions of Social Security and Proposed Reforms**

	Current System (1)	NCRP (2)	Aaron & Reischauer (3)	Moynihan (4)
Captured by our model				
OASDI tax rate (%)	12.4	10.4 (2% into ISA)	—	11.4, 10.4, 11.4, 12.4, 12.7, 13.4 (PAYGO)
Wage cap in 2003 (% taxed)	$82,800 (85)	—	—	$97,500 (87)
PIA factors (%)	90, 32, 15	90.00, 21.36, 10.01	—	—
Minimum benefit	Yes	Increases to AIPL	—	—
NRA	67	70	—	70
AIME (included years/drop years)	35/10	43/5	38/7	38/10
Spousal benefit	1/2	1/3	1/3	—
Survivor's benefit	max(hus,wife)	—	3/4 (hus+wife)	—
COLA	Indexes by CPI	Reduces CPI by 0.5 percentage points	— (fix CPI)	Reduces CPI by 1.0 percentage point
Not captured by our model				
Earliest eligibility age (EEA)	62	65	64	—
State and local government workers	Most	All new	All new	All new
Earnings test	Cut benefits by 1/3	Eliminate at age 70	—	Eliminate at age 62
Tax on Social Security benefits	Above threshold	—	Like private pension	Like private pension
Investment in the trust fund	Government bonds	—	Part into corporate stocks and bonds	—

Notes: A dash means no change from current system. Other abbreviations and subtleties are described in the text.

the individual accounts would be invested in private debt and equity markets.

We do not explicitly model the Feldstein-Samwick plan, or any other plan based on individual accounts, as such plans involve little or no redistribution (except to the extent that some privatization plans include minimum benefits and survivor benefits).[24] In our modeling framework, such plans are equivalent to the repeal of the system. Our model is better suited to capturing the effects of reforms that do not alter the basic tax and benefit nature of the current system. Thus, in our model, the effects of the Feldstein-Samwick plan are the opposite of the effects of the current Social Security system.

5.3.2 The National Commission on Retirement Policy (NCRP) Plan

The 1999 NCRP proposal is also associated with the names of Senators Breaux and Gregg and Representatives Kolbe and Stenholm. One version is a defined benefit (DB) plan based on the current OASDI tax rate, but we evaluate only the other version, which sets aside 2 percentage points of each person's tax into a mandatory individual saving account (ISA). Since each retired individual receives back his or her own ISA, plus earnings, such a mandatory savings plan does not redistribute between members of a generation in the long run. It has a net present value tax of zero for each individual and therefore does not enter our calculations. The remaining "tax and benefit" portion of this plan is scaled back from current law. As shown in the first row of table 5.1, the OASDI tax rate is cut from 12.4 percent to 10.4 percent.[25] The next row shows that this plan does not change the wage cap.

With taxes cut substantially, closing the Social Security deficit means that benefits must be cut dramatically. The NCRP plan cuts benefits in several ways. The largest cut is in the calculation of benefits called the PIA in equation (4). In that calculation, "PIA factors" are applied to AIME between the bend points. As shown in the third row of table 5.1, the long-run NCRP plan would still provide 90 percent of AIME up to the first bend point, but the 32 percent rate between the two bend points is cut to 21.36 percent, and the 15 percent rate above the second bend point is cut to 10.01 percent. Thus, benefits are cut disproportionately for high-income individuals. This change is progressive, even in a lifetime context, as we confirm below.

In fact, this plan adds benefits to low-income individuals, another pro-

24. Also, individual accounts that require annuitization at a single rate will retain some redistribution due to differential mortality (see Brown, chap. 10 in this volume).

25. These reforms state changes in terms of the current 12.4 percent OASDI rate, as shown in the table. However, 1.8 percentage points of that tax go to disability insurance (DI), and we model only OASI. With the 2 points diverted into ISA accounts, the 10.6 percent OASI rate becomes 8.6 percent.

gressive change. Current law has a small "minimum benefit" that depends on the number of quarters of earnings but that can reach as high as $6,235 per year (at 1995 levels, but indexed). As indicated in the next row of table 5.1, the NCRP plan would raise this minimum benefit to the indexed "aged individual poverty level" (AIPL), which was $7,761 in 1995 (a 24 percent increase).

The next biggest cut in benefits occurs through the NCRP's increase in the ultimate normal retirement age (NRA) from sixty-seven to seventy.[26] This change is regressive for three reasons. First, it means that individuals will work and pay taxes for more years, and those taxes are generally regressive because they apply only to earnings below the wage cap. Second, it means that individuals will retire later and receive benefits for fewer years. Because the benefit schedule is progressive, that cut in benefits is regressive. Third, because of income-differentiated mortality, the higher retirement age means that low-income individuals have a disproportionate increase in their chance of dying before they receive retirement benefits.

The NCRP plan also changes the number of years' earnings used in the AIME calculation. Current rules use thirty-five years, which means that ten years of low earnings can be dropped from the calculation. This includes the five years that can be dropped before the AIME calculation at age sixty-two and the additional five years of earnings after age sixty-two that can be used to replace lower earnings from before sixty-two. The NCRP plan says it would "include earnings for all years," and we interpret this to mean all years up to the AIME calculation. Since the NCRP plan raises the early retirement age (and AIME calculation) from sixty-two to sixty-five, the individual can still use five subsequent years of earnings (until retirement at age seventy) to replace lower earnings from before sixty-five. In other words, effectively, five years still can be dropped.[27]

Under current law, any married retiree can receive the higher of his or her own benefit or half of what the spouse receives. This latter option is called the spousal benefit. The next row of table 5.1 shows that the NCRP plan would allow only one-third of the spouse's benefits. This cut would most affect any person whose income is low relative to his or her spouse, but remember that we do not count that person as "poor" (because we

26. Like other reforms considered here, the NCRP plan would also later increase the NRA above age seventy to account for subsequent increases in longevity (to maintain a constant number of expected years of life after retirement). We cannot model this provision as an increase in the retirement age, unless we were also to raise survival probabilities (which would roughly *maintain* the expected number of years of benefits).

27. In Coronado, Fullerton, and Glass (1999), we use the same model to analyze the redistributive impact of specific reform components. We found any reduction in the number of drop years allowed to be a regressive reform. Including the low-earning years reduces AIME somewhat more for low-income workers because they have more zero-earning years. In addition, that decline in AIME reduces benefits at the 90 percent PIA factor for individuals below the first bend point, and it reduces benefits at a low PIA factor for those with income above the bend points.

assume each person gets half of the couple's total income). Perhaps surprisingly, this change is slightly progressive. As it turns out, middle- and high-income couples have more disparate incomes and make greater use of the spousal benefit.

While the current system is fully indexed for inflation, it uses the Consumer Price Index (CPI). This index has been criticized for overstating inflation and therefore scaling up benefits by more than necessary amounts to maintain living standards for retired beneficiaries. The NCRP plan, like other reform plans, would require a downward revision in the CPI, which would raise some net revenue. If the issue were described only in terms of accurate indexation for inflation, then we would not be able to capture this provision. If the Bureau of Labor Statistics does not change the CPI, however, the reform says that benefits will be indexed explicitly to the CPI minus 0.5 percentage points. We model that change as a real cut in benefits. Specifically, real benefits fall at 0.5 percent per year, starting at the age of retirement. Because the benefit schedule is progressive, any cut in benefits would normally be regressive. However, benefits are cut more for those who live longer and continue to experience real benefit cuts each year. Since high-income individuals live longer, this particular form of benefit cut has uncertain effects. As it turns out, the net effect of this provision is somewhat regressive in our model.

Thus, some aspects of the NCRP plan are progressive, and some are regressive. Our calculations below will show the net effects of all these changes together. Table 5.1 also lists a few provisions that are not captured by our model. The NCRP plan would also raise the age for early retirement from sixty-two to sixty-five (to match the three-year increase in the NRA from sixty-seven to seventy). It would extend OASDI coverage to all state and local government employees hired after 1999. Under current law, if a Social Security beneficiary works after normal retirement age, retirement benefits are reduced by $1 for every $3 earned above a certain threshold. This feature is not captured in our model, because we assume no earnings after retirement. The NCRP plan would also eliminate this retirement earnings test for individuals after NRA (seventy).

5.3.3 The Aaron and Reischauer (A&R) Plan

Any reform plan must face fundamental choices about the very nature of Social Security. The current system is partially funded, so a reform could raise revenue and create a fully funded program, or it could return to the original pay-as-you-go (PAYGO) idea. The current system is explicitly a transfer program that redistributes from workers to retirees, to those with low income, to nonearning spouses, and to women (because they live longer). Any reform could choose either to remove these transfer elements or to enhance them.

Rather than make wholesale changes to Social Security, the plan devised by Aaron and Reischauer (1998) would "fix" the current system. It would "close the projected long-term deficit and make Social Security better reflect current social and economic conditions, while preserving Social Security's fundamental character" (96). As a consequence, this plan tinkers with a number of provisions in ways that individually raise a bit of revenue while closing a significant portion of the projected shortfall by investing the trust fund in private debt and equity markets.

The A&R plan is summarized in column (3) of table 5.1. As it turns out, many of these changes appear at the bottom of the column, under features "not captured by our model." The A&R plan would raise the earliest eligibility age (EEA) from sixty-two to sixty-four (to match the currently provided two-year increase in the NRA from sixty-five to sixty-seven). Like other plans, it would cover all new state and local employees. Whereas current law collects income tax on Social Security benefits only above some threshold, the A&R plan would tax Social Security benefits just as if it were a private pension.[28] As mentioned above, the A&R plan would also raise some money by transferring part of the Social Security Trust Fund from government bonds to higher-yielding corporate stocks and bonds. We use only one discount rate, ignoring different risk premia, so we do not capture this provision either. We might note, however, that many of these ignored provisions have no obvious implications for redistribution.

The top of column (3) shows the provisions of the A&R plan that *are* captured in our model. First, this plan would change the number of years of earnings used in the AIME calculation from thirty-five to thirty-eight. Including more low-earning years means that AIME is reduced, and thus benefits are lower. The calculation still drops four years before the AIME calculation, and it still uses three more years (from sixty-four to sixty-seven) to substitute for earlier low-earning years. Thus it drops the seven lowest-earning years to age sixty-seven. Like the NCRP plan, the A&R plan would raise a bit of money by cutting the spousal benefit from one-half to one-third of the benefits of the higher-earning spouse. As mentioned above, the reduction in the number of dropped years is regressive and the reduction in the spousal benefit somewhat progressive—at least by our measurements, according to which each spouse's well-being is based on half of the couple's lifetime income.

Next, the A&R plan makes a change to the "survivor's benefit," which currently allows a widow or widower to receive his or her own benefit or the deceased spouse's benefit (whichever is larger). In the table, this rule is represented by "max (hus, wife)." Instead, the A&R plan would provide three-

28. That means it would exempt the amount that was already subjected to income tax (such as the employee's payroll tax share, which comes out of taxable income), but it would tax the rest of social security benefits—since those dollars have not yet been subject to income tax.

quarters of the *combined* benefits of both spouses ("3/4[hus + wife]"). The logic for this change is based on the cost of living for one person compared to the cost for two together. Compared to current law, however, it provides more benefits to some individuals and less to others. If two spouses had the same earnings, for example, then either person's survival benefit would become three-quarters of the total, which is 50 percent *more* than under current law (according to which either person would get half of the total). If a lower-earning spouse had own benefits of less than one-third of those of the higher-earning spouse, then either person's new survivor's benefit would be less than under current law.[29] In our calculations, this particular provision is found to be progressive. As mentioned above, low-income couples tend to have more similar incomes, since both must work at low-paying jobs. Equal incomes gain from this reform provision. Middle- and high-income couples tend to have more disparate incomes, since they can afford for one person to stay at home, and thus gain less or actually lose from this proposal.

