MetLife®

Retirement Income

and the Sensitive Sequence of Returns

By: Moshe A. Milevsky, Ph.D., and Anna Abaimova

For: MetLife

WHY METLIFE INVESTORS COMMISSIONED THIS REPORT ON RETIREMENT INCOME

More and more Americans are bearing the financial burden of their retirement years alone – without help from a company pension plan or a substantial Social Security benefit. With these limited guaranteed income sources, it is often difficult to ensure that you have adequate income that will last as long as you live.

At MetLife, we believe that education is the first step to building financial freedom. This report was provided by **Moshe A. Milevsky, Ph.D.,** a thought leader on retirement income for MetLife, our financial professionals and our customers. We hope you find it informative and educational.

THE AUTHORS

Moshe A. Milevsky, Ph.D.,* is an associate professor of finance at the Schulich School of Business at York University in Toronto. He is also executive director of The IFID Centre in Toronto and is the author of the recently published (2006) book, *The Calculus of Retirement Income*.

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* **Moshe A. Milevsky, Ph.D.,** is neither an employee nor affiliated with MetLife. MetLife commissioned and provided remuneration for this white paper. The opinions expressed are solely his own and do not necessarily reflect those of MetLife.

TIMING OF MARKET LOSSES AND YOUR RETIREMENT INCOME

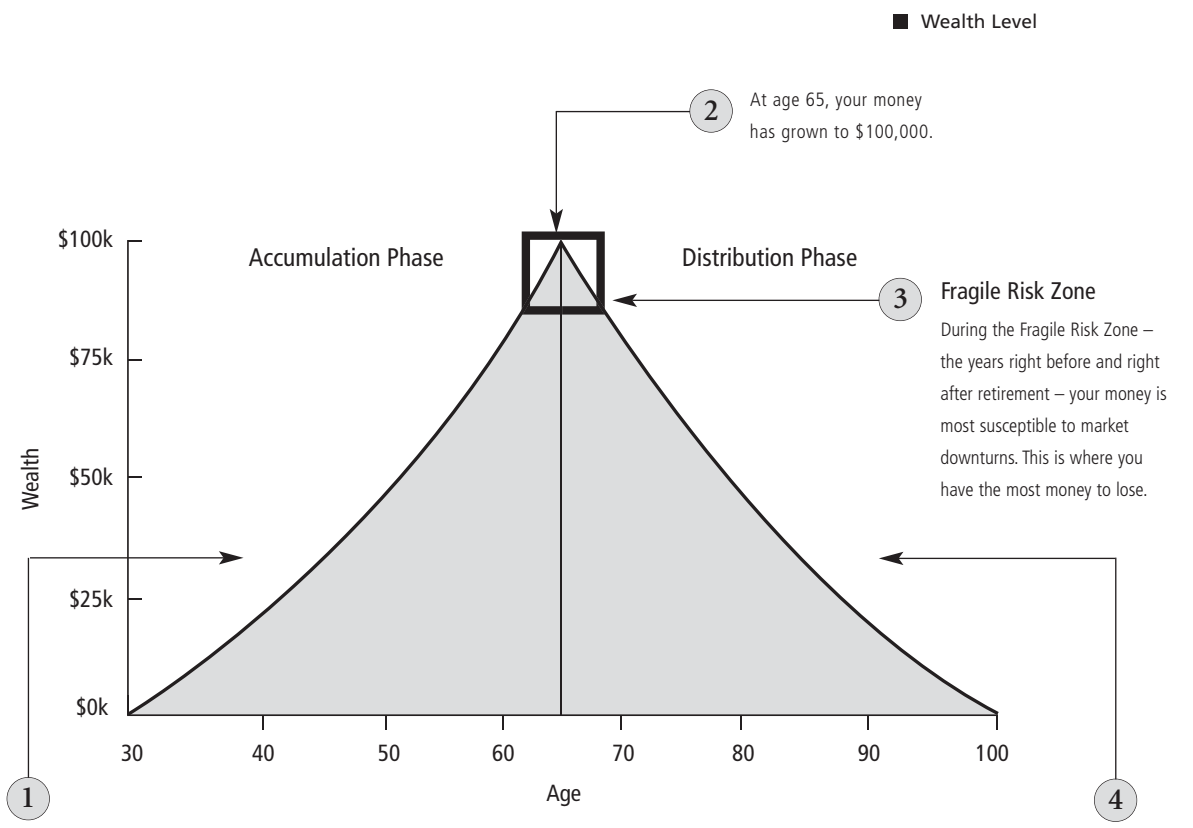
When would you rather lose money? That question might sound odd, since a casual reader's reaction is likely to be "never." But the fact is that when you are investing in the stock market over long periods of time, experiencing a bear market (down market) is an inevitable fact of financial life. Even the most experienced adviser will admit that you must risk money, and therefore occasionally lose money, in order to make money. Thus, a cautious reader — after pondering the opening question for a bit — is likely to appreciate that it is better to experience negative investment returns when you have the least amount of money invested. You don't want to encounter a bear market when you have a large nest egg. It is best to earn these inevitable negative returns at a point in time when your nest egg is much smaller.

