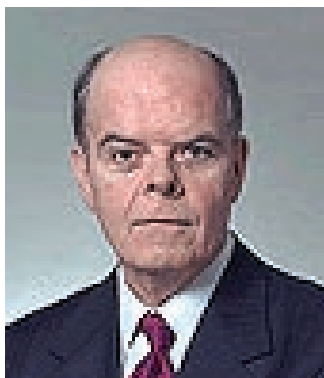


# Investing and Spending in Retirement

## White Paper



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### Executive Summary

Americans are retiring in their early 60s and living long lives in retirement. Many of these Americans lack the luxury of an old-style retirement plan providing guaranteed income in retirement. They might have accumulated wealth to carry them through the retirement years, but many do not understand how to invest that wealth and how to make sure that it “lasts a lifetime”. This paper investigates “spending rules” for retirees, the rate of spending that can be sustained in retirement. The spending rule has to be low enough so as not to exhaust wealth in the event of lower asset returns than expected. The paper shows that spending rules have to be based on real, not nominal, returns, and must be set at rates lower than the average real returns expected in the future. The asset allocation of the portfolio must be chosen along with the spending rule, since the two are very much related to one another. In general, the lower the allocation to stocks in the portfolio, the lower must the spending rule be. The paper will not settle on a specific spending rule in retirement, but it will show that the rule depends on the portfolio chosen, the expected real returns of each asset in the portfolio and the volatility of those returns, and the target level of wealth.

## Introduction

Many Americans don't really understand how long their retirement may be. Life expectancy has increased steadily over the last 50 years at the same time that the age of retirement has fallen. According to the Labor Department, the median age of retirement for both men and women is 62 years of age.<sup>1</sup> Americans at that age can often look forward to twenty or even thirty more years of life in retirement. Yet few Americans have a coherent plan to make sure their resources will last that long. Savings are often inadequate and spending is often too high to be sustainable. Investment decisions, moreover, are often inconsistent with spending rates.

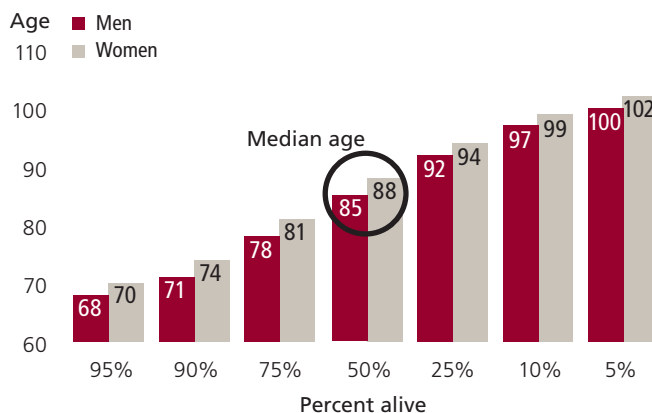
Some Americans are fortunate enough to have guaranteed pensions that provide them with a steady income throughout their retirements. These are the old-style defined benefit pensions that were once quite common in corporate America.<sup>2</sup> The pensions provide a guaranteed income to the employee and often to the employee's spouse in the event of the death of the employee. Sometimes the income is indexed to inflation, rising with the cost of living during retirement. Today, the balance has shifted away from defined benefit pension plans to defined contribution pension plans, like the 401(k) plan, where workers contribute part of their salaries to the plan with firms often matching or supplementing the employee contributions. Employees with these pension plans are, in a sense, responsible for their own retirement. If they save enough during their careers and invest wisely, they can enjoy a comfortable retirement.

How much is "enough"? That depends on how much they hope to spend in retirement and how much income they can derive from their portfolios. This paper will explore both investing and spending in retirement. Decisions that Americans make about investing and spending can make a big difference in determining how financially secure they are in retirement.

