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THE ECONOMICS OF BEQUESTS IN PENSIONS AND SOCIAL SECURITY

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ABSTRACT

Experience in private pension plans and recent policy discussions about investment-based reforms of Social Security suggest that some form of bequest is likely to be part of any such reform that is enacted. This paper provides a first examination of the potential magnitudes of such bequests and of their effect on retirement annuities and asset accumulation.

The most likely form of bequest, the "preretirement bequest" made when employees die before normal retirement age, reduces the funds available for post-retirement annuities by about 16 percent or, equivalently, requires a one-sixth increase in the Personal Retirement Account saving rate to maintain the same level of post-retirement annuities.

We also analyze a variety of post-retirement bequest options. The least costly option that we consider is adding a "ten-year-certain" feature to the life annuity, thereby providing a bequest whenever the retiree dies before age 77. This would reduce annuities, relative to providing only preretirement bequests, by about 6 percent. The most costly option that we consider would provide a bequest equal to the remaining actuarial value of the PRA annuity at the time of death and would require reducing all annuities by about 23 percent unless the PRA saving rate is raised.

We analyze the size distribution of bequests that would result under different bequest rules and consider the implications for aggregate capital accumulation.

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The Economics of Bequests in Pensions and Social Security

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One of the apparent advantages of Social Security and of private pensions is that they provide an annuitized form of retirement income that allows retirees to avoid "wasting" some of their lifetime accumulation in the form of unintended bequests.[1] In practice, however, individuals generally choose to forego the potential gain from full annuitization in order to have the prospect of providing a bequest with some of their lifetime accumulation.

For example, given the choice between an ordinary life annuity (for the retiree or the retiree and spouse) and a "ten-year-certain" annuity that provides that benefits continue for at least ten years even if the annuitant dies, most participants in defined contribution TIAA-CREF plans select the ten- year-certain annuity.[2] More generally, the participants in virtually all defined contribution plans choose to bequeath the entire value of their accumulated accounts if they die before reaching retirement age instead of committing

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[1]See Brown et al (1999) for estimates of the utility gain that an egoistic retiree who does not place any utility value on making a bequest obtains by being able to annuitize retirement assets.

[2]TIAA-CREF is the largest private pension plan with more than $250 billion in assets. Among male retirees, 74 percent now choose some period of certain benefits in addition to a life annuity.

those funds to an annuity at an earlier pre-retirement age.[3]

Moreover, countries that have adopted investment-based Social Security programs to supplement or replace traditional pay-as-you-go systems also generally provide for bequests both when individuals die before retirement and when they die during their retirement years.[4] For many people, an attraction of supplementing the existing pay-as-you-go Social Security system in the United States with an investment based system is that it would give middle and lower income individuals the opportunity to accumulate wealth and make significant bequests. Recent legislative proposals for investment-based supplements to the U.S. Social Security program provide for such bequests.[5] The ability to provide bequests in this way is also regarded as an advantage of using individual retirement accounts rather than a single government fund as a way of achieving an investment-based supplement to Social Security.

A mechanism for making significant bequests is attractive both to those who would receive the bequests and those who would make the bequest. The financial assets that heirs receive in this way would, if saved and spent gradually, allow them to maintain consumption in the face of substantial financial risks, including long-term unemployment, large uninsured health expenditures, or substantial property losses. In addition, financial assets give individuals the ability to quit an undesirable job and seek new work or to

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[3]This paper provides an estimate of the increased value of the annuity that would be possible if individuals used their accumulated funds to purchase annuities during their pre-retirement years.

[4]See Feldstein (1998) and World Bank (1994) for descriptions of the investment based systems in a number of countries.

[5]These include the explicit proposals that have been put fourth by Senators Moynihan and Kerry, by Senators Gramm and Domenici, and by Senators Gregg and Breaux. The provision of bequests was also a feature of the two individual account proposals contained in the report of the official Social Security Advisory Council.

undertake entrepreneurial activities.[6] The ability to make such bequests to children or grandchildren is appealing to those who would make them because it provides an opportunity to express generosity at the end of life (Bernheim, 1998) and because it offers the "strategic" advantage of strengthening filial loyalty (Bernheim, et. al., 1985).

Although it might be argued that individuals who want to make bequests could save explicitly for this purpose, it is the lack of foresight and self-discipline to accumulate for their own old age that justifies mandatory Social Security pensions. This same inability to do long-term saving can also justify helping individuals to make the bequests that they would like to make but lack the ability to achieve.[7]

The provision of bequests is also a matter of practical program design in a system of investment-based personal retirement accounts. Although retirees could in principle be required to annuitize their accumulated assets at retirement with no provision for bequests, those individuals who die before retirement must be allowed to make bequests unless the government taxes away the entire value of their accumulated assets at death or requires that all pre-retirement saving be invested in the form of annuities as it accumulates. Foreign experience and the revealed preferences in private defined contribution plans in the United States imply that neither of those would be popular options.

Previous academic analyses of investment-based Social Security reforms have ignored the possibility of bequests, implicitly assuming that all saving would be invested in annuities both during working

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[6]Rosen, Holtz-Eakin and Joulfaian (1993) show that moderate size bequests increase significantly the probability that individuals will begin entrepreneurial activities.

[7]Bequests are of course an uncertain way of helping children and grandchildren. An explicit form of saving to make nonrandom gifts might in principle be a useful supplement to a pension system with bequests.

years and after retirement.[8] In contrast, the present paper examines a variety of possible options for bequests before retirement and during the retirement years. Although our calculations use the individual employee as the unit of analysis, the level of projected pay-as-you-go benefits to which we compare the investment-based annuities corresponds to the Social Security actuaries' projections for the benefits of retirees, spouses, survivors and the disabled.[9] The bequests that we study here are therefore supplementary to these additional benefits that are specified in current law.

We examine three types of issues about such bequests. First, we ask how expensive such bequests would be in terms of the saving rate necessary to support such bequests without reducing the associated annuities. Alternatively, we ask by how much different bequest rules would require reducing the annuity if the saving rate used to fund the investment-based pensions was not raised when bequests were introduced. Second, we examine the probability distribution of bequests by size and by timing under different bequest options. And, third, we consider the macroeconomic consequences of bequests on capital accumulation.

