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Endowment spending in volatile markets: what should fiduciaries do?

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Abstract Spending rules often guide institutions in determining the annual expenditures from their endowments. A typical rule is five percent of some measure of the value of the endowment. That many institutions utilize the same type of spending rule suggests that these institutions set their spending rules independent of their investment strategy. This paper argues that for many institutions the spending rule and the investment strategy need to be determined simultaneously. The key to understanding this simultaneity is the institution's willingness to reduce its endowment expenditures when the endowment drops in value. As an institution becomes more reluctant to reduce its expenditures in bad times, the need to set both its spending rule and investment strategy simultaneously increases. One practical implication is that even if an institution believes, for instance, that the returns of a particular class of assets, like equities, will be greater over the long run than the returns of other assets, that institution may still choose to hold some of these other assets if the resulting portfolio has smaller short-term volatility—despite the smaller long-run return.

Keywords Endowments · Spending rule · Retirement · Investing · Long-run returns · Asset allocation

JEL Classification G11 · G23

In the late sixties, McGeorge Bundy, former President of the Ford Foundation and close confidant to President Jack Kennedy, exhorted colleges and universities to tilt their endowments towards equities and within equities even more risky equities. The rationale is

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that colleges and universities have long-term horizons and therefore should adopt the strategy of maximizing "long-term total return",[1] even though the Foundation's report recognized that such a strategy may entail substantial short-term volatility or short-term risk. The view that equities will provide superior returns over the long run may have its roots in Fisher and Lori's original studies of equity returns from 1926 through 1960.[2] More recently, Siegel analyzed yearly stock and fixed-income returns and concluded that the probability over any 30-year horizon from 1802 through 2006 that stocks will have greater returns than those realized by fixed-income assets is "virtually 100 percent".[3]

The theme of this paper is that even though an institution has a long-term horizon, many institutions should still focus on short-term volatility and do indeed face a tradeoff between potentially larger long-term returns and short-term volatility. Those institutions for which this tradeoff is relevant are those that rely on a steady flow of income from their endowment, and for these types of institutions, short-term volatility matters, as short-term volatility is directly related to the probability that an institution will be able to maintain a steady future flow of income. Thus, some institutions may rationally choose conservative investment strategies with their smaller short-term volatility, even though these institutions have long-term horizons.

The paper begins with a discussion of spending rules for endowments. It then moves onto some simulations that show how spending rules and investment strategy interact. The final section concludes the paper.

1 Spending rules

Institutions willingly increase their spending levels as their endowments rise in value. Yet, institutions often find it extremely painful to reduce spending as their endowments fall in value. Some institutions rely on their endowment income to cover ongoing salaries and expenses and any reduction in spending from their endowments would lead to an immediate curtailment of services. Harvard and Yale present recent examples of this pain as their risky endowments both dropped roughly 30 percent in the year ended June 30, 2008, with the result that these institutions laid off staff and reduced non-salary expenses, even stopping construction of building projects in mid-stream.[4] Yet, other institutions use their endowments to fund discretionary and easily postponed projects and can more easily reduce their spending from endowments.

We shall first explore two spending rules that are extreme in that the first never reduces spending when an endowment drops in value and the second decreases spending immediately. We then examine more realistic spending rules that allow a gradual reduction or increase in spending as an endowment changes in value.

A spending rule that captures the tendency for an institution to increase spending as the endowment value increases but not decrease spending when the endowment value decreases will be termed the *Ratchet Rule*: Based upon today's needs and prospects for the future, the institution picks an initial spending level as a percent of the current value of the endowment at the beginning of the first year. The spending level in each of the subsequent

[1] Managing Educational Endowments (1969, p. 33).

[2] Fisher and Lorie (1964).

[3] Siegel (2008, p. 26).

[4] Hechinger (2009).

years is the maximum of: (a) the nominal value of the spending level from the prior year, or (b) a spending level determined by the product of the initial percent and the current value the endowment at the beginning of the year.[5] This rule is extreme in that it never allows a reduction in spending no matter how poorly the endowment performs, but it serves to illustrate the role that short-term volatility plays in the interaction of spending rules and investment strategies.

Although extreme, the *Ratchet Rule* has desirable properties in that spending never decreases but only increases or remains the same. Consequently, the probability that the spending pattern of an institution could conform to this rule over an extended number of years is of interest. A related rule with even more desirable properties modifies the *Ratchet Rule* with the provision that the minimum spending increase in any year be the maximum of the prior year spending adjusted up by the CPI or a percent of the prior year endowment. For reasons of space, we shall not present any analysis of this rule, but we should note that in a world of inflation, the probability of succeeding with this rule is less than that the *Ratchet Rule*.

Another variant of the *Ratchet Rule* that is commonly cited by financial advisors is what we shall term the *Retirement Rule*. Spending is initially set at four percent of a retiree's wealth; in subsequent years, spending is increased or decreased each year by the CPI regardless of the change in the value of the retiree's wealth. We shall examine the sensitivity of this rule to variations in the initial percentage of wealth spent and asset allocation.[6]

At the other extreme is a fully flexible spending rule that spends a fixed percentage of the endowment each year (the *Flexible Rule*), which calls for an immediate increase or decrease in spending as the value of an endowment changes. Although extreme, the *Flexible Rule* is one to which private foundations must adhere, as they are required to spend a minimum of five percent of their endowment each year, subject to certain adjustments that this paper will ignore.