In considering these issues, it will be helpful to know just how long our savings must last. Figure 1 presents some estimates of how long current 62 year-olds are likely to live, estimates made by the Society of Actuaries. For a 62 year-old man today, the median age of death is estimated to be 85 years, with 25% of his cohort likely to live to be 92 years-old. For a 62 year-old woman, the median age is 88 and the 25% point is reached at 94 years. For a married couple at 62 years old, the relevant statistic is the life expectancy of the surviving spouse. The median age of death for the surviving spouse is 92 years of age! So the nest-egg accumulated for retirement must last a long time.

With lifetimes this long, investment horizons must be just as long. In fact, they need to be longer because you may live longer than the average person your age. Yet Americans entering retirement often choose portfolios appropriate for retirees of their grandparents' generation who typically lived only a few years after they retired. Retirees of that generation used to invest in bonds during retirement. Investing in bonds surely seems the safe thing to do. It helps us to sleep at night if we avoid stocks and other volatile investments. That's all well and good for emotional wellbeing, but does the average American realize how little can be spent if a portfolio is weighted heavily towards bonds?

**Figure 1. Life expectancy of today's 62-year-olds**



Source: Society of Actuaries and Financeware

### Spending rules for retirement

There is a key concept in retirement planning that most Americans have not even heard of. That is the concept of a “spending rule,” a rate of spending in retirement that can be sustained through time. If the retiree has a defined benefit retirement plan, spending can be tied to the income from that plan (plus Social Security). Most of us are not fortunate enough to have such a plan. For those many Americans with only defined contribution retirement plans, there is no guaranteed income from those plans, and retirement spending must depend on returns from accumulated wealth.

Many retirees base their spending in retirement on the “income” from their bonds and stocks. They choose their portfolios so as to maximize the coupons from their bond portfolios and dividends from their stock portfolios. This strategy may or may not be ideal as an investment strategy, but it should not be the basis of a spending rule. Retirees should be willing to use both income and principal from their portfolio if the spending can be sustained.

To see why bond coupons or stock dividends may be the wrong basis for spending in retirement, consider a simple example. Suppose that the retiree puts the entire portfolio in long-term government bonds. Would it be safe to spend the coupons on these bonds? In answering this question, we will establish an important principal: the spending rule must be based on the real, or inflation-adjusted, return on the portfolio.

Suppose the retiree has \$1 million invested in bonds with 5.3% coupons, and suppose the inflation rate in the future is expected to be 2.5%. If the retiree spends the coupons on the bonds, the retiree will be able to spend \$53,000 per year in retirement. As every retiree knows, however, inflation can wear away the spending power of this \$53,000. With an inflation rate of 2.5%, the cost of living rises by 28% in ten years and by 64% in twenty years.

In order to keep spending in line with inflation, the retiree must hold spending to about 2.7% per year, the inflation-adjusted return on the bond portfolio.<sup>3</sup> And the retiree must plow back into the portfolio the inflation component of the return. Otherwise, the real value of the portfolio will fail to keep pace with inflation.

Most retirees, however, would find it hard to get along with a spending rule as low as 2.7%. To sustain a higher spending rule, it's important to invest in assets that, historically at least, have outperformed bonds. Retirees, however, face a problem in assessing the returns that might be earned in the future. The decades of the 1980s and 1990s saw unusually high stock and bond returns. Consider Table 1 which reports the real, or inflation-adjusted, returns on stocks and bonds over two periods, 1981-2000 and 1951-2004. In the twenty-year period, 1981-2000, the real return on the S&P 500 was an incredible 11.6% per year on average, while the real return on the medium-term Treasury bond was 6.1%.

These returns help to explain why Americans have yet to focus on spending rules in retirement. If you are earning between 6.1% and 11.6% on your portfolio in real terms, there seems to be no need to focus on whether a 4% or 5% spending rule is sustainable. In the longer period stretching back to 1951, however, the real return on the S&P 500 averaged only 7.5% and the real return on the Treasury bond averaged only 2.4%. If returns revert to these long-run averages, retirees will have to pay a lot of attention to their spending rates.

