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THE DISTRIBUTIONAL EFFECTS OF AN
INVESTMENT-BASED SOCIAL SECURITY SYSTEM

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ABSTRACT

In this paper we study the distributional impact of a change from the existing pay-as-you-go Social Security system to one that combines both pay-as-you-go and investment-based elements. Critics of investment based plans have been concerned that such plans might reduce the retirement income of low-paid workers or of surviving spouses relative to what they would get from Social Security, and might therefore increase the extent of poverty among the aged. Our analysis in this paper shows that this is generally not the case, even in plans that make no special effort to maintain or increase redistribution.

Our principal finding is that virtually all of the demographic groups that we examine would receive higher average benefits under a mixed system with an investment-based component than the benefits that they would receive under current Social Security rules. There would also be a smaller share of individuals with benefits below the poverty line. While the transition to a mixed system would require additional resources for the next few decades, in the long run the extra cost of funding the mixed system -- a three percent saving contribution rather than a six percent rise in the tax rate -- is substantially lower than that of funding the pay-as-you-go system.

Our individual-level data permit us to go beyond comparing group means to analyze the full distribution of the benefits that individuals would receive under the two different systems. These comparisons show that the overwhelming majority of individuals would have higher benefits with the investment based system than with the pure pay-as-you-go system. The relatively small number of individuals who would receive less from the investment based system is further reduced when the effects of the Supplementary Security Income program are taken into account. These basic conclusions remain true even if the future rate of return in the investment-based component of the mixed system is substantially less than past experience implies.

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The Distributional Effects of an Investment-Based Social Security System

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In this paper we study the distributional impact of a change from the existing pay-as-you-go Social Security system to one that combines both pay-as-you-go and investment-based elements.¹ Such a transition can avert the large tax increases that would otherwise be necessary to maintain the level of benefits promised under current law as life expectancy increases. According to the Social Security actuaries (Board of Trustees, 1999), retaining the existing pay-as-you-go system would eventually require raising the current 12.4 percent Social Security payroll tax rate to about 19 percent to maintain the current benefit rules or cutting benefits by more than one-third in order to avoid a tax increase. In contrast, previous research showed that adding an investment-based component with savings equal to two percent of covered earnings to

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¹For a discussion of the distributional impact of the existing Social Security system see Liebman (this volume), Coronado et al (1999), Gustman and Steinmeier(1999) and the classic papers by Hurd and Shoven (1995) and Boskin et al (1987).

the existing 12.4 percent pay-as-you-go system would be sufficient to maintain the benefits promised under current rules without any increase in tax rates (Feldstein and Samwick 1997, 1998a, 1998b).

Most proposed investment-based systems would increase the link between a worker's earnings and the worker's retirement benefits, potentially reducing the amount of redistribution that occurs through the Social Security system. Critics of investment based plans have been concerned that such plans, even if desirable for a typical employee, might reduce the retirement income of low-paid workers or surviving spouses relative to what they would get from Social Security, and might therefore increase the extent of poverty among the aged. Our analysis shows that this need not be the case, even in plans that make no special effort to maintain or increase redistribution, so long as sufficient funding is contributed to the investment-based component (and current funding levels are continued for the PAYGO component).

To analyze the actual distributional effect of a shift to a mixed system of Social Security funding, we use a rich data set of government administrative records on the lifetime earnings of a cohort of workers and spouses who retired in the early 1990s combined with a government survey of those same individuals. More specifically, we use the 1990 and 1991 panels of the Survey of Income and Program Participation matched to Social Security administrative data on earnings and benefits. We simulate the impact of alternative potential reforms using the cohort of individuals from the SIPP-SSA match who were born between 1925 and 1929 (and were therefore between the ages of 61 and 65 in 1990) and present results in a way that can be thought of as representing the impact of the reforms on the entire cross-sectional population of aged Social Security beneficiaries at a point in time. We use these data to study who the likely future

gainers and losers would be after a transition to such a system as well as to analyze some of the options for increasing the progressivity in such a system that have been proposed in the recent public debate on Social Security reform.

We focus our analysis on the benefits for retirees and their surviving spouses, excluding disability benefits and benefits for children and non-aged parents. Financing this portion of the overall OASDI program with pure pay-as-you-go financing would require raising the relevant portion of the Social Security payroll tax from 9.4 percent today to 15.4 percent in 2075.² The mixed system that we analyze leaves the portion of the payroll tax allocated for retirement benefits at 9.4 percent and supplements this with a three percent contribution to Personal Retirement Accounts that invest in a stock-bond portfolio. While the three percent account contributions require extra resources in the next few decades compared with a completely pay-as-you-go-system³, in the long-run they replace the six percent of payroll tax increase that would otherwise be necessary.⁴ We assume that the future pay-as-you-go benefits are reduced by the

²Of the total 19.9 percent of payroll in OASDI costs that are forecast for 2075, 2.59 percent are for DI benefits, roughly 0.28 percent are for young survivors (including children), and roughly 1.6 percent are OASI benefits at ages 65 and above for people who converted from DI benefits when they reached the normal retirement age. The DI estimate comes directly from the 1999 Trustees' Report. The other two estimates rely on Table II.H2 in the Trustees' Report which provides projections of the number of beneficiaries of each type in future years and weight these projections by the average benefit levels for each type of beneficiary in 1997 from the Annual Statistical Supplement.

³ The additional resources could come from a temporary increase in the payroll tax or from transfers from general revenue. Feldstein and Samwick (2000) present a third mechanism – borrowing by the trust fund with subsequent repayment made possible by the returns to the increased capital accumulation.

⁴ Thus total contributions in the mixed plan are 15.4 percent – a payroll tax of 12.4 (9.4 percent for retirement and 3 percent for DI and young survivors) plus the 3 percent for personal retirement accounts. In the long-run, this is substantially less than the 19 percent payroll tax that

same proportion as the tax revenue (i.e., by 39 percent since 6 percent is 39 percent of 15.4 percent) and analyze how the sum of the remaining pay-as-you-go benefits and the Personal Retirement Account annuities received by each individual compares to the Social Security benefits that would be paid with the full 15.4 percent tax.

We assume that worker's personal retirement accounts are annuitized at the person's retirement date, using a single unisex mortality series for everyone. Each spouse in a married couples is required to obtain a joint and survivor's annuity that pays the widow/er two-thirds of the benefit the couple received when both spouses were alive. We further assume that accounts are split equally upon divorce, and that workers who die before age 65 bequeath their accounts to their surviving spouse if they have one and to any other designee if they do not. The annuities in our simulations are variable annuities that allow beneficiaries to continue to receive the same rate of return in retirement as workers receive in that year.

Our principal finding is that in the long run virtually all of the demographic groups that we examine would receive higher average benefits under a mixed system with an investment-based component than the benefits that they would receive under current Social Security rules with a substantially higher tax cost. There would also be a smaller share of individuals with benefits below the poverty line than under a pure pay-as-you-go system that maintained current law benefit rules. Taking into account the lower cost of funding the mixed system in the long run – a three percent saving contribution rather than a six percent rise in the tax rate -- also implies higher internal rates of return on the taxes-plus-savings in the fully phased-in mixed system than

would be necessary in total to continue the pay-as-you-go system. In both plans there is also revenue from the taxation of benefits. In the mixed plan, we allocate all of this revenue to finance DI benefits and benefits for young survivors.

on the taxes paid in the pure pay-as-you-go system. Transition generations would also experience higher retirement benefit levels than under current Social Security rules, and again this would apply to virtually all demographic groups. However, these generations might also face higher contribution rates.⁵

Our individual data permit us to go beyond comparing group means to analyze the full distribution of the benefits that individuals would receive under the two different systems. These comparisons show that the overwhelming majority of individuals would have higher benefits with the investment based system than with the pure pay-as-you-go system. The relatively small number of individuals who would receive less from the investment based system is further reduced when the effects of the Supplementary Security Income program are taken into account.

These basic conclusions remain true even if the future rate of return in the investment-based component of the mixed system is substantially less than past experience implies. We repeat our analysis for various demographic groups and individuals on a “low rate of return” assumption, i.e., on the assumption that the rate of return in the investment based portion is so low that the odds are nine-to-one that it would be exceeded in practice. Even in this worst tenth percentile case, there are few individuals who would be significantly worse off under the mixed system than they would be with the pure pay-as-you-go system.

Note that by comparing the benefits under the mixed plan to the full Social Security benefits promised under current law, we are setting a high hurdle for the mixed plan. Many proposed Social Security reform plans would reduce benefits compared with current law. If we were to compare the mixed plan to such a plan, the results would be much more impressive.

⁵ See footnote 3 above.

We also explore two options for increasing the redistribution to individuals with low incomes or retirees with low benefits. We find that without any increase in the total cost of the Personal Retirement Account deposits such a system can provide beneficiaries who have low lifetime-incomes with the same average percentage increase in benefits as higher-income beneficiaries, while still allowing most high-income individuals to have higher benefits in the investment based-system than in the pay-as-you-go system. Moreover, such funding of the personal retirement accounts substantially diminishes the chance that lower income families will have lower benefits than under current law in the case that financial market performance does not achieve its historic average.

The paper begins in section 1 with a review of the basic economics of converting from a pay-as-you-go system to a system that is wholly or partially investment-based. Section 2 then discusses the data and technical assumptions used in our calculations. The analysis of results begins with the simplification of the extreme case of a pure investment based system. Section 3 examines the effects of such a system on the mean benefits of different demographic groups, the fraction of each group that would gain or lose from such a shift, and the effect on the number of people who would potentially be in poverty. Section 4 then goes beyond these averages and proportions to look at each individual and assess the distribution of gains and losses within each demographic group. With this simplified extreme case as background, section 5 then examines a more realistic mixed system in which the current 12.4 percent OASDI payroll tax rate continues and is supplemented by a three percent saving rate in Personal Retirement Accounts instead of the six percent tax rate increase that would be needed to fund current law benefits. Section 6 then considers the effect of substituting a low probability poor return performance that has only

about one-chance in ten of occurring. Finally, section 7 modifies the assumption that the Personal Retirement Accounts deposits are a fixed percentage of each individual's covered earnings to consider PRA deposits that are either the same number of dollars for all participants or a combination of a fixed dollar amount and a portion of earnings.

1. Investment-Based Social Security Reform: The Economics of Prefunding

The Social Security Administration Office of the Actuary projects that rising life expectancy and continued low rates of fertility will reduce the ratio of workers to beneficiaries from 3.4 today to 2.0 in 2035 and 1.8 in 2075. This aging of the population implies that, in order to maintain the level of benefits promised under current law under a (largely) pay-as-you-go system, OASDI taxes would have to rise from the current level of 12.7 percent of payroll (including both the 12.4 percent payroll tax and revenue from the taxation of benefits) to 19.9 percent of payroll in 2075, an increase of 57 percent.⁶ As we noted above, financing the current law rules for retiree benefits alone would require increasing the tax rate by six percent of covered earnings, from 9.4 percent of earnings to 15.4 percent of earnings.

This large future tax increase (or the equivalent benefit cut) can be averted by prefunding future Social Security benefits. Prefunding involves setting aside resources today that would otherwise be consumed and allowing them to accumulate until they are needed to finance retirement benefits in the future. The basic intuition is that a dollar in benefits 35 years from now can be funded by setting aside a much smaller amount today.

⁶ Some academic demographers suggest that the needed tax increase could be even higher (Lee and Tuljapurkar, 1998). It is important to note that the tax increase is not a temporary phenomenon associated with the retirement of the baby-boom generation; rather it is a permanent change associated with long run demographic trends.

From the standpoint of the entire economy, additional savings today earn a real rate of return equal to the pre-tax marginal product of capital, which is likely to be around 7.5 percent.⁷ Thus \$100 of retirement benefits (in today's prices) 35 years from now could in principle be financed by setting aside only \$7.96 today, i.e., the present value of \$100 in 35 years discounting by a real return of 7.5 percent [$\$7.96 = \$100 / (1.075)^{35}$].

Four points about this rate of return are worth emphasizing. First, the rate of return earned through prefunding can be obtained for the economy as a whole only by increasing national savings. Simply shifting funds into private assets that would otherwise be used for reducing national debt (as some plans for investing the trust fund in equities as well as some carve-out individual account plans do) would simply move returns from the private to the public sector without increasing total national resources.⁸

Second, all of the economic logic behind prefunding applies whether the prefunding occurs through collective investing on behalf of the Social Security trust fund or through individual retirement savings accounts. While there are serious arguments both for and against collective investing,⁹ we believe that it is highly unlikely that the political system would adopt the magnitude of prefunding discussed in this paper unless the prefunding occurs through private

⁷ Poterba (1997) estimates that the pre-tax marginal product of corporate capital is 8.5 percent. Since some capital may be invested in housing or abroad, the marginal product for all capital could be somewhat lower than this. In addition, the increase in the capital stock could cause the marginal product of capital to fall. Feldstein and Samwick (1997) show that with Cobb-Douglas production technology, the reduction in the marginal product would be about 20 percent in the long run.

⁸ Elmendorf and Liebman (2000) examine the impact of Social Security reform on national savings.

⁹ See for example Diamond (1999) and the comments on it by Feldstein (1999).

savings accounts.

Third, prefunding comes at a cost. It requires the current generation to give up consumption in order to make future generations (with higher standards of living) better off. The logic behind prefunding is that the high rates of return on additional savings imply that current generations must give up only a little consumption to prevent future generation from giving up a large amount of consumption. Equivalently, if individuals today accept a slightly higher tax rate than would otherwise be necessary, it will be possible to avoid a much larger tax increase in the future. Whether, this tradeoff is worth making depends on one's view of the intergenerational social welfare function (see Feldstein, 1996 and the explicit calculations presented in Feldstein and Samwick 1997, 1998a) and the increased excess burden that would be caused by higher future tax rates.¹⁰

Fourth, part of the national return to incremental saving occurs to governments through taxes. Even when those savings are invested in stocks and bonds in "tax exempt" personal retirement accounts, a portion of the total return is collected by the federal, state and local governments in the form of corporate profits taxes and business property taxes. While in principle these incremental tax revenues could be rebated to the investment-based Social Security accounts (just as the Federal government transfers the income taxes collected on Social Security benefits to the Trust Fund), we recognize that such transfers may be politically unlikely,

¹⁰ The low rates of observed savings by the current generation is not evidence that current workers would oppose this transfer to future generations. Private savers cannot (outside of tax favored retirement accounts) earn the pre-income tax rate of return on their savings, thus their savings is distorted by the income tax. In addition, the need for a government provided Social Security retirement system is largely predicated on the inability of individuals to make farsighted savings decisions.

especially with respect to the taxes collected by state and local governments. In the calculations that follow we therefore underestimate the total return to the economy by assuming that the investment-based Personal Retirement Accounts earn the return on a balanced stock-bond portfolio, a return that therefore is after all taxes paid at the corporate level.

