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POTENTIAL PATHS OF SOCIAL SECURITY REFORM

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EXECUTIVE SUMMARY

This paper presents several alternative social security reform options in which the projected level of benefits for every future cohort of retirees is as high as or higher than the benefits projected in current law. These future benefits can be achieved without any increase in the payroll tax or in other tax rates. Under each option, the Social Security Trust Fund is solvent and ends with a sustainable positive and growing balance. Each option combines the current pay-as-you-go system of defined benefits with an investment-based personal retirement account (PRA). Assets in the PRA can be bequeathed if the individual dies before normal retirement age. We also consider the option in which an individual can take all or part of his accumulated PRA balance as a lump sum at normal retirement age. The basic plan that we present in greatest detail combines a transfer to the PRA of a portion of the individual's payroll tax equal to 1.5 percent of earnings if the individual agrees to deposit an equal out-of-pocket amount. The additional national saving that results from this option leads to increased business investment and therefore to

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increased general tax revenue; a portion of that revenue, equal to 1 percent of the PRA balances, is transferred to the Social Security Trust Fund. The other options that we present include plans with no out-of-pocket contributions by individuals and others with no transfer of general revenue to the Trust Fund. We also discuss the implications of different rates of return on the PRA balances and, more generally, the issue of risk, including a market-based method of guaranteeing the real principal of all PRA deposits.

1. INTRODUCTION

It is now widely recognized that the social security benefits projected under current law cannot continue to be financed by the existing 12.4-percent payroll tax. The government's Social Security Actuaries project that paying the benefits implied by current law would eventually require raising the payroll tax to more than 18 percent.[1] There are only three possible responses to this situation: reduce future retirement incomes, increase the taxes used to finance future benefits, or save more now and invest those savings in a productive way. Increasing national saving and earmarking those funds for the payment of future retirement benefits would lower the present value of the cost of providing any level of benefits.[2] Avoiding future tax increases also avoids the greater deadweight loss that would be caused by the distorting effects of higher marginal tax rates.

Although we favor the increase in retirement saving, the choice among the three possibilities is not a technical economic issue, because it involves a value judgement about how the costs and benefits should be divided among current and future population cohorts. As economists we can show the possibilities and trade-offs, but the choice is inevitably one that must be decided by the political process.

Moreover, even if it is accepted that it would be preferable to raise saving for retirement rather than cutting benefits or increasing future taxes, there are further normative decisions that can only be resolved in the political process. Should current and future employees be required

[1] See the *2001 Social Security Trustees Report*, which is available at www.ssa.gov/OACT/TR/index.html.

[2] This lower present value reflects the fact that the productivity of additional investment exceeds the appropriate discount rate. For an extensive discussion of this issue and some of the related academic debate, see Martin Feldstein and Jeffrey Liebman, "Social Security," forthcoming in volume 4 of the *Handbook of Public Economics* and available now as NBER Working Paper 8451 at www.nber.org/papers/w8451. See in particular section 7.1.3, "The Gain from Prefunding Social Security."

to save more as a condition of maintaining their retirement incomes? Should the on-budget surpluses that are projected after the next few years be committed to financing future retirement benefits? That would cause the increased retirement saving to come at the expense of the public or private consumption that would otherwise be financed by spending those on-budget surpluses or using them to finance personal tax cuts. In this paper, we consider alternative combinations of retirement saving policies so that those responsible for the policy decisions may have a better understanding of the possible options.

Each of the alternative options for social security reform that we discuss combines the existing pay-as-you-go system with a new system of personal retirement accounts (PRAs) invested in stocks and bonds. To keep our task manageable, we make four key assumptions:

1. Those who are now retired or will soon retire will receive the full pay-as-you-go benefits specified in current law.
2. The existing payroll tax rate and base will not be increased.
3. For each future cohort of retirees, the projected combination of the pay-as-you-go benefits that can be financed with the existing payroll tax and the investment-based personal annuities will equal or exceed the benefits that are projected for that cohort under current law.[3]
4. There will be a permanent financing solution for social security that establishes solvency over the Actuaries' 75-year forecasting period. By *75-year solvency*, we mean that, in 2075, the Social Security Trust Fund is not only positive but *growing* as a result of the reform. This definition of solvency is to be contrasted with the common description of eliminating the 75-year *actuarial deficit* used by the Social Security Actuaries. The *2001 Social Security Trustees Report* indicates that an increase in revenues equal to 1.86 percent of taxable payroll in each year is sufficient to maintain a positive balance in the Trust Fund through the year 2075. However, such a payroll tax increase would eliminate the 75-year actuarial deficit by *temporarily* building up the Trust Fund and then drawing it down. In 2075, the Trust Fund would be equal to only one year's benefits and will be rapidly shrinking. After that, a large permanent financing gap of more than 6 percent of taxable payroll[4] would remain for each future year. This also implies that the 75-year actuarial deficit would only be eliminated for the first year after the tax increase;

[3] It is also unnecessary to change the projected retirement age or the way in which benefits are indexed for inflation.

[4] *Taxable payroll* refers to the earnings on which the OASDI payroll tax is levied. It includes the income of the self-employed that is subject to the social security tax.

after the first year, the system would again have a 75-year actuarial deficit, which would grow larger each year. The 75-year actuarial deficit thus vastly understates the size of the reform required to permanently restore solvency to the Social Security system.

It is possible to satisfy all four goals in a mixed social security system because of the higher expected rate of return that can be earned on the extra saving that is created in the investment-based portion of the new system. The paper indicates how the old and new systems work together to finance the costs of transition to the new mixed system.

Although our analysis deals with the average of all workers and beneficiaries in each birth cohort and does not explicitly discuss distributional issues within cohorts, the results that we present imply that the combined future benefits at every income level can be made equal to or greater than those projected in current law. More specifically, since the combined benefits from the pay-as-you-go system and the investment-based accounts equal or exceed the benefits projected in current law for the *average* of all individuals in each birth cohort, it is possible to change the existing pay-as-you-go defined-benefit formula in a way that achieves that same result at each income level.

In contrast to the detailed proposals in two of our previous papers,[5] the options described here give individuals full ownership of their PRAs, with the right to bequeath the entire accumulated funds if they die before retirement. In addition, the amount of the individual's pay-as-you-go social security benefits is never reduced in response to the size of that individual's personal retirement account annuities.

More specifically, our calculations assume that PRAs can be bequeathed to anyone the individual designates if he or she dies before the annuity begins at "normal retirement age" (now 65 for anyone born before 1938 and increasing according to current law to 67 for those born after 1959). In addition, the PRA annuity will continue to be paid for 10 years even if the annuitant dies during the first ten years after the annuity begins, a common feature in private retirement plans known as a *ten-year certain* life annuity. These bequests and the continued annuity payments are in addition to the survivor insurance benefits currently provided in the pay-as-you-go program (as modified like the other pay-as-you-go benefits

[5] Martin Feldstein and Andrew Samwick, "Two Percent Personal Retirement Accounts: Their Potential Effects on Social Security Tax Rates and National Saving," *Tax Notes*, May 4, 1998, pp. 615–620, and Martin Feldstein and Andrew Samwick, "Allocating Payroll Tax Revenue to Personal Retirement Accounts to Maintain Social Security Benefits and the Payroll Tax Rate, *Tax Notes*, June 19, 2000, pp. 1645–1652. These articles are also available as NBER Working Papers 6540 and 7767, available at www.nber.org/papers.

according to the rules that we describe below). The combination of these PRA bequests and the traditional pay-as-you-go survivor benefits can make surviving spouses better off in the mixed system than they would be in the current pay-as-you-go system even if the full pay-as-you-go benefits projected in current law were feasible.

A further difference from our previous analyses is that we now separate out the disability-benefit component of social security and focus on the Old Age and Survivors Insurance (OASI). We assume that the disability insurance (DI) component will be financed by the pay-as-you-go tax. We therefore set aside the portion of the payroll tax that the Social Security Actuaries estimate will be needed to finance the disability benefits provided in current law.[6] According to the calculations of the Social Security Actuaries, with the disability payments treated separately, the payroll tax that is needed in the future for OASI would have to rise from today's actual 10.6 percent of taxable payroll to 16.65 percent in 2075.[7]

In the plans that we analyze, a portion of each individual's payroll tax is transferred to that individual's investment-based PRA instead of going into the Social Security Trust Fund. In section 2, individuals qualify for this transfer by contributing some out-of-pocket funds of their own and accepting the explicit reduction in future pay-as-you-go benefits that is needed to establish the solvency of the social security system. More specifically, in the basic plan that we analyze in section 2, individuals can transfer payroll taxes of 1.5 percent of their earnings to their PRAs if they also voluntarily contribute an equal amount of their own funds. Although experience with private-sector defined-contribution plans suggests that a one-to-one matching rate would induce a very high participation rate, this might not be true if individuals are also required to accept an explicit reduction in future pay-as-you-go benefits in order to qualify for the matching transfer of payroll tax funds. The feasibility of this basic plan therefore depends on the ability of the political process to reduce pay-as-you-go benefits for all future retirees, regardless of whether they

[6] We do this so that our analysis will be directly comparable with the proposals developed by the President's Commission on Strengthening Social Security.

[7] The Social Security Actuaries forecast that the cost of the OASI benefits in 2075 under current benefit rules would be 16.82 percent of payroll. The income tax collected on OASI benefits, under current law, would equal 0.89 percent of payroll, implying a net cost for the OASI benefits of 15.93 percent of payroll. The forecast for the cost of the DI benefits is 2.57 percent of payroll. With no change in the DI component of the payroll tax from the current 1.8 percent of payroll, there is a shortfall of 0.77 percent of payroll. Of this, 0.05 percent of payroll comes from the income tax on DI benefits, implying a net cost of the DI benefits of 0.72 percent of payroll in addition to the current 1.8-percent tax. The funds needed for the combination of the OASI program and the financing shortfall of the DI program are thus 16.65 percent of taxable payroll.

choose to have a personal retirement plan or not. If the political process can legislate such a future reduction in pay-as-you-go benefits, individuals are very likely to make the contribution necessary to obtain the matching funds, especially if the government adds a guarantee that the combined benefits will not be less than the full benefits projected in current law. But if the government is politically incapable of imposing a significant mandatory reduction in future pay-as-you-go benefits, many individuals might choose to stay with the current system in the hope that future Congresses would raise taxes on future workers to maintain their current-law projected benefits.

In section 3 we therefore consider alternative plans in which individuals do not have to make out-of-pocket contributions. The PRAs are financed by a combination of transfers from the payroll tax plus a matching of general revenue funds. In this context, even individuals who believe that traditional benefits might not be reduced during their retirement years would have an incentive to accept the combination of lower pay-as-you-go benefits and higher government-financed PRA annuities. This would be particularly true if the government also provided a guarantee that the combined benefits would be at least as large as the pay-as-you-go benefits projected under current law.

As we discuss below, the creation of PRAs increases total national saving. The higher saving finances additional business investment in new plant and equipment. The greater capital stock implies more taxable income and therefore more tax revenue. Our analysis in sections 2 and 3 assumes that the government transfers a portion of that incremental tax revenue to the Social Security Trust Fund. We recognize, however, that there is uncertainty about the magnitude of the incremental tax revenue and therefore about the amount of such funds that can appropriately be transferred from general revenue to the Trust Fund. Our general strategy in sections 2 and 3 is to be quite conservative in our estimate of the amount of incremental revenue available to supplement the Trust Fund. In section 4 we go further and show what can be done if little or none of the additional revenue is used to supplement the Trust Fund.

