Managing a Retirement Portfolio: Do Annuities Provide More Safety?

John J. Spitzer

Even with the generally recognized "safe" withdrawal amount of 4% of the retirement portfolio starting balance, more than 5% of retirement portfolios will run out of money over a 30-year period. Bootstrap simulations were used to estimate the probability of outliving a retirement portfolio as increasing proportions of a tax-deferred account are annuitized. The impacts of Required Minimum Distributions and taxable Social Security income were incorporated into the analysis. Results indicate that annuities significantly extend the length of time the portfolio lasts, but the expected balance remaining (estate size) will decrease substantially, a trade-off of security versus a legacy. Advisors and planners may find the graphical exposition helpful when showing clients different tradeoff options.

Key Words: annuity, asset allocation, bootstrap, required minimum distributions, retirement withdrawals

Introduction

How much to withdraw each year from a retirement portfolio is a complex decision: withdraw too much and the retiree outlives the retirement portfolio; withdraw too little and the good times that might have been are forfeited. The percentage of time that a portfolio runs out of money before 30 years has elapsed will be referred to as the shortfall rate or the shortfall probability. Three interrelated issues that affect outcomes were included:

1. The withdrawal rate and asset allocation both affect the shortfall rate and estate size.
2. Required Minimum Distributions (RMDs) influence the withdrawal amount, which in turn influences the shortfall rate.
3. Fixed term, guaranteed, inflation-adjusted annui ties decrease the shortfall rate but also decrease estate size.

A fixed, 30-year guaranteed, inflation-adjusted annuity was integrated into a retirement withdrawal strategy (while also noting the effect of RMDs), and the effect on shortfall risk and estate size was observed. The study closely followed the logic and format of Spitzer (2008), with modifications to account for the annuities. Starting portfolio balances of three different sizes were specified; six different annuity percentages were used, and withdrawals were made annually over 30 years. A bootstrap method was employed in order to account for the variability in portfolio returns through time. Ameriks, Veres, & Warshawsky (2001) showed that the inclusion of an annuity in the retirement withdrawal process provided more certainty and longer withdrawal periods. This study determined how the probabilities of success and the sizes of the ending balance are affected as the annuity amount is increased.

Literature Review

Four distinct areas were integrated: (a) Safe Withdrawal Amounts and Asset Allocation, (b) Required Minimum Distributions (RMDs), (c) Order of Withdrawals, and (d) Annuities. Tax-deferred accounts, such as a 401(k), a 403(b), a traditional IRA, a 457 plan, and a Keogh plan are generically referred to as a Tax Deferred Account (TDA).

Safe Withdrawals & Asset Allocation

Whether the TDA money can last for 30 years or not depends on the yearly withdrawal amount, the asset allocation of the portfolio, and the market rates of return during the withdrawal period. Bengen, in a series of articles beginning in 1994 and ending in 2006, studied the question of what is "safe" to withdraw each year from an individual's retirement portfolio if the portfolio has to last at least

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30 years. Bengen's studies incorporated different withdrawal amounts, different asset allocations and asset types, different rebalancing frequencies, and withdrawal periods of different lengths. This research found that when the portfolio is allocated 50%-60% to stocks and the remainder to bonds, withdrawal rates (inflation adjusted) of about 4%-5% of the starting balance of the retirement portfolio would last for 30 years. Bengen (2006) included "an annuity-like scheme" where "the nominal value of the client's dollar withdrawals remains the same during retirement; the real value will fluctuate unpredictably" (Executive Summary). Bengen suggested that an immediate annuity (not inflation adjusted) with an initial payout of 5% or more might be considered in place of a managed portfolio if one is willing to give up access to the portfolio.

Cooley, Hubbard, & Walz (1998, 1999, and 2003) used different data and methods but arrived at similar conclusions. Others have extended these results by changing the asset types and the asset allocations and have shown that it is possible to increase the "safe" withdrawal rate by a small amount. However, the recommendation of a 4%-5% withdrawal amount with 50% - 70% of the portfolio in stocks and the remainder in bonds seems to be generally accepted and widely recommended. Cooley et al. (2003) found a 19% shortfall rate over 30 years with 4% withdrawals and a 50% stock/50% bond allocation. They showed that by increasing the stock allocation to 75%, the shortfall rate could be decreased to 16%. Spitzer, Strieter, and Singh (2007) provided interesting graphics that illustrate the trade-off of withdrawal rate to success rate and how both are affected by asset allocation. Their results indicated about a 6% shortfall rate with 4% withdrawals and a 50/50 stock/bond allocation. The rather disparate results between these two papers may be attributed to the fact that Cooley et al. (2003) used monthly data and long-term corporate bond returns in a Monte Carlo study, while Spitzer et al. (2007) used annual data with U.S. government intermediate-term bond returns in a bootstrap. A question raised here centers on what "safe" really means; to some a 19% shortfall rate is acceptable, but to others nothing short of 0% shortfall will suffice. Each retiree must determine what "safe" means to them. The ability to reduce the shortfall rate with annuities to an "acceptable" level was the goal of this paper. The 4% rule was used as a starting point; exactly how safe the rule is and how much additional safety can be achieved with the addition of annuities will be revealed.

