Modern Portfolio Decumulation: A New Strategy for Managing Retirement Income

by Richard K. Fullmer, CFA

Executive Summary

- This article outlines a strategy to improve the ability to obtain a stable and steady stream of distributions for life from a retirement portfolio and at the same time fund future wealth goals, such as for gifts and bequests.
- Typically, planners suggest managing longevity risk either by annuitization or in the spending plan (by reducing spending in the event of poor market performance or outliving the plan). This paper proposes an alternative method for managing it in the investment portfolio.
- Conventional approaches often fail to properly define the investment problem. To be effective, it is important to fully address longevity risk and use appropriate and complete measures of risk and risk aversion. For this problem, modern portfolio theory is an inadequate framework for portfolio construction.
- A new multiple-period, cash-flow-based investment framework is described that incorporates a dynamic asset allocation strategy and uses the cost of lifetime annuitization as a “hurdle” for managing longevity risk in the portfolio.
- By transforming longevity risk into investment risk and actively managing it in the investor’s portfolio rather than the spending plan, this approach is particularly useful for investors with a strong desire to maintain a given standard of living.

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This article describes a new framework for efficient portfolio construction in the “decumulation” phase of the investment lifecycle, in which an investor who has accumulated assets over time wishes to use those assets to fund ongoing living expenses. It combines elements of both investment theory and actuarial science, introducing an effective way to manage longevity risk in the portfolio.

Most retirees have two financial goals: funding consumption and retaining wealth. Consumption goals may be specified in terms of purchasing power (monthly amounts to be adjusted for inflation). The amount needed from the portfolio to fund the consumption goal in any time period is equal to that period’s consumption goal less the amount of income available from other sources, such as Social Security, pensions, and part-time work.

Wealth goals are amounts desired in the portfolio beyond those needed to fund consumption. Gifts and bequests are examples.

The consumption and wealth goals compete for the same resources in that the investor’s portfolio must fund both. Once the demands of these goals and the degree of emphasis that the retiree places on them have been determined, the task is to determine how to allocate the portfolio to achieve them.

Approaches to Managing Longevity Risk

It is common to categorize approaches to managing longevity risk in terms of insured annuitization or self-annuitization. The former involves the transfer of risk to an insurance company, whereas the latter involves systematic withdrawals from an investment portfolio. Here, the term *annuitization* refers to insured annuitization through the purchase of an immediate fixed (or inflation-adjusted) annuity. Annuitization essentially “decumulates” assets immediately by irrevocably exchanging them for a future stream of payments. Such an exchange means the assets are no longer available to fund wealth goals or unexpected expenditures that may occur.

Annuitization transfers longevity risk to a third party. But a systematic withdrawal plan offers no such transfer. Thus, formulas are often suggested for reducing future spending in the event of poor markets or unexpectedly high inflation. This amounts to managing longevity risk through spending management. This approach sacrifices the investor’s standard of living in the event of poor market returns.

Another approach is available, however: managing longevity risk through portfolio management. In this approach, it is the portfolio, rather than the investor’s standard of living, that responds to market performance and economic conditions.

Understanding that annuitization offers insurance against living too long leads us to consider these classic guiding principles for making insurance decisions:

1. Never risk more than you can afford to lose
2. Do not buy insurance that you do not need

A logical conclusion is to annuitize when you need to, but not before. This concept plays an important role in the framework that follows. Before describing this framework, however, a review of conventional approaches highlights key issues we must first address.

Conventional approaches to meeting a retiree's consumption and wealth goals are commonly derived from existing models for wealth accumulation, such as Harry Markowitz's breakthrough paper describing efficient portfolio construction using mean-variance optimization. Although modern portfolio theory may serve the industry well for those saving for the future, it falls short as a methodology for decumulation. The purpose of accumulation is to acquire wealth; the purpose of decumulation is to achieve lifetime cash flows from the portfolio. Traditional modern portfolio theory

- Assumes no cash flows, the retiree's primary investment objective.
- Ignores the investor's risk aversion for failure to achieve the cash flows.
- Incorporates a single-period framework. But decumulation is a multiple-period investment problem as the required cash flows are periodic and ongoing.
- Uses an inadequate definition and measure of risk (the standard deviation of return).
- Assumes a known time horizon, even though the retiree's time horizon is unknown.

To achieve lifetime income from a portfolio, the financial planning methodology and the investment framework must address these shortcomings. Specifically, they must fully address longevity risk, avoid the fallacy of time diversification of risk, measure risk completely, and account for the investor's aversion to cash-flow risk.