Most colleges and universities utilize a spending rule that determines spending levels as a predetermined percent of a base determined by a moving average of prior market values (the *Average Rule*). According to the 2007 National Association of College and University Officers (NACUBO) Endowment Study, 371 calculated the base as an average of three prior year-end market values or of twelve prior quarterly market values. Another 84 used a moving average of market values of other than three years or twelve quarters. The *Average Rule* allows for both upwards and downwards adjustment but with a lag. It might be noted that 32 colleges and universities spend a predetermined percentage of the beginning market value, a rule that is identical to the *Flexible Rule*.

Dimmock reports that the typical percentage that universities and colleges use is five percent of some moving average.[7] For most of the following analyses, we shall use a five percent spending rate, but we shall later vary the spending rate to determine the sensitivity of spending levels to various spending rates.

[5] Note that the spending level is determined at the beginning of the year (the same as the end of the prior year), which facilitates the budgeting process, and then expensed at the end of the year.

[6] Scott et al. (2008) present a comprehensive survey of the literature recommending this rule.

[7] Dimmock (2008, p. 8) The 2007 NACUBO survey reports an average spending rate over 792 institutions of 4.6 percent of their endowment—slightly less than 5 percent reported in the text. The difference is due in part to the denominator used in the calculation of these percentages. In the survey, the denominator is the beginning-of-year value, while the Spending Rule uses an average of prior values. When the value of the endowment is increasing over time, the average value over a number of years will be less than the current value, so that spending expressed as a percent of current value will be less than spending expressed as a percent of an average value. The reverse occurs when the value of the endowment is declining over time.

2 Simulated returns

To illustrate the relation between spending rules and investment strategy, we use annual returns from two fifty-year periods. In both of these periods, the returns on stocks exceeded the returns on bonds, and as a consequence, a buy-and-hold investor would have been better off holding an all-equity portfolio rather than a portfolio invested in both bonds and stocks. Yet, as shown below, an institution may still choose a portfolio invested in both bonds and equities rather than an all-equity portfolio even though the former has a smaller expected return. Focusing on just bonds and equities is a gross simplification of actual institutional portfolios that often contain hedge funds and other exotic assets that may exhibit much more short-term risk than equities and particularly the large-cap equities that will be utilized in this paper. This simplification however allows us to focus on the role of short-term volatility in the interaction of short-term risk and spending rules.

The two fifty-year periods are 1926–1975 and 1958–2007, which represent the first fifty years and the last fifty years of the Ibbotson-Sinquefield data at the start of this project. The specific series used are the yearly returns on large stocks measured by the S&P 500 with dividends reinvested and the yearly returns on long-term governments measured by the single government bond with maturity closest to 20 years. Other series could have been used, but these specific series are sufficient to illustrate the interaction of spending rules and investment policy. In the 1926–1975 period, the geometric or compounded annual return on equities was 9.0 percent, which exceeded the return on bonds of 3.1 percent; in the 1958–2007 period, the corresponding compounded returns are 11.2 and 6.8 percent (Table 1). In both periods, equities have both greater realized returns and greater yearly volatility than bonds. The returns of both bonds and equities in the second period exceed their corresponding returns in the first period, making the second period a better investing environment. Because of the smaller standard deviation of bond returns, a buy-and-hold portfolio that is invested in both bonds and stocks and rebalanced annually will exhibit less annual return volatility than an all-equity portfolio, as well as lesser returns.

For each of the fifty-year periods, we undertake 10,000 simulations of fifty years. There are two common ways to select a random sample of the fifty returns for each simulation: without and with replacement. Without replacement, the first return sampled is selected randomly from the fifty returns; the second return sampled is selected randomly from the remaining forty-nine returns; and so on. With replacement, the first return sampled is selected randomly from the fifty returns; the second return sampled is selected randomly from the fifty returns; and so on.

Table 1 Summary statistics for the two 50-year simulation periods

Variable	Geometric mean	Arithmetic mean	Standard deviation	Correlation		
				Stocks	Bonds	CPI
1926–1975						
Stocks	9.0	11.4	22.6	1.000	0.011	−0.039
Bonds	3.1	3.3	5.5		1.000	−0.230
CPI	2.3	2.4	4.8			1.000
1958–2007						
Stocks	11.2	12.4	16.6	1.000	0.142	−0.225
Bonds	6.8	7.3	10.8		1.000	−0.212
CPI	4.1	4.2	3.0			1.000

A principal difference between these two sampling techniques is that without replacement each of the fifty returns will be sampled once, while with replacement the same return can be sampled more than once. Thus, sampling without replacement is equivalent to randomly reordering the fifty returns with the result that the annual compounded rates of returns, as well as the standard deviations and correlation, are the same for every simulation. As a consequence, for any simulation, we know in advance that an all-equity buy-and-hold strategy will provide a greater return than a strategy invested in both equities and bonds. In contrast, in a simulation with replacement, an all-equity strategy may provide lesser returns than a diversified strategy, when that simulation over samples smaller equity returns and larger bond returns.

Since the point of this paper relates to the sequence of returns, asset allocation, and the spending rule, we shall focus on the simulations without replacement. Thus, any finding that a diversified portfolio is superior to an all-equity portfolio is due to the sequence of returns and not that bonds provided better returns than equities in that simulation. Further, we utilize the same set of random returns to evaluate each spending rule. By utilizing the same returns, we can be more confident that the effect of different spending rules upon wealth and spending levels is the spending rules and not a different set of random variables.

