Spending Policy
Is 4 Percent the Best You Can Do?

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In 2004, the editor of the *Journal of Financial Planning* described an article published a decade before, "Determining Withdrawal Rates Using Historical Data," by William Bengen, as "some of the best content of the Journal over the previous 25 years."[1] The article that follows here suggests a spending policy that can be applied more generally, is safer, and often produces spending levels greater than Bengen's "4-percent rule."

Bengen used historical returns to determine empirically a maximum, safe real spending level. His work suggests that retirees begin withdrawing 4 percent and then adjust the dollar amount annually by inflation. We call this the "4-percent rule" even though the 4 percent is only the initial withdrawal rate. It offers consistency and a high probability of not running out of money over 30 to 40 years or so. It provides no prescription to increase the withdrawal should circumstances allow nor to decrease the withdrawal should the risk of ruin appear. Bengen's approach presumes that past is prologue. Those of us who just lived through 2008 and are enduring a terrible decade can be excused for questioning that assumption.

The following approach is more general. It can be used by investors with much different horizons (shorter or longer) and adjusted to reflect views that future returns will differ from historical returns.

Life spans, future rates of return, and the order of returns cannot be accurately or precisely predicted. In the absence of perfect foresight a perfect spending policy is impossible. Like Bengen, we seek a practical policy.

What makes a good spending policy?

Safety. The retiree should not run out of money.

Inflation protection. It should allow for cost-of-living adjustments.

Consistency. Real withdrawal amounts should be consistent. People are averse to uncertainty of income and do not like reductions in income and standards of living. If adjustments are to be made, smaller adjustments are preferred to larger ones.

Maximization of spending. More spending is preferred to less.

This article considers bequests secondary to spending during one's lifetime, though the appendix provides an adjustment to deal with bequests. Further, bequests may be made a priority by making gifts out of spending. Alternatively, assets may be devoted to bequests through insurance and other financial planning techniques. In the absence of life insurance, the uncertainty of longevity provides an expectation of a bequest because investors must be conservative in their assumptions about life spans and expected returns. The investor who employs a safe spending rule simultaneously creates the expectation of a bequest.

Annuity Rule

The spending rule proposed here is to withdraw (spend) the amount produced from the following annuity calculation. Hence we call this the "annuity rule." The subscripts *t* emphasize the fact that these amounts will change with time and the calculation would be performed periodically (e.g., yearly).

where
a_t = amount to withdraw at time t
v_t = value of portfolio at time t

n_t = number of periods expected for which to plan. (We suggest using a life expectancy of 120, so for a 65-year-old n_t = 55; for a 66-year-old n_t = 54, etc.)
r_t = the geometric average rate of return expected on the portfolio for the future n_t periods at time t
i_t = the average inflation rate expected over the next n_t periods at time t.

$$a_t = v_t \times \frac{1-x_t}{1-x_t^{n_t}}$$

where

$$x_t = \frac{1+i_t}{1+r_t}$$

This is an annuity due formula, which means that withdrawals begin immediately and the withdrawal amount *a* can be increased by *i* each year (assuming *r* is earned each year).

Annuity Calculation

The annuity calculation produces the maximum amount that can be increased by inflation without running out of money, given accurate assumptions. Because accuracy is unrealistic, however, one should be conservative with respect to the return or mortality assumptions or both. We've been extremely conservative with mortality, assuming death at age 120, the maximum age in our mortality table. This simplified the modeling because no individual could live longer than this.

Let's assume that a person retires with a portfolio value of $1 million, plans to live 56 additional years, expects annual inflation of 3 percent, and forecasts a portfolio return of 7 percent. The annuity calculation produces an initial withdrawal amount of $42,404. The inflation and portfolio returns seem rea-

sonable for many portfolios and environments. The 56-year time horizon implies that the just-turned 65-year-old dies at 120. Despite this obviously conservative assumption, the initial withdrawal rate is slightly above that proposed by Bengen. That's because the return is fairly reasonable and Bengen's result was the product of a hostile investment environment.

Our calculation offers a great deal of flexibility. It allows one to plan for a future that is entirely different from the past. It may be adjusted for institutions by assuming a very long horizon (indeed, the initial withdrawal rate in the above example falls to about $37,383 for an infinite horizon).

The real difference: The annuity approach outlined above assumes periodic adjustments to the withdrawal rate. Compared with Bengen's approach, both are conservative in that both are unlikely to run out of money. Both are safe, though the annuity rule is safer. The 4-percent rule is more consistent but leaves more money on the table while the annuity rule allows higher levels of withdrawals.

