The Rodney L. White Center for Financial Research

Institutional Spending Rules and Asset Allocation

Marshall E. Blume

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The Wharton School
University of Pennsylvania

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Marshall E. Blume
University of Pennsylvania
blume@wharton.upenn.edu
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Institutional Spending Rules and Asset Allocation

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 chose to hold a portfolio diversified over equities and other assets—despite the smaller long-run return.

Institutional Spending Rules and Asset Allocation

In the late sixities, 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 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 concludes 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.

[1] "Managing Educational Endowments," Advisory Committee on Endowment Management, The Ford Foundation, 1969, p. 33

[2] Larry Fisher and James H. Lorie, "Rates of Return on Investments in Commons Stocks," Journal of Business, 1964, v37(1), 1-21.

[3] Jeremy J. Siegel, **Stocks for the Long Run** (McGraw Hill, 2008), p. 26.

The paper begins with a discussion of spending rules for endowments. It then moves on to some simulations that show how spending rules and investment strategy interact. The final section contains a postscript on public policy.

I. Spending Rules

Institutions tend to increase their spending levels as their endowments rise in value. Yet, not all institutions are as willing to reduce their spending levels 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. Other institutions use their endowments to fund discretionary and easily postponed projects and can 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 is: 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 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.[4] We shall refer to this spending rule as the Ratchet Rule. This rule is extreme in that it never allows a reduction

[4] 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.

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.

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 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.[5] 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] Stephen G. Dimmock, "Background Risk and University Endowment Funds," Michigan State, unpublished manuscript, 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.

II. 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-stock portfolio rather than a portfolio diversified over bonds and stocks. Yet, as shown below, an institution may may still choose a portfolio diversified over bonds and equities rather than an all-equity portfolio.

The two-fifty years 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 returns on large stock and the returns on long-term governments. 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 compound annual returns on equities of 9.0 percent exceeded the returns on bonds of 3.1 percent; in the 1958-2007 period, the corresponding returns are 11.2 percent and 6.8 percent (Table 1). In both periods, equities have both larger realized returns and greater 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 diversified over 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.

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 diversified over 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 oversamples smaller equity returns and larger bond returns.

Since the point of this paper relates to the sequence of returns 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.

III. 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 successful in any given year if the endowment after spending is positive.

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 percent to six percent.

A. 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 diversified over bonds and stocks provides a greater probability of success after 50 years than an all-equity portfolio (Figure 1). In the earlier 1926-1975 period, a 50-percent equity portfolio provides the greatest probability of success (45 percent of the simulations), while a 40- or 60-percent equity portfolio provides nearly the same probability. An all-equity portfolio provides a success rate of only 24 percent. In the later 1958-2007 period, any portfolio with equities from 30 to 60 percent provides a greater than 99 percent probability of success. Similarly to the first 50 years, an all-equity portfolio provides a smaller probability of success (90 percent) than a portfolio diversified over 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 diversified portfolio (Figure 2)—suggesting that the results are robust to the method of sampling.

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 and on two strategies: an all-equity strategy and a 50-percent equity portfolio. An all-equity strategy provides the greatest buy-and-hold return; the 50-percent equity portfolio maximizes the probability of success in the 1926-1975 years and provides a probability success of greater than ninety-nine percent in the 1958-2007 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 10000 simulation with good returns early on (Figure 3). The equity returns during the first ten years were 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 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 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 one of the 10,000 simulations illustrates this effect (Figure 4). Here the equity returns in the first 10 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 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 (Figure 5). Even though, as shown above, the all-equity portfolio has a greater probability of failure than a 50-percent equity portfolio, the spending from an all-equity portfolio if it succeeds is likely to be much greater than that of a 50-percent equity portfolio. In short, there is a direct tradeoff between extremely good results and the probability of failure.

B. Other Initial Spending Percentages

To illustrate the differences in success for different initial spending percentages, we analyze again the less favorable first fifty-year sample without replacement. The probability of success at 50 years hinges greatly on the initial spending percentage. At three percent, the probability of success is above 85 percent for any asset allocation from zero percent equities to 100 percent equities (Figure 6), and the greatest probability of success—100 percent probability of success—occurs with an allocation of 20 to 30 percent in equities. As the initial spending percentage increases, the probability of success falls for any asset allocation. With a six-percent initial spending level, the probability of success for any asset allocation is less than 10 percent.

Interestingly, the equity allocation for the portfolio with the greatest probability of success increases 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 percent 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 (Figure 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 (Figure 8) show similar trends with the decline in spending levels for the five- and six-percent spending levels occurring

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.

C. Mean Reversion

Before proceeding to the analysis of the CPI 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 cause spending to increase 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.

V. The Flexible Rule

Both the Ratchet and CPI Rules 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

$$\left[(1+r_1)(1+r_2)...(1+r_{n)}\right](1-p)^n$$

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.

VI. The Average Rule

The Average Rule is less extreme than either the Ratchet Rule or the Flexible Rule when the value of an endowment falls, as it does allow a phased reduction in spending over a number of years. Thus, if the endowment declines 30 percent and remains the same for the next two years, an institution using the typical three-year averages will see its levels will 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.

We shall first examine an Average Rule where the base is an average of the endowment values over the three prior years and the spending level for the following year is five percent of this base—a widely used rule. Again, we utilize the less favorable 1926-1975 period and sampling without replacement. None of the 10,000 simulations results in ruin, which suggests that this version of the Average Rule has 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 sample with replacement and obtained the same result—no failures.

At year 50, the Average Rule generates an average spending level of $284,843 for an all-equity strategy.[6] As the proportion in equities decreases, the average spending level declines. For example, the average spending level is $98,326 for a 50-percent equity strategy. However, the greater average spending level for an all-equity strategy does come with costs. In one out of every ten years, an institution would have to reduce its spending from endowment by 12.4 percent or more in one year and by 27.1 percent or more over three years. In contrast in one out of every ten years, an institution with a fifty-percent equity portfolio would face reduction in spending that is approximately half of those facing an institution with an all-equity portfolio—6.9 percent in one year and 15.9 percent over three years.

Thus, an institution following the Average Rule faces a tradeoff between volatility of spending levels and potentially greater spending levels. To illustrate this tradeoff, we plot at year 50 the standard deviation of one-year changes in spending levels and the three-year changes against the average spending level for allocations to equity ranging from zero to 100 percent (Figure 9). Much like the Markowitz efficient set, there is a clear tradeoff between the

[6] In order to maintain comparability with later analyses using a five-average we exclude the first four 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.

volatility of short-term spending changes and expected spending levels. It might be noted that in these years, an institution should never have held an all-bond portfolio as a portfolio with ten percent in equities provides virtually the same short-term volatility but greater expected spending levels. Thereafter, volatility and expected spending levels increase monotonically.