### Volatility and Uncertainty

The returns just cited are average real returns. It's important to assess the impact of the volatility of these returns. You can drown in a pond with an average depth of 3 feet. Consider the case of the S&P 500 over 1951-2004. The standard deviation of the monthly returns on the S&P was 14.4% expressed annually while the real return was 7.5%. Suppose that a retiree sets spending at the expected real return of 7.5%. Figure 2 shows the results for a \$1 million portfolio invested over 20 years. The cases shown are those where actual average returns are equal to 7.5% and where actual average returns are one standard deviation above or below 7.5%. If average real returns are equal to the spending rate, the retiree keeps the original portfolio intact over the 20 year period studied. The portfolio has grown in nominal terms with the cost of living, but the real value of the portfolio remains at \$1 million. If average real returns are one standard deviation below 7.5%, the \$1 million portfolio shrinks to less than \$100,000.

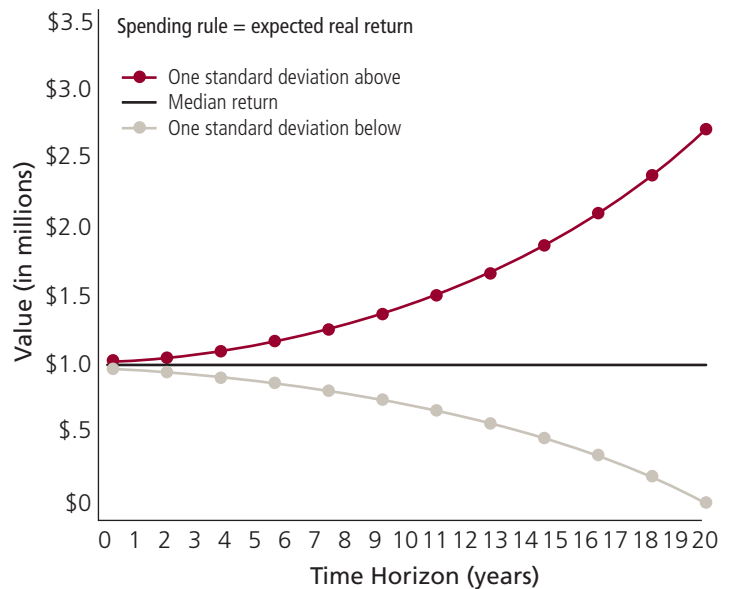
The situation may be even worse than pictured because the timing of the returns matters. Bad returns may occur early in retirement. A bear market like that experienced in 2000-2002 can cripple a retirement. To take into account such bad scenarios, we use simulation methods where a large range of different outcomes

can be examined. By considering many trials drawn from a sample with given average returns and volatilities, we can try to model the investment uncertainties facing retirees. Each trial will consist of at least 1000 simulations drawn randomly from a statistical distribution. It's the random nature of the drawing that gives the simulation method its "Monte Carlo" name.<sup>4</sup>

Returns are not the only source of uncertainty for the retiree. Central to investing and spending in retirement is longevity risk. If we knew for certain when we were to die, we could have a strategy for using up our capital before death. This is the principal behind annuities

**Figure 2. Portfolio values diverge with returns**

Real returns, one standard deviation above and below the median



that guarantee income up until death. To properly model spending rules, it's important to incorporate longevity risk directly into the simulation. The simulation software we will use, Financeware, does just that. Whenever a simulation is run, it draws from the mortality distributions developed by the Society of Actuaries. So in any given simulation, the man or woman may die early in retirement or live long past the median age of death for that cohort.

### **Portfolios of stocks and bonds**

Because risk is central to the success or failure of spending rules, we will try to reduce risk by diversifying the portfolio. In the case of bonds, the bond returns are based on the Lehman Aggregate index which is a well diversified, market-weighted, index of investment grade bonds. In the case of stocks, both foreign and domestic stocks are included, with foreign stocks being 20% of the total stock allocation. Foreign stocks are represented by the Morgan Stanley EAFE index, while U.S. stocks are represented by the Russell 3000 index. So a 50/50 bond/stock portfolio consists of 50% in the Lehman Aggregate index, 40% in the Russell 3000 index, and 10% in the EAFE index.