Required Minimum Distributions (RMDs)

The Internal Revenue Service (IRS) allows individuals to accumulate money in retirement accounts on a tax-deferred basis. Once the individual is no longer adding money into the account, the IRS recoups taxes due on the previously deferred income. To that end, the IRS requires that beginning at age 70 1/2, the retiree must begin withdrawing money from those accounts and pay taxes on the distributions. Prescribed minimum amounts must be withdrawn every year from the retiree's TDA. These RMDs may result in the retiree withdrawing more money from their TDA than they would otherwise choose to do; further, the withdrawal may be in excess of the "safe" withdrawal amount discussed above.

IRS Publication 590, *Individual Retirement Arrangements*, contains the "Uniform Lifetime Table" (Appendix C, 104) which contains divisors at each age from 70 and above that determines the RMDs for most couples. Table 1 shows the reciprocals of the numbers from the Uniform Lifetime Table and indicates the percentage of the current year-end portfolio balance that must be withdrawn. For example, at 73 years of age, the RMD will be approximately 4.05% of the TDA balance; at age 83, the RMD will be about 6.13%; and at age 93, it will be 10.42% of the remaining balance. The required distribution can be larger than the desired distribution. The distribution size depends on the current asset value of the portfolio and the required percentage in Table 1. There is a potential conflict here. A retiree may want to follow the advice of his or her financial advisor (restrict withdrawals to 4% of the initial balance), but RMDs may make compliance with that advice impossible.

Although RMDs are recognized in the withdrawal and retirement literature, to date only Spitzer (2008) has investigated the effect of RMDs on portfolio shortfall risk and on the balance remaining after 25, 30, and 35 years. Spitzer found that if the retiree was forced by the RMDs to distribute more than the desired 4% of the starting portfolio balance and if the excess could be reinvested in a taxable account, then RMDs would have no significant effect on shortfall risk. That is, RMDs are not a significant threat if a determined and responsible effort is made to manage the excess withdrawal. Spitzer also showed that purchasing tax-exempt vehicles (e.g., Roth IRAs) and/or concurrently purchasing Roth IRAs while taking RMDs was ineffective. Roth IRA purchases resulted in higher shortfalls than the simple "brokerage account reinvestment" strategy.

Table 1. Percentage of Portfolio Required at Each Age

Age % Required for distribution		
70	86	102
3.65	7.09	18.18
71	87	103
3.77	7.46	19.23
72	88	104
3.91	7.87	20.41
73	89	105
4.05	8.33	22.22
74	90	106
4.20	8.77	23.81
75	91	107
4.37	9.26	25.64
76	92	108
4.55	9.80	27.03
77	93	109
4.72	10.42	29.41
78	94	110
4.93	10.99	32.26
79	95	111
5.13	11.63	34.48
80	96	112
5.35	12.35	38.46
81	97	113
5.59	13.16	41.67
82	98	114
5.85	14.08	47.62
83	99	
6.13	14.93	115
84	100	and over
6.45	15.87	52.63
85	101	
6.76	16.95	

Note: From "Do RMDs endanger 'safe' portfolio withdrawal rates?" by J.J. Spitzer, 2008, *Journal of Financial Planning, 21*(8), p. 44. Copyright 2008 by The Financial Planning Association. Reprinted with permission. The table is adapted from IRS Uniform Lifetime Table (Individual Retirement Arrangements, IRS Publ. No. 590. Appendix C, p. 104.)

Order of Withdrawals

A growing area in the retirement and withdrawals literature examines the sequencing of withdrawals from different types of portfolios (e.g., Traditional IRAs, Roth IRAs, and brokerage accounts). Of particular importance in the present context is the withdrawal order from TDAs and from brokerage accounts. Keebler (2007), for example, recommended withdrawing retirement income first from taxable accounts, next from tax-deferred accounts, and last from tax-free accounts (Roth IRAs). Lange (2006) echoed these sentiments. Reichenstein (2006) examined circumstances under which withdrawing from Roth accounts before TDA accounts is warranted. With reference to brokerage accounts, Reichenstein stated that "the key assumption is that the effective tax rate for most investors on stocks held in taxable accounts is well above zero. Therefore, as a rule of thumb, individuals should withdraw funds from the taxable account before the retirement account. As discussed in the text, the exception to this rule of thumb is the few individuals who will await the step-up in basis at death" (p. 19). Spitzer and Singh (2006) noted an additional exception to the advice that withdrawals from brokerage accounts should precede withdrawals from TDAs. Spitzer and Singh (2006) found that when the after-tax rate of return on the brokerage account exceeds the rate of return on the TDA, a greater number of withdrawals could be obtained by withdrawing from the TDA first. This interesting property will be incorporated into this study (see Endnote 3).