1. Personal Retirement Accounts and Pre-retirement Bequests

In an investment based system, individuals accumulate a fraction of each year's wages in Personal Retirement Accounts (PRAs) during working years and receive annuities during retirement. The deposits to these accounts may be financed by the individuals themselves, by their employers, or by the government. The deposits may be set at a level that permits the resulting annuities to fully replace the pay-as-you-go system of benefits or at a level that only supplements a pay-as-you-go system. The issues of who funds

[8]See for example Feldstein and Samwick (1997, 1998a, 1998b) and Kotlikoff (1996, 1998).

[9]About one-third of the total cost of benefits are for the additional benefits for spouses, survivors, dependents and the disabled.

the accounts and of whether the accounts are intended to replace the existing pay-as-you-go system or to supplement the existing system are not directly relevant to our analysis.[10] The structure of the calculations makes it clear that the size of the annuities and of the bequests are proportionate to the savings rate. Although we analyze a level of savings that could fully replace the existing pay-as-you-go system in the long run, readers can consider the effect of smaller investment based programs by a proportionate reduction in all of our dollar amounts.

In a system with no pre-retirement bequests, the individual is implicitly required to buy a retirement annuity with each year's PRA deposit. The rate of return on the pre-retirement saving of those who survive in any given year is therefore the sum of the ordinary market return on the assets in the account plus the increased value that results form receiving a share of the assets of those who died during the year.

More specifically, consider a cohort of individuals who enter the labor force at age 21. Let N(s) be the number of individuals of the cohort who are alive and working at age s, let w(s) be the annual wage of the representative individual in that cohort in year s, let α be the fraction of wages contributed each year to the personal retirement accounts[11], and let R(s) be the investment return in that year. If bequests are not permitted, the funds that are owned by those who die at age s are automatically reinvested in the accounts of those who remain alive, as they would be in an actuarially fair annuity. During the pre-retirement

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[10]Feldstein and Samwick (1997, 1998b) analyze plans based on employee-employer contributions that would eventually replace the existing tax financed system completely. Feldstein and Samwick (1998a, 1999) describe a plan to use government deposits in individual accounts to supplement the benefits that could be financed with the existing level of Social Security payroll taxes. Feldstein, Ranguelova and Samwick (1999) analyze both types of plans in a stochastic environment.

[11]Savings in Personal Retirement Accounts are based on wages up to the maximum earnings taxed under Social Security. This maximum was $68,400 in 1998.

period, those who live to the end of their s-th year will have accumulated (as a cohort) an amount

(1) $$M(s) = [\ 1 + R\ (s-1)\ ]\ M(s-1) + \alpha\ w(s)\ N(s)$$

where M(s) is the aggregate PRA balance for the cohort as a whole. A representative member of the cohort who survives to age s will therefore have accumulated

(2) $$A(s) = [\ 1 + R\ (s-1)\ ]\ A(s-1) + \alpha\ w(s) + [\ 1 + R\ (s-1)\ ]\ [\ N(s) - N(s-1)]A(s-1) / N(s)$$

where the term $[(\ N(s) - N(s-1)\ )]\ A(s-1)/\ N(s)$ indicates the amount transferred to each survivor's account in year s - 1 from those who died during that year.

Permitting bequests of the accumulated account balances during the pre-retirement years changes this accumulation by eliminating the increment in equation 2 that comes from the accounts of those who died during the year. The value of the assets of an individual who survives to age t (and therefore the magnitude of that individual's bequest if he or she dies in that year) evolves according to

(3) $$A(s) = [\ 1 + R\ (s-1)\ ]\ A(s-1) + \alpha\ w(s)$$

To assess the magnitude of the potential bequests and the effect of bequests on the amount accumulated at age 66, we use the cohort of individuals who are 21 years old in 1998 and the age-specific mortality rates for this cohort as projected by the Social Security actuaries in the Statistical Supplement to the Social Security Bulletin. We look at a representative individual in this cohort who has mean age-specific earnings in each year, again using the projections of the Social Security actuaries.

2. A Model of Uncertain Investment Returns

Our analysis assumes that the Personal Retirement Account balances are invested in a portfolio consisting of 60 percent stocks and 40 percent corporate bonds. The accumulation of assets in the PRAs and the annuities and bequests at each age reflect the uncertain returns on these assets.

To analyze this uncertainty, we assume that the personal retirement account portfolio is continually rebalanced to maintain 60 percent equities and 40 percent debt.[12] We use the S&P500 index and a Salomon Brothers corporate bond index as proxies for the stock and bond investments. Both indexes are assumed to follow a geometric random walk with drift. This implies that the log returns for each type of asset are serially independent and identically distributed with given mean and variance. Thus if $p_e(s)$ and $p_b(s)$ are the log levels of the equity and bond indexes at time s, we assume

$$p_e(s) = p_e(s-1) + \mu_e + u_e(s)$$

and

$$p_b(s) = p_b(s-1) + \mu_b + u_b(s)$$

where μ_e and μ_b are the mean drift per period in the logarithmic value of equities and bonds, while $u_e \sim$ iid N $(0, \sigma^2_e)$ and $u_b \sim$ iid N $(0, \sigma^2_b)$. The covariance between the stock and bond returns is σ_{eb}.

With a continuously compounded 60:40 equity-debt portfolio, the log level of the overall portfolio would satisfy the following random walk if there were no additions or payouts:

$$p(s) = p(s-1) + \mu + u(s)$$

with $u \sim$ iid N $(0, \sigma^2)$. To derive the values of μ and σ^2 we use the lognormal property of the returns.

More specifically, if μ^*_i is the mean return on asset i in level form, the mean return on the 60:40

[12]This ratio is selected to correspond approximately to the debt-equity ratio of U.S. corporations so that the rate of return on capital at the corporate level can correspond to the return to these portfolio investments without considerations of the relative yields on debt and equity. The 60:40 ratio is also a common ratio used by corporate pensions.

portfolio is the weighted average $\mu^* = 0.6\ \mu_e^* + 0.4\ \mu_b^*$. Because we assume the log returns to be normally distributed, $\mu^*_i = \mu_i + .5\ \sigma^2_i$. This implies that

$$\mu + 0.5\ \sigma^2 = 0.6\ (\mu_e + 0.5\ \sigma^2_e) + 0.4\ (\mu_b + 0.5\ \sigma^2_b)$$

where

$$\sigma^2 = 0.36\ \sigma^2_e + 0.16\ \sigma^2_b + 0.48\ \sigma_{eb}$$

From these two equations and the measured mean and variance of the log returns on stocks and bonds we can derive the log return on the portfolio and the variance of that return.

