Sustainable Withdrawal Rates: The Historical Evidence on Buffer Zone Strategies

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Executive Summary

- The decumulation discussion involves four variables: (1) the amount of assets at retirement, (2) the optimal asset allocation, (3) the initial withdrawal rate, and (4) the withdrawal strategy
- Unfortunately, there is no such thing as the correct or optimal answer to what each of these four variables should be
- When evaluating different strategies, a common metric is the portfolio success rate, which is the percentage of times a particular decumulation strategy sustains a time-series of real withdrawals
- Some financial planners advocate the use of buffer zones—the use of money market funds to ensure the safety of withdrawals—as a component of a decumulation portfolio
- This paper examines four strategies involving the use of buffer zones and a variety of withdrawal rates, and compares the success of each strategy to the success of a traditional withdrawal strategy

As the baby boomer generation moves into retirement, we are seeing increasing research and discussions on the topic of portfolio decumulation strategies. The decumulation discussion necessarily involves four variables: (1) the amount of assets a person should have at the time of retirement, (2) the optimal asset allocation to sustain a desired series of withdrawals, (3) the initial withdrawal rate, and (4) the withdrawal strategy. The amount of assets at retirement is a straightforward number, and in fact, some people like to refer to it as "the number." The optimal asset allocation is the amount invested in stocks, bonds, and money market instruments (cash). The initial withdrawal rate is the amount of cash withdrawn the first year as a percentage of the value of the portfolio at the time of retirement. The withdrawal strategy is how the dollar amount withdrawn each year after the first year is adjusted. There are a variety of withdrawal strategies. The two simplest ones are a fixed annuity, in which the dollar amount never changes, and a real annuity, in which the dollar amount increases each year by the rate of inflation.

Unfortunately, as much as many people would like to think so, there is no such thing as the correct or optimal answer to what each of these four variables should be (see, for example, Milevsky and Huang 2011). There are several reasons for this. First, the goal of decumulation strategies is to assure the client that the desired withdrawals can always be made; that is, that the portfolio will not die before the client does. However, many clients may have a competing goal, and that is to live comfortably. Second, clients differ in both their risk tolerance and risk capacity. With respect to risk tolerance, some clients may be willing to take on more risk in the hopes of achieving higher withdrawals and a larger estate. Risk capacity will be based on the client's projected living expenses, and to what extent these are necessities versus luxuries as well as fixed versus variable in nature. In addition, risk capacity is also a function of the amount of

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other income the client has, and the fixed versus variable nature of that income.

When evaluating different strategies, a common metric is the portfolio success rate, which is the percentage of times a particular decumulation strategy sustains a time-series of real withdrawals. Milevsky (2007) provides a compelling argument in favor of using an alternative calculus-based metric, Retirement RiskQuotient. However, the literature is full of studies that look at portfolio success rates using a variety of methodologies, including overlapping historical periods, bootstrapping, and Monte Carlo simulations, and the portfolio success rate is commonly employed by practitioners. Cooley, Hubbard, and Walz (CHW) (2011) provide an excellent review of the literature on decumulation strategies.

One series of studies, known as the Trinity studies, used a simple but highly informative research approach to evaluate decumulation strategies in terms of different asset allocation structures, a multitude of withdrawal rates, and several time horizons. The most recent version of these studies was published in April 2011 (CHW 2011). In this study, CHW considered 5 asset allocations, starting with 100 percent stocks and moving in 25 percent increments to 100 percent bonds. They also considered withdrawal rates ranging from 3 percent to 12 percent in 1 percent increments, and time horizons going from 15 years to 30 years, in 5-year increments.

Few of these types of studies consider the role of cash in decumulation portfolios. We are aware that some financial planners advocate the use of buffer zones as a component of a decumulation portfolio. See, for example, Evensky and Katz (2006) and Horan (2011) for a discussion of this strategy. A buffer zone involves the use of money market funds to ensure the safety of withdrawals taken over the near future and to avoid selling in an undervalued market. For example, suppose there is no inflation (for simplicity) and a person has a $100,000 portfolio, and he or she wants to withdraw 5 percent of this amount—$5,000—per year.[1] If this person were using a three-year buffer zone, he or she would put three years' worth of withdrawals—$15,000—into cash. The remaining $85,000 goes into an investment portfolio that consists of risky assets. At the end of the year, this person withdraws $5,000 from the investment portfolio if the investment portfolio goes up during the year. If the investment portfolio goes down in value, then the retiree takes the money from the cash holdings. If the investment portfolio goes up the second year after going down the first year, the retiree takes the annual withdrawal from the investment portfolio, and also liquidates enough of the investment portfolio to bring the cash position back up to its original value. The retiree takes direct withdrawals from the investment portfolio without replenishing the cash position only if the investment portfolio has gone down four or more years in a row.