A further examination of the spending levels at year 50 shows that those from an all-equity strategy are greater than those for a 50-percent equity strategy at virtually all levels of probability (Figure 10). This demonstrates the critical importance of the ability of an institution to adjust its spending from an endowment. As an institution is more able to adjust its spending levels to short term volatility in returns, it can assume more equity risk and the greater associated long-run returns.

The above demonstrates that shifting from equities to bonds reduces short-term volatility in spending levels, but this is not the only way to reduce short-term volatility. One might expect that using a longer averaging period than the typical three years would lead to less volatility, at least over a one or three year horizon. To examine this conjecture, we analyze a five- year average. In lengthening the base, the first question to ask is whether such an Average Rule will retain sufficient downward flexibility in spending to avoid ruin. There is sufficient downward flexibility: None of the 10,000 simulations using the 1926-75 data without replacement led to ruin.

A plot of standard deviation of one-year of percentage changes in one-year spending levels against percentage in stocks confirms the smoothing ability of using a five-year average rather than a three-year average (Figure 11). Also presented are the standard deviations for the three-year Average Rule and a one-year Average Rule, which is the same as the Fully Flexible Rule discussed above. Plots of the volatility of the three-year percentage change tell a similar

story (not shown). The average spending levels at year 50 are approximately the same for all three versions the Average Rule.[7] Thus, an institution can use a longer-averaging interval and thereby increase its allocation to equities with potentially better long-run returns with no increase in the short-term volatility in spending levels. Of course, under any Average Rule, an institution will ultimately have to drop its spending level in response to a decline in its endowment. The critical question that an institution faces is how fast it can reasonably reduce its spending and the answer to this question interacts with the asset allocation decision. Both spending rules and asset allocation should be determined simultaneously.

VII. Where Are We?

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

[7] The average spending at 50 years for the 5-year Average Rule exceeded that for the 3-year Average Rule, which in turn exceeded that 1-year Average Rule, although the differences are all small and not reported in the text. The reason is that as the averaging period increases, there is less immediate adjustment as the endowment increases, effectively reducing the spending rate. From 1926-1975, returns were positive on average so that spending based upon longer averaging periods would result initially in lesser spending which would ultimately result in greater spending.

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, an institution should determine both its spending rule and asset allocation simultaneously.

VIII. A Policy Postscript

Currently, private foundations must spend five percent of their endowment each year or they face substantial tax penalties. Congress has been examining whether colleges and universities should be subject to the same rules and has collected substantial information from these institutions. The results of this study suggest that it would be a mistake to subject colleges and universities to such rules.

The five percent rule for private foundations is equivalent to the Fully Flexible Rule of this paper under which an institution must adjust their spending annually to any change in the endowment value. In an attempt to smooth these adjustments, the vast majority of higher educational institutions utilize a three-year or twelve-quarter moving average as the base to

which they apply their spending percentage. If Congress imposes the private foundation spending rule on higher educational institutions, these institutions would lose the advantages of being able to smooth spending levels in response to changes in their endowments. That these institutions currently do attempt to smooth their spending levels indicates that any attempt of Congress to remove such smoothing would be to their detriment.

Table I
Summary Statistics for the Two 50-Year Simulation Periods

Variable	Geometric Mean	Arithmetic Mean (percent)	Standard Deviation	Correlation		
				Stocks	Bonds	CPI
A. 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
B. 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

Figure 1
Probability of Success at 50 Years for 5% Ratchet Rule without Replacement