A plan for systematic withdrawal from a portfolio cannot eliminate longevity risk. A common approach for dealing with this is to select a "drop-dead" date that the investor is statistically unlikely to reach. Then, a methodology such as Monte Carlo simulation is used to determine the likelihood that a spending and investing plan will last to that date.

Using this approach, longevity risk derives from two sources:

1. Running out of money during the selected time horizon (because the assumptions did not turn out in reality as planned)
2. Running out of money after the selected time horizon (because the investor outlived the drop-dead date)

If longevity risk is managed in the spending plan, the portfolio need not deal with it. But if it is managed in the portfolio, the investment model must fully account for it.

A Different Measure of Risk

A common misunderstanding in financial planning is that time diversifies risk. It does not. When risky assets are included in a portfolio, risk always increases with time and this effect is magnified in decumulating portfolios.

Yet it is common to use either historic or projected portfolio returns over long time horizons to show how risky portfolios appear suitable over long holding periods. Figure 1 shows hypothetical average annualized real returns for a 60 percent equity/40 percent bond portfolio (see Appendix A for assumptions).

Since the range of outcomes narrows over time, Figure 1 seems to show that risk decreases with longer time horizons. However, this conclusion is wrong. The problem here is a "flaw of averages." Figure 1, while interesting, does not convey the risk. It is not *average* return that matters, but *cumulative* return. Cumulative returns directly measure changes in wealth.