Of course, in reality, you can't control when a bear market will hit. We suspect that this fear keeps many newly minted retirees awake at night and causes others to avoid the stock market entirely. Neither of these strategies is healthy or optimal. Thus, broadening the understanding of the risk that we all face during retirement (in this white paper), we will explore the details of how the sequence of investment returns — specifically when you lose money — can have an impact on the sustainability of retirement income. Once you recognize and appreciate the magnitude of the risk, you will be in a better position to manage it!

THE FRAGILE RISK ZONE – THE WORST TIME TO LOSE MONEY

Start by imagining a stylized picture of your financial net worth as you age and progress through the human life cycle. The chart to the right provides such a snapshot based on the assumption that you save approximately $2,400 per year (in year 2006 dollars) from age 30 until age 65, at which point you start to withdraw $3,400 per year (in year 2006 dollars) until the money is completely exhausted. During this entire period, your invested money is assumed to earn 1% per year (after inflation). We picked these numbers because the math works out so that you run out of money at exactly age 100. You have the most amount of money at age 65: roughly $100,000. This is obviously a very hypothetical picture of your financial life cycle, but it provides us with some important intuition.

LIFETIME WEALTH CYCLE



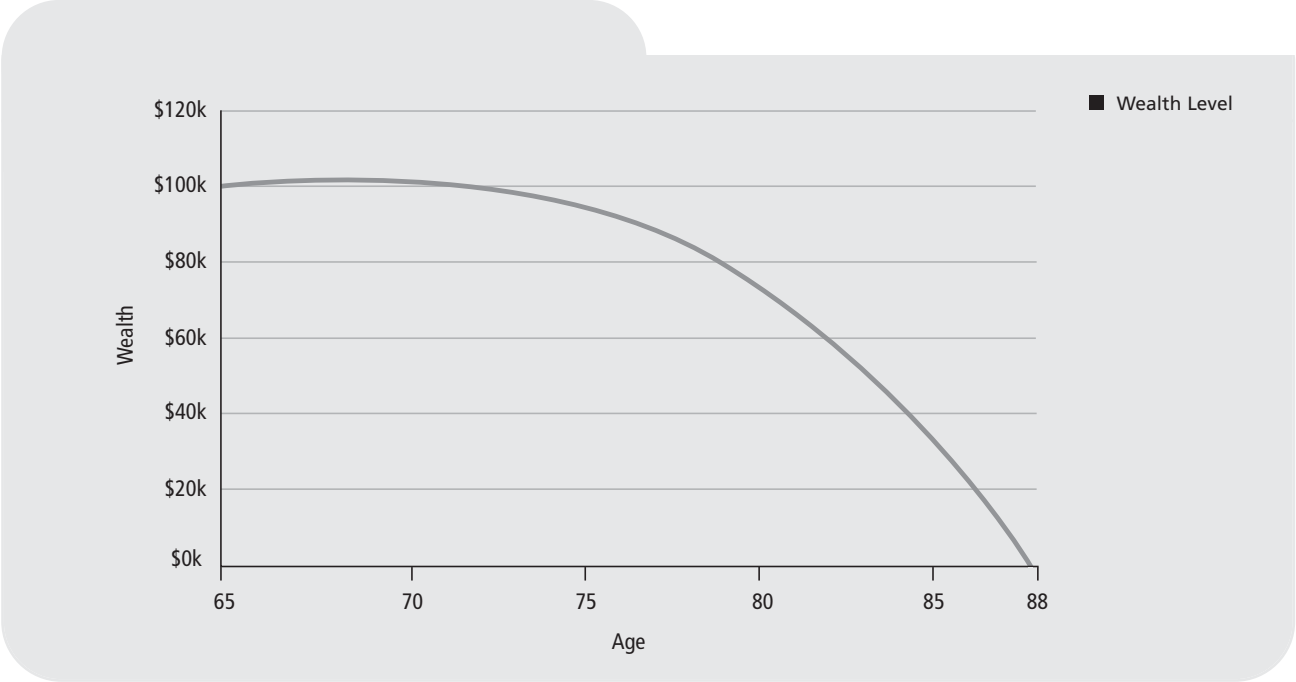
HYPOTHETICAL EXAMPLE. FOR ILLUSTRATIVE PURPOSES ONLY. DOES NOT REPRESENT ANY SPECIFIC INVESTMENT.