Section 5 discusses the potential risk to future retirees that arise in the investment-based part of the system and how a privately provided guarantee of the real value of the PRA deposits can reduce that risk. Section 6 discusses the possibility of lump-sum payments from the PRA accounts at age 67 instead of annuitization. There is a brief concluding section.

The accounting model used in this paper follows the same procedure that we used previously by basing our calculations on the detailed economic and demographic projections of the Social Security Actuaries. The model is also calibrated so that, with the current social security law, it

closely approximates the time series of benefits, revenue, and Trust Fund assets predicted in the *2001 Social Security Trustees Report*.[8] The unit of analysis for the simulations of the pay-as-you-go system is the individual. Benefits for spouses, dependents, and survivors are subsumed in the individual benefit provision, which is then scaled so that the OASI benefits correspond to those projected by the Social Security Actuaries. We use the Census Bureau's projections of future age structures of the U.S. population. These projections incorporate projections of future birth, death, and immigration rates. We scale up the projected population of every age to coincide with the aggregate population projections of the Social Security Administration for each future year.

The simulations assume that individuals begin work at 21 and continue to work until the year before they reach the normal retirement age legislated for their birth cohort (or die if that occurs sooner). Since not everyone in the population of working age actually works in each year, we adjust the labor-force participation rate to obtain the number of covered workers in each future year that is projected by the Social Security Actuaries.

Our calculations embody the historical data for social security taxable payroll for the years before 2001 and then use the forecast of taxable payroll in the intermediate assumptions of the *2001 Social Security Trustees Report* for subsequent years. According to that forecast, the average real wage rises at 1.0 percent per year in the long term. Our calculations assume that movements of the average real wage reflect changes in the age structure of the labor force, differences among age groups in the relative level of wages, and the overall rate of increase of age-specific wage rates.

2. A BASIC MIXED SYSTEM WITH EQUAL PRA CONTRIBUTIONS

Our analysis assumes that the PRA system begins with the year 2003 and that, in the basic plan analyzed in this section, all employees in that year shift 1.5 percent of their 12.4-percent payroll tax to the new PRAs and make an equal out-of-pocket contribution.[9] Of the remaining 10.9

[8] The *2001 Social Security Trustees Report* and the accompanying 75-year forecasts on which our simulations are based are available at www.ssa.gov/OACT/TR/index.html.

[9] See Fred Goldberg and Michael Graetz, "Reforming Social Security: A Practical and Workable System of Personal Retirement Accounts," in *Administrative Aspects of Investment Based Social Security Reform*, J. Shoven (ed.), Chicago: Chicago University Press (2000) for a description of a low-cost way of shifting a portion of payroll tax funds to individually-chosen mutual fund managers, insurance companies, or banks. The paper is also available as NBER Working Paper no. W6970 (www.nber.org/papers/W6970).

percent, 1.8 percent is separated as it is today for the pay-as-you-go disability program. The remaining 9.1 percent of taxable payroll is available to pay OASI benefits in 2003, with the excess added to the OASI Trust Fund balance.

The investments in the PRAs and the post-retirement variable annuities are assumed to earn a real rate of return of 5.5 percent after inflation.[10] A portfolio invested 60 percent in the Standard & Poor's 500 portfolio of common stock and 40 percent in a portfolio of corporate bonds during the fifty-year period through 1995 had a mean return of 6.9 percent.[11] We deduct 0.4 percent for administrative costs[12] and an additional 1.0 percent as a conservative "margin of safety" of the mean return. We follow the Social Security Trustees in assuming that the real return on government bonds in the Social Security Trust Fund will decline gradually to a 3.0-percent real interest rate in the future.

2.1 Aggregate PRA Deposits, PRA Annuities, and PRA Balances

The combined PRA deposits of 3 percent of taxable payroll are projected to be $131 billion (at the year 2001 price level) in 2003. The deposited amounts increase over time as earnings rise, reaching $170 billion in 2020, $220 billion in 2040, and $334 billion in 2075, the final year of our analysis. These figures are shown in column 1 of Table 1.

We assume that individuals begin to receive payments from their PRAs at their normal retirement ages as specified in current law (i.e., 65 for anyone born before 1938 and increasing according to current law to 67 for those born after 1959) in the form of a variable annuity that earns the same 5.5-percent real rate of return that we assume for the accumulation phase.[13] The first annuities are paid to individuals who become 65 in

[10] See section 5 below for the implications of alternative real rates of return: a 3.5-percent real rate of return (the real rate that is currently available on U.S. Treasury Inflation Protected Securities), as well as real rates of 5.0, 6.5, and 7.5 percent.

[11] For technical analytic reasons, it is common among academic finance specialists to describe rates of return on portfolios that contain equities in logarithmic terms even though it is the *level* rate of return that matters for investors. The mean logarithmic rate of return of the 60 : 40 stock–bond portfolio described above was 5.9 percent over the same 50-year period, but with the associated volatility this implies a mean level return of 6.9 percent.

[12] This 40-basis-point charge may be more than the amount that would be needed in practice. TIAA–CREF now offers a variable annuity of the type described here based on the Russell 3000 stock index with an annual expense ratio of 0.37 percentage points, even though TIAA–CREF has to manage collection of account deposits at varying intervals, permits fund transfers whenever the individual wants, and is required to provide a detailed quarterly report to each individual.

[13] For a description of how such a variable annuity works, see Martin Feldstein and Elena Ranguelova, "Individual Risk in an Investment-Based Social Security System," *American Economic Review*, September 2001 (Vol. 91, No. 4, pages 1116–1125). This is also NBER Working Paper 8074 (available at www.nber.org/papers/W8074).

TABLE 1
Aggregate Personal Retirement Account Deposits, Annuities, and Assets

Year	Deposits 2001 $ billion (1)	Annuities 2001 $ billion (2)	Annuities % of Payroll (3)	Assets 2001 $ billion (4)	Assets % of payroll (5)
2005	136.0	0.3	0.0	422.6	9.3
2010	147.2	3.4	0.1	1,335.6	27.2
2020	169.8	34.2	0.6	4,060.5	71.8
2030	192.2	121.1	1.9	8,026.4	125.3
2040	219.5	270.0	3.7	12,966.3	177.2
2050	248.7	489.0	5.9	18,666.3	225.2
2060	279.9	758.6	8.1	24,217.9	259.5
2070	315.0	991.5	9.4	29,727.1	283.1
2075	333.8	1,129.3	10.2	32,465.8	291.8

All estimates relate to the basic plan described in section 2 of this paper.

Source: Authors' calculations based on the projections in the *2001 Social Security Trustees Report.*

the year 2004 and total only $100 million.[14,15] Total annuities grow rapidly, reaching $3.4 billion in 2010, $121 billion in 2030, and $1129 billion in 2075 (all in year 2001 dollars). These figures and amounts for selected intermediate years are shown in column 2 of Table 1. The rapid rise in the annuity amounts reflects increases in the number of annuitants and in the average annuity amount. The latter increase reflects the increased number of years of PRA contributions among successive cohorts of retirees as well as rising real earnings.[16]

[14] In practice, the program might require a minimum of, say, five years of deposits to avoid very small annual payments. Individuals who retire with less than five years of deposits might receive a lump-sum distribution or be allowed to leave the funds to accumulate for a lump-sum distribution at a future date. Our analysis assumes that individuals above normal retirement age are not participating in the PRA system, but that obviously could be allowed in actual practice.

[15] The PRA annuities, like the pay-as-you-go benefits, are subject to personal income tax if the total income of the taxpayer exceeds a threshold limit. We show both the PRA annuities and the pay-as-you-go benefits net of this income tax in all of our tables and calculations.

[16] Permitting pre-retirement bequests and the ten-year certain life annuity reduces the PRA funds available to pay the annuity to the retired employee. Martin Feldstein and Elena Ranguelova calculated that the pre-retirement bequests reduce the funds available for the annuity by 14 percent and that the ten-year certain feature of the life annuity reduces the funds by an additional 5.5 percent. We recognize these costs in the calculations throughout the paper by reducing the funds that are available to finance the retiree's PRA annuity to 81 percent of what they would otherwise be [(0.945)(0.86) = 0.81]. This implies that the PRA benefits that could be financed with a 2-percent PRA contribution in the absence of the bequest provisions would, all other things equal, require a 2.5-percent PRA

The same payments are shown in column 3 of Table 1 as percentages of the taxable payroll of all individuals in each of the selected years. The amounts rise from less than 0.1 percent of taxable payroll in 2010 to 1.9 percent in 2030, 5.9 percent in 2050, and 10.2 percent in 2075.[17] Note that this 10.2 percent of taxable payroll would be more than sufficient to fill the gap between the net OASI tax of 9.27 percent[18] of payroll and the tax rate of 15.93 percent of payroll that the Social Security Actuaries forecast as the cost of OASI program in 2075 under current law.[19]

The aggregate value of the funds in all PRAs grows with the PRA deposits of 3 percent of each year's taxable payroll and with the 5.5-percent rate of return on the existing PRA assets, and is diminished by the annuity payouts and lump-sum bequests. The resulting aggregate PRA value is shown in column 4 of Table 1 in billions of year 2001 dollars, and in column 5 as a percentage of the corresponding aggregate taxable payroll. The PRA assets rise rapidly, from $1,336 billion in 2010 to $8,026 billion in 2030 and $32,466 billion in 2075. As a percentage of taxable payroll, these assets rise from 27 percent in 2010 to 125 percent in 2030 and 292 percent in 2075.

The PRA system adds to national saving and therefore increases national investment in business plant and equipment. This increase in saving and investment occurs through two different channels. First, the individuals contribute 1.5 percent of earnings directly to their PRA accounts. The interest and dividends earned in these accounts is a further source of national saving. And the retained-earnings portion of the extra profits that result from the increased investment in business plant and equipment also add to private saving and to business investment.

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contribution with pre-retirement bequests and ten-year certain annuities. For Feldstein and Ranguelova's calculations, see their paper "The Economics of Bequests in Pensions and Social Security," in *The Distributional Aspects of Social Security and Social Security Reform*, M. Feldstein and J. Liebman (eds.), Chicago: Chicago University Press, forthcoming, which is also NBER Working Paper no. 7065, April 1999, available at www.nber.org/papers/W7065.

[17] Since 1 percent of taxable payroll corresponds to between 0.40 percent of gross domestic product (GDP) in 2001 and 0.35 percent of GDP in 2075, the annuity payments rise from about 0.04 percent of GDP in 2010 to about 3.5 percent of GDP in 2075.

[18] The total OASDI tax rate remains unchanged at 12.4 percent. Of this, 1.8 percent is earmarked for the DI program and 1.5 percent is transferred to the PRAs. The net shortfall in the financing of the DI program reduces the funds available for the OASI benefits by an additional 0.72 percent, as explained in footnote 7, while the income tax on OASI benefits that is transferred to the Trust Fund under current law adds 0.89 percent of payroll. Combining these four components implies net funds for OASI of 9.27 percent of payroll.

[19] See footnote 7. The cost rate for the OASI benefits is 16.82 percent, of which 0.89 percent is financed by the income tax on OASI benefits for a net cost of 15.93 percent of payroll.