Annuities

Annuities come in a variety of sizes and flavors, and the use of annuities in retirement portfolios is not new. Financial advisors often suggest the use of variable annuities for their clients. Since annuities are instruments predominantly sold by insurance companies, insurance companies are proponents of their use (see Dus, Maurer, and Mitchell (2005) for a review of the annuities literature; their literature review contains an extensive discussion of several withdrawal strategies that integrate life annuities).

Annuities are often thought of as complex, expensive, and (sometimes) unfair[1]. There is a potentially confusing array of annuities such as fixed, immediate, indexed, single life, joint life, guaranteed, lifetime, and inflation protected to name a few. A variable annuity generates an income stream dependent on a portfolio essentially managed by the annuitant. Actually, the annuitant has traded the management of the retirement portfolio for the management of the annuity portfolio. The variable annuity and retirement portfolio are both subject to shortfall risk. Life annuities pay out for as long as the annuitant lives. If the annuitant dies soon after purchasing the life annuity, the remainder of the payout may be forfeited. Guaranteed annuities will continue to pay out for a guaranteed period, even if the annuitant is deceased. Dual-annuitant instruments and guaranteed annuities are less punitive, but they cost more. Annuitants with long lives are subsidized by annuitants with short lives. Consequently, life annuities are not appealing instruments for individuals with average or short life expectancies. Milevsky and Young (2007) stated that "individuals should *always* hold some annuities..." (p. 3167). When annuities can be purchased at different points in time, Milevsky and Young recommended that individuals annuitize part of their wealth as soon as possible, and then purchase more annuities later. They concluded that the amount to annuitize increases with wealth, with risk aversion, with portfolio volatility, and with better health assessments (p. 3167). Ameriks, Veres, & Warshawsky (2001) incorporated immediate annuities into a retirement withdrawal strategy. They concluded that "the withdrawal factor can be sustained with more certainty, for longer time periods, by adding the risk-pooling characteristics of an immediate annuity to the overall retirement portfolio" (Discussion section, ¶ 2).

The current research focuses on surviving a 30-year withdrawal process and doing so while maintaining the same standard of living. To that extent, the annuity of interest is a fixed, 30-year guaranteed, inflation-adjusted annuity. This annuity is rare, but it does exist. For example, Vanguard provides such an instrument (www.aigretirementgold.com/vlip). The annuity pays a fixed (real or inflation-adjusted) amount for as long as the annuitant lives but for a minimum of 30 years. If the annuitant dies before 30 years, the annuity continues to pay out the inflation-adjusted amount to heirs. Vanguard (September 2007) quoted an annuity payout of 4.295% of the purchase amount for an inflation-adjusted, 30-year immediate annuity[2]. For purposes of the current study, the rounded value of 4.3% was used. If the money used to purchase the annuity comes from a qualified account like a TDA, the IRS considers the RMD requirement on the annuity purchase amount to be fulfilled. All income received from the annuity is taxed as ordinary income, and since withdrawals will be made on a regular basis and are irrevocable, the IRS is guaranteed to receive the taxes that are due on the tax-deferred money. Any money remaining in the TDA is still subject to the RMD.

Analysis

An Illustrative Example

Neil and Anna Singer are both 66 years old, have been married for 30 years, and have amassed TDAs with a combined value of alternately \$0.5M or \$1.0M or \$1.5M one year before their retirement. They plan to retire at age 66 when their Social Security benefits will jointly total \$30,000 per year. They may have \$15,000 each in Social Security benefits, or they may have unequal components that total \$30,000. They have no other financial assets. It was assumed that money is withdrawn from their TDAs at the beginning of a year and that taxes are paid at the end of the year. In order to keep the analysis manageable, it was assumed that the Singers live in a state that has no state income tax.

Assumptions and Behaviors

1. All calculations are in real terms, i.e., inflation adjusted. The implementation proceeds as follows:
   a. The rates of return (described in a later section) that are used to determine the value of the TDA are inflation-adjusted.
   b. The Internal Revenue Service modifies federal income taxes annually for inflation such that taxes have the same *real* burden from year to year for the same real income. The 2008 federal tax schedule is used throughout, and taxes are calculated on real income as if it had been earned in 2008.
   c. In reality, the Social Security Administration adjusts benefits annually with Cost of Living Adjustments (COLAs) which are linked to the Consumer Price Index (CPI). The Singers' nominal Social Security benefits may change over time, but the real value of their benefits payments is held constant at \$30,000 in 2008 dollars.
   d. Lastly, the annuity payments made to the Singers are inflation-adjusted, that is, in 2008 dollars. Nominal annuity payments are assumed to increase synchronously with the CPI, similar to the Social Security COLA.
2. The Singers will follow the widely accepted "safe" guidelines that were previously described. To that end, the Singers will withdraw 4% of their starting portfolio balance each year and will rebalance annually in order to maintain a 50%/50% stock/bond allocation.