4-Percent Rule vs. Annuity Rule

To compare Bengen's constant real spending strategy with an annuity calculation, we ran 10,000 trials of a Monte Carlo simulation. Each trial had a pair of 65-year-old investors, each with $1 million. The investors invest in identical portfolios and experience random returns drawn from a population with a 7.2-percent arithmetic average and a 6-percent standard deviation (7-percent geometric return). A 3-percent inflation rate is assumed. This simulation also incorporates the uncertainty of mortality. In each of the 10,000 trials the lifespan of the two investors is random according to the probabilities given in the unisex IRS 2009 table. That means that some investors may live only one year more, some may live to age 120. The median life span is 21 additional years with about half living between 14 and 26 additional years. The only difference

between the two investors is spending policy. One spends $40,000 real every year until death or bankruptcy, whichever comes first. The other uses the annuity equation above at the beginning of every year, applying the previous year's ending market value to determine the current year's withdrawal. A remaining life expectancy n of 56 is used the first year, 55 the second, and so forth.

In every trial, the 4-percent-rule investor spends $40,000 in the first year. The annuity-rule investor spends $42,404. As long as the annuity-rule investor achieves the expected return, he can enjoy this spending advantage.

The choice of spending policy depends heavily on behavioral issues, mainly utility. It is difficult to compare which of two streams of income makes an investor happier. Would you rather spend $40,000 real for three consecutive years or $42,000, $42,000, and $37,000? Given this difficulty, we offer several metrics to compare the spending rates (see table 1).

1. The first metric indicates that in this simulation the annuity rule is as safe or safer than the 4-percent rule. This is no surprise because the annuity calculation decreases the spending as the portfolio value decreases and it assumes a long lifespan.
2. In one trial the investors might live 20 additional years, in another, 25. There is an average real cash flow for each trial. The second metric is the median of all 10,000 averages.
3. The third metric is the arithmetic average of these averages. The data

from this simulation are evidence (but not proof) that the annuity calculation allows the investor more money to spend—in this case, an average of 6 percent more.

4. The fourth metric is based on the intuitive assumption that investors will prefer consistent cash flow streams to lumpy ones. Rather than use the arithmetic average of the annual cash flows, we calculated the geometric average. The geometric average penalizes lumpiness (e.g., the geometric average of $42,000, $42,000, and $37,000 is $40,262 compared to the arithmetic average of $40,333). The median geometric average is slightly higher for the annuity rule.

5. The fifth metric applies a utility function that assumes a reference point of $40,000 real, meaning that the utility associated with this value is set to zero. Because the 4-percent rule produces $40,000 in spending nearly every year, the utility of this approach is zero, and if the annuity rule produces a positive (negative) value the utility is better (worse). In this analysis we use the following function for utility.[2] If the withdrawal value x is greater than or equal to $40,000, the utility is $(x-40,000)^{0.88}$. If the withdrawal value x is less than $40,000, the utility is $2.25 * (x-40,000)^{0.88}$. This rewards extra spending near the reference point at roughly half the value that diminished spending penalizes utility. For example, if the withdrawal value is $41,000, the extra $1,000 has a utility value of 437, about

Metric	4% Rule	Annuity Rule
TABLE 1: RESULTS: 7% GEOMETRIC RETURN, 6% STANDARD DEVIATION		
1. Probability of success (not running out of money)	99%	100%
2. Median arithmetic average real cash flow	$40,000	$42,411
3. Average arithmetic average real cash flow	$39,958	$43,032
4. Median geometric mean of real cash flow	$40,000	$42,404
5. Median average utility of real cash flow	0	805
6. Probability cash flow is greater than other method	31%	69%
7. Median real terminal value	$932,683	$850,920

one-half the absolute value of the utility of $39,000, which is −982. This function has the attractive properties that extra income (i.e., withdrawal value above the reference point) does not please as much as lost income displeases. Also it accounts for a diminishing marginal utility to extra income. Using this utility function we still find that the annuity calculation is superior to the 4-percent rule because it has a median utility value of 855.

6. The sixth metric shows that, despite not running out of money, the annuity calculation produces a higher average withdrawal amount in about 69 percent of the trials. In other words, of the 10,000 trials, the annuity-rule investor had a higher spending rate than the 4-percent-rule investor in about 6,900 trials.

7. The seventh and final metric shows the median of the real terminal values. Not surprisingly, the median of the terminal values under the annuity rule is lower because more was spent. If the goal is to maximize spending, one is seeking a lower terminal value (given the same

investment portfolio). Even as we've applied this annuity rule, a significant amount of money is left on the table.

Based on this Monte Carlo simulation one might be quick to choose the annuity calculation. Yet a subtle but important flaw in this analysis needs attention. The Monte Carlo simulator selected returns from a population with a 7-percent geometric average return while the annuity calculation assumed a future return of 7 percent. That foresight is not to be counted on and we shall address it.

It's fair to point out that Bengen's 4-percent rule also enjoys the benefits of look-ahead bias. It's not as if retirees starting retirement in 1926 knew they could count on the 4-percent rule. The 4-percent rule was derived by looking backward.

