Partial Privatization of Social Security: A Simulation of Possible Outcomes and Risks to Workers

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Abstract

Social Security reform as put forward by the President's Commission on Strengthening Social Security (2001) includes three model proposals each of which contain voluntary privatized accounts. Opting for private savings incurs the penalty of losing benefits that accrue in a set-aside account. Three simulations were run using Monte Carlo simulation based on historical distributions of stock and bond returns. These simulations projected end-of-period savings under different market conditions for Model 2, the only model projecting elimination of Social Security deficits. In all cases the average privatized account accumulations were greater than the set-aside benchmark account; however, the probability of falling below the set-aside account's lost benefits range from a low of 13% to a high of 30%. The considerable probability of failing to exceed a lost-benefits account will be an important consideration for workers in determining whether or not to exercise the option to participate. © 2003 Academy of Financial Services. All rights reserved.

1. Introduction

The report of the President's Commission (2001) on Strengthening Social Security proposes three models for reform, each of which includes a personal savings account that could be invested in a variety of securities, including corporate and treasury bonds as well as equities. Personal savings accounts build on the earlier proposals of the Federal Advisory Social Security Council (1997), which included two proposals with personal accounts (PAs). The President's Commission's version of PAs offers an option to participate, unlike the required participation of the previous proposed plans. The present value cost of underfunded

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Social Security (SS) obligations are approximately $3 trillion (Shrieber & Shoven, 1999). Partial or even full privatization will not make up that shortfall, but it could help. The size of the deficit depends on assumptions made. For example, if immigration is higher than anticipated or economic growth exceeds the assumptions made, then the deficit could be a surplus.

The choice of investment vehicles for a PA would vary and could range from index funds to a much wider selection of investments. Alternatively, a portion of payroll taxes could simply be allocated to private security accounts by the government without individualized accounts, under the assumption that returns would be greater than those afforded by the current Social Security Trust (SST) fund. Currently the SST earns an imputed 5.9% rate of return on surplus funds (Niggle, 2000), subject to change with government borrowing conditions. The government, by spending surpluses, is essentially borrowing from itself at the imputed SST rate of interest and in effect creating obligations to the SST. A SS deficit is compiled that will need to be repaid out of general revenues, and/or increased payroll taxes, and/or cuts in benefits. To avoid further buildup of these obligations, some type of privatization scheme that assumes greater returns to workers than implied under the current system could make it economically and politically feasible to reduce benefits.

Under the Social Security Administration's (SSA) most-likely-scenario assumptions put forward in the President's Commission's report, SS benefit payments are projected to exceed payroll taxes by 2016 with an anticipated deficit of $318 billion by 2035 (President's Commission, 2001). Without a major increase in taxes, cuts in benefits, or a complete overhaul of the benefit programs, actual benefit payments would have to fall to just 74% of promised benefits by 2038 to accommodate the discrepancy between SS tax collections and payments.

If taxes alone were to be increased to eliminate the shortfall instead of implementation of privatized savings reforms, then rates would need to be increased from the current 12.4% of payroll to 17.8% immediately and further increased to as high as 19.4% by 2075 (President's Commission, 2001). As privatization and benefit changes such as those proposed by the President's Commission or tax increases are delayed, any solution that is undertaken will need to be more radical; that is, if SSA's most likely assumptions underlying the projected deficit do, in fact, occur. The most likely assumptions under which most projections are made foresee population growth of just 0.1% for the next 75 years, considerably below the Census Department forecast of 0.5% and much less than the 1.2% of the last 75 years (Niggle, 2000; Board of Trustees OASDI, 2001). Nearly steady-state population figures mean a slowdown in growth of the labor force, which the most likely assumptions project will grow only 0.1% over the next 50 years. Labor-force growth tracking population growth assumes that entry of women into the labor force has peaked and will remain at current levels. Anemic real GDP growth of just 2% is foreseen until 2007, and only 1.3% thereafter compared to 3% average GDP growth for the 20th century. Even during the worst decade of the 1930s GDP grew at 1.3%. Productivity and real wage growth are also expected to slow to 1%, considerably less than productivity growth of the last century and below the last two decades. Even with fewer workers entering the workforce, unemployment is still projected to be 5.5%. These projections translate into deficits that make reform seem necessary. With only slight modifications toward more positive projections all these deficits could become surpluses or with a slightly

darker forecast, deficits expand much more rapidly (Board of Trustees OASDI, 2001). Even though there is disagreement of just how bleak or bountiful the future may be, the most likely forecast with its anemic economic prospects appears to be both conservative enough to recognize a problem exists and insufficiently dire to make it possible to postpone a solution a bit further into the future. The reform opportunity may not last long, however. The politics of enacting dramatic reforms will grow increasingly problematic as the size of the retiree contingent increases (Fretz & Veall, 2001).