The CRSP data for the postwar period from 1946 through 1995 imply that for stocks and bonds the mean log real rates of return were 7.0 percent and 3.3 percent.[13] The corresponding standard deviations are 16.6 percent for stocks and 10.4 percent for bonds. The covariance of the stock and bond log returns is $\sigma_{eb} = 0.0081$. Taken together, these parameters imply an average log real rate of return on the 60:40 portfolio of 5.9 percent with a standard deviation of 12.5 percent.

In the analysis that follows, we reduce the mean log return from 5.9 percent to 5.5 percent to reflect potential administrative costs. [14]

Although the equation for p(s) describes the way that the logarithmic value of the PRA account would evolve during the accumulation years if there were no external additions, the actual individual PRA accounts would be augmented annually by a fraction α of the individual's wage and, when there are no pre-

[13]The bond rate of return is based on the Salomon Brothers AAA bond returns adjusted to a more typical corporate bond yield by adding two percentage points.

[14]This estimate of the administrative cost may be compared with the cost of about 0.2 percent charged now in indexed equity funds by mutual fund companies like Vanguard and Fidelity. Bond funds generally have lower administrative charges.

retirement bequests, by the distributed share of the PRA balances of those members of the cohort who die during the year. These are shown in equations 2 and 3 above. Since those equations are stated in level rather than logarithmic form, the value of $1 + R(s) = \exp [r(s)]$ where $r(s)$ is the logarithmic rate of return in period s implied by $r(s) = p(s) - p(s-1) = \mu + u(s)$.

We use equation 3 to simulate 10,000 evolutions of the Personal Retirement Account values for each year from age 21 through age 100, taking into account the mortality probabilities and the stochastic distribution of returns. Our stochastic simulations recognize the uncertainty of the future mean return as well as the annual variations in returns around that future mean. For each of the 10,000 simulations, we begin by drawing a mean rate of return from a distribution with a mean of 0.055 and a standard deviation of 0.0177, the standard error or the mean estimate based on our 50- year sample of observations. We then generate an 80-year series of returns that have this mean and a standard deviation of 0.125.

We assume that individuals save 6 percent of their wages each year in PRA accounts and that the pay-as-you-go tax declines from the initial 12.4 percent to zero. For comparison, the Social Security actuaries project that the current pay-as-you-go tax rate of 12.4 percent will have to rise to more than 18 percent in a purely tax financed pay-as-you-go system in order to provide the benefits that are promised in the Social Security law. In contrast, we show in this paper that, with no bequests and a saving rate of six percent, the median annuity at age 67 is 2.05 times the future Social Security benefits promised in current law (which we call the "benchmark benefits") and that there is a 90 percent probability that the PRA annuity at age 67 will equal or exceed 76 percent of the benchmark benefit.[15] Since the benchmark

[15]For a more complete analysis of these risk issues, see Feldstein and Ranguelova (1998).

pay-as-you-go benefit replaces approximately 40 percent of the pre-retirement wage, the median annuity based on a six percent replacement rate would correspond to a replacement rate of 81 percent. The mean annuity exceeds the median and corresponds to 2.98 times the benchmark benefits.

3. The Distribution of Pre-retirement Bequests

We now study the annuity financed by a six percent saving rate to see the effects of mortality risk and investment uncertainty on the distribution of bequests. Table 1 shows the implied distribution of pre-retirement bequests of different sizes for individuals who die at different ages between 25 and 67. These bequests are all based on the potential experience of a representative individual who earns the mean wage [16] and who makes annual saving deposits of six percent of that wage to a Personal Retirement Account. The distribution of bequest values reflects the variation in rates of return on the assets in the Personal Retirement Accounts. Column 2 shows the annual age-specific mortality rates, i.e., the probabilities that an individual of that age will die and leave a bequest. The cumulative probability of leaving a bequest (i.e., the probability of dying by that age conditional on being alive at age 21) is shown in column 3.

The mean and standard deviation of those bequests, in thousands of 1998 dollars, is shown in columns 4 and 5. For comparison, the corresponding mean wage projected for that year is shown in column 6.[17] The simulation of 10,000 forecasts is used to calculate the probabilities that the bequest will

[16]The mean wage is the mean of the wage distribution subject to the ceiling on the taxable earnings for Social Security ($68,400 in 1998) and adjusted for multiple excess wages. The multiple excess wages adjustment accounts for the fact that some individuals who receive wages from more than one employer may earn less than the taxable ceiling at each job but their total earnings may exceed that ceiling.

[17]This is also the mean of the truncated distribution with all wages at or above the ceiling truncated as if they are at the celing and adjusted for multiple excess wages.

exceed various multiples of the future mean wage; these probabilities are shown in columns 7 through 10.

Table 1

Distribution of Pre-Retirement Bequests, 6.0% saving rate

Age	Mortality Rate	Cumulative Probability of Bequest	Bequest Size		Mean Wage	Probability that Bequest Exceeds Multiples of Mean Wage			
			Mean ($000)	Standard Deviation ($000)		1x	2x	3x	4x
(1)	(2)	(3) (4)	(5)	(6)	(7)	(8)	(9)	(10)	
25	0.0010	0.004	5	1	29.0	0.000	0.000	0.000	0.000
30	0.0013	0.009	14	4	30.5	0.001	0.000	0.000	0.000
35	0.0016	0.016	29	10	32.1	0.311	0.007	0.000	0.000
40	0.0019	0.025	51	21	33.7	0.801	0.174	0.027	0.005
45	0.0023	0.035	83	42	35.4	0.953	0.528	0.216	0.086
50	0.0034	0.047	128	78	37.2	0.986	0.762	0.479	0.284
55	0.0054	0 .067	193	138	39.1	0.995	0.880	0.675	0.490
60	0.0085	0.097	285	241	41.1	0.998	0.930	0.797	0.653
65	0.0142	0.143	417	420	43.2	0.998	0.958	0.868	0.758
67	0.0172	0.168	487	518	44.1	0.998	0.967	0.888	0.791

All dollar amounts are in 1998 prices.

The representative individuals in this simulation have the mean age-specific covered earnings in each year. Six percent of these wages are deposited annually to the Personal Retirement Accounts.

These calculations are based on 10,000 two-stage simulations. First we generate the log mean return by drawing from a distribution with mean 0.055 and a standard deviation of 0.0177. We then generate an 80-year series of annual returns that have this mean and a standard deviation of 0.125.