More specifically, we assume a portfolio with 60 percent stock (the Standard and Poors 500 portfolio) and 40 percent corporate bonds, a balance that reflects the ratio in which corporations finance their capital accumulation. The real logarithmic return on such a portfolio in the half century from 1946 to 1995 was 5.9 percent. We subtract 40 basis points for administrative costs to obtain the 5.5 percent real return that we use in most of our calculations. We discuss in section 3 why this understates the actual mean return since 1946. In section 6 we explicitly recognize the uncertainty of this return and analyze a low-probability “poor portfolio performance” case.

To assess the extent to which prefunding can reduce the required pay-as-you-go tax rate, it is necessary to consider the implicit rate of return on the pay-as-you-go system. In the long-run, the pay-as-you-go system has an implicit rate of return equal to the rate of growth of the Social Security tax base (Samuelson, 1958). According to the OASDI trustees (1999), that tax base will expand in real terms by about 1.1 percent a year over the next 75 years as labor force growth averages 0.2 percent a year and real taxable wage growth averages 0.9 percent a year.

The comparison of the 1.1 percent growth rate for the payroll tax base and the 5.5 percent rate of return on investment-based accounts shows the profound effect that prefunding can have on the cost of financing future Social Security benefits. Consider an individual who works from age 25 to age 65 and then retires with a life expectancy of nearly 20 years. To illustrate this, we

approximate the costs of financing each \$100 of benefits under the two systems by assuming that all of the contributing or saving is done at the midpoint of the working years (age 45) and all of the benefits are paid at age 80. With this 35 year time span, each \$100 in retirement benefits requires contributions to the pay-as-you-go system of $\$100 / (1.011)^{35} = \68.18 or savings in the investment based system of $\$100 / (1.055)^{35} = \15.35 . Thus each dollar of tax required in a pay-as-you-go system with a 1.1 percent implicit rate of return can be replaced by $15.35/68.18 = 0.225$ dollars in an investment based system with a 5.5 percent rate of return.

These calculations imply that the 15.4 percent long-run OASI tax could in principle be replaced with a 3.5 percent Personal Retirement Account saving rate (i.e., 0.225×15.4 percent = 3.5 percent). Alternatively, a pure prefunded system could use a saving rate that is higher than this 3.5 percent in order to achieve a higher expected benefit, to provide a cushion against the possibility of a lower than expected rate of return, and to ensure that even those individuals who receive a higher than average return from the current Social Security system come out with higher benefits under the reformed system. Therefore, in this paper we assume a 9 percent Personal Retirement Account saving rate, i.e., a rate that is only slightly more than half (58 percent) of the required long-run pay-as-you-go tax rate.

The relative cost of investment-based and pay-as-you-go benefits (i.e., 0.225) can also be used in evaluating the mixed system by calculating the cost of avoiding the 6 percent increase in the tax rate from 9.4 percent to 15.4 percent that would be necessary to finance retirement benefits under the current pay-as-you-go Social Security system. This calculation implies that a 1.35 percent Personal Retirement Account saving rate can replace a 6 percent increase in the payroll tax rate. The analysis of the mixed system in this paper assumes instead a 3.0 percent

Personal Retirement Account saving rate. This is only half of the increase that would be required in the long-run with the pure pay-as-you-go system but provides both a higher level of expected benefits and a cushion against the risk of a lower rate of return.

It is important to emphasize that the analysis in this paper deals with only the long-run situation in which the demographic change has increased the cost of the pay-as-you-go system and the alternative plans are fully phased in. In practice, of course, it would be necessary to go through a transition period in which the population is aging and the new funding system is gradually put into place. Thinking about the pure funded case shows the nature of the transition problem and how it can be solved in practice. Nearly all of the 12.4 percent OASDI payroll tax is currently needed to pay benefits to current retirees, survivors and disabled beneficiaries. Over time this would grow to 19.9 percent if no investment based component is introduced. The 0.225 percent relative cost factor implies that the 19.9 percent could be financed in the long run by saving 4.47 percent of covered earnings. But adding that 4.47 percent to the 12.4 percent at the start of the transition would no doubt be a politically unacceptable burden. It is unnecessary, however, to go immediately to the long-run funding rate. A gradual transition is possible in which the saving rate starts at less than its long-run value and increases gradually as the rising level of investment-based benefits makes it possible to reduce the pay-as-you-go tax rate. Feldstein and Samwick (1997) show how the current 12.4 percent can be gradually replaced with a much lower prefunded investment-based system by increasing the initial combination to 14.4 percent and then gradually bringing that total down to less than the initial 12.4 percent.

The distributional impact during the transition period will depend on the exact timing of the pay-as-you-go benefit declines relative to the distribution of the personal retirement account

annuities. Throughout the transition a smaller fraction of benefits will come from the individual accounts and a larger fraction from the traditional defined benefit Social Security system than will be the case at the end of the transition. If the cuts in traditional Social Security benefits are phased in at the same rate as the individual accounts accumulate, then retirees in the transition generations will also have higher expected retirements benefits than under current law.

However, some transition individuals may also pay higher total contribution rates than under current law. We do not consider any of these transition issues in the current paper.

2. The Microsimulation Model¹¹

As we noted above, our microsimulation model is based on a match of the 1990 and 1991 panels of the Survey of Income and Program Participation (SIPP) to Social Security administrative earnings and benefit records for those same individuals. We select SIPP sample members who were born from 1925 through 1929, and construct lifetime earnings and marital histories from age 21 through age 64 using the administrative records and the SIPP topical module on marriage. We then simulate the sample members' Social Security benefit levels under today's Social Security rules (rather than under the ones they actually experienced), and simulate their personal retirement account accumulations under the alternative policy rules outlined in the previous section.

The strength of our simulation model is that it reflects the full range of experience of the different individual members of an actual cohort, including periods of unemployment, child-rearing, low-earnings, divorce, etc. Because we have 40 years of actual covered earnings for

¹¹Readers who are not interested in the technical description of our method can go directly to the next section.

each sample member as well complete marital histories, we can be confident that our results portray the full range of distributional outcomes that would have occurred for this cohort if it had experienced these alternative Social Security systems.¹² Compared with other microsimulation models used to study the distributional implications of Social Security reform, we rely little on projected or imputed data. Since we are particularly concerned about the lower tail of the benefit distribution, our ability to observe extreme cases and to reflect the complicated cross correlations between marital status, earnings, retirement, and mortality is important.

Our data have two drawbacks, however. The first is that the future cohorts affected by Social Security reform will differ along important dimensions from the cohort that we study. In particular, women in future cohorts of retirees will reach retirement having had much more extensive labor market experience, and marriage rates will be lower, particularly in some lower-income populations. Second, we have to make some imputations to account for spouses who were absent at the time of the 1990/1991 SIPP (due to death or divorce) and because our administrative earnings data were truncated at the Social Security taxable maximum. The full details of our matching and imputation methods are described in the data appendix.

Once we have constructed complete earnings and marital histories, we calculate benefit streams for ages 60 through 100. We assume that sample members claim benefits at their actual retirement age (obtained from the Social Security benefit records). For the individual account plans, we similarly assume that sample members annuitize their accounts at the same age that

¹²We ignore behavioral responses to these alternative Social Security rules.

they chose to start receiving Social Security benefits or at age 65, whichever is earlier.¹³ We then calculate Social Security benefits at each age from 60 to 100.¹⁴ For married and divorced sample members, we calculate separate benefit streams corresponding to the benefits the sample member would receive if his or her spouse were still alive and if the spouse were dead (assuming that the sample member were still alive).

Using these benefit streams, we construct a simulated cross-section of Social Security beneficiaries by treating each benefit-year as an observation and weighting each observation by the probability that the sample member is alive in that year. For married and divorced individuals, the weights on each of the two benefit streams account additionally for the probability that the spouse is alive. We use mortality tables classified by age, race, sex, and education thereby incorporating socioeconomic differences in mortality. Brown, Liebman, and Pollet (this volume) constructed these mortality tables by fitting a Gompertz-Makeham function to data from the 1979-1985 National Longitudinal Mortality Study (NLMS) using non-linear least squares. The period life tables estimated from the NLMS were used to create mortality ratios (at each single year of age) for each race-education-sex group relative to the overall mortality rate for the relevant sex. These ratios were then applied to Social Security Administration life tables for male and females born in 1990 to produce the mortality tables used in this paper. Potential benefit-years with zero benefits are not included in the sample. For

¹³ This assumption is made in order to facilitate comparisons between the different systems. In practice, it would probably make more sense to have a standard annuitization age in order to avoid adverse selection problems.

¹⁴ Benefits vary by age because they can depend on whether the sample member's spouse has started receiving benefits yet.

example, only widows who take benefits at age 60 have observations at age 60.¹⁵

Table I displays two sets of means for our sample. The first column displays the means for our 2720 sample members, weighted for sampling and to correct for sample attrition due to imperfect matching to administrative data. At the time of the SIPP surveys, 54 percent of the members of our 5-year cohort were female, 74 percent were married, and 92 percent were white. Column 2 presents weighted means for our simulated cross-section of beneficiaries. Thus each of the 2720 sample members contributes up to 41 observations from age 60 to 100 weighted by the probability that they survive to that point in time. As would be expected, due to lower mortality rates of women, a higher fraction, 59 percent, of this simulated cross section of beneficiaries is female. The fraction that is married declines as spouses die. Thus, in the simulated cross-section of beneficiaries 53 percent are married compared to 74 percent at the time of the SIPP, and 38 percent are widow/ers compared to 14 percent at the time of the survey. Similarly, the fraction that is black is lower in the simulated cross section because of higher mortality rates for blacks than for whites.

3. A Pure Prefunding System

Although our primary interest is in the distributional effect of a mixed system that combines the existing pay-as-you-go finance with an investment based component, we begin our

¹⁵ We adopted this cross-sectional methodology after seeing a similar approach used by David Pattison at the Social Security Administration. However, our approach differs from that used in studies such as Social Security Administration (1999) because we do not discount the benefit levels back to age 65 as SSA does. We believe that our approach better represents the cross-sectional distribution of all beneficiaries and does not underweight older beneficiaries, particularly older widows.

analysis in the current section by considering the analytically pure case of completely replacing the traditional pay-as-you-go financing with a prefunding system of individual accounts. Since there are different possible combinations of pay-as-you-go and investment based systems, the pure prefunding system provides a useful limiting case. It also exaggerates the distributional effects and makes them easier to study.

We follow the procedure described above to compare the benefits that the retirees in our sample would receive in a pure pre-funded system (after it is fully phased in) with the benefits that they would receive under the existing pay-as-you-go Social Security rules (which we will refer to as the individual's benchmark Social Security benefits.) Our focus in this section is just on the beneficiaries and the amounts of benefits that they would receive. In section 4 we combine this information with the different amounts that these individuals would pay during their working years as either taxes for the Social Security program or as savings deposited into the Personal Retirement Accounts. This allows us to calculate the internal rates of return and net present value for different subgroups as a way of assessing the net distributional consequences of the shift from tax financed Social Security benefits to the funded Personal Retirement Account system.

Although a complete shift to a pure investment based system has occurred in several countries, other nations have combined pay-as-you-go defined benefit systems with defined contribution investment based prefunding. A system that combines some prefunding with a portion of the traditional pay-as-you-go finance would have a muted effect on distribution compared to the pure prefunding system examined in the current section. We examine one such mixed system in section 5 where we assume that the current pay-as-you-go tax rate continues to exist and that benefits are scaled down to the amount that could be financed by such a tax rate

with the older population that will prevail in 2075, the date that we use for comparing the two systems.¹⁶

Currently OASDI benefits are 10.8 percent of payroll (the fact that this is lower than the 12.4 percent OASDI payroll tax explains the existence of the Social Security surplus). However, some of these benefit payments are for disability benefits and other benefit categories such as children and young widows that we do not model. Using numbers from the Social Security Trustees' Report, we calculate that the cost of the portion of the OASDI program that we simulate in this paper will rise from 9.4 percent of payroll today to 15.4 percent of payroll in 2075. The most direct comparison of the fully phased-in version of the prefunded system with the existing pay-as-you-go system would assume that the retirees pay the same 15.4 percent of their wages each year during their working lives under both systems, with those funds going to pay concurrent benefits under the pay-as-you-go system and being invested in the personal retirement accounts in the prefunded system. However, since one of the advantages of the prefunded system is that it would allow a lower rate of contribution in the long-run than the tax rate of the pay-as-you-go system, our analysis assumes that individuals contribute only 9 percent of their covered earnings to their Personal Retirement Accounts during their working lives. This represents a 42 percent reduction in the cost of providing for their retirement income relative to the 15.4 percent required in the pay-as-you-go system. As we noted above, we examine the implications of this for the internal rate of return and for the net present value in different subgroups in section 5.

¹⁶ Although we do not explicitly model the transition to the pure prefunded system, the mixed system that we study in section 5 indicates the nature of the distributional effects that might be observed along such a path.

Our analysis assumes that individuals invest in a way that produces a 5.5 percent real rate of return on their Personal Retirement Account contributions after allowing for administrative costs of 0.4 percent.¹⁷ As we noted above, 5.9 percent has been the mean for the period 1946 to 1995 of the logarithmic real return on a portfolio consisting of 60 percent stocks (the Standard and Poors 500 index) and 40 percent corporate bonds. Four comments about this rate of return are warranted.

First, 5.9 percent is the return to investors on the portfolio of stocks and bonds and therefore understates the overall return to the nation of the incremental savings generated in the PRA accounts. To the extent that those savings are invested in corporate capital, they generate taxes to the federal, state, and local governments, including both corporate profits taxes and property taxes. This extra tax revenue permits reductions in other taxes or increases in government spending. We make no attempt to calculate how this extra benefit would be distributed in the population.

Second, the 5.9 percent mean return is the mean of the logarithmic annual returns. The corresponding mean return of the ordinary level rates of return is about one full percentage point higher, or 6.9 percent.¹⁸

¹⁷Administrative costs of 0.4 percent are about twice the rate charged by efficient equity index funds like the Vanguard fund. Bond funds generally have lower charges than equity funds. TIAA-CREF now offers a variable annuity with an administrative cost of 0.37 percent. These existing funds must incur expenses in collecting funds that would be avoided in a system in which funds are deposited annually in individual accounts by the government. For a discussion of these issues, see the NBER volume on the administrative costs of Social Security reform edited by John Shoven (Shoven, 1999) and the paper by Goldberg and Graetz (1999).

¹⁸The lognormal approximation for the rate of return implies that $E(1 + R) = \exp \{E(r) + 0.5 \text{ var}(r)\}$ where R is the level rate of return, r is the logarithmic rate of return, $E(x)$ is the expected value of x and $\text{var}(x)$ is the variance of x . Since $E(r) = .059$ and $\text{var}(r) = (0.125)^2 =$

Third, ending the post-war sample period in 1995 excludes the 125 percent rise in share prices between 1995 and 1999 and the significant if smaller rise in bond prices since that time. Extending the period through 1999 would raise the rate of return from 6.9 percent for 1946 to 1995 to about 7.5 percent for 1946-1999. Understating the actual average past rate of return in these two ways provides a margin of safety for the year to year fluctuations of the rate of return in the future and for the possibility that the stock market is particularly vulnerable to a downward correction at the present time.