Finally, the A&R plan would undertake unspecified corrections in the CPI. The reasoning is the same as that described above, namely, that the current CPI has been criticized for growing too quickly. This plan would leave those corrections to the economics experts, however, and not subtract any number of points from the CPI. With the system fully indexed to an accurate measure of inflation, we assume that real benefits are maintained.

Again, some of these provisions are progressive and some regressive. Most are small, however, and so the overall progressivity of the A&R plan is not expected to differ much from that of current law. As we show below, the A&R plan is slightly more progressive than the current Social Security system.

5.3.4 The Moynihan Plan

In terms of fundamental choices about the nature of Social Security, Senator Moynihan's 1999 reform proposal would head in a different direction. Whereas the 1983 changes raised revenue to generate a partially funded Social Security trust fund, this plan would return to PAYGO. The current trust fund would be drawn down by a temporary *reduction* in the current 12.4 percent OASDI tax rate to 11.4 percent (for the years 1999–2000) and to 10.4 percent (for 2001–2024). Then, when the trust fund is depleted, and that tax on a smaller number of workers is not enough to cover the benefits for a larger number of retirees, the rate would have to rise again to 11.4 percent (for 2025–29), 12.4 percent (for 2030–44), 12.7 percent (for 2045–54), 13.0 percent (2055–59), and 13.4 percent thereafter. These numbers are summarized in the top of column (4) of table 5.1.

29. The break-even point is the point at which one's benefit is one-third of the higher-earning spouse's benefit, because $(3/4)(1 + 1/3) = \max(1/3, 1)$.

Since our model considers only the long-run provisions of these reforms, the Moynihan plan must be represented by the 13.4 percent tax rate. We show results with the 13.4 percent rate in our tables below. In the long run, with this rate, overall net tax rates on all individuals are substantially higher than for the other reforms (and higher than for current law). The reason is that this plan disperses the trust fund to those of us in current generations—by lowering *our* overall net tax rates. For this reason, results below also show the effects of the Moynihan plan with the low 10.4 percent rate.

The wage cap was $76,200 in year 2000, and it is projected to reach $82,800 in 2003. As indicated in the second row of the table under the current system, this wage cap will cover about 85 percent of wages. This percentage has been falling, because high wage rates have been growing faster than average wages. The Moynihan plan would raise the wage cap to $97,500 in 2003, which would cover about 87 percent of wages, and it would still be indexed thereafter. We calculate the real increase in the long-run wage cap for our model. This change is progressive, because it collects additional payroll tax from those above the current wage cap. On the other hand, we should note, the increase in the OASDI tax rate to 13.4 percent is regressive, given any wage cap, because it collects only from those below the cap. Again, our model can calculate the net effect on progressivity.

The Moynihan plan also speeds up the currently scheduled increase in the NRA to sixty-seven, and it continues that increase to the age of seventy (for those retiring in 2073 and later). This change is regressive, for three reasons mentioned above: First, individuals pay the regressive payroll tax for more years; second, they receive the progressive benefit schedule for fewer years; third, low-income workers also die sooner, so the fall in their survival probability from age sixty-seven to seventy is greater than for high-income workers.

Because it increases the normal retirement age by three years (from sixty-seven to seventy), the Moynihan plan also increases the number of years of earnings in the AIME calculation by three (from thirty-five to thirty-eight). The lowest ten years of earnings are still ignored. This change is regressive, for reasons mentioned in note 27.

Like the NCRP, the Moynihan plan requires a reduction in the index used to maintain real benefits after retirement. If those corrections are not made within the CPI, then benefits will be indexed by the CPI minus 1 percentage point. We model this change as a 1 percent cut in real benefits each year after retirement.

The bottom of column (4) of the table indicates the provisions of the Moynihan plan that are not captured by our model. Like other reforms, it extends coverage to all new state and local workers. Like the NCRP plan, it eliminates the current earnings test for those beyond the retirement age who work. While the NCRP plan would eliminate this test at age seventy, the Moynihan plan would eliminate it at age sixty-two. Finally, like the

A&R plan, the Moynihan plan would change the income tax to cover all Social Security benefits as if they were private pensions.

5.4 Results

Our initial simulations use the enacted provisions of the Social Security Act, applied to a future cohort born in 1990. Results are presented in table 5.2.The last row shows the overall average *un*discounted taxes paid minus benefits received, in thousands of dollars per person. The reason for showing undiscounted net taxes is to shed some light on the overall solvency of the Social Security system. Our model cannot project actual inflows and outflows, since we do not use demographic forecasts, but a conceptual point can be made about solvency in a world with unchanging demographics: With a constant number of entering twenty-two-year-olds in each of the sex-race-income cells in our model, the undiscounted sum of taxes paid per individual ($103,200) equals the sum of taxes paid by all ages alive at one time. Similarly, the undiscounted sum of benefits ($164,900) is the sum of benefits paid out to all ages alive at one time. On this basis, the current Social Security system loses the difference ($61,700 per twenty-two-year-old) each year.[30]

Column (1) of table 5.2 shows the present value net tax as a fraction of lifetime potential income for each quintile under the current system. This net tax rate rises from 0.62 percent for the lowest-income quintile to 1.01 percent for the highest-income quintile. Thus, current law is progressive, but not uniformly so. The highest net tax rate applies to the middle-income quintile (1.07 percent). The benefit structure is progressive, even on a lifetime basis, but that progressivity is largely offset by the regressive tax system (which exempts earnings above the wage cap) and by various features of the system that tend to favor high-income groups (like the fact that high-income individuals tend to live longer and therefore receive benefits longer).

A large number of recent articles on Social Security reform have dealt with privatization of the system or other large-scale overhauls of the program (e.g., Kotlikoff, Smetters, and Walliser 1998). If complete privatization were to provide actuarially fair returns, with no redistributions between individuals, then the effects of complete privatization in our model are exactly the reverse of those of the current Social Security system. Thus, the results in this first column for the current system can be viewed as the distributional impact of an extreme reform—the repeal of Social Security.

30. If we multiply this $61,700 figure by the number of twenty-two-year-olds alive in 1994 (about 3.7 million), we get a total loss of about $228 billion per year. This figure lies between the "low" and the "high" deficit projected by the U.S. Social Security Administration (1998). As mentioned above, their "intermediate" projected deficit for the year 2075 is $480 billion in 1995 dollars, but that includes DI and pertains to a larger population.

Table 5.2 **Long-Run Distributional Impacts of Social Security Reform**

Lifetime Income Quintile	Net Social Security Tax Rates (%)						
	Current System (1)	Feldstein & Samwick (2)	NCRP (3)	Aaron & Reischauer (4)	Moynihan (with 10.4% payroll tax) (5)	Moynihan (with 13.4% payroll tax) (6)	Equal % Benefit Cut
1	0.62	0.00	1.83	0.68	2.38	4.05	1.56
2	0.74	0.00	1.91	0.95	2.30	3.84	1.59
3	1.07	0.00	2.15	1.25	2.58	4.18	1.89
4	0.96	0.00	1.96	1.15	2.34	3.79	1.70
5	1.01	0.00	1.77	1.15	2.24	3.52	1.60
	Changes in Net Social Security Tax Rates from Current System						
1		−0.62	1.21	0.06	1.76	3.43	0.94
2		−0.74	1.17	0.21	1.56	3.10	0.85
3		−1.07	1.08	0.18	1.51	3.11	0.82
4		−0.96	1.00	0.19	1.38	2.83	0.74
5		−1.01	0.76	0.14	1.23	2.51	0.59
Total undiscounted taxes minus benefits, in $ thousands per person	−61.7	0.0	−5.6	−55.4	−8.0	23.1	−30.8

Source: Authors' calculations.

Note: See text for abbreviations.

Because the current system is progressive, its repeal would be a regressive change.

Feldstein and Samwick (1998) do not suggest the repeal of the current system, but instead outline a plan to make it solvent and actuarially fair. Most importantly, their plan deals with the costs of a transition that honors the current promise of benefits to existing generations. That transition does not emerge in our long-run model. If the Feldstein-Samwick plan is actuarially fair in the long run, then it does not take net taxes from anyone. Column (2) of table 5.2 shows these zero net tax rates in the top panel and the change from current law in the bottom panel. To the extent that our calculations accurately reflect the long-run progressivity of the current system, the change to zero tax rates would be a regressive change, but not uniformly regressive.

The results in table 5.2 are illustrated in figure 5.1, where the net tax rate for the current system is the lowest of these six lines, rising from 0.62 percent for the first income group to 1.07 percent for the middle group and 1.01 percent for the high-income group. The Feldstein-Samwick plan would be represented by the horizontal axis, with zero tax rates for all groups.

The NCRP plan has both progressive and regressive elements. It would lower the regressive payroll tax by 2 percentage points and make the benefit schedule more progressive, but it would also cut benefits by raising the retirement age, by including more years of earnings in the benefit calculation, and by reducing the CPI by 0.5 percentage points. Since benefits are generally progressive, these benefit cuts are regressive. The net effects of all these changes are shown for the NCRP plan in column (3) of table 5.2. The net tax rate on the lowest-income group would rise to 1.83 percent, but the rate on the highest-income group would rise to only 1.77 percent. Again, the middle group pays the highest tax rate (2.15 percent). The bottom panel of table 5.2 shows that the increase in tax rate is highest for the group whose income is lowest. Thus, the reform is a regressive change to the current system. On the other hand, figure 5.1 shows that the NCRP system overall is fairly flat, with a net tax rate of around 2 percent of lifetime income for all groups.