The mean bequests grow rapidly with age, from just $5,000 for those who die at age 25 to $128,000 at age 50, and more than $400,000 for those who die just before retirement. Even by age 35, the mean bequest of an individual who has had average earnings all his life would be nearly as large as the average earnings in that year. By age 50 the mean bequest is more than three times mean earnings. Recall that this is with a six percent saving rate. If the saving rate were limited to two percent of earnings, as it might be in a system that combines pay-as-you-go and investment-based components, these means and standard deviations would be reduced by a factor of three.

The increasing relative variance of the bequest size (seen by comparing columns 5 and 4) reflects the fact that the annual returns follow a random walk, causing the variance of the return to grow with time. The probability distributions described in columns 7 through 10 show that those who die in middle age are increasingly likely to leave bequests that are a significant multiple of the average wage at the time of their death. Thus among 50 year olds who die, virtually all bequests exceed the average wage, 76 percent of bequests exceed twice the average and 48 percent exceed three times the average wage.

In considering these values, it should be recalled that the cost of providing these pre-retirement bequests while maintaining the 6 percent PRA saving rate is to reduce the funds available to finance annuities among the vast majority of individuals who do not die before reaching retirement age. The payment of pre-retirement bequests reduces the mean accumulation of assets at age 66 by 14 percent, causing the annuities to decline by the same percentage. Table 2 shows the effect of providing pre-retirement bequests on the distribution of the variable annuity payments. We report the variable annuity payments as a fraction of the "benchmark benefits" -- the benefits

Table 2

Effects of Pre-Retirement Bequests on the Distribution of the Variable Annuity Payments as a Fraction of Benchmark Social Security Benefits

	No Bequests			**Pre-Retirement Bequests**					
Cumulative	Age			Age 67		Age 77		Age 87	
Probability	67	77	87	PRA Saving Rate		PRA Saving Rate		PRA Saving Rate	
				0.06	0.07	0.06	0.07	0.06	0.07
0.01	0.38	0.21	0.12	0.34	0.40	0.18	0.21	0.10	0.12
0.02	0.45	0.26	0.16	0.40	0.47	0.23	0.26	0.15	0.17
0.05	0.59	0.38	0.26	0.52	0.61	0.34	0.39	0.22	0.26
0.10	0.76	0.55	0.39	0.67	0.78	0.48	0.56	0.34	0.40
0.20	1.04	0.81	0.63	0.91	1.07	0.71	0.83	0.55	0.65
0.30	1.34	1.12	0.92	1.17	1.36	0.98	1.14	0.81	0.94
0.40	1.66	1.47	1.30	1.44	1.68	1.28	1.50	1.13	1.32
0.50	2.05	1.90	1.78	1.78	2.08	1.65	1.92	1 54	1.80
0.60	2.49	2.46	2.42	2.16	2.52	2.14	2.49	2.10	2.45
0.70	3.16	3.24	3.36	2.73	3.19	2.81	3.27	2.90	3.39
0.80	4.17	4.60	4.90	3.59	4.19	3.96	4.62	4.24	4.94
0.90	6.12	7.29	8.60	5.26	6.13	6.29	7.34	7.42	8.66
0.95		8.50	10.99	13.31	7.29	8.50	9.44	11.02	11.45	13.35
0.98		12.14	17.02	22.53	10.43	12.17	14.60	17.04	19.37	22.60
0.99		15.24	22.21	31.41	13.06	15.24	19.00	22.17	26.88	31.36

Benchmark Social Security Benefits are the future benefits projected for the individuals who are 21 in 1998 based on current Social Security rules.

The representative individuals in this simulation have the mean age-specific covered earnings in each year. Six percent of these wages are deposited annually to the Personal Retirement Accounts.

These calculations are based on 10,000 two-stage simulations. First we generate the log mean return by drawing from a distribution with mean 0.055 and a standard deviation of 0.0177. We then generate an 80-year series of annual returns that have this mean and a standard deviation of 0.125.

promised to each cohort under the Social Security law.[18] The first three columns show the cumulative probability distributions of annuity payments relative to benchmark benefits for retirees at ages 67, 77, and 87 with no pre-retirement bequest and a 6 percent saving rate. The next 6 columns show the same cumulative distributions but for the case in which individuals can bequeath their accounts if they die before age 67. For this case we consider PRA saving rates of 6 percent and 7 percent.

The results indicate that permitting pre-retirement bequests does not significantly increase the risk to retirees and that the increased risk can be fully offset by raising the PRA saving rate from 6.0 percent to 7.0 percent. With that increase in the saving rate, the risk distribution of annuity payments with pre-retirement bequests is essentially the same as the distribution with no bequests and a 6 percent saving rate. The median benefits with the 7 percent saving rate and pre-retirement bequests is 2.08 times the benchmark benefit level (column 6), virtually unchanged from the 2.05 times the benchmark value with the 6 percent saving rate and no bequests (column 2). The corresponding values at the tenth percentile of the distribution are 0.78 times the benchmark and 0.76 times the benchmark. The similarity continues at the higher age levels shown in Table 2.

The logic of the calculation is such that this same 17 percent proportional increase in the saving rate would be sufficient for any initial saving rate. For example, a PRA annuity that is intended to supplement rather than replace the tax financed retirement Social Security benefits would produce essentially the same distribution of annuities with either a two percent saving rate and no bequests or a 2.33 percent saving rate and pre-retirement bequests.

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[18]See section 4 below for a description of the variable annuities.

4. Post-Retirement Bequests

The magnitude of potential bequests is increased substantially if retirees can bequeath some part of their post-retirement income as well as their pre-retirement accumulation. We consider first how a variable annuity system would work and then examine a variety of alternative bequest options, assessing the cost in terms of reduced annuities or increased pre-retirement savings needed to produce those bequests. We begin with a life annuity for the retiree alone and then extend our analysis in section 5 to a double life annuity for the retiree and a spouse.

Our analysis assumes that the post-retirement annuity is financed with the same stock-bond mix as the individuals had during the pre-retirement years. When there is no post-retirement bequest, we assume that the individual receives variable annuity payments that adjust according to

the changes in the value of the PRA account balance caused by changes in market rates of return. More specifically, in a standard variable annuity contract, the "baseline" annuity benefit that would be paid at age 67 (on an annuity purchased at age 66) reflects the PRA assets at the beginning of the individual's 66^{th} year, the expected mortality rates at all future ages, and the assumption that the future return will be equal to the expected portfolio rate of return (5.5 percent in the current context). Each year the actual size of the variable annuity payment is increased or decreased from the initial value in proportion to the change in the market value of the PRA assets relative to the market value that would have prevailed if the expected 5.5 percent return had actually occurred.