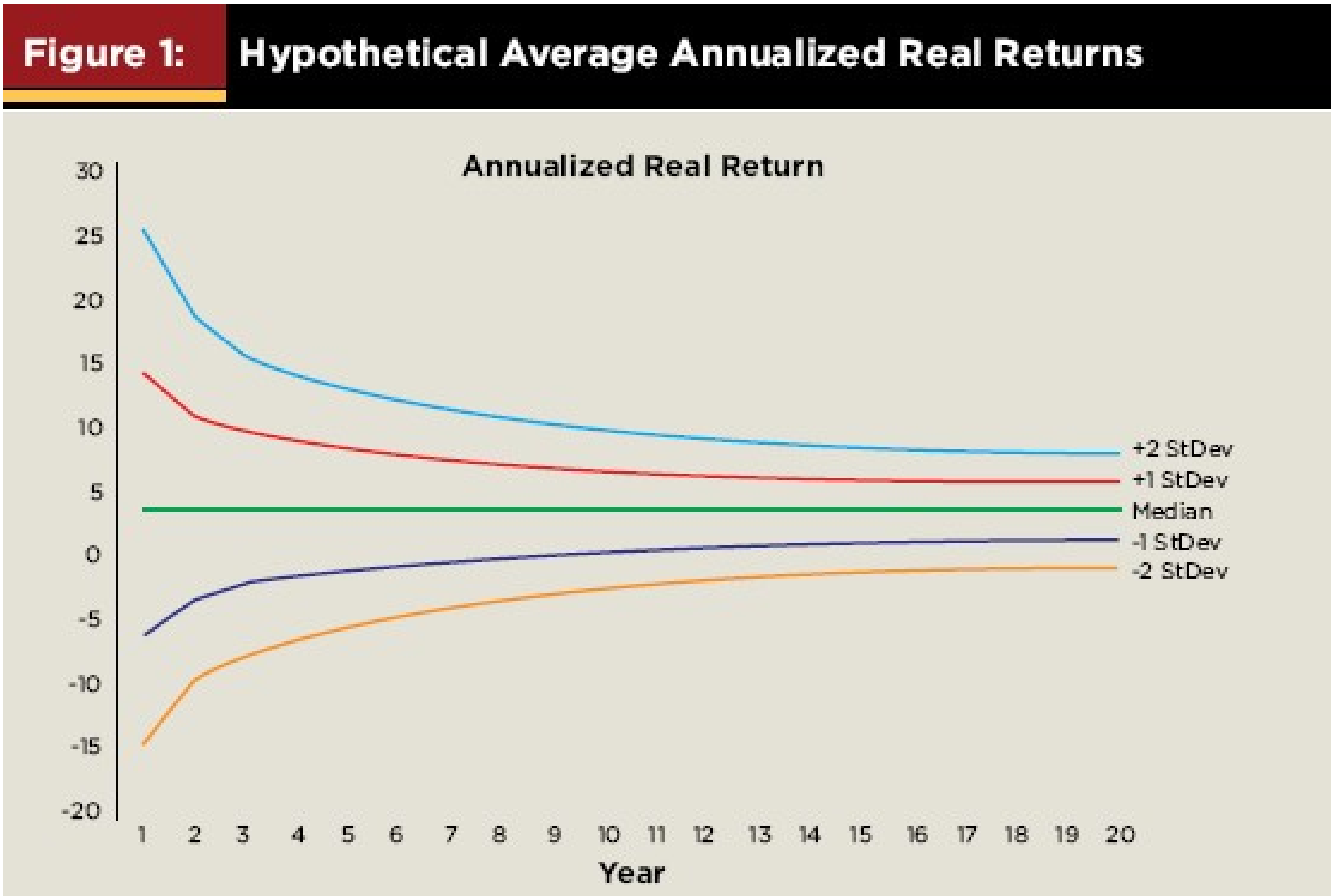
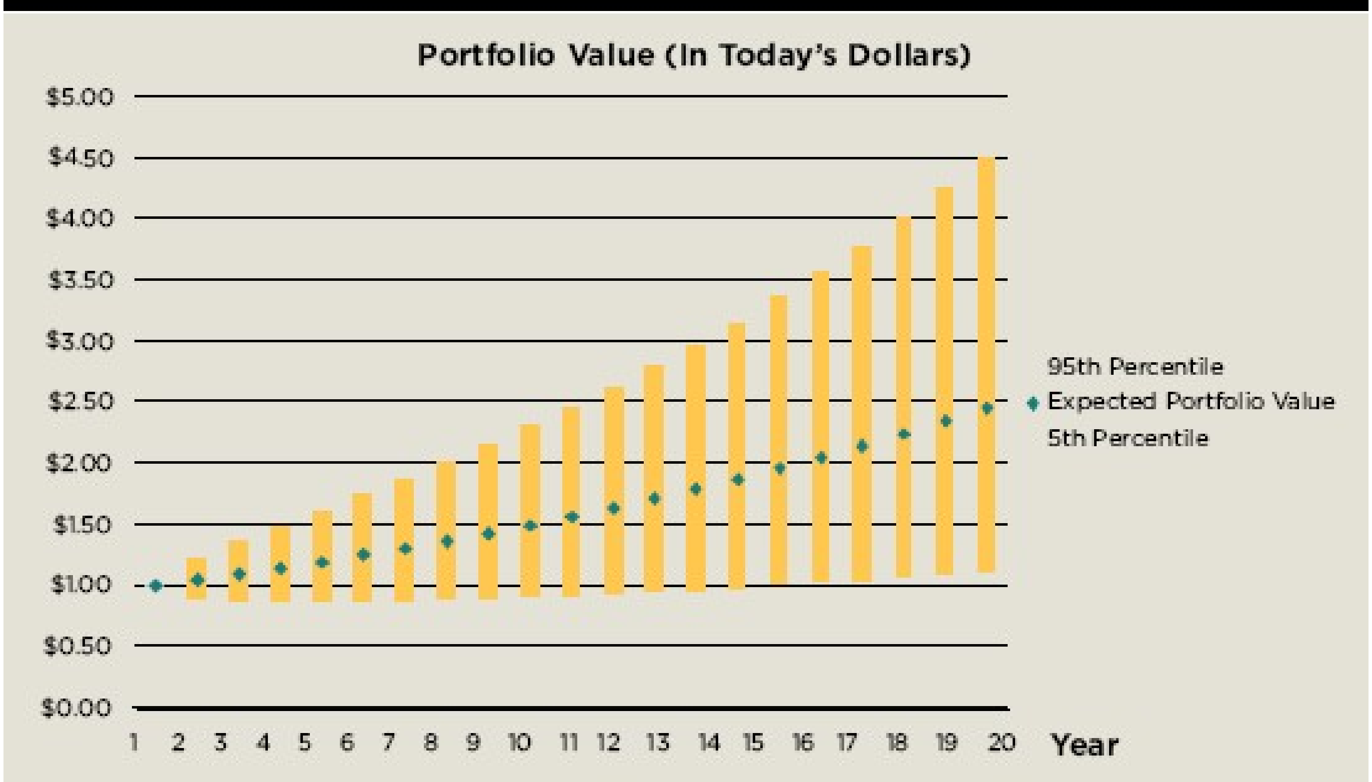


Figure 2 shows cumulative real returns for the same scenario as Figure 1. Although the standard deviation of average returns decreases over time, the standard deviation of cumulative returns increases over time. Should there be no cash flow into or out of the portfolio over the time horizon, the asset balance will show the same pattern as the cumulative return, as shown in Figure 3.