The bottom of the NCRP column in table 5.2 shows the annual shortfall. By raising the net tax rate for everyone, the NCRP plan is able to reduce the annual shortfall as measured in our model from \$61,700 per person to only \$5,600 per person (and provisions that we do not capture may raise the rest of the needed revenue to balance the Social Security budget). Yet (one might ask) if "balance" means that all Social Security benefit payments are covered by payroll taxes, then why is the net tax rate still positive (at about 2 percent of lifetime income)? A zero balance in our model is represented by total taxes equal to benefits without discounting, to represent all cohorts alive at one time. In contrast, the net tax rate in

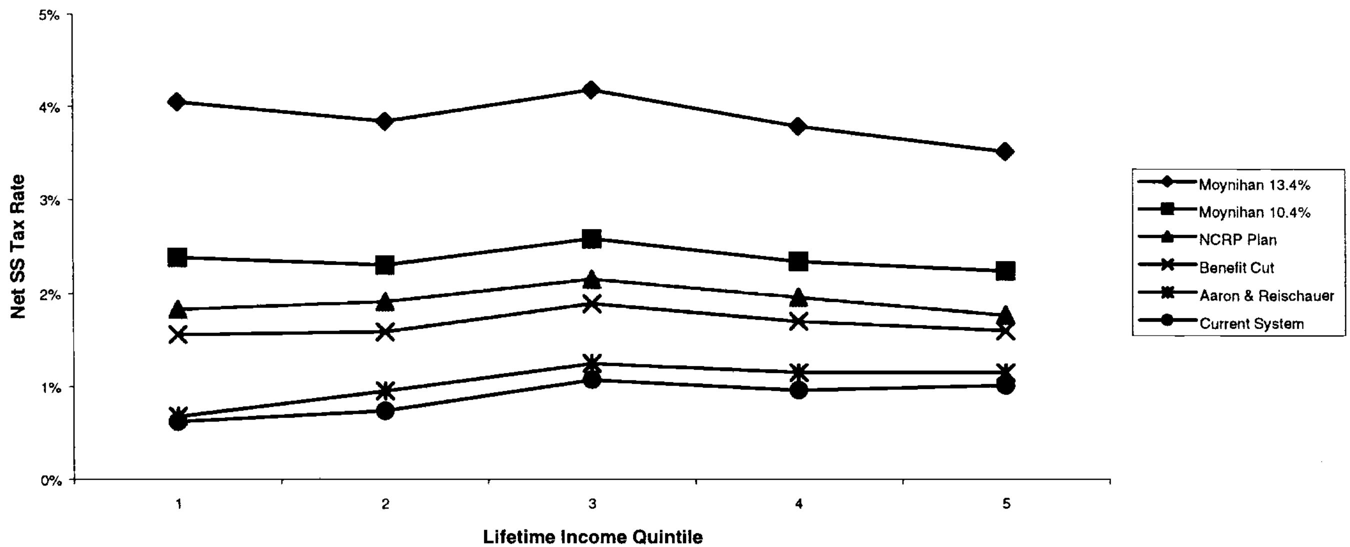

Fig. 5.1 Net social security tax rates under current system and proposed reforms (using 2 percent discount rate)

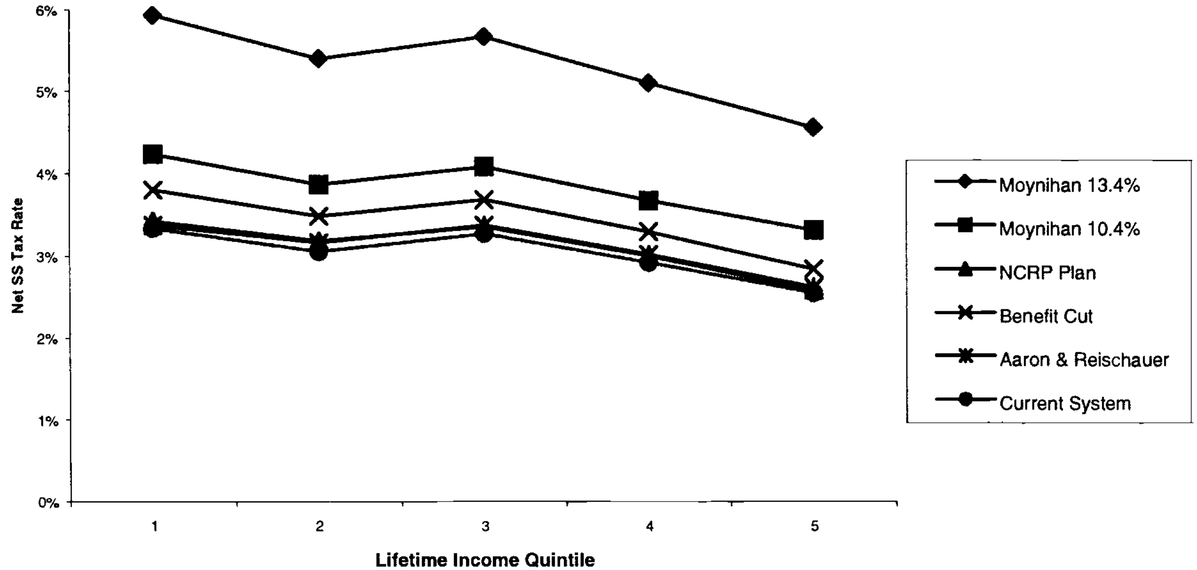

Fig. 5.2 Net social security tax rates under current system and proposed reforms (using 4 percent discount rate)

our model is the discounted present value of one's taxes minus one's own benefits during life. Since taxes come before benefits, discounting means that the present value of taxes outweigh the present value of benefits, for a positive net tax rate.[31]

Aaron and Reischauer (1998) make less dramatic modifications to Social Security. As indicated earlier, they would raise some revenue in ways not captured in our model, and they would reduce benefits by raising the number of years of earnings included in the benefit calculation (from thirty-five to thirty-eight). This provision is regressive in our model. The A&R plan would also cut the spousal benefit from one-half to one-third, and it would change the survivor's benefit to three-fourths of the combined benefits of husband and wife. These changes are both somewhat progressive. Column (4) of table 5.2 shows that the net effect is slightly progressive. The lowest-income group's net tax rate rises only slightly, from 0.62 percent to 0.68 percent, but the highest-income group's net tax rate rises from 1.01 percent to 1.15 percent. In figure 5.1, the A&R plan begins near the current system and raises net tax rates only slightly with income.

The Moynihan plan receives two columns in table 5.2 (and two curves in figure 5.1). Column 5 shows the long-run effects of the Moynihan plan with a 10.4 percent payroll tax (which actually only applies to years 2001–2024). Even with this reduced tax, however, net tax rates all rise to at least 2.3 percent because this plan incorporates major benefit cuts. It raises the retirement age to seventy, includes more low-earning years in the benefit calculations, and reduces indexing by 1 percentage point. Effectively, each person's real benefits are cut by 1 percent per year. Because benefits are progressive, these benefit cuts are regressive. On the other hand, the cut in regressive payroll taxes is progressive. Our table and figure show the net effects, where this version of the Moynihan plan has a very flat net tax rate (2.38 percent on the lowest-income group and 2.24 percent on the highest-income group).[32] By removing the small amount of progressivity of current law, the change is regressive. Tax rates rise by 1.76 percent for the poor group and by 1.23 percent for the rich.

31. However, the net tax rates in this table bear no direct relationship to the annual shortfall shown in the last row. According to the logic in the text, an unfunded PAYGO system would have zero annual deficit but positive net tax rates. In contrast, a fully privatized system would have zero taxes *and* zero benefits, for a zero annual balance and zero net tax rates. A fully funded tax and benefit scheme could have a zero net tax rate overall but positive annual taxes minus benefits. A related problem not captured in these numbers is that a reform plan may be designed to balance the social security budget in a present value sense, and not necessarily in each year of the long run we calculate. The difference is the transition. A plan may employ higher positive net tax rates in the long run just to help pay for the currently promised but unfunded benefits to the current generations.

32. This column is a bit misleading because it uses a short-run tax rate (10.4 percent in 2001–24) with a long-run retirement age (which takes effect in the year 2065). Similarly, the column with the 13.4 percent tax rate probably overstates the effects of this plan. The truth may lie in between.

The other version of the Moynihan plan employs the eventual 13.4 percent tax rate (after year 2060) and is reflected in column (6) of the table. Net tax rates rise even more, ranging from 4.05 percent for the lowest-lifetime-income group to 3.52 percent for the highest-lifetime-income group. Again the change is regressive, to the point that the entire system is now regressive. As shown in the figure, these net tax rates all lie well above those of any other plan. The reason is related to the switch back to PAYGO. This plan depletes the current partial funding of Social Security. Without a trust fund that earns a rate of return, eventual tax rates must be much higher to balance the Social Security budget year by year.

Current law may not be a relevant comparison, however, if it is not sustainable. Even if policy makers omit these reforms and do nothing, the budget shortfall may necessitate eventual cuts in benefits or increases in taxes. Therefore, as an alternative basis of comparison, we also show the effects of a proportionate cut in benefits (in column [7] of table 5.2). Somewhat arbitrarily, we set this benefit cut to eliminate half of the current shortfall in our model. This amount of benefit cut aids comparability, because it places the net tax rates near the middle of the reform plans (see figure 5.1). The result is 18.9 percent less benefits for all individuals.

Because the Social Security benefit formula is progressive, we expect this cut in benefits to be regressive. In fact, the wish to avoid the regressivity of this eventual "forced" cut in benefits would seem to be a reason that policy makers wish to plan ahead by designing their own reforms now. As it turns out, however, this do-nothing approach is no more regressive than the other planned approaches. In table 5.2, the net tax rate rises from 1.56 percent on the poor group to 1.89 percent on the middle group, and then falls back to 1.60 percent on the rich group. In figure 5.1, the line that represents this proportional benefit cut has the same shape as the lines for the reform plans: mostly flat, with some tendency to rise in the middle of the lifetime income distribution.

5.5 Sensitivity Analysis

We now vary some of the crucial assumptions of the model and observe how much these assumptions affect our results. Instead of showing many additional numbers in tables, however, we show only figures. Comparison to figure 5.1, then, reveals important differences.

First, we consider an increase in the discount rate from 2 percent to 4 percent. As discussed in section 5.2.6, this discount rate is supposed to reflect the alternative rate of return available to savers. Most studies of Social Security use a rate like our 2 percent, but Caldwell et al. (1999) and others argue that the rate should be higher. If so, results might more closely resemble the results with a 4 percent discount rate in figure 5.2.

As is immediately evident from a comparison of figures 5.1 and 5.2, an increase in the discount rate makes *all* of these Social Security systems more regressive. Recall that all plans have offsetting effects: Payroll taxes in all plans are regressive (because of the wage cap) and benefits in all plans are progressive (because of the formula). Yet taxes are paid before retirement, and benefits are received after. Therefore, a higher discount rate reduces the weight on these later progressive benefits, and it thereby increases the relative weight on the earlier regressive taxes. Figure 5.2 shows that net tax rates now slope down for the current system and all reform plans. One plan is not really more regressive than another. The order of the plans is about the same as before, with the lowest net tax rates for current law, followed by A&R, the benefit cut, and the Moynihan plan. The Moynihan plan with a 13.4 percent payroll tax rate still has net tax rates significantly above the other plans. One other noteworthy point is that *all* systems have higher net tax rates than in figure 5.1. The increase in the discount rate reduces the present value of taxes, but it reduces the present value of benefits by more.

Second, we consider a redefinition of lifetime income. Up to this point, we have argued that lifetime potential income should include the value of leisure and time spent at home. We wish to classify individuals from those who are well off to those who are not, and that time at home provides part of the well-being of those individuals. Consider, for example, one individual who works forty hours per week at $10 per hour and another individual who works twenty hours per week at $20 per hour. Previous studies that classify individuals by actual earnings would put both of these individuals into the same income group. Instead, we argue that the second individual is "richer" because he or she has the same take-home pay as well as the extra twenty hours per week at home to care for children, cook dinner, clean house, do the gardening, or just relax.

These are the reasons that we assign each individual 4,000 hours per year valued at that individual's wage rate. As a consequence, however, this "potential" income may be about twice the value of actual earnings (of a person who works about 2,000 hours per year). When we use this larger measure of potential earnings in the denominator of our net Social Security tax rate calculation, the resulting net tax rates are lower than in other previous studies.

To make our results more comparable to those from previous studies. figure 5.3 provides net tax rates based on actual earnings. Specifically, the present value of Social Security taxes minus benefits is divided by the present value of actual earnings for each group. We do not reclassify individuals into quintiles based on actual earnings. (For comparability with the basic results in figure 5.1, we return to the 2 percent discount rate of figure 5.1.)