There is one drawback to choosing a diversified mixture of stocks and bonds. The three indexes chosen begin in the 1970s, not in 1951. If the returns on these indexes were used without modification, the series would be measured beginning in 1979, the first year when the shortest index, the Russell 3000 index, is available. That would mean that the simulations

would be based on the high real returns of the 1980s-1990s bull market. Instead of truncating the data set by starting in 1979, we choose to use a premium method to estimate returns. The average real return on each stock index is measured relative to the S&P 500 over the common period for which both series are available. Then that same discount or premium is used to estimate what the index would have earned over the 1951-2004 period. In the case of the Russell 3000, for example, the premium was -0.1% from 1979 to 2004, so the real return on the Russell 3000 is set at 7.4% (7.5% - 0.1%). In the case of the EAFE index, the returns could be measured beginning in 1970. The premium found, -0.2%, leads to an expected real return of 7.3%. In the case of the Lehman Aggregate, the benchmark is the medium-term Treasury bond, and the premium of 0.3% leads to an expected real return of 2.7%. Using this methodology, the 50/50 stock/bond portfolio outlined above has an average real return of 5.2%.<sup>5</sup>

Standard deviations and correlations were handled differently. In order to reflect the benefits of diversification in the simulations, we measured standard deviations and correlations using the three assets over the common period for which they were available, 1979-2004. There is no particular reason to believe that volatility statistics drawn from this twenty-five year period won't be good estimates of the volatility of the portfolio in the future.

**Baseline case: Can two live more cheaply than one?**

We begin with two sets of simulations that will illustrate how spending rules are analyzed. The first simulation will be for a 62 year-old man who has just retired. The second simulation will be for a 62 year-old married couple also newly retired. In both cases, we will assume that average real returns will match those of 1951-2004. Both sets of simulations will be for a 50/50 stock/bond portfolio.

At retirement, the 62 year-old man is assumed to choose a spending rule that will be automatically adjusted by inflation each year. For example, a 5% spending rule for a retiree with \$1 million will permit the retiree to spend \$50,000 (before tax) the first year. With a 2.5% inflation rate, spending will rise to \$51,250 the second year, and so on. Later simulations will allow part of the spending to fluctuate with the size of the portfolio rather than being a set dollar amount (adjusted for inflation).

The 62 year-old is assumed to want to use his wealth to support his retirement. That is, he has no plans to leave a bequest, so his wealth can be used up during his lifetime. This will allow him to raise his rate of spending higher than in the case where his aim is to keep a given wealth level intact. Later simulations will allow for a specific bequest. Of course, he does not know his age of death ahead of time, so the challenge will be to adopt a spending rule that will keep his wealth positive throughout the remainder of his life.

The retiree must choose a spending rule low enough so that he does not run out of money before death. In the presence of uncertainty, however, it is difficult to eliminate all possibility of running out of money. So the aim is to choose a spending rule low enough so that the probability of running out of money ("failure") is low. So we will be asking the following question:

*What is the probability of failure if a specific spending rule is adopted?*

Simulations are run for spending rules ranging from 3% to 6% of initial wealth.

The results for a single man at 62 are quite encouraging. With average real returns matching those of 1951-2004, a spending rule of 5% has only a 5% probability of failure. That is, in 5% of the simulations, the 62 year-old man runs out of money before his death. A 4.5% spending rule reduces the failure rate to 1%.