3. The Singers will file federal income taxes as "married, filing jointly," and they will not itemize (the 2008 federal tax schedule that they will use is reproduced in Table 2.) The exemption for each filer is $3,500, and their standard deduction is $13,000 since both filers are over 66 years of age. The total of their standard deduction ($13,000) and their personal exemptions ($7,000) is $20,000.
4. Social Security benefits are taxed by a somewhat complex set of criteria. The IRS bases how much of the Social Security benefits are subject to tax on the amount of "Provisional Income," defined as the Adjusted Gross Income excluding Social Security benefits plus non-taxable interest plus one half of the Social Security benefits. The Singers would pay no income tax on their Social Security benefits if their Provisional Income was less than $34,000. If their Provisional Income is between $34,000 and $44,000, up to half of their Social Security benefits may be subject to tax. Lastly, if their Provisional Income is more than $44,000, up to 85% of their Social Security benefits may be taxable ("Your Benefits May Be Taxable," Social Security Online. The bootstrap will dynamically calculate the taxable amount of Social Security benefits using the logic from the Social Security Benefits Worksheet (IRS Form 1040 Instructions, 2008 p. 27.)

Table 2. Federal Tax Table 2008

Schedule Y-1–Use if your 2008 filing status is married filing jointly or qualifying widow(er)

If your taxable income is over	But not over	The tax is:	Of the amount over
$0	$16,050	$0 + 10%	$0
16,050	65,100	1,605.00 + 15%	16,050
65,100	131,450	8,962.50 + 25%	65,100
131,450	200,300	25,550.00 + 28%	131,450
200,300	357,700	44,828.00 + 33%	200,300
357,700	—	96,770.00 + 35%	357,700

Determining the Target Withdrawal Amount

When the Singers retire, their net after-tax income in their first year (assuming no annuity purchase) is called the Disposable Income Benchmark (DIB). The derivation of the DIB follows from Spitzer (2008). The dollar amounts of their DIBs for the three starting balances are shown in the last column of Table 3.

The marginal tax rates for the three starting balances are 10%, 15%, and 25% respectively in the first year. If the Singers have the $1 million dollar TDA, they will withdraw 4% of it ($40,000) in real terms in that first year. Their "Provisional Income" for calculating the taxable portion of their Social Security income is $55,000 ($40,000 withdrawal + 1/2 of their Social Security). The taxable amount of their Social Security benefits is $15,530, making their Adjusted Gross Income equal to $55,350. Their taxable income (after deducting $20,000) is $35,350 leaving them with a federal tax bill of $4,500. The Singers have disposable income of $65,500 (withdrawal amount + Social Security benefit – federal income taxes). The with-

Table 3. Withdrawals, Taxes, and Disposable Income Benchmark for the Singers for Three Starting Balance Amounts

Starting balance (millions)	Target withdrawal (4%)	Taxable portion of social security	Federal tax due	Disposable tncome benchmark (DIB)
0.5	20,000	1,500	150.00	49,850.00
1.0	40,000	15,350	4,500.00	65,500.00
1.5	60,000	25,500	9,062.50	80,937.50

drawal amount, taxable Social Security benefit, federal tax, and disposable income benchmark (DIB) for all three starting balances are shown in Table 3. The values discussed for the $1,000,000 starting balance are in the middle row of Table 3. Each DIB represents a target standard of living for the Singers that they perceive to be "safe."

Annuitizing Part of the Retirement Portfolio

The primary focus of this investigation was to measure the effect on shortfall risk and estate size when annuities are added to the retirees' portfolio. If the Singers initially do not have an annuity, the entire TDA is subject to RMDs. Alternately, suppose that the Singers purchase an annuity with 20% of their starting balance ($200,000 annuity in the $1,000,000 example). Now, only 80% of the initial TDA amount is subject to RMDs. The annuity will pay out $8,600 (4.3% of $200,000) every year in real terms for the next 30 years. This implies that the Singers can maintain the same level of living (DIB) by withdrawing only $31,400 from their remaining $800,000 TDA. Note that the Singers are drawing less than 4% (3.925%) of their TDA since the annuity is paying out more than 4%. Certainly, this must increase the success rate of the withdrawal process. This same logic was applied to four more annuity scenarios at 40%, 60%, 80%, and 100% of the starting balance. Summarizing, there will be six annuity sizes- from 0% to 100% of the starting balance in increments of 20% - and three different starting balances of $500,000, $1,000,000, and $1,500,000 for a total of 18 distinct conditions. Different starting balances were chosen to reflect the different tax rates that would prevail with different size DIBs. One final clarification is that RMD requirements (as per Table 1) are always in effect for any money in the TDA after age 70 1/2; the money that is in the annuity is taxed as ordinary income and has no additional RMD liability.