Note: The years just before and just after retirement are typically the most sensitive ones, with respect to poor investment returns. All else being equal, it is far preferable to lose money at the lower corners of this pyramid as opposed to the middle.

As you can see from the chart above, the worst possible time to experience a negative return is when you have the greatest amount of money at stake. This is right before and right after retirement at age 65, and it is the period of transition from a wealth accumulation phase to the income and distribution phase. Sure, a bear market at age 30 might hurt, but it won't have much of an impact on your retirement lifestyle since you have many years of savings ahead of you. The same intuition applies to age 90 and beyond. At the top of the pyramid you are in a Fragile Risk Zone. Keep this picture in mind as you read on.

RETIREMENT INCOME SCENARIO ONE: FIXED 8% RETURN

Here are some other indisputable facts about the calculus of retirement income. Assume that a $100,000 portfolio is earning a fixed nominal rate of 8% per year and is subjected to withdrawals of $7,000 per year, adjusted for an annual inflation rate of 3.5%. More precisely, this portfolio is earning 0.6667% per month and $583 (plus an inflation adjustment of 3.5%/12) is withdrawn on a monthly basis. Given these assumptions, we know with certainty that this nest egg will be exhausted within 23 years (275 months). If you start this process at age 65, you will run out of money just before your 88th birthday. We will label this baseline case Scenario One. The chart below illustrates the smooth and predictable path your portfolio will take on its way to zero. Stated differently, a spending rate of 7% of the initial nest egg (adjusted for inflation) is sustainable under a fixed 8% nominal investment return for almost 23 years.



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HOW ONE MARKET LOSS CAN IMPACT HOW LONG YOUR RETIREMENT INCOME LASTS

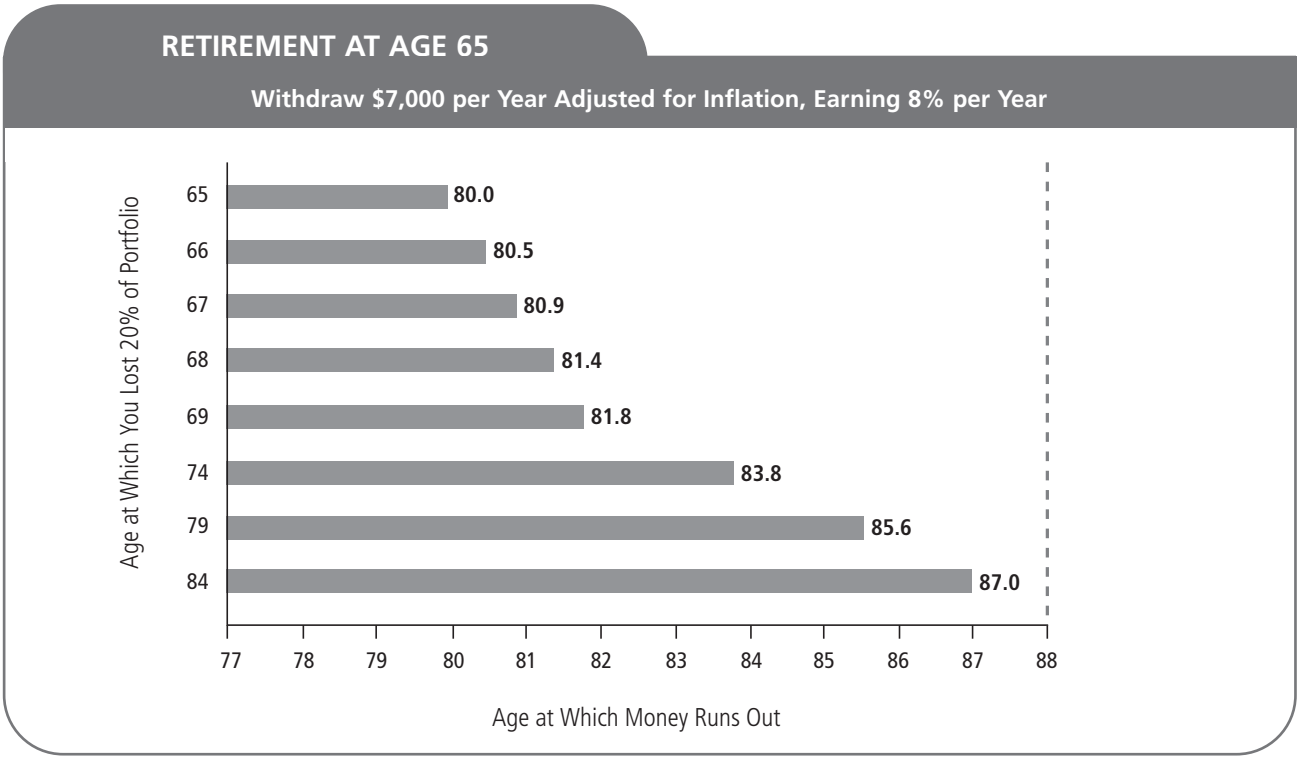
Of course, it is highly unlikely that your portfolio will earn a smooth and predictable investment return each year. Most likely it will experience zigs and zags along the way. We will now investigate how one such zig can impact how long a portfolio lasts.