When the measure of income in the denominator is cut approximately in half, the net tax as a fraction of income is about twice the size it was

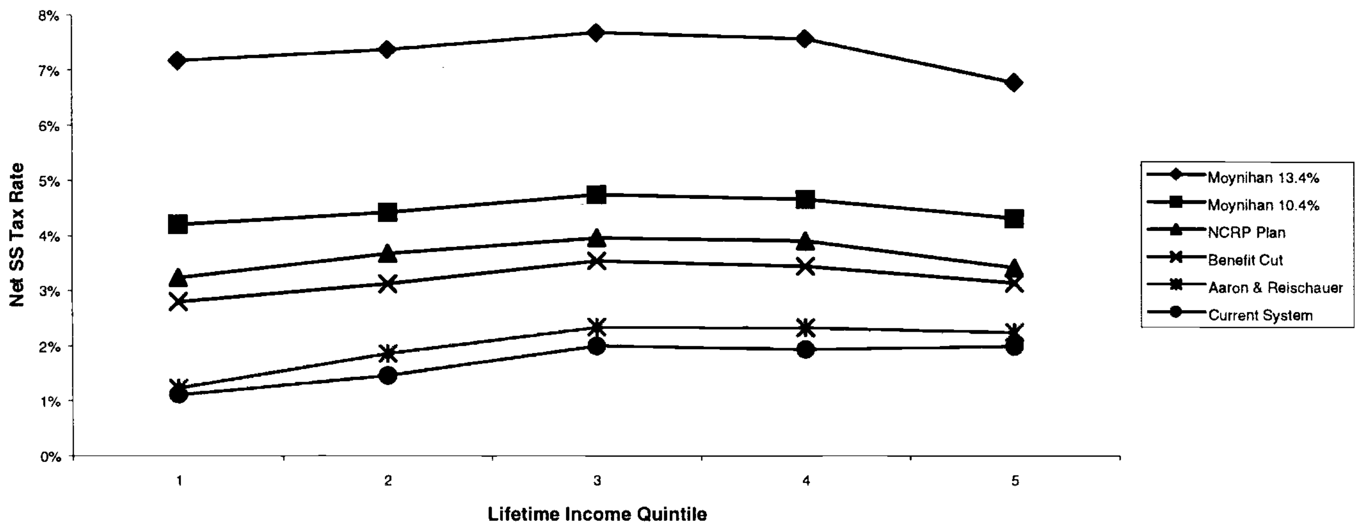

Fig. 5.3 Net social security tax rates under current system and proposed reforms (as a percentage of actual earnings, using 2 percent discount rate)

before. Otherwise, figure 5.3 looks much like figure 5.1. The current Social Security system has the lowest overall net tax rates and is slightly progressive. The A&R plan features net tax rates that are not much higher and slightly more progressive. The proportional benefit cut has the next higher net tax rates, and it is fairly proportional (rather than progressive). The NCRP plan is then followed by the Moynihan plans, where all are approximately proportional. The high-rate Moynihan plan looks a bit more regressive than the others (just as in figure 5.1).

Finally, we consider a different redefinition of lifetime income. Even if all agree that an individual's well-being includes the value of time at home, we could still debate the price at which to value that leisure. Up to this point, leisure has been valued at the individual's wage rate. To the extent that an individual can choose what amount to work, an hour at home must be worth at least that individual's wage rate, or else that person would instead have worked that hour.

A problem with this valuation, however, is that a given hour of leisure activity is worth more to a high-wage person than to a low-wage person. Implicitly, the assumption is that the high-wage person receives more well-being or more enjoyment from each hour of leisure. As an alternative, we consider a measurement based on a common set of prices to evaluate all goods that different individuals receive. This alternative measurement takes the view that a person is classified as well off if he or she receives more goods: more food, more furniture, or more leisure. To determine whether one person's bundle is worth more than another person's bundle, the researcher would use a given price per unit of each good (such as food, furniture, or leisure). Actual income or actual total expenditure *does* value purchased goods at the same prices for all individuals, and it can be augmented to value leisure at the same price for all individuals. To value all units of leisure at the same price, we use the average of all individuals' wage rates. The results are shown in figure 5.4.

With all individuals' time at home valued at the same wage rate, figure 5.4 shows that all Social Security plans look more progressive. To explain this result, note that the revaluation of leisure *reduces* potential income for the high-income group (which raises their net tax rate as a fraction of income) and *raises* potential income for anyone with less than the average wage rate (which lowers their net tax rate as a fraction of income). The important point is simply that the characterization of any tax system as regressive or progressive depends substantially on the definition of "income"—a term for which we have no unambiguous definition.

Otherwise, again, the differences between the plans are similar to those in other figures above. The current system has the lowest overall net tax rates. The A&R plan's tax rates are slightly higher and slightly more progressive. The "benefit cut" is next, followed by the NCRP plan and the

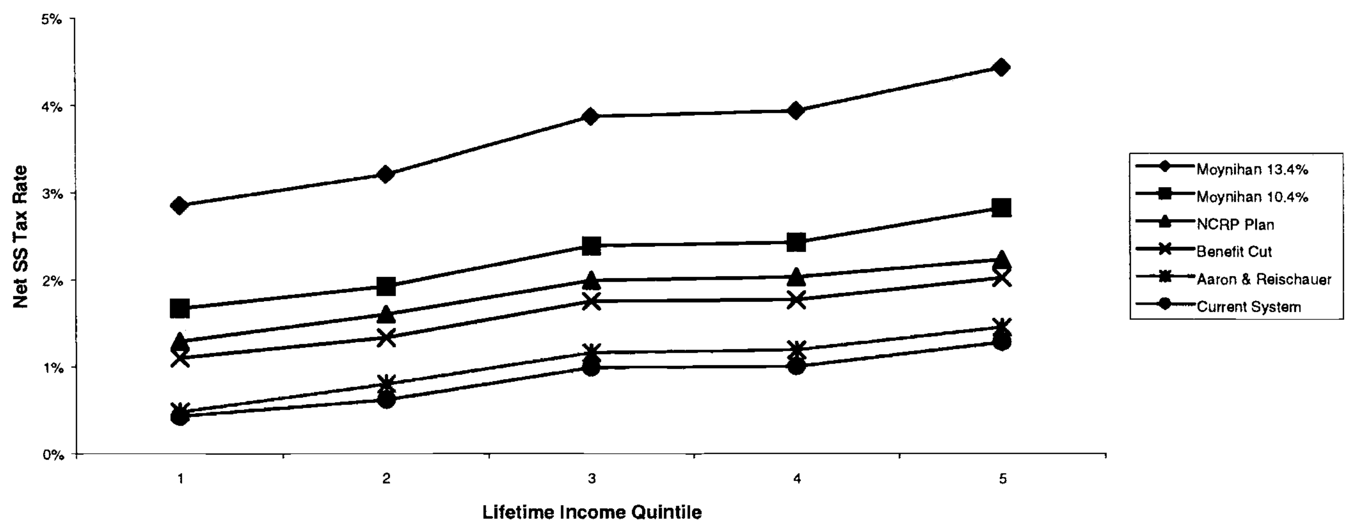

Fig. 5.4 Net social security tax rates under current system and proposed reforms (valuing leisure at average wage rate, using 2 percent discount rate)

Moynihan plan. All look progressive in figure 5.4, but one is not noticeably more or less progressive than any other.

5.6 Conclusion

This chapter uses a lifetime framework to address questions about the progressivity of Social Security and proposed reforms. We use a large sample of diverse individuals to calculate lifetime income, to classify individuals into income quintiles, and then to calculate the present value net tax in each group. We note, however, that this type of calculation does not answer all questions. In addition to redistributing between income groups, Social Security also redistributes between groups based on age, gender, or family size, redistribution not shown in our results. Also not addressed here are questions about effects of Social Security reform on labor supply, savings, and the government budget.

Recent Social Security reform proposals have many large apparent differences. Some would raise revenue to fund all future promises, and others would deplete the current partial trust fund and return to PAYGO financing. Some would remove implicit transfers between groups, and others would enhance them. Some cut the payroll tax, and others increase it. The retirement age may be raised or not, and the benefit formula may be changed or not.

In a lifetime context, we find that these provisions tend to offset each other's effects on progressivity. Each plan has both regressive and progressive elements, so the net effect is not necessarily a great deal different from the current system. Despite these many differences between the reform plans, we find that they have similar effects on overall progressivity. In our basic calculations, the slightly progressive current system would be slightly more progressive in the A&R plan, and it would become slightly regressive in each of the other plans. The pattern of progressivity is affected by alternative assumptions, but it is affected in similar ways for the current system and proposed reforms. None of these reforms greatly alters the current degree of progressivity on a lifetime basis.

Appendix 5A

Data and Methodology

This appendix is divided into five parts, describing respectively the selection of the sample from the PSID, the estimation of log wage regressions and calculation of potential lifetime earnings, the estimation of earnings profiles, the derivation of income-differentiated mortality, and the calculation of Social Security benefits.

Data and Sample Selection

We use the PSID for the years 1968 to 1989, which gives us twenty-two years of data for a sample of the population. We select our sample based on three criteria. First, our sample members are not taken from the low-income subsample of the PSID. While the data contain weights so that the low-income sample can be merged with the representative sample, we felt that the representative sample provided sufficient data for our purposes. Second, we require that sample members remain in the sample for the entire period. Survey respondents may have died, or may have simply decided that the survey was no longer worth their time, and we judged that including individuals such as these was not worth the possible distortion in the data and additional computational work required to track these individuals. Third, we only include individuals whose relationship to head status did not change during the sample period.

Because of these criteria, we cut off a group of individuals who were less than thirty in 1968. We disproportionately eliminate women from the sample, because the PSID always classifies the man of a couple as the head of household. A single man who marries during the period remains head of household and is included in our sample, but a single woman who marries does not maintain the same relationship to head status for the whole period and would be excluded.

Our final sample consists of 1,086 heads and 700 wives. It captures 66 percent of the original, non–low-income PSID sample, including 92 percent of heads and 66 percent of wives. Because we did not extract data for those who dropped out of the sample or changed their relationship to head status, we cannot formally test whether their exclusion biases the parameters in our wage and earnings regressions. As reflected in table 5A.1, however, the observable characteristics of our sample are remarkably similar to the original sample. We therefore believe it is unlikely that our econometric estimates are significantly biased, or that our sample selection skews the conclusions we draw about the progressivity of the Social Security system and various reform proposals.

Log Wage Regressions and the Calculation of Potential Lifetime Income

As our analysis is intended to reflect a steady state, we abstract from real economic growth that occurred during our sample period. We want to isolate life-cycle movements in wages so that our wage profiles will not be specific to one generation during a particular time frame. Adjusting for economic growth and inflation yields lifetime wage profiles that can be used to analyze the distributional impact of Social Security in a more general, structural sense. We therefore adjust the nominal wage rate using

Table 5A.1 **Sample Selection**

	Original PSID Sample	Sample Used in Analysis
Number of people	2,780	1,786
Under age 30 (%)	36	25
Education of head (%)		
High school diploma	33	32
College degree	12	12
Education of wife (%)		
High school diploma	46	50
College degree	8	7
Race of head (%)		
White	92	94
Black	7	5

the Social Security Administration's Average Wage Index, which reflects growth in average nominal wages over the sample period. Using this index to deflate wages removes the effects of both inflation and real growth in wages.