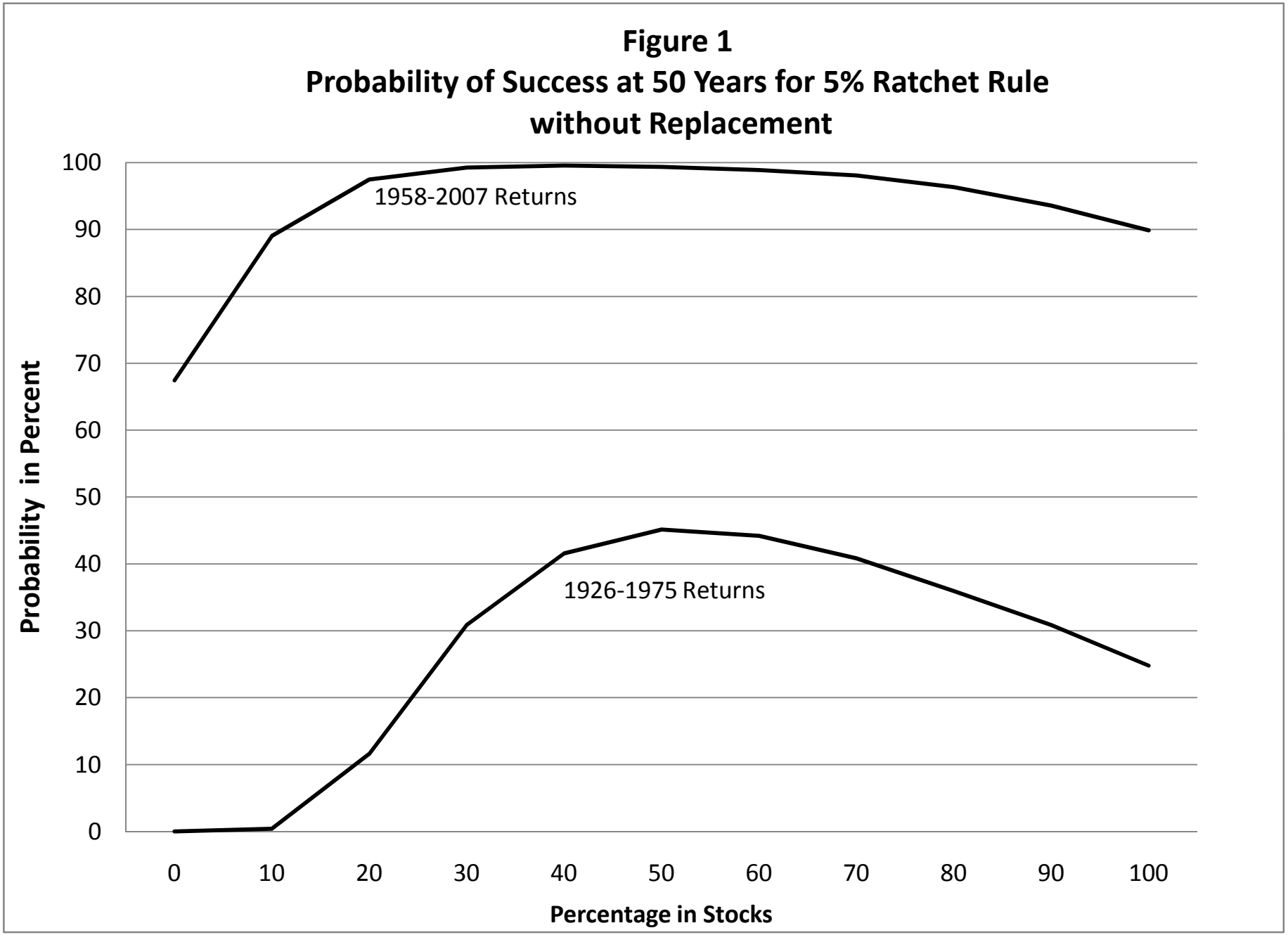


Figure 2
Probability of Success at 50 Years for 5% Ratchet Rule with Replacement

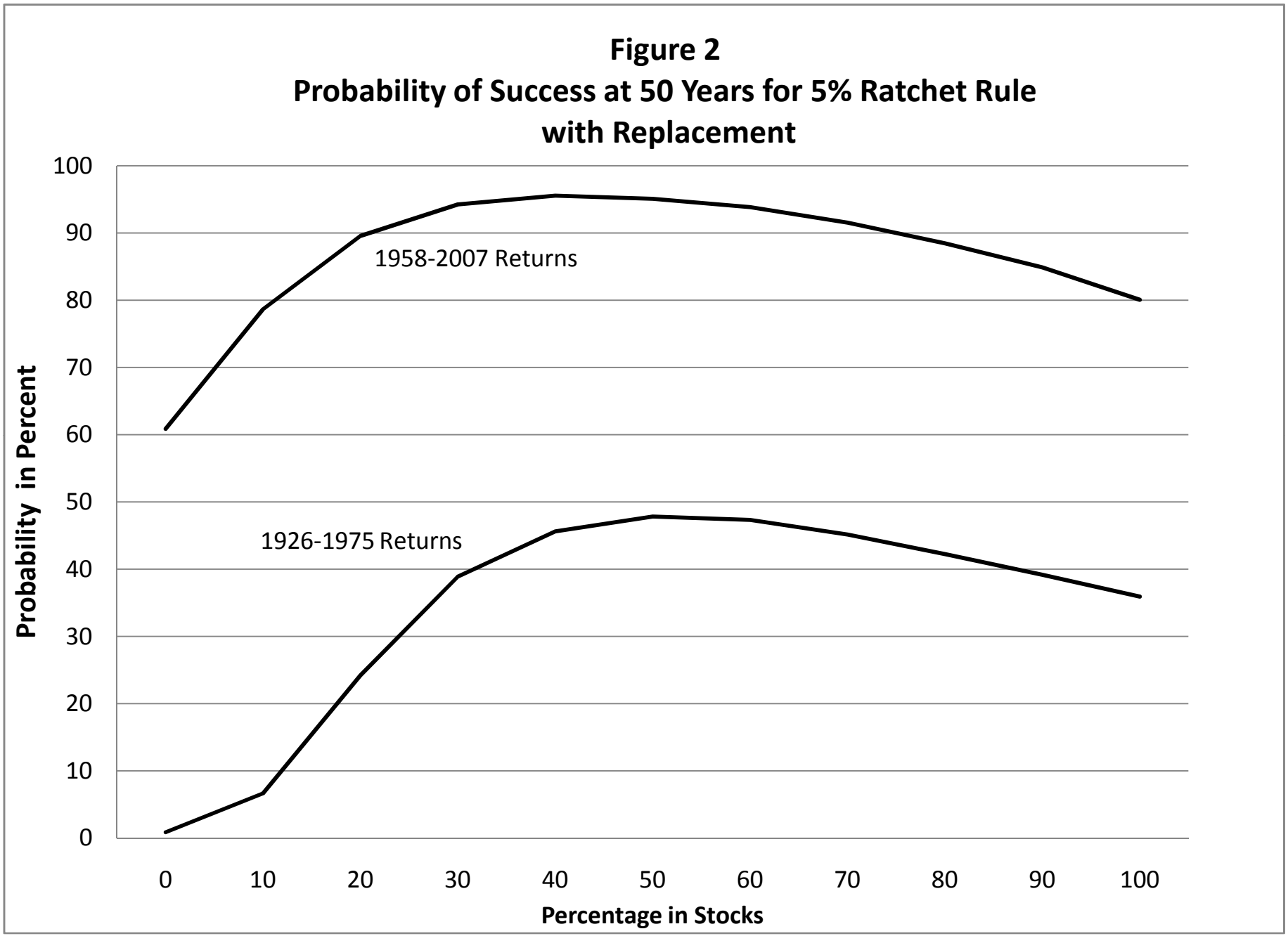
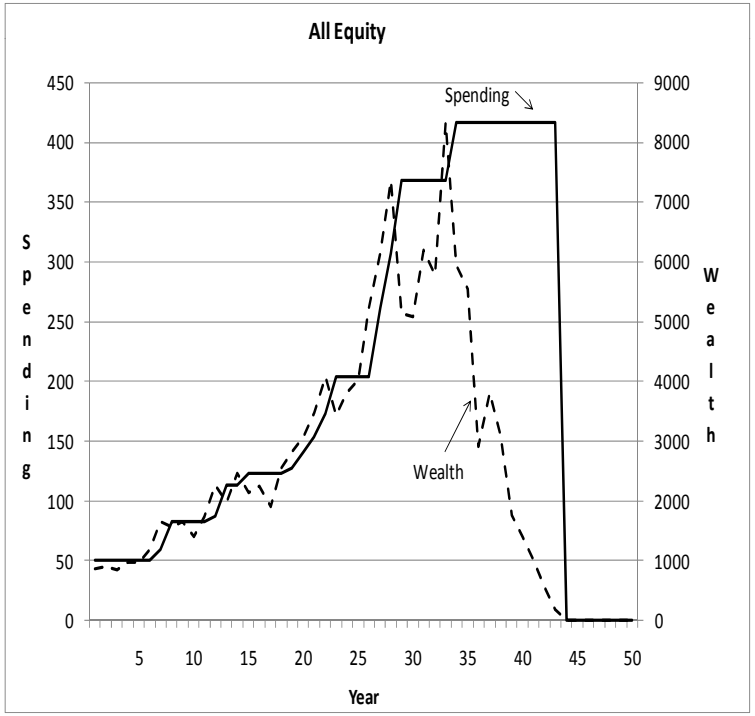


Figure 3
The Effect of Initial Good Returns on Spending and Wealth

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.