3 The *Ratchet Rule*

The *Ratchet Rule* ratchets spending upwards when returns are good and but does not decrease spending when returns are poor. We simulate this spending rule 10,000 times for each of the 50-year periods for portfolios with different percentages in equities varying from zero to one hundred percent in steps of ten percent. The portfolios are rebalanced yearly. When the required spending is more than the moneys in the endowment, we assume that all of the endowment is used and both the future endowment and spending are zero. A strategy is deemed a failure in any given year if the endowment after spending is zero.

We first report results where the initial spending rate is five percent and the initial endowment is one million dollars. To measure the sensitivity of spending levels to the spending percentage, we then analyze the results where spending percentages vary from three to six percent.

3.1 Initial spending of five percent

In both 50-year periods, the simulations that assume an initial spending rate of five percent and utilize random samples without replacement show that a portfolio invested in both bonds and stocks provides a lesser probability of failure after 50 years than an all-equity portfolio (Fig. 1). In the earlier 1926–1975 period, a 50-percent equity portfolio provides the least probability of failure (55 percent of the simulations), while a 40- or 60-percent equity portfolio provides nearly the same probability. An all-equity portfolio provides a failure rate of 76 percent. In the later 1958–2007 period, any portfolio with equities from 30 to 60 percent provides probability of failure of less than one percent. Similarly to the first 50 years, an all-equity portfolio provides a greater probability of failure (10 percent) than a portfolio invested in both equities and bonds. The simulations that again assume an initial spending rate of five percent but utilize instead random samples *with* replacement show similar advantages of a portfolio invested in both bonds and equities (Fig. 2)—suggesting that the results are robust to the method of sampling.

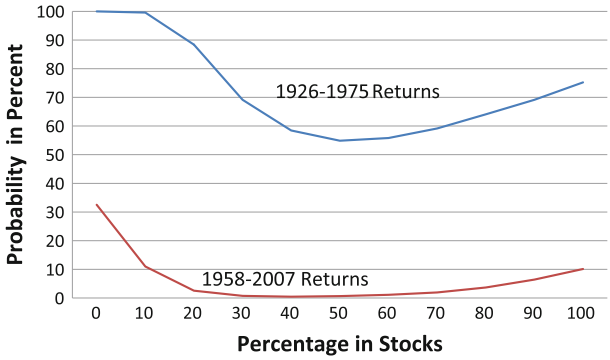

Fig. 1 Probability of failure at 50 years for 5% *Ratchet Rule* without replacement

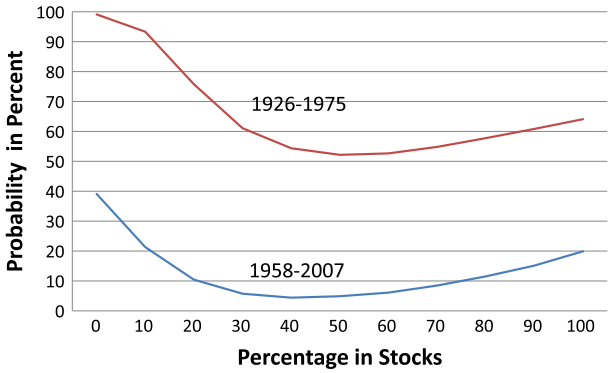

Fig. 2 Probability of failure at 50 years for 5% *Ratchet Rule* with replacement

To examine in more detail the simulated results for the simulations without replacement, we focus on the first fifty-year sample where the probability of failure is greater than it is in the later samples and on an all-equity strategy and a 50-percent equity strategy. We pick these two strategies as an all-equity portfolio provides the greatest buy-and-hold return, and the 50-percent equity portfolio minimizes the probability of failure in the 1926–1975 years.

When the returns in the first part of the simulated fifty years are larger than the spending percentage, or what might be termed good returns, an institution will tend to ratchet up its spending to unsustainable levels. To illustrate, we examine in detail one of the 10,000 simulation with good returns early on (Fig. 3). This particular simulation was not selected at random but rather selected as one in which the returns early on were good. The annual compounded equity return during the first ten years was 9.2 percent per year, 14.3 percent during the next ten years, and 11.1 percent during the third ten years. As a result, the spending level increased from $50,000 to $417,000 by year 35. The annual compounded equity returns over the next ten years were −1.9 percent per year, driving the wealth downwards as spending remained at $417,000. By year 44, the institution would have run out of money. In contrast, the initial returns on a 50-percent equity portfolio were less extreme, so that the spending ratcheted up to only $111,000 by year 29. Even with the relatively poor returns in the fourth ten-year period, the institution was able to maintain the lower spending level, although wealth was still decreasing. At year 50, the spending was 19 percent of the endowment, and this level of spending may not be sustainable over the next

Buy-and-Hold Annual Returns		
Years	Equity Percentage	
	100	50
1-10	9.2	6.6
11-20	14.3	9.4
21-30	11.1	6.7
31-40	-1.9	2.4
41-50	12.8	8.5

The table and figures illustrate for one simulation the effect of initial good returns on wealth and spending for one simulation without replacement for the 50 years from 1926 through 1975 for the 5% ratchet rule. The table to the left sets forth the returns by decade. The figure to the left depicts all equity portfolio and shows how spending increases to unsustainable levels and then wealth depletes. The figure to the right depicts an fifty-percent equity portfolio and shows how a diversified portfolio mitigates the increase in spending during the initial good returns. The spending scale is always five percent of the wealth scale.