Taxes and Rebalancing

If there were no RMDs, the Singers would withdraw only what they needed from their TDA and let the balance continue to grow tax-deferred. When the Singers withdraw more money from the tax-deferred account than required to meet their DIB, they will reinvest all disposable income in excess of their DIB into a brokerage account; Spitzer (2008) found this strategy to be successful. The earnings on the brokerage account are added to the Singers' taxable income each year and reinvested in the brokerage account.[3] In order to take advantage of the favorable tax treatment for qualified dividends, accounts will be rebalanced each year in a special way. The TDA account and the brokerage account will be rebalanced such that the overall allocation (TDA + brokerage account) will always be 50/50, with as high a percentage of stocks in the brokerage account as possible[4].

The Bootstrap and Results

Overview

Bootstrap simulations are performed in order to measure the effect of the different annuity amounts on shortfall risk and estate size when rates of return are stochastic.[5] For each of the three Starting Balances, six annuities will be "purchased" in amounts of 0%, 20%, 40%, 60%, 80%, and 100% of the initial TDA balance(s). There are 18 = (3 x 6) conditions. Annuity choices range from 0% annuity (the entire Starting Balance is in the TDA) to 100% annuity (no money remains in the TDA.) As more and more of the TDA is annuitized, less and less of the TDA is exposed to market risk. It is expected that shortfall risk will fall to zero as the annuity percentage increases. How fast this happens is of great interest.

Data Used

Annual inflation-adjusted rates of return from 1926 through 2004 for stocks (S & P 500) and bonds (intermediate-term U.S. Treasury bonds) were obtained from *Stocks, Bonds, Bills and Inflation: 2005 Yearbook (SBBI)*. S&P 500 Index income returns (dividends) and intermediate term U.S. Treasury returns were also obtained from the SBBI yearbook. Total returns data determine how the portfolios grow while income returns data are used to estimate taxable earnings from the brokerage accounts.

Describing the Bootstrap

The variables below help describe the withdrawal process:

SB	=	Starting Balance ($500,000, $1,000,000, or $1,500,000).
ϕ	=	Proportion of the Starting Balance to be annuitized (0, 0.2, 0.4, 0.6, 0.8, or 1.0).
APA	=	Annuity Purchase Amount (ϕ*SB).
AAP	=	Annual Annuity Payout (4.3% of APA).
DIB	=	Disposable Income Benchmark = the amount of after-tax money available in the first year of retirement, given starting balance = SB when $\phi = 0$; i.e. when there is no annuity.
TDA Withdrawal	=	The larger of (a) the RMD on the TDA and (b) the withdrawal required to attain the DIB. Endnote 3 is pertinent here.

BA = Brokerage account; incremented by excess TDA withdrawals when RMDs require large withdrawal amounts; BA will contain stock and bond mutual funds with as much in stocks as possible while maintaining an overall 50/50 stock/bond allocation.

RA = The TDA account from which TDA withdrawals are taken, but which grows or shrinks with the market as rates of return on stocks and bonds change.

When $\phi < 1.0$, some money will remain in the TDA. When RMDs begin at age 70 1/2, RMD withdrawals could exceed the DIB, resulting in the creation of a brokerage account.

Both the TDA and the brokerage account will be subject to market fluctuations as rates of return on stocks and bonds change. The taxable portion of the brokerage account will change as the income returns on stocks and bonds change. This variability will affect the value of the TDA as well as the value of the brokerage account from year to year. The variability will also affect the taxable portion of Social Security (for the $500,000 and $1,000,000 portfolios). TDA withdrawals, brokerage earnings, taxable income, and taxes will vary as RMD amounts change and as rates of return fluctuate from year to year. When RMDs begin at 70 ½, required withdrawals (for $\phi < 1.00$) may be larger or smaller than required to meet the DIB; the required withdrawal amount changes with the size of the TDA, which is dependent on rates of return and asset allocation. Some portfolios will run out of money before 30 years (shortfalls). The bootstrap will count the number of shortfalls and will calculate the Median Balance Remaining over 100,000 30-year periods for each of the 18 Starting Balance/Annual Annuity Payout scenarios.[6] The Appendix contains a complete description of the bootstrap algorithm. The data obtained from these simulations provide quantitative information on shortfall probabilities and terminal estate size as annuity size changes.

Results

Shortfall Probabilities

Table 4 contains both the Shortfall Probabilities and Median Balance Remaining for the three Starting Balances and all six annuity proportions, ϕ. These data are graphically presented in Figure 1 and Figure 2. The reader is encouraged to use both the numerical and graphical data; each format provides a unique view of the outcomes. Figure 1 depicts the shortfall probabilities at six distinct annuitization amounts for the three Starting Balances. The shortfall probabilities have very little variability across Starting Balances. For example, in the left-most cluster of bars for 0% annuitization [$\phi = 0$], the shortfall probabilities are nearly identical, ranging from 5.57 to 5.84. On the other hand, for any Starting Balance, the pair-wise differences in shortfall probabilities between the annuity amounts are all statistically significant at $p < 0.0005$.[7] As an example, for the $1,000,000 Starting Balance, the shortfall probability at $\phi = 0.0$ is 5.84% while the shortfall probability at $\phi = 0.2$ is 5.13%. These probabilities are statistically different from each other at $p < 0.0005$.