We want to estimate a separate wage regression for working wives and household heads, but we question the idea of pooling the positive observations of the wives who work consistently throughout the sample with those who work only occasionally. We found that a woman would have to work at least 750 hours a year throughout her working life, an amount slightly less than half time in order for own Social Security benefits to be greater than the spousal benefits she could receive based on her husband's earnings (assuming she earns the same wage as her husband). Thus, we divide the working wives into two groups based on whether or not they averaged at least 750 hours of work per year throughout the sample. We ran our log wage regressions separately for the two groups, and then ran another one pooling the two groups, in order to perform an *F*-test. The results suggest that these two groups should indeed be analyzed separately. We therefore estimate three log wage regressions: for household heads, habitually working wives, and occasionally working wives.

We regress the log of the wage rate on an individual fixed effect and other variables like age, age squared, and age cubed. Because we have a fixed effect for each individual, we cannot use variables that do not vary over time (like race or gender). However, we do include age interacted with education, race, and gender. For the heads of household, we use all positive observations of wages, which gives us 19,130 observations on our 1,086 heads. The results of this regression are shown in table 5A.2. Using the resulting fixed effects and coefficients, we then fill in missing observations during the sample period and observations outside the sample period so that each individual has a wage rate for every year of his entire economic life from age twenty-two to sixty-six.

Table 5A.2 Log Wage Regression for Heads of Household

Independent Variable	Coefficient	T-Statistic
Age	0.1343	6.26
Age^2	−0.003313	−8.53
Age^3	0.000026	9.55
Age × education	0.003669	4.87
Age^2 × education	−0.0000326	−4.52
Age × female	−0.0239	−1.89
Age^2 × female	0.000306	2.11
Age × white	0.0167	1.32
Age^2 × white	−0.000240	−1.67
Individuals		1,086
N		19,130
Adjusted R^2		0.57

For each of the two groups of working women, we take all positive observations and regress the log of the wage rate on an individual fixed effect and variables for age and the interaction between age and education. The PSID does not have a race variable for the wives in the sample. For the wives who averaged more than 750 hours of work annually, we have 5,413 observations on 311 women. for those who work occasionally, but less than 750 hours, we have 2,292 observations on 296 wives. The results of the log wage regressions for the two groups of working wives can be found in table 5A.3. For these two groups, we again use the estimated fixed effects and coefficients to fill in missing observations within the sample and to simulate observations outside the sample, so that each woman has a complete wage profile. To each of the ninety-three women who did not work at all we assign the median fixed effect from the occasional workers and then use the coefficients from this group's regression to fill in an entire profile of potential hourly wages. Using the wage profile for each individual, we calculate the present value of potential lifetime income. We use this income to delineate quintiles.

The Estimation of Earnings Profiles

For each of our five lifetimes income quintiles, we estimate three new regressions for actual earnings of heads, habitually working wives, and part-time working wives. Our dependent variable is actual annual earnings. As above, we deflate earnings by the Social Security Administration's Average Wage Index to adjust for both inflation and real economic growth. Since earnings represent a continuous variable truncated at zero, we use a tobit framework for estimation. Here we assume that earnings are the product of optimal hours of work and a wage rate that is exogenous to the individual. Optimal hours of work can be positive or negative, so optimal earnings can be described as a latent variable, y^*:

Table 5A.3 Log Wage Regressions for Wives

Independent Variable	Habitual Workers	*T*-Statistic	Occasional Workers	*T*-Statistic
Age	0.0493	1.25	0.0104	0.102
Age^2	−0.000647	−0.949	0.000985	0.522
Age^3	0.0000018	0.399	−0.0000111	−1.03
Age × education	−0.000252	−0.106	−0.00538	−0.965
Age^2 × education	0.0000085	0.344	0.0000262	0.419
Individuals		311		296
N		5,413		2,292
Adjusted R^2		0.55		0.36

$$y_i^* = \mathbf{X}_i\beta + \varepsilon_i ,$$

where **X** is a vector of personal characteristics that determine the individual's wage and desired hours of work. We assume that observations of zero hours worked imply that desired hours of work are less than or equal to zero. Actual earnings, y, are observed only if y^* is greater than zero. If y^* is less than or equal to zero, then actual earnings are zero:

$$y_i = y_i^* \quad \text{if} \quad y_i^* > 0$$

$$y_i = 0 \quad \text{if} \quad y_i^* \leq 0 .$$

In the first stage described above, in which we divide people into lifetime income quintiles, our dependent variable was log wages. Thus we use generalized least squares estimation with individual fixed effects. In this second stage, the tobit model is nonlinear. We judged that the additional programming effort to include fixed effects in our tobit estimation was not worth while, given that such estimation also implies inconsistent parameter estimates (Heckman and MaCurdy 1980). By excluding fixed effects in this stage, we are able to include race, gender, and education variables in the earnings regressions without interacting them with age. For each regression for the heads of household, we begin with independent variables for age, age squared, age cubed, education, education squared, the product of age and education, a dummy variable for whether the head is female, age interacted with the female dummy, and a dummy for whether the head is white. We then eliminate variables that are insignificant. The results of the regressions for heads can be found in table 5A.4. For wives who averaged more than 750 hours of work a year, we begin with age, age squared, age cubed, education, education squared and the product of age and education. We again eliminate the insignificant regressors. Results for these regressions can be found in table 5A.5. We follow a similar procedure for

Table 5A.4 Tobit Earnings Regressions for Heads

Independent Variable	(Poorest) First Quintile	Second Quintile	Third Quintile	Fourth Quintile	(Richest) Fifth Quintile
Constant	−8,132.46	−30,327.00	−2,488.82	−85,422.40	−11,116.00
	(1.76)	(6.13)	(10.20)	(12.75)	(5.83)
Age	1,059.26	1,961.75	2,389.17	4,521.45	6,722.26
	(5.50)	(9.92)	(7.82)	(22.55)	(12.54)
Age^2	−13.64	−23.02	−35.43	−50.39	−90.61
	(6.64)	(10.61)	(14.62)	(22.44)	(20.95)
Age × education			54.67		107.59
			(4.72)		(4.85)
Education	636.43	2,069.38	−3,554.69	2,811.77	−1,912.73
	(6.03)	(4.93)	(2.96)	(3.77)	(1.79)
$Education^2$	−5.45	−60.97	84.76	−93.01	
	(5.35)	(3.25)	(2.47)	(3.18)	
Female	−15,432.50	−36,378.60	−8,338.69	−7,919.65	−28,415.50
	(5.46)	(5.73)	(5.80)	(5.05)	(12.22)
Age × female	148.24	548.23			
	(2.73)	(4.53)			
White	1,785.82		2,505.66	5,242.61	13,890.80
	(2.63)		(1.91)	(3.59)	(5.19)
Sigma	15,012.6	16,429.6	17,149.2	18,262.5	34,386.6
	(81.64)	(85.09)	(84.32)	(89.81)	(92.16)
% positive observations	90	93	95	96	95

Notes: *T*-statistics are in parentheses. Sigma is the standard error of the regression.

Table 5A.5 **Tobit Earnings Regressions for Habitually Working Wives**

Independent Variable	(Poorest) First Quintile	Second Quintile	Third Quintile	Fourth Quintile	(Richest) Fifth Quintile
Constant	−14,128.30	−4,324.50	17,493.00	22,901.90	29,809.20
	(2.53)	(0.59)	(1.18)	(1.11)	(0.54)
Age	1,100.17	947.28	−2,154.25	−4,597.56	−11,867.60
	(7.62)	(4.56)	(1.98)	(3.09)	(5.75)
Age^2	−12.60	−15.03	75.45	142.90	333.48
	(9.51)	(7.52)	(2.91)	(3.97)	(6.79)
Age^3			−0.68		−2.85
			(3.44)		(7.56)
Age × education	10.33	46.05		−1.30	
	(1.38)	(3.74)		(4.64)	
Education	−1,371.47	−1,788.95	190.00	3,522.40	15,155.10
	(2.27)	(3.06)	(1.52)	(3.39)	(2.14)
$Education^2$	64.97			−88.25	−510.36
	(3.18)			(2.13)	(2.10)
Sigma	6,392.47	8,777.50	10,216.40	11,548.40	15,471.30
	(52.55)	(46.22)	(48.26)	(39.36)	(37.76)
% positive observations	84	83	84	85	84

Notes: T-statistics are in parentheses. Sigma is the standard error of the regression.

wives who average less than 750 hours of work per year, and these results can be found in table 5A.6.

To simulate out-of-sample observations, we multiply the independent variables of each individual by the appropriate coefficients from his or her group's earnings regression. In addition, we include a random component, which we obtain by using the estimated standard error of each group's regression (shown in tables 5A.4–5A.6) to generate a normally distributed random variable. This random component is intended to represent unforeseen circumstances that affect earnings. It also means that individuals with the same observed characteristics will not have exactly the same earnings profile. Simulated earning observations are thus calculated as

$$\hat{y}_i = \mathbf{X}_i \hat{\beta} + \hat{\varepsilon}_i ,$$

where $\hat{\boldsymbol{\beta}}$ is the vector of estimated coefficients from our earnings regressions, and $\hat{\varepsilon}_i$ is the random component obtained by using the standard error of the regression to generate a random variable. Using this procedure, both positive and zero observations are generated. We found that the number of zeros generated for each group is consistent with the number of zero observations observed for that group during the sample years.

Derivation of Extended, Income-Differentiated Mortality

To extend the mortality tables from age eighty-five through ninety-nine, we make three assumptions. First, we assume that the probability of remaining alive beyond age eighty-five decreases annually by a constant amount (Faber and Wade 1983). Second, we set to zero the probability of remaining alive after age ninety-nine. This age seems a reasonable cut-off point, since less than 0.7 percent of all Social Security beneficiaries are older than ninety-five (U.S. Social Security Administration 1997). Third, given these two conditions, we find the constant annual change in the probability each year for each sex-race group such that the resulting set of probabilities yields the same life expectancy at age eighty-five as in the *Vital Statistics* (U.S. Department of Health and Human Services 1993).

Table 7 in Rogot et al. (1992) shows information on actual deaths in the sample for each annual income group, within each race-sex-age group. For example, consider white males, ages twenty-five to thirty-four. For each range of income (e.g., $10,000 to $14,999 in 1980 dollars), their table shows the number of individuals in their sample ($N = 14{,}563$), the number of observed deaths during the sample period ($O = 115$), and the number of deaths that would be expected if all income groups had the same mortality rate ($E = 92.2$). They then divide to calculate the Observed/Expected ratio ($O/E = 1.25$). Actual deaths in that low-income group are 25 percent higher than what would be expected using tables not differentiated by income.