The President's Commission's three proposals would all reduce benefits promised by Old Age and Survivors Insurance (OASI) for moderate and more highly paid workers while increasing them for the lowest paid workers. In each of the plans put forward there is an option to establish and contribute to a personal account that would either be in addition to OASI mandated savings (Model 3) or a redirection of tax payments (Models 1 and 2) to personal accounts. Any funds diverted from traditional OASI plans into personal accounts would be offset by an assumed compounded accumulated amount, i.e., a lost-benefits account, which would be used to calculate reductions in OASI retirement benefits. The assumed rates of return on monies diverted from the retirement system to PAs would be 0.5% above the total returns for Treasury bonds in Model 1, 1% below the total Treasury bond returns in Model 2 and 0.5% above the total Treasury bond returns in Model 3. Individual investors will be at risk of making decisions that end up with retirement values below the value of the lost benefits. In order to determine how likely different PA investments are to exceed lost benefits, simulations based on the historical performance of stocks and bonds will be used below to estimate the probability of PAs exceeding lost benefits.

Model 1 proposes workers invest up to two percentage points of their 12.4% annual contributions into a personal savings account. The greater the number of workers attracted to accept voluntary participation in privatized accounts, the larger the decrease in government pension obligations. Under the most likely economic assumptions, a large financing gap covering the transition period in which money in the pay-as-you-go system is diverted to PAs would be created. Benefits would still be uncertain unless additional funding was to be provided.

Model 2 proposes to provide real benefits at least as great as those promised under the current system by allowing workers to set aside four percentage points of their contributions up to a ceiling of $1,000, a ceiling indexed to wage growth. SS benefits would be offset by accumulations in a lost-benefits account, which would compound based on PA set-asides at a rate 1% below the realized annual rate of return of Treasury bonds. SSA calculates that on average the accumulated PA will be more than sufficient to make up for the decline in benefits accruing in the hypothetical account using assumptions of 6.5% real returns on equities, 3.5% real returns on corporate bonds, and 3% real returns on Treasury bonds.

Under the most likely SSA assumptions currently promised benefits would be reduced substantially if the system were not reformed, so the tradeoff of accepting PAs versus promised benefits, though uncertain, is likely a better choice for workers than doing nothing at all. Model 2 of the proposed reforms would slow the growth of the primary insurance factors used to calculated OASI retirement benefits by tying them to the CPI rather than to real-wage growth. On average, real-wage growth has been 1% above the CPI. This change would effectively reduce benefits and cut the currently projected deficit by an estimated 2.07

percentage points of taxable payroll (Goss & Wade, 2002). This reduction eliminates nearly half of the anticipated additional taxes that would otherwise be required to cover current promised benefits. Lower-wage workers would receive an increase in benefits under Model 2 equivalent to a 40.4% hike for those with earnings at the minimum wage or less who contribute for 30 years. The goal is to increase benefits so that 30-year minimum wage workers receive benefits equivalent to 120% of the poverty level. These increases are phased in for low-wage workers according to years of contributions beginning only after 20 years of contributions. Survivor's benefits would rise to 75% of the benefit the couple would receive if both were still alive. This is an increase from the current maximum of 67%. A final provision of Model 2 seeks permanent funding from the General Fund to cover any annual shortfalls that might occur, particularly during the transition period to partial privatization.

Model 3 successively reduces the factors used to calculate retirement benefits to account for increasing longevity. Benefits for high earners would be reduced, whereas lower earners would receive enhanced benefits. Dedicated transfers from the General Fund of the Treasury would be increased and the maximum wages subject to taxes increased. Widowers would gain a higher proportion of benefits. The actuarial balance would be reduced by 1.94% from these adjustments. PAs would be established by diverting 2.5 percentage points of OASI contributions not to exceed $1,000 to PAs with the stipulation that workers electing this transfer would be required to match it with an additional 1% of contribution above current OASI taxes. The additional contribution would be eligible for a tax credit. Compounded accumulations in a lost-benefits account representing the 2.5% annually diverted would be assumed to grow at a rate of 0.5% below the annual realized Treasury bond rate of return and would be used to reduce eventual SS paid benefits.

Because Model 2 is the only one of the three to project a complete elimination of the SS deficit, it is the focus of the subsequent analysis and simulation. If the Model 2 choice of PA investment options were simply between a portfolio with returns equivalent to Treasury bond yields and a portfolio offering a Treasury bond yield less 1%, the amount at which the lost-benefits account compounds, all rational individuals would be willing to accept. The possible inclusion of equities and corporate bonds as possible investment choices complicate the allocation decision.