Fourth, we provide explicit calculations in section 6 of the distributional effect of a prefunded system with a substantially lower rate of return, substituting 3.5 percent for the 5.5 percent. The statistical analysis reported in Feldstein and Rangelova (1998) shows that the historic experience implies that an annuity with a cumulative rate of return higher than 3.5 percent would be experienced in 90 percent of the realizations from the process that generated the observed rates of return between 1946 and 1995.¹⁹

Table II compares the mean benefits that would be paid to various retiree groups under existing pay-as-you-go Social Security rules with the PRA annuities that they would receive from the investment based accounts with the net 5.5 percent real rate of return. For each population group we also note the percentage of beneficiaries whose PRA annuities would be greater than or

.016, the mean of the level return is given by $E(1+R) = \exp(0.067) = 1.069$, i.e., a 6.9 percent real level rate of return.

¹⁹ Some additional variance could arise because individuals would be allowed to choose among various mutual fund managers. However, this additional variance would be quite small. Chevalier and Ellison (1999) estimate that the standard deviations of excess returns (relative to the market) of large growth and income mutual funds is around 3.5 percent. Since our estimates use a market standard deviation of 12.5 percent, accounting for the extra 3.5 percent spread would increase our overall standard deviation by less than 5 percent.

equal to the benefits that those individuals would receive from the Social Security program.²⁰ In addition, we show the percentage of individuals whose benefits are lower than the poverty line under the current law Social Security rules and in the PRA system.

All of these calculations assume that the beneficiaries begin receiving benefits at their actual age of claiming benefits or at age 65, whichever is earlier.²¹ The dollar amounts that we report are per retiree. This convention implies that a married couple receives twice the benefits that we report. Under the Social Security system, the per retiree benefit for a married couple is found by adding the retiree benefit of the primary earner plus the spouse benefit or the second earner's benefit, whichever is higher, and then dividing the sum by two. In the investment-based options, the Personal Retirement Account (PRA) annuities of both members of a married couple are combined and the sum is divided by two. Recall that the simulation assumes that retirees experience their actual earnings histories, restated in 1999 dollars, and will receive benefits under the current (1999) law benefit rules. When an individual reaches the age at which he claims benefits, his PRA balance is fully annuitized. Those individuals who die prematurely bequeath their PRA balances to their spouse if they have one or to someone else if they have no spouse. All amounts are in 1999 dollars and wage levels.

²⁰ If benefit levels under both plans are below the SSI guarantee, we treat the two plans as providing equal retirement benefits.

²¹ We simulate benefit levels under the current normal retirement age of 65, even though we are considering a fully phased in system that would exist after the retirement age has been raised to 67 (or higher). We do this because we do not want to bias the results of our analysis in favor of personal retirement accounts in assuming no behavioral responses to the benefit cuts implicit in raising the retirement age. In doing so, we tilt our results in favor of the traditional Social Security system, in assuming that the benefits we simulate could be afforded with 15.4 percent of payroll. In fact, if the NRA of 65 were maintained, paygo Social Security benefits would cost more than 15.4 percent of payroll.

The top line of the table shows (column 1) that the average annual current law Social Security benefit in our sample of retirees, funded with a 15.4 percent payroll tax, would be \$9,291.²² By contrast, PRA annuities for the same group of individuals with the same earnings histories, funded with 9 percent of covered earnings, produce a mean annuity of \$21,412 (column 2). The mean annuity is thus more than twice as high with the PRA system as with current Social Security rules even though the 9 percent funding rate is only slightly more than half of the 15.4 percent payroll tax rate required in the long-run for the pay-as-you-go Social Security system with the current benefit rules.²³ Column 3 reports that 98 percent of all beneficiaries would have PRA annuities that were greater than or equal to the benefits they would receive from Social Security under current law.

Finally, columns 4 and 5 report the effect of the reform on the percentage of retirees whose total income would be below the poverty level on the basis of their Social Security or PRA benefits taken alone. We say “benefits taken alone” to emphasize that this makes no allowance for Supplemental Security Income payments or other sources of retirement income (private pensions, federal and state government pensions, private savings, earnings, etc.)

²² In comparison, the Social Security Administration reports average benefits actually received by new beneficiaries (retired workers, husbands/wives, and widows) of \$8000 in 1997. Accounting for wage growth between 1997 and 1999 would eliminate about one-third of the gap between the two averages. In addition, our simulation model assumes that workers faced a taxable maximum that was equivalent to current levels throughout their careers, raising their covered earnings relative to actual retirees.

²³ The two mean annuities could be made equal by cutting the PRA saving rate from 9 percent to just 4.0 percent, only about one-fourth of the 15.4 percent payroll tax needed to fund the current law Social Security benefits with the future demographics and projected earnings. While it would be interesting to examine the distributional effects of the shift to a pure prefunded systems with different saving rates, we do not pursue this here.

Columns 4 and 5 show that the Social Security benefits taken alone would leave 18.9 percent of beneficiaries below the poverty line while this would fall to 9.2 percent with the PRA system. Thus PRA prefunding, using a saving rate that is less than 60 percent of the tax rate that would be required for pay-as-you-go Social Security cuts the potential poverty rate by more than half.

The rest of the table provides similar information for several different population subgroups. In every group, the mean PRA annuity substantially exceeds the mean benefits that would be paid under current-law Social Security rules, the number of beneficiaries who would receive more from the PRA annuity substantially exceeds the number who would receive more from Social Security, and the potential poverty rate under Social Security rules is substantially higher than it would be in the PRA system. After commenting on some of these comparisons we will look at a graphic representation of the outcomes for individual beneficiaries that indicates the extent to which some individuals would receive less from the PRA system than they would receive under existing Social Security rules.

Although all of the subgroups do substantially better with the PRA system than with the traditional Social Security, there are differences in the extent to which this is true. Some of these differences are what might have been expected, but we found others surprising.

Married individuals gain relatively less on average than other groups. The mean PRA annuity of \$17,152 of married men is 2.04 times the Social Security benefits of \$8,425 per person for the same individuals. The ratio is similar (2.15) but not identical for married women.²⁴ By comparison, the ratio of PRA benefits to current law Social Security benefits is 2.36 for non-

²⁴The amounts for married women are not the same as the amounts for married men because only individuals born between 1925 and 1929 are included in the calculations. Thus both members of married couples are not always in the sample.

married (widowed, divorced, or never married) men and 2.56 for non-married women.²⁵ This reflects two things. First, many married couples gain from the existing Social Security rule that gives benefits of 150 percent of the benefit of the primary earner whenever that amount is greater than the couple would have received on the basis of their individual earnings, even if the secondary earner had little or no earnings. Second, under the PRA system that we simulate, women who become widows after both spouses claim benefits, receive a retirement benefit that is two-thirds of what the couple was receiving. In contrast, Social Security provides widows with benefits that range between 50 percent and two-thirds of the couple's benefit, depending on the relative earnings of the two spouses. Moreover, if the widow's husband dies before claiming benefits in the PRA program, the widow inherits the account balance and eventually annuitizes it (as well as her own account if she has not previously claimed benefits either) at a single life rate.

This explains why widows and widowers not only have greater proportional gains but also have substantially more per capita benefits than married individuals. Divorced individuals also do well under the PRA plan relative to Social Security, especially if their former spouse is still alive or if their marriage lasted for fewer than 10 years. Social Security provides spouse benefits to divorced spouses that are only one-half of the benefit received by the ex-spouse while the ex-spouse is still alive (this prevents the system from creating an incentive for divorce). Moreover, the system provides no benefits to divorced spouses from marriages that lasted fewer than 10 years. In contrast, our PRA plan splits the accounts of the two spouses at the time of divorce regardless of the length of the marriage, and therefore often results in higher benefits.

²⁵Note that although the per person benefits are higher for the single retirees of all sorts, the benefits for the married couples with the man in the age range are twice \$17,152 or \$34,304, substantially higher than the household benefits in the other groups.

The poverty figures in columns 4 and 5 show that married couples that depend exclusively on the Social Security or PRA benefits are less likely to be below poverty than the unmarried retirees (widows, widowers, divorcees, and those who were never married). The shift from Social Security to the PRA benefit reduces the portion below poverty by much more among these high poverty unmarried groups than among the married. For example, while the proportion of married women who would be in poverty on the basis of Social Security benefits alone falls from 13 percent to 9 percent, the proportion of non-married women who would be in poverty falls from 26 percent to 9 percent.

Women who become widowed or divorced at an early age are particularly vulnerable under current Social Security rules. A woman who is widowed at 50 and who does not remarry will receive benefits based on her own earnings record (which may have large gaps during child raising years or may only begin at age 50) or on the limited earnings record of her husband, often leaving her with relatively low benefits when she turns 65 . The PRA system provides her with substantially more benefits when she retires because the amount in her husband's account passes to her if he dies before age 65 and accumulates value through the investment return.

The situation is similar for women who become divorced at an early age and do not remarry. The combination of account splitting at the time of divorce and the long period over which to earn investment returns generally results in higher benefits than they receive under Social Security.

This advantage of the PRA system is shown in the row marked Early Widows and Divorcees which refers to women who were widowed or divorced before the age of 50 and not remarried before retirement. We combine the young widows and young divorcees for this

calculation because the sample of each taken separately would be too small. Their mean benefit under current Social Security rules would be only \$8,249 while their PRA annuities would be \$22,044, a ratio of 2.67 and therefore substantially higher than the ratio for married men and women. 99 per cent of the PRA annuities of these young widows and divorcees would exceed the Social Security benefits that they would get under current rules. The percentage of “young widow and divorcees” whose benefits at retirement age are below the poverty line declines from 46 percent under current rules to 15 percent in the PRA system.

Table IIa also presents separate results for whites, blacks and Hispanics. All three groups gain substantially from the switch, even those who are divorced, widowed, or never married. The mean gain is larger for whites than for blacks but the reduction of the proportion of retirees who are potentially in poverty is greatest among blacks, a decline from 53 percent to 21 percent among unmarried blacks. Thus the shift to the PRA system is potentially much more important for blacks than it is for whites in combating poverty in old age.

Another way of assessing how the shift would affect different socio-economic groups is to compare the potential effect on households with different primary earner education levels. All three of the education groups enjoy a more than doubling of mean benefits both when married and single, but the relative gain is lower among those with a college education (2.02 when married and 2.27 with unmarried) than among those with a high school education (2.15 and 2.59) or those with less than a high school education (2.03 and 2.48). The reduction in poverty is greatest among the unmarried with less than a high school education; the proportion that potentially receives less than the poverty level falls from 35 percent to 13 percent among those with less than a high school education.

The greater relative gain among those with less than a college education is surprising at first since it is natural to think that the lower educated group would have lower incomes and therefore, given the nature of the Social Security rules, would have higher benefits relative to previous earnings (and therefore to PRA benefits) than those with more education and earnings. The contrary observed result may reflect the greater likelihood that married college attendees are more likely to be in a couple where the wife receives benefits as a spouse rather than as a retired worker, a situation that raises the value of Social Security benefits relative to lifetime earnings. The college educated group also has lower age-specific mortality rates, increasing the expected number of years of benefits.

Table I Ib presents results by lifetime income, defined as the Average Indexed Monthly Earnings (AIME) of the higher earner in the household. The overall pattern suggests that the reductions in potential poverty are the greatest in the lower income quintiles, while upper-income households have the largest proportional gains from switching to a PRA system. This classification must be regarded with great caution, however, since many of those who are classified as in the lowest quintile on the basis of their covered earnings may have worked for state governments or for the federal government for much of their life and have not actually had low incomes. The distributional results are therefore more meaningful for higher income quintiles. Education and race may also be better ways to assess how the reform would affect those with lower lifetime earnings. Finally, it is important to emphasize that all income groups benefit substantially from the shift, and that the reductions in potential poverty are largest for those most at risk.

3.1 Comparing Individual Benefits

We now go beyond the comparison of the mean benefits and other summary statistics for each of the demographic groups that are shown in Table I to examine how each of the individuals in our sample would do under the two systems. Figure 1 compares the simulated annual annuity benefits from the PRA accounts (the vertical axis) to the simulated annual social security benefits under current law (the horizontal account) for all beneficiaries. As in Table IIa, the PRA benefits are based on a contribution of 9 percent of earnings, approximately 58 percent of the 15.4 percent payroll tax that would be required to finance the pay-as-you-go OASI Social Security benefits for those who retire in 2075. Each point in the figure represents an individual in the sample weighted to represent the population sampling weight and the survival probabilities, as described in section 2 of this paper. To conform to Census restrictions on disclosing information on individuals, each point has been slightly modified from the actual location by adding random noise, a process known as “random jittering” in the statistical literature. This procedure does not change the overall appearance of the figure in a perceptible way. Note that the scale of the two axes is different; the annual Social Security benefits (horizontal scale) range from zero to \$20,000 per beneficiary while the PRA annuities for the same individuals range from zero to \$60,000.

The ray from the origin represents equal values of simulated Social Security benefits and simulated PRA annuities. Any point above the line corresponds to an individual who would receive more from the PRA system based on a 9 percent contribution rate than from the Social Security system despite the substantially higher 15.4 percent tax rate. The figure illustrates the statistic in Table II that nearly all individuals would receive more from the PRA system than from the Social Security system.

The figure goes beyond that summary statistic by showing the Social Security benefit level and the PRA annuity of each individual in our sample who would gain or lose in the shift to a prefunded system and the magnitude of the net gain or loss. It is clear that most of those who appear to lose from the shift are individuals with relatively low Social Security benefits. It is significant therefore to consider the role that Supplemental Security Income (SSI) would play in supplementing both the regular Social Security benefits and the PRA annuities. SSI is a federal government program that currently provides means tested supplemental benefits so that the combination of regular Social Security benefits, other income (from assets, pensions, and work) and the SSI benefit together provide a specified minimum income. Since our figures are benchmarked to 1999 income levels, the relevant SSI amounts are \$6000 per year for a single individual and \$9012 per year for a couple. This implies that incomes below \$4506 per person in married couples and \$6000 for unmarried individuals should not be observed under either the Social Security system or the PRA system.²⁶

To show the implication of this in a clear way, Figure 2 repeats the points in figure 1 for married individuals and adds vertical and horizontal lines corresponding to the federal SSI guarantee level (i.e., \$4506); to make the points clearer we limit the range to individuals with Social Security benefits up to \$12,000 per person. No point inside this SSI box would be observed in practice. Note that some individuals with Social Security benefits at or below the SSI level will have PRA benefits above that level and some with Social Security benefits above the SSI level will receive only the SSI level of benefits under the PRA program. The diagonal line

²⁶Some individuals who appear to be eligible for SSI payments do not take up their SSI benefits. McGarry (this volume) discusses this issue.

from the origin still shows the equal value combinations of Social Security benefits and PRA annuity payments, but any point inside the SSI box will be raised to the SSI level.