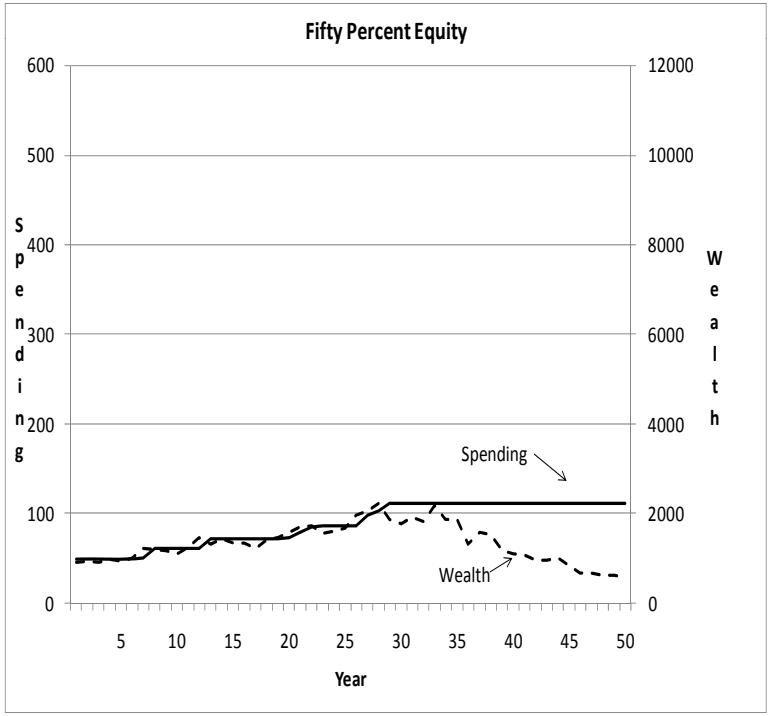
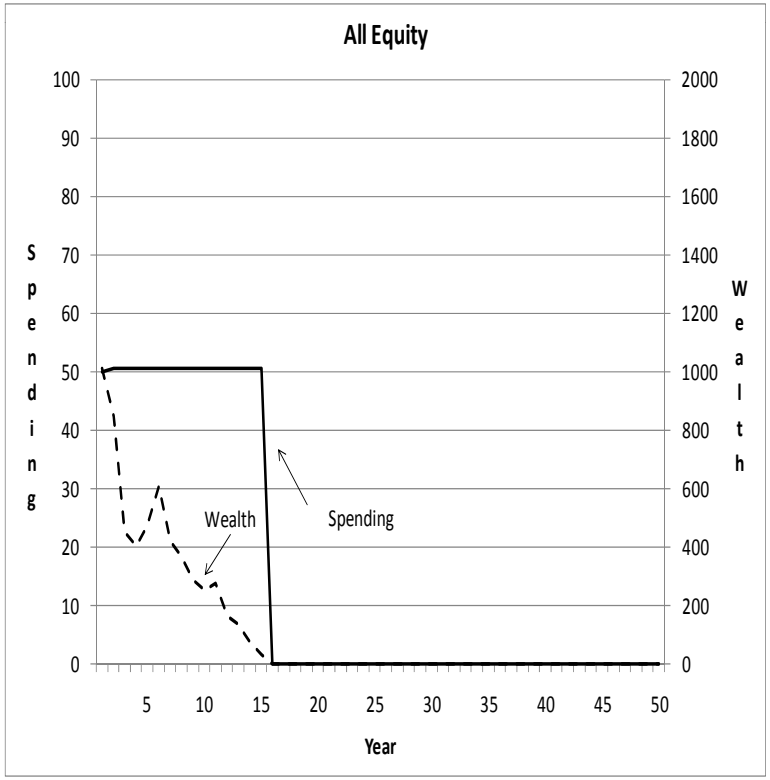


Figure 4
The Effect of Initial Poor Returns on Spending and Wealth

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.



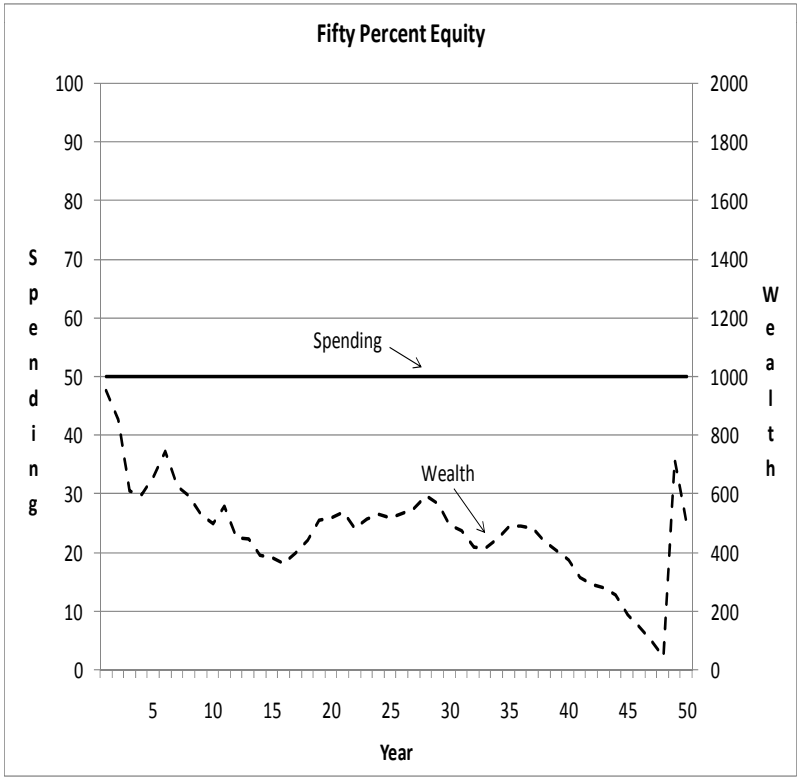


Figure 5
Spending Distribution at 50 Years for 5% Ratchet Rule for Simulations without Replacement 1926-1975