The second way in which the PRA system adds to national saving is through its effect on future government spending and future tax reductions. The future transfer of funds from the government budget to the PRA accounts reduces the size of the government's unified budget surplus and thereby reduces the likelihood that future Congresses and administrations will use those funds to finance additional government spending or additional tax cuts that finance private spending.[20] The funds that are shifted to PRAs are additions to personal saving and therefore to national saving.[21] The net effect of reduced future government spending and smaller future tax cuts, combined with a shift of funds from the government accounts to PRAs, implies that PRA deposits increase national saving.

It is of course difficult to know just how much all of this would add to national saving. The answer depends on the reaction of future Congresses to smaller unified surpluses and on the way that households adjust other behavior in response to their PRA deposits. The extent of the increase in national saving is relevant to the finances of social security because the rise in business plant and equipment that results from the additional saving means greater national income and therefore greater tax revenue that can be used to augment the Trust Fund without raising tax rates or decreasing other government spending. Because of the uncertain magnitude of the increased saving, we use conservative assumptions about the additional tax revenue and, in Section 3, show the implications of ignoring the extra tax revenue completely.

The simplest way to estimate the increased tax revenue that results from the increased national saving is to consider the likely effect on corporate profits and therefore on corporate tax revenue.[22] Incremental

[20] The tendency for Congress and the administration to spend unified budget surpluses is consistent with the budget history of the past half century, in which unified surpluses have virtually never been allowed to occur. Even the off-budget surpluses in the Social Security Trust Fund that accumulated as a result of the 1983 social security reforms were more than matched by on-budget deficits, producing overall budget deficits.

[21] If households expect that the mixed system of pay-as-you-go benefits and PRA annuities will essentially just maintain the level of benefits projected in current law, they have no reason to reduce saving or to increase spending from other assets. For many individuals who do little or no saving now, the provision of PRAs may create a vehicle for new saving and for education about the nature of financial investment that induces more such saving. It would be fairly simple for the financial institutions that provide PRAs to offer the opportunity for a parallel personal investment account, a feature that we do not try to incorporate into our analysis.

[22] A more general analysis would recognize that over time the increase in the nation's capital stock would reduce the rate of return to capital and increase wages. The extra corporate tax would therefore be less than the amount described in the following text, but there would also be increased personal income tax revenue on the higher wage and salary

investments in the corporate sector have earned a real return of about 8.5 percent[23] and have been subject to an average federal corporate income tax rate of about 29 percent, implying that the government receives 2.5 percent of the incremental corporate capital.[24] Of course, not all of the increased national saving flows into corporate investments, since some of it goes into owner-occupied housing and other non-corporate investment, and some flows abroad. To recognize that fact, we scale down the return that the federal government gets on incremental saving by one-fifth, from 2.5 to 2.0 percent of the incremental saving.

In our earlier papers, we assumed that the entire PRA balance represented a net increase in the nation's capital stock and therefore applied the 2-percent revenue rate to the entire PRA balance to estimate the amount of incremental revenue that the government receives as a result of creating the PRA system. In the current section, we limit the estimated incremental revenue to just 1 percent of the PRA balance.

A possible rationale for that estimate would be that each dollar of out-of-pocket individual PRA deposits raises the national saving rate by a dollar, implying incremental revenue of 2 percent of that part of the PRA balance, while the transfer of payroll tax revenue to the PRA account does not add anything at all to national saving. Applying the 2-percent rate on the half of PRA accumulation that results from the voluntary personal saving implies a 1-percent overall rate on the full PRA account. We think this is extreme and unrealistic. We believe that the transfer of payroll tax revenue does add to national saving (for the reasons described earlier in this section) and that each dollar of out-of-pocket PRA deposits represents less than a dollar of additional saving. We regard the assumption that incremental federal tax revenue is 1 percent of the PRA balances as a conservative estimate of the combined effect of both types of saving.

As we show in section 2.2, with the Trust Fund augmented by this incremental revenue and with the PRA annuities permitting smaller pay-as-you-go benefits without reducing the total combined benefits of

incomes. Since the offsetting effects are of similar size, an estimate based on the corporate tax calculation with an unchanged rate of return is an adequate approximation for the current purpose.

[23] See James Poterba, "The Rate of Return to Corporate Capital and Factor Shares: New Estimates Using Revised National Income Accounts and Capital Stock Data," *Carnegie Rochester Conference Series on Public Policy* 48:211–246.

[24] The 5.5-percent rate of return that we assume reaches PRA investment accounts is after the corporate tax payments to the federal and state governments as well as after the investment management fees.

individuals, the Trust Fund remains permanently positive.[25] Indeed, a significant amount of the incremental corporate tax revenue is not needed in the longer run, and some of those funds could therefore be used to reduce other taxes or to finance other government spending.

2.2 *The Trust Fund and the Growth of Pay-as-You-Go Benefits*

Under current law, the sum of the OASI portion of the payroll tax and other OASI Trust Fund receipts (viz., the interest on the Trust Fund balance and the general revenue transferred to the Trust Fund on the basis of taxing the benefits of high-income retirees) is projected to exceed the OASI benefits only through 2021. After that, benefits can continue to be paid temporarily by borrowing from the public through the sale of the governments bonds that are held in the Social Security Trust Fund. When the Trust Fund bonds are exhausted in 2040, social security pay-as-you-go benefits will have to be cut or taxes will have to be raised.[26]

The advantage of the basic mixed system is that the Trust Fund remains positive at all times in the future without any increase in taxes, while the projected combination of the PRA annuities and the pay-as-you-go benefits for each cohort of retirees exceeds the pay-as-you-go benefits that are projected in current law (but that could not be financed without a tax increase in the current pure pay-as-you-go system). To do this, the pay-as-you-go portion of total retirement benefits must be reduced from the levels projected in current law to levels that can be financed but that are nevertheless high enough so that the total combined benefits exceed the pay-as-you-go benefits projected in current law. We will refer to those current-law projected benefits as the *benchmark benefits.*

There are a variety of ways that the pay-as-you-go benefits can be reduced relative to the levels projected in current law. In this section, we use a very simple method that reduces pay-as-you-go benefits by 0.3 percent for each year that the individual participates in the PRA system during the first five years of the program (2003 through 2007), followed by reductions of 0.6 percent per year during the next six years (2008 through 2013), 0.9 percent per year during the five years after that (2014

[25] Our analysis of the solvency of the Social Security Trust Fund does not depend on our estimates of national saving, but only on the willingness of future congresses and administrations to transfer general revenue to the Trust Fund equal to 1 percent of the PRA balances. We show in section 3 that the Trust Fund can remain solvent and the combined benefits be equal or greater than the benefits projected in current law with an infusion of general revenue that is much smaller than 1 percent of the PRA balances.

[26] The familiar statements that benefits would exceed taxes in 2016 and that the Trust Fund would be exhausted by 2038 correspond to the entire OASDI system, including DI.

through 2018), 1.2 percent per year during 2019 through 2025, and finally 1.5 percent per year up to a cumulative maximum reduction of 40 percent of the benchmark benefits. For example, an individual who is 50 years old in 2003 and retires at 66 in 2019 would receive pay-as-you-go benefits that are 9.6 percent less than the benefits specified in current law.[27] As we show in section 2.3 below, the combination of these pay-as-you-go benefits and the variable annuity available at age 66 would slightly exceed the benchmark benefits projected in current law for his cohort. A 21-year-old in 2003 would reach retirement age in 2049; his combined benefits would exceed the pay-as-you-go benefit in current law by 20 percent (and would exceed the pay-as-you-go benefits that could then be financed by a 12.4-percent payroll tax by substantially more).

Before looking at what the combined benefits would mean to each age cohort in each future year, we consider the effect of the mixed system on the path of the Trust Fund. The balance in the Trust Fund is increased each year by the sum of four things: (1) the payroll taxes collected (i.e., the 10.6-percent payroll tax for OASI less any required transfer to cover the DI shortfall), (2) the interest earned on the existing Trust Fund balance, (3) the personal income tax revenue collected under current law on the pay-as-you-go benefits paid to retirees with incomes above certain thresholds, and (4) the transfer of some or all of the incremental tax revenue that results from increased national saving and investment. At the same time, the Trust Fund is reduced by the sum of OASI benefits paid and by the 1.5 percent of taxable payroll transferred to the PRA accounts. The PRA system thus affects the annual change in the balance of the trust fund by (1) reducing the inflow of taxes by 1.5 percent of taxable payroll, (2) reducing the outflow of OASI benefits according to the rule described in the previous paragraph, and (3) adding some or all of the incremental tax revenue that results from the increased national saving.

With the current pure pay-as-you-go system, the Trust Fund balance for the OASI program starts to decline in 2021[28] and becomes negative in 2038; these figures are shown for selected years in dollars of 2001 in column 1 of Table 2 and as a percentage of taxable payroll in column 2. We assume that the Social Security Trust Fund borrows to finance its

[27] Employees who join the labor force and start making contributions to PRA accounts after 2025 have their pay-as-you-go benefits reduced by 1.5 percent for each year that they work, up to a maximum of 40 percent.

[28] The decline in the balance occurs five years after benefits exceed payroll tax receipts, because the Trust Fund also receives interest on its accumulated balances.

TABLE 2
OASI Trust Fund Balances

Year	*Current law*		*Basic plan*	
	2001 $billion (1)	Percent of payroll (2)	2001 $billion (3)	Percent of payroll (4)
2005	1,578.5	34.8	1,380.6	30.5
2010	2,292.6	46.7	1,741.4	35.5
2020	3,164.2	55.9	1,982.2	35.0
2030	2,260.9	35.3	1,129.3	17.6
2040	−559.0	−7.6	81.2	1.1
2050	−4,764.8	−57.5	355.3	4.3
2060	−11,410.9	−122.3	1,864.4	20.0
2070	−21,625.6	−206.0	4,441.1	42.3
2075	−28,473.4	−255.9	6,154.7	55.3

Estimates in columns 3 and 4 relate to the basic plan described in section 2 of this paper. Estimates in columns 1 and 2 assume that the Trust Fund borrows to pay obligations after it is depleted.

Source: Authors' calculations based on the projections in the *2001 Social Security Trustees Report.*

deficit after 2038 at the same government bond rate (3 percent real, according to the Social Security Actuaries) at which the Trust Fund can invest surpluses. The Trust Fund balance becomes increasingly negative if taxes are not raised or benefits reduced.

This exploding level of Trust Fund debt can be contrasted with the projected Trust Fund balances under the basic mixed-system plan that are shown in columns 3 (in dollars of 2001) and in column 4 (as percentages of the taxable payroll). The balance in the Trust Fund is positive in every year. It declines to a low of just $8.9 billion in 2043, and then begins to increase rapidly, reaching $355 billion in 2050, $1.9 trillion in 2060, and $6.2 trillion in 2075. By 2065, the Trust Fund balance exceeds 30 percent of taxable payroll. After that date, it is possible to maintain the Trust Fund at 30 percent of taxable payroll while shifting even less than 1 percent of the PRA balances into the Trust Fund. This would permit significant incremental tax revenue with which to reduce other taxes or to finance other government outlays.

2.3 Comparing the Mixed-System Benefits in the Basic Three-Percent Plan and the Benefits in Current Law

The features of the basic plan—i.e., the gradual reduction in pay-as-you-go benefits and the provision of PRA annuities that are based on deposits of a combined 3 percent of taxable payroll contribution and a 5.5-percent real return on the PRA accounts and PRA annuities—imply that

each cohort of retirees would receive more in each year from the combination of the two types of benefits than they would receive under existing pay-as-you-go benefit rules.