Figure 2: **Hypothetical Cumulative Total Real Returns**

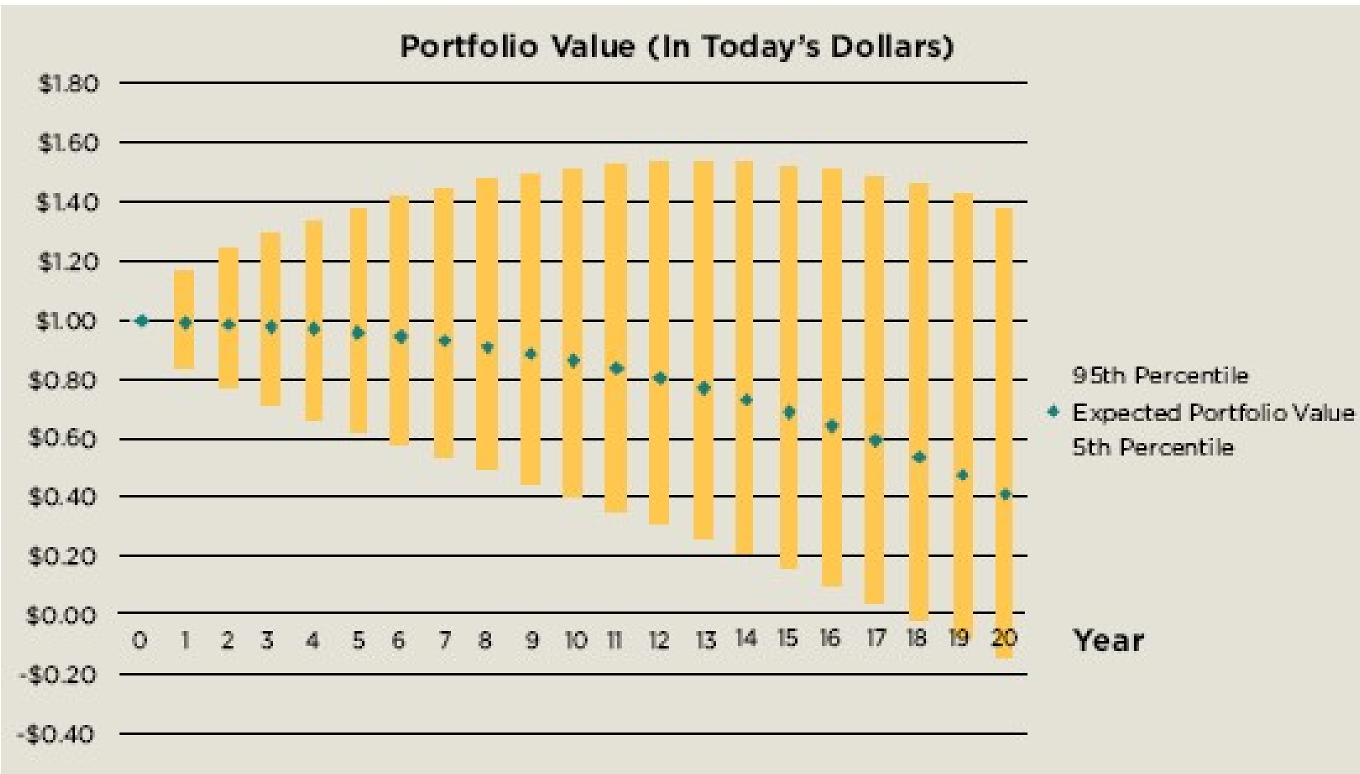
Figure 3: **Hypothetical Real Wealth Per Dollar Invested for Portfolio with No Withdrawals or Further Investments**



Figures 2 and 3 together show that the standard deviation of cumulative return is a suitable measure of risk for lump-sum investment portfolios (where no cash flows are involved). As shown in the two charts, the investor's level of wealth is directly tied to the cumulative return. This explains why traditional wealth-based portfolio construction models use the standard deviation of cumulative return to measure risk.

But this is not the case with decumulating portfolios, where cash flows are the primary objective. If market returns are poor early in retirement, the portfolio may go broke before the markets recover. Figure 4 shows the projected asset balance for the same portfolio assuming a 5 percent withdrawal rate in the first year, subsequently adjusted for inflation. Clearly, the pattern shown in this chart has little resemblance to the cumulative return chart shown in Figure 2. It is evident that the standard deviation of return is not a suitable measure of risk for the retirement income problem. Probability alone does not risk make. History is littered with the wreckage of those who learned this lesson the hard way.