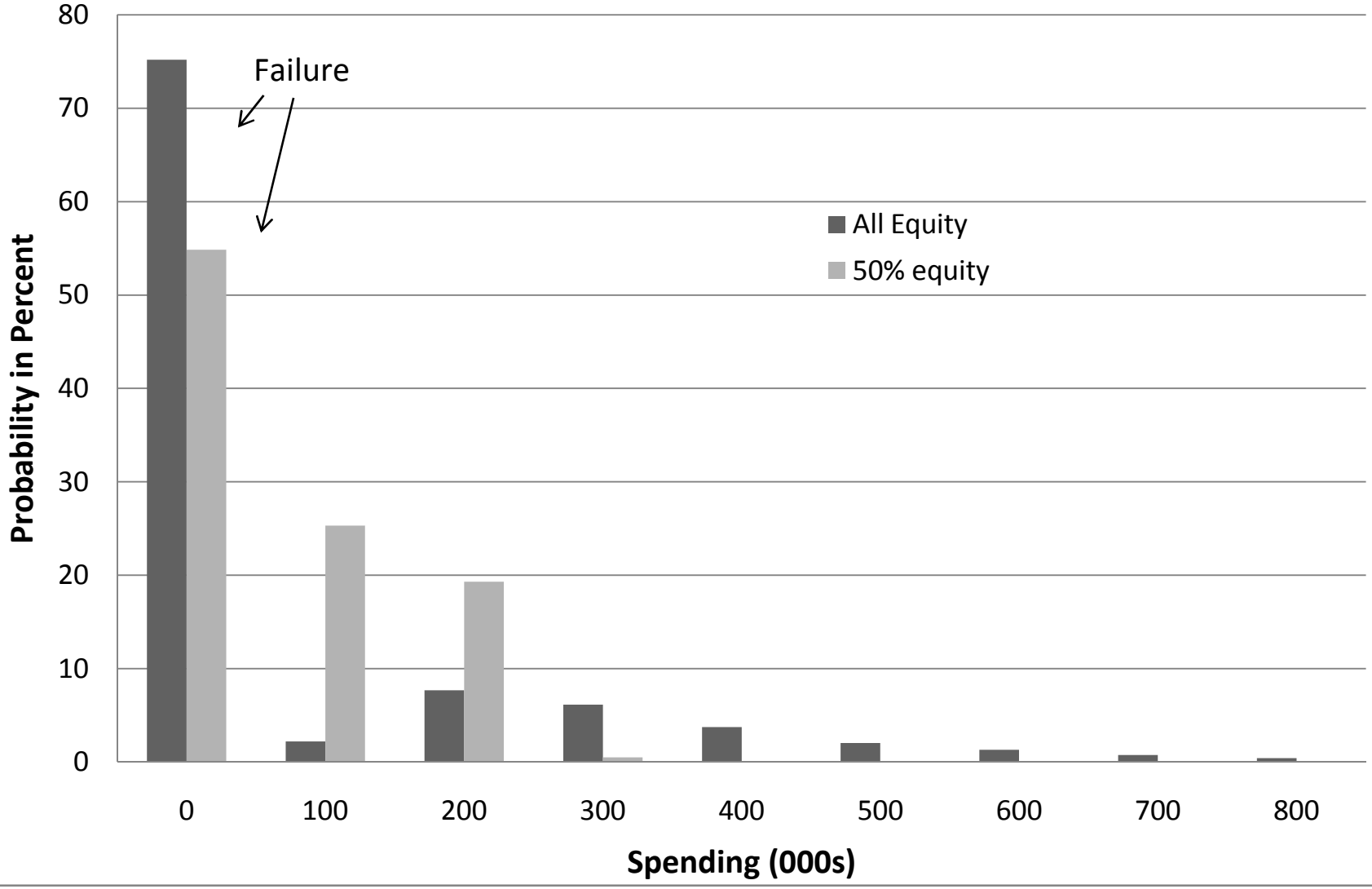


Figure 6
Probability of Success at 50 Years for Ratchet Rules
by Initial Spending Percentage and Percentage in Stocks
without Replacement--1926-1975

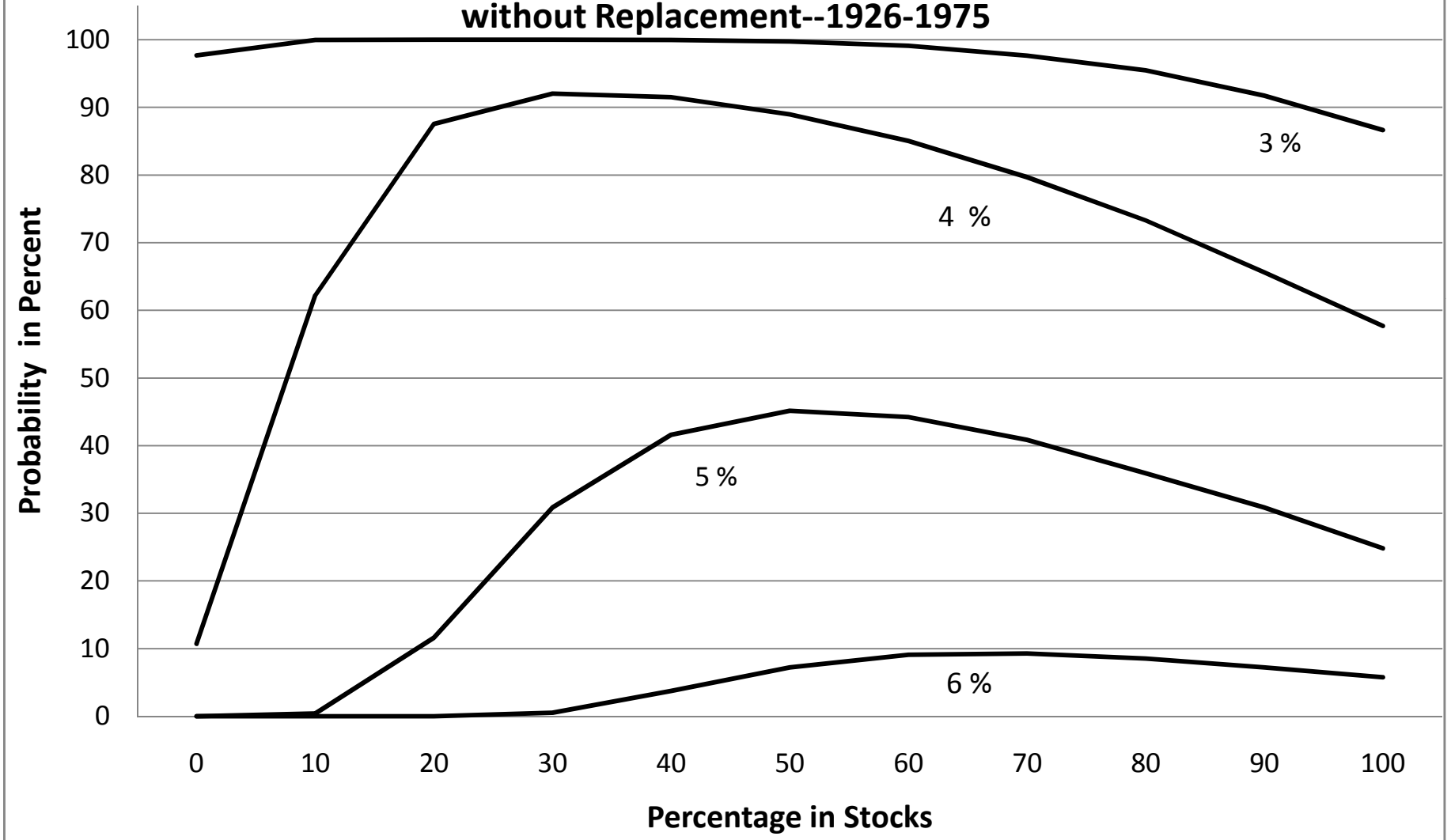


Figure 7
Average Spending for Various Ratchet Rules with 50 Percent Equities without Replacement--1926-1975