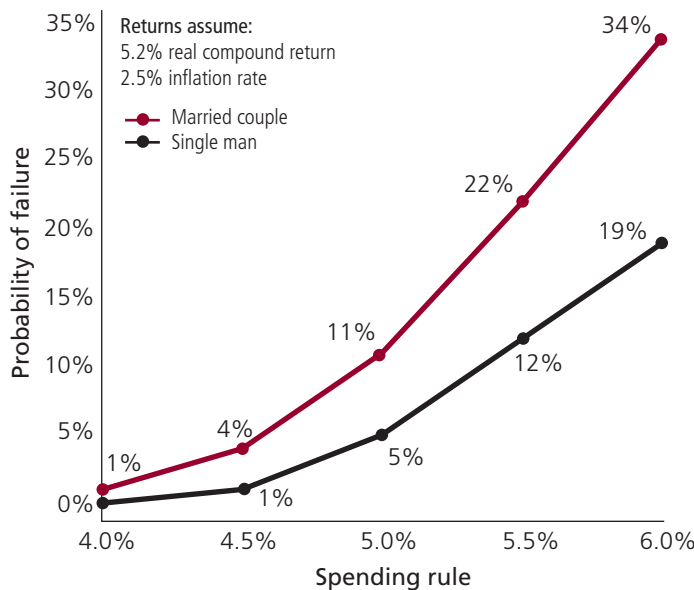
Consider how these results are changed if the family consists of a married couple rather than a single man. The results will be different for two reasons. First, there are two lives to worry about rather than one, so the death of the surviving retiree

will generally be later than that of a single retiree. Second, the second person involved is a woman with a longer life expectancy. The results of both sets of simulations are reported in Figure 3.

Consider first a 5% spending rule. The probability of failure for the couple is 11% rather than the 5% found for a single man. If the spending rule is lowered to 4.5%, the probability of failure becomes 4% rather than 1%. The morale of the story seems to be: reduce your spending in order to enjoy marital bliss. Isn't it true that "two can live more cheaply than one?"

**Figure 3. Spending rules and probability of failure**

Failure rates for a single man and married couple at 62 years of age



**Effects of different asset allocations and lower expected returns**

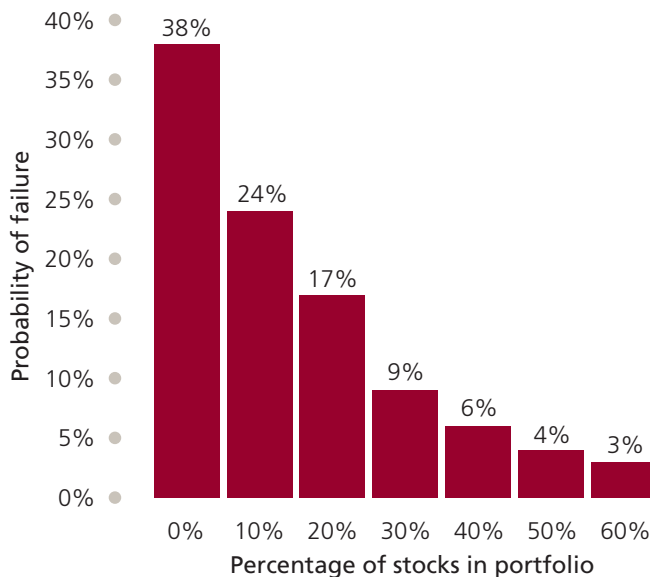
Running out of money is a horrible prospect for a retiree. Is it possible to reduce the probability of failure by choosing a less risky portfolio? The answer is counterintuitive. You would think that reducing the proportion of stocks in the portfolio from 50% to (say) 20% would reduce the risk of running out of money. In fact, it has the opposite effect. Consider the case of a married couple at 62 years of age that chooses a 4.5% spending rule in retirement. Figure 4 shows the failure rates for different portfolios ranging from 0% in stocks to 60% in stocks. As stated above, a married couple at 62 years of age has a 4% chance of running out of money

if the portfolio chosen has 50% in stocks and 50% in bonds. If the proportion of stocks is reduced to 20%, the probability of running out of money soars to 17%. The reason becomes clear once you compare the spending rule of 4.5% with the expected real return on bonds of 2.7%. The real return on bonds is simply too small to support a reasonable spending rule.