Consider for example a typical 30-year-old employee in 2003 who would reach normal retirement age in 2040.[29] Under current law, his benchmark level of benefits (i.e., the full level of benefits projected in current law) would be $15,300 (in 2001 dollars). However, since the Trust Fund is exhausted by that date and the available payroll tax can finance only a fraction of all benefits specified in current law, benefits must be reduced to the available funds if taxes are not to be increased. Reducing benefits by the same proportion for all retirees in each year in order to make the aggregate OASI benefit equal to the available revenue[30] would reduce the initial benefit for the person who was 30 years old in 2003 by 31.1 percent to $10,550. That person would see his real benefits reduced further in subsequent years; for example, when he is 87, the projected benefits would be reduced from 68.9 percent of the current benchmark for his cohort to 65.6 percent, i.e., from $10,550 to $10,037.

In contrast, the mixed system analyzed here would combine pay-as-you-go benefits equal to 61 percent of the benchmark level (the result of the formula described above for making annual reductions in the pay-as-you-go benefit) and a PRA annuity equal to $6,520, or 42.6 percent of his benchmark benefit. The 30-year-old can therefore expect a combined benefit that is 103.6 percent of his benchmark benefit in current law and 150.2 percent of the benefit that could be paid in the pure pay-as-you-go system without an increase in the payroll tax rate. In addition, the individual can bequeath his accumulated PRA balance if he dies before age 67 and will provide a ten-year certain annuity to his heirs of $6,520 a year until age 77 if he dies before that age.

Column 1 of Table 3 shows the benchmark level of annual benefits in 2001 dollars for retirees who will reach normal retirement age in selected years starting in 2005. Under current law, these benefits remain unchanged in real terms throughout the individual's retirement. Note that the real benchmark benefit increases by 36 percent between 2005 and 2030 and by 107 percent between 2005 and 2075.

Column 2 shows the effect of reducing all benefits after the Trust Fund is empty to the amount that could be paid without raising the payroll

[29] Recall that our analysis is for an average beneficiary. This includes a mixture of income levels and marital status such that multiplying benefits of the average beneficiary by the projected number of beneficiaries gives the projected aggregate amount of benefits.

[30] This is the 10.6-percent payroll tax plus the income tax on OASI benefits and minus the funds needed to fill the gap in the DI financing (see footnote 7 for a description for 2075).

TABLE 3

Average Retiree Benefits by Year Attaining Normal Retirement Age: Current Law, Current Law with Financing Limit, and Basic Plan

Year	Current law benchmark (2001 $) (1)	Current law with financing limits (2001 $) (2)	Basic plan: Pay-as-you-go benefits (2001 $) (3)	PRA annuity (Percent of benchmark) (4)	Current law with financing limits (Percent of benchmark) (5)	Basic plan: pay-as-you-go benefits (Percent of benchmark) (6)	Basic plan: combined benefits (Percent of benchmark) (7)
2005	10,550	10,550	10,480	0.9	100.0	99.3	100.2
2010	11,790	11,790	11,470	3.1	100.0	97.3	100.4
2020	12,840	12,840	11,450	11.1	100.0	89.2	100.2
2030	14,310	14,310	10,880	25.2	100.0	76.0	101.2
2040	15,300	10,550	9,330	42.6	68.9	61.0	103.6
2050	17,130	11,720	10,280	60.8	68.4	60.0	120.8
2060	19,540	12,810	11,730	68.3	65.6	60.0	128.3
2070	21,190	13,380	12,710	69.3	63.1	60.0	129.3
2075	21,870	13,560	13,120	74.8	62.0	60.0	134.8

Estimates in columns 3, 4, 6 and 7 relate to the basic plan described in section 2 of this paper.

Source: Authors' calculations based on the projections in the *2001 Social Security Trustees Report*.

tax. The benefits shown are for the first retirement year of each cohort; they then decline in each subsequent year.

Column 3 shows the reduced pay-as-you-go benefits that result from the benefit adjustment rule described above, again stated in real 2001 dollars. Note that the reduced pay-as-you-go benefits in each future year remain almost as high as the real benefits are in 2005. After 2053, the reduced pay-as-you-go benefits are actually higher in every year than they are in 2005.

Column 4 shows the PRA annuity for the cohort reaching normal retirement age in each year. Columns 5 and 6 restate the pay-as-you-go benefits as a percentage of the benchmark level. Column 7 shows the combined benefit as a percentage of the benchmark benefit. The combined benefit is never lower than the benchmark in current law. Cohorts that are young today or that are yet to join the labor force would benefit greatly from the fully phased-in PRA system, with combined benefits rising from 10 percent more than the benchmark level to 35 percent more than the benchmark level.[31]

The growing excess of the combined benefits relative to the benchmark can be thought of as a cushion against the increasing risk that occurs through time with the increased reliance on the PRA portion of the total, a subject to which we return in section 5.[32] Before doing so, we discuss the provision of government guarantees and then consider several alternatives to the basic plan that we have described in this section.

2.4 *Government-Guaranteed Benefits*

The basic plan would be more attractive to employees if the government guaranteed that each one's combined benefit would be at least as large as the benchmark level projected in current law.[33] With such a guarantee, the person could receive more income than his benchmark benefit if the investment performs better than expected but could not receive less if the investment performs worse than expected.

A guarantee would in effect make future taxpayers responsible for the difference between the benchmark benefit and the actual combined value

[31] It would of course be possible for the social security program to pay higher pay-as-you-go benefits in the earlier years, allowing the Trust Fund to be temporarily in deficit, and then to repay that debt and make the Trust Fund positive before the end of the 75-year forecast period. We do not examine this idea further.

[32] It might also be thought of as compensation for taking the increased risk of greater reliance on the investment-based portion.

[33] That was a feature of the plan that we analyzed in Martin Feldstein and Andrew Samwick, "Two Percent Personal Retirement Accounts: Their Potential Effects on Social Security Tax Rates and National Saving," *Tax Notes*, May 4, 1998, pp. 615–620.

of the pay-as-you-go benefit plus the annuity that would be paid on a *standard investment portfolio.* An individual who invests in such a standard portfolio—e.g., 60 percent of the PRA balance invested in a broad index of stocks like the S&P 500 and 40 percent in a corporate bond index—would receive from the government the difference (if any) between the combined benefit that results from this investment plus the reduced pay-as-you-go benefits and the benchmark level of benefits in current law for that future year.

Even if an individual chooses to invest in a portfolio that is different from the standard one, the government could compensate the individual on the basis of the shortfall that would have occurred if the individual had invested in the standard portfolio. Individuals would thus have the opportunity to be guaranteed to receive the full benchmark level of benefits by investing in the standard portfolio but would not lose the value of that guarantee if they chose a different portfolio.[34]

Calculations by Feldstein and Ranguelova[35] and Feldstein, Ranguelova and Samwick[36] show that the expected cost to future taxpayers of providing such a guarantee would be relatively small. In most years, even after the system is fully phased in, the great majority of individuals in every cohort of retirees would receive combined benefits that exceeded the benchmark benefit, and there would be no need for guarantee payments. The government could spread the cost of any payments that were required over time by borrowing when payments were due and repaying in later years or by establishing a fund for financing future shortfalls when they occurred.

The guarantee might also be made optional, with employees paying a small surcharge on the payroll tax to purchase the guarantee from the government, eliminating any net tax on future employees. In an optional

[34] Basing the guarantee on a standard portfolio would also not induce individuals to take on excessive risk in their portfolios. See Andrew Samwick, "Social Security Reform in the United States," *National Tax Journal* 52(December 1999):819–842, for a further discussion on this point.

[35] See Martin Feldstein and Elena Ranguelova, "Individual Risk and Intergenerational Risk Sharing in an Investment Based Social Security System," NBER Working Paper no. 8639 (1998), available at www.nber.org/papers/W6839. See also Martin Feldstein and Elena Ranguelova, "Individual Risk in an Investment Based Social Security System," *American Economic Review* 91(September 2001):1116–1125, available as NBER Working Paper no. 8074 at www.nber.org/papers/W8074.

[36] The paper by Martin Feldstein, Elena Ranguelova, and Andrew Samwick, "The Transition to Investment-Based Social Security When Portfolio Returns and Capital Profitability Are Uncertain" appears in *Risk Aspects of Investment-Based Social Security Reform,* John Campbell and Martin Feldstein (eds.), Chicago: Chicago University Press (2001) and is available at www.nber.org/papers/w7016.

plan, the form of the guarantee could be tailored to individual preferences. The cost could be reduced by providing less than a 100-percent guarantee.

The appendix to this paper presents a calculation that shows that even when the mixed system is fully phased in and the pay-as-you-go system provides only 60 percent of the benchmark level of benefits, the expected cost to taxpayers of a full benefit guarantee would be about 0.6 percent of payroll. Since the pay-as-you-go benefits would be substantially greater than 60 percent of the benchmark level for retirees during the next several decades, the cost of the guarantee during those decades would be significantly less than 0.6 percent of payroll.

We return in section 5 of this paper to a more general discussion of risk and guarantees. For now, we turn instead to alternatives to the basic plan that do not require individuals to make out-of-pocket contributions to their personal retirement accounts.

3. ALTERNATIVE PLANS WITH NO OUT-OF-POCKET CONTRIBUTIONS

The basic plan described in section 2 should appeal to anyone who believes that his pay-as-you-go benefit will inevitably be reduced along the kind of path described in that section. For someone like that, participating in the basic plan means receiving a dollar-for-dollar match for the out-of-pocket funds contributed to his personal retirement account without having to accept any additional reduction in future benefits.

But what if a person believes that the benchmark level of benefits projected in current law will not be decreased during his lifetime because future Congresses will vote to raise taxes or to borrow? Since the Trust Fund accounting now implies that there are funds available to pay projected benefits through 2038, someone who is 50 years old or older might feel that there is limited risk of any benefit reduction during his life. And since Congress raised taxes in 1983 when the Trust Fund was about to be exhausted in order to allow benefits to remain almost unchanged, employees might well believe that would happen in the future when the Trust Fund was again on the brink of exhaustion.

Such a person might be willing to pay 1.5 percent of his earnings into a PRA in order to receive an equal matching transfer from his payroll tax payments, but might not voluntarily accept a reduction in future pay-as-you-go benefits as part of such a package. Without such a reduction, there would be no improvement in the fiscal condition of social security and therefore no reduction in the need for future increases in social security taxes.

There are of course features of the basic plan that might make it attractive enough to cause people to accept it. The funds accumulated in the PRAs would not be subject to future legislative changes and would be available for bequests and possibly for a lump-sum withdrawal at retirement age. The combined benefit would be projected to be as large as under current law, and there would be the opportunity for greater retirement income if the investments outperform the assumed 5.5-percent real rate of return. With a government guarantee that the combined benefits would at least equal the benefits in current law, the employee would have an upside potential but no downside risk. Nevertheless, it might be only those who regarded the future benefits as either uncertain or sure to be reduced who would voluntarily shift to the basic plan that requires them to contribute 1.5 percent of payroll out of pocket.

The obvious implication is that if the political process is to achieve voluntary acceptance of an option like the basic plan of section 2, it must be made clear in legislation that future benefits will be reduced for all retirees, regardless of whether or not they participate in the plan. If that is done, the attractiveness of the dollar-for-dollar match and the guarantee will induce virtually everyone to participate.

