

PORTFOLIO SELECTION AND GUARANTEE COSTS IN INDEXED, GUARANTEED PRIVATIZED SOCIAL SECURITY ACCOUNTS

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ABSTRACT

We examine privatized social security from the perspective of a participant. If there are no guarantees, the participant is likely to invest in some diversified mix of stock and bond funds. Using an option pricing model we show that if the government guarantees the principal, rational participants will shift their entire contribution to the riskiest fund available for investment, which in turn will maximize the cost of providing the guarantee. We find that the cost of the guarantee is substantially lower for younger participants than for older participants if the guaranteed principal is not indexed for inflation, but the difference is small if the guaranteed principal is indexed for inflation.

INTRODUCTION

President George W. Bush and others have advocated partial privatization of the social security system. President Bush mentioned it during his presidential campaigns in 2000 and 2004, and his State of the Union Address in January 2005. Besides President Bush, other politicians have expressed strong opinions on this issue as well. The privatization plans being discussed currently will divert a portion of the payroll tax to Privatized Social Security Accounts that will be managed by individual participants. The privatization proposals have generated a lot of opposition, mainly because they remove the guarantee of payments that is a part of the current social security system. Adding a government guarantee to the current privatization proposal could make the privatization of social security more acceptable.

The cost and implications of providing a government guarantee are important issues. We show how option pricing models can be used to calculate the cost of the guarantee for different types of investment portfolios, both with and without indexing the guaranteed amount for inflation. Restructuring social security is a complex issue, and most of the discussion on the merits and shortcomings of privatization has focused on macroeconomic considerations. We examine the issue from the perspective of a participant in the social security system and the choices he or she has to make in allocating the social security contribution to a mix of investments¹.

A PRIVATIZED SOCIAL SECURITY ACCOUNT

Since our interest is in portfolio selection and guarantee costs in a government guaranteed privatized social security system, we will assume a simple design for privatized accounts and focus only on the characteristics of the system that will influence portfolio selection and guarantee costs. We assume that,

1. Individuals can contribute up to \$1,000 of their payroll to a Privatized Social Security Account.

2. Individuals may select any combination of the following four funds for investing their contribution to the Privatized Social Security Account: (a) U.S. Treasury bill fund, (b) Long-term government bond fund, (c) Large-company stock fund, and (d) Small-company stock fund.
3. The money will be withdrawn at retirement.

PORTFOLIO SELECTION WITHOUT A GUARANTEE

If there are no guarantees provided by the government, individuals will select a portfolio from the available funds based on their personal tolerance for risk and their ability to bear risk. Typically older individuals will select portfolios with lower risk and younger individuals will pick portfolios with higher risk with the expectation of a higher return. We can use mean-variance analysis to select the best portfolios at different levels of risk. Using the data from Ibbotson Associates' 2003 Yearbook for estimates of average return, standard deviation, and correlation between asset classes, we construct the mean-variance efficient portfolios shown in Table I for four different levels of risk. The portfolios are: (1) A minimum risk portfolio, (2) A low risk portfolio which maximizes expected return, given risk similar to a long term bond portfolio, (3) A medium risk portfolio which maximizes expected return, given risk similar to large company stock portfolio, and (4) A portfolio which maximizes the expected rate of return. All four portfolios have been constructed with a no short-sales constraint.

Table I
Optimal Portfolios without a Guarantee

	<u>Minimum Risk</u>	<u>Low Risk</u>	<u>Medium Risk</u>	<u>High Risk</u>
<u>Asset Weights (%)</u>				
U.S. Treasury bills	94.67	19.63	0.00	0.00
Long-term govt. bonds	3.44	44.89	22.31	0.00
Large-company stocks	0.41	19.43	38.59	0.00
Small-company stocks	1.48	16.05	39.10	100.00
<u>Summary Statistics (%)</u>				
Expected Return	4.13	8.46	12.64	16.95
Standard Deviation	3.08	10.00	20.00	33.19
Dividend Yield	0.02	0.52	1.11	1.12

PORTFOLIO SELECTION WITH A GUARANTEED PRINCIPAL

Assuming that the government guarantees the principal contributed to the privatized social security account, the participant in the system will receive at least \$1,000 at retirement. If the investment does poorly and has a total value less than \$1,000, the government will make up the shortfall between the \$1,000 principal contributed and the total value of the investment. If the investment does well and its total value is greater than \$1,000, the participant will receive the \$1,000 principal contributed plus income and any capital gains at retirement. The payoff pattern on retirement date for this guaranteed account is identical to the payoff pattern for a protective put.