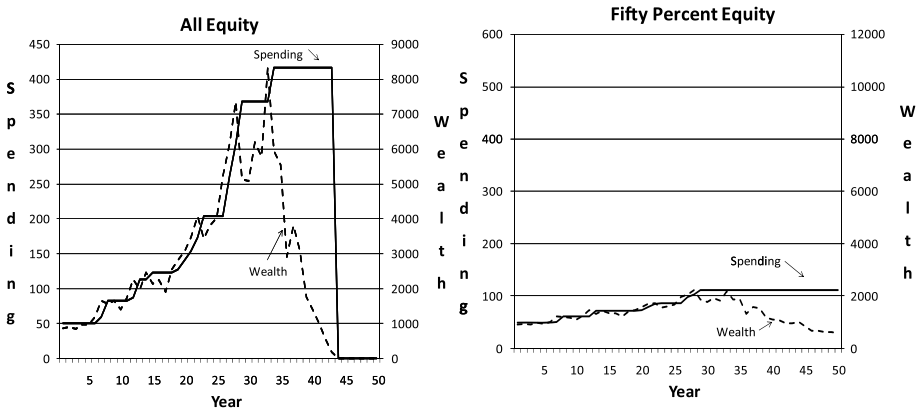

Fig. 3 The effect of initial good returns on spending and wealth

fifty years. Even here, the spending level has been ratcheted up to perhaps an unsustainable level although the year of possible ruin is more than 50 years in the future.

When initial returns in the first part of the simulated fifty years are less than the spending percentage, or what might be termed poor returns, the initial spending level, even though not ratcheted up, may still be unsustainable. Another non-randomly selected simulation of the 10,00 simulations illustrates this effect (Fig. 4). Here the annual compounded equity returns in the first ten years were −2.4 percent per year. While maintaining a spending level of $50,000, an institution with an all-equity portfolio would eat into its endowment to such an extent that even with returns of 16.3 percent in the next ten years, the wealth would go to zero at year 16. In contrast, the returns on a fifty-percent equity portfolio were less extreme in the first ten-years and the reduction in the endowment was not as great. Indeed, the very good annual compound returns of 18.4 percent in the third ten-year period would lead to an increase in the endowment. Again, the spending level of $50,000 may be unsustainable in the future as the spending level at year 50 is 10 percent of the endowment.

As a further analysis, we have plotted the distribution of spending at year 50 for both strategies (Fig. 5). As expected, the range of spending for the all-equity portfolio is more extreme than for a 50-percent equity portfolio. The probability of failure is 75 percent for an all-equity portfolio, but only 55 percent a 50-percent equity portfolio. At the other extreme, the probability of a spending level of over $200,000 is 14 percent for an all-equity portfolio, but les than one percent for a 50-percent equity portfolio. In sum, there is a direct tradeoff between extremely good results and the probability of failure.

3.2 Other spending percentages

To illustrate the differences in failures for different spending percentages, we analyze again the less favorable first fifty-year sample without replacement. The probability of

Buy -and - Hold Annual Returns		
Years	Equity Percentage	
	100	50
1-10	-2.4	0.9
11-20	16.3	10.1
21-30	18.4	11.5
31-40	0.1	3.0
41-50	10.5	7.0

The table and figures illustrate the effect of poor returns on wealth and spending using one simulation without replacement in the first part of the 50 years from 1926 through 1975 for the 5% ratchet rule. The table to the left sets forth the returns by decade. The figure to the left depicts an all equity portfolio and shows how spending remains at five percent even as wealth is depleted. The figure to the right depicts a fifty percent equity and shows how a diversified portfolio mitigates this depletion of wealth. The spending scale is always five percent of the wealth scale.

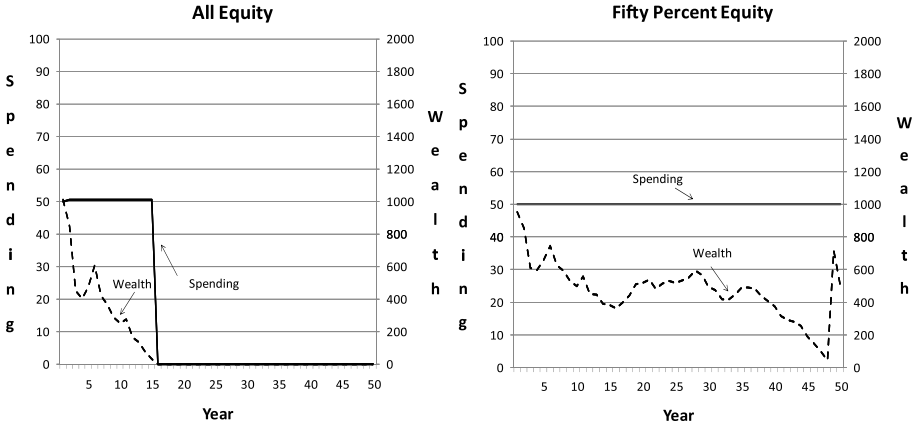

Fig. 4 The effect of initial poor returns on spending and wealth

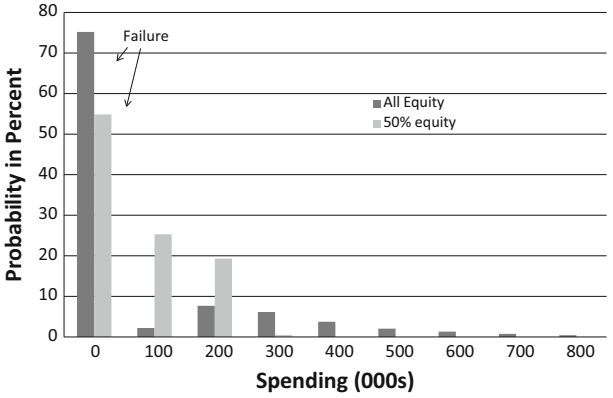

Fig. 5 Spending distribution at 50 years for 5% *Ratchet Rule* for simulations without replacement 1926–1975