We ran two additional simulations, each using a 7-percent return assumption in the annuity calculation. In one simulation the 10,000 trials drew returns from a population with a 6-percent average and the other an 8-percent average. The results are shown in tables 2 and 3. In this way we can see the effects

of experiencing worse-than-expected and better-than-expected returns.

Tables 2 and 3 illustrate the results as compared to the 4-percent rule.

Table 2 shows that with returns from a population with a 6-percent geometric average, the 4-percent rule runs out of money 4 percent of the time, while the annuity rule will manage some payout 100 percent of the time. One imagines that a retireee would adjust the payout as the prospect of ruin appeared. However, the 4-percent rule offers no prescription for such action, so it is not possible to model such changes. One can see that if actual returns are below historical results, the risk of ruin with the 4-percent rule increases. The returns of 2008 and this decade suggest that one should not rely entirely on the historical record to encompass the range of outcomes that the future may offer.

Longevity Insurance/ Lifetime Annuities

This exercise in the study of spending rules brings into focus the value of longevity insurance, specifically lifetime annuities that begin at a later age. Spending rules have to be conservative enough to handle unexpectedly long lifetimes. If everyone saves as if they are going to live well beyond life expectancy, then one-half of the people are saving too much. To make this clear, imagine a world with two investors, both age 65. One will pass in 15 years while the other will live 25 years. They don't know which will outlive the other. If they both save as if they are going to live 25 years, they will save too much in aggregate because they will live only 20 years on average. If they cooperate, each of them could reduce their savings, and thus increase their spending, by the amount required to fund five years. This is precisely what a deferred annuity would accomplish.

The use of a deferred annuity would allow the investor to use the annuity

TABLE 2: RESULTS: 6% GEOMETRIC RETURN, 6% STANDARD DEVIATION

Metric	4% Rule	Annuity Rule
1. Probability of success (not running out of money)	96%	100%
2. Median arithmetic average real cash flow	$40,000	$39,364
3. Average arithmetic average real cash flow	$39,810	$39,396
4. Median geometric mean of real cash flow	$40,000	$39,207
5. Median average utility of real cash flow	0	−1,034
6. Probability cash flow is greater than other method	54%	45%
7. Median real terminal value	$712,345	$706,797

TABLE 3: RESULTS: 8% GEOMETRIC RETURN, 6% STANDARD DEVIATION

Metric	4% Rule	Annuity Rule
1. Probability of success (not running out of money)	100%	100%
2. Median arithmetic average real cash flow	$40,000	$45,867
3. Average arithmetic average real cash flow	$39,997	$47,205
4. Median geometric mean of real cash flow	$40,000	$45,699
5. Median average utility of real cash flow	0	1,985
6. Probability cash flow is greater than other method	13%	87%
7. Median real terminal value	$1,168,974	$1,005,170

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rule with greater certainty. The 65-year-old retiree who has purchased an annuity to insure his spending past some age (say 85) can use an n of 20 in the first year, 19 the second, and so forth.

A good spending policy cannot compensate for a bad investment portfolio (or just unfortunate results). The consistency of the withdrawal stream will depend on the consistency of the portfolio returns. The 4-percent rule is a very good rule. We offer the annuity rule, particularly combined with a deferred annuity, as a more flexible and possibly lucrative alternative. ⌘

Appendix

Following are two variations on the annuity formula.

If n is infinity, as one might want to assume for an endowment or foundation, then the annuity calculation becomes

$$a_t = v_t \times (1 - x_t)$$

where

$$x_t = \frac{1 + i_t}{1 + r_t}$$

If one would like to plan on a terminal value (e.g., a bequest) of b, then

$$a_t = (v_t - bx_t^{n_t}) \times \frac{1 - x_t}{1 - x_t^{n_t}}$$

where

$$x_t = \frac{1 + i_t}{1 + r_t}$$

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Endnotes

[1] William P. Bengen, 1994, Determining Withdrawal Rates Using Historical Data, *Journal of Financial Planning* (October 1994), available at http://spwfe.fpanet. org:10005/public/Unclassified%20Records/ FPA%20Journal%20March%202004%20-%20The%20Best%20of%2025%20Years_%20 Determining%20Withdrawal%20Rates%20U sing%20Histo.pdf.

[2] The parameters of this utility function are based on A. Tversky and D. Kahneman, Advances in Prospect Theory: Cumulative Representation in Uncertainty, *Journal of Risk and Uncertainty* 5, no. 4 (October 1992): 297–323.

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investable products such as hedge fund replication funds, giving investors access to entire asset classes that previously were inaccessible. ⌘

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Endnote

[1] According to the 2007 Yale Annual Report, the Yale Endowment allocated 23.3 percent of its portfolio to absolute return strategies, 18.7 percent to private equity, and 27.1 percent to real assets, representing a 69.1 percent allocation to alternative strategies.

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