Government projections for accumulated retirement funds for Model 2 include three portfolios with the low-risk portfolio consisting of 100% Treasury bonds, the moderate-risk portfolio made up of 50% equities, 30% corporate bonds, and 20% Treasury bonds, and the high-risk portfolio consisting of 100% equities. SSA assumes a 3.5% real return on corporate bonds, 3% on Treasury bonds, and 6.5% real return on equities with a 0.3% annual management fee applied to accumulated assets (Goss & Wade, 2002). The 6.5% real returns on equity are just below the 7% average for the 1951–2000 period. Goss and Wade state that real returns on equities are assumed to be lower in the future because of a reduction in the equity premium with the greater acceptance of equities as investment vehicles by a greater portion of the population. SSA assumed real returns on corporate bonds are above the 2.6% 1951–2000 average and real returns on treasury bonds of 3% are also greater than the 1951–2000 average of 2.5%. Table 1 shows SSA projections and comparisons under Model 2 with PA for low-, medium-, and high-wage workers compared to current benefits. Model 2 benefits exceed current benefits for all workers in 2032 and 2052 by substantial amounts

Table 1
Projected benefits under model 2 (2032 and 2052) compared with 2001 current benefits and 2052 with current law benefits fully funded in 2001 dollars

	Retirement year	Low-wage worker	Medium-wage worker	High-wage worker
Current benefits	2001	7,644	12,624	16,392
Benefits with PA	2032	11,160	15,444	19,680
Increase over current benefits with PA	2032	46%	22%	20%
Benefits with PA	2052	13,608	20,016	24,684
Increase over current benefits with PA	2052	78%	59%	51%

even under a best-case scenario where all promised benefits are paid. If actual SS payments are in line with projected shortfalls, i.e, payments at just over 70% of obligations, the superiority of Model 2 is even greater. These calculations do not show the probability of PA failing to outperform the lost-benefits portfolio.

2. Macroeconomic, annuities, and reform

Any reduction in the OASI tax collections that result from redirecting funds to PAs will necessitate transition funding. All three models require this diversion. Plans that requires further savings beyond current OASI taxes—in essence additional taxation even where partially subsidized (Model 3)—lowers consumption over a working lifetime in exchange for future consumption that will at least meet current retirement and SSA-promised benefits. Reforms that cut benefits should motivate more current savings (Shrieber & Shoven, 1999). Though immediate reduction in consumption would have an adverse economic impact, over the longer-term productivity would increase from increased savings because it would result in more capital being available per worker (Pestieau & Possen, 2000)

All three proposed models attempt to enhance the progressivity of OASI benefits. Under the current system, the lowest wage quintile has a negative lifetime net tax rate (LNTR) that rises from −5.7% to −2.8% with younger cohorts successively less negative (Gokhale, 1998). The bottom 20% of workers have a negative lifetime net tax rate but the degree of that negativity declines for younger segments of this cohort. The middle 20% or workers pay between 5% and 5.9% LNTR whereas the top 20% have LNTR of 5% to 5.3%, a lower rate due to the cap on taxable wages. The effective pension floor provided by the continuing role of OASI in a partial privatization plan would aid in maintaining progressivity of benefits, but the portion of benefits from PA returns would reduce the degree of progressivity because those benefits would accrue from returns on investments.

SSA estimates management fees for PAs will be comparable to that experienced by government worker savings plans of about 0.3% per year on average (Goss & Wade, 2002). It is unclear whether management fees would be applied differentially to specific types of accounts. Another cost is the purchase of an end of working life annuity whether or not this is deemed desirable by retirees. By opting out of the OASI for up to $1,000 per year, workers must also be able to purchase an inflation indexed annuity for the amount invested in their

PA that would provide a payout at least comparable to what they would receive for the forfeited benefits in order to be economically whole. SS benefits are the only fully indexed annuity available to (nearly) all workers (Federal Advisory Council, 1997).

In order to make an informed economic decision to accept or reject the PA option, workers need to know or at worst would have to assume that an inflation-indexed annuity at an equivalent imputed cost of OASI annuities would be available upon retirement. When deciding on whether or not to exercise the privatized account option, workers would be confronted with uncertainty about just what markets would develop for annuities in the future, assuming they wanted to replace current annuitized benefits with like benefits. This may be less important given that the historic demand for annuities has been limited in the United States and at the same time subject to adverse selection, i.e, those with longer life expectancies tend to buy annuities (Mitchell et al., 1999).

Because insurance companies as sellers have actuarial tables of their clientele they have adjusted premiums to reflect the longer-lived annuitant applicant population. Markets would likely adjust to a wider distribution of applicants, if in fact a more varied group of applicants did develop, but initially the costs could be higher for buyers with life expectancies. The "money's-worth-ratio"—the expected present discounted value of the uncertain annuity payment stream divided by the present value cost—would be lower for those with average life expectancy. None of the proposals create inflation indexed annuities for retirees but rather leave that to individual retiree discretion. In the United Kingdom, where a portion of defined contribution retirement accounts are legally required to be annuitized, demand for annuities beyond this requirement is very limited. In 1999, 90% of annuity payouts were to compulsory annuity holders and 94% of new annuities purchased were compulsory (Poterba, 2001). In Chile, where there are no mandates for annuities, 40% of participants selected lifetime annuities—60% choose the payout option with the risk of drawing down assets prior to death.