The basic question in this paper is: would the use of buffer zones have enhanced or reduced the portfolio success rates over what would have been achieved by not using buffer zones over our test period? We will examine four strategies involving the use of buffer zones and a variety of withdrawal rates. We then compare the success of each strategy with the success of the traditional withdrawal strategy as described in CHW (2011).

Methodology

The four strategies we consider are to have buffer zones of one to four years of inflation-adjusted withdrawals. The reason for these four strategies lies in the frequency of successive down years in the market. A review of stock and bond market returns provided in Bodie, Kane, and Marcus (2011) shows that over the period 1926 to 2009, there has been only one time when the stock market went down exactly four years in a row, only two times when the market went down exactly three years in a row, only one time when the market went down exactly two years in a row, and 12 times when a down year was sandwiched between two up years. Similarly, there was one time the bond market was down three years in a row, three times it was down two years in a row, and 12 times when the bond market had a down year sandwiched between two up years.

Our investment portfolios will follow the standard used by CHW, namely, starting with 100 percent in stocks and nothing in bonds, and moving in increments of 25 percent to nothing in stocks and 100 percent in bonds.[2] Keep in mind that we are running two portfolios. The first is the money market fund portfolio (MMF) and the second is the investment portfolio. The two portfolios combined represent the investor's total portfolio. The percentage composition of the total portfolio between cash and the investment portfolio will vary according to the rates of return earned by each of the two portfolios and the rate of inflation.

For our stock and bond data, derived from Bodie, Kane, and Marcus (2011), stocks are represented by the Standard and Poor's 500 Index and bonds are represented by the Lehman Brothers Long-Term Treasury Index. For the yield on cash, we use as a proxy a portfolio constructed by Kenneth French that rolls over one-month T-bills. Rates of inflation, which we censor to a lower bound of zero, also come from this data set and are represented by the year-over-year change in the Bureau of Labor Statistics' Consumer Price Index for All Urban Consumers. Our total database encompasses the period 1926 to 2009 (which is the same period used in CHW). To test whether a withdrawal rate is sustainable, we use overlapping periods of 15, 20, 25, and 30 years (again, the same as CHW). Thus, our first 15-year time frame uses returns for the period 1926 to 1940. Our second uses the returns for 1927 to 1941, etc. This allows a total of 70 different time frames used for testing each withdrawal rate. The first 20-year time frame covers the period 1926 to 1945, and we end up with 65 different testable periods. Similarly, we have 60 different testable periods for the 25-year rule, and 55 periods for the 30-year rule.

The withdrawal rates will vary from 3 percent to 9 percent of the real value of the original portfolio. Although CHW report on withdrawal rates up to 12 percent, the last three withdrawal rates provide no additional useful results, and we think their reporting of results would be much tidier if they dropped the last three withdrawal rates.

Because of our use of cash, our computations are slightly different than CHW. The value of the MMF portfolio at the end of year t is defined as the greater of zero or

$$V_{M,t} = V_{M,t-1} - W_t \text{ if } R_{I,t} \leq 0 \quad (1)$$

and

$$V_{M,t} = V_{M,t-1} + T_t \text{ if } R_{I,t} > 0 \quad (2)$$

where $V_{M,t}$ = value of the MMF portfolio at the end of period t

W_t = portfolio withdrawal for period t based on the withdrawal rate and adjusted for inflation

T_t = cash transferred from the investment portfolio necessary to restore the MMF portfolio to its real original value