The results cited above assume that investors will earn the same average real return on stocks as in 1951-2004. If average returns are measured over a period that ends soon after a twenty-year bull market, however, then the averages may give too high an estimate of future

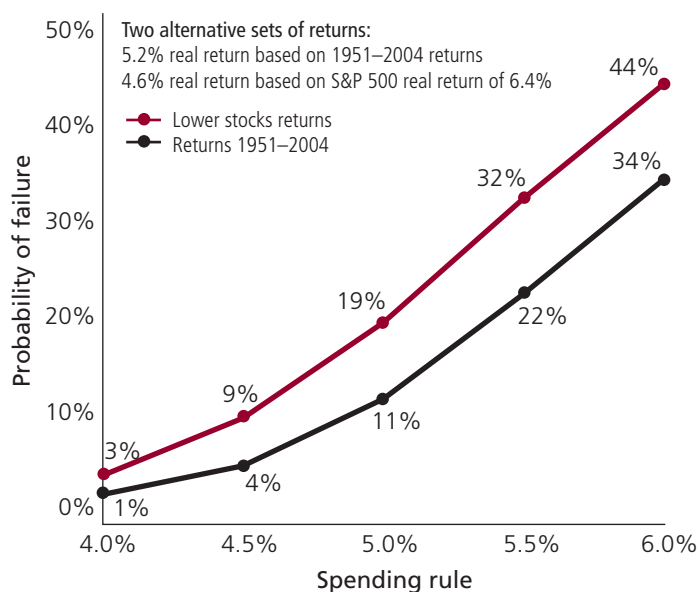
**Figure 4. Effects of stock/bond allocation**

4.5% spending rule for a 62-year-old married couple



**Figure 5. Effect of lower expected returns**

50/50 stock/bond portfolio for a married couple at 62 years of age



returns. It's well known that price earnings ratios today are higher for the S&P 500 than they were, on average, over this period. What if average returns on stocks are lower in the future? Over the period from 1926 to 1980, prior to the start of the two-decade long bull market, the S&P stock index had an average real return of only 6.3%. Over the shorter period from 1951 to 1980, the average real return was almost identical at 6.4%. A second set of simulations was run with the real returns on stocks based on an average return of 6.4%, 1.1% lower than in the previous simulations.<sup>6</sup> With a 50/50 stock/bond portfolio still assumed, the expected real return on the portfolio falls to 4.6% because of the lower stock return. Once

again, the spending rule is varied from 4% to 6% in retirement.

Figure 5 presents the failure rates for both sets of returns, those based on average returns from 1951 to 2004 and those based on the lower real return on stocks of 6.4% rather than 7.5%. If a 4.5% spending rule is chosen for this couple, the failure rate rises to 9% from 4%. A 5% spending rule results in a failure rate of 19% instead of 11%. It is evident from this figure that the average returns assumed in the simulation matter a lot. If we suspect that the bull market of the 1980s and 1990s is unlikely to be repeated in the future, spending rates will have to be lowered accordingly.

### **Effects of bequests and variable spending rules**

There are two features of the simulations discussed above that need to be investigated. First, the simulations assume the retirees are willing to use up wealth during their lifetimes. Some retirees may want to leave a bequest to charity or to their heirs. Second, the simulations assume that the retirees will keep spending constant (in real terms) regardless of how high or low their investment returns are. We will investigate changing both features.

Consider first the bequest motive. The simulations might be designed so that the target level of wealth at death is some fraction of the original wealth level (adjusted for inflation). The retirees may choose this target for two different reasons. As stated above, the higher target will provide a bequest after death. But the higher target may also be chosen because retirees regard a decline in the portfolio anywhere near 100% as a disaster. Instead of a target level of zero wealth at death, suppose we assume that the retirees have a target level equal to 50% of the initial wealth.