More explicitly, let A(66) be the value of the assets that the individual has accumulated at the beginning of the 66^{th} year, let R be the expected real rate of return on the portfolio of assets used to finance the retirement annuity, and let p(s|66) be the probability of reaching age s conditional on being alive at age

66. The actuarial present value (APV) at age 66 of a fixed real annuity of \$1 for life beginning at age 66 is then:

$$APV = \sum_{s=67}^{s=100} p(s|66)\ (1+R)^{-(s-66)}$$

where we assume that all individuals alive at age 99 die at the end of the 100th year. Since the PRA account has assets equal to A(66) when the annuity is established, the annual annuity that the individual would receive in the 67th year is a(67) = A(66) / APV if the expected return of R is actually realized in the 66th year. In practice, of course, the actual rate of return varies from year to year. The annuity payments are adjusted in proportion to the annual changes in the asset value in such a way that the accumulated fund of the individuals with survival probabilities p(s|66) is exhausted over the 34 year potential retirement period. If R(s) is the actual rate of increase of the asset value during year s, the value of the annuity paid in that year is a(67) = [A(66)/ APV)](1 + R(66))/(1+R). Similarly the annuity at age 68 reflects the changes in the market value of the assets during the 66th and 67th years: a(68) = a(67) (1 + R(67))/(1+R)= (A(66)/ APV) [(1 + R(67))/(1+R)][(1 + R(66))/(1+R)].

These annuity payments leave no room for post-retirement bequests in the sense that, for the birth cohort as a whole, the annuity payments between ages 67 and 100 just exhaust the aggregate value of the assets that had been accumulated at age 66. It is possible however to reduce each annuity payment by some factor k and provide for a bequest at the time of the retiree's death. The value of k will depend on the particular bequest rule. We now consider two of the many possible types of possible bequest rules: (1) rules that combine actuarial life annuities and N-year-certain payouts; (2) a residual balance bequest rule

that provides a lifetime annuity but that also provides a bequest that is equal to the original accumulated PRA balance at the time of retirement [A(66)] supplemented by the increases in the nominal account value resulting from investment returns until the time of death and reduced by the sum of the actual annuities paid to the retiree. Our use of a variable annuity (i.e., one in which the annuitant takes the risks associated with investing in a stock-bond portfolio) precludes bequest rules that promise a fixed dollar payment at death.[19]

Table 3 compares the costs and benefits of the different post-retirement bequest rules. All of the options are assumed to include full pre-retirement bequests. The basic PRA saving rate in these simulations is 6 percent of wages.

Row one corresponds to the case (studied in section 3) in which there is a pre-retirement bequest but no post-retirement bequest. With the 6 percent saving rate, the mean value of the annuity at age 67 in 10,000 simulations is equal to 2.57 times the benchmark Social Security benefit in current law; this is shown in column 3. The corresponding median annuity, shown in column 5 of Table 2, is 1.78 times the benchmark benefit. The annuity reduction factor (column 2) is the constant proportionality factor, k, by which the specified post-retirement bequest reduces all annuity benefits relative to the benefits that would be paid with the pre-retirement bequest but no post-retirement bequest. By definition, k = 1 for the "No Bequest" option of row 1. The "Required PRA Saving Rate" shown in column 4 is the saving rate required to have the same mean annuities at each retirement age as the option with no post-retirement bequest based on a 6 percent saving rate, i.e., 6.0/k.

[19]In practice it would of course be possible to have a portion of the funds in a fixed annuity so that a fixed dollar payment at death could be promised.

Table 3

Effects of Alternative Post-Retirement Bequest Rules

Post-Retirement Bequest	Annuity Reduction Factor	Mean Annuity*	Relative Bequests PRA Saving Rate**	Required Distribution of Bequests with 6 % saving rate		Distribution of Bequests with adjusted saving rate	
				Mean	Standard Deviation	Mean	Standard Deviation
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. None	1.00	2.57	6.00	0.00	0.00	0 .00	0.00
2. 10-year certain	0.94	2.41	6.42	0.52	0.66	0.56	0.71
3. 20-year certain	0.83	2.13	7.26	1.51	2.35	1.83	2.84
4. Residual Balance	0.71	1.83	8.46	2.49	3.73	3.51	5.26

* The mean PRA annuity at each age relative to the Social Security "benchmark" benefit.

** The PRA saving rate required to make the mean annuity at each age equal to the value with no-post-retirement bequests.

The mean and standard deviation of bequests in Columns 5 through 8 are stated as the present value of bequests discounted to age 67 and stated as multiples of the mean wage when the cohort was age 66.

4.1 Ten-Year and Twenty-Year Certain Annuities

In private pension plans a popular alternative to a pure life annuity is an option that provides for a minimum number of years of annuity payments even if the retiree dies during those years. Two common forms are the "ten-year-certain life annuity" and the "twenty-year-certain life annuity". If the retiree dies after this specified period, there is no bequest.

The proportional reduction in the regular life annuity that is required to permit a ten-year- certain payment is calculated by equating the actuarial present value of the regular life annuity $[\Sigma_{s = 67 \text{ to } 100} a(s)\, p(s|66)\, (1 + R)^{-(s - 66)}]$ to the sum of a fixed ten year reduced annuity $[\Sigma_{s = 67 \text{ to } 76} k\, a(s)\, (1 + R)^{-(s - 66)}]$ and the actuarial present value of the similarly reduced life annuity beginning 11 years after retirement $[\Sigma_{s = 77 \text{ to } 100} k\, a(s)\, p(s|66)\, (1 + R)^{-(s - 66)}]$ where $1 + R = E(e^{r(s)})$, is the expected value of the gross return. The value of k calculated in this way implies that the pre-retirement saving rate that would be required to maintain the initial annuity distribution is just the basic saving rate divided by the value of k since that raises the PRA assets at the time of retirement by the factor 1/k.

The results for ten-year and twenty-year-certain annuities are shown in rows 2 and 3 of Table 3. A ten-year-certain payment reduces the available annuity by only 6 percent, i.e., by the factor k=0.94 in column 1. The ability of a six percent reduction in the annuity payment to compensate for the fact that the annuity will be paid for at least 10 years even if the retiree dies before age 77 reflects the relatively low mortality probability during those years. With the basic 6 percent saving rate, the mean annuity at age 67 is still 2.41 times the benchmark social security benefit. Achieving the same mean annuity with the ten-year-certain payment as with no post-retirement bequest requires increasing the six percent saving rate by a factor of 1/k = 1.064 to a saving rate of 6.42 percent (shown in column 4).