The value of the investment portfolio is the greater of zero or

$$V_{I,t} = V_{I,t-1} \times (1 + R_{I,t}) - W_t - T_t + INT_{M,t} \text{ if } R_{I,t} > 0 \quad (3)$$

$$V_{I,t} = V_{I,t-1} \times (1 + R_{I,t}) + INT_{M,t} \text{ if } R_{I,t} \leq 0 \text{ and } V_{M,t} > 0 \quad (4)$$

$$V_{I,t} = V_{I,t-1} \times (1 + R_{I,t}) + INT_{M,t} - W_t + V_{M,t-1} \text{ if } R_{I,t} \leq 0 \text{ and } V_{M,t} = 0 \quad (5)$$

where $V_{I,t}$ = value of the investment portfolio at the end of period t

$R_{I,t}$ = rate of return on the investment portfolio during period t

$INT_{M,t}$ = interest earned on the MMF portfolio during period t

Note that we have opted to add the interest income from the MMF portfolio to the investment portfolio, rather than leave it in the MMF holdings. Also, for the purpose of simplicity, we assume that in the event the investment portfolio is exhausted, future $INT_{M,t}$ is simply reinvested in the MMF portfolio.

The first strategy we test is to have the MMF portfolio equal to one year's withdrawal. For presentation purposes, we assume an initial value of the combined portfolio of $100,000. Thus, for a withdrawal rate of 3 percent and a one-year buffer, we set the MMF initially at $3,000. If the investment portfolio goes up during the year, at the end of the year the inflation-adjusted portfolio withdrawal is removed from the investment portfolio along with any amount needed to bring the MMF portfolio value up to its desired balance because of inflation, and all of the interest income in the MMF portfolio is transferred to the investment portfolio. If the investment portfolio goes down, the withdrawal is removed from the MMF portfolio along with the interest transferred to the investment portfolio. The only time the investment portfolio can go down and a withdrawal still be made from that portfolio is if the desired withdrawal exceeds the available balance in the MMF. A withdrawal rate is considered sustainable if at the end of the time horizon the value of the combined portfolios is greater than zero.

Rationale for the Use of Buffer Zones

Let us consider why a buffer zone strategy might be superior to a static one. The simplest argument is that a buffer zone strategy allows one to avoid selling when prices are down. Under the assumption that there is mean reversion in market returns, this strategy will mitigate the effects of bear markets. However, the results from regressions of our time series of stock and bond returns on their respective lagged one-year values provide no evidence of autocorrelation in market returns. The results from both ordinary least square and Yule-Walker estimation methods (available upon request) show that lagged returns did not have an impact on current returns at even the 20 percent significance level. This implies that mean reversion, at least at the annual frequency, is simply an illusion in clients' minds.

A more sophisticated argument in favor of a buffer zone strategy is that combining cash with an investment portfolio reduces the standard deviation of returns, although it will also reduce the average rate of return over time. But the reduction in the standard deviation of returns may do more to help preserve the value of the portfolio than the reduction in actual return. This reduces to an empirical question of which impact is greater.

Results

The key to determining whether there is value in the strategy of maintaining a buffer zone is whether such portfolios allow withdrawal rates to be sustained a higher percentage of times than if one does not use a buffer zone. To that end, we have created Table 1 using the exact same methodology as CHW. Specifically, Table 1 shows withdrawal rates ranging from 3 percent to 9 percent across the top of the table. The table consists of five segments; each segment reports the results for a different composition of investment portfolio over time horizons of 15, 20, 25, and 30 years.

As an example of how to interpret Table 1, consider the last number of the first row in the table, 67.5 percent.

This means that when the initial portfolio consisted of 100 percent stocks, the time horizon was 15 years, the initial withdrawal rate was 9 percent of the portfolio's original value, and subsequent withdrawals were inflation adjusted, 67.5 percent of the portfolios examined were able to produce the desired cash flows.

We next compute the success rates that would have been achieved for buffer zones of one, two, three, and four years' worth of withdrawals. The success rates for the four-year buffer zone are provided in Table 2. (The success rate tables for the other buffer zone strategies are available from the authors upon request.) The success rates are compared point for point with those in Table 1. For example, in Table 2, we see that when the portfolio is 100 percent stocks and the time horizon is 30 years, then for withdrawal rates of 3 percent through 9 percent, the percentages of successes are 100, 88, 56, 28, 16, 8, and 0. The comparable numbers from Table 1 are 100, 96, 60, 36, 28, 24, and 16. Thus, when the withdrawal rate is greater than 3 percent, the CHW approach has a higher success rate. When the withdrawal rate is 3 percent, the success rates are identical for the two approaches. For this asset allocation and time horizon, the buffer zone strategy never produces a higher success rate. This same type of comparison is made for each row and each column.