Any point below the diagonal line but inside the SSI box will not correspond to lower benefits under the actual PRA system because of the SSI supplement. The key point to note is that in the presence of the SSI guarantee there are very few points in which the PRA system provides lower income than the Social Security system.²⁷

Figure 3 shows the combinations of Social Security benefits and PRA annuity levels for women who are not married at retirement age (i.e., are widowed, divorced or never married). There are very few points in which the PRA benefit would be less than the Social Security benefit. When the benefit levels in the two systems are adjusted for SSI, i.e., each individual's retirement income has been adjusted up to the SSI level if it would otherwise be below, the small number of potential losers is substantially reduced. Only those points that are outside the "SSI box" and below the diagonal line would receive lower benefits.

The result is even more striking for "young" widows and divorcees (Figure 4) where virtually all of the individuals in the sample would be better off under the PRA system than under existing Social Security rules.

Figure 5 presents the same analysis for blacks. Almost all of this group would get higher retirement benefits under the PRA plan with a 9 percent contribution rate than under the Social Security plan with the 15.4 percent tax rate, often very much higher. While some of this group

²⁷ If a beneficiary had sufficient other income to be ineligible for SSI, then it would be possible for a person with a point in the bottom right portion of the SSI box to have lower income in a PRA system than under Social Security. But no one would end up with total income below the federal SSI standard. The cost of the SSI program would also be reduced since the PRA benefits would raise the incomes of many of those who now qualify for SSI benefits.

with low Social Security benefits would have even lower PRA annuities, this would rarely occur in practice because of the SSI program.

Figure 6 shows a similar analysis for individuals in households in which the primary earner had less than a high school education. Again virtually everyone in this group would have a higher retirement income in the PRA system and SSI would eliminate many of those shortfalls that remain.

4. Taking Taxes into Account: Internal Rates of Return and Net Present Values

The analysis of section 3 focused on the benefits that individuals would receive under the two systems. Although we noted that the 9 percent long-run rate of contribution to the PRA system would be substantially less than the corresponding 15.4 percent long-run tax required to fund the pay-as-you-go system, our analysis did not take this into account explicitly. We now remedy that by comparing the internal rates of return and the net present values of different population subgroups under the current Social Security rules with the rates of return and net present values that those groups would have in the PRA system.²⁸

The rate of return calculations for the PRA system are sensitive to the PRA annuity assumptions and to the bequest rules. All PRA balances are fully annuitized when the individual reaches retirement. Although an actuarially fair PRA system would give each individual the same rate of return, we noted above that we assume that the PRA annuities would be calculated using a single uniform unisex mortality table. The PRA system therefore gives a higher rate of return to those groups that have higher life expectancies, a difference that is particularly

²⁸It is important to emphasize that these rates of return are after the transition to the new system is complete. During part of the transition to the PRA system, contributions rates might be higher under the PRA system than under the pay-as-you-go system.

important in favoring women relative to men. With respect to bequests, we assume that a married individual who dies before age 67 bequeaths his PRA balance to his spouse if he or she has one and to someone else if there is no spouse.

The internal rate of return is calculated for each individual as follows. For individuals who are never married, we calculate the internal rate of return on the stream that begins with the taxes paid by the individual and the individual's employer at a combined 15.4 percent rate and switches to the benefits that the individual receives in each year; with each year weighted by the probability that the individual is alive at that age, using the age-sex-race-education mortality probabilities described above. For married couples, one half of the combined payroll taxes paid by the couple in each year that they are married is assumed to be paid by each individual (in years in which the spouses were not married, the entire payroll tax is attributed to the spouse who paid the tax). When the individuals receive benefits as a couple, half of the total benefit in each year is assumed to be received by each. When one of the couple dies, the remaining benefits are attributed only to the surviving spouse. The same procedure is followed for divorce: the divorced individual is assumed to pay half of the couple's combined payroll tax while married and to receive the relevant benefits after divorce.²⁹ In each situation, the internal rate of return for each individual in the couple is then based on these calculated tax payments and benefit receipts. From the SIPP marriage topical module we observe annual marital status for each individual including up to three marriages and divorces. Rates of return are reduced to account for the payroll taxes paid by cohort members who died before the time of the SIPP survey.

²⁹Recall that at the time of a divorce the PRA balances of the two individuals are combined and divided equally between them.

Implicitly, we assume that each deceased member of the cohort had earnings when they were alive that were equal to the average earnings of a person in the same sex-age-race-education subgroup. Rates of return are increased to account for the bequests by cohort members who died while single and before claiming benefits. The full amount of the bequest is treated as a benefit accruing to the sex-age-race-education subgroup of the decedent, and he or she is assumed to have had a personal retirement account equal to the subgroup average for people of his or her age.

Our estimates of the internal rate of return in each subgroup (and for all individuals) is done for the aggregate taxes and benefits in the relevant subgroup. Thus, individuals with higher earnings and benefit levels receive more weight in the internal rate of return calculations.

For all participants in our sample, the switch from the pay-as-you-go system to the PRA system raises the rate of return from about 1.4 percent in the unfunded Social Security system³⁰ to 5.5 percent in the PRA system. Although the differences between the two rates of return is substantially greater for some population groups than it is for others, reflecting the redistribution implied by the Social Security rules and the differences in PRA returns due to the use of a single unisex mortality table for calculating the PRA annuity payments, it is also true that all of the subgroups that we consider experience substantial rate of return increases.

Table III presents results for each of the subgroups for which an internal rate of return can be calculated. This is straightforward for the classifications that can be identified at age 21: sex,

³⁰This is the rate of return on Social Security contributions for the cohort that we study. Different cohorts would have different rates of return but, after the baby-boom demographic transition, all groups would receive approximately the rate of growth of real money wages.

race, and education. We do not present results for marital status since it is not generally known at age 21 and varies over an individual's lifetime.

It is tempting to say that the groups with the biggest increase in rate of return benefit most from the shift, and in some sense this is true. But such a comparison does not take into account the relative magnitudes of the tax and of the saving deposits under the two systems. A given rise in the internal rate of return is worth more in absolute amount when the magnitude of the tax and saving deposit is larger. We therefore also present estimates of the net present value of the time paths of payments and receipts for the Social Security and PRA systems.

The first column of Table III shows the internal rates of return of the current pay-as-you-go Social Security system for different population subgroups. We use our age-sex-race-education life tables to calculate the probability that each such person is alive to pay the tax in each year of his or her working life and to receive the Social Security benefit at each age. Since we are modeling the fully phased-in systems, we assume that the individuals (and their employers) pay 15.4 percent of their covered earnings in each year (from age 21 to their retirement age). The corresponding PRA calculations in column 2 assume that the individuals and/or their employers contribute 9 percent of their covered earnings and receive a 5.5 percent net rate of return on their contributions subject to the same mortality tables.

Women receive a higher return under Social Security than men because of their greater longevity and lower earnings; column one shows a return of 0.62 percent for men and 1.95 percent for women. The difference between woman and men increases slightly if we shift to the PRA system: an increase of 4.04 percent for men (to 4.66 percent) and an increase of 4.29 percent for women (to 6.24 percent), primarily reflecting the use of the unisex life table.

The results by race are quite interesting. Whites and blacks receive essentially the same rate of return under Social Security, with blacks receiving slightly less (1.27 percent) than whites (1.36 percent). Blacks do not receive a higher rate of return from Social Security despite their lower incomes because of differences in mortality rates with blacks being more likely to die before they receive any benefits and then, conditional on reaching age 65, to die earlier than whites who reached that age. More specifically, if we look just at those who live to age 65 the internal rate of return for blacks is slightly higher for whites, demonstrating how important mortality before age 65 is in racial differences in returns.³¹

Under the PRA, the gains for the two groups are very similar, with whites receiving slightly higher rates of return than blacks because both groups are assumed to purchase annuities at the same rates even though whites have a greater life expectancy.

Columns 3 through 8 contrast the net present value of the benefits and taxes for each of these groups, using three alternative real discount rates. We regard the 3 percent real rate (used in columns 5 and 6) as approximately the value that could be obtained after tax by an investor who could invest in the PRA portfolio of stocks and bonds. As a sensitivity test we repeat this analysis for real discount rates of both one percent and five percent. All other things equal, a group that has had higher incomes throughout its life will pay more payroll tax in the Social Security program and make larger contributions in the PRA system; it will therefore have a larger positive net present value (NPV) if its internal rate of return exceeds the discount rate and a

³¹As we explained above, these rates of return are based on the total taxes and benefits for the population subgroup, i.e., these are the weighted average of the individual rates of return with weights equal to the amount of taxes paid and benefits received. A simple unweighted average shows a much higher return for blacks that is more than twice the rate for whites. See Liebman (this volume) for more detail.

larger negative net present value if its internal rate of return is less than the discount rate.

The first row shows that for the average participant the lifetime NPV of the pay as you go Social Security system is negative (minus \$26,475) when discounting at 3 percent (column 5). In contrast, with the PRA system the lifetime NPV for the average participant (shown in column 6) is a positive \$48,414. With a one percent discount rate, both systems have positive present values (columns 3 and 4) but the difference between the two widens: \$186,992 in the PRA and \$11,510 with Social Security. A five percent discount rate makes the Social Security NPVs more negative and reduces the NPV of the PRA system to a smaller positive amount. The higher the discount rate, the smaller the overall NPV difference between the two systems.

As would be expected, the higher rates of return that women get in both the current Social Security system and the PRA system translates into more favorable NPVs for women than for men. Results for the other demographic groups are similarly straight forward.

5. A Mixed System: Pay-as-You-Go plus Investment Based

Although the pure investment based system that we examined in sections 3 and 4 provides a useful benchmark, it is not a realistic prospect for the United States. The countries that adopted pure investment based systems are ones in which the traditional pay-as-you-go systems were generally regarded by the public as bankrupt, corrupt, and in need of fundamental reform. That is not the situation in the United States. The Social Security program is highly regarded and the public is seeking a way of maintaining the system (“saving Social Security”) without the large tax increase that would be required if the pure pay-as-you-go system continued.

As we noted above, several countries now operate Social Security retirement systems that include both traditional defined benefits financed on a pay-as-you-go basis with an investment

based defined contribution benefit.³² Proposals for such a hybrid system have been made in the United States by academic researchers, advisory groups, and politicians. The proposal that we examine in this section would maintain a pay as you go system with a tax of 12.4 percent of payroll. An estimated three percent of the 12.4 percent (along with the revenue that is collected from the taxation of benefits) would be needed to continue the disability benefits provided in current law as well as benefits for young survivors. Since retirement benefits will require 15.4 percent of payroll in 2075, the 9.4 percent of the payroll tax that remains after providing for DI would be sufficient to finance 61 percent of current law benefits. This plan would supplement these reduced pay-as-you-go benefits (implemented as an across-the-board reduction in all retirement benefits) with a PRA system with contributions equal to 3 percent of covered earnings, i.e. half of the 6 percent of earnings increase that would be required in the 15.4 percent pure pay-as-you-go financing.³³

Tables IVa and IVb show the effects of this mixed system for the same population subgroups discussed above. The resulting benefits for the mixed system are of course a hybrid of the pure Social Security benefits shown in column 1 and the benefits that would result from a pure PRA system (shown in column 2 of Table IIa). More specifically, the benefits shown in column 2 of Table IV are approximately equal to 61 percent of the pure Social Security benefits shown in column 1 of Table IIa (the ratio of the 9.4 percent current pay-as-you-go OASI tax to

³²See Feldstein (1998) for discussions of such mixed systems in Australia and the United Kingdom and Feldstein and Siebert (2001) for discussions of reform in Europe.

³³ Both systems receive additional revenue from the taxation of benefits. In the mixed system, these revenues are used to continue to provide full (i.e. not reduced to 61 percent) DI benefits.

the 15.4 percent that would be required in the pure Social Security system) plus three-ninths of the 9 percent pure PRA benefits shown in column 2 of Table IIa.

The relative gains among the different marital groups are qualitatively similar to the pure case of Table II but more muted. On average, beneficiaries see their per capita annual benefits increase by \$3,607 or 39 percent, despite the substantial reduction in the cost of financing the combined package. The gain among married couples is around \$2,600 per person, a 30 percent rise over the traditional Social Security benefit. The relative gain is greater among the other marital status groups: unmarried women gain 47 percent for example. Potential poverty reduction is also greatest among these groups; for women who are widowed, divorced, or never married, the potential poverty rates are reduced from almost 25 percent with the current Social Security law to 15 percent with the mixed system. Women gain more than men, a reflection of the unisex life tables and the greater annuities received by widows. More specifically, the gains average 30 percent for married men and 41 percent for unmarried men. In contrast, married and unmarried women gain 34 percent and 47 percent. Those women who were widowed or divorced by the age of 50 have an even greater relative gain, rising by 51 percent. The potential poverty rate for this group is cut from over 45 percent to 21 percent.

Although whites gain more than blacks, the potential poverty reduction among blacks is more substantial than among whites. Hispanics gain relatively least because a substantial share of the Hispanics in our sample are immigrants for whom the current Social Security rules provides a very high return on contributions.³⁴ When the change is assessed in terms of the

³⁴On the impact of Social Security rules on immigrants, see Gustman and Steinmeier (1998) and Liebman (this volume).

impact on potential poverty, it is the unmarried blacks who benefit most with potential poverty falling from 53 percent to 35 percent. Hispanics benefit less because they have less time in the country as PRA participants to benefit from the PRA accumulation.

When beneficiaries are classified by the education of the highest earner in the household, the smallest proportional gain tends to go to those with more than a high school education. This group with the highest education level does well under the traditional Social Security rules because the wives in this group are most likely to receive benefits as spouses. The less than high school group also has the greatest gain when measured by the reduction in poverty.

When we examine income in Table IVb, we see that all groups gain, though the higher quintiles receive the largest percentage increases in benefits. The first two quintiles, however, have the largest reductions in potential poverty.

5.1 Comparing Individual Benefits

More than 95 percent of the retirees would receive more from the mixed system than from the pure Social Security system. The proportion of gainers differs among the various groups but exceeds 90 percent except for married Hispanics, whose gain is limited by the large fraction of immigrants in this group.

The scatter plots showing the way that individuals are affected are similar to the pure PRA results shown in section 3 but with a reduced difference between the Social Security benefit and the mixed system benefit for each individual. Any point that is above the equal-benefit line in the pure PRA scatter diagrams (implying that the PRA benefit exceeds the Social Security benefit) will continue to be above the line in the mixed system but with the distance reduced. We therefore present only four scatter diagrams for comparison with the earlier results.

Figure 7 shows the results for all beneficiaries. The key things to notice are that most people are above the equal benefit line, that the points are more tightly clustered near the line than they were before, and that the people who are below the line tend to be below by a very small amount.