Table 4. Shortfall Probability and Median Balance Remaining ($M) for Three Starting Balances by Annuity Proportion (ϕ)

Starting balance ($M)	ϕ	Shortfall probability (%)	Median balance remaining ($M)
0.5	0	5.72	0.76
	0.2	5.13	0.63
	0.4	4.25	0.49
	0.6	2.66	0.36
	0.8	0.49	0.23
	1	0.00	0.08
1.0	0	5.84	1.48
	0.2	5.13	1.22
	0.4	4.27	0.95
	0.6	2.81	0.68
	0.8	0.54	0.41
	1	0.00	0.11
1.5	0	5.57	2.20
	0.2	5.10	1.80
	0.4	4.29	1.41
	0.6	2.75	1.02
	0.8	0.52	0.62
	1	0.00	0.19

Shortfall risk falls monotonically from a high near 5.8 (at $\phi = 0$) to 0% when $\phi = 1.00$. 60% annuitization cuts the risk of running out of money by more than half, and at $\phi = 0.8$, shortfall risk has been reduced to slightly more than

Figure 1. Shortfall Probability by Percent of the Portfolio Annuitized for Three Portfolio Sizes

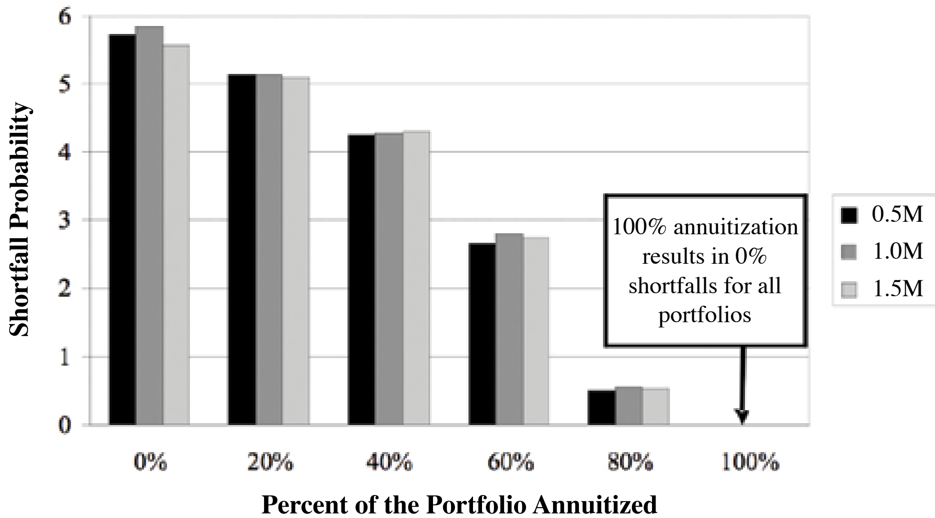
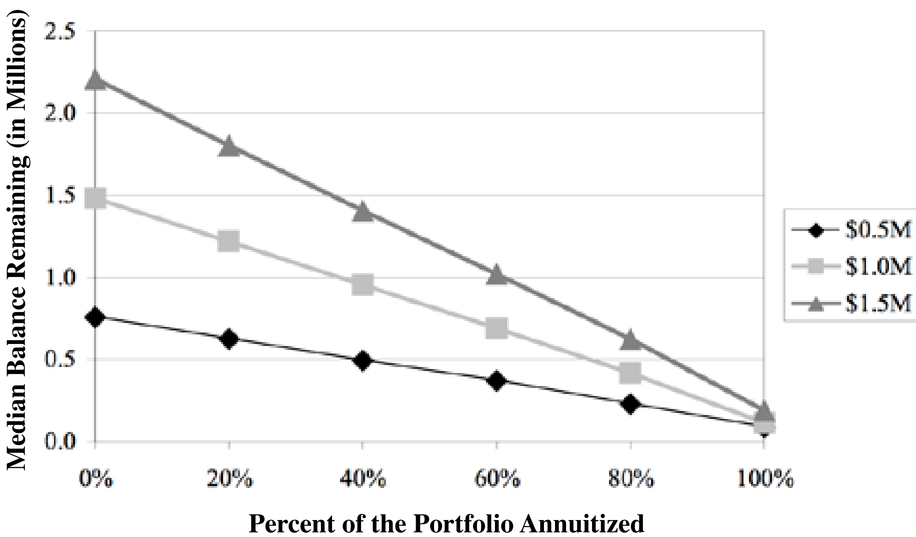


Figure 2. Median Balance Remaining (in Millions of Dollars) by Percent of the Portfolio Annuitized for Three Portfolio Sizes



one-half percent. Not surprisingly, shortfall is zero when all the money is in the annuity and none remains in the TDA. An annuitization of 100% is, by definition, 100% safe - it cannot run out of money.