The results of comparing Table 1 with all four buffer zone strategies are presented in Table 3. Note that our one-year buffer zone strategy produces a better success rate only one time out of 140 comparisons, and the CHW strategy produces a better success rate than the buffer zone strategy 32 times out of 140 comparisons. The two-year buffer zone strategy had the better success rate 9 times, whereas the CHW strategy is better 50 times. For the three-year and four-year strategies, the numbers are 12 versus 67

Table 1: Percentage of Portfolios in Which the Specified Withdrawal Has Been Sustained in the Absence of a Buffer Portfolio

Payout Period	3%	4%	5%	6%	7%	8%	9%
100% Stocks							
15 years	100	100	100	92.5	77.5	72.5	67.5
20 years	100	100	88.6	71.4	62.9	54.3	42.9
25 years	100	100	83.3	63.3	46.7	36.7	30
30 years	100	96	60	36	28	24	16
75% Stocks/25% Bonds							
15 years	100	100	100	92.5	77.5	70	65
20 years	100	100	85.7	68.6	57.1	48.6	42.9
25 years	100	100	70	46.7	40	30	23.3
30 years	100	96	56	28	20	16	8
50% Stocks/50% Bonds							
15 years	100	100	100	90	72.5	65	52.5
20 years	100	100	82.9	65.7	48.6	37.1	34.3
25 years	100	96.7	63.3	40	30	23.3	20
30 years	100	88	32	24	16	8	0
25% Stocks/75% Bonds							
15 years	100	100	100	87.5	67.5	50	42.5
20 years	100	100	74.3	51.4	37.1	34.3	31.4
25 years	100	80	46.7	33.3	23.3	20	13.3
30 years	100	56	24	12	8	0	0
100% Bonds							
15 years	100	100	100	80	47.5	42.5	40
20 years	100	91.4	60	37.1	34.3	31.4	20
25 years	100	56.7	36.7	23.3	20	13.3	10
30 years	84	36	12	8	0	0	0

Table 2: Percentage of Portfolios in Which the Specified Withdrawal Has Been Sustained When the Buffer Portfolio Equals Four Years of Withdrawals

Payout Period	3%	4%	5%	6%	7%	8%	9%
100% Stocks							
15 years	100	100	100	92.5	75	70	62.5
20 years	100	100	88.6	68.6	57.1	45.7	34.3
25 years	100	96.7	66.7	50	33.3	23.3	16.7
30 years	100	88	56	28	16	8	0
75% Stocks/25% Bonds							
15 years	100	100	100	95	75	67.5	47.5
20 years	100	100	88.6	65.7	51.4	37.1	22.9
25 years	100	100	63.3	46.7	30	23.3	13.3
30 years	100	84	40	20	8	4	0
50% Stocks/50% Bonds							
15 years	100	100	100	97.5	75	62.5	45
20 years	100	100	82.9	62.9	40	31.4	11.4
25 years	100	96.7	56.7	30	23.3	13.3	3.3
30 years	100	72	24	16	8	0	0
25% Stocks/75% Bonds							
15 years	100	100	100	97.5	67.5	45	40
20 years	100	100	77.1	48.6	34.3	25.7	11.4
25 years	100	86.7	36.7	23.3	20	13.3	0
30 years	100	48	24	8	0	0	0
100% Bonds							
15 years	100	100	100	90	55	42.5	32.5
20 years	100	100	62.9	34.3	31.4	20	5.7
25 years	100	63.3	30	23.3	16.7	6.7	0
30 years	92	36	8	4	0	0	0