Imagine that your retirement portfolio is shocked in one (and only one) year with a minus 20% investment return. The chart below illustrates the extent to which the date your portfolio runs out of money will be accelerated depending on the year in which this investment shock occurs. For example, earning a minus 20% investment return in the first year of retirement (at age 65) leads to running out of money at age 80 rather than at age 87.9, thus shortening the sustainability of the portfolio by 7.9 years. The shock impact is reduced when the minus 20% investment return occurs at age 74, causing a loss of 4.1 years relative to the baseline case. The message contained within this chart should be clear: The later you earn a negative return, the better.

Market Terms:

- **Bear market** — A market condition in which the prices of securities are falling or are expected to fall. Although figures can vary, a downturn of 15% – 20% or more in multiple indexes (Dow or S&P 500) is considered an entry into the bear market.
- **Bull market** — A financial market of a certain group of securities in which prices are rising or are expected to rise.
- **Market correction** — A reverse movement, usually negative, of at least 10% in a stock, bond, commodity or index.

Source: www.investopedia.com, January 2007.



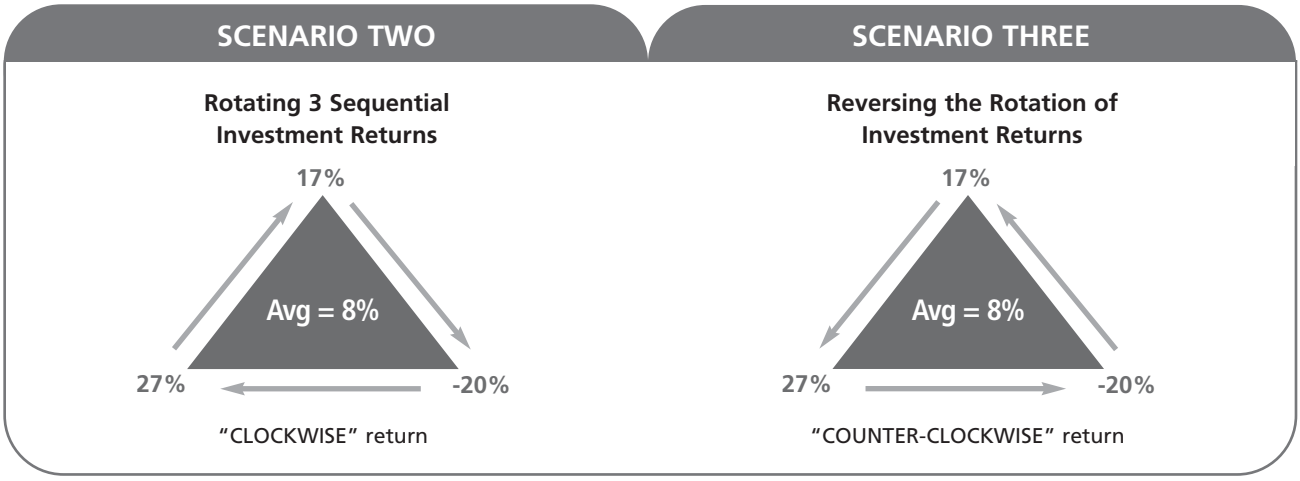
HYPOTHETICAL EXAMPLE. FOR ILLUSTRATIVE PURPOSES ONLY. DOES NOT REPRESENT ANY SPECIFIC INVESTMENT.