Median Balance Remaining

Figure 2 illustrates how the size of the annuity affects the size of the estate (as measured by Median Balance Remaining) at the end of 30 years. The Balance Remaining is simply the sum of the TDA balance (if any) and the brokerage account balance (if any) at the end of 30 years. Each median is obtained from the 100,000 values of Balance Remaining for each Starting Balance. Since the value of the annuity itself is zero at the end of 30 years, estate size is dependent on how much money was left in the TDA after annuitization and the brokerage account balance. The larger the annuity is, the smaller the Balance Remaining. As expected, Balance Remaining is largest for the largest

Starting Balance and smallest for the smallest Starting Balance. Median Balance Remaining for $\phi = 1.00$ is non-zero since the annuity payout (4.3%) exceeded the DIB payout of 4%. The excess was put into the brokerage account, which creates a (relatively) small Balance Remaining.

Conclusions

This paper examines several withdrawal tactics for the Singers who retire at age 66 with full Social Security benefits. The Singers' goal is to withdraw a "safe" amount from their TDA each year, but they fear that RMDs may force them to withdraw "unsafe" amounts. In order to assuage their concerns, part of the starting portfolio is placed into a fixed (inflation-adjusted), guaranteed 30-year annuity to determine whether their security can be increased. The findings are as follows:

1. Purchasing an annuity does reduce shortfall risk. At the extreme, purchasing an annuity for the full value of the retirement portfolio reduces the risk of shortfall over 30 years to zero. Since the annuity payout used here is 4.3%, the annuity provides more annual income than the annual income provided by a 4% withdrawal amounts without any annuity. Shortfall risk is zero with 100% annuitization but more than 5.5% without it.
2. Annuitization affects the estate size remaining after 30 years. With no annuitization ($\phi = 0$), the median size of the estate after 30 years is about 150% the size of the starting portfolio. With 100% annuitization, the median estate size, assuming reinvestment of the surplus, falls to between 8% and 19% of the Starting Balance.
3. There is a clear trade-off for the retiree – security versus legacy. If the retiree is not comfortable with shortfall probabilities of 19%, or 16%, or even 5%, the annuity strategy provides any level of comfort up to 0% shortfall probability. Providing a high level of security comes at the cost of not being able to provide a larger estate to heirs.
4. Previously cited studies attempted to measure short fall risk for retirement withdrawals. Cooley et al. (2003) and Spitzer et al. (2007) found shortfall rates ranging from 19% down to 6% at the 4% withdrawal rate with 50/50 allocation. The results here indicate that a retiree can use annuities to decrease these shortfall rates significantly. In fact, the retiree can tailor the amount of acceptable shortfall risk to the amount of acceptable Balance Remaining. Many retirees are not interested in leaving a legacy but rather achieving financial security throughout their retirement. For these retirees, annuitizing a large portion of their retirement portfolio may provide that security.

Implications

This study should provide a better understanding for planners and financial advisors of the costs and benefits of annuities. The graphs provide easily understood information to clients concerning the trade-offs between a choice of attaining a (relatively) safe retirement and/or leaving an estate to heirs. Individuals must make their own decision about the amount to annuitize; these results provide multiple data points to assist in that decision. The advisor's role is to show a client the implications of different decisions. Following the recommendation of Milevsky and Young (2007), annuitizing need not be done all at once. A retiree might annuitize half of their TDA upon retirement and, when and if the TDA significantly increases in value due to a bull market, annuitize another percentage of the TDA. The initial annuitization significantly reduces shortfall risk, while the second annuitization locks in the proceeds of the market upswing. Since the guaranteed payout period will be shorter for subsequent annuity purchases, annuity cost per dollar of payout will decrease.

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Appendix: The Bootstrap Algorithm

The following describes one replication of the bootstrap. For one of the three Starting Balances ($500,000, $1,000,000, $1,500,000), and for one of the six annuitization proportions (ϕ = 0, 0.2, 0.4, 0.6, 0.8, or 1.00): first, calculate the size of the Annuity Purchase (AP = ϕ*SB), and, second, determine the Annual Annuity Payout (AAP = 0.043*AP). Then:

1. From a uniform distribution, generate a random integer between 1926 and 2004. This is the "year" subscript (t) and selects the historical rate of return for stocks, r(s,t), and for bonds, r(b,t), for the t-th year from the previously cited Ibbotson data. The rate of return in the t-th year on the TDA account is $r(t) = \lambda r(s,t) + (1-\lambda)r(b,t)$, where λ is the proportion of stocks, as previously described. The rate of return on the brokerage ac count is calculated similarly, using the γ-weights: $\gamma r(s,t) + (1-\gamma)r(b,t)$. γ is the proportion of stocks in the brokerage account.

2. The percent of earnings distributed from the brokerage account is calculated in a parallel manner for this "year" as $\gamma p(s,t)$ from stocks and $(1-\gamma)p(b,t)$ from bonds. p(s,t) and p(b,t), (also obtained from SBBI) are the percent of stocks and bonds distributed in the t-th year.