The post-retirement bequests are separate from the pre-retirement bequests and, for the cohort as a whole, are in addition to them. For any individual, the mean expected bequest is p(death before age 67)* (mean pre-retirement bequest) + [1 - p(death before age 67)] * (mean post-retirement bequest.)

Columns 5 and 6 show the mean and standard deviation of the post-retirement bequests that would be available with the basic six percent saving rate. These bequest values are the present values as of age 67 (discounting at the expected return on the PRA balances) and are reported as a multiple of the projected mean wage in the year that the cohort reached age 67 ($44,087 in 1998 dollars). The value of 0.52 in column 5 of row 2 implies that the mean of the post-retirement bequests in the 10,000 simulations has a present value as of age 67 of $22,925. Associated with this mean present value of bequests is a standard deviation shown in column 6. In interpreting this standard deviation it should be noted that the distribution is lognormal and therefore not symmetric.

With the adjusted saving rate that is needed to maintain the same distribution of annuity payments that would prevail with no post-retirement bequests, i.e., a saving rate of 6.42 percent, the value of the bequests rises by the same proportional amount. The mean bequest shown in column 7 is 0.56 times the mean wage in the year that the cohort reaches age 67.

A twenty-year-certain rule means that the annuity payments continue after death until at least the time when the retiree would have been 87 years old even if he died before then. The extra ten years of guaranteed payments at a time when the mortality rate is increasing rapidly requires a further reduction in benefits of 11 percent of the standard benefit, i.e., from 94 percent of the standard annuity with the ten-year-certain rule to 83 percent with the twenty-year-certain rule. But, even with this reduction, the six percent PRA saving rate implies a mean annuity at age 67 that is still 2.13 times the benchmark Social

Security benefit. To offset this decrease and achieve the same annuity distribution that would occur with no post-retirement bequest requires increasing the six percent saving rate to 7.26 percent.

Columns 5 and 6 show the mean and standard deviation of the present value of post-retirement bequests that would be available with the basic six percent saving rate, reported as a multiple of the mean wage in the year that the cohort reached age 67. The mean present value bequest as of age 67 with the 6 percent saving rate is $66,571; this rises to $80,679 if the saving rate is adjusted to 7.26 percent.

4.2 Residual Balance Annuities

An alternative type of bequest rule would give heirs the actuarial value of the remaining lifetime annuity payments at the time of the retiree's death. This is equivalent to the original account value at the time of retirement [A(66)] reduced by the sum of the annuities actually paid and supplemented by the increases (or decreases) in the nominal account values resulting from the investment returns. More explicitly, if the retiree dies at age s after receiving the annuity payment k a(s) the bequest would evolve according to $A(s) = [1 + R (s-1)] A(s-1) - k a(s)$. We refer to this as the Residual Balance Bequest and show the main effects in row four of Table 3.

The required value of k can be calculated by equating the actuarial present value of the regular life annuity $[\Sigma a(s) p(s|66) (1 +R)^{-(s - 66)}]$ to the sum of the actuarial present value of the reduced annuity $[\Sigma k a(s) p(s|66) (1 + R)^{-(s - 66)}]$ and the actuarial present value of the bequests $[\Sigma [p((s+1)|66) - p(s|66)] A (s) (1 + R)^{-(s - 66)}]$ where $p(s+1)|66) - p(s|66)$ is the probability of dying at age s and $1 + R = E(e^{r(s)})$ is the expected return on the PRA balance. We find that k = 0.71, a 29 percent reduction in the potential annuity levels relative to providing only pre-retirement bequests.

Even with this reduction, the PRA program with a six percent saving rate would provide a mean

annuity that is 1.83 times the benchmark Social Security benefit (column 3). To maintain the "no post-retirement bequest" probability distribution of annuity income while giving the "residual balance" bequest requires raising the saving rate from 6.0 percent to 8.5 percent (column 4).

Turning from the annuities to the bequests, with the 6 percent saving rate the present value of bequests as of age 67 is 2.49 times the mean wage in the year that the cohort reaches age 67 or $109,777 in 1998 prices. With the saving rate raised to 8.5 percent to maintain the original distribution of retirement annuities, the mean present value of the bequests rises to $154,745.

5. Bequests to Spouses and Double Life Annuities

Bequests to spouses are different from intergenerational transfers. Social Security provides additional benefits to surviving spouses whose own benefits are relatively low and private pension plans in the United States are required to continue annuity payments to surviving spouses unless that spouse specifically relinquishes his or her right to a benefit.

There are a variety of possible arrangements for providing annuity benefits to a surviving spouse.[20] The simplest of these is a double life annuity. This provides that the variable annuity continues to be generated in the same way until both the retiree and the retiree's spouse have died. The cost of providing such a double life annuity depends on the sex of the primary beneficiary (the "retiree") and the difference

[20]Recall that our basic analyses (e.g., Feldstein and Samwick, 1998a; Feldstein and Ranguelova, 1998) assume that benefits will be provided, as specified in current law, to spouses, survivors and the disabled as well as to retirees. The bequests that we study in this paper would be supplementary to these additional benefits already provided in current law. Note that, with a PRA saving rate of 6 percent, the benefits that we calculate are not of the amount that must be set aside to pay disability and survivor benefits called for in current law. Operationally, a fraction of the 6 percent PRA saving could be set aside to purchase survivor and disability insurance while still financing the retirement benefits cited in this paper.

in age between the retiree and the spouse. For our calculations we assume a male retiree who is two years older than his wife.

With this assumption, the probability that the spouse is alive at the time of the retiree's death decreases from 0.89 if the retiree dies at age 67 to 0.75 if the retiree dies at 77 and 0.51 if the retiree dies at 87. Our simulations imply that replacing a single life annuity with a double life annuity reduces the annuity that can be financed with our 60:40 stock-bond investment mix by 20 percent. Alternatively, to maintain the same annual payments if the single life annuity is replaced with a double life annuity requires raising the saving rate by 25 percent, e.g., increasing for example from 6.0 percent to 7.5 percent.