failure at 50 years hinges greatly on the initial spending percentage. At three percent, the probability of failure is less than 15 percent for any asset allocation from zero percent equities to 100 percent equities (Fig. 6), and the least probability of failure—0 percent probability of failure—occurs with an allocation of 20–30 percent in equities. As the initial spending percentage increases, the probability of failure increases for any asset allocation. With a six-percent initial spending level, the probability of failure is greater than 90 percent for any asset mix. Interestingly, the equity allocation for the portfolio with the

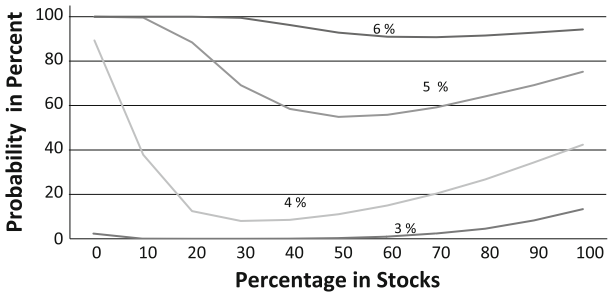

Fig. 6 Probability of failure at 50 years for *Ratchet Rules* by initial spending percentage and percentage in stocks without replacement—1926–1975

greatest probability of failure decreases as the initial spending percentage increases. At higher levels of spending, an institution needs to put more and more weight on equities with their greater expected returns to compensate for the higher spending. Indeed, at a six-percent spending level, any allocation to fixed-income assets up to and including 20 percent leads to certain failure. Put another way, smaller spending levels allow an institution to include more fixed-income assets to reduce the short-term volatility and still maintain to a sufficiently high expected return to meet its spending needs.

The average spending levels vary in interesting ways as the initial spending percentage changes. As above, we hold the allocation to equities at 50 percent but vary the initial spending percentage from 3 to 6 percent. For 16 years, the average spending levels at 6 percent exceed the spending levels at lesser percentages, but thereafter the spending levels decrease rapidly (Fig. 7). For slightly over twenty years, the average spending levels for larger initial spending percentages exceed average spending for the lower initial spending percentages. Thereafter, the average spending levels for the five- and six-percent initial spending levels decrease. The average spending for the four-percent spending rule exceeds the median for the five percent spending rule after 24 years and then levels off by 50 years. Similar statistics for an all-equity portfolio (Fig. 8) show similar trends.

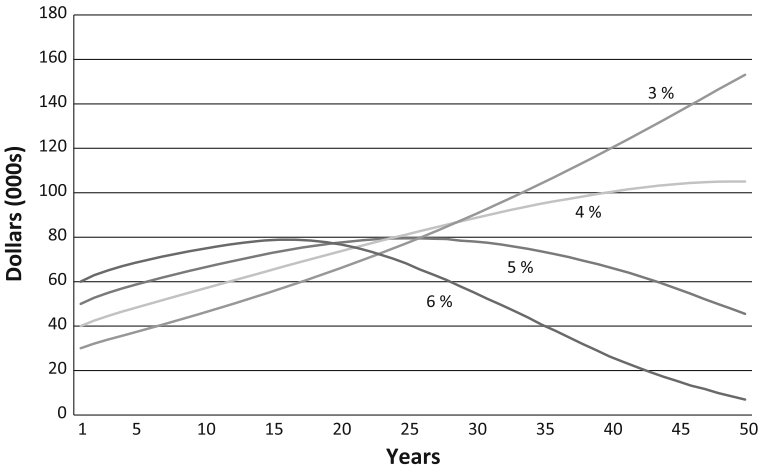

Fig. 7 Average spending for various *Ratchet Rules* with 50 percent equities without replacement—1926–1975

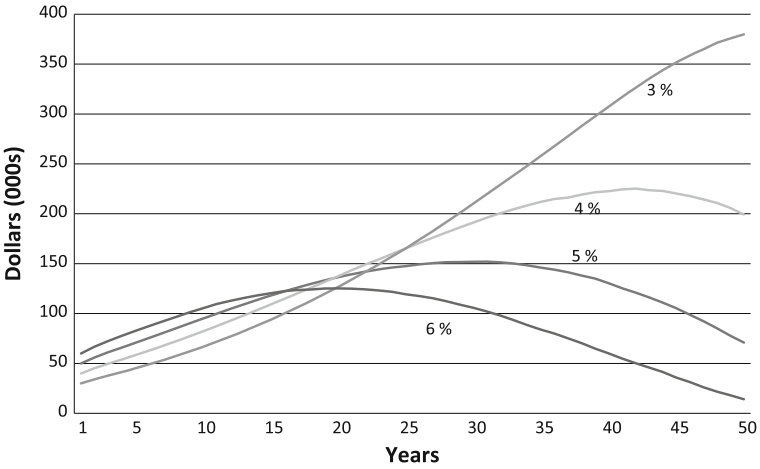

Fig. 8 Average spending for various *Ratchet Rules* with 100 percent equities without replacement—1926–1975

The above shows the importance of the initial spending percentage in determining what happens in the long run—after say 20 years. A one-percentage point difference in initial spending has a great effect on the average spending in the long run. Trustees of institutions must weigh the need for immediate spending against the potential of substantially greater spending levels in the long run in choosing an initial spending level.