Raising the target level of wealth will raise the probability of failure, since now failure is defined as having initial wealth fall below 50% of the initial wealth. So it's important to find some other way to mitigate the effects of a bad sequence of returns.

Realistically, retirees are not going to keep spending the same amount if their wealth has fallen drastically. And they are not like to keep their wealth constant if they have had a whole string of good returns. So the second modification we will make is to have spending vary with current wealth.

It may not make sense for all spending to vary with wealth. (A proportional spending rule of 5% would cut the dollar amount spent in half, adjusted for inflation, if wealth falls by 50%). Perhaps a reasonable plan is to have half of spending vary with wealth and the rest be fixed (in real terms) over time. We will consider a plan where wealth is allowed to drop to 50% of its initial level and where half of the spending is tied to current wealth. So, for example, a 5% spending rule for retirees with \$1 million will be split into \$25,000 that is held fixed over time (adjusted for inflation) and 2.5% that will vary with the level of wealth. This flexibility in the spending rule will make it easier to keep wealth above the target level.

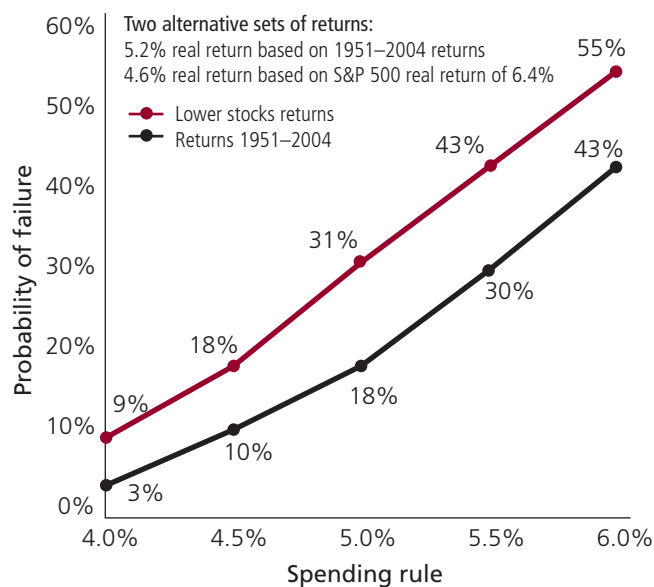
Figure 6 shows the results of these simulations based on two sets of return assumptions, real returns equal to those of the 1951-2004 period and lower real returns for equity equal to those found in the 1951-1980 period. These simulations are once again for 62 year-old married couples who are newly retired. The results are quite distressing. Spending rules of 5% are downright dangerous with 18% failure rates based on 1951-2004 historical returns and 31% failure rates based on lower returns for equity. (Would you want a nearly one-third chance of dropping below your target wealth?) Spending rules of 4.5% result in 10% or 18% failure rates depending on whether equity has an average real return of 7.5% (the 1951-2004 average) or 6.4% (the 1951-1980 average).

The bottom line is that spending rates as low as 4.5% appear to be problematical. If real returns on equity average 6.4%, failure rates are as high as 9%. And if the retiree has a target wealth of 50% rather than 0%, failure rates range much higher.

Do retirees have portfolios large enough to live on 4% of wealth? Some do, of course. But for many American families, retirement in this “new age” of defined contribution plans may be bleak.

**Figure 6. Higher target wealth and flexible spending**

Target at 50% of initial level. Spending rule: ½ fixed in dollars and ½ proportional to wealth



### **How can I turn a defined contribution plan into a defined benefit plan?**

Many retirees relying on their savings to finance a retirement envy the financial security of those with defined benefit plans. Such plans guarantee an income flow for the rest of the retiree's life. In some cases, the income flows are indexed to inflation. The great advantage of such plans is that they insure against the most important risk in retirement – longevity risk. Longevity risk is the risk that the retirees will run out of money before they die.