The double life annuity can also be extended to permit bequests to other heirs after the retiree and the retiree's spouse have both died. Using the residual balance method of calculating bequests means permitting other heirs to receive the actuarial value of the remaining account balance. This is equivalent to reducing the original account value at the time of retirement [A(66)] by the sum of the annuities paid to the retiree and spouse and supplementing it with the increases in the account values resulting from the investment returns. If the "second to die" dies when the retiree would have been age s, the bequest would be A(s) which evolves from A(66) according to

$A(s) = [1 + R(s-1)]\, A(s-1) - k\, a(s)$. Table 4 shows the probability of bequest to non-spousal heirs, the mean bequest, and the standard deviations of the bequests at each age as well as the overall mean and standard deviation of the bequests. These bequests are shown as multiples of the mean earnings of employees in each year. The projected mean earnings (in 1998 dollars) in each year is shown for comparison. The analysis for bequests in all years (shown in the last row of the table) converts the bequests into multiples of mean covered earnings in the year that the bequest is received.

The probability of a bequest shown in column 2 includes pre-retirement as well as post-retirement bequests. In both situations, the other heirs receive bequests only if both the husband and wife have died.

Table 4

Post-Retirement Bequests to Non-Spousal Heirs with a Double Life Annuity*

Age	Probability of Bequest To Non-Spousal Heirs	Mean Bequest	Standard Deviation Of Bequest	Mean Earnings ($000)
30	0.000008	0.5	0.1	31
40	0.000032	1.5	0.6	34
50	0.000097	3.4	2.1	37
60	0.000550	6.9	5.8	41
70	0.004024	7.2	8.6	45
80	0.020680	6.3	10.1	50
90	0.075238	4.5	9.8	55
All		5.1	10.0	42

* The PRA account earns a mean return of 5.5 percent with a standard deviation of 12.5 percent; see text for more details. The employee in these calculations is a male with a spouse who is two years younger. Bequests are stated as multiples of the mean earnings in the year of bequest. Mean earnings, shown in the fifth column, are in constant 1998 dollars.

The probability that an heir other than a spouse receives a benefit in any year is low until the primary retiree is quite old because until then the probability that at least one spouse is alive is quite high. With the six percent saving rate assumed in these calculations, the mean bequests when they occur are quite substantial, rising from $126,000 (3.4 times average individual annual earnings) at age 50 to $324,000 (7.2 times average individual annual earnings) when the second member of the couple dies when the primary annuitant would have been 70 years old. This amount is six times the annual individual earnings in the year of bequest. The final row of Table 4 shows that the mean bequest is 5.1 times the average covered earnings in the year that the bequest is made.

The bequests described in Table 4 assume a couple with just a single-earner, an increasingly rare situation in the American economy. When both members of a couple work, a double life annuity with residual bequests offers more attractive prospects to other heirs. We analyze in Table 5 the situation for a two-earner couple both of whom have double life annuities. In this analysis, each member of the couple receives a PRA annuity while they are alive. When the first member of the couple dies, the remaining member of the couple receives both annuity payments. At the death of the remaining member, the other heirs receive the actuarial value of the remaining balances in both annuities.

The specific distribution of such Residual Balance bequests depends on the ages of the couple and on the amounts that each earns. As an example, we consider a couple in which both members earn the average wage and in which the wife is two years younger than her husband. We assume that the pre-retirement bequest that is paid to a surviving spouse is consumed during his or her lifetime. While we understand that additional amounts may be bequeathed, for the purpose of this analysis, we count as a bequest to other heirs only the amounts that come directly from PRA accounts or annuities and not funds that were accumulated by the decedent from previous bequests received or in other ways. Table 5 shows, as a function of the age that the husband is

Table 5

Post-Retirement Bequests to Non-Spousal Heirs:
Two-Earner Couples with a Double Life Annuity*

Age	Probability of Bequest To Non-Spousal Heirs	Mean Bequest	Standard Deviation Of Bequest	Mean Wage ($000)
30	0.000015	0.5	0.1	31
40	0.000065	1.6	0.7	34
50	0.000218	3.6	2.2	37
60	0.001129	7.2	6.1	41
70	0.007612	9.6	11.4	45
80	0.036794	10.5	16.7	50
90	0.131211	7.7	16.6	55
All		7.1	15.5	42

* The PRA account earns a mean return of 5.5 percent with a standard deviation of 12.5 percent; see text for more details. Husband and wife in these calculations both earn the mean age-specific covered earnings in each year. Bequests are stated as multiples of the mean earnings in the year of the bequest. Mean earnings, shown in the fifth column, are in constant 1998 dollars. The age refers to the age that the husband was (or would have been) in the year of the bequest.

or would have been, the probability of a bequest to non-spousal heirs, the mean and standard deviation of those bequests, and the average earnings in that year.

The probability of a residual balance bequest to other heirs during the pre-retirement years is higher in a two-earner couple than in a single-earner couple because a wife who is the second to die has a PRA balance to bequeath. In a single-earner couple, the other heirs receive a pre-retirement PRA bequest only if the husband is the second to die.[21] Similarly a widow who dies in the post-retirement years and who has

[21]Recall the distinction introduced in the previous paragraph between PRA bequests and other bequests.

had no labor earnings of her own has no PRA account if her husband died before age 67. She therefore leaves no PRA bequest. In contrast a widow who had her own earnings history can leave her annuity to her nonspousal heirs even if her husband died before.

The expected value of the bequests is also higher in the two-earner case because on the death of the second spouse the heirs can receive the residual balance of two accounts per couple if both spouses die after age 66.

6. Macroeconomic Consequences of Bequests

An investment-based Social Security system in which the PRA deposits represent incremental saving also raises the national saving rate. An examination of the potential magnitude of the increased capital accumulation is presented by Feldstein and Samwick (1998a), who estimate the evolution of PRA assets in an economy in which population and wage earnings grow between 1995 and 2070 according to the projections of the Social Security actuaries. The Feldstein-Samwick analysis assumes that two percent of the covered wages of each employee are deposited in Personal Retirement Accounts each year, that these assets earn a real nonstochastic 5.5 percent rate of return, and that individuals receive actuarially fair annuities beginning at age 65. There are no bequests in either the pre-retirement or post-retirement years. With these assumptions, the aggregate balance in the PRA accounts reaches 38 percent of GDP by the year 2030 and 79 percent of GDP by the year 2070.[22]

The extent to which this accumulation of PRA assets raises the nation's capital stock depends on

[22]The analysis is partial equilibrium and ignores the effect of this calculation on the marginal product of capital, the level of wages and the tax rates required to fund government purchases of goods and services. An updated version of this analysis, using Social Security projections of 1998, is presented in Feldstein and Samwick (1999).