3.3 Mean reversion

Before proceeding to the analysis of the *Retirement Rule*, let us consider the effect of mean reversion upon these above results–first when initial returns are poor and second when the initial returns are good. The effect of mean reversion is to induce negative autocorrelation into the observed returns series with a greater than usual probability of good returns following poor returns, and vice versa. The concern with initially poor returns is that the spending will eat into the endowment value. As the endowment value decreases, the fixed spending level becomes an ever increasing percentage of the endowment, so that even above average returns cannot restore the endowment to a sustainable level. Mean reversion will mitigate this effect, as poor returns are more likely to be followed by good returns, helping to reverse the decline in the endowment. In contrast, high initial returns lead to increases in spending to unsustainable levels, and mean reversion will exasperate this trend. As spending goes up with good returns, there is now a greater probability of poor returns. Parenthetically, it is mean reversion that reduces the long-term risk of an all-equity buy-and-hold strategy, as the probability of an extremely poor return following an extremely poor return is reduced.

3.4 The *Retirement Rule*: a special case

In examining the *Retirement Rule*, we shall utilize a 25-year horizon rather than the 50-year horizons examine above, as a 25-year horizon is more appropriate for a person retiring at 65 years of age. This rule starts with spending at 4 percent of the initial wealth

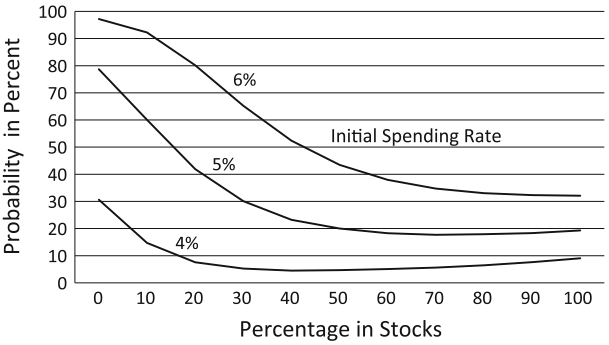

Fig. 9 Probability of failure at 25 years for *Retirement Rule* for various initial spending rates without replacement 1926–1975

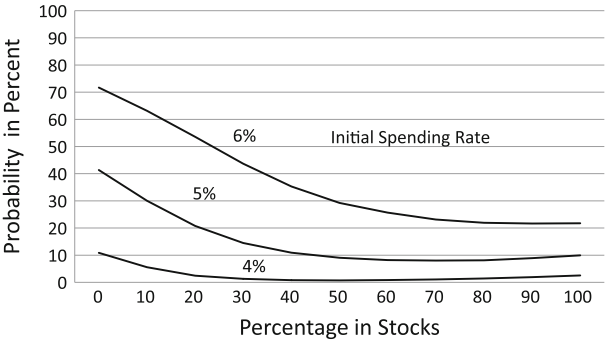

Fig. 10 Probability of failure at 25 years for *Retirement Rule* for various initial spending rates without replacement 1958–2007

and then increases the spending each year by the CPI. We shall also examine initial spending rates of 5 and 6 percent. As expected, the probability of success is smaller in the 1926–1975 sample (Fig. 9) than in the 1958–07 sample (Fig. 10).

In the earlier sample with it poorer returns with an initial spending of 4 percent, the probability of failure is 30.6 percent for an all-bond portfolio, dropping to the minimum of 4.5 percent for a 40-percent equity portfolio, and then increasing to 9.1 percent for an all-equity portfolio. However, any investment strategy from 30 to 70 percent has a failure probability of less than 6 percent—not much different from the minimum failure rate of 4.5 percent. With an initial spending rate of 5 percent, the minimum failure of 17.7 percent occurs with 70-percent equity portfolio, and with a rate of 6 percent, the minimum failure of 32.1 percent occurs with an all-equity portfolio. Intuitively, as the spending rate increases, a retired person must take on more short-term volatility with the greater expected returns to achieve his or her objectives. The results for the latter years 1958–2007 are similar, with the exception that the probabilities of failure are uniformly smaller as would be expected.

4 The *Flexible Rule*

The *Ratchet Rule* and the variant *Retirement Rule* involve some form of inflexibility in the adjustment of spending levels to changes in the value of the endowment. Now what happens if an institution follows the *Flexible Rule* spending a fixed percentage of its

endowment each year–with spending levels increasing with good returns and falling with poor returns?

Let r_t be the return for year t, and p be the proportion of the endowment expensed at the beginning of the year. Then, the amount available for investment at the beginning of the first year for a one-dollar endowment is

$$(1-p)$$

and the value of the endowment at the end of the first year is

$$(1+r_1)(1-p).$$

After n years, the value of the endowment is

$$[(1+r_1)(1+r_2)\cdots(1+r_n)](1-p)^n.$$

The term in brackets is just the returns on a buy-and-hold strategy, and the total endowment is just the product of this return and the constant $(1-p)^n$. Thus, the value of the endowment at year n is the same for any ordering of the returns, and short-term volatility does not matter.