With the guarantee the participant in effect owns the \$1,000 portfolio purchased with the contribution, plus a put option on the portfolio. The total value of the investment is the sum of the values of the

\$1,000 portfolio and the put option. A rational individual will maximize the total value of the investment. Since the value of the initial portfolio purchased is fixed at \$1,000, the participant will maximize the total value of the investment by maximizing the value of the put option on the portfolio. The put option value is also the cost of the guarantee provided by the government. Since the investment is held to the retirement date, the put option is a European option and we use the Black-Scholes option pricing model for calculating its value. The Black-Scholes model does have limitations when used for long-lived options and options on portfolios that contain fixed income instruments, but it is still helpful in providing a useful perspective on the issue of government guarantees.

The put option is an at the money option with a strike price of \$1,000. We calculate the values of the put options on the four portfolios shown in Table I for times to retirement that range from 5 years to 30 years. The dividend yield and standard deviation of portfolio return shown in Table I are used as inputs to the Black-Scholes model. For riskless rates we use the term structure of interest rates based on treasury issues (Wall Street Journal).

The calculated values of the put options for the four portfolios are shown in Table II. For example, for a participant who has 30 years to retirement and invests \$1,000 in a medium-risk portfolio, the value of the put option is \$32.40. This implies that the cost to the government will be 3.24% of the amount contributed by this individual. For a participant with 30 years to retirement, the last row of the table shows that the value of the put option varies from close to zero for the minimum-risk portfolio to \$98.12 for the high-risk portfolio. For a participant with 5 years to retirement, the first row of the table shows that the value of the put option varies from \$0.10 for the minimum-risk portfolio to \$206.96 for the high-risk portfolio. For the range of times to retirement shown, the guarantee has the lowest value for a young individual who invests in a minimum-risk portfolio and has the highest value for an older individual who invests in a high-risk portfolio.

Table II
Guaranteed Principal
Value of Put Option for a \$1,000 Contribution

Time to Retirement (Years)	Minimum-Risk Portfolio		Low-Risk Portfolio		Medium-Risk Portfolio		High-Risk Portfolio	
	(\$)	(%)	(\$)	(%)	(\$)	(%)	(\$)	(%)
5	0.10	0.01	29.75	2.97	108.97	10.90	206.96	20.70
10	0.00	0.00	14.35	1.44	93.53	9.35	201.58	20.16
15	0.00	0.00	5.63	0.56	68.63	6.86	168.03	16.80
20	0.00	0.00	2.36	0.24	50.51	5.05	137.09	13.71
25	0.00	0.00	1.25	0.12	40.16	4.02	115.92	11.59
30	0.00	0.00	0.70	0.07	32.40	3.24	98.12	9.81

A rational individual will maximize the sum of the values of the portfolio purchased (\$1,000) and the put option. Therefore, each participant will select the high-risk portfolio regardless of age since that maximizes the value of the put option. Without the guarantee a young participant with 30 years to retirement might have selected the high-risk portfolio anyway. However, without the guarantee an older participant with 5 years to retirement is more likely to have selected either a minimum risk or a low-risk portfolio, and the existence of the guarantee changes this individual's selection to a high-risk portfolio. If the government did offer this kind of opportunity to all participants, the cost to the government will

about twice as high for an individual with 5 years to retirement (20.70%) than for an individual with 30 years to retirement (9.81%), assuming that all participants select the high risk portfolio.

PORTFOLIO SELECTION WITH A GUARANTEED PRINCIPAL INDEXED FOR INFLATION

To provide some protection to the real return that participants earn on their social security contribution, the guarantee could be made on the contributed principal indexed for likely inflation. This will also make the program more attractive to all participants. We get the estimate for the potential inflation from the difference in yields on treasury bonds and Treasury Inflation Protection Securities. For a five-year term it was around 2.62% (Wall Street Journal, December 20, 2004). Assuming that inflation over the five years is a constant 2.62% per year, the guaranteed amount indexed for inflation over five years is \$1,138.05. This value is now the strike price for the put option.