Other costs of any reform plan are the lost benefits due to benefit reductions the plan explicitly sets out to make. These reductions differentially affect economic groups; lower paid workers gain by reform whereas middle and high earners face benefit cuts whether or not they accept the PA option. Those losing expected benefits would be motivated to try and make up for those losses by either choosing the PA option or saving more towards retirement. Lower income workers may be the less motivated to accept the PA option, having already gained from the proposed reform.

A PA investment in Treasury bonds should be attractive to many workers. Investing 100% in Treasury bonds foregoes the possibility of considerably greater returns from a 100% equity portfolio or a portfolio of mixed assets, but this is less important when investments held outside of SS are included in an overall portfolio allocation strategy. If an investor is viewing his/her entire portfolio rather than the narrower choice within PAs, the place of SS within an overall portfolio of investments would change with privatization. Reichenstein (1998) suggests SS benefits should be viewed as a bond and their after-tax present value calculated at the time of retirement to be added to the asset mix as a fixed income security. The tax treatment of the PA option would be the same as current SS benefits: a maximum of 85% of distributions would be taxed. This tax benefit would enter into allocation decisions as well.

Fraser, Jennings and King (200), using Treasury inflation protected securities (TIPS) as a proxy for SS find that adding TIPS to a portfolio offers substantial risk-reduction opportunities. Workers with assets beyond SS could rebalance their overall portfolios opting for risk-free inflation-protected bonds in their PA while increasing equities outside of SS. The net result of portfolio rebalancing would leave the government with retirement obligations in the form of TIPS, much the same as under current SS without privatization.

Any worker choosing either the moderate-risk mixed-asset portfolio or the high-risk equity portfolio in his/her PA would be accepting the possibility that his/her portfolio would fail to outperform Treasury bonds less 1% compounding in the set-aside lost-benefits portfolio. Although stocks may outperform bonds in the long-term as Jeremy Siegel (1998) argues, for shorter periods the probability of superior performance is less certain. Because the portfolio is at risk, the risk of substantial losses that cannot be recouped as retirement approaches is considerable. Individuals could reduce this risk by gradually shifting to more conservative investments as retirement approaches. With reforms as proposed applying to all those under 55 years of age, the option to invest could be exercised both for long and short investment-period horizons. Though it would be an obviously advantageous situation to accept the option to invest in Treasury bonds, the value of the option to invest for increasingly longer periods in riskier assets is dependent on the probability of accumulating a PA greater than the lost-benefits portfolio. Simulations can model that probability providing valuable information for decision making.

3. Prior simulation analyses

Shrieber and Shoven (1999) proposed two-tier plan in which 2.5% of OASI taxes are allocated to personal savings accounts with workers contributing an additional 2.5% into such an account. This is similar to Model 3 but with greater funding. A floor benefit of $500 indexed to the CPI is provided by SSA and the remainder of benefits is earned through investment returns. The gap between the floor benefit and the currently promised benefits is greater for higher earnings. In a simulation 45 years of earnings are modeled with average wages expected to grow at 1% above the assumed 2% inflation rate. Shrieber and Shoven assume 10% nominal stock returns with a 20% standard deviation, 6% corporate bond returns with a 10% standard deviation, and 6% government bond returns. Portfolios consist of 50% equity and 50% bonds. For 90% of retirees' accumulations, including the floor account, exceed current promised OASI benefits. Using a series of possible scenarios with the first retirement cohort retiring in 1912 assumed to have earned historical returns over the 1858 to 1912 period and so on rolling forward, even the worst market performances left retirees only slightly below promised current benefits while for the overwhelming number of scenarios gains far exceeded SS benefits.

The importance of Shrieber and Shoven's floor benefit was illustrated in a second smaller simulation (Goodfellow & Schrieber, 1999) which showed that one third of lower paid workers were at considerable risk of failing to receive current law benefits under a complete privatization plan but with a floor benefit could offset downside risk to a great extent. Because all three proposals call for partial privatization, a floor benefit remains intact.

4. Historical returns as a model for the future

The last two presidential commissions recommending privatization in one form or another both met during the 1990s during the bull market. Shiller (2000) points out that the bull market of the 1990s did not exhibit the obvious correlation between earnings and stock prices shown in the bull market of 1920–1929. The bull market of the 1990s also exhibited an extreme disconnection between the Gordon Growth Model valuation of stocks as the present value of dividends and the actual high prices attained. Shiller correctly predicted a market downturn, which occurred immediately subsequent to publication of his book. His forecast for the future is for continued dismal equity returns. Overvaluation as expressed in historically high price earnings relationships in the late 1990s was considerably greater than that experienced before the crash of 1929, leaving the market vulnerable for continued corrections (Shiller, 2000).