In sum, an institution that follows the *Flexible Rule*, knew in advance that a buy-and-hold all-equity strategy would produce the greatest return, and wanted to maximize long-term wealth should choose an all-equity strategy. The spending levels will change from year to year and these changes will mirror the high volatility of the returns on equities.

5 The *Average Rule*

The *Average Rule* is less extreme than either the *Ratchet Rule* or the *Flexible Rule* as it allows a phased reduction in spending over a number of years when the value of an endowment falls. Thus, if the endowment declines 30 percent and remains the same for the next two years, an institution using a typical three-year average will see its spending levels drop 10 percent per year for each of the following three years for a total drop of 30 percent—not 30 percent in one year.

In analyzing the *Average Rule*, we utilize three versions of the rule to calculate the base upon which the spending level is derived—a one-year average of past endowment values, a three-year average, and a five-year average.[8] Initially, we set the spending rate to the commonly used five percent of the base. As in the prior section, we focus on the less favorable 1926–1975 period and sampling without replacement. None of the 10,000 simulations for any of the averaging intervals results in ruin, which suggests that these versions of the *Average Rule* have enough downward flexibility to avoid spending levels that are unsustainably high, as occurred with the *Ratchet Rule*. To examine the sensitivity of this result to the type of sampling, we replicated the simulations using the 1926–1975 period *with* replacement and obtained the same result—no failures.

As discussed above, many institutions find it difficult to reduce spending from endowment when the endowment falls in value. As a metric to focus on declines in spending, we define failure as percentage drop in spending levels over a number of years.

[8] To initialize say the five-year average, we set each of the five lagged values used in calculating the average to one million dollars. Thus, the first year base is one million dollars. In calculating the second year base, the last lagged value is dropped and the simulated value added. As a result, after five years of simulation, the base is based upon simulated values.

We vary the percentage decline from 10 to 20 to 30 percent and measure this percentage decline over a one-year interval, a three-year interval, and a five-year interval. The analyses presented in the text utilize a 30-percent decline in spending.[9]

The probability of a 30-percent decline in spending over one year for an all-equity portfolio is 100 percent using a one-year average for the base (Fig. 11). This is not surprising as any decrease in value is immediately translated into a decrease in spending, and there are two years in the 1926–1975 period in which equities show a loss of more than 30 percent. Using a longer averaging period reduces the immediate impact of a loss, so that the probability of failure for an all-equity portfolio drops to 16.0 percent with a three-year average and 1.9 percent with a five-year average. Regardless of the averaging interval, there are no failures for any strategy involving fifty or less percent in equities.

For an all-equity strategy, the average spending level in year 50 increases slightly as the averaging period increases; $291,864 in year 50 using a five-average, $284,843 using a three-year average, and $279,010 using a one-year average. This increase in average spending with length of averaging period persists for any strategy with 40 percent or more in equities. A possible reason for this relation is that the return on equities over the 1926–1975 years is 9.0 percent—much in excess of the five percent spending rule. In such an environment, postponing spending will lead to great values of the endowment in future years, and a five-year average postpones more spending that an average of fewer years. However, the differences in average spending as a function of the averaging interval are small in comparison to the effect on the rate of failure. Further, below 40 percent equities, there is virtually no relation between average spending levels and the percent in equities. In sum, as the proportion in equities declines, both the probability of failure and the average spending levels decreases: again verifying the tradeoff between spending volatility of average future spending levels.

As the number of years over which we measure the decline in spending increases, the risk of failure increases significantly for the three- and five-year *Average Rules* (Figs. 11, 12, and 13). For an all-equity portfolio using a three-year average, the risk of a decline in spending of 30 percent over one year is 16 percent, over three years 95 percent, and over five years 95 percent. This increase through the third year is a reflection of the smoothing from using a three-year *Average Rule*. The decline is just delayed with most of the decline occurring within three years as would be expected. For an all-equity portfolio using a five-year average, the risk of a decline in spending over one year is 2 percent, over three years 68 percent, and over five years 87 percent. Again the longer averaging interval delays the adjustment.

As with the *Ratchet Rule,* the average level of spending at 50 years is sensitive to the spending rate (Fig. 14). At any equity allocation, the rate of failure over a five-year period for a spending rule of 4 percent is uniformly less than that for a spending rule of 5 percent, and the average spending level is uniformly greater. For an all-equity strategy, the rate of failure for the 4 percent rule is 78 percent and for the 5-percent rule 87 percent. The corresponding spending levels are $391,572 and $290,864.

The above analysis assumes that there are no new contributions to the endowment fund, only withdrawals. But some institutions have an active program in raising new endowment money. One way to model such a program is to assume that the institution raises new money as a percent of the same base used in the spending rule. For sake of presentation, let

[9] In order to maintain comparability with later analyses using a five-average we exclude the first five years of the simulations in calculating summary statistics. For the average spending in year 50, this exclusion has no effect, but it does have an effect of statistics using the time series of simulated results.