Note: If each year you earn a nominal rate of 8% and spend $7,000 per $100,000 of the initial portfolio and increase this amount each year by an inflation rate of 3.5%, your wealth will go to zero within the 22nd year or at age 87.9 (represented by the dashed vertical line). However, if your portfolio is shocked in one single year, losing 20%, the ruin date may be much sooner.

RETIREMENT INCOME SCENARIOS TWO AND THREE: AVERAGE 8% RETURN

We now explore a slightly different question. What happens if instead of earning a constant return of 8%, the portfolio earns an arithmetic average[1] of 8% over the retirement horizon? How variable is the final outcome, and what does it depend on?

To put some structure around the problem — since there are so many ways to generate an average return of 8% — imagine that the annual investment returns are generated in a cyclical and systematic manner. The illustrations below show two such scenarios, which we label Scenario Two and Scenario Three, respectively. Under Scenario Two, during the first year of retirement, the portfolio earns 17%; in the second year of retirement, it loses 20% and in the third year of retirement, it earns 27%. The cycle then repeats itself in year number four, etc. By construction, the arithmetic average of these numbers is exactly 8%. Likewise, each month we plan on withdrawing the same $583 adjusted for inflation, which is $7,000 per year adjusted for inflation. This cyclical process continues in three-year increments until the nest egg is exhausted and the money runs out.



HYPOTHETICAL EXAMPLE. FOR ILLUSTRATIVE PURPOSES ONLY. DOES NOT REPRESENT ANY SPECIFIC INVESTMENT.

Note: In SCENARIO TWO, you earn 17% in the first year of retirement, then -20% in the second year, then 27% in the third year, etc. This process continues in three-year cycles forever. The arithmetic average return is 8%. Then, in SCENARIO THREE the hypothetical example is reversed. In the second year of retirement, you go left along the triangle (to 27%) instead of right (to -20%), etc. Technically, this scenario involves the same asset class and earns the same average arithmetic return of 8%, but the sequence is different.

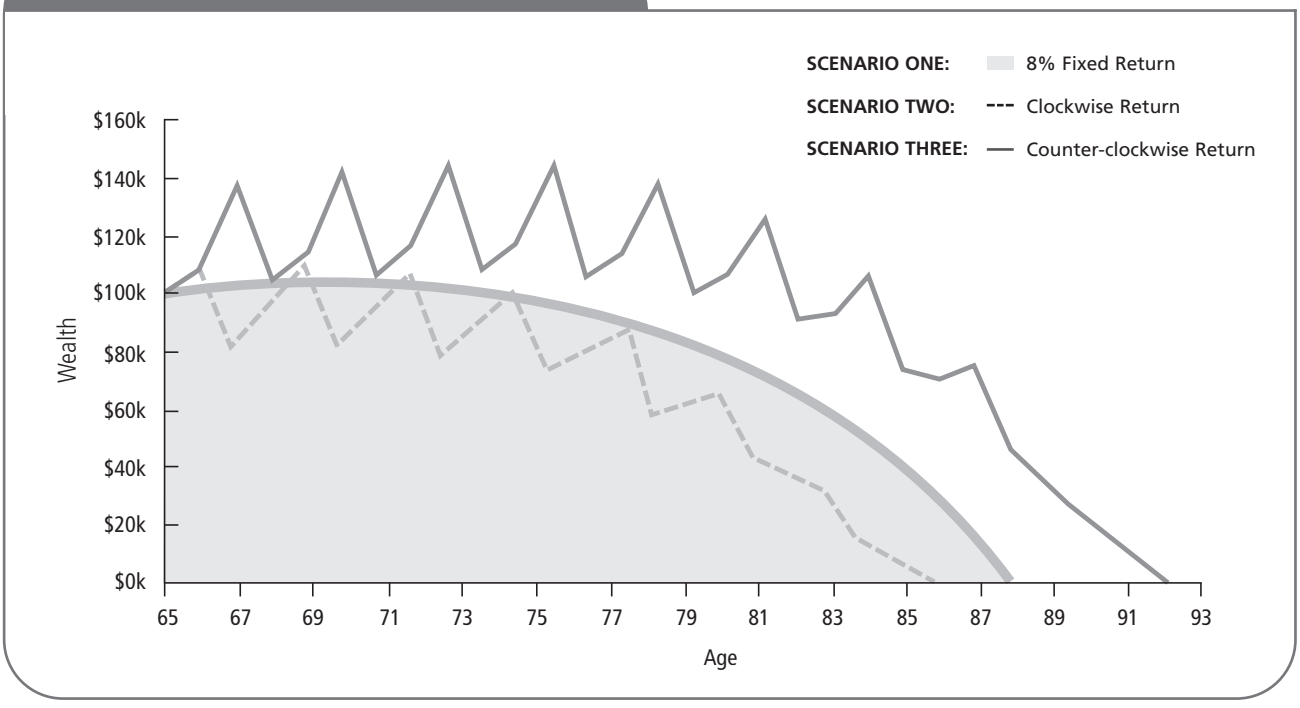
HOW WILL THESE SCENARIOS IMPACT YOUR RETIREMENT INCOME?