Concurring with Shiller, Diamond (1999) argues that stock markets in the long term cannot exceed the growth rate of dividends, which in turn are tied to the growth rate of GDP. Writing in 1999, Diamond calculated the market would have to decline 35% to 45% over 10 years in order to resume a 7% real growth rate and be in line with an optimistic 5.5% GDP growth rate that would be needed to support such price appreciation. In making its projections for future stock-market returns, the SSA uses a 6.5% real rate of return on equities (Goss & Wade, 2002) but elsewhere assumes GDP growth of under 2% for most of the 21st century and poor gains in productivity (Board of Trustees OASI, 2001). It would be difficult to imagine an economic scenario in which the stock market could outperform the economy by such margins for an extended period of time. If the SSA projections allowed for more robust GDP growth to support such projected market returns, reform would be obviated by increases in tax receipts. There is a significant inconsistency between the high real returns on equities for the long-term and the expected growth rate of GDP. When such inconsistencies exist, the stock market can be overvalued similarly to the experience in the late 1990s. Diamond's calculation of the type of stock-market decline that would be required to bring valuations back to reality actually occurred over a far shorter period from March 2000 to July 2002. The market correction could be sufficient to allow for SSA assumed growth in market equity valuation but only if GDP growth rates are considerably greater than 2% and productivity improvement are above SSA projections.

5. The model

Setting aside the economic inconsistency of robust stock-market returns and anemic GDP growth, simulations will be run by using historical stock-market data as a proxy for future returns to gauge the advantage of PAs over benefits workers surrender when they accept the Model 2 option. One of those simulations will use the worst performing 50-year period since 1926 as the underlying distribution. This "worst performing" market may not adequately represent the more dire market that would be associated with below 2% GDP growth, but it is a useful historical proxy for gloomy economic times. The focus of the analysis will be the potential risk and gain from accepting a PA option from an individual worker's standpoint.

Simulations modeling potential resulting retirement portfolios under different conditions using Model 2 assumptions were run by using historical distributions of real equity, corporate bond, and Treasury bond returns from the entire 1926–2000 period and subsegments of that period (Ibbotson, 2001). The performance of three portfolios were projected; one consisting of 100% equities, a second of a mixed portfolio consisting of 50% equities, 30% corporate bonds, and 20% Treasury bonds, and a third lost-benefits portfolio consisting of Treasury bonds less 1% to mirror the lost-benefit portfolio mandated by Model 2 for those electing to take the PA option. For those exercising a PA option, the goal is to exceed the benefits in the set-aside account, which effectively are subtracted from SS distributions. The accumulated returns of the first two portfolios are subject to management fees of 0.3%, the management fee estimated by SSA (Goss & Wade, 2002). Workers are assumed to contribute the maximum amount of $1,000 per year, increasing by 1% per year in real terms in accordance with anticipated real wage growth under the most likely economic projection and the stipulation of Model 2 which allows indexation of contributions to real wages. The end-of-period accumulated savings for each investment, assuming a maximum 44-year working lifetime, can be expressed as:

$$\text{Portfolio}_{44}: \sum_{t=1}^{44} 1000(1.01)^{t-1} \prod_{q=t+1}^{44} \left((1 + r_{pq})(1 - s) \right)$$

Where: $r_{pq} = 0.5r_{e_t} + 0.3r_{CB_t} + 0.2r_{TB_t}$ for the mixed portfolio and $r_{pq} = r_{e_t} + 0r_{CB_t} + 0r_{TB_t}$ for the equity portfolio, r_{eq} = equity returns in period q, r_{CBq} = corporate bond returns in period q, r_{TBqt} = treasury bond returns in period q, and $s = 0.003$, the service charge for portfolio maintenance.

The lost-benefits account can be represented as:

$$\text{Lost Benefits}_{44} = \sum_{t=1}^{44} 1000(1.01)^{t-1} \prod_{q=t+1}^{44} (1 + r_{Bq} - .01)$$

where r_{Bq} = the returns on treasury bonds in period q.

The first year's $1,000 contribution, under the simplifying annuity annual contributions at year's end, does not earn a return until year two with accumulation continuing until at most the 44th year; thus, q = t + 1. Benefits accrued are calculated each year so that comparisons can be made with the lost-benefits account over working lives from 1 to 44 years.

A correlation matrix was calculated for equity, corporate, and Treasury bond real returns for the 1926–2000 period. Simulations of the three asset returns are run for a 44-year working life using 100,000 iterations with @Risk software constrained to select period-to-period returns that adhere to the distribution and correlation matrix for the 1926–2000 period. Monte Carlo simulation produces returns for each asset in each portfolio for each year of each iteration of each simulation based on historical standard deviations, returns, and correlations. The same analysis is repeated for the other two periods used to model simulations. Descriptive statistics of the three periods modeled and their underlying distributions are shown in Table 2. The probability of exceeding the lost-benefits portfolio is then calculated by using the means and standard deviations of the distribution of the 100,000 simulations from each portfolio run. Because the "end of investment period" is calculated