We know the annual income of every individual in our PSID sample, so

Table 5A.6 Tobit Earnings Regressions for Part-time Working Wives

Independent Variable	(Poorest) First Quintile	Second Quintile	Third Quintile	Fourth Quintile	(Richest) Fifth Quintile
Constant	2,738.87	2,049.33	−27,560.40	−29,957.00	108,105.00
	(1.06)	(0.13)	(2.83)	(5.88)	(4.26)
Age	−68.30	−2,970.23	1,505.06	739.21	−10,479.20
	(1.58)	(3.14)	(5.60)	(5.03)	(5.72)
Age^2		86.98	−16.69	−9.12	267.93
		(4.06)	(5.73)	(5.49)	(6.28)
Age^3		−0.69			−2.156
		(4.30)			(6.69)
Age × education		−50.12			
		(3.59)			
Education	−409.04	4,947.28	−2,579.50	1,870.71	1,219.79
	(2.96)	(4.24)	(1.78)	(2.59)	(7.05)
$Education^2$		−119.18	138.56	−58.73	−12.19
		(2.86)	(2.25)	(2.01)	(7.53)
Sigma	9,067.14	6,708.64	9,759.96	7,926.30	12,086.00
	(17.96)	(25.78)	(24.70)	(35.60)	(30.62)
% positive observations	31	28	26	39	34

Notes: T-statistics are in parentheses. Sigma is the standard error of the regression.

we need to exclude the "unknown income" category from the table in Rogot et al. (1992). If we simply ignored this category, the overall *O*/*E* ratio would not be 1.0 for all income groups together. For this reason, we recalculate the expected deaths based on the subset of their individuals for which income is known, and recalculate *O*/*E* ratios for each group. The average of these new *O*/*E* ratios is 1.0, as desired. We then apply the appropriate ratio to each cell. Results for twenty-five to thirty-four-year-olds are shown in the top half of table 5A.7.

Finally, since annual income is volatile, we do not want to apply these annual-income-differentiated *O*/*E* ratios to the annual income of each person each year. Instead, we base differential mortality on lifetime income, in three steps. First, after we compute the present value of lifetime income for each of the 1,786 individuals in our PSID sample, we assign each a ranking compared to all individuals in our sample. For example, an individual whose lifetime income ranks 432 our of the 1,786 individuals is ranked in the 24th percentile. Second, for each of the annual income groups in table 5A.7, we likewise determine percentile rankings based on income (shown in the third column). Third, for each individual in our sample, we match the percentile of his or her lifetime income to the percentile for the same age-race-sex category in table 5A.7. For example, a white female aged twenty-seven who has lifetime income at the 24th percentile would be matched to the $10,000–14,999 annual income group (which lies between the 18th percentile and the 36th percentile). That individual would then be assigned that group's *O*/*E* ratio for white females (1.17). Finally, this ratio is used to scale the probability of death for that individual's age, sex, and race in the *Vital Statistics* (which are not differentiated by income).

A remaining problem, however, is related to causality: Our procedure essentially uses the individual's income as a determinant of death, even though the annual income levels in table 5A.7 may be determined in part by illness immediately preceding death. This problem is somewhat mitigated by the fact that the CPS data used by Rogot et al. (1992) is based on total combined family income, rather than just the decedent's income.

Calculation of Social Security Benefits

Every variable in this appendix is specific to each individual, but we drop the index *i* for expositional simplicity. For an unmarried individual, the Social Security benefit at age *j* is

$$\mathrm{BEN}_j = \mathrm{PIA}_j \times \mathrm{CPI}_{62,j} \, ,$$

where PIA is the primary insurance amount and $\mathrm{CPI}_{62,j}$ is the cumulative inflation index from age sixty-two to the age at which the benefit is computed. Then the mortality-adjusted benefit is

Table 5A.7 Ratio of Observed Deaths to Expected Deaths (O/E) for Each Race-Sex Group

Annual Family Income	Number (*N*)	Percentile	O/E White Male	O/E White Female	O/E Other Male	O/E Other Female
		Ages 25–34				
< $5,000	11,670	6.31	1.68	1.51	1.54	1.86
$5,000–9,999	22,085	18.25	1.20	0.97	0.81	1.01
$10,000–14,999	33,331	36.27	1.28	1.17	1.36	1.01
$15,000–19,999	32,231	53.70	1.12	0.76	0.71	0.84
$20,000–24,999	30,729	70.31	0.80	0.97	0.92	0.36
$25,000–49,999	48,375	96.47	0.73	0.94	0.72	0.44
> $49,999	6,529		0.61	1.15	0.72	0.44
N	184,950		81,461	85,047	7,752	10,690
		Ages 65–74				
< $5,000	13,386	6.65	1.39	1.23	1.15	1.06
$5,000–9,999	20,418	49.83	1.19	1.06	0.99	1.00
$10,000–14,999	13,774	70.13	0.98	0.88	0.95	0.85
$15,000–19,999	7,082	80.57	0.75	0.93	0.79	0.91
$20,000–24,999	4,868	87.75	0.79	0.74	0.92	0.85
$25,000–49,999	6,669	97.62	0.73	0.80	0.79	0.87
> $49,999	1,614		0.59	0.79	0.79	0.87
N	67,841		27,245	34,727	2,452	3,417

Source: Rogot et al. (1992, table 7).
Note: The "expected" number of deaths is based on the overall death rate within the age-sex-race category, not differentiated by income, while "observed" deaths are the actual number of deaths in each income group.

$$E_{22}(\text{BEN}_j) = \text{BEN}_j \times P_j ,$$

where $E_{22}(\text{BEN}_j)$ is the expected value at age twenty-two of the benefit to be received at age *j*, and P_j is the conditional probability of survival to age *j*, given survival to age twenty-two. For married individuals, the basic benefit is computed in the same manner. We compute the spousal benefit for the wife (or analogously, the husband) as

$$\text{SpBEN}_j = 0.5 \times \text{SBEN}_{js} ,$$

where SpBEN_j is the spousal benefit at wife's age *j*, SBEN_{js} is the husband's PIA adjusted for inflation to age *js*, and *js* is the husband's age when the wife is age *j*. Similarly, we calculate the survivor benefit as

$$\text{SurvBEN}_j = \text{SBEN}_{js} ,$$

where SurvBEN_j is the wife's survivor benefit after the death of the husband. If the other spouse is alive, we assume that a married individual receives the greater of his or her own benefit (BEN) or the spousal benefit (SpBEN). If the other spouse is deceased, the individual receives the greater of his or her own benefit (BEN) or the survivor benefit (SurvBEN). Using PH_j and PW_j for the husband's and wife's survival probabilities, the husband's mortality-adjusted benefit is

$$E_{22}(\text{HBEN}_j) = \text{PH}_j[\text{PW}_j \text{ Max}(\text{BEN}_j, \text{SpBEN}_j) + (1 - \text{PW}_j) \text{ Max}(\text{BEN}_j, \text{SurvBEN}_j)],$$

where $E_{22}(\text{HBEN}_j)$ is the expected value at age twenty-two of the husband's benefit. This expected value includes only the dollars going directly to husband. A symmetrical calculation is made to determine the wife's mortality-adjusted benefit:

$$E_{22}(\text{WBEN}_j) = \text{PW}_j[\text{PH}_j \text{ Max}(\text{BEN}_j, \text{SpBEN}_j) + (1 - \text{PH}_j) \text{ Max}(\text{BEN}_j, \text{SurvBEN}_j)].$$

We then compute the present value of expected taxes and benefits at age twenty-two for each individual, using alternative values for the constant real discount rate r:

$$\text{PVTAX} = \sum_j \frac{E_{22}(\text{SST}_j)}{(1 + r)^{j-22}},$$

$$\text{PVBEN} = \sum_j \frac{E_{22}(\text{BEN}_j)}{(1 + r)^{j-22}}.$$

References

Aaron, Henry J. 1977. Demographic effects on the equity of Social Security benefits. In *The economics of public services,* ed. M. Feldstein and R. P. Inman, 151–73. London: Macmillan.

Aaron, Henry J., and Robert D. Reischauer. 1998. *Countdown to reform.* New York: Century Foundation Press.

Altig, David, Alan J. Auerbach, Laurence J. Kotlikoff, Kent A. Smetters, and Jan Walliser. 1997. Simulating U.S. tax reform. Washington, D.C.: Congressional Budget Office.

Auerbach, Alan J., and Laurence J. Kotlikoff. 1987. *Dynamic fiscal policy.* New York: Cambridge University Press.

Boskin, Michael J., Laurence J. Kotlikoff, Douglas J. Puffert, and John B. Shoven. 1987. Social Security: A financial appraisal across and within generations. *National Tax Journal* 40 (March): 19–34.

Burkhauser, Richard V., and Jennifer Warlick. 1981. Disentangling the annuity from the redistributive aspects of Social Security. *Review of Income and Wealth* 27 (December): 401–21.

Caldwell, Steven, Melissa Favreault, Alla Gantman, Jagdeesh Gokhale, Thomas Johnson, and Laurence J. Kotlikoff. 1999. Social Security's treatment of postwar

Americans. *Tax policy and the economy,* vol. 13, ed. James M. Poterba, 109–48. Cambridge, Mass: MIT Press.
Coronado, Julia Lynn, Don Fullerton, and Thomas Glass. 1999. Distributional impacts of proposed changes to the Social Security system. *Tax policy and the economy,* vol. 13, ed. James M. Poterba, 149–86. Cambridge, Mass.: MIT Press.
———. 2000. The progressivity of Social Security. NBER Working Paper no. 7520. Cambridge, Mass.: National Bureau of Economic Research, February.
Duggan, James E., Robert Gillingham, and John S. Greenlees. 1993. Returns paid to early Social Security cohorts. *Contemporary Policy Issues* 11 (October): 1–13.
———. 1995. Progressive returns to Social Security? An answer from Social Security records. Research paper no. 9501. Washington, D.C.: U.S. Treasury Department, Office of Economic Policy.
Duleep, Harriett Orcutt. 1986. Measuring the effect of income on adult mortality using the longitudinal administrative record data. *Journal of Human Resources* 21 (spring).
Faber, Joseph F., and Alice H. Wade. 1983. *Life tables for the United States: 1900–2050.* Actuarial Study no. 89. Washington, D.C.: Social Security Administration, Office of the Actuary.
Feldstein, Martin, and Andrew Samwick. 1998. The transition path in privatizing Social Security. In *Privatizing Social Security,* ed. Martin Feldstein, 215–63. Chicago: University of Chicago Press.
Flowers, Marilyn, and John B. Horowitz. 1993. Distributional implications of the Social Security spouse benefit. *Southern Economic Journal* 60 (October): 490–94.
Fox, Alan. 1982. Earnings replacement rates and total income: Findings from the retirement history study. *Social Security Bulletin* 45 (October): 3–23.
Fullerton, Don, and Diane Lim Rogers. 1993. *Who bears the lifetime tax burden?* Washington, D.C.: Brookings Institution.
Garrett, Daniel M. 1995. The effects of differential mortality rates on the progressivity of Social Security. *Economic Inquiry* 7 (July): 457–75.
Geanokopolos, John, Olivia S. Mitchell, and Stephen P. Zeldes. 1998. Social Security money's worth. NBER Working Paper no. 6722. Cambridge, Mass.: National Bureau of Economic Research, September.
Gramlich, Edward M. 1996. Different approaches for dealing with Social Security. *Journal of Economic Perspectives* 10 (summer): 55–66.
Hamermesh, Daniel S., and Albert Rees. 1993. *The economics of work and pay.* New York: Harper Collins College Publishers.
Heckman, James J., and Thomas E. MaCurdy. 1980. A life cycle model of female labor supply. *Review of Economics Studies* 47 (January): 47–74.
Hurd, Michael D., and John B. Shoven. 1985. The distributional impact of Social Security. In *Pensions, labor, and individual choice,* ed. David A. Wise. Chicago: University of Chicago Press.
Ibbotson Associates. 1998. *Stocks, bonds, bells, and inflation 1998 yearbook.* Chicago: Ibbotson Associates.
Kotlikoff, Laurence J., Kent A. Smetters, and Jan Walliser. 1998. Social Security: Privatization and progressivity. *American Economic Review* 88 (May): 137–41.
Lee, Julie, Mark McClellan, and Jonathan Skinner. 1999. Who benefits from Medicare? In *Tax Policy and the Economy* 13, ed. James M. Poterba, chap. 3. Cambridge, Mass.: MIT Press.
Moynihan, Daniel Patrick. 1999. Social Security Solvency Act of 1998: Brief description of provisions. Washington, D.C.: U.S. Senate. Unpublished paper.
Myers, Robert J., and Bruce D. Schobel. 1983. A money's-worth analysis of Social Security retirement benefits. *Society of Actuaries Transactions* 35 (October): 533–61.