Those many retirees relying on defined contribution plans with no such guaranteed income streams can try to create a defined benefit plan ex post. This income stream is obtained by investing a portion of the initial wealth in an immediate fixed annuity. The annuity works by pooling a large group of retirees of the same age in the same pool. Some will die early and will end up not capturing as much income as the average member of the pool. Others will die much later and will capture much more than the average member of the pool. By joining a pool of other retirees of the same age, retirees can guarantee that they never run out of money.

Why does that increase income in retirement? The reason is that the wealth invested in the annuity can be deliberately exhausted before death. It's always possible to increase the "income" on a bond portfolio if we are willing to use up the capital in that portfolio. The immediate fixed annuity does just that.

There is one big drawback against many annuities offered to retirees. They do not protect against inflation. For the same reason that we base spending rules on real returns so that nominal spending can rise with inflation, we should want to invest in annuities that are indexed to inflation. The income from these inflation-indexed annuities will naturally be lower than in the case of a nominal annuity. But investing in an inflation-indexed annuity will protect against two major risks in retirement – longevity risk and inflation risk. This is exactly what the current social security system does. It provides us life-time income that is indexed to the CPI.

It's not really necessary to run new simulations to illustrate outcomes if such annuities are purchased. Consider a retiree who decides to invest a third of the portfolio in immediate annuities indexed to inflation. That annuity will provide a floor on retirement income very much like Social Security does. Given that floor, the retiree can consider simulations like those already analyzed, but where "disaster" leaves the retiree with some floor level of income.

### Concluding comments

Americans are retiring in their early 60s and living long lives in retirement. Many of these Americans lack the luxury of a defined benefit plan providing them income in retirement. They might have accumulated wealth to carry them through the retirement years, but many do not understand how to invest that wealth and how to make sure that it “lasts a lifetime”. That’s why it is so important to address the issue of spending rules in retirement.

No set of simulations can give you a spending rule that is the “correct one”. So let’s summarize the key issues that those contemplating retirement must address. First, you need to focus on the risk that really matters in retirement, the risk of running out of money. Second, you need to base your spending rate on the returns you expect to earn on your portfolio after inflation has been taken out.

Third, the higher the proportion of bonds in the portfolio, the lower has to be the spending rate. Fourth, the spending rate has to be lower than the expected real, or inflation-adjusted, return because otherwise your risk of failure will be too high. Fifth, you have to recognize that we are not sure about what average real returns will be in the future, so we may have to be even more conservative than past returns would indicate.

No spending rule and investment plan can eliminate the financial uncertainties of retirement, but sensible planning can help to stretch wealth through the retirement years. But for this to happen, retirees must be much more deliberate in their financial decision-making in retirement. And that starts with sensible spending rules and investment allocations.

The author would like to thank Ronald Madey for his comments on a previous draft.

<sup>1</sup>The median age of retirement for the years 1995-2000 was 62.0 for men and 61.8 for women (Department of Labor, October 2001).

<sup>2</sup>Only 24% of Americans working in the private sector have defined benefit pensions compared with 48% who have defined contribution pensions (Department of Labor, August 2004).

<sup>3</sup>The real, or inflation-adjusted return, can be approximated by subtracting the inflation rate from the nominal return. It’s more accurate to use a compound formula:  $(1 + 0.053) / (1 + 0.025) - 1 = 2.7\%$ .

<sup>4</sup>Monte Carlo methods are widely used in the physical and social sciences to simulate random outcomes.

<sup>5</sup>Financeware requires an arithmetic nominal return for the portfolio, not a compound (or geometric) real return. So the assumed inflation rate of 2.5% and the actual arithmetic real returns on stocks and bonds were used to obtain arithmetic nominal returns for the simulation.

<sup>6</sup>Fama and French (2001) discuss other ways to derive estimates of long-run returns such as by replacing actual capital gains on stocks with the rates of growth of dividends or earnings. These approaches result in lower estimates of future stock returns. See also Marston (2003) and Arnott and Bernstein (2002) for a discussion of long-run returns.

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