It is not clear, however, that the political process can convincingly deliver the bad news that future pay-as-you-go benefits must be cut for everyone even if that news is combined with a plan that allows people to achieve the original level of benefits by contributing only 1.5 percent of earnings to a PRA. In this section we therefore consider alternative options that achieve the four goals of social security reform without any out-of-pocket payments by current or future employees. Those four goals are: (1) provide the pay-as-you-go benefits promised to existing retirees; (2) maintain the projected level of combined benefits for each future cohort of retirees at or above the level of benefits indicated in current law; (3) avoid any increase in payroll tax rates; and (4) make the Social Security Trust Fund solvent in the sense that it either remains permanently positive (so that the pay-as-you-go benefits can always be financed from the available payroll tax revenue) or borrows for a while but then returns to a growing positive balance that makes it clear that no future increase in the payroll tax will be needed.

The key to achieving these four goals without the out-of-pocket contributions of the basic plan of section 2 is to inject some general revenue into the personal retirement accounts.[37] The official projections of the

[37] This program is thus a combination of the mixed systems that we explored in two of our earlier papers. Martin Feldstein and Andrew Samwick, "Two Percent Personal Retirement

Congressional Budget Office indicate that there are substantial future on-budget surpluses (i.e., budget surpluses excluding those of the Social Security program) that could be used for this purpose after the first few years of a new PRA system. The Congressional Budget Office's *Budget and Economic Outlook* issued in August 2001 projects on-budget surpluses of $108 billion in 2008, rising to $184 billion in 2010. Although the CBO does not provide estimates beyond 2011, these on-budget surpluses would continue to grow for a number of years in the future even if the tax-law provisions that are now scheduled to end in 2011 are continued into the future.[38]

We present two options of this general type. The first option combined a transfer of 2 percent of payroll taxes to personal retirement accounts with an additional 1-percent matching contribution by the government, financed from general on-budget surpluses.[39] The second option enriches the program in the early years by adding an additional $50 billion a year to the PRAs from the on-budget surpluses from 2008 through 2017.

These transfers of on-budget surpluses would reduce the ability of future Congresses and administrations to increase spending or cut personal taxes, i.e., the ability to finance increased public or private consumption. This would be in addition to the reduction of the unified surpluses caused by the transfer of payroll tax revenue to the personal retirement accounts. The transfer of budget funds to the personal retirement accounts would thus increase national saving and the nation's stock of capital. Although we recognize that not every dollar added to the personal retirement accounts constitutes new saving, we continue to assume (as we did in section 2) that the increase in nation's capital stock that does occur leads to additional national income and therefore additional tax revenue equal to at least 1 percent of the assets in the

Accounts: Their Potential Effects on Social Security Tax Rates and National Saving," *Tax Notes*, May 4, 1998, pp. 615–620, dealt with a system in which all PRA deposits came from on-budget surpluses; Martin Feldstein and Andrew Samwick, "Allocating Payroll Tax Revenue to Personal Retirement Accounts to Maintain Social Security Benefits and the Payroll Tax Rate, *Tax Notes*, June 19, 2000, pp. 1645–1652, dealt with a system in which all PRA deposits came from the payroll taxes.

[38] An economic downturn in 2001 and 2002 would temporarily reduce government revenue and budget surpluses, but should not have any significant effect on the long-run surpluses. It is of course difficult to know how much of the projected surpluses might be spent on anti-terrorist activities in both the short run and the more distant future.

[39] Such surpluses are not present during the first few years of the assumed phase-in schedule, but would be available by 2008.

personal retirement accounts. We transfer this additional revenue to the Trust Fund.[40]

The transfer of 2 percentage points of payroll taxes into the PRAs depletes the Trust Fund balances more rapidly than the 1.5 percent assumed in the basic plan of section 2. To balance that faster depletion, we adopt a more rapid and larger cumulative adjustment of future pay-as-you-go benefits to 50 percent of the benchmark level of benefits. The benefit adjustment is slow enough, however, that the projected value of the combined benefits remains greater than the benchmark benefits for each cohort of retirees.

The results of this plan are summarized in Table 4. Column 1 shows the level of pay-as-you-go benefits relative to benchmark benefits for selected birth cohorts, listed by the year in which members of that cohort reach normal retirement age. The reduction is quite slow, with those who reach age 67 in 2020 receiving pay-as-you-go benefits equal to 89.5 percent of the benchmark level. Even those who are now just 38 years old and who will reach age 67 in 2030 would receive pay-as-you-go benefits of 75.5 percent of the benchmark. Only in 2047 does the ratio of pay-as-you-go benefits to the benchmark reach the long-run value of 50 percent.

Column 2 of Table 4 shows that the projected value of the combined benefits exceeds the benchmark level by a slight amount for those cohorts who will retire between now and 2040 and then rises significantly, when the pay-as-you-go share is no longer being reduced, to a projected gain of 18.3 percent in 2060 and 24.8 percent in 2075. These results are very similar to the combined benefits of the basic plan shown in column 7 of Table 3.

The combination of the reduction in pay-as-you-go benefits and the transfer of the new incremental tax revenue equal to 1 percent of the aggregate PRA balances to the Trust Fund is sufficient to keep the Trust Fund solvent. More specifically, the Trust Fund becomes negative in 2030 but starts to repay the borrowing in 2048 and returns to a positive balance after 18 years in 2066. By 2070 the Trust Fund is equal to 13 percent of payroll and rising faster than total payroll, reaching 28.4 percent of payroll in 2075.

The second plan uses some of the projected on-budget surpluses to augment the PRAs during the early years of the transition. More specifically, in each year from 2008 through 2017 an additional $50 billion (at 2001 prices) is transferred into the individual PRAs as a proportional

[40] In section 4 we consider an option in which there is no transfer of the incremental revenue to the Trust Fund.

TABLE 4
Plans with No Out-of-Pocket Contributions

Year	*General revenue equal to 1 percent of payroll*			*General revenue equal to 1 percent of payroll plus $50 billion per year from 2008 to 2017*		
	Reduced pay-as-you-go benefits (Percent of benchmark) (1)	Combined benefits (Percent of benchmark) (2)	Trust Fund balance (Percent of payroll) (3)	Reduced Pay-as-you-go benefits (Percent of benchmark) (4)	Combined benefits (Percent of benchmark) (5)	Trust Fund balance (Percent of payroll) (6)
2005	99.2	100.1	28.9	99.2	100.1	28.9
2010	97.3	100.4	31.3	97.0	100.4	31.4
2020	89.5	100.5	24.8	87.5	100.4	26.2
2030	75.5	100.7	−0.1	72.0	100.7	5.2
2040	58.0	100.6	−24.3	52.5	100.5	−11.8
2050	50.0	110.8	−26.8	50.0	117.3	−4.6
2060	50.0	118.3	−11.9	50.0	121.4	19.3
2070	50.0	119.4	13.0	50.0	119.4	53.0
2075	50.0	124.8	28.4	50.0	124.8	72.7

All estimates are based on the plan described in section 3 of this paper. "Benefits" refers to the average retiree benefit for the cohort reaching the normal retirement age in the specified year.

Source: Authors' calculations based on the projections in the *2001 Social Security Trustees Report.*

supplement to the transfer of payroll taxes. In 2010 for example, this $50 billion of real transfer is approximately equivalent to an additional 1 percent of payroll, or about 0.4 percent of GDP. With more funds going into the PRA accounts, it is possible to reduce the pay-as-you-go benefits more rapidly and still maintain combined benefits that are as large or larger than they were in the first general-revenue option. This is seen by comparing column 4 with column 1. The smaller pay-as-you-go benefits and the larger PRA balances work independently to keep the Trust Fund larger than it would otherwise be. The Trust Fund remains positive until 2033, begins repaying its borrowings in 2043, and returns to a positive level in 2053. As column 6 of Table 4 shows, the Trust Fund borrowing remains relatively small.

As we noted in the introduction, the decision whether to use general revenue in this way or to rely on individual out-of-pocket contributions involves value judgments about who should bear the costs and benefits of the transition to a mixed system and on the ability of the political process to make the reduction of pay-as-you-go benefits for all future retirees an agreed starting place for reform.

4. ALTERNATIVE PLANS WITHOUT GENERAL REVENUE TRANSFERS

The plans examined in sections 2 and 3 all involved some use of general revenue. In section 3, this was an explicit transfer of projected on-budget surpluses to the personal retirement accounts. In both sections, the plans involved a transfer of general revenue equal to 1 percent of the PRA assets to the Trust Fund. Although we have explained in section 2 why we believe that such a transfer is a conservative estimate of the extra revenue that would result from the additional national saving, we are aware that not everyone shares our view about the appropriateness of this transfer. Similarly, there is no general agreement about the appropriateness of using general revenue to supplement the PRA contributions.

In this section we therefore examine what can be done without general-revenue transfers or with very limited transfers. We summarize three options with no general-revenue transfer to the PRAs, plus one that involves a very small amount. These are not put forward as particularly attractive options, but as an indication of the implications of precluding general-revenue transfers.[41]

[41] In the current social security system there is already a transfer of general revenue equal to the income tax collected on the benefits of high-income retirees. That transfer is continued in all of the plans analyzed in the current paper.

In each option, 1.5 percent of taxable payroll is transferred from the payroll tax revenue to the PRAs and is matched by an equal contribution, implying that the PRA saving rate each year is equal to 3 percent of payroll.

4.1 No Transfer of Incremental Tax Revenue: Full Benchmark Benefits

Eliminating the transfer to the Trust Fund of the estimated incremental tax revenue equal to 1 percent of the PRA balances would leave social security insolvent for the 75-year forecast horizon. Without that transfer, the combination of removing 1.5 percent of taxable payroll from the payroll tax inflow and reducing the pay-as-you-go benefits according to the formula described in section 2 causes the Trust Fund to become negative and the negative balance to get larger and larger. The basic plan is too generous to be financed without some general revenue.

One way to avoid insolvency is to reduce the pay-as-you-go benefits, particularly in the more distant future when the projected PRA annuities are very large relative to the benchmark level of benefits. We examine therefore the limiting case in which the pay-as-you-go benefits are reduced at a rate that just balances the growth of the *projected* PRA annuities. This implies that if the real rate of return in the PRA accounts turns out to be the projected 5.5 percent, the combined benefits will just equal the benchmark benefits for each future cohort of retirees. If the real rate of return in the PRA accounts exceeds the projected 5.5 percent, the combined benefits will be greater than the benchmark benefits, and the opposite is true if the rate of return is less than 5.5 percent.

Column 1 of Table 5 shows the benchmark level of pay-as-you-go benefits (in dollars of 2001) for retirees who reach normal retirement age in different years. Column 2 shows the level of PRA annuities for those who reach normal retirement age in those years. The difference between those two columns is the reduction in the pay-as-you-go benefit that would be specified in the reform legislation.

With benefits limited in this way and with no transfer of general revenue to the Trust Fund, the latter becomes negative in 2030 and must borrow in order to keep financing the required level of pay-as-you-go benefits. By 2064, the reductions in the pay-as-you-go benefits are large enough that the payroll tax receipts exceed the sum of the pay-as-you-go benefits and the interest on the Trust Fund's debt. At that point, the Trust Fund begins to repay its liabilities.