Figure 8 refers to women who are divorced or widowed before age 50 and who do not remarry and can be compared to figure 4 in section 3. Virtually all of the points are above the equal benefit line with only a handful of individuals who are both below the line and outside the SSI box.

Figure 9, for blacks, shows that almost all the points are above the line and the few that are below are mostly at levels of income at which the individuals would be eligible for SSI. In short, all of these individuals would be better off with the mixed system than with traditional Social Security.

Finally, figure 10 shows that the results for the low education group (i.e., males with less than a high school education) are similar. The losses are small and mostly in the income range where SSI would be available. The gains for the gainers are substantially larger than the losses for the losers.

5.2 Internal Rates of Return and NPVs in the Mixed System

Table V presents the internal rate of return and net present value calculations for the mixed system and compares those calculations with the corresponding estimates for the pure Social Security system. The mixed plan produces an overall internal rate of return of 3.07 percent, reflecting the 1.4 percent on the pay-as-you-go portion and the 5.5 percent on the PRA portion. The differences among the subgroups follow the same pattern as they did for the pure

PRA option but in a muted way. The gain in net present value (calculated as of age 21) averages \$27,666 for all beneficiaries using a 3 percent discount rate.

6. The Risk of Low Investment Returns

Our analysis until now has assumed that the PRA accounts earn a real return of 5.5 percent. We now examine the effects on different population subgroups and individuals of the risk that the return earned in PRA accounts will be very much lower than it would have been in the past.

As we noted in section 3, the mean logarithmic real return on a balanced portfolio of 60 percent stock (the Standard and Poors 500) and 40 percent corporate bonds for the 50 year period 1946 through 1995 was 5.9 percent. We subtract 0.4 percent for administrative costs to arrive at the 5.5 percent that we used in these analyses. As we explained above, using the mean logarithmic return understates the mean of the actual level returns by about one percentage point, allowing a margin of safety for fluctuations in the investment return. A further reduction of nearly one percentage point results from not extending the sample to 1999.

Our examination in this section draws on the Feldstein and Rangelova (1998) and Feldstein, Rangelova and Samwick (1999) analyses of the investment risks in an investment based or mixed system. Those analyses showed that the benefits generated by a pure PRA system with a six percent PRA saving rate or by a mixed system with a 2.3 percent PRA saving rate (and continuation of the current pay-as-you-go tax rate) have a very high probability of exceeding the traditional Social Security benefits. Those calculations were for a representative agent with average earnings and not for an actual sample of individuals of the type that we study here.

We now use the disaggregated sample data to examine whether there are some

demographic groups that would be more adversely affected by investment risk than others. We do not perform the same kind of full analysis of the complete distribution of returns that Feldstein and Rangelova did for the representative agent. Instead we focus on a particular low probability “pessimistic” scenario and evaluate the effects on different population groups if this outcome occurs. More specifically, we assume that instead of a 5.5 percent real rate of return the PRA account earns only 3.5 percent. Simulations based on the mean-variance experience from 1946 through 1995 implies that this would be at the tenth percentile of the probability distribution of the annuity payments that would be earned by an individual who had contributed in every year from age 21 through age 66. Thus there is essentially a 90 percent probability based on past experience with the variability of returns that the representative individual’s PRA annuity would be greater than the PRA benefit based on a 3.5 percent return.³⁵

We begin this analysis with the pure investment based case. In our judgement this involves more risk of benefit reductions than most individuals would want. This risk could be reduced or eliminated by the type of pay-as-you-go supplementary benefit (conditional on the PRA portfolio return) that is examined in Feldstein and Rangelova (1998) and Feldstein, Rangelova and Samwick (1999). An alternative possibility is that a cohort that learns at age 45 or 50 that it has received an unusually low rate of return might decide to increase the PRA savings above the nine percent, reducing the risk of shortfalls in retirement, while still paying

³⁵More explicitly, we calculated the 3.5 percent as the average level return at the tenth percentile of the 10,000 simulations of the portfolio return performed in Feldstein and Rangelova (1998). This 3.5 percent return can be compared to the 4.1 real return implicit in the current price for Treasury Inflation Protected Securities and to the 3.0 percent interest rate assumed by the Social Security Trustees as the future real return on Treasury bonds in the Social Security Trust Fund.

substantially less than the 15.4 percent payroll tax that would be required in the pure pay-as-you-go-system.

Alternatively, this risk might be reduced or eliminated by private options that provide guarantees of minimum benefits in exchange for some reduction in average or maximum returns. We do not explore any of these ideas here. Nor do we discuss the role that a means tested program like Supplemental Security Income might play. Instead we discuss the pure investment based system briefly and then turn to the more realistic mixed system. The reduced dependence on the investment-based component in the mixed system substantially lowers the risk to individuals. Other ways of reducing the shortfall below the Social Security benchmark and the fraction of individuals whose benefits are below the poverty level are discussed in the next section.

Table VIa shows that, with a 3.5 real rate of return, the mean PRA benefit for all retirees would be \$10,938, about 18 percent higher than the mean pay-as-you-go Social Security benefits. Thus in more than 90 percent of the possible rate of return outcomes, the pure PRA system would produce a mean benefit for all retirees that exceeds the corresponding mean of the traditional Social Security benefits.

Comparing the remaining rows of column 1 and 2 shows that even in this “tenth percentile low return scenario” the mean PRA benefit exceeds the mean traditional Social Security benefit in most demographic subgroup that we study (the exceptions are married blacks and Hispanics and the bottom two income quintiles). Thus among married couples the mean benefit in this low return case would be roughly \$8,900 per person (\$17,800 per couple) or 7 percent more than the mean Social Security benefit. For unmarried women, the relative gain is

substantially greater: a 30 percent increase from \$10,112 to \$13,122. Although there are differences among the groups, the key point is that even in this very poor performance case the mean PRA benefit is higher than the mean Social Security benefit for almost every subgroup even though the 15.4 percent tax rate is replaced by a 9 percent saving rate.

Although the mean PRA benefits compare favorably with the mean Social Security benefits, a significant fraction of individuals would receive less in PRA benefits than they would have received from Social Security. Among all the individuals in our sample, only 72 percent would receive PRA benefits as large as their benchmark Social Security benefits; see column 3 of table VIa. The gap between PRA benefits and Social Security benefits in these cases is however not large. Among those with lower benefits under the PRA plan, 51 percent have benefits that are within 15 percent of their benchmark Social Security benefits. To put this reduction in perspective, it is helpful to bear in mind that the 9 percent saving rate is equivalent to less than two-thirds of the tax that would otherwise have to be paid for the Social Security benefits and that the adverse effect shown in Table VI occurs only in the worst ten percent of possible outcomes.

Table VIIIa presents the results for the “10th percentile low return scenario” in the mixed system with PRA savings of three percent and a pay-as-you-go OASI tax rate unchanged at 9.4 percent. Despite this very poor investment performance, the overall average combined benefit still exceeds the current law Social Security benchmark. Married men experience an average loss of three percent while most unmarried subgroups have higher means in the mixed PRA system even with this lowest tenth percentile return.

The last two columns of Table VIIIa show that the impact of the shift on potential poverty

is usually negligible in this case of the lowest 10th percentile return. Stated differently, if the investment experience is better than the lowest 10th percent of cases that can be expected on the basis of the postwar record, there will be a reduction in the potential poverty among retirees.

The estimates in column three show that only 54 percent of beneficiaries would receive benefits from the mixed system than were greater than or equal to the current law pay-as-you-go in this worst tenth percentile case.³⁶ The differences however are usually fairly small. 87 percent of the individuals with lower benefits under the mixed plan have benefits that are less than 15 percent below those in the current law Social Security system.

This is shown in figure 11 by the fact that almost all of the points lie very close to the equal benefit line, with the more substantial departures above the line than below. The differences are not large and could again be offset by a conditional government payment that fills the shortfall, by a mid-career adjustment in the cohort PRA saving rate, by private market guarantee arrangements, or by modifying the PRA contributions in the way discussed in the next section.

7. Redistributive Funding of Personal Retirement Accounts

In previous sections we have shown that most of the time a PRA system that is funded with contributions that are proportional to earnings can provide essentially all demographic and income groups with a combination of higher benefit levels and lower levels of taxation than would be available under a purely pay-as-you-go system. Moreover, the reductions in potential

³⁶Recall that when both plans produce benefit levels below the SSI guarantee, the plans are considered to provide equal benefits. Under the mixed plan with low returns, SSI costs would be higher than under the pay-as-you-go approach. However, the additional costs would be less than 2 percent of total retirement benefits.

poverty are largest for the groups that are most at risk of poverty. Nonetheless, higher income groups tend to receive benefit increases from a PRA system relative to the Social Security system that are larger than those of lower income groups.³⁷ Furthermore, low lifetime-income workers remain at greatest risk of falling into poverty if financial markets perform worse in the future than they have historically. Although some analysts are concerned that an investment based system would increase the inequality of benefits, it is important to emphasize that the plans that we study in this paper produce an increase in the income of virtually all retirees and will likely reduce rates of poverty among the elderly.³⁸

Redistributive funding of personal retirement accounts can increase the relative gains for low-income households, and reduce the risk that lower-than-expected returns leaves them in poverty.³⁹ A wide range of different funding formulas to do this have been suggested. In this section, we consider two simple funding formulas that have been discussed in the policy debate . We present options in the context of our mixed plan. Therefore, we continue to assume pay-as-you-go benefits equal to 61 percent of current law benefits but replace the PRA savings equal to 3 percent of covered earnings with alternative contributions that have the same aggregate cost.

³⁷ The presence in our sample of government workers with low covered earnings exaggerates the percentages of low-income workers relative to what we will expect to see in future cohorts. However, it does not have much impact on our estimates of the relative gains and losses by workers at a given income level.

³⁸ See Feldstein (1999) for a discussion of different distributive goals.

³⁹ An alternative approach to protecting lower-income beneficiaries is to reduce the traditional Social Security benefits by relatively less for this group.

More specifically, one percent of covered earnings for each employee⁴⁰ has the same total cost as \$300 per worker (in 1999 dollars, indexed to average wages thereafter). In the first option, the individual accounts contributions are a flat amount of \$900 per worker, while in the second the annual contributions into the PRA accounts are 1.5 percent of the worker's covered earnings plus \$450.

Table X shows mean benefits by income quintile for Social Security and the three different formulas for funding the personal retirement accounts under a 5.5 percent investment return. Notice that under the accounts funded with 3 percent of covered earnings, the increase in benefits relative to Social Security rises from 19 percent in the second quintile to 39 percent in the fifth quintile among married couples, and from 38 percent in the second quintile to 55 percent in the fifth quintile among the unmarried. In contrast, the middle plan that mixes flat contributions and earnings related contributions replicates the progressivity of Social Security – with roughly equal percentage increases for each quintile: 28 percent for the second quintile, 30 percent for the fourth quintile, and 28 percent for the fifth quintile among married couples, and from 52 percent in the second quintile to 48 percent in the fourth quintile, and 43 percent in the fifth quintile among the unmarried. The plan with flat contributions is substantially more redistributive than Social Security, increasing benefits by 37 percent in the second quintile, 23 percent in the fourth quintile, and only 17 percent in the fifth quintile among married couples. A

⁴⁰More accurately, one percent of the covered earnings of workers who meet the current Social Security requirement of annual earnings of \$3000 a year. Many individual account plans require a minimum level of earnings to qualify for an annual contribution in order to reduce administrative costs associated with very small accounts. In the redistributive options that we are discussing, a minimum earning threshold is likely to be necessary to prevent people from gaming the system by working for only a few hours during the year but still earnings a full contribution.

similar pattern occurs among the unmarried. The relative increases for blacks and Hispanics are quite a bit higher in the redistributive plans as well.

Table XI focuses on the poverty impact of the three plans in the case in which the market performs poorly – a 3.5 percent return. It is clear that the more redistributive plans reduce the risk to the lowest income beneficiaries. For example, under the proportional to earnings approach, 19 percent of widowed, divorced, or never married individuals in the second quintile have benefits below the poverty line if the market performs poorly. In contrast, only 12 percent have benefits below poverty in the 1.5 percent plus \$450 plan, and only 9 percent in the \$900 per covered worker plan.

8. Conclusion

Investment-based Social Security reform provides a way to prevent the benefit cuts and payroll tax increases that would otherwise be necessary, adjustments that would likely have deleterious impacts on those who depend most heavily on Social Security. Nonetheless, critics of investment-based Social Security reforms have argued that by increasing the link between earnings and benefits, this approach threatens the progressivity of the system and could lead to additional poverty among the elderly. This paper shows that this need not be the case. We find that essentially all demographic and income groups can benefit from an investment based system with a lower saving rate than the projected long-run pay-as-you-go tax, and that the potential reductions in poverty are the largest for those most at risk of ending up poor. A mixed system that combines the investment-based accounts and pay-as-you-go benefits can achieve such results, even if financial markets perform extremely poorly. Finally, we show how alternative

contributions to personal retirement accounts can enable an investment-based system to equal or exceed the redistribution of the current Social Security system.

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Data Appendix

Our data set is created by matching the 1990 and 1991 panels of the Survey of Income and Program Participation (SIPP) to Social Security administrative records on earnings from 1951 through 1990 (the Summary Earnings Record -- SER) and benefit records from 1995 (the Master Beneficiary Record -- MBR) for those same individuals.

From the public use sample of the SIPP, we selected all individuals from the first wave of each SIPP panel who were age 60 or above in 1990 (individuals who were 60 years or above at the start of the 1990 panel, 61 years or above at the start of the 1991 panel). We also used variables on marital history from the wave-two topical module of the SIPP. We included data on spouses of people in the age range, even if they themselves were not in the age range. Our ultimate unit of observation is the individual, so a married couple with two individuals in the appropriate age range would be counted as two observations. However, for programming purposes, married couples were stacked into one observation. We then matched these observations to the SER, and discarded observations that did not match to earnings.

Next we created our cohort -- individuals who were born from 1925 through 1929. We chose 1929 as a cut off because it ensures that we can observe earnings through age 64 for everyone in the sample (our earnings data extend through 1990). We wanted as narrow an age group as possible so that we would not have age groups that had already lost significant numbers of Social Security beneficiaries due to death. However, given our modest sample sizes, we decided to use 5 birth years of data. We dropped individuals whose year of birth in the SER was more than 5 years from their year of birth in the SIPP.

For the never married and married individuals, the SIPP-SER match produced the earnings data necessary for our simulation.¹ For previously married individuals, however, the former spouse is not in our data set, so we do not have the spouse's SER earnings record. For many of these individuals (those receiving spouse benefits, widow/er benefits, or dually entitled worker benefits), we were able to obtain the former spouse's Primary Insurance Amount (and therefore their Average Index Monthly Earnings) by further matching to the MBR. For the rest (those receiving retired worker benefits only), we imputed a spouse PIA using the correlation between respondent and spouse PIA for similar individuals from the New Beneficiary Survey -- an older sample that obtained earnings and benefit records for former spouses of sample members. We dropped disabled individuals (and couples with a disabled member) and unstacked married couples so that each individual in the couple counts as an observation if both spouses were members of the 1925 to 1929 birth cohort.