Table 2
Real equity, corporate bond and treasury bond returns

	Eq	Corp bonds	Tbonds
Market statistics 1926–2000			
Correlation matrix			
Eq	1.0000		
Corp bonds	0.3237	1.0000	
Tbonds	0.2559	0.9539	1.0000
	Mean	Standard eviation	
Eq	0.0981	0.2077	
Corp bonds	0.0286	0.1032	
Tbonds	0.0254	0.1097	
Worst 50 years market statistics 1930-1979			
Correlation matrix			
	Eq	Corp bonds	Tbonds
Eq	1.0000		
Corp bonds	0.2851	1.0000	
Tbonds	0.1884	0.9182	1.0000
	Mean	Standard deviation	
Eq	0.0710	0.2254	
Corp bonds	0.0109	0.0807	
Tbonds	0.0033	0.0824	
Most recent 50 years market statistics 1951-2000			
Correlation matrix			
	Eq	Corp bonds	Tbonds
Eq	1.0000		
Corp bonds	0.3864	1.0000	
Tbonds	0.2982	0.9631	1.0000
	Mean	Standard deviation	
Eq	0.1002	0.1796	
Corp bonds	0.0264	0.1134	
Tbonds	0.0249	0.1193	

each year for the 44-year life of the investments, the probability of exceeding the lost-benefits portfolio is calculated annually; thus, probabilities for any retirement horizon up to 44 years are calculated.

6. Results

6.1. Simulating PA performance with 1926–2000 data

Standard deviations and mean portfolio accumulations are calculated year-by-year for the 44-year period. The probability of exceeding the lost-benefits portfolio accumulation is calculated for each year of the simulation:

$$Cumulative\ Normal\ Density \left[\frac{cum_{E_t} - cum_{S_t}}{stdev_{E_t}} \right] = Probability.$$

This analysis is comparable to value at risk (VaR) analysis in that the focus of the analysis is the probability of failure to exceed a targeted goal. The targeted value in this analysis is the lost-benefits portfolio and the probability of exceeding it. The calculation is applied to the mixed portfolio to arrive at year-to-year probabilities. Fig. 1 shows that the probability of both PA investment equity or mixed accounts exceeding the lost-benefits account is at worst just below 65% for those retiring soon after accepting the PA option. The equity portfolio probability of providing superior returns rises from just below 65% to just over 80% for those retiring 11 years after accepting the PA and stays above 80% until year 26, after which it declines to below 75% for those staying in exclusively equity investments for 44 years. The decline in the probability of exceeding the lost-benefits portfolio can be attributed to volatility "catching up" to the equity portfolio, more widely dispersing the distribution than the comparable lost-benefits portfolio distribution, and thus leaving a greater portion of the equity account under-performing the lost-benefits portfolio as time passes. The dispersion of the equity portfolio also grows more rapidly than the dispersion of the mixed portfolio. After a crossover in year 10 the mixed portfolio dominates the equity portfolio probability of exceeding the lost-benefits portfolio. The most risk-averse investors could select the arbitrage Treasury bond portfolio, which is guaranteed to outperform the lost-benefits portfolio by 0.70% each year after management expenses and thereby lock 100% certainty of beating the lost-benefits account. If many risk-averse workers demanded a 99% or 95% certainty of beating the lost-benefits portfolio, levels of certainty frequently used in VaR analysis, demand for Treasury bonds would increase and interest rates would decline, ceteris paribus, making equities more attractive and the risk of the Treasury bond portfolio being outperformed by equity or mixed portfolio more likely. Under such a scenario, changes in perceived opportunities would likely attract an increasing portion of workers away from Treasury bond accounts to equity and mixed portfolios. Examining just where equilibrium would exist is beyond the scope of this paper.

Real dollar differences between PA portfolios and the lost-benefits portfolio (Fig. 2) reward workers with expected end-of-period savings much greater than the lost-benefits portfolio. The equity portfolio with greater risk is markedly superior for longer-term investments to the mixed portfolio. The equity portfolio under this distribution leaves 44-year workers with on average $600,000 more in their retirement account than the lost-benefits portfolio, whereas the mixed portfolio puts them over $160,000 ahead. Such gains are the typical focus of advocates for privatization. The downside is that mixed portfolio investors do worse than the lost-benefits account 15% of the time, whereas 100% equity investors do worse 27% of the time. Such a degree of risk could be unacceptable if this were pensioners' entire retirement portfolio, but it is only a portion of retirement savings. The OASI floor that remains provides the security to accept some risk. For more affluent investors, PAs represent another asset account and a way of accumulating tax-free savings.