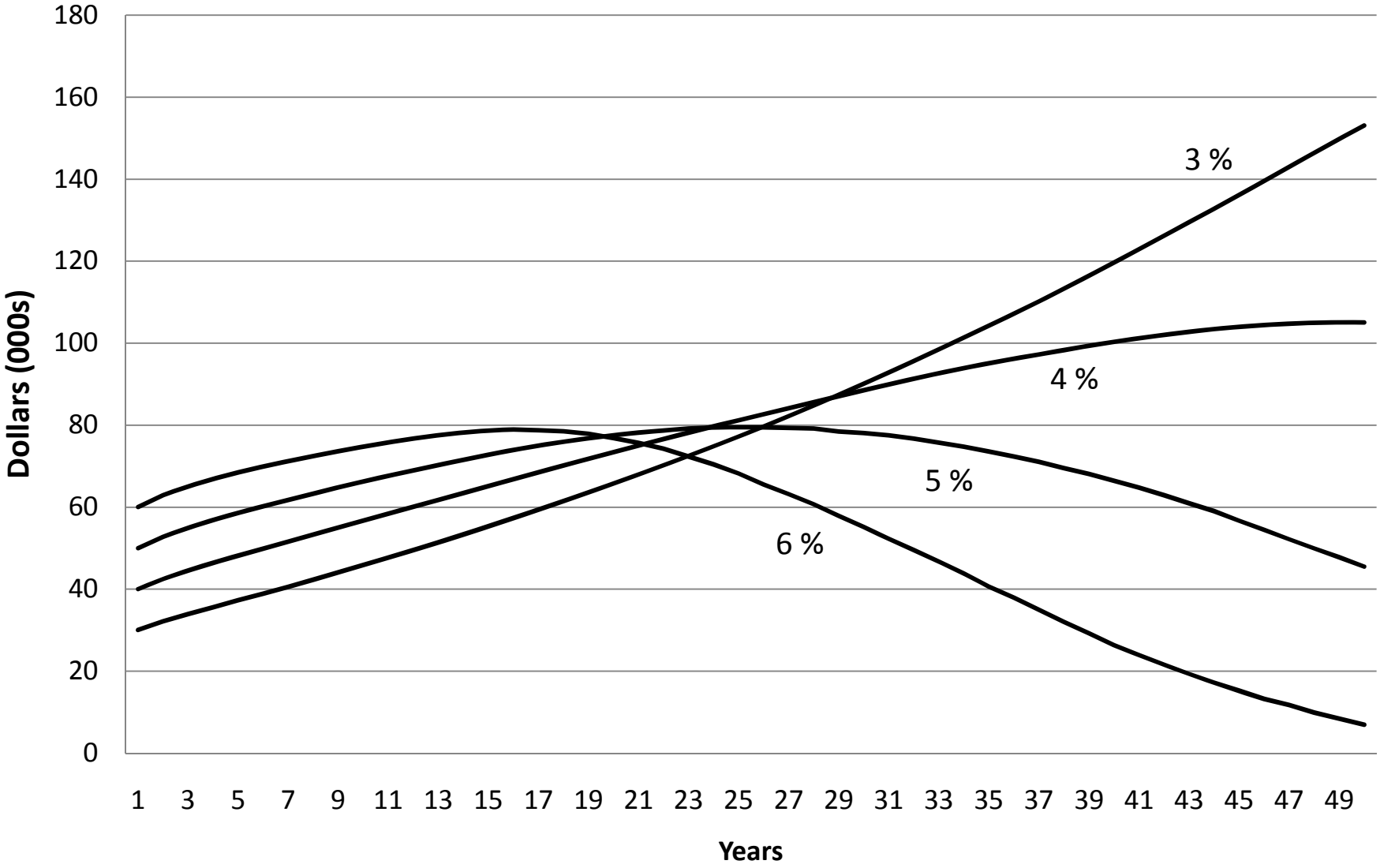


Figure 8
Average Spending for Various Ratchet Rules with 100 Percent Equities without Replacement--1926-1975