Table 3: Summary of Comparisons

	One-Year Buffer		Two-Year Buffer		Three-Year Buffer		Four-Year Buffer	
Portfolio Composition	(1) # of times buffer zone more successful	(2) # of times CHW more successful	(3) # of times buffer zone more successful	(4) # of times CHW more successful	(5) # of times buffer zone more successful	(6) # of times CHW more successful	(7) # of times buffer zone more successful	(8) # of times CHW more successful
100% stocks	0	8	0	10	0	14	0	19
75% stocks/ 25% bonds	0	7	1	13	2	16	2	17
50% stocks/ 50% bonds	0	9	2	14	2	16	2	16
25% stocks/ 75% bonds	0	7	2	10	2	13	3	14
100% bonds	1	1	4	3	6	8	6	11
Totals	1	32	9	50	12	67	13	77
Initial Withdrawal Rate								
3%	0	0	1	0	1	0	1	0
4%	1	3	2	4	3	4	3	5
5%	0	5	1	6	2	8	3	9
6%	0	7	3	6	4	9	4	13
7%	0	3	2	8	2	13	2	16
8%	0	6	0	14	0	16	0	17
9%	0	8	0	12	0	17	0	17
Totals	1	32	9	50	12	67	13	77
Time Horizon (in years)								
15	0	4	5	5	6	10	6	11
20	1	8	2	12	3	16	4	20
25	0	8	1	16	2	22	2	24
30	0	12	1	17	1	19	1	22
Totals	1	32	9	50	12	67	13	77

and 13 versus 77. Because the differences in returns generated by the two strategies are increasing in the size of the buffer zone, so too is the number of times the two strategies differ in terms of their success rates. Regardless of the size of the buffer zone, the CHW strategy clearly dominates the buffer zone strategy.

Things get a little more interesting when we compare success rates by asset allocations, withdrawal rates, and time horizon. To do so, we have created Table 4, which summarizes the results from Table 3. The first section of the table summarizes the comparison based on asset allocation. Here we see that the buffer zone strategy outperformed the CHW strategy 35 times out of 560 comparisons, but that the CHW strategy outperformed the buffer zone strategy 226 times out of 560 comparisons. More importantly, when the asset allocation was 100 percent stocks, the buffer zone strategy never bested the CHW strategy, but the CHW strategy bested the buffer zone strategy 51 times. The performance differentials for the first three asset allocations are 51 times, 48 times, and 49 times. When the asset allocation is 25 percent stocks, the differential declines to 37 times. However, when we look at an investment portfolio that is 100 percent bonds, the performance differential falls to only 6 times. Tables 3 and 4 convey that the positive relationship between performance differentials and the allocation of the investment portfolio to stocks strengthens with the size of the buffer zone.

Let's now analyze the cumulative results based on withdrawal rates. When the withdrawal rate is 3 percent, the buffer zone strategy dominates 3 times and the CHW strategy never dominates. For a 4 percent withdrawal rate, the buffer zone strategy is better 9 times, but the CHW strategy is better 16 times, for a differential of 7 in favor of CHW. This differential grows to 22, 24, 34, 53, and 54 times for withdrawal rates of 5 percent to 9 percent. In fact, for withdrawal rates of 8 percent and 9 percent, the buffer zone strategy never produced a better result. From this, we infer that at a low withdrawal rate of 3 percent, it doesn't really matter whether one uses buffer zones. But the higher the withdrawal rate, the more damage occurs with the use of buffer zones. Table 3 shows this trend strengthens with the size of the buffer zone. The damage inflicted upon success rates because of the buffer zone strategy is increasing with the withdrawal rate because higher withdrawal rates require higher portfolio growth rates for success, and the use of a buffer zone impedes portfolio growth because of the presence of the MMFs in the asset allocation. Although there is greater volatility in the time series of returns produced by a CHW strategy than a buffer zone strategy, the growth effect ultimately dominates the volatility effect in terms of its impact on performance differentials.

The bottom section of Tables 3 and 4 shows the summaries of the comparisons across time horizons. The most favorable comparison, as one would expect, is when the time horizon is 15 years. In this case, the buffer zone strategy is more successful 17 times, although the CHW strategy is more successful 30 times. This differential of 13 is minor compared to differentials of 46, 65, and 67 in favor of the CHW strategy for time horizons of 20, 25, and 30 years.

An Additional Comparison

We appreciate that when a planner is working with a client, the recommendation of an asset allocation of only stocks and long-term bonds with no MMF allocation may make the client extremely nervous. The client may mistakenly think that he or she is safer with

Table 4: Comparison of Success Rates by Asset Allocation, Withdrawal Rate, and Time Horizon

Asset Allocation	# of times buffer zone more successful	# of times CHW more successful
100% stocks	0	51
75% stocks/25% bonds	5	53
50% stocks/50% bonds	6	55
25% stocks/75% bonds	7	44
100% bonds	17	23
Totals	35	226
Initial Withdrawal Rate		
3%	3	0
4%	9	16
5%	6	28
6%	11	35
7%	6	40
8%	0	53
9%	0	54
Totals	35	226
Time Horizon (in years)		
15	17	30
20	10	56
25	5	70
30	3	70
Totals	35	226