The chart below illustrates the result of this particular hypothetical example, graphically. Notice that in Scenario Two, an average return of 8% is worse than a fixed return of 8% every year. Indeed, since we started retirement on the wrong foot — i.e., we had poor performance in the initial years — the date we hit zero occurs almost two years earlier, or at age 86. The positive 27% return in our third, sixth, ninth, etc., year of retirement isn't enough to offset the minus 20% returns in the second, fifth, eighth, etc., year of retirement.[2] Remember the old portfolio arithmetic: if you lose 50% this year, you need 100% to make it up next year. And, you need even more than 100% if you are withdrawing money!

Now, an interesting thing occurs when we reverse the triangle of investment returns and instead move in the other direction, as in Scenario Three. In other words, first we earn 17%, then 27% and only then do we lose 20%. In the illustration on the previous page, Scenario Three displays the same triangle but with the arrows going in the other direction. Notice that the long-term behavior and performance of both rotating triangles remain the same. The average investment return is the same 8%, and the geometric mean return is a constant 5.9%, regardless of what side of the triangle we start retirement earnings and withdrawals.

However, the interesting result is that this time around (in Scenario Three) the money runs out at age 92.5 as opposed to age 86.1 (in Scenario Two) or 87.9 (in Scenario One). As you can see, in this case an arithmetic average of 8% leads to a better outcome than a fixed 8%. Sometimes earning something on average is better than earning it for certain.

"TRIANGULATE YOUR DATE OF RUIN"



HYPOTHETICAL EXAMPLE. FOR ILLUSTRATIVE PURPOSES ONLY. DOES NOT REPRESENT ANY SPECIFIC INVESTMENT.

Note: SCENARIO ONE: In a deterministic world your date with destiny is perfectly predictable. If at the start your wealth equals $100,000 and you spend about $580 per month (or $7,000 per year) adjusted for inflation (3.5% per year) and earn a fixed 8% per year (or 0.67% per month), you get ruined within the 22nd year of retirement. SCENARIO TWO: Earning an average arithmetic return of 8% is worse than exactly 8%, when you start your retirement in a bear market. SCENARIO THREE: Earning an arithmetic average return of 8% is better than exactly 8% each year, when the initial return is favorable.

IMPACT OF THE SEQUENCE OF RETURNS ON RETIREMENT RUIN

The variance in outcomes (or the spread in the retirement ruin dates) would have been even greater if we started with -20% or 27% as opposed to the 17%. For example, if the triangle sequence was -20% (bear market in year 1), 17% (in year 2) and then 27% (strong market in year 3), etc., the age of ruin would be 82.3. This is more than five years earlier than the baseline case.

The chart below summarizes the impact of the various possible sequences on the ruin age. It also displays the variation in years between a particular sequence and the baseline case of a fixed 8% each year of retirement. Notice that this gap in ruin ages can get quite large. There is a 12.3 year gap between cycling through the two sequences: (-20%, 17%, 27%) versus (27%, 17%, -20%).

SAME AVERAGE: DIFFERENT OUTCOME

Return Sequence	Ruin Age	+/- Years
+8%, +8%, +8%...	87.92	N/A
-20%, +17%, +27%...	82.25	-5.67
+17%, -20%, +27%...	86.08	-1.83
+17%, +27%, -20%...	92.50	4.58
+27%, +17%, -20%...	94.50	6.58

Initial wealth = $100,000; assumed spending per year: $7,000 per annum adjusted for inflation.

Note: In all cases, the rotating triangles earned an 8% average return during retirement. If you retire directly into a bear market versus directly into a bull market, the gap in sustainability can be greater than 12 years. Timing is everything.