6.2. Simulating PA performance with the worst market performance data

Next, the simulation was modeled on returns over the worst 50-year market as measured by the poorest risk-return trade off. The 50-year period with the highest coefficient of

variation (CV), $\dfrac{\sigma_{equity}}{r_{equity}}$ would be considered the worst performing market from 1926 to 2000. The 1930–1979 period was the worst. Equities had real returns of 7.1% and a standard deviation of 22.54%; a considerably higher standard deviation and lower return than the 1926–2000 period overall. SSA projections use a 6.5% return on equities, 0.5% below the worst 50-year period but SSA projections do not provide variability making them less useful to determine risk. The high standard deviation of equities over the 50 worst years increase the probability of more PA-simulated portfolios failing to exceed the lost-benefits portfolio. Bonds also did poorly in the worst 50-year period, providing a real return of only 1.09% and an 8.07% standard deviation whereas Treasury bonds barely eked out gains above inflation at 0.33% with a standard deviation of 8.24%. Workers electing a 100% Treasury bonds portfolio would effectively earn a zero rate of return after management fees.

The SSA projections provide for a smaller equity premium speculating this will hold in the future. For the simulations herein, the actual historical distributions will be used because these provide both actual returns and variability. Assuming an historical underlying distribution for the simulation, Fig. 3 shows that the mixed portfolio dominates the equity portfolio regardless of the investment horizon. However, in expected real dollar superiority to the lost-benefits portfolio, the equity portfolio still outperforms the mixed portfolio with a 44-year accumulated differential averaging over $250,000 (Fig. 4). The mixed portfolio is far behind at just over an $80,000 superior accumulation. Although the expected real-dollar accumulations outstrip the lost-benefits portfolio, the probability of failing to outperform occurs nearly 30% of the time for 100% equity investors and 15% of the time for the mixed portfolio.

6.3. Simulating PA performance with 1951–2000 historical data

Using 1951–2000 data, a time period marked by higher equity returns and lower volatility than the 1926–2000 or the 1930–1979 periods to generate the simulation produces the most favorable scenario for beating the lost-benefits portfolio. For mixed-portfolio investors the probability of outperforming the lost-benefits portfolio is nearly 87%; it is 79% for equity investors (Fig. 5). In real-dollar terms this simulation also produces the best real-dollar superior accumulations, with the equity portfolio rising to an expected accumulated differential of over $650,000 with the mixed-portfolio differential of over $166,000 (Fig. 6). Still, there remains a 13% probability of the mixed portfolio under-performing the lost-benefits portfolio and 21% probability for the equity portfolio under-performing. Even in good economic times there is significant risk of under-performing the lost-benefits portfolio.

7. Discussion

Under all three markets simulated, the likelihood of outperforming the lost-benefits portfolio for workers retiring earlier in their careers levels off for the mixed portfolio but begins declining after about the 20th year for the equity portfolio. For both the equity and mixed portfolio, the expected or average superiority of either portfolio to the lost-benefits

portfolio increases with the contribution period. Expected superiority rises most rapidly for the equity portfolio even as the probability of under-performance increases. The distribution of portfolio outcomes becomes more dispersed, particularly for the equity portfolio, as the holding period increases, even as the superiority of performance rises. The simulation from the 1926–2000 data (Fig. 1) shows the probability of superior performance is greater for the mixed portfolio than for the equity portfolio for nearly the entire contribution lifetime. In the worst market simulation (Fig. 3), the mixed portfolio's probability of superior returns dominates the equity portfolio for any contribution period. It is only with the 1951–2000 data (Fig. 5) that the equity portfolio has a slightly better probability of being superior to the lost-benefits portfolio. More risk-averse workers, regardless of contribution horizon, would likely be less willing to invest in equities with the knowledge of comparative risk of outperforming the lost-benefits portfolio. The temptation of dramatically superior average returns to equity investors, however, could sway a sizeable proportion of less risk-averse workers.

Model 2 offers a PA option that even risk-averse workers would not refuse, given the obvious arbitrage opportunity of investing in treasury bonds or TIPS. Although there is considerable risk to those that seek greater returns with equity or mixed portfolios, failing to exceed the lost-benefits set-aside portfolio is no greater than 30% for 100% equity portfolios invested over a working lifetime. For those choosing the more modest mixed portfolio, failing to beat the lost-benefits portfolio over a lifetime of investing was at worst just 15%. The attraction of the potential real-dollar differentials should entice most investors to accept the option offer, particularly in the context of PA as part of a larger portfolio of assets.

Because partial privatization still leaves workers with a floor pension plan, the risk taken with PAs is not exceptional. It may be that most workers would take the opportunity to invest in equities, attracted by lucrative potential while afforded floor-benefit protection. Workers without other retirement savings could view PAs as an opportunity to participate in the stock market not otherwise available to them. The downside risk to less experienced investors is the possibility that they may move their money in and out of each respective portfolio with a frequency that would increase management fees and with poor timing returns could be quite low. Although the government foresees prohibiting preretirement withdrawals from PA accounts, there are no explicit restrictions against migrating from one portfolio or type of investment to another with some frequency that could either raise overall management fees or fees specifically to those participants attempting to time the market.