National Commission on Retirement Policy (NCRP). 1999. The twenty-first century retirement security plan. Washington, D.C.: Center for Strategic and International Studies.

Nelissen, Jan H. M. 1998. Annual versus lifetime income redistribution by Social Security. *Journal of Public Economics* 68 (May): 223–49.

Panis, Constantijn W. A., and Lee A. Lillard. 1996. Socioeconomic differentials in the returns to Social Security. RAND Labor and Population Program Working Paper Series no. 96–05. Santa Monica, Calif.: RAND Distribution Services.

Pechman, Joseph A., and Benjamin A. Okner. 1974. *Who bears the tax burden?* Washington, D.C.: Brookings Institution.

Rofman, Rafel Paulino. 1993. *Social Security and income distribution: Mortality and equity in pension plans.* Ph.D. diss. University of California, Berkeley.

Rogot, Eugene, Paul D. Sorlie, Norman J. Johnson, and Catherine Schmitt. 1992. *A mortality study of 1.3 million persons by demographic, social, and economic factors: 1979–1985 follow-up.* NIH Publication no. 92–3297. Bethesda, Md.: National Institutes of Health.

Steuerle, C. Eugene, and Jon M. Bakija. 1994. *Retooling Social Security for the twenty-first century: Right and wrong approaches to reform.* Washington, D.C.: Urban Institute Press.

U.S. Congressional Budget Office. 1999. *Raising the earliest age for Social Security benefits.* Washington, D.C.: U.S. Congressional Budget Office.

U.S. Department of Health and Human Services. 1993. *Vital statistics of the United States: 1989.* Hyattsville, Md.: Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics.

U.S. Social Security Administration. 1997. *Annual statistical supplement, 1997.* Washington, D.C.: GPO.

———. 1998. *The 1998 annual report of the board of trustees of the Federal Old Age and Survivors Insurance and Disability Insurance Trust Funds.* Washington, D.C.: GPO.

Williams, Roberton C. III. 1998. Equity in Social Security benefit determination: The effect of ignoring some working years. Department of economics, Stanford University. Unpublished paper.

Comment Stephen C. Goss

This chapter presents an analysis of the progressivity of the Social Security Old Age, and Survivors Insurance (OASI) program across groups separated by the level of lifetime potential earnings. The authors calculate the net Social Security tax (the difference between the present values of taxes paid and benefits receive) under present law and under four proposals designed to restore long-range solvency for OASDI. The net tax is expressed in relative terms, as a percentage of the lifetime potential earnings for each group, and is referred to as a net tax rate. Progressivity is defined as the state in which the net tax rate rises as lifetime potential income rises.

This chapter makes a real contribution to the analysis of progressivity

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in Social Security, providing a potentially useful measure for assessing the degree of progressivity across proposed formulations of Social Security. This kind of assessment should help policy makers achieve a balanced understanding of the implications of different reform proposals.

This discussion reviews briefly the measures of money's worth that have evolved and how these measures have provided a basis for assessing progressivity in the Social Security program. Finally, I make a number of suggestions for improving the calculations using this approach and for the specific calculations presented in this chapter.

Measures of Money's Worth

The net tax (the negative of the "net subsidy" referred to by Steuerle and Bakija 1994) is one of a family of "money's worth" measures. Another, the "money's worth ratio," is the ratio of the present value of expected benefits to expected taxes. Like the net tax, the money's worth ratio requires selection of a discount rate. In each case, the benefits under the plan in question are being effectively compared to the benefits that could have been achieved by investing the same taxes in a defined-contribution account that realized a rate of return equal to the assumed discount rate.

A third measure is the internal rate of return, i.e., the constant real rate of return on taxes for each generation that would just allow the taxes to pay for benefits under the plan. If the internal rate of return is less than the assumed discount rate for the other measures, then the net tax is positive and the money's worth ratio is less than 1.0. Comprehensive estimates using each of these three measures for a range of proposals were presented in appendix 2 of volume 1 of the report of the 1994–96 Advisory Council on Social Security.

All of these measures are sensitive to accurate and consistent measurement of both taxes and benefits. Because these measures compare the differences between two large values (taxes and benefits) that tend to be fairly similar in size, even small inconsistencies can be magnified into large errors.

Measurement of Progressivity

Progressivity may be assessed in a number of ways. A plan with a decreasing internal rate of return (or a decreasing money's worth ratio) as the earnings level increases has traditionally been referred to as progressive. This kind of progressivity is observed for the current U.S. Social Security program even though the payroll tax, taken alone, is regressive. (Earnings above $72,600 are not taxed for 1999.) The regressivity of the tax is irrelevant in this case because earnings above the taxable maximum amount are not considered in computing benefits.

Steuerle and Bakija (1994) used the net subsidy to illustrate that for the first several decades during which the OASDI program was maturing, the net subsidies were greater for high earners than low earners, even though internal rates of return and money's worth ratios were lower for high earners. This implied a kind of regressivity of the program even though standard analysis of internal rates of return indicated otherwise. Use of the net subsidy concept in analyzing progressivity assumes that amounts of taxes and benefits that are equal in discounted present value can be ignored. Thus, the difference between discounted benefits and taxes is taken to represent the net gain or loss (subsidy or tax).

The authors of this paper have transformed the net tax (net subsidy) to a relative form, the net tax rate, which is far more useful for assessing progressivity than is the net tax itself. The authors choose to divide the net tax by *total potential* lifetime earnings and categorize workers with the same measure.

This choice has the effect of portraying a program with a maximum taxable amount as less progressive at higher earnings levels than does the internal rate of return. If, for example, we had a program that provided a money's worth ratio of 0.8 for all participants, this would mean a net tax of 20 percent of the present value of each worker's taxes. With a 10 percent payroll tax rate, this would then mean a net tax rate of 2 percent of taxable earnings for all workers, indicating a program that is neither progressive nor regressive. However, with the authors' definition of the net tax rate, a worker with a lifetime earnings level that is double the taxable limit would have a net tax rate of only 1 percent, which suggests a regressive program.

In addition, the use of potential rather than actual earnings to categorize workers dampens the extent to which the current benefit formula appears to be progressive. Under this approach, a worker who works only twenty years and thus benefits from the weighted benefit formula is categorized as if he or she had worked at the same wage rate for all years from entry into the workforce until retirement. This has the effect of diluting the tendency for lower benefit-to-tax ratios in the class of high-lifetime-income workers. The authors provide an illustration of the effect of using actual rather than taxable earnings in the denominator of the net tax rate in figure 5.3. It is unclear whether workers were reclassified on the basis of lifetime actual rather than potential earnings. If not, it would be useful to add a figure with this reclassification.

For the sake of comparison (sensitivity analysis), it would also be useful to add a graph showing net tax rates where the net tax is divided by actual taxable earnings. This would isolate the tendency to show regressivity at higher earnings levels from the inclusion of nontaxable earnings. It would include only the tendency toward regressivity that is due to different mortality assumed by earnings class. A further graph assuming no difference in mortality by income level would also isolate this effect.

Unlike the internal rate of return and the money's worth ratio, the authors' choice of the net tax rate (as percent of total earnings) translates the regressivity of the tax alone into the program itself. Doing this is consistent with a view that any net tax that is needed to support the program should be assessed proportionally on *total* earnings, unlimited by the program taxable maximum. Consistent with this view, however, would be an intent to distribute any net subsidy (if the net tax is in aggregate negative) proportionally by total rather than taxable earnings. As with measures of money's worth, assessment of progressivity is extremely sensitive to proper and consistent measurement of the values of benefits and taxes.

Progressivity for the Whole Program

The Social Security program is a complex and highly integrated package of benefits, so it is very difficult to separate out particular benefits and the associated taxes. As discussed below, money's worth analysis and progressivity analysis are best performed for the program as a whole. This chapter, like most analyses of Social Security, focuses only on retirement benefits. Because workers with lower earnings have not only higher mortality but also higher disability incidence, focusing only on retirement benefits understates the overall progressivity of the Social Security program. If analysis cannot readily be extended to include expected disability benefits, then the effect of this omission should be described.

Measurement of Benefits and Taxes

In developing a measure like the net tax rate, accurate and consistent measurement of taxes and benefits is critical. While the intention of the authors is primarily to analyze progressivity, the absolute levels of their estimated net tax rates provide a meaningful measure of money's worth, whether intentional or not. The absolute level of the net tax rates is very sensitive to any bias in estimates of benefits or taxes. For example, if benefits are understated by 10 percent, then estimates of the net tax rate will be overstated by much more than 10 percent.

Progressivity analysis would also be affected if, for example, disability benefits are excluded (as they are in this chapter and in most such analyses). While workers with lower earnings tend to die younger, a regressive influence, they also tend to become disabled more, a progressive influence. (Note that the average primary insurance amount (PIA) for new male disabled worker awards in 1997 was 15 percent below the average PIA for new male retired worker awards. This means the average earnings level for disabled workers is more than 15 percent below that for retired workers.) If expected disability benefits cannot be included in the analysis, the effect of their exclusion on program progressivity should be noted.

Matching OASI Benefits and Taxes

The authors acknowledge that in comparing OASI taxes (ultimately 10.6 percent of taxable earnings) to OASI benefits simulated only for retirees plus their aged spouses and aged surviving spouses, their analysis excludes about 5 percent of OASI benefits that are paid from the OASI trust fund to (young) survivors. This exclusion could be partially remedied if the analysis was restricted to workers who survive with certainty to the normal retirement age (NRA). The current approach of modeling death between ages twenty-two and NRA (sixty-seven) includes the taxes paid by workers who die prematurely, but excludes much or all of the benefits associated with such deaths. This tends to understate net tax rates but may have little effect on progressivity.

However, the current analysis also excludes an additional, larger category of benefits, retirement benefits payable to "disability conversions." The Disability Insurance taxes (ultimately 1.8 percent of taxable earnings) pay only for disability benefits until a disabled worker reaches the NRA. At that point, the disabled worker is converted to retired worker status and receives benefits from the OASI trust fund. The cost of these benefits after disability conversion represents a form of extended disability insurance, in large part, that is financed from OASI taxes. Thus, if the analysis is restricted to retirement benefits commencing at NRA, and the expected value of disability conversion benefits is excluded, then the portion of the OASI tax that finances this insurance should also be excluded. The total cost of disability conversion benefits is about 10 percent of OASI retirement-benefit cost, so the "premium" for this insurance is significant portion of this amount.