the way in which other private and public saving responds to the introduction of investment-based Social Security. We ignore these issues here and focus just on the way in which the introduction of bequests would alter the accumulation of PRA assets.[23]

Although our framework of analysis in the current paper does not permit us to calculate the effects of bequests on aggregate PRA assets in each year, we can show the impact of bequests on PRA asset accumulation by comparing the mean PRA asset values for representative individuals of different ages under the different bequest assumptions. The figures in column 2 of Table 6 are the cohort's aggregate PRA accumulations with no bequests. These figures, based on a saving rate of six percent, are in billions of 1998 dollars and are shown as a function of the age of the cohort members. The cohort's PRA assets rise from $54 billion at age 30 to $978 billion at age 60 before beginning a post-retirement decline during the next decade. These aggregate accumulation values correspond to amounts per cohort member of approximately $16,000 at age 30 and $280,000 at age 60.

The effect of pre-retirement bequests is shown in column 3. Each figure in this column shows the assets at the identified age as a percentage of the baseline assets shown in column 2. Most of the reduction in assets occurs at ages close to retirement. At age 50 the mean PRA balance is 96.7 percent of the no-bequest baseline amount. This declines to 86.6 percent by the time of retirement and remains at that level since no further bequests are made. These figures imply that the net reduction in total PRA assets of all generations at a point in time is likely to be less than 10 percent.

[23]The effect of bequests on national saving depends also on what the individual bequest recipients do with the received amount.

Table 6

PRA Assets as a Percent of the No Bequest Baseline with Different Bequest Rules*

Age	No Bequests Baseline (billion)	Pre-Retirement Bequests Only	10-year certain	20-year certain	Residual Balance
(4)	(2)	(3)	(4)	(5)	(6)
30	54	99.5	99.5	99.5	99.5
40	181	98.5	98.5	98.5	98.5
50	446	96.7	96.7	96.7	96.7
60	978	92.1	92.1	92.1	92.1
70	917	86.3	87.5	92.6	91.2
80	546	86.3	80.7	106.0	106.8
90	179	86.2	80.6	71.2	116.7

* Baseline PRA Assets are based on a PRA plan with no bequests. Dollar amounts are in 1998 dollars. The other bequest options all assume the pre-retirement bequests.
The post-retirement bequests shown in column 4 through 6 are based on single life annuities.

A ten-year-certain annuity (in combination with the pre-retirement bequests), shown in column 4, implies a decline in PRA assets at all ages. Until retirement age, the decline is the same as with the pure pre-retirement bequest since the ten-year-certain annuity is only available after retirement age. Between 67 and 77 the PRA assets decline more slowly because the annuity payout rate is reduced in order to finance the ten-year-certain option. The difference however is not large. After age 77 the assets are smaller than with just the pre-retirement bequests because of the larger average annuity payout between ages 67 and 77 and the corresponding reduced annuity to be financed after age 77.

With the twenty-year-certain option, the PRA assets actually rise relative to the baseline amount during the early retirement years because in those years the reduced level of the annuity outweighs the

twenty-year-certain payments made to the heirs of those who have died. By age 87, however, the annuity payments must be lower than in the ten-year-certain case (to compensate for the greater number of years of guaranteed benefits) and therefore the assets that support those annuities must be lower.

Finally, the residual balance bequests imply higher assets at all ages because of the much more substantial reduction of the annuity payments. Unlike the ten-year-certain and twenty-year-certain annuities, in the residual balance case the assets do not decline in old age because the annuity benefits remain unchanged and the expected value of the residual balance bequest increases as the assets accumulate.

In general, therefore, permitting bequests is likely to reduce PRA assets by relatively small amounts. Even these modest declines overstate the effect of bequests on total capital accumulation because they do not take into account the effect of bequest on non-PRA assets that are accumulated as a result of PRA bequests. Moreover, if the PRA saving rate is adjusted to stabilize the annuity levels, the net effects of bequests on asset accumulation would be positive.

5. Conclusions

Experience in private pension plans and recent policy discussions about Social Security suggest that some forms of bequests is likely to be part of any enacted investment-based Social Security reform . This paper provides a first examination of the potential magnitudes of such bequests and of their effect on retirement annuities and asset accumulation.

Investment-based Personal Retirement Accounts (PRAs) would accumulate substantial funds, some of which would be distributed as bequests. We analyze the effects of a six percent saving rate, a level that would provide a nearly 80 percent probability that the annuity payments at age 67 are at least equal to the

future benefits promised in current Social Security law. (Pure pay-as-you-go financing would require a payroll tax rate of more than 18 percent to finance the same benefits.) With such a saving rate, the cohort reaching age 21 in 1998 would expect to accumulate more than $50 billion by age 30 and more than $900 billion by age 60, all expressed in the prices of 1998. These amounts are about $16,000 per employee at age 30 and $300,000 at age 60.

The most likely form of bequest is the "pre-retirement bequest" made when employees die before retirement age. The alternative to such bequests would be a 100 percent tax at death on all accumulated PRA assets or an administratively complex system of mandatory annuitization of all savings as they accumulate. Providing such bequests reduces the funds available for post-retirement annuities by about 16 percent or, equivalently, requires a one-sixth increase in the PRA saving rate (e.g., from 6 percent to 7 percent) to maintain the same level of post-retirement annuities as would be possible with the mandatory annuitization or all savings.

We also analyze a variety of post-retirement bequest options. The least costly option that we consider is adding a "ten-year-certain" feature to the life annuity, thereby providing a bequest whenever the retiree dies before age 77. This would reduce annuities, relative to providing only pre-retirement bequests, by about 6 percent. The most costly option that we consider would provide a bequest equal to the remaining actuarial value of the PRA annuity at the time of death and would require reducing all annuities by about 29 percent. These reductions in the annuity levels could be avoided by increasing the PRA saving rate by a corresponding amount.

The size of the bequests and the impact on asset accumulation is proportional to the PRA saving rate. The results in this paper are based on a PRA saving rate of 6 percent, a level of saving that could in

principle eventually substitute completely for the pay-as-you-go tax and finance all benefits with a margin of safety. The PRA saving rate required for the more realistic task of stabilizing the current 12.4 percent payroll tax rate while maintaining the benefits projected under current law would be about two percent. The pension and capital accumulation effects of such a mixed system would be about one-third of the amounts shown in this paper.

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