Column 3 shows the Trust Fund assets or liabilities as a percentage of taxable payroll for the same selected years. Even at the end of the 75 years, the Trust Fund is still in deficit. The deficit is however shrinking

TABLE 5
Alternative Plan with No General Revenue Transfer

Year	*Average retiree benefit for cohort reaching the normal retirement age in the specified year*		Trust Fund balance by calendar year (2001 $billion) (3)
	Current-law Benchmark (2001 $) (1)	PRA annuities (2001 $) (2)	
2005	10,550	90	1,372.3
2010	11,790	370	1,684.1
2020	12,840	1,420	1,615.9
2030	14,310	3,600	−28.2
2040	15,300	6,520	−2,570.1
2050	17,130	10,420	−4,535.7
2060	19,540	13,350	−5,374.6
2070	21,190	14,690	−5,143.4
2075	21,870	16,360	−4,547.4

Estimates relate to the plan described in section 4 that maintains full benchmark benefits with no transfer of general revenue to the Trust Fund. Estimates in column 3 assume that the Trust Fund borrows to pay current obligations after it is depleted and repays when receipts exceed required payments.

Source: Authors' calculations based on the projections in the *2001 Social Security Trustees Report.*

rapidly and at an accelerating rate. Although our model cannot project beyond 2075 because of the limits imposed by the social security data on which we base our calculations, extrapolation suggests that the system could get back to full solvency by about 2090 or before.

Although this does combine the benchmark level of benefits and the eventual long-run solvency of the system, it does so by making the combined benefits in the long run depend overwhelmingly on the PRA annuities with only a small role for the pay-as-you-go benefits. In 2050, for example, the PRA annuities are projected to be $10,420, or 61 percent of the current-law benchmark benefits of $17,130. The pay-as-you-go benefits for that year would be set in advance at the difference between these two amounts, $6,710, or only 39 percent of the benchmark.[42]

[42] We emphasize that the level of pay-as-you-go benefits for each future year is set in advance and does not depend on the actual level of PRA annuities. It would of course be possible to set the pay-as-you-go benefits to fill the gap that exists *ex post* between the PRA annuities and the benchmark benefits, as we did in Martin Feldstein and Andrew Samwick, "Allocating Payroll Tax Revenue to Personal Retirement Accounts to Maintain Social Security Benefits and the Payroll Tax Rate," *Tax Notes,* June 19, 2000, pp. 1645–1652. That would provide a government guarantee that individual combined benefits could not be less than they are under current law. We return to the issue of risk and guarantees in section 5 below.

4.2 No Transfer of Incremental Tax Revenue: 97.25 Percent of Full Benchmark Benefits

A small adjustment in the level of the combined benefits can avoid the 75-year insolvency of the social security system. Reducing the pay-as-you-go benefits of all cohorts that retire in 2004 and beyond by enough to cut the combined benefits by 2.75 percent of the benchmark level makes the system solvent within the 75 years. This reduction means that the projected value of the combined benefits is 97.25 percent of the full benchmark benefits.

With this small reduction in projected benefits, the Trust Fund must borrow to pay the pay-as-you-go benefits in the years 2032 through 2055 but then begins to repay its borrowing. The Trust Fund returns to a positive balance in 2075, and the payroll tax receipts then exceed the pay-as-you-go benefits, implying that the Trust Fund will continue to rise after that date.

The reduction of 2.75 percent is the smallest reduction consistent with bringing the Trust Fund back to a positive balance by 2075. A larger reduction would of course bring about balance at an earlier date.

4.3 No Transfer of Incremental Tax Revenue: Full Benchmark Benefits and Payroll Tax Surcharge

An alternative to reducing benefits is to add a small surcharge to the payroll tax. An increase of just 0.30 percentage points for the 75 years, raising the overall OASDI rate from 12.4 to 12.70 percent, would achieve 75-year solvency (defined, as above, as a positive and growing Trust Fund in 2075) while making the projected value of the combined benefits equal to the benchmark level in current law.

With this small infusion of extra revenue, the Trust Fund must begin borrowing in 2034 but can start repaying in 2055 and would fully repay its borrowing by 2075. At that point, the Trust Fund balance would be permanently growing without the 0.30-percent additional payroll tax revenue.

4.4 A Small Transfer of Incremental Tax Revenue Equal to 0.23 Percent of PRA Balances

The basic plan examined in section 2 involved a general revenue transfer equal to 1 percent of PRA balances. While we regard that as a conservative estimate of the additional revenue that results from the "1.5 percent plus 1.5 percent" basic PRA system, we have estimated the minimum transfer that permits the combined benefits to equal the benchmark benefits for each retiree cohort while maintaining 75-year solvency.

The answer is a general-revenue transfer of 0.23 percent of PRA balances. In 2030, PRA balances are 125 percent of taxable payroll and therefore about 50 percent of GDP. A general revenue transfer equal to 0.23 percent of these balances would be only one-third of one percent of taxable payroll and about one-eighth of one percent of GDP. Even in 2075, when the PRA balances are 291 percent of taxable payroll, the revenue transfer would be only three-fourths of one percent of taxable payroll.

With this transfer, the combined benefit can be kept at the benchmark level for each cohort of retirees. The Trust Fund becomes negative in 2032 and begins repaying in 2053. The borrowing is fully repaid by 2075.

5. RISK AND GUARANTEES[43]

In this section we return to the issue of the risk that is inherent in investment-based accounts that we discussed in section 2.4 and consider how that risk can be reduced by guarantees that do not put a potential burden on future taxypayers. We focus on the basic plan of section 2, but the same logic applies also to the general-revenue-financed plan of section 3.

The first point to emphasize is that all of the plans described in this paper are for mixed systems and not for pure investment-based plans. During the first few decades, the overwhelming majority of benefits in each year is financed by payroll taxes on a pay-as-you-go basis and is therefore not exposed to market risk. In the basic plan, it takes nearly 50 years before the investment-based portion of benefits is as large as the pay-as-you-go portion. Even after 75 years, the pay-as-you-go benefits provide 60 percent of the benchmark level of benefits and more than 40 percent of the combined benefits from the two sources.

Someone who is 40 years old in 2003 would reach normal retirement age in 2030. For such an individual, the reduced pay-as-you-go benefits would still be 75 percent of the benchmark level projected in current law. The investment risk only affects the remaining portion of the benchmark benefit. If the entire PRA account were totally lost—an investment outcome that is hard to imagine—the individual would still receive 75 percent of the benefits projected in current law.

Because of the growth of real wages, the real level of benefits of future retirees will continue to grow despite the reductions in the pay-as-you-

[43] This section draws on analyses presented in John Campbell and Martin Feldstein, *Risk Aspects of Investment-Based Social Security Reform*, Chicago: Chicago University Press (2001).

go benefit implied by the formula described in section 2.[44] The average retiree reaching normal retirement age in 2003 is projected to receive annual benefits of $10,170 (in 2001 dollars). Because each individual's benefits are indexed to the Consumer Price Index after retirement, they retain their real value throughout the individual's retirement. The average benchmark benefit per retiree is projected to grow over time with each new cohort of retirees as real wages rise. But even with the reduction, the actual pay-as-you-go benefit would *rise* from $10,170 in 2003 to $10,880 in 2030 (in 2001 dollars). It would temporarily decline after that, but only to a low of $9,250 in 2041 (a decrease of 9 percent from the initial level) and would then begin rising again. By 2060 the average new retiree would receive pay-as-you-go benefits of $11,730, and by 2075 it would be $13,120 (a real increase of 29 percent). These figures on the real "reduced" pay-as-you-go benefit are shown in column 1of Table 6.

These pay-as-you-go benefits are what the individual would receive in the totally improbable case in which the PRA investments became completely valueless. With the 5.5-percent real return that we used in the calculations of section 2, the combined benefits would be the amounts shown in column 2 of Table 6 in dollars of 2001 and in column 3 as a percentage of the benchmark benefit. The combined benefits rise from $10,170 in 2003 (when no PRA benefits are paid) to $14,480 in 2030, $20,700 in 2050, and $29,480 in 2075, a 35-percent increase over the benchmark benefit.

Any calculation that assumes that all of the investment in personal retirement accounts is lost (column 1) is obviously absurdly pessimistic. We regard the 5.5-percent real return as a conservative estimate of what is likely to happen. The actual returns could be higher or lower. In the remainder of this section, we look at the implications of the uncertainty about the rate of return and how the risk might be reduced.

5.1 *Implications of Past Volatility*

Past experience with the volatility of stock and bond returns provides a basis for assessing the potential risk of a mixed system. In the next 20 years, the mixed system is almost all still pay-as-you-go with the reduced pay-as-you-go benefits equal to more than 85 percent of benchmark level for each new cohort of retirees. For those retirees, the investment risk is clearly very small. To focus on the maximum-risk case,

[44] Recall that the pay-as-you-go benefit is reduced from the benchmark level in current law by 0.3 percent per year for each year that individuals participate between 2003 and 2007, by 0.6 percent per year of participation for the next six years, by 0.9 percent per year for the next five years, by 1.2 percent per year for the next six years, and then by 1.5 percent per year up to a cumulative maximum of 40 percent.

TABLE 6

Combined Benefits with Different Investment-Based Rates of Return

	Benefits							
		PRA return = 5.5%		*PRA return = 3.5%*		7.5%	*PRA return = 6.5%*	5.0%
Year	Pay as you go (No PRA annuity) (2001 $) (1)	2001 $ (2)	Percent of benchmark (3)	2001 $ (4)	Percent of benchmark (5)	(Percent of benchmark) (6)	(Percent of benchmark) (7)	(Percent of benchmark) (8)
2005	10,480	10,570	100.2	10,550	100.0	100.3	100.3	100.2
2010	11,470	11,840	100.4	11,760	99.8	101.1	100.8	100.3
2020	11,450	12,870	100.2	12,450	97.0	104.6	102.2	99.3
2030	10,880	14,480	101.2	13,110	91.6	116.3	107.9	98.3
2040	9,330	15,850	103.6	12,810	83.7	140.4	119.2	97.4
2050	10,280	20,700	120.8	15,310	89.3	186.9	147.8	110.6
2060	11,730	25,080	128.3	18,050	92.3	205.0	159.5	116.6
2070	12,710	27,400	129.3	19,640	92.7	207.8	161.2	117.4
2075	13,120	29,480	134.8	20,890	95.5	218.7	168.9	122.0

All estimates relate to the basic plan described in section 2 of this paper.

Source: Authors' calculations based on the projections in the *2001 Social Security Trustees Report.*

consider what happens after 2040 when the mixed system is fully phased in and the pay-as-you-go portion is reduced to 60 percent of the benchmark benefits. Before that, the pay-as-you-go benefits are relatively larger and the risk is correspondingly less.

Calculations by Feldstein and Ranguelova[45] imply that there is less than one chance in five that the combined annuity payable at age 77, i.e., the sum of the pay-as-you-go benefit and the PRA annuity, would be less than 100 percent of the benchmark benefit.[46] Equivalently, the odds are more than four to one that the combined benefit will actually exceed the benchmark benefit projected in current law. Similarly, the analysis implies that there is less than one chance in ten that the combined benefits would be less than 83 percent of the benchmark, and less than one chance in 100 that they would be less than 69 percent of it.