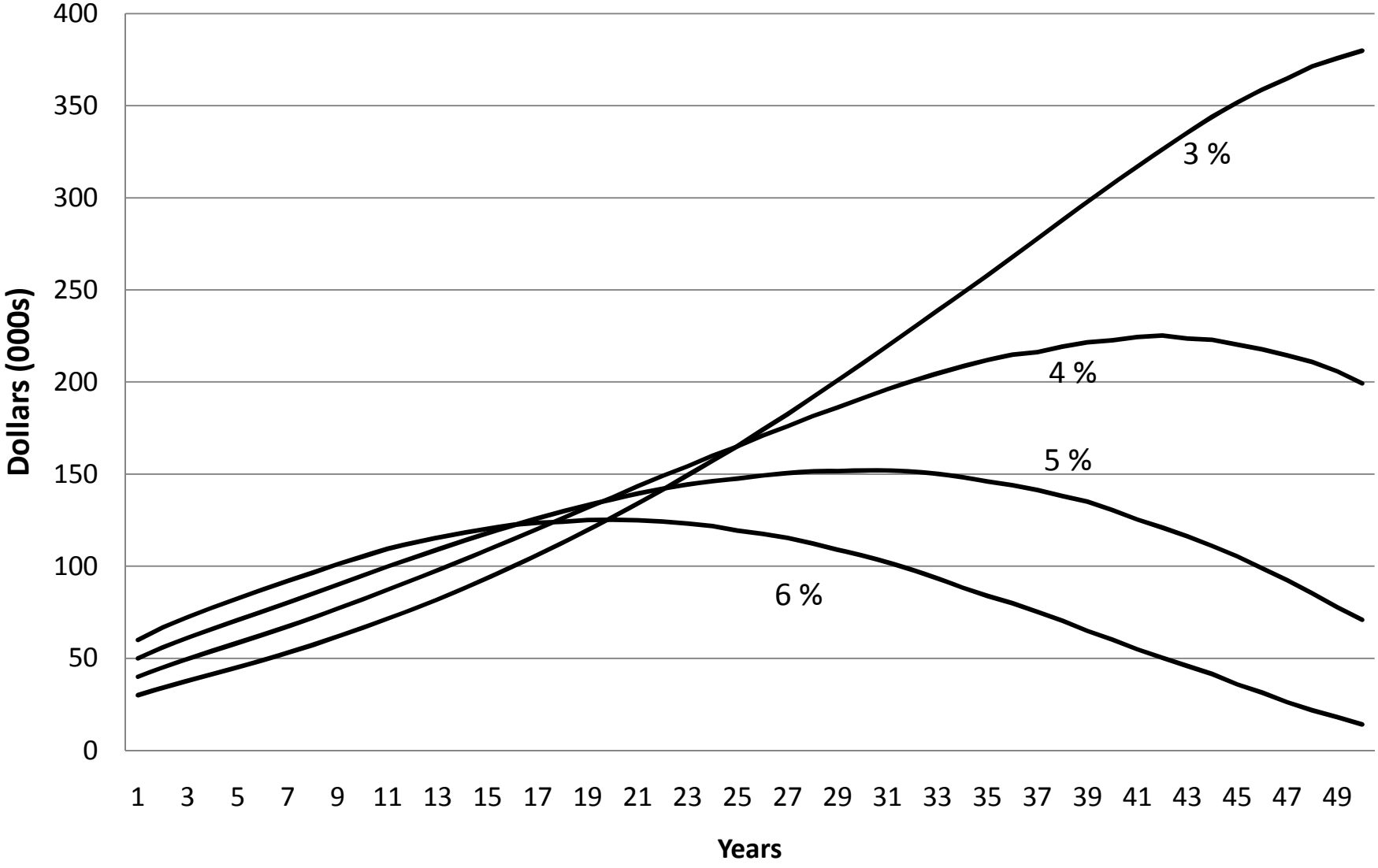


Figure 9
Standard Deviations of Spending Changes
versus Average Spending Levels at 50 Years
Using Three-Year Moving Average Value and Five Percent Rule
1926-1975

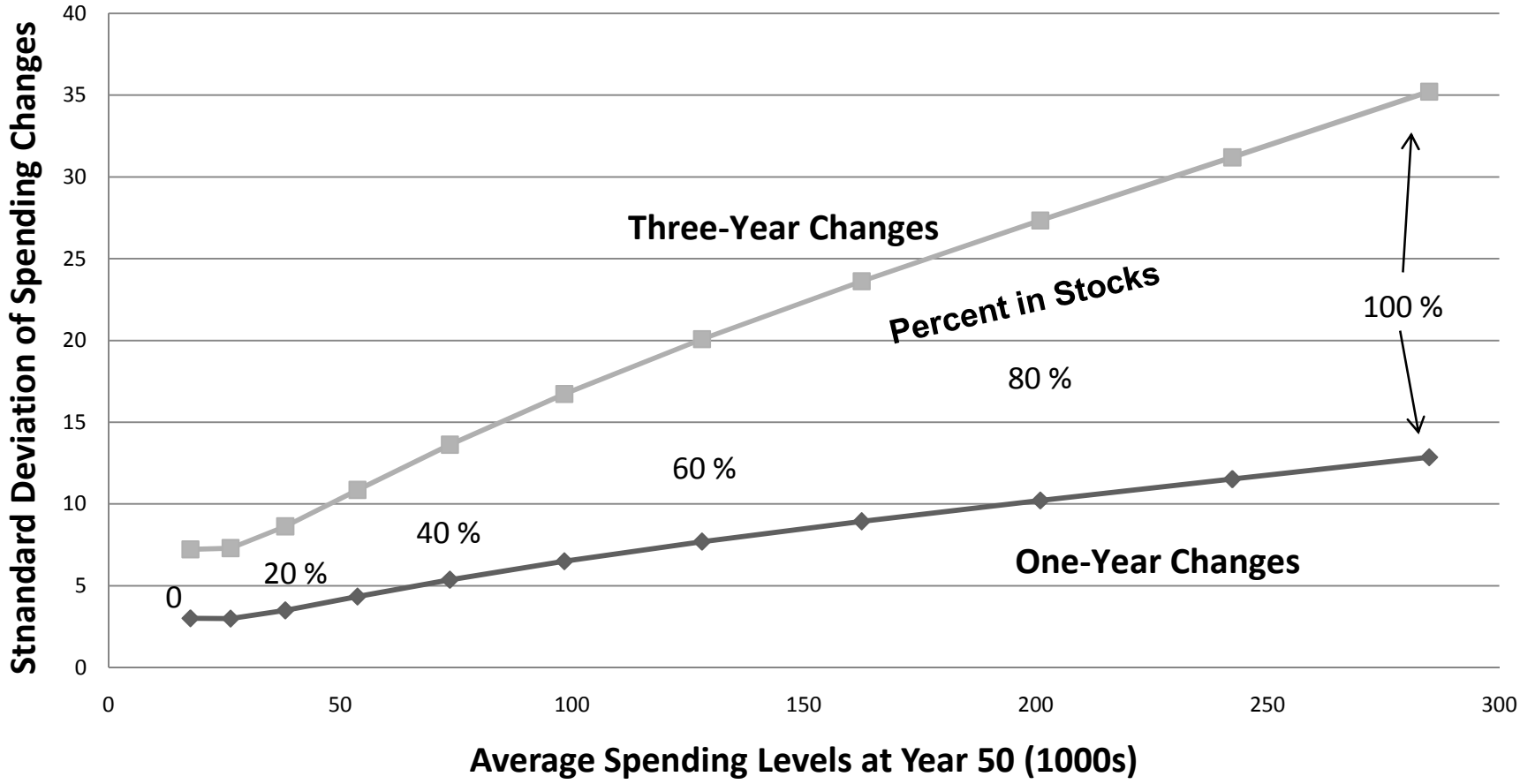


Figure 10
Spending Distribution at 50 Years for 3 Year 5% Moving Average Rule for Simulations without Replacement 1926-1975