A TALE OF TWO PORTFOLIOS: AN ILLUSTRATION OF THE IMPORTANCE OF SEQUENCE OF RETURNS

Example #1 on the following page moves beyond the hypothetical triangle and examines the same phenomenon using real world numbers. We have examined a 21-year period and assumed that we invested $100,000 in two investment portfolios, labeled Portfolio A and Portfolio B. Both portfolios were subject to $5,000 annual withdrawals at the beginning of each year, adjusted by an annual inflation rate of 3.5%. Both portfolios earned the same sequence of returns but in a reversed order.

In Example #2, the same initial deposits and annual withdrawal amounts are made, as in Example #1. However, this time, instead of earning the same sequence but in a reverse order, the two portfolios earned two different sequences of returns that shared the same average return and standard deviation (and thus the same geometric mean return) during the 21 years. This means that $1 invested in year 1 in either Portfolio A or Portfolio B would have grown to the same ending value of $6.58 by the end of year 21. As buy-and-hold vehicles, these two portfolios perform identically. Based on Modern Portfolio Theory, they are at the same position on the efficient frontier.[3]

Yet the final outcome under retirement withdrawals is quite different in both Example #1 and Example #2. In both cases, Portfolio A, which systematically withdraws $5,000 per year, adjusted for inflation from an initial investment of $100,000, runs out of money in the 16th year. Similarly, Portfolio B in both cases, which starts with $100,000 and engages in the same withdrawal strategy, ends up with more wealth (in nominal terms) than it started with in year 1. In Example #1, this ending balance is $386,497, while in Example #2 it is $187,090. Why this enormous difference in outcomes between Portfolio A and B even though they were seemingly identical portfolios?

The answer and blame once again lies in the poor markets during the initial years.

For instance, in Example #1, notice how Portfolio A experienced negative returns of -18.39% and -19.14% in years one and two, while Portfolio B earned strong returns in the first two years. Of course, in the long run, they both earned an arithmetic average of close to 10% per annum. And, even though Portfolio A earned strong returns throughout the following three years to make up for the first three years, it was too late. The damage was done.

EXAMPLE #1:
THE SAME SEQUENCE OF RETURNS, BUT IN REVERSE ORDER

End of Year	Portfolio A	Balance	Portfolio B	Balance
1	-18.39%	$77,528	26.57%	$120,241
2	-19.14%	$58,506	19.61%	$137,631
3	-4.59%	$50,712	5.26%	$139,237
4	18.47%	$53,510	16.57%	$155,846
5	6.79%	$51,018	33.60%	$200,540
6	14.30%	$51,527	21.23%	$235,909
7	-15.39%	$38,395	13.92%	$261,752
8	14.59%	$36,709	-1.61%	$251,277
9	8.95%	$32,821	21.03%	$296,146
10	19.52%	$31,084	16.21%	$336,230
11	20.72%	$29,011	20.72%	$397,392
12	16.21%	$25,230	19.52%	$466,249
13	21.03%	$21,391	8.95%	$499,749
14	-1.61%	$13,353	14.59%	$563,719
15	13.92%	$5,992	-15.39%	$470,097
16	21.23%	**$0**	14.30%	$527,763
17	33.60%	$0	6.79%	$554,352
18	16.57%	$0	18.47%	$646,101
19	5.26%	$0	-4.59%	$607,610
20	19.61%	$0	-19.14%	$483,551
21	26.57%	$0	-18.39%	**$386,497**

Arithmetic Mean[1]	**10.4%**
Standard Deviation[4]	**14.6%**
Geometric Mean[1]	**9.4%**
$1 Grows to	**$6.58**

HYPOTHETICAL EXAMPLE. FOR ILLUSTRATIVE PURPOSES ONLY. DOES NOT REPRESENT ANY SPECIFIC INVESTMENT.

Note: $100,000 is invested into each of two hypothetical portfolios at the start of year one. Portfolio B earns the same returns as Portfolio A, but in a reversed sequence. $5,000 is withdrawn at the start of year one from each portfolio, and this amount is increased each year by inflation (3.5% per annum). Portfolio A runs out of money in year 16, while Portfolio B ends up better than it started.