Once we had a former spouse's PIA for the previously married individuals, we calculated an Average Indexed Monthly Earnings (AIME) by inverting the Social Security benefit formula. We then calculated (separately for men and women) the average share of earnings earned in each year for people in our sample with earnings histories (separately for men and women), and generated an earnings record for the missing spouses by spreading their AIME according to the average share of earnings earned in each year, subject of course to the constraint that a former spouse of a widow or widower could not have earnings in years after his or her death.

¹ In some case, we were required to impute earnings at the beginning or end of the career if the 1951-1993 period did not include all years from age 21 to age 64.

The earnings data report earnings only up to the taxable maximum for the year. In the past, the taxable maximum was much lower relative to average earnings than it is today. In order to be able to simulate the current Social Security rules, we imputed a level of earnings above the taxable maximum for sample members with earnings at the taxable maximum. We did this by estimating a two-limit tobit regressed on a constant (i.e. with no other independent variables) separately for men and women for each year between 1951 and 1990. The level of earnings is fit very well by a normal distribution until a percentile that is above the current taxable maximum. The regressions produced an estimate for mean earnings and a regression error. Using these parameter estimates, we randomly drew from a normal distribution with the appropriate mean and variance until each topcoded observation was replaced with a draw above the topcode.

Based on the sample member's earnings history and the earnings history of the spouse, we calculated Social Security benefits. Our calculations incorporate nearly all of the retirement benefit provisions, including covered worker requirements, the minimum benefit, spouse benefits, survivor benefits, and reductions for claiming benefits before the normal retirement age. We do not simulate the delayed retirement credit (instead assuming that everyone in our sample claims benefits by age 65), nor do we have adequate information to implement government pension offset provisions.

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Table 1
Characteristics of Sample

	1925-1929 cohorts at time of 1990 and 1991 SIPP	Simulated cross-section of beneficiaries
Male	46.1 %	41.0%
Female	53.9 %	59.0%
Married (including separated)	73.7 %	52.8%
Widowed	13.6%	38.0%
Divorced	8.6 %	5.8%
Never married	4.1%	3.4%
White (and other)	92.4%	93.2%
Black	7.6%	6.8%
Hispanic (can be either race)	4.3%	4.0%
Less than high school	30.8%	28.8%
High school	53.5%	55.5%
More than High school	15.9%	15.6%
Age 60-61	NA	2.4%
Age 62-64	NA	10.7%
Age 65-75	NA	40.0%
Age 75-85	NA	29.2%
Age 85+	NA	17.6%
Unweighted sample size	2,720	Up to 41 benefit years x 2,720
Weighted sample size	3.424 million (per birth year)	71.156 million

Table IIa
Comparison of Benefits Levels from 9 Percent PRA and Social Security

	Average Benefit levels		Percentage of Beneficiaries with PRA Benefits >= SS Benefits	Percent with retirement benefits below the poverty line	
	Current-Law Social Security	PRAs Funded With 9 % of Payroll (5.5% Rate of Return)		Current-Law Social Security	PRA
All beneficiaries	9,291	21,414	97.9	18.9	9.2
Married Couples					
Men	8,425	17,152	97.8	13.7	9.2
Women	8,185	17,582	97.2	13.5	9.1
Whites	8,413	17,657	97.6	12.9	8.5
Blacks	6,229	10,850	96.1	29.5	22.6
Hispanics	5,896	9,123	86.4	38.7	31.4
Less than high school	7,613	15,476	97.5	16.5	12.0
High school	8,227	17,652	98.1	13.4	8.9
College and above	9,440	19,074	96.3	10.5	6.2
Widowed, Divorced, and Never Married					
Men	11,120	26,264	98.7	22.4	8.7
Women	10,112	25,837	98.1	25.6	9.4
Early widow/divorce	8,249	22,044	99.0	45.8	14.6
Whites	10,673	26,933	98.2	21.8	8.0
Blacks	7,562	16,484	98.9	53.3	20.5
Hispanics	7,961	18,316	95.2	46.8	27.3
Less than high school	9,135	22,684	98.4	34.5	12.8
High school	10,932	28,329	98.8	18.9	6.2
College and above	12,475	28,316	95.7	13.3	7.9

Table IIb
Comparison of Benefits Levels from 9 Percent PRA and Social Security

Average Benefit levels				Percent with retirement benefits below the poverty line	
	Current-Law Social Security	PRAs Funded With 9 % of Payroll (5.5% Rate of Return)	Percentage of Beneficiaries with PRA Benefits >= SS Benefits	Current-Law Social Security	PRA
Married Couples					
Lowest Lifetime Income Quintile	3,899	5,189	92.8	71.4	49.9
Second Quintile	6,610	11,270	94.4	13.8	7.3
Third Quintile	8,504	16,871	97.6	3.9	2.7
Fourth Quintile	9,462	21,339	99.8	2.2	1.6
Highest Quintile	10,478	24,240	100.0	1.9	1.3
Widowed, Divorced, and Never Married					
Lowest Lifetime Income Quintile	5,414	9,651	96.0	94.1	41.7
Second Quintile	9,310	21,196	98.3	18.7	1.0
Third Quintile	11,564	29,521	97.8	1.8	1.5
Fourth Quintile	12,947	35,819	99.9	0.0	0.0
Highest Quintile	14,722	41,210	100.0	0.0	0.0

Table III
Comparison of IRRs and NPVs from 9 Percent PRA and Social Security

	Internal Rate of Return		Net Present Value at Age 21 (per capita)					
	Current- Law Social Security	PRAs Funded With 9 % of Payroll (5.5% Rate of Return)	1% discount rate		3% discount rate		5 % discount rate	
			SS	9% PRA	SS	9% PRA	SS	9% PRA
All beneficiaries	1.35	5.54	11,510	186,992	-26,475	48,414	-31,911	5,176
Men	0.62	4.66	-11,323	132,172	-36,166	28,484	-36,895	-2,975
Women	1.95	6.24	32,554	237,515	-17,543	66,782	-27,318	12,688
Whites	1.36	5.55	12,070	194,859	-27,328	50,487	-32,987	5,458
Blacks	1.27	5.38	5,461	101,982	-17,257	26,013	-20,285	2,126
Hispanics	1.81	5.71	16,572	113,596	-11,835	29,881	-16,783	3,901
Less than high school	1.32	5.49	8,439	150,566	-22,658	39,020	-27,142	3,899
High school	1.39	5.62	13,470	206,310	-27,660	54,046	-33,768	6,408
College and above	1.30	5.34	11,114	196,585	-30,536	48,521	-35,614	3,493

Table IVa
Comparison of Benefits Levels from Mixed Plan and Social Security

	Average Benefit levels		Percentage of Beneficiaries with Mixed Plan Benefits >= SS Benefits	Percent with retirement benefits below the poverty line	
	Current-Law Social Security	Mixed Plan (5.5% Rate of Return)		Current-Law Social Security	Mixed Plan
All beneficiaries	9,291	12,898	96.2	18.9	13.1
Married Couples					
Men	8,425	10,941	96.3	13.7	12.2
Women	8,185	10,935	95.0	13.5	11.2
Whites	8,413	11,102	95.7	12.9	11.1
Blacks	6,229	7,478	95.8	29.5	25.8
Hispanics	5,896	6,696	78.7	38.7	33.0
Less than high school	7,613	9,879	95.9	16.5	14.6
High school	8,227	10,984	95.9	13.4	11.3
College and above	9,440	12,211	95.0	10.5	9.0
Widowed, Divorced, and Never Married					
Men	11,120	15,649	97.4	22.4	12.9
Women	10,112	14,882	96.5	25.6	15.4
Early widow/divorce	8,249	12,462	98.1	45.8	25.1
Whites	10,673	15,595	96.7	21.8	12.6
Blacks	7,562	10,183	97.9	53.3	34.8
Hispanics	7,961	11,041	91.7	46.8	40.0
Less than high school	9,135	13,225	97.2	34.5	21.7
High school	10,932	16,221	97.6	18.9	9.4
College and above	12,475	17,173	92.6	13.3	10.3

Table IVb
Comparison of Benefits Levels from Mixed Plan and Social Security

Average Benefit levels			Percentage of Beneficiaries with Mixed Plan >= SS Benefits	Percent with retirement benefits below the poverty line	
Current-Law Social Security	Mixed Plan (5.5% Rate of Return)	Current-Law Social Security		Mixed Plan	
Married Couples					
Lowest Lifetime Income Quintile	3,899	4,147	89.1	71.4	63.7
Second Quintile	6,610	7,855	88.9	13.8	9.9
Third Quintile	8,504	10,896	95.7	3.9	3.1
Fourth Quintile	9,462	12,979	99.5	2.2	2.0
Highest Quintile	10,478	14,576	100.0	1.9	1.8
Widowed, Divorced, and Never Married					
Lowest Lifetime Income Quintile	5,414	6,574	94.1	94.1	66.9
Second Quintile	9,310	12,838	95.7	18.7	3.0
Third Quintile	11,564	17,010	96.1	1.8	0.8
Fourth Quintile	12,947	19,967	99.8	0.0	0.0
Highest Quintile	14,722	22,864	100.0	0.0	0.0

Table V
Comparison of IRRs and NPVs from Mixed Plan and Social Security

	Internal Rate of Return		Net Present Value at Age 21 (per capita)					
			1% discount rate		3% discount rate		5 % discount rate	
	Current- Law Social Security	Mixed Plan (5.5% Rate of Return)	SS	Mixed Plan	SS	Mixed Plan	SS	Mixed Plan
All beneficiaries	1.35	3.07	11,510	71,991	-26,475	1,191	-31,911	-17,154
Men	0.62	2.27	-11,323	39,809	-36,166	-11,301	-36,895	-22,853
Women	1.95	3.71	32,554	101,651	-17,543	12,705	-27,318	-11,902
Whites	1.36	3.07	12,070	74,695	-27,328	1,214	-32,987	-17,801
Blacks	1.27	3.09	5,461	42,779	-17,257	941	-20,285	-10,162
Hispanics	1.81	3.38	16,572	50,282	-11,835	3,814	-16,783	-8,408
Less than high school	1.32	3.05	8,439	58,577	-22,658	748	-27,142	-14,459
High school	1.39	3.12	13,470	79,425	-27,660	2,223	-33,768	-17,951
College and above	1.30	2.91	11,114	74,356	-30,536	-1,592	-35,614	-20,169

Table VIa
Comparison of Benefits Levels from 9 Percent PRA with Lower Returns and Social Security

	Average Benefit levels		Percentage of Beneficiaries with PRA Benefits >= SS Benefits	Percent with retirement benefits below the poverty line	
	Current-Law Social Security	PRAs Funded With 9 % of Payroll (3.5% Rate of Return)		Current-Law Social Security	PRA
All beneficiaries	9,291	10,938	72.1	18.9	21.5
Married Couples					
Men	8,425	8,796	64.4	13.7	20.0
Women	8,185	9,007	69.6	13.5	20.2
Whites	8,413	9,047	67.5	12.9	19.0
Blacks	6,229	5,639	51.6	29.5	43.3
Hispanics	5,896	4,836	47.4	38.7	53.0
Less than high school	7,613	7,913	63.6	16.5	23.7
High school	8,227	8,993	68.5	13.4	20.8
College and above	9,440	9,935	66.8	10.5	13.7
Widowed, Divorced, and Never Married					
Men	11,120	13,491	72.3	22.4	21.3
Women	10,112	13,122	80.1	25.6	23.8
Early widow/divorce	8,249	10,602	77.4	45.8	36.4
Whites	10,673	13,715	78.4	21.8	20.2
Blacks	7,562	8,453	74.1	53.3	27.6
Hispanics	7,961	9,368	72.2	46.8	53.5
Less than high school	9,135	11,478	78.7	34.5	31.5
High school	10,932	14,400	79.4	18.9	17.5
College and above	12,475	14,784	71.2	13.3	15.8

Table VIb
Comparison of Benefits Levels from 9 Percent PRA with Lower Returns and Social Security

Comparison of Benefit Levels from a 1 Percent PRA with Lower Returns and Social Security					
	Average Benefit levels		Percentage of Beneficiaries with PRA Benefits >= SS Benefits	Percent with retirement benefits below the poverty line	
	Current-Law Social Security	PRAs Funded With 9 % of Payroll (3.5% Rate of Return)		Current-Law Social Security	PRA
Married Couples					
Lowest Lifetime Income Quintile	3,899	2,593	61.6	71.4	92.5
Second Quintile	6,610	5,812	32.5	13.8	32.9
Third Quintile	8,504	8,649	51.1	3.9	6.4
Fourth Quintile	9,462	10,946	81.9	2.2	2.2
Highest Quintile	10,478	12,430	90.0	1.9	1.9
Widowed, Divorced, and Never Married					
Lowest Lifetime Income Quintile	5,414	4,827	75.9	94.1	84.5
Second Quintile	9,310	10,845	63.5	18.7	19.4
Third Quintile	11,564	15,063	78.5	1.8	2.9
Fourth Quintile	12,947	18,323	90.9	0.0	0.0
Highest Quintile	14,722	20,903	91.8	0.0	0.0

Table VII
Comparison of IRRs and NPVs from PRA Plan with Lower Return and Social Security

	Internal Rate of Return		Net Present Value at Age 21 (per capita)					
	Current- Law Social Security	PRAs Funded With 9 % of Payroll (3.5% Rate of Return)	1% discount rate		3% discount rate		5 % discount rate	
			SS	9% PRA	SS	9% PRA	SS	9% PRA
All beneficiaries	1.35	3.53	11,510	69,640	-26,475	6,981	-31,911	-10,192
Men	0.62	2.66	-11,323	40,574	-36,166	-4,081	-36,895	-15,068
Women	1.95	4.22	32,554	96,427	-17,543	17,176	-27,318	-5,698
Whites	1.36	3.53	12,070	72,577	-27,328	7,337	-32,987	-10,538
Blacks	1.27	3.41	5,461	37,903	-17,257	3,139	-20,285	-6,452
Hispanics	1.81	3.67	16,572	43,381	-11,835	5,150	-16,783	-5,240
Less than high school	1.32	3.47	8,439	55,291	-22,658	5,061	-27,142	-8,817
High school	1.39	3.61	13,470	77,621	-27,660	8,645	-33,768	-10,429
College and above	1.30	3.35	11,114	72,065	-30,536	5,133	-35,614	-12,350

Table VIIIa
Comparison of Benefits Levels from Mixed Plan with Lower Returns and Social Security