3. RMDs and taxes are taken out at the end of the "year." If the RMD amount is insufficient to meet the Singers' DIB, the Singers will take out enough money to meet their DIB. (The TDA withdrawal amount that the Singers desire to take out is based on their DIB and their AAP.)
4. If the RMD amount removes more money than the Singers want, the excess amount is put into the brokerage account. The money required to fund the Singers' DIB is taken first from RMDs, then from the brokerage account if the TDA is exhausted. Taxable income is calculated each "year" based on annuity income, TDA income, brokerage account income and the taxable portion of Social Security income. Taxes are calculated each "year" based on taxable income and qualified brokerage account earnings.

5. Steps 1 through 4 are repeated (if possible) for 30 years. A count is maintained of the number of times that the Singers run out of money during that cycle (that is, they have no money left in either the TDA or the brokerage account) before 30 years. If the Singers have money remaining in the TDA or brokerage account at the end of 30 years, the total amount is saved so that the Median Balance Remaining can be calculated.
6. Steps 1 through 5 are repeated 100,000 times in order to obtain the percentage of shortfalls and Median Balance Remaining for a single starting balance at a single annuity proportion (ϕ). The process is repeated 18 times for each of the 3 Starting Balance X 6 annuity proportion conditions.

Endnotes

[1]Edelman, Salisbury, & Larson, (2002) describe "actuarially unfair" in the following way: "However, prices in the individual annuity market, like prices in many insurance markets, diverge from their actuarially fair level for two primary reasons. First, insurance companies incur administrative and sales expenses to underwrite and market annuity products, and these costs, plus some level of profit, must be captured in the premiums that are charged. Second, individuals who voluntarily purchase annuities tend to live long than nonpurchasers. As a result of this "adverse selection," insurance premiums must be set high enough to compensate insurers for the fact that they will have to make annuity payments for a longer period of time. As the annuity prices are raised, some individuals with shorter life expectancies may find that these actuarially unfair annuities are no longer attractive" (p. 156).

[2]In May 2008, the Vanguard annuity payout had increased slightly to 4.53%. A fixed single life annuity with 30 years guaranteed (but without the inflation adjustment) had a payout of 6.57% at that time. A fixed single life annuity with no guarantee and no inflation protection had a payout of 7.84%. Vanguard was the only company that the author could find that provided an inflation-adjusted guaranteed annuity in New York State.

[3]The treatment of taxes in the brokerage account needs some additional explanation. Both the stock and bond portions of the Singers' brokerage account are assumed to be in mutual funds. Earnings from the bond portion of the brokerage account are taxed annually as ordinary income. Earnings on the stock mutual fund are assumed to consist of qualified dividends and long-term capital gains. Capital losses are not included in the computation of taxable income, and no carryover is performed. Long-term capital gains and qualified dividends will be taxed annually at 5% for taxpayers in the 10% and 15% marginal tax brackets and at 15% for taxpayers in the 25% or higher bracket.

[4]If the TDA balance is small, it is possible that the RMD will not satisfy the DIB; that is, the required distribution is not enough to meet the Singers' needs. Under this circumstance, the Singers will take sufficient money out of their TDA to meet their DIB. The alternative is to take the RMD from the TDA and then take additional money from the brokerage account. As previously noted, Spitzer & Singh (2006) show that when the after-tax return on the brokerage account is greater than the return in the TDA, withdrawing from the TDA first extends the withdrawal process. Given the historical returns on stocks and bonds, it is assumed that the expected (after-tax) return on the (100% stock) brokerage account will exceed the expected return in the TDA which will be more than 50% bonds.

[5]While multiple investigative methods suggest themselves, the bootstrap is the superior choice. Non-stochastic tools, such as spreadsheets that use constant rates of return, are unrealistic. Rates of return change unpredictably through time causing unpredictable changes in taxable social security benefits, taxes, portfolio balances, RMD amounts, and brokerage account balances. Stochastic methods, such as Monte Carlo simulations or bootstrap simulations, are superior in this respect. Monte Carlo methods use computers to generate rates of return from certain probability distributions. Unfortunately, the appropriate probability distribution to draw from is unknown. Investigators often base their Monte Carlo simulations on the assumption that rates of return are normally (or log-normally) distributed. For the annual data used here, the assumption of normality cannot be confirmed by statistical testing; hence, Monte Carlo is a dubious choice. Bootstrapping methods sample with replacement from the same dataset, in this instance from the historical data. No assumptions about the underlying distribution are necessary. Bootstrapping was used by Ameriks, Veres, and Washawasky (2001), Spitzer et al. (2007), and Spitzer (2008).

[6]Other papers have used Average Balance Remaining to measure the estate size at the end of the withdrawal period. Because the frequency distribution of "Balance Remaining" is quite right-skewed, the median is considerably

smaller than the mean. Half of the retirees will attain a Balance Remaining of more than the median amount and half will attain less. Significantly less than half the retirees will attain the average Balance Remaining. Since the Median Balance Remaining is a more informative measure, it is used in lieu of the average.

[7]One-tailed *t*-test on proportions.

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