The caveat that future market performance cannot be accurately predicted by past market performance could be a serious issue particularly given the anemic real GDP growth forecast. Considering that GDP growth since 1930 has averaged over 3.5%, the SSA forecasted growth well below 2% would certainly be reflected in a less buoyant stock market. PAs, by bringing more capital into the market, could contribute to raising worker productivity that would enhance these forecasts and in turn boost GDP and equity returns.

Model 2, by establishing a voluntary PA without raising taxes or *requiring* additional worker contributions, seems to be a painless solution, but there are costs to moving from pay-as-you-go to partial privatization. Diverting OASI taxes to private accounts would mean the government would need to find funds from other sources to pay current and future retirees whose retirement was to have been funded by the diverted OASI taxes. Pestieau and Possen

(2000) argue that allowing some of OASI contributions to be invested privately will not solve shortfalls because the government must pay for the transition. Returns that a subsequently partially or even fully funded generation earns will be reduced by the interest rate on the debt issued to pay for the transition thereby reducing their returns to the same level they would be without a transition. Results for individuals could still differ for privatization depending on retirement account selection and savings horizon but the aggregate pensions savings could produce the same degree of benefits. Economy wide gains are possible from the infusion of additional capital into the private sector. This could make up for any loss to economic growth due to increased government borrowing which would, in any case, be necessitated by SS shortfalls in the absence of privatization.

8. Conclusion

With a projected shortfall that would result in substantial reduction in benefits, the President's Commission (2001) has proposed partial privatization in each of its three models as a way in which to prop up benefits that would otherwise be reduced. Model 2 allows for four percentage points of the current 12.4% contribution to OASI up to $1,000 to be allocated to private accounts. Three simulation scenarios compared Model 2 privatized accumulations and the probability of exceeding a set-aside lost-benefits account. Using historical data from three time periods to model the simulation, it was shown that both all equity and mixed privatized accounts provided expected accumulations well above the lost-benefits account provisions. However, there is some risk to workers that privatized accounts could under-perform. This risk is as high as 30% for all equity portfolios in a simulated "worst" market based on 1930–1979 data. The risk is as low as 13% for a mixed stocks and bonds portfolio using 1951–2000 market data to model the simulation.

The real-dollar gains compared to the lost-benefits portfolio invested in Treasury bonds less 1% are substantial, ranging from a low of $80,000 for a mixed portfolio to over $650,000 for an equity portfolio accumulating over a 44-year saving period. Given that privatization would still leave the bulk of OASI benefits on a pay-as-you-go system providing a floor for recipients, the risk of partial privatization is reduced.

The President's Commission has painted a gloomy forecast of 21st century economic and productivity growth. At the same time the commission offers PAs to both rescue SS from projected deficits and offer at least the same level of promised benefits for participants. The contradiction between a poorly performing economy and returns to PAs sufficient to exceed lost benefits is a major logical hurdle. If the economy does in fact perform well enough to provide PA benefits better than those in benchmark lost-benefit accounts then there would be no need to add privatization to SS. If the economy performs poorly, workers will end up with lower retirement benefits. Putting these contradictions aside and relying on historical market and bond returns, simulations run here demonstrate that even if markets performed at the worst risk/return tradeoff levels of any recent 50-year period, workers would still have an good chance of accumulating savings greater than those accruing in a set-aside lost-benefits account.

Including the PA with the entire asset mix held by workers, while beyond the scope of this

paper, does offer interesting strategies that may make the use of the PA somewhat different than the President's Commission's intended. If workers elect to exclusively purchase government issued securities for their PAs, then they will effectively be creating their own version of SS, albeit with actual bonds rather than SS Trust bonds. For example, if TIPS are offered as an elective investment for PAs, then a large number of workers could select these for their PAs. Because principal is growing with inflation, purchasers of TIPS effectively lock-in a real rate of return. The government would effectively exchange SS obligations for bond obligations that may have yields even higher than those imputed to SS Trust bonds creating greater projected deficits.

Annuitization of accrued privatized savings is not clearly addressed in any of the proposals brought forth by the President's Commission. The lack of clarity on the conversion of privatized accounts into an inflation-protected payout stream comparable to current SS presents an element of uncertainty to workers. This uncertainty raises the risk of exercising the privatization option that is not captured in the comparisons made in the simulations.

What is clear from the simulation analysis is that workers in even the worst of historical economic circumstances would very likely improve their retirement prospects with privatized accounts. Without including all aspects of workers portfolios the attractiveness of the PA is diminished because there is still a sizeable probability of failing to beat the lost-benefits portfolio. Favorable tax treatment of payouts of PAs, at most taxable at 85% of ordinary income taxes, and considering other assets in an overall portfolio increases their viability. Maintaining a floor payout for SS benefits also makes PAs compelling. Add to this the option to invest in TIPS or Treasury bonds and the superiority of PAs is clear. What is less clear is how well this solution will succeed in bailing out the federal government from projected SS deficits. It could be that those deficits will only be shifted to general government obligations.

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