5.2 *Alternative Rates of Return*

An alternative way of assessing the extent of risk in the mixed system is to calculate the combined benefit that would result if the individual received substantially less than the 5.5-percent real rate of return each year on PRA balances. Column 4 of Table 5 shows the combined benefit (i.e., the pay-as-you-go benefit plus the PRA annuity) under the basic plan that would result if the real rate of return were only 3.5 percent instead of the 5.5 percent used in our other calculations. Such a low rate of return is an extremely conservative assumption for a portfolio that consists of 60 percent stocks and 40 percent corporate bonds. A 3.5-percent real return

[45] Martin Feldstein and Elena Ranguelova, "Individual Risk in an Investment-Based Social Security System," *American Economic Review* 91(September 2001):1116–1125, available as NBER Working Paper no. 8074 at www.nber.org/papers/W8074.

[46] The figures in Table 1 of Feldstein and Ranguelova show the probability distribution of the annuity level that would result from a PRA saving rate of 6 percent of taxable payroll with no additional pay-as-you-go benefits. That distribution indicates that there is an 80-percent probability that the PRA annuity at age 77 would exceed 84 percent of the benchmark benefit. Dividing the 6-percent PRA saving rate in half implies that, with a PRA saving rate of 3 percent of taxable payroll, there is an 80-percent probability that the PRA annuity at age 77 would exceed 42 percent of the benchmark benefit. Feldstein and Ranguelova's analysis made no provision for bequests. Allowing for preretirement bequests of the accumulated PRA assets and for a 10-year certain life annuity at normal retirement age reduces the PRA annuity by 19 percent. This implies that the 42 percent of benchmark benefits is reduced to 34 percent. This is for a system with no pay-as-you-go benefit. With a pay-as-you-go benefit equal to 60 percent of the benchmark benefit, the combined level is 94 percent of the benchmark. Since Feldstein and Ranguelova's calculations also use part of the PRA fund to finance disability benefits, the implication is that there is an 80-percent probability that the combination of the pay-as-you-go benefit and the PRA annuity will be substantially greater than 100 percent of the benchmark OASI benefit. For further details, see also the Appendix to the current paper.

over a lifetime of investing corresponds to approximately the 14th percentile in the distribution of rates of return, i.e., based on the experience in the 50 years from 1946 to 1995, the odds are six to one that the actual return would exceed 3.5 percent. A 3.5-percent real rate of return is also the rate of return that is available on the riskless Treasury Inflation Protected Securities (TIPSs) issued by the U.S. government.[47]

With a 3.5-percent real rate of return on the PRA assets, someone who reaches normal retirement age in 2022 (i.e., today's 45-year-old) would receive combined benefits equal to 96 percent of the benchmark level of benefits. Even when the real value of the reduced pay-as-you-go benefit reaches its lowest level (in 2041), the new retiree (today's 27-year-old) would receive 83 percent of the benchmark benefit. The real value of the combined benefit ($12,820) would then be 30 percent higher than the real value of the average benefit now. After that the shortfall from the full benchmark benefit declines; in 2060, for example, the very low 3.5-percent real rate of return produces a combined benefit equal to 92 percent of the benchmark level. These figures are shown in columns 4 and 5 of Table 6. The Trust Fund remains solvent in this case, but must borrow from 2036 to 2051. It then begins repaying and returns to a positive value in 2074 and is both positive and growing in 2075.

The uncertain distribution of rates of return is symmetric, the return is as likely to be 2 percent higher than the 5.5 percent rate of return as it is to be 2 percent lower. To indicate this upside potential, we show in column 6 of Table 6 the combined benefits (relative to the benchmark) with a real return of 7.5 percent. During the first 20 years of the new program, there would be little difference between the combined benefits with the 5.5-percent real return and the 7.5-percent real return. After that, the combined benefit based on the 7.5-percent rate of return would rise rapidly, reaching 140 percent of the benchmark level in 2040, 187 percent in 2050, and more than 200 percent by the late 2050s.

As we noted above, a portfolio of 60 percent stocks and 40 percent bonds produced a real mean return of 6.9 percent during the period 1946 through 1995. We converted this into our assumed mean return of 5.5 percent by subtracting 0.4 percent for administrative costs and an additional 1 percent as a margin of safety. Alternative mixtures of stocks and bonds would produce higher and lower rates of return after similar adjustments.

[47] TIPSs are bonds issued by the U.S. Treasury that adjust the interest payment and the principal for changes in the consumer price index during the life of the bond. A person who invests now in a 20-year TIPS is guaranteed by the federal government to get a real return of 3.5 percent.

A 6.5-percent rate of return (see column 7 of Table 6) produces combined benefits that are better in every year than the 5.5-percent case, but the difference only becomes substantial after about 30 years. With the 6.5-percent return, the Trust Fund is always positive and is rising substantially at the end of the 75-year forecast period.

The results for the 5.0-percent rate of return (shown in column 8 of Table 6) show that some cohorts would receive less than the benchmark level of benefits but the difference would be very small. The group with the largest reduction is those who reach normal retirement age in 2040. Their projected combined benefits are 97.4 percent of the benchmark level. The Trust Fund would be solvent; it would have a negative value between 2039 and 2050, but would then be positive and rising.

We have also examined the effect of ignoring the incremental revenue and making no transfer to the Trust Fund from general revenue. Section 3 showed that with a 5.5-percent real return the system could have 75-year solvency (i.e., would return to a positive and growing Trust Fund balance within 75 years) by reducing benefits for all future retirees by 2.75 percent to 97.25 percent of the benchmark level or by increasing the payroll tax rate by 0.30 percentage points from 12.4 to 12.7 percent, or by some combination of parts of both those changes. If the real return is only 5 percent, achieving 75-year solvency with no transfer of general revenue to the Trust Fund could be achieved by reducing benefits for all future retirees by 7 percent (to 93 percent of the benchmark level) or by raising the payroll tax rate by 0.75 percentage points (from 12.4 to 13.15 percent).

5.3 Real-Principal Guarantees

In section 2.4 we discussed the idea of a government guarantee that the combined benefits would be at least as large as the benchmark level for each generation. We noted that the government might either provide such a guarantee or sell it to those who were willing to pay for the protection.

A simple alternative form of guarantee that we find attractive is an optional PRA *real-principal guarantee* in which the individual is guaranteed that the value of the PRA account at normal retirement age will be at least as large as the sum of all the deposits made to that account. Stated differently, the individual would be guaranteed not to lose any of the real value of the money put into the account.

To take a simple example, consider someone whose *real* income (in 2001 dollars) rises from $25,000 at age 21 to $70,000 at age 66 in $1,000 annual increments. With the basic 3-percent ("1.5 percent plus 1.5 percent) plan, such a person would save $65,500 in his PRA over those

years. The real-principal guarantee would promise that he would have at least $65,500 (in 2001 dollars) in his account at age 67.[48]

To make this option available to everyone, the government could require any financial institution (mutual fund, insurance company, or bank) that wanted to provide PRA investment accounts to offer the option. Each individual would be free to decide whether or not he or she wanted to choose the guarantee option.

To provide such a guarantee without exposing itself to any risk, the financial institution could invest a fraction of the PRA saving in zero-coupon TIPs.[49] To see how this would work in practice, consider a 40-year-old who earns $50,000. Under the basic plan, the individual would transfer $750 of his payroll tax to a PRA account and add a $750 out-of-pocket contribution, for a total of $1,500. To guarantee that at least the same real $1,500 would be there 27 years later when the individual reached age 67, the financial institution that provides the PRA account would invest enough of the $1,500 in a zero-coupon TIPS to provide a $1,500 real payment after 27 years. Since long-term TIPSs have a real yield of 3.5 percent (and a very flat yield curve), we can estimate that the required investment in the TIPS would be $1500 $(1.035)^{-27}$ = $593. The financial institution could therefore invest $593 in the TIPS and the remaining $907 in stocks, confident that the value of the TIPS at age 67 would be $1500 and therefore that the real value of the PRA balance corresponding to the saving at age 40 would be $1500 plus the value to which the $907 invested in stocks had grown.[50]

During the half century from 1946 to 1995, the real return on the Standard & Poor's index averaged 8.4 percent.[51] If we subtract 40 basis points for administrative costs, the equity return would be 8.0 percent. With $953 of the $1500 invested in a TIPS with a yield of 3.5 percent and $907 invested in equities with an expected yield of 8.0 percent, the

[48] If the individual is 21 in 2003 and the inflation is 2 percent a year over his working life, the real-principal guarantee at age 67 would be $163,000 in the dollars of 2049.

[49] The Treasury now only issues TIPSs with interest coupons, but the financial sector could easily strip these bonds to create a zero-coupon TIPS as it has for ordinary Treasury bonds. (The remaining interest-payment inflation guarantees could then be combined with corporate bonds to provide an attractive security that has substantial but partial inflation protection and the higher yield associated with corporate risk). Alternatively, the Federal government could itself issue zero-coupon TIPSs as part of its ordinary debt management.

[50] In practice, the financial markets might provide a way of "packaging" such TIPS-based protection to PRA providers. The net effect however would be the same as if each PRA account were invested in the appropriate mix of stocks and bonds.

[51] The real logarithmic return was 7.0 percent with a standard deviation of 16.6 percent, implying the real level return of 8.4 percent.

overall expected real rate of return for such a 40-year-old would be 6.2 percent. The expected accumulation in this mixed account would therefore be slightly more than $7500, of which the real principal of $1500 would be fully guaranteed.

Younger employees would have a higher fraction of their PRA deposits invested in stocks, and older ones a lower fraction. For example, guaranteeing the value at age 67 of a 25-year-old's PRA deposit would require investing only 23.5 percent of the PRA deposit in TIPSs, providing an overall stock–bond expected return of 6.9 percent. For a 55-year-old, the TIPSs would be 66 percent of the PRA deposit, implying an overall expected rate of return of 5.0 percent.[52]

Since the overall rate of return in the PRA with a real-principal guarantee would decline from about 7 percent to 3.5 percent at age 66, the overall lifetime rate of return (taking into account the number of years for which funds would be invested) would not be very different from the 5.5 percent assumed in our basic calculations, with the exact expected rate of return for each individual depending on the time path of that individual's earnings. The expected PRA benefits with such a guarantee would therefore not be significantly different from the benefits that we examined without such a guarantee, but with a constant 60 : 40 mixture of stocks and bonds.

The real-principal guarantee is an attractive option to require financial institutions to offer, because it is easy for PRA participants to understand and easy for the financial institutions to provide without incurring any risk themselves. Financial institutions might also offer more complete guarantees in which individuals accept a lower rate of return in exchange for a guaranteed level of benefits. One way for individuals to pay for such guarantees would be by trading some of the potential benefits in excess of the benefits that could be achieved with the riskless rate of return of 3.5 percent (shown in column 4 of Table 5) for a guarantee that the benefits or the implied rate of return will not be below some floor. Feldstein and Ranguelova[53] explore such a *collar* option[54] and show conditions under which it would be possible to purchase the benchmark

[52] This pattern of gradually shifting the investments from a large percentage in stocks to a large percentage in the inflation-protected government bonds is consistent with the philosophy of life-cycle funds in private defined-contribution plans.

[53] Martin Feldstein and Elena Ranguelova, "Accumulated Pension Collars: A Market Approach to Reducing the Risk of Investment-Based Social Security Reform," in *Tax Policy and the Economy, 2000*, Cambridge, MA: MIT Press (2001). This is also available as NBER Working Paper no. 7861 at www.nber.org/papers/w7861.