	Average Benefit levels		Percentage of Beneficiaries with Mixed Plan Benefits >= SS Benefits	Percent with retirement benefits below the poverty line	
	Current-Law Social Security	Mixed Plan (3.5% Rate of Return)		Current-Law Social Security	Mixed Plan
All beneficiaries	9,291	9,406	53.7	18.9	20.8
Married Couples					
Men	8,425	8,156	39.0	13.7	17.5
Women	8,185	8,077	50.1	13.5	17.9
Whites	8,413	8,232	44.5	12.9	16.7
Blacks	6,229	5,741	35.4	29.5	38.9
Hispanics	5,896	5,267	37.1	38.7	48.5
Less than high school	7,613	7,358	40.5	16.5	21.2
High school	8,227	8,098	49.0	13.4	17.9
College and above	9,440	9,165	36.9	10.5	12.4
Widowed, Divorced, and Never Married					
Men	11,120	11,392	54.7	22.4	22.5
Women	10,112	10,643	68.1	25.6	25.0
Early widow/divorce	8,249	8,648	69.8	45.8	41.8
Whites	10,673	11,189	64.7	21.8	21.5
Blacks	7,562	7,506	62.9	53.3	51.6
Hispanics	7,961	8,058	62.5	46.8	53.0
Less than high school	9,135	9,490	66.0	34.5	33.3
High school	10,932	11,578	66.6	18.9	18.6
College and above	12,475	12,663	53.0	13.3	14.8

Table VIIIb
Comparison of Benefits Levels from Mixed Plan with Lower Return and Social Security

Average Benefit levels			Percentage of Beneficiaries with Mixed Plan Benefits >= SS Benefits	Percent with retirement benefits below the poverty line	
	Current-Law Social Security	Mixed Plan (3.5% Rate of Return)		Current-Law Social Security	Mixed Plan
Married Couples					
Lowest Lifetime Income Quintile	3,899	3,282	59.6	71.4	87.9
Second Quintile	6,610	6,035	16.9	13.8	23.7
Third Quintile	8,504	8,155	27.4	3.9	4.9
Fourth Quintile	9,462	9,515	52.1	2.2	2.2
Highest Quintile	10,478	10,639	59.4	1.9	1.9
Widowed, Divorced, and Never Married					
Lowest Lifetime Income Quintile	5,414	4,966	68.0	94.1	92.5
Second Quintile	9,310	9,387	48.7	18.7	18.6
Third Quintile	11,564	12,191	67.6	1.8	1.6
Fourth Quintile	12,947	14,135	75.6	0.0	0.0
Highest Quintile	14,722	16,095	70.6	0.0	0.0

Table IX
Comparison of IRRs and NPVs from Mixed Plan with Lower Return and Social Security

	Internal Rate of Return		Net Present Value at Age 21 (per capita)					
	Current- Law Social Security	Mixed Plan (3.5% Rate of Return)	1% discount rate		3% discount rate		5 % discount rate	
			SS	Mixed Plan	SS	Mixed Plan	SS	Mixed Plan
All beneficiaries	1.35	2.12	11,510	32,797	-26,475	-12,658	-31,911	-22,297
Men	0.62	1.35	-11,323	9,241	-36,166	-22,174	-36,895	-26,893
Women	1.95	2.74	32,554	54,507	-17,543	-3,889	-27,318	-18,060
Whites	1.36	2.12	12,070	33,862	-27,328	-13,205	-32,987	-23,152
Blacks	1.27	2.22	5,461	21,288	-17,257	-6,750	-20,285	-13,055
Hispanics	1.81	2.49	16,572	26,794	-11,835	-4,470	-16,783	-11,476
Less than high school	1.32	2.11	8,439	26,694	-22,658	-10,635	-27,142	-18,729
High school	1.39	2.16	13,470	36,466	-27,660	-12,943	-33,768	-23,579
College and above	1.30	2.00	11,114	32,830	-30,536	-16,065	-35,614	-25,455

Table X
Comparison of Benefits Levels Under Different Redistributive Funding Options
for Personal Retirement Accounts in the Mixed Plan

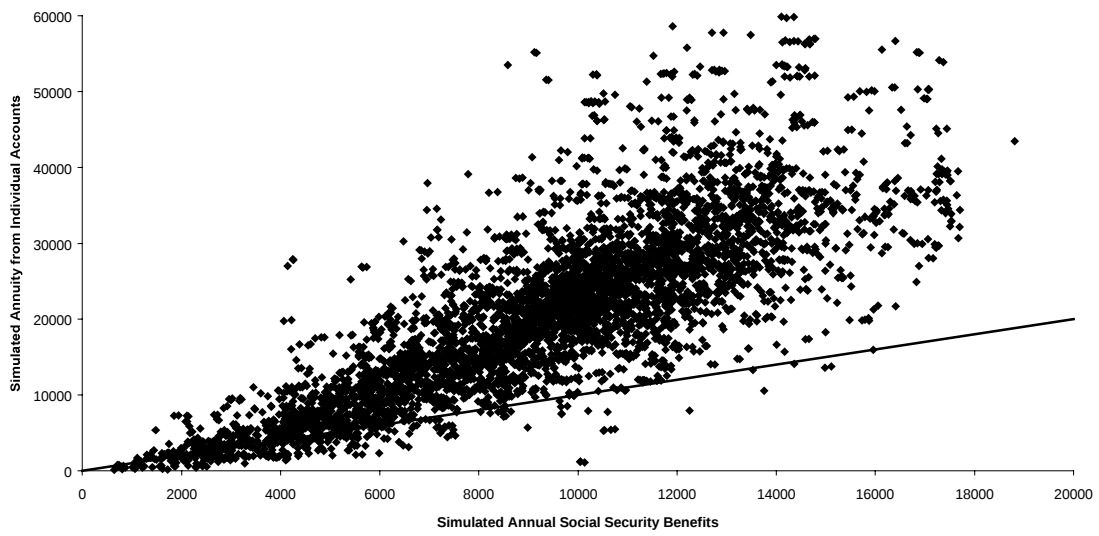
Average Benefit Levels				
	Current- Law Social Security	Mixed Plan 3 percent of payroll accounts (5.5% Return)	Mixed Plan 1.5% of payroll + \$450 per worker (5.5% Return)	Mixed Plan \$900 per worker (5.5% Return)
Married Couples				
Lowest Lifetime Income Quintile	3,899	4,147	4,856	5,564
Second Quintile	6,610	7,855	8,447	9,040
Third Quintile	8,504	10,896	10,809	10,722
Fourth Quintile	9,462	12,979	12,330	11,680
Highest Quintile	10,478	14,576	13,433	12,290
Whites	8,413	11,102	10,783	10,464
Blacks	6,229	7,478	8,128	8,778
Hispanics	5,896	6,696	7,219	7,741
Widowed, Divorced, and Never Married				
Lowest Lifetime Income Quintile	5,414	6,574	8,422	10,270
Second Quintile	9,310	12,838	14,129	15,420
Third Quintile	11,564	17,010	17,195	17,380
Fourth Quintile	12,947	19,967	19,115	18,263
Highest Quintile	14,722	22,864	20,981	19,099
Whites	10,673	15,595	15,819	16,044
Black	7,562	10,183	11,770	13,357
Hispanics	7,961	11,041	12,028	13,014

Table XI
Comparison of Retirement Benefits to Poverty Level Under Different Redistributive Funding Options
for Personal Retirement Accounts in the Mixed Plan with a 10th Percentile Return

Percent with Retirement Benefits Below the Poverty Line				
	Current- Law Social Security	Mixed Plan 3 percent of payroll accounts (3.5% Return)	Mixed Plan 1.5% of payroll + \$450 per worker (3.5% Return)	Mixed Plan \$900 per worker (3.5% Return)
Married Couples				
Lowest Lifetime Income Quintile	71.4	87.9	78.6	71.9
Second Quintile	13.8	23.7	21.0	20.0
Third Quintile	3.9	4.9	5.3	6.5
Fourth Quintile	2.2	2.2	2.2	2.5
Highest Quintile	1.9	1.9	1.9	2.0
Whites	12.9	16.7	15.3	14.7
Blacks	29.5	38.9	31.9	29.1
Hispanics	38.7	48.5	38.8	36.6
Widowed, Divorced, and Never Married				
Lowest Lifetime Income Quintile	94.1	92.5	85.2	68.0
Second Quintile	18.7	18.6	12.4	9.3
Third Quintile	1.8	1.6	0.8	1.5
Fourth Quintile	0.0	0.0	0.0	0.0
Highest Quintile	0.0	0.0	0.0	0.0
Whites	21.8	21.5	18.4	14.7
Black	53.3	51.6	45.6	36.8
Hispanics	46.8	53.0	47.8	36.3

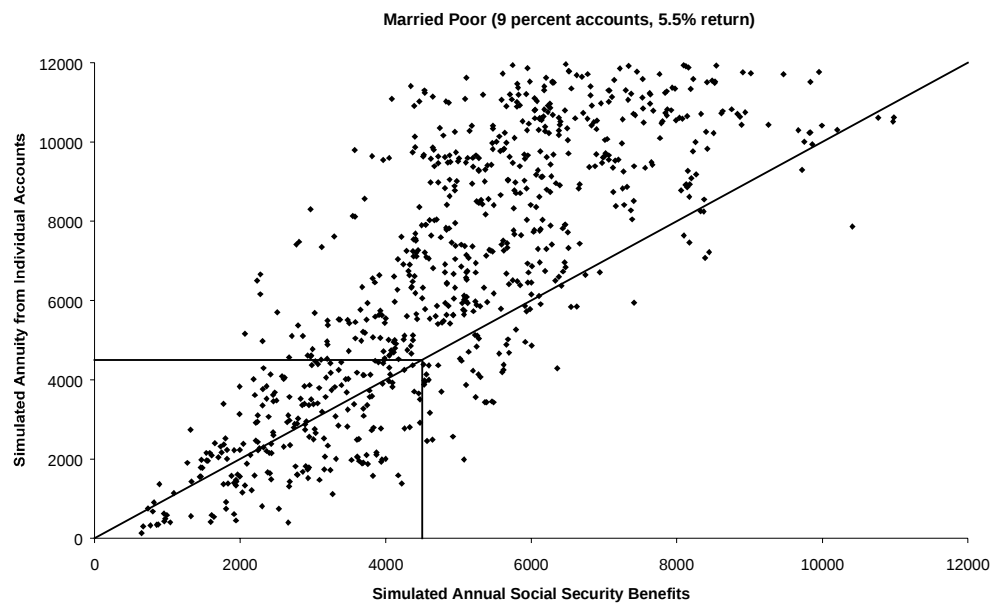
Figure 1

All Beneficiaries (9 percent accounts, 5.5% return)



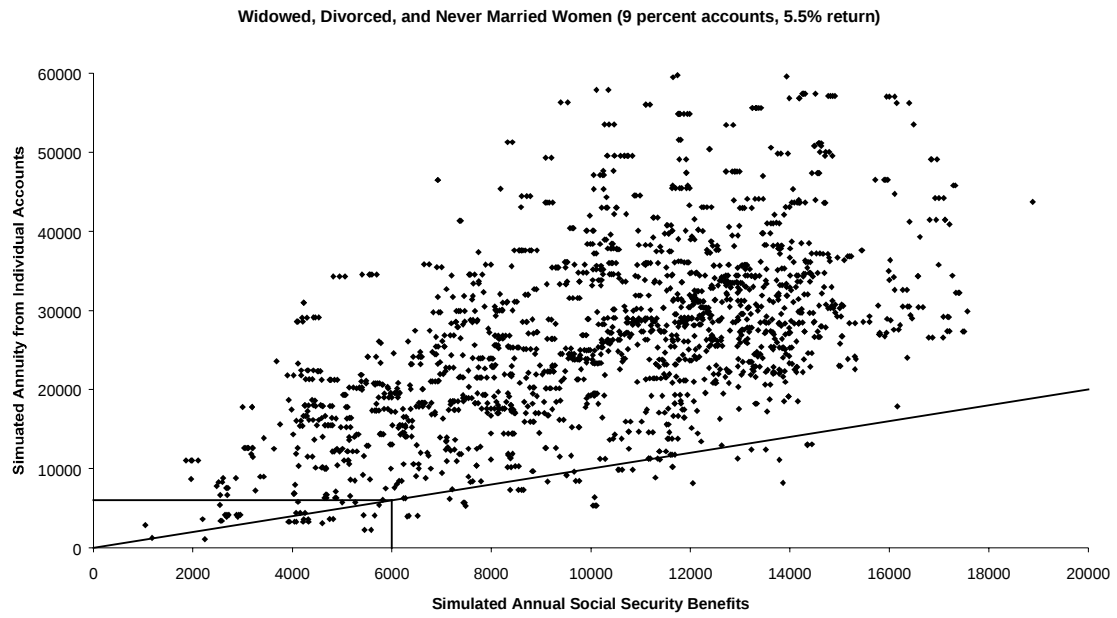
The points have been randomly jittered to preserve confidentiality.

Figure 2



The points have been randomly jittered to preserve confidentiality.

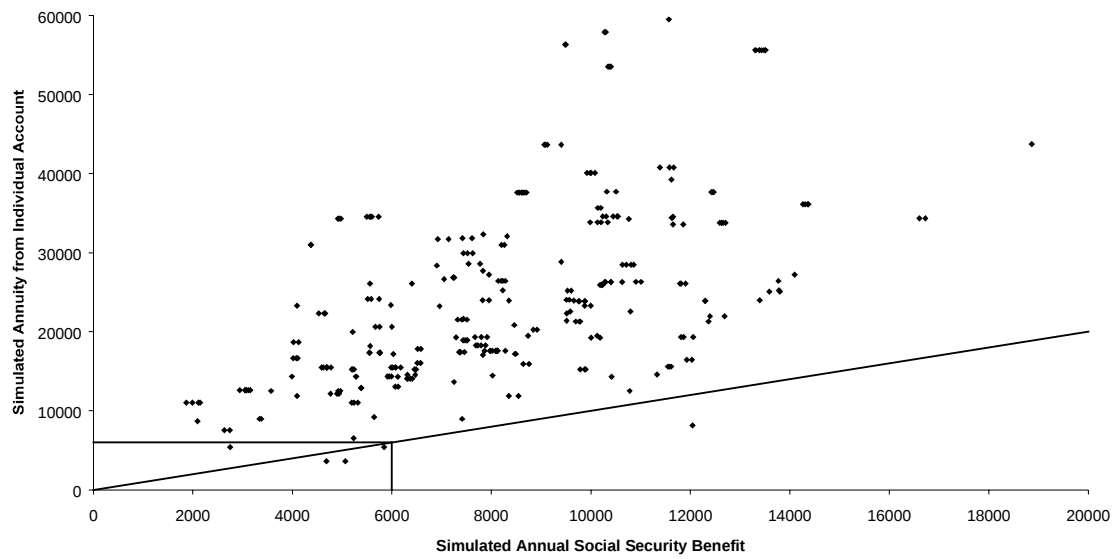
Figure 3



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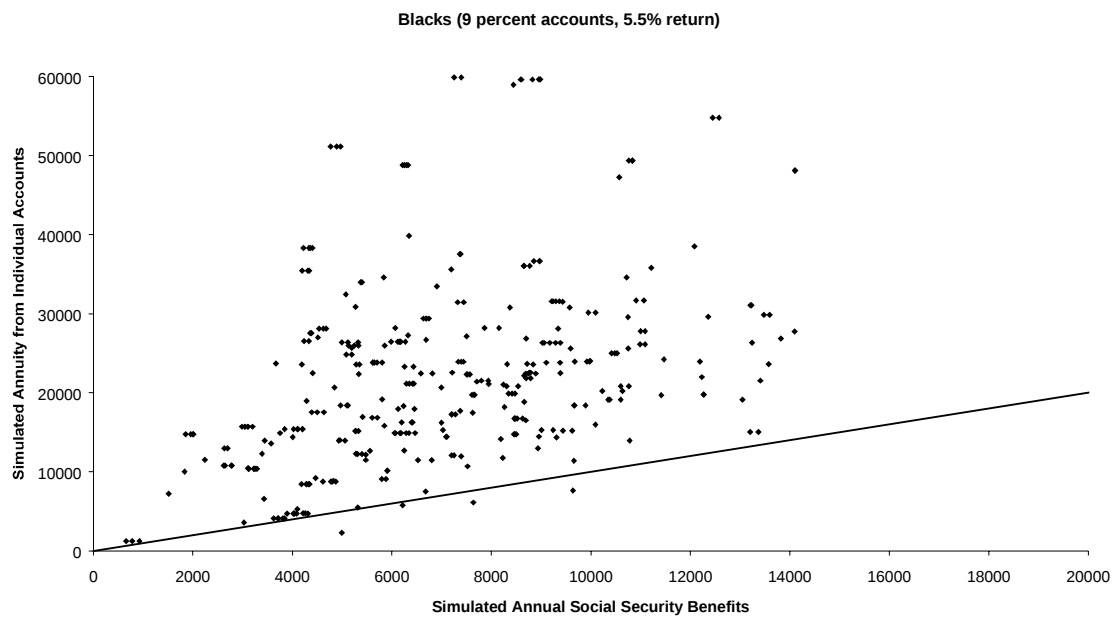
Figure 4