In fact, due to the complex integration of benefits, the only way to assure a comprehensive match between taxes and benefits for Social Security, and to assure comprehensive analysis of progressivity for the program, is to include *all* OASDI benefits and taxes. This requires modeling of young survivor benefits, disability benefits, and disability conversion benefits, in addition to retirement and aged survivor benefits. If this is done, then the comparison to the total OASDI payroll tax rate is straightforward. This is the approach used for the estimates in appendix 2 of volume 1 of the report of the 1994–96 Advisory Council on Social Security. Where this cannot be done because of data limitations, the effects of the limitation should be discussed.

Mortality

The authors use mortality tables from the *Vital Statistics of the United States 1989* (U.S. Department of Health and Human Services 1993). These tables are based on "period" mortality data for experience around the year

1990. However, the authors simulate "a hypothetical future cohort with a birth year of 1990" for their analysis. The authors cite the probabilities of a twenty-two-year-old white male's surviving to ages sixty-five and eighty-five as 75.8 percent and 22.3 percent, respectively. However, projected mortality specifically for the 1990 birth cohort used in trustees' report projections (see the U.S. Social Security Administration's Actuarial Study no. 107 [1992]) indicate probabilities of 83.2 percent and 35.9 percent for all males. Moreover, where the authors cite that 31 percent of the population is still alive at age eighty-five, while Actuarial Study no. 107 indicates that this percentage is expected to be 45 percent for the cohort born in 1990. Differences of this magnitude would have very substantial effects on net tax rates and may influence progressivity.

The authors should consider using projected mortality for the 1990 birth cohort. If the *Vital Statistics* life tables are used, then the description of the hypothetical workers should be modified to indicate the use of 1990 period mortality with ultimate program benefit and tax provisions for the simulation.

Mortality by Income

The authors make a very sensible choice in assigning relative mortality at each age based on lifetime average earnings, rather than earnings at that age. However, because the underlying data provided by Rogot et al. (1992) are based on current income rather than lifetime income, there is some element of inconsistency. The authors do point out that the fact that the Rogot data are family income from the Current Population Surveys (CPS) means that the relative level at each age may not be very far off from the relative lifetime level of earnings.

Appendix table 5A.7 provides relative mortality factors by income only for the age group twenty-five to thirty-four. It would be useful to add these factors for other age groups used in the analysis, most importantly for ages sixty-five and older.

Assumed Retirement at Age Sixty-Seven

The authors assume that all workers would work until reaching their NRA (sixty-seven) if they do not die earlier. In fact, a large proportion of insured workers currently begin receiving benefits well before reaching the NRA. This tendency is expected to continue in the future.

The marginal increase in PIA (the unreduced benefit) for work after benefit eligibility at age sixty-two is small relative to the additional taxes paid because of the weighting in the benefit formula and the inclusion of only the highest thirty-five years in the Average Indexed Monthly Earnings (AIME). Thus, assuming that all workers work until age sixty-seven significantly understates money's worth and overstates the net tax. To the extent that workers with lower earnings retire earlier, assuming retirement at age sixty-seven for all workers results in a systematic underestimate of the actual progressivity that exists in the program.

For the National Commission on Retirement Policy (NCRP; 1999) and Moynihan (1999) plans, increases in the NRA above sixty-seven are said to be regressive largely because the methodology assumes that the hypothetical worker will always delay retirement to the NRA. If workers continue to retire more nearly at the earliest eligibility age (sixty-two) in the future, then increase in the NRA will be more nearly equivalent to an across-the-board benefit reduction for workers of all earnings levels. This would have a far smaller effect on progressivity. The chapter should point out that most of the effect of increasing NRA on progressivity results from the assumption that retirement age will rise directly.

Early Retirement Reduction Factors

Note 6 in the chapter suggests that for low-paid workers who tend to have higher mortality rates, the actuarial reduction factors are "likely to be too great." In fact, the tendency is the opposite. Higher mortality implies a larger actuarial reduction for earlier retirement, so that universal reduction factors are relatively more favorable for groups with higher mortality, like men. It should be further noted, however, that disabled persons have substantially higher-than-average mortality, so that workers becoming initially entitled to retirement benefits at ages sixty-two and over have an expected mortality that is lower than the average for the population as a whole.

Treatment of Stock Returns and Inclusion of Individual Accounts

Three of the four proposals considered depend significantly on investment in stock for the payment of future benefits. The Aaron and Reischauer (A&R) plan (1998) increases advance funding in the trust funds substantially and invests a part of the Social Security trust funds in stock and other private securities. The assumption of a higher return for stock (7 percent real) than for government bonds (3 percent real) allows a given tax rate to provide more benefits. Thus, the assumed higher rate of return for stock is automatically incorporated in the relationship between benefits and taxes under the A&R plan.

For the hypothetical, fully privatized, fully defined-contribution proposal (associated with Feldstein and Samwick 1998), and the individual account portion of the NCRP plan, the authors assume that the present values of taxes (contributions) and benefits (distributions) are equal. This implicitly assumes that the real yield on individual account investments is equal to only 2 percent. However, assuming a 7 percent real yield for stock and a 3 percent real yield for government bonds with a universal real discount rate of 2 percent, the expected present value of investments in defined-contribution individual accounts would be greater than the amount of the initial investment. While the theory of risk-adjusted returns argues against portraying this expected gain, it should not be ignored for the defined-contribution plans if it is reflected in the A&R plan (and the defined benefit portions of the other plans).

For the sake of consistency, the authors should include the expected gains from stock and bond investment in the defined-contribution individual accounts. The alternative would be to leave the treatment of individual investments alone (at an implicit 2 percent real rate of return) but to modify the benefits provided under the defined benefit program so that they are affordable with only a 2 percent return on trust fund investments.

Changes in the Consumer Price Index (CPI) or Cost of Living Adjustment (COLA)

Three of the plans include a provision that specifies or anticipates a change in the CPI or COLA. The authors have included the effect on benefits of this change for two of the plans, Moynihan and NCRP, because the reduction in COLA is more nearly specified, regardless of what action the Bureau of Labor Statistics takes. The effect of the change on benefits was not reflected in A&R because that plan anticipates more than it specifies a change. the treatment of CPI/COLA change should perhaps be made consistent (either by including for all or excluding for all) for two reasons. First, a portion of the change in CPI anticipated by these plans has already occurred with the implementation of geometric weighting in the CPI earlier this year. Second, while A&R do not specify the COLA change, the estimates that result in the estimated long-range solvency for the plan assume that the changes will occur with certainty.

Equal Benefit Cuts Under Current Law

Recognizing that the payroll tax rates provided under current law are not sufficient to provide long-range solvency, the authors develop an alternative "Equal % Benefit Cut" alternative. The 18.9 percent benefit cut is assumed to eliminate about one-half of the long-range shortfall. If benefit levels were gradually reduced to extend solvency of the current program on a roughly pay-as-you-go basis, a 30 percent cut would be required for the cohort born in 1990. For the sake of consistency with the other plans, which all are estimated to achieve long range solvency, this equal percent benefit cut should perhaps be set at 30 percent.

Other Clarifications

A number of small issues about the specification of the proposals to reform Social Security might be clarified before publication. For example, the provision in the NCRP plan to include all years of earnings in the numerator of the AIME would do so literally. This means that AIME would no longer be a true average, but a ratio with potentially more years of earnings in the numerator than the number of years in the denominator.

Another example is the 75 percent of couple benefits for widow(er)s in the A&R proposal. This provision is intended to provide 75 percent of the sum the couple would be receiving if both were still alive. Thus, the lower-earning spouse would contribute to the couple benefit either his own worker benefit or one-third of the spouse's worker benefit, whichever is higher. Accordingly, 75 percent of the couple benefit could not be less than benefit provided under current law.

References

Aaron, Henry J., and Robert D. Reischauer. 1998. *Countdown to reform.* New York: Century Foundation Press.

Feldstein, Martin, and Andrew Samwick. 1998. The transition path in privatizing Social Security. In *Privatizing Social Security,* ed. Martin Feldstein, 215–63. Chicago: University of Chicago Press.

Moynihan, Daniel Patrick. 1999. Social Security Solvency Act of 1998: Brief description of provisions. Washington, D.C.: U.S. Senate. Unpublished paper.

National Commission on Retirement Policy (NCRP). 1999. The 21st century retirement security plan. Washington, D.C.: Center for Strategic and International Studies.

Rogot, Eugene, Paul D. Sorlie, Norman J. Johnson, and Catherine Schmitt. 1992. *A mortality study of 1.3 million persons by demographic, social, and economic factors: 1979–1985 follow-up.* NIH Publication no. 92-3297. Bethesda, Md.: National Institutes of Health.

Steuerle, C. Eugene, and Jon M. Bakija. 1994. *Retooling Social Security for the twenty-first century: Right and wrong approaches to reform.* Washington, D.C.: Urban Institute Press.

U.S. Department of Health and Human Services. 1993. *Vital statistics of the United States: 1989.* Hyattsville, Md.: Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics.

U.S. Social Security Administration. 1992. *Life tables for the United States Social Security area 1900–2080.* Actuarial Study no. 107, Social Security Publication no. 11-11536. Washington, D.C.: Social Security Administration.

Discussion Summary

Because disability and life insurance programs have different consequences for income redistribution, *Martin Feldstein* suggested that the issues raised by modifying the retirement portion of the Social Security system should be kept separate from the disability insurance program. The decision to keep a pay-as-you-go disability system can be independent of the proposed changes in the old age insurance program.

Charles Blahous argued that the version of the NCRP plan modeled in this chapter differs in important ways from the actual NCRP plan, making the results in the paper difficult to interpret and possibly misleading. In addition, he questioned whether the chapter's methodology was appropriate for comparing plans of different sizes. In particular, comparing an across-the-board cut in benefits to less drastic cuts with other very progressive changes should imply that the NCRP plan is more progressive than the straight benefit cut option. However, the results in the chapter seem to suggest otherwise. In addition, Blahous noted that it is not a coincidence that the plans assessed with the highest net Social Security tax rates have the highest percentage of costs met through payroll taxes, because general revenue requirements above Social Security payroll taxes are not considered. Finally, there is some inconsistent treatment between plans when calculating net tax rates. For example, the portion of the NCRP plan with the improved rate of return—the individual account portion—is ignored while the remaining segment with the lower rate of return is considered. This introduces significant problems when comparing plans. The authors described various changes outlined by the NCRP plan. Their explanation for the regressive appearance of the NCRP plan compared to straight benefit cuts is the large reduction in the number of drop years as well as the increase in the retirement age. According to the authors, the reduction of drop years is the most regressive reform component that they have analyzed.

Gary Burtless did not think that redistribution to the long-lived at the expense of the short-lived should be considered as a shortcoming of the redistributive impact of different plans. This redistribution is inherent when mandatory annuitization is imposed for everyone using the same annuity table, but this is not fundamental to Social Security. This type of redistribution could be avoided by eliminating annuitization completely or by using annuity tables that varied with life expectancy.

A number of participants were concerned about the chapter's approach to modeling plans that adjust Social Security's cost-of-living provisions. Plans that specified that benefits would be indexed at a rate below the growth rate of the CPI were penalized, but proposals that redefined the CPI in a way that would likely reduce its growth rate were not penalized. Since the two approaches would produce the same decrease in benefits, they should produce equivalent results.