[54] The option is called a "collar" because it places both upper and lower limits on the amount that the individual would receive.

level of benefits in every year by giving up some portion of the potential return above that level.[55]

6. LUMP-SUM BENEFITS

Our analysis throughout this paper has assumed that individuals receive benefits in the form of a mandatory variable life annuity. This guarantees that the PRA portion of the combined benefits will be spread out over the entire retirement years. By making the annuitization mandatory, the problem of self-selection is virtually eliminated. And by using or permitting a variable annuity, the individual is able to continue to obtain the same expected high real rate of return during retirement that he earned during the preretirement accumulation years.

There are of course alternative possibilities for the options that could be offered to persons at age 67. They might be allowed to take the all or part of the accumulated principal in the PRA as a lump sum, spending it as they want. Some might want to buy a retirement home, or invest in a post-retirement business, or use it to finance education for a grandchild or a gift to children or others. Because individuals would still have the pay-as-you-go benefits, even those who choose to spend or give away the entire accumulation would still have a significant level of retirement benefits (shown in column 1 of Table 5 for the basic plan).

Alternatively, retirees might be permitted to withdraw principal funds from their PRA at age 67 as long as the amount that remains is sufficient (with a 5.5-percent real return) to finance combined benefits equal to the benchmark level or to some fraction like 90 percent of that level.

We do not explore these options in detail, but only comment on the size of the fund that would be accumulated at age 67 by the different age cohorts. With the basic "1.5 plus 1.5" PRA plan, an average retiree who reaches normal retirement age in the year 2030 (and therefore has had 27 years of accumulation) would have a projected PRA balance of $42,550 (in 2001 dollars). For someone who reaches normal retirement age in 2050, and has therefore participated in the PRA throughout his working life, the accumulated PRA balance would be $136,540 (in 2001 dollars). These reflect real rates of return in the PRA accounts of 5.5 percent.

[55] Feldstein and Ranguelova's paper shows that in principle it is possible with traditional Black–Scholes option values to buy a complete guarantee against getting less than the benchmark level of benefits by giving up only part of the above-benchmark potential return. On this idea of using derivatives to protect the value of pension benefits, see the very useful paper by Zvi Bodie, "Financial Engineering and Social Security Reform," in *Risk Aspects of Investment-Based Social Security Reforms*, John Campbell and Martin Feldstein (eds.), Chicago: University of Chicago Press (2001).

7. CONCLUSION

This paper examines a variety of alternative mixed social security systems that combine traditional pay-as-you-go defined benefits with investment-based defined-contribution PRAs. The funds going to the PRA come from a combination of existing payroll tax payments and either voluntary individual out-of-pocket contributions or transfers from general revenue.

In the primary options that we examine, the projected level of combined benefits for each future cohort of retirees equals or exceeds the benefits projected in current law. We discuss the issue of risk, present estimates of the cost of guarantees, and outline ways that guarantees could be provided at no cost to taxpayers. We analyze the sensitivity of our results to different rates of return and to different assumptions about the funding sources and the transfers of general revenue to the Trust Fund and the PRAs.

In all of the options that we examine, the Social Security Trust Fund remains solvent. Even when it is temporarily negative and forced to borrow, the Trust Fund returns to a positive balance and is increasing faster than payroll at the end of the 75-year period of Social Security actuarial projections.

All of the options that we examine have the following features:

1. The PRA funds are invested in a portfolio of stock and bond mutual funds. At normal retirement age, the accumulated fund is used to purchase a variable annuity invested in the same mix of stocks and bonds.
2. The traditional pay-as-you-go benefits that are financed by the payroll tax are reduced for retirees in a way that depends on how many years they participate in the PRA system or are eligible to participate in the system.
3. There is no change in benefits for those who are now retired or who will retire in the near future.
4. The disability program is kept separate and financed on a pay-as-you-go basis.
5. Personal retirement account (PRA) balances can be bequeathed to anyone if the individual dies before normal retirement age.
6. The PRA annuity that begins at normal retirement age continues for at least 10 years even if the retiree dies during this period.
7. The survivor and dependent portions of the OASI program continue in addition to the bequest and 10-year certain features.

Table 7 summarizes some of the key features and results of the principal options that we have considered. We hope that this analysis will be helpful to those who now have the important responsibility of reforming the social security system.

APPENDIX: THE COST OF A BENEFIT GUARANTEE

This appendix presents a simple calculation of the expected cost to future taxpayers of providing a guarantee that the combined benefits in the basic plan of section 2 will exceed the benchmark level of benefits projected in current law. The cost of such a guarantee depends on the level of pay-as-you-go benefits and on the riskiness of the PRA annuity.

During the early decades, while the new mixed system is being phased in, the pay-as-you-go benefits are a larger fraction of the benchmark benefits than they will be when the former have been reduced to the feasible long-run share of the latter. In this appendix, we focus on the long run when the pay-as-you-go benefits are reduced to 60 percent of the benchmark level.

The riskiness of the PRA portion depends on the composition of the investment.[56] We assume that the individual invests in a portfolio of 60 percent stocks (represented by the mean and standard deviation of the return on the Standard & Poor's index from 1946 to 1995) and on the mean and standard deviation of a corporate bond index.[57] We assume further that the same investment is the basis for a variable annuity that is purchased when the individual reaches normal retirement age. The uncertainty of the annuity payments increases as the individual ages, since the funds are invested for a longer period of time. We focus on the potential experience of 77-year-old retirees as representative of an average or somewhat older than average retiree.

The calculations by Feldstein and Ranguelova[58] provide a cumulative probability distribution of variable annuity payments as a fraction of the

[56] Recall our discussion in section 2.4 that the guarantee can be extended to those who invest in a portfolio that is different from the standard one by compensating them on the basis of the shortfall that would have occurred if they had invested in the standard portfolio. They would thus have the opportunity to be guaranteed to receive the full benchmark level of benefits by investing in the standard portfolio but would not lose the value of that guarantee if they chose a different portfolio.

[57] Our procedure also reflects the fact that the future mean return is itself uncertain. The uncertainty of future returns thus reflects the mean uncertainty as well as the annual volatility.

[58] Martin Feldstein and Elena Ranguelova, "Individual Risk in an Investment-Based Social Security System," *American Economic Review* 91(September 2001):1116–1125, available as NBER Working Paper no. 8074 at www.nber.org/papers/W8074.

TABLE 7
Summary of Principal Alternatives Examined in this Paper

PRA funding (Percentages of taxable payroll)	Annual transfer to Trust Fund	Rate of return (%)	Trust Fund solvency	Trust Fund borrowing	Benefits relative to the benchmark	Section of the paper
1.5% from payroll tax 1.5% out-of-pocket	1.0% of PRA assets	5.5	Yes	None	All cohorts > 100%	2
Same	Same	5.0	Yes	2039–2045	All cohorts > 97% All cohorts before 2015 or after 2043 > 100%	5.2
Same	Same	3.5	Yes	2036–2051	All cohorts > 83% All cohorts before 2033 or after 2055 > 90%	5.2
2.0% from payroll tax 1.0% from general revenue	Same	5.5	Yes	2030–2048	All cohorts > 100%	3

2.0% from payroll tax 1.0% from general revenue $50 billion per year, 2008–2017	Same	5.5	Yes	2033–2042	All cohorts > 100%	3
1.5% from payroll tax 1.5% out-of-pocket	None	5.5	Yes, by 2090	2030–2063	All cohorts = 100%	4.1
Same	None	5.5	Yes	2032–2055	All cohorts = 97.25%	4.2
Same	0.30% of payroll	5.5	Yes	2034–2054	All cohorts = 100%	4.3
Same	0.23% of PRAs	5.5	Yes	2032–2054	All cohorts = 100%	4.4
Same	None	5.0	Yes	2036–2055	All cohorts = 93%	5.2
Same	0.75% of payroll	5.0	Yes	2040–2055	All cohorts = 100%	5.2

benchmark social security benefits for a 77-year-old retiree who has saved 6 percent of his payroll earnings during his working life and retired at age 67. Feldstein and Ranguelova's calculations do not provide any adjustments for bequests. The relevant part of the probability distribution shown in those papers is:

Cumulative probability	Annuity as fraction of benchmark with 6% saving
0.01	0.21
0.02	0.26
0.05	0.39
0.10	0.56
0.20	0.84
0.30	1.16

With a 3-percent saving rate, the annuity at each probability level would be half of these levels. The payment of bequests and the 10-year certain annuity feature assumed in the basic plan reduces the remaining amount by an additional 19 percent. The cumulative probability distribution of the available annuity is therefore:[59]

Cumulative probability	Annuity as fraction of benchmark with 3% saving and bequests
0.01	0.085
0.02	0.105
0.05	0.158
0.10	0.227
0.20	0.340
0.30	0.470

These probabilities imply that with a fully phased-in mixed system in which the pay-as-you-go benefits provide 60 percent of the benchmark benefits, the probability distribution of the combined benefits associated with a 3-percent saving rate and the corresponding distribution of guarantee payments would be:

[59] Feldstein and Ranguelova's calculations did not provide separately for disability benefits. Since the current analysis continues to fund the disability benefits on a pay-as-you-go basis, the PRA funds available for the OASI benefits would be substantially greater than this distribution implies. This implies that the current analysis overstates the cost of providing the guarantee.

Cumulative probability	Combined annuity as fraction of benchmark	Guarantee payments as fraction of benchmark
0.01	0.685	0.315
0.02	0.705	0.295
0.05	0.758	0.242
0.10	0.827	0.173
0.20	0.940	0.060
0.30	1.070	0.000

The remainder of the probability distribution is associated with combined benefits that exceed the benchmark and therefore that do not require any guarantee payment. To be conservative, we calculate the expected guarantee payment by using the midpoint of each interval except the first and last, a technique that overstates the true expected payment. We also estimate the guarantee payment associated with the first percentile by assuming that there is a probability of 0.005 of a full guarantee payment of 0.40 of benchmark (implying that the PRA annuity is worthless) and a probability of 0.005 of a guarantee payment that is halfway between this 0.40 percent of benchmark and the 0.315 percent of benchmark at the 0.01-percent cumulative probability level. For the interval between cumulative probabilities of 0.20 and 0.30, we estimate that the combined annuity is equal to the benchmark at a cumulative probability of 0.25; we then estimate the payment in the interval between 0.20 and 0.25 as the midpoint between 0.06 and zero.

Proceeding in this way, we have the following probabilities and guarantee payments expressed as a fraction of the benchmark level of benefits:

Probability	Guarantee Payment
0.005	0.400
0.005	0.358
0.01	0.305
0.03	0.268
0.05	0.208
0.10	0.116
0.05	0.030

The expected guarantee payment is the sum of the products of the probability and the guarantee payment, implying an expected guarantee payment of 3.84 percent of the benchmark.[60,61]

[60] A similar calculation implies that the cost for a 67-year-old would be 1.94 percent of the benchmark level of benefits.

[61] Note that this is the expected value of the cost, i.e., the average value over a large number of years. It does not include any extra cost for bearing risk. As noted above,

Using the Social Security Actuaries' estimates that the net cost of the full benchmark benefit would be 15.9 percent of payroll[62] implies that an expected guarantee payment equal to 3.84 percent of the benchmark benefit corresponds to 0.61 percent of payroll. We stress again that this is in the long run when the pay-as-you-go benefits are reduced to only 60 percent of the benchmark. The cost of the guarantee would be less before the pay-as-you-go benefits reach this level.

however, the government spreads this risk over a large number of taxpayers and, by borrowing, can spread it over future taxpayers as well as those who are alive at the time that the funds are needed.

[62] See footnote 7 of the main text. As explained there, this 15.9 percent is net of the estimated personal income recapture of social security benefits.