Women Widowed or Divorced Before Age 50 (9 percent accounts, 5.5% return)



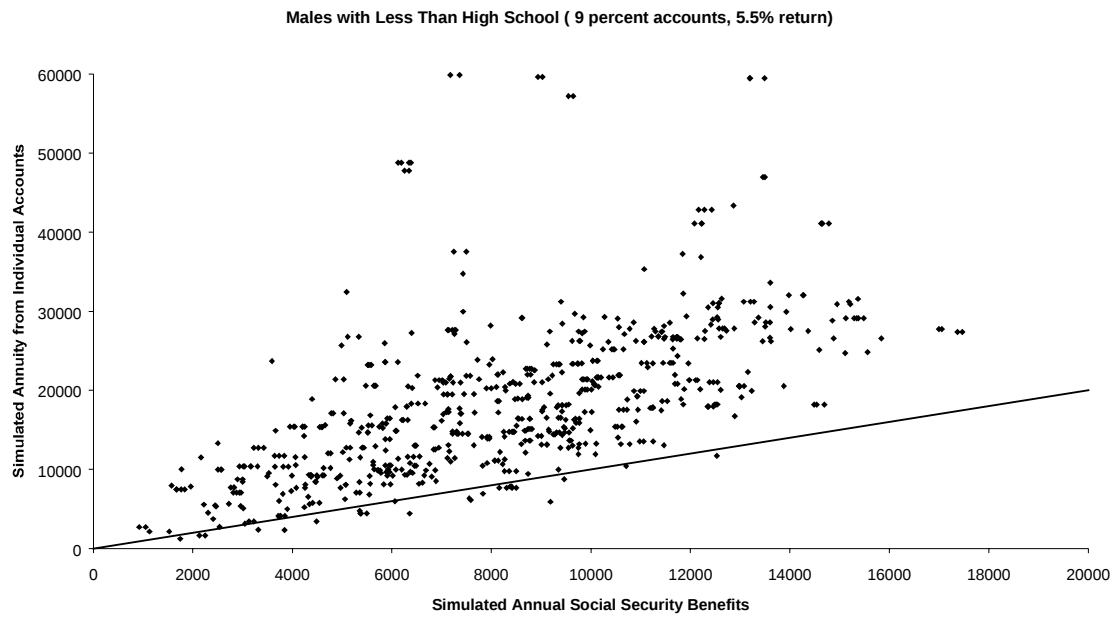
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Figure 5



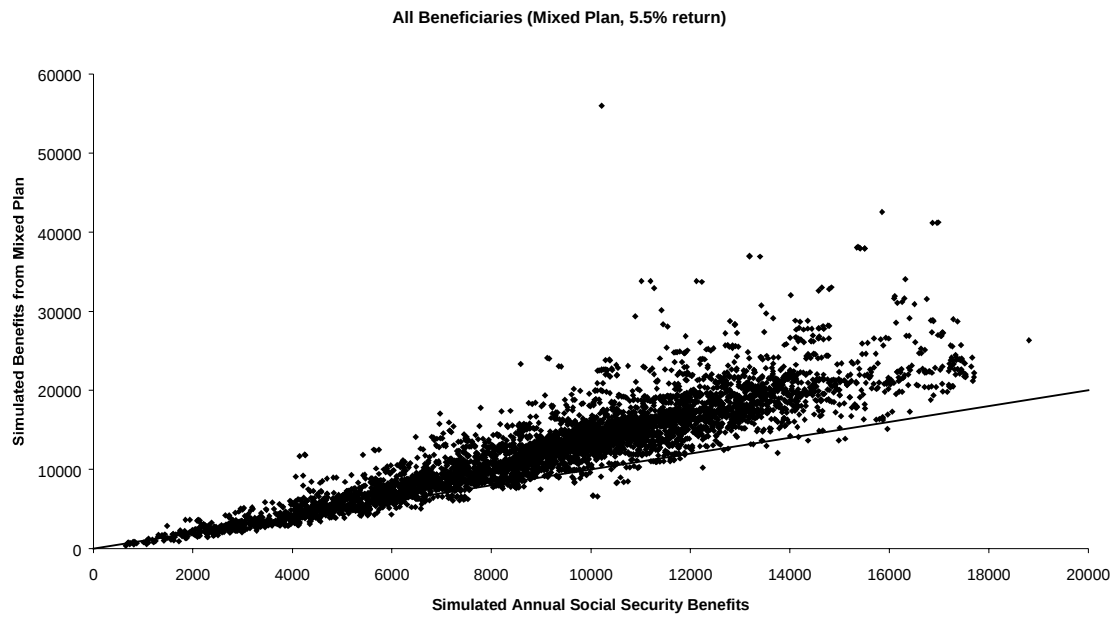
The points have been randomly jittered to preserve confidentiality.

Figure 6



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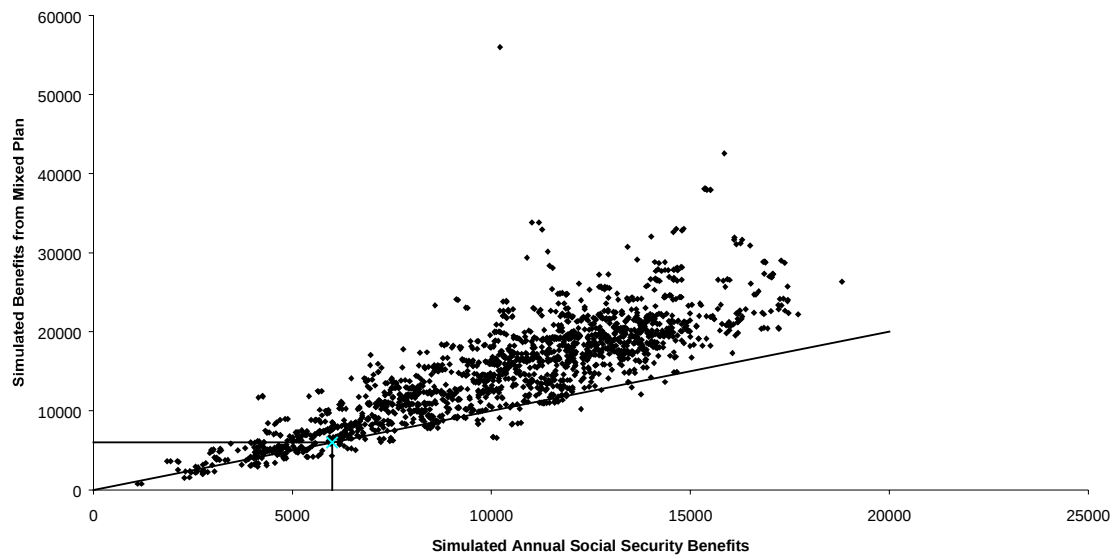
Figure 7



The points have been randomly jittered to preserve confidentiality.

Figure 8

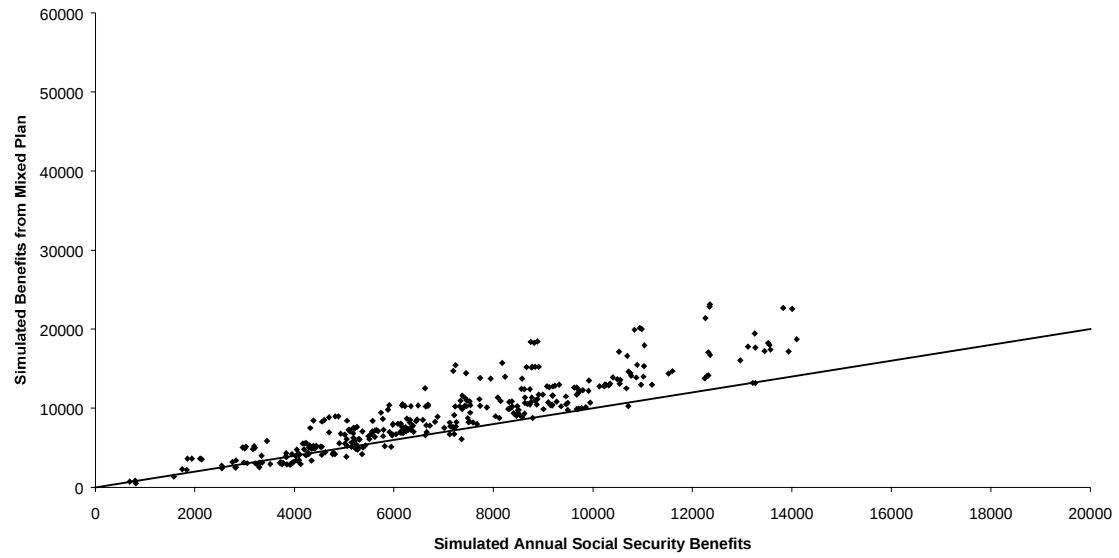
Widowed, Divorced, and Never Married Women (Mixed Plan, 5.5% return)



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Figure 9

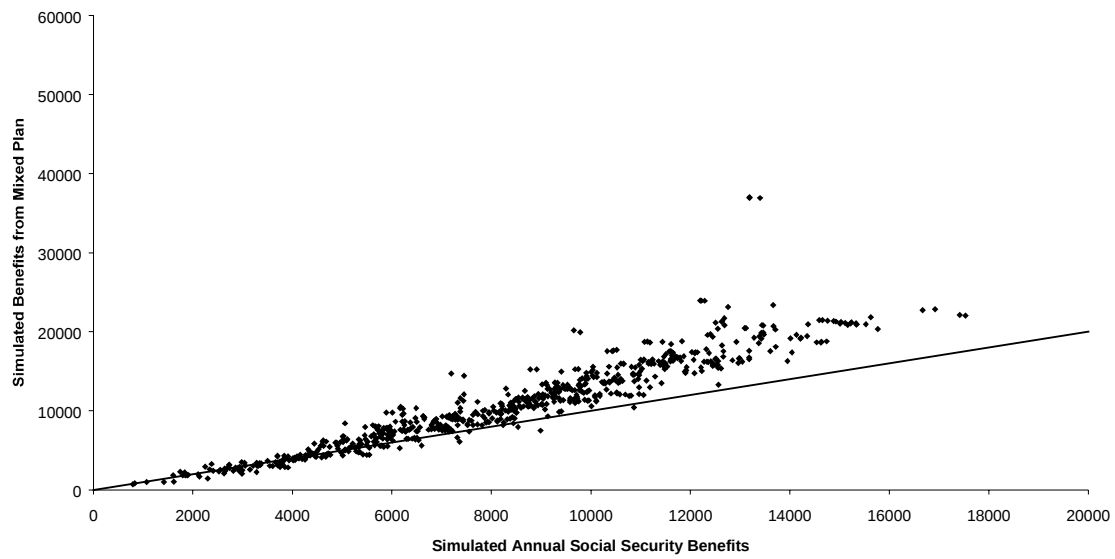
Blacks (Mixed Plan, 5.5% return)



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Figure 10

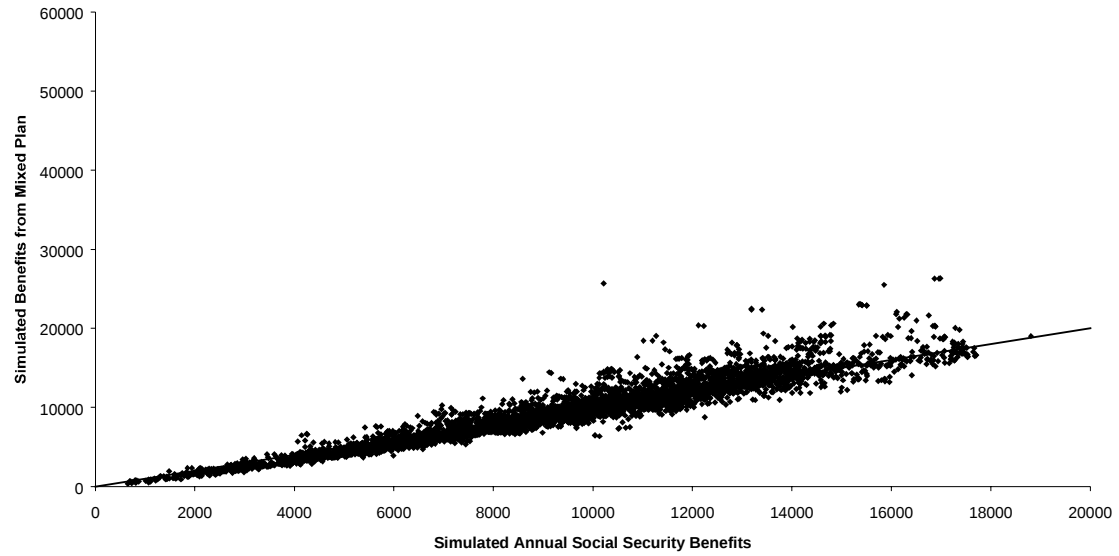
Males with Less than High School Education (Mixed Plan, 5.5% return)



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Figure 11

All Beneficiaries (Mixed Plan, 3.5% Return)



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