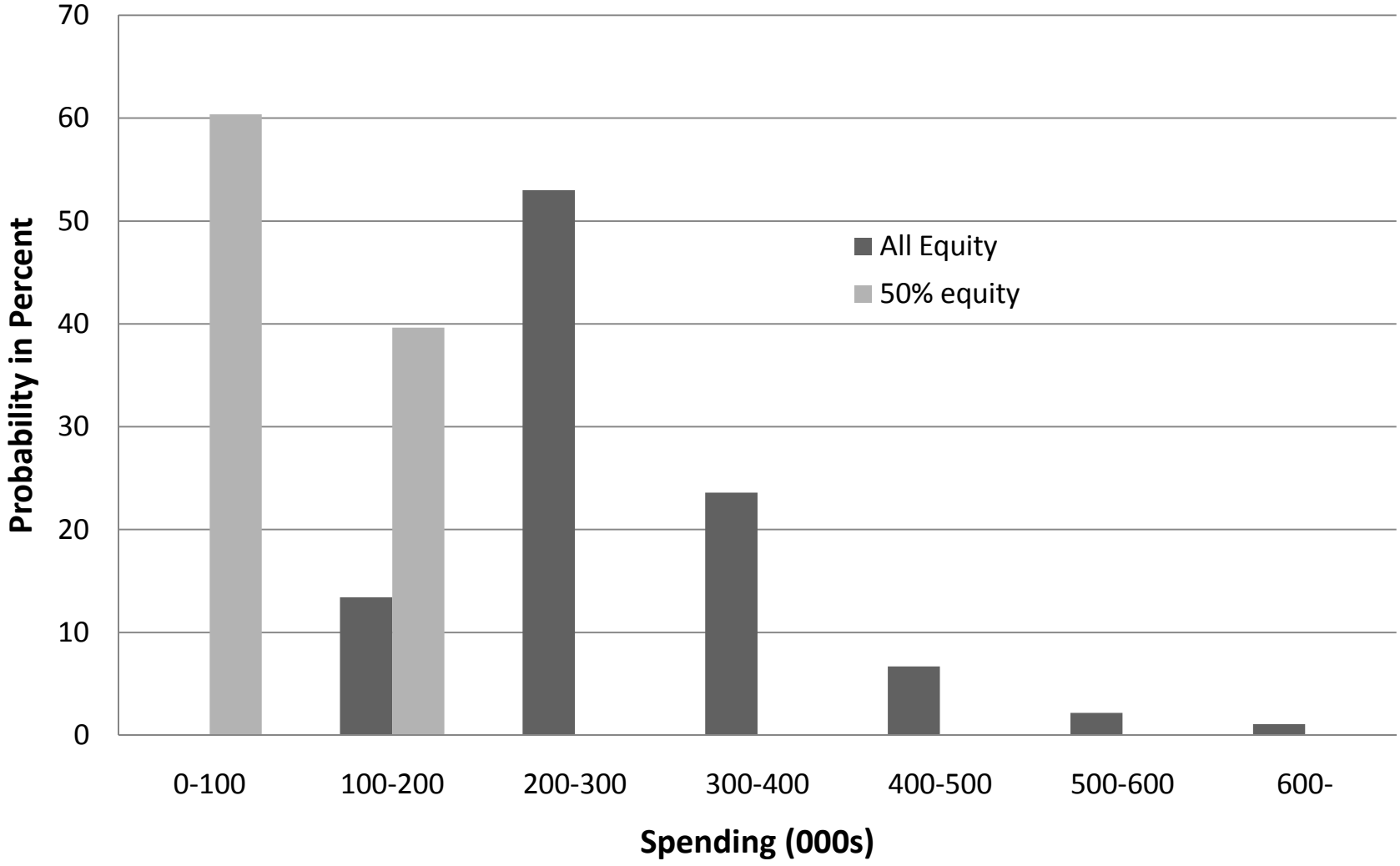
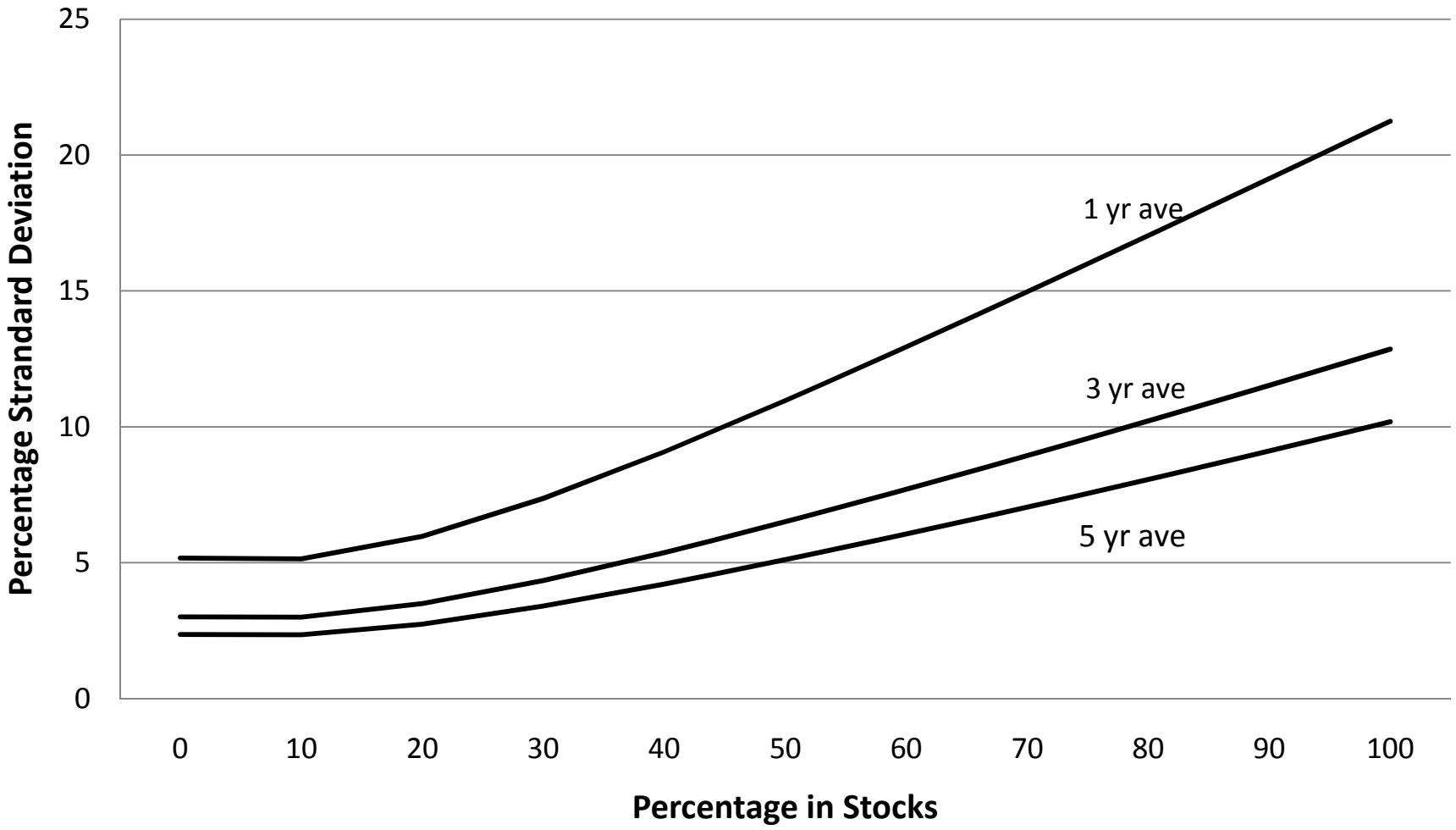


Figure 11
Standard Deviation of One-Year Spending Changes for Various Average Rules versus Percentage in Stocks without Replacement--1926-1975



The Rodney L. White Center for Financial Research

The Wharton School
University of Pennsylvania
3254 Steinberg Hall-Dietrich Hall
3620 Locust Walk
Philadelphia, PA 19104-6367

(215) 898-7616
(215) 573-8084 Fax
http://finance.wharton.upenn.edu/~rlwctr

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