EXAMPLE #2:
DIFFERENT SEQUENCE OF RETURNS, BUT SAME AVERAGE RETURN AND STANDARD DEVIATION

End of Year	Portfolio A	Balance	Portfolio B	Balance
1	-18.39%	$77,528	7.56%	$111,681
2	-19.14%	$58,506	8.72%	$115,796
3	-4.59%	$50,712	-3.35%	$106,736
4	18.47%	$53,510	20.08%	$121,509
5	6.79%	$51,018	19.62%	$138,481
6	14.30%	$51,527	-13.64%	$114,458
7	-15.39%	$38,395	17.68%	$127,458
8	14.59%	$36,709	11.11%	$134,555
9	8.95%	$32,821	16.39%	$148,944
10	19.52%	$31,084	-9.11%	$129,184
11	20.72%	$29,011	-9.76%	$110,206
12	16.21%	$25,230	12.62%	$115,891
13	21.03%	$21,391	-16.38%	$90,588
14	-1.61%	$13,353	7.72%	$89,154
15	13.92%	$5,992	36.73%	$110,836
16	21.23%	**$0**	27.59%	$130,729
17	33.60%	$0	12.80%	$137,682
18	16.57%	$0	20.75%	$155,420
19	5.26%	$0	14.99%	$168,043
20	19.61%	$0	28.95%	$201,299
21	26.57%	$0	-3.74%	**$187,090**

Arithmetic Mean[1]	**10.4%**
Standard Deviation[4]	**14.6%**
Geometric Mean[1]	**9.4%**
$1 Grows to	**$6.58**

HYPOTHETICAL EXAMPLE. FOR ILLUSTRATIVE PURPOSES ONLY. DOES NOT REPRESENT ANY SPECIFIC INVESTMENT.

Note: $100,000 is invested into the same Portfolio A at the start of year one. However, this time, instead of earning the same returns in a reversed sequence, Portfolio B earns a different set of returns that shares the same expected return (mean) and same risk (standard deviation). $5,000 is withdrawn at the start of year one from each portfolio and this amount is increased each year by inflation (3.5% per annum). While on average the performance of the two portfolios appears to be the same, the outcomes are quite different. Portfolio A runs out of money in year 16, while Portfolio B ends up better than it started.

CONCLUSION: PROTECT YOUR RETIREMENT PORTFOLIO WITH A PRODUCT ALLOCATION STRATEGY

You and your neighbor might own the exact same investments, have the exact same asset allocation and might be spending the exact same amounts during each year of retirement, yet you might run out of money at very different ages.

It all comes down to your portfolio's performance during the first few years of retirement. If you retire and immediately experience a bear market (e.g., year 2000), while your neighbor retires into a strong bull market (e.g., year 1998), you might find yourself 10 to 15 years short of retirement income.

This phenomenon, which comes under the awkward-sounding label of sequence-of-return risk, cannot be mitigated using conventional investments and asset allocation strategies.

Rather, we believe that the only way to avoid an early date with ruin is by adopting a *product allocation strategy* that can help protect and guard the retirement portfolio against a bear market at the worst possible time.

Notes

1 pgs. 6, 10, 11 Note the difference between an arithmetic and a geometric average or mean. An arithmetic mean or average return can be calculated by adding the values of the returns and dividing this sum by the number of the returns. In contrast, a geometric mean return or the compound growth rate can be calculated by multiplying together one plus each return value, taking the nth root of the resulting product (where "n" represents the number of return values) and end by subtracting one. The geometric mean return accounts for periodic compounding, whereas the arithmetic mean return does not.

2 p. 7 This result may seem surprising, so let us explain how to verify this calculation in a spreadsheet. Start with $100,000 and have it earn 1.4167% in the first month. Then, withdraw $583*(1+3.5%/12) and have the remaining sum earn the same 1.4167% for the next month. Do this for 12 months, increasing the withdrawn amount by the monthly inflation rate of 3.5%/12 and then repeat the process for 12 months under an investment return of -1.6667% per month, which is a loss of 20% per year. Finally, repeat for 12 additional months under an investment return of 2.2500% per month, which is a gain of 27% per year. Every 36 months the pattern should repeat itself. Start with twelve 1.4167% numbers, then twelve -1.6667% numbers and finally twelve 2.2500% numbers. You should have a very long column of returns, which mimics the "Date of Portfolio Depletion" chart, with the account ultimately reaching zero just after your 86th birthday.

3 p. 9 Modern Portfolio Theory: A theory on how risk-averse investors can construct portfolios in order to optimize market risk for expected returns, emphasizing that risk is an inherent part of a higher reward. Also called portfolio theory or portfolio management theory. Source: Markowitz, Harry M., Portfolio Selection: Efficient Diversification of Investments, New York: John Wiley & Sons, 1959.

4 pgs. 10-11 Standard deviation: A measure of the dispersion of a set of data from its mean. The more spread apart the data is, the higher the deviation. In finance, standard deviation is applied to the annual rate of return of an investment to measure the investment's volatility (risk).

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