Figure 4: Hypothetical Real Wealth Per Dollar Invested for Portfolio with 5 Percent Initial Withdrawal Rate Annually Adjusted for Inflation



Monte Carlo simulation tools are popular, and their probabilistic methodology is an improvement over the deterministic methods of their predecessors. But the probability of bad outcomes is not a complete measure of risk. Decomposing risk into its two primary components reveals that the magnitude of bad outcomes is as important as the probability. Risk is measured as the product of these two components: Total Risk = Probability x Magnitude.

Actuaries and risk analysts will quickly recognize this equation. Even though the probability of a bad outcome may be small, if the magnitude is large then the overall risk may be significant and therefore the investment model must account for it.

Accounting for the Investor's Aversion to Cash-Flow Risk

A prevalent assumption in retirement planning is that if the plan fails, the investor must either spend less or go back to work. The term cash-flow risk refers to the risk that the portfolio will fail to deliver the lifetime cash flows required to fund consumption goals. Commonly, the investor's aversion to *cash-flow* risk is addressed during the planning process by making conservative assumptions. Less commonly is it factored into the portfolio construction model, in which case the implication to the portfolio manager is that the investor has no aversion to cash-flow risk at all, but is perfectly willing to accept the risk of a reduced standard of living.

This may be acceptable for investors willing to raise or lower their standard of living based on the ups and downs of the market. But for investors less willing to assign control of their livelihood to the vicissitudes of the markets, cash-flow risk aversion must be built into the portfolio manager's investment model.

A Framework for Portfolio Decumulation

Having identified shortcomings in the conventional approaches that must be overcome, the framework for decumulation follows.

Portfolio construction models generally are written as an objective function, which defines exactly what the portfolio manager is charged with accomplishing for the investor. The objective is to maximize wealth, subject to achieving the desired cash flows to fund a lifetime of consumption and the desired bequest and other wealth goals. Appendix B illustrates this objective function in mathematical terms, addressing the periodicity of the cash-flow goals and the investor's risk tolerance for achieving them. It also discusses the application of shortfall risk measures. "Shortfall" describes the risk that the portfolio may fail to meet the investor's ongoing objectives. This measures risk in terms that are readily meaningful to the investor while accounting for both the probability and magnitude components of risk.

A complication in the decumulation problem is that an uncertain lifetime makes the time horizon largely unknown. If the horizon is unknown, how can shortfall risk be measured? Furthermore, how can the objective function possibly be optimized?

One method is to use mortality statistics to model the time horizon as a probability density function and then incorporate it into a stochastic model for calculating a probability of success or ruin. In practice, this method is limited as a means for determining an optimal portfolio. The reason is subtle. The stochastic mortality approach models the paths of numerous potential lifespan horizons, which implies that retirees have many lives to live even though in reality they have only one. Constructing a portfolio based on numerous phantom lives is problematic because although longevity risk management is possible using multiple real lives, it is not possible using phantom lives.

This insight is a key point to resolving the dilemma. Let's return now to the guiding principle to insure (annuitize) when you need to, but not before. The logical inference is to construct the optimal investment portfolio of assets for the individual's goals while continually evaluating the *option* to annuitize those assets when (and only when) necessary to ensure continuing lifetime income. Rather than simply annuitizing assets early in retirement, the idea is to leverage the option to annuitize those assets later. As Milevsky and Young (2002) show, this is a real option with real value that can be quantified.

Transforming Longevity Risk into Investment Risk

The key for leveraging this optionality is setting the projected cost to annuitize the investor's desired lifetime income stream as a *wealth* goal in the objective function. Doing so effectively transforms longevity risk into investment risk, because now it is the portfolio's job to preserve the ability to annuitize the desired lifetime income stream. By combining these separate but related types of risks, they can be managed holistically and thus more effectively. Although this method may not guarantee the ability to annuitize on any particular future date (unless an insurance company underwrites the guarantee), the investor is free to exercise the annuitization option at any time. By monitoring the investor's wealth relative to the current cost of annuitization, the decision to invest or annuitize can be continually evaluated by a financial advisor. To implement, a two-step process is used.

Step 1. Select a time horizon during which the investor (a) is willing and able to forecast a spending budget (define the cash-flow goals) and (b) strongly desires to avoid relinquishing liquidity and control of financial assets.