Table 5: Comparison of Buffer Zone Strategies to the CHW 100% Bond Strategy

Portfolio Composition	# of times 100% bonds more successful	# of times buffer zone more successful
100% stocks	0	91
75% stocks/25% bonds	0	89
50% stocks/50% bonds	2	81
25% stocks/75% bonds	5	59
100% bonds	23	17
Totals	30	337
Initial Withdrawal Rate		
3%	0	19
4%	0	54
5%	3	47
6%	3	63
7%	3	61
8%	6	51
9%	15	42
Totals	30	337
Time Horizon (in years)		
15	2	68
20	12	89
25	13	87
30	3	93
Totals	30	337

100 percent of his or her portfolio in long-term bonds. So, the issue is, if the planner cannot convince the client to use a pure investment portfolio strategy, then which strategy is optimal: (1) a buffer zone strategy, or (2) a strategy of 100 percent long-term bonds?[3] To resolve this question, we have constructed Table 5, which summarizes a comparison of all of the buffer zone strategies with the bottom row section of Table 1 that represents the strategy of a 100 percent long-term bond portfolio.

In Table 5, we see even more dramatic results. The buffer zone strategy prevails over the bonds-only strategy 337 times to 30 times. However, there is one exception to the trend, the case in which the pure bond strategy is compared with the bond and buffer zone strategy. In this case, the pure bond strategy produced the better outcome 23 times compared with 17 times for the buffer zone strategy.

Conclusions

Combining our results from above, one could argue that based on historical returns, if a decumulation portfolio is allocated as 100 percent bonds, and the retiree uses a 3 percent withdrawal rate, then no real harm is done, but no significant advantages are achieved through the use of a buffer zone. As soon as equities are introduced into the portfolio or the withdrawal rate goes above 3 percent, the use of a buffer zone strategy of any sort—one year, two years, three years, or four years—is more likely than not to leave the investor worse off than if he or she simply set up an investment portfolio with a static asset allocation.

Although the results from this study show that a static asset allocation strategy is superior to a buffer zone strategy at minimizing longevity risk, the use of a buffer zone may be merited if it will impact one's investment portfolio choice. To elaborate, it may provide a psychological mechanism to induce clients to accept stock exposure. With the one exception of comparing a pure bond asset allocation to a bond and buffer zone strategy, it is clear that buffer zone strategies are much superior to a long-term bond portfolio strategy.

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Endnotes

1. In the presence of inflation, the withdrawals and desired money market fund portfolio balances are adjusted for inflation.
2. Portfolios consisting of both stocks and bonds are rebalanced at the end of each year.
3. We appreciate that researchers have consistently found that global minimum variance portfolios always contain stock, and thus might represent a better comparison than a 100 percent bond portfolio; we also believe that at least some investors believe a 100 percent bond portfolio is the least risky in terms of longevity risk, and this is the point we are addressing in this section.

References

Bodie, Zvi, Alex Kane, and Alan J. Marcus. Rates of Return 1926–2009 matrix (retrieved May 12, 2011). http://highered.mcgraw-hill.com/sites/dl/free/0073530700/856676/table_5_2_Data.xls.

Cooley, Phillip, Carl Hubbard, and Daniel T. Walz. 2011. "Portfolio Success Rates: Where to Draw the Line." *Journal of Financial Planning* 24, 4 (April): 48–60.

Evensky, Harold, and Deena B. Katz. 2006. *Retirement Income Redesigned: Master Plans for Distribution*. New York: Bloomberg Press.

Lewis, Katherine Reynolds. "Hedging 7 Big Retirement Risks." Bankrate.com (retrieved December 6, 2011). www.bankrate.com/finance/retirement/hedging-7-big-retirement-risks-1.aspx.

Milevsky, Moshe A. 2007. "A Gentle Introduction to the Calculus of Sustainable Income: What Is Your Retirement RiskQuotient?" *Journal of Financial Services Professionals* 61, 4 (July): 51–62.

Milevsky, Moshe A., and Huaziong Huang. 2011. "Retirement Spending on Planet Vulcan: Longevity Risk and Withdrawal Rates." *AAII Journal* 33, 9 (September): 7–11.