Table III shows the values of the put option, recalculated with the inflation indexed principal as the strike price. When compared to the values in Table II, the put values in Table III are substantially higher across the board, as a result of the substantially higher strike prices for the options. The increase is much greater for longer times to retirement than shorter ones.

Table III
Guaranteed Principal Indexed for Inflation
Value of Put Option for a \$1,000 Contribution

Time to Retirement (Years)	Minimum-Risk Portfolio		Low-Risk Portfolio		Medium-Risk Portfolio		High-Risk Portfolio	
	(\$)	(%)	(\$)	(%)	(\$)	(%)	(\$)	(%)
5	9.72	0.97	75.28	7.53	171.21	17.12	278.15	27.81
10	1.64	0.16	68.40	6.84	192.31	19.23	324.58	32.46
15	0.20	0.02	55.26	5.53	188.65	18.86	328.51	32.85
20	0.04	0.00	47.93	4.79	185.48	18.55	326.37	32.64
25	0.02	0.00	46.81	4.68	189.50	18.95	329.81	32.98
30	0.01	0.00	45.68	4.57	191.23	19.12	328.57	32.86

For the minimum-risk and low-risk portfolios the put values decrease as time to retirement increases in Table III, just as they do in Table II. However, in contrast to Table II, the Table III put values generally increase as time to retirement increases for the medium-risk and high-risk portfolios. For a participant who has 30 years to retirement and selects the high risk portfolio, the value of the put option and the corresponding cost of the guarantee increases more than threefold from 9.81% to 32.86%, when the guaranteed principal is indexed for inflation.

The difference between the cost of the guarantee for younger and older participants is much smaller when the guarantee is indexed for inflation. For example if the guarantee is indexed for inflation and portfolio selection is restricted to a low-risk portfolio, the cost of the guarantee lies in a small range from 4.57% to 7.53% of the amount contributed. For a medium-risk portfolio the costs range from 17.12% to 19.12% of the amount contributed.

IMPLICATIONS

The design of a guaranteed privatized social security system needs to account for the following implications of the portfolio selection choices that will be made by rational participants in such a system, and the resulting cost of the guarantees:

1. Since rational participants given a choice of portfolios to select from will select only the riskiest portfolio, the government needs to offer only one portfolio for investment.
2. The government can control the cost of the guarantee by offering a low to medium risk portfolio of stocks and bonds as the fund available for investment.
3. To keep the cost of the guarantee low, the government could choose to guarantee only the contributed principal. This approach involves a trade-off, where the government gives participants the opportunity for a better upside return on social security contributions, but takes away inflation indexing which is a part of the current system.
4. Since the cost of guaranteeing older participants is substantially higher than guaranteeing young participants when only the contributed principal is guaranteed, the government could minimize start-up costs for a privatized system by starting the program with young participants only. Of course, as the participants age, the cost of guaranteeing their contributions will rise.
5. Guaranteeing the inflation-indexed principal increases the cost of the guarantee substantially across the board, but far more so for young participants than for older ones. A relatively age-neutral policy could be implemented by providing a low to medium risk portfolio for investment and guaranteeing the inflation-indexed principal. While such a policy is more equitable in some ways, it would be substantially more expensive for the government than the other policies described above.
6. Congress would have the choice of: (1) funding the guaranteeing cost up front, each time a contribution is made by a participant, or (2) simply making a promise to fulfill the guarantee at a future date from future revenues if needed. The second approach would result in an intergenerational transfer of wealth, while the first approach would not.

CONCLUSION

A government guarantee will radically change the portfolio selection choices made by most participants in a privatized social security system. A guarantee gives a put option to the participant. To maximize the value of the overall investment, a rational participant will seek to maximize the value of this put option by investing in the most volatile investment portfolio available in the privatized social security system, which in turn increases the cost of the government guarantee. When only the contributed principal is guaranteed, the cost of the guarantee is lower for young individuals than older ones. For higher risk portfolios this cost structure reverses when the guaranteed principal is indexed for inflation, and the cost is higher for young individuals than for older ones. From a public policy perspective, our analysis argues neither for the creation of a guaranteed privatized social security program, nor against it. Instead it suggests caution, and that any explicit or implicit guarantee by the government must be considered carefully in the design of such a system.

ENDNOTES

1. For a literature survey and references, please contact the authors.