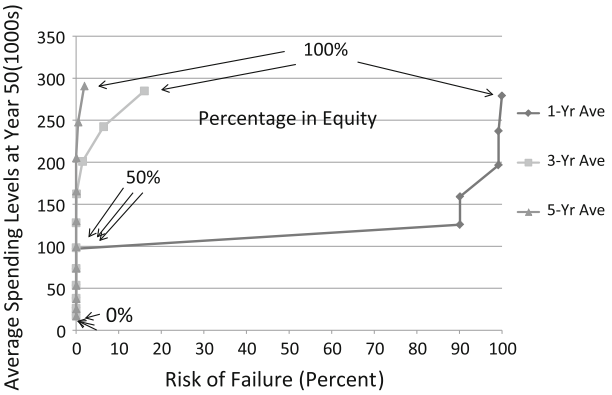

Fig. 11 Spending levels at year 50 (5% rule) versus risk of failure defined as a 30% decline in spending over 1 year 1926–1975

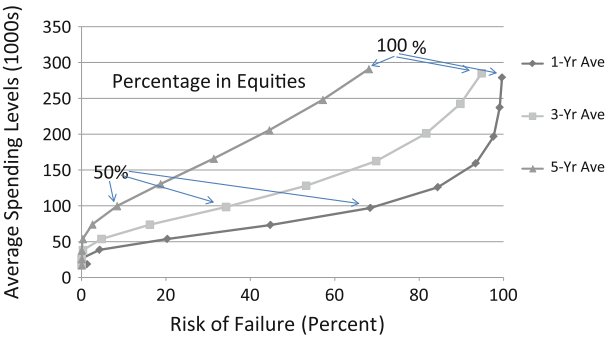

Fig. 12 Spending levels at year 50 (5% rule) versus risk of failure defined as a 30% decline in spending over 3 years 1926–1975

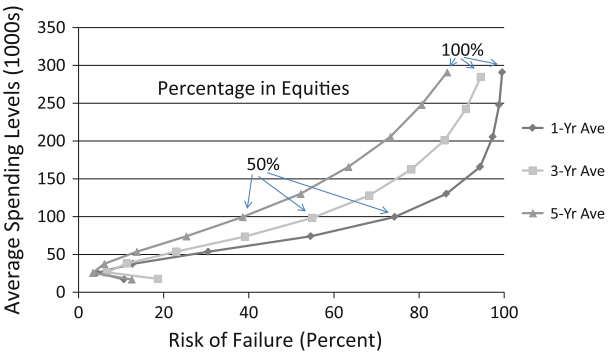

Fig. 13 Spending levels at year 50 (5% rule) versus risk of failure defined as a 30% decline in spending over 5 years 1926–1975

us assume that this percentage is one percent. Formally, such an inflow can be thought of as a reduction in the spending rate. Thus, an institution that has a spending rule of 5 percent and receives one percent in contribution is logically identical to an institution that has a spending rate of 4 percent, and we have already analyzed for both the *Ratchet Rule* and the *Average Rule* the effect on failure and spending levels as the spending rate is reduced.

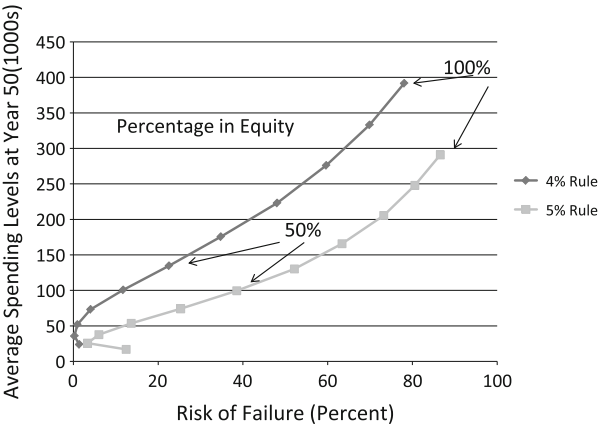

Fig. 14 Spending levels at year 50 versus risk of failure defined as a 30% decline in spending over 5 years (5 year ave) 1926–1975

6 What should fiduciaries do?

The key finding of this paper is that an institution that is reluctant to reduce spending when the value of its endowment falls should determine its spending rule and the investment strategy simultaneously. Such an institution may rationally choose a portfolio with a lower long run return than one with a greater long run return. The reason is short-term volatility. An institution that desires steady, non-decreasing expenditures from its endowment needs to be concerned about the possibility of a string of poor returns. Portfolios with smaller short-term volatility reduce this probability.

The critic may point out that the results here are based upon only two fifty-year periods and that even these periods overlap. But this criticism misses the point. The important assumption of this paper is that asset classes with greater expected long-run returns display greater short-term volatility than asset classes with lesser expected long-run returns. It is short-term volatility that determines the variability in spending level over the next year or so, and the ability of an institution to adjust spending downwards will always be an important factor in determining a spending rule and asset allocation.

The big question is whether the return on equities over the long run will exceed the returns on other classes of assets. This statement is different from the statement that equities have greater expected returns, which is a statement that on average equities will have greater returns. Although historical evidence indicates that the returns on equities in virtually any long run period have exceeded the returns on bonds, this evidence is no guarantee that the same will happen in the future. This uncertainty might lead an institution to add some bonds to an all-equity portfolio, quite apart from the reasons given in this paper.

In conclusion, a fiduciary should ask what the effect of a decline in spending is on institution and how fast the institution can adjust to a decline. The fiduciary should also determine the horizon of the institution. The answers to these questions will help an institution to determine simultaneously its spending rule and asset allocation.

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