This "liquidity horizon" may be of any length. Because it is not an assumed drop-dead date, however, it does not necessarily have to extend beyond life expectancy as a means of mitigating longevity risk. Having been transformed into investment risk, longevity risk is now actively managed inside the portfolio rather than in the selection of a drop-dead date.

Step 2. Set the wealth target at the end of this horizon as the amount needed to fund a lifetime annuity. Ideally, this target will be exceeded and the annuitization decision can be deferred indefinitely, but this is the minimum requirement. The annuitization cost calculation uses simple and well-established formulas (see Appendix C for an example that applies this methodology).

Visualizing the Framework

Figure 5 illustrates a hypothetical scenario. An initial $1 million investment is shown in dark blue, the cash-flow goals are in red, and the wealth goals are in yellow and green. A 20-year liquidity horizon is selected as denoted by the shaded region. A 5 percent initial withdrawal rate is used ($50,000 in the first year). Inflation-adjusted spending is desired to maintain the investor's standard of living, so the chart shows real values (today's dollars).

Figure 5: Example of Framework Showing Investment Goals

In the event that the investor is still living after 20 years, ongoing cash flows continue to be needed. These are accommodated by the solid yellow bar indicating the minimum amount required in the portfolio to fund the purchase of a lifetime annuity at the end of year 20. Other wealth goals are indicated by the green bar. As long as the portfolio achieves the cash flow and wealth goals, it will have met its purpose of providing lifetime income.

Illustrating the Investment Strategy

Figure 6 shows various points on the efficient frontier for hypothetical mean-variance optimal portfolios using the traditional definition of risk for wealth accumulation.

Figure 6: Wealth Accumulation Efficient Frontier

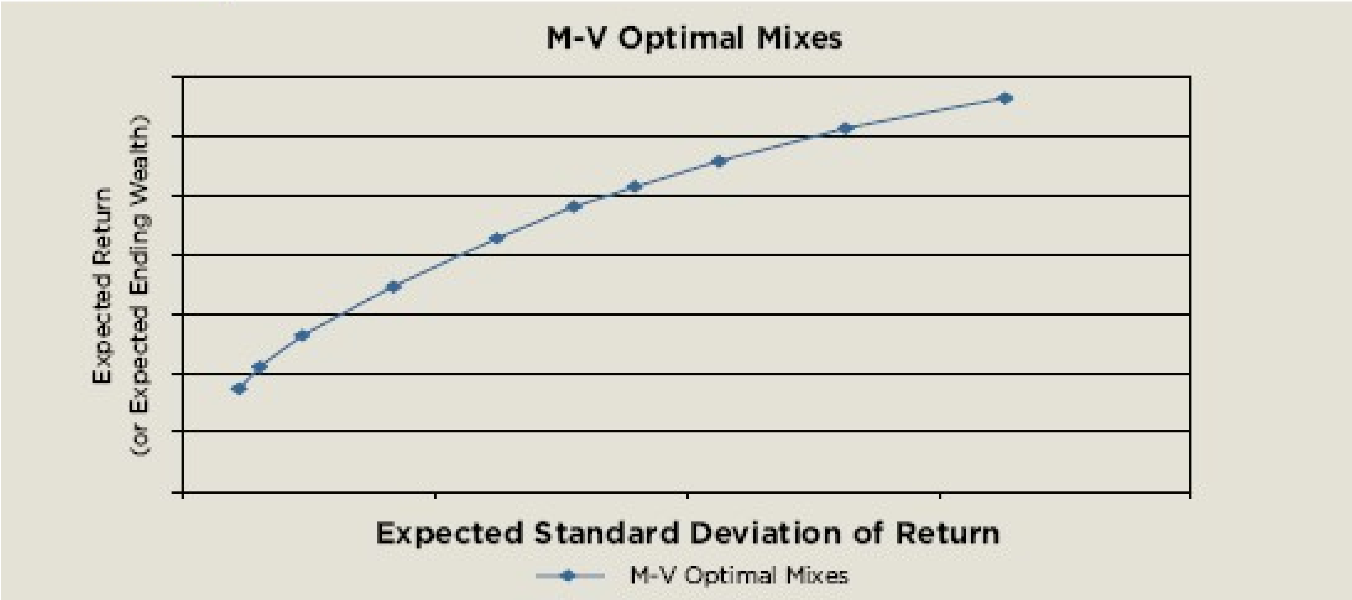


Figure 7 illustrates these same portfolios in the context of the decumulation framework as described in Appendix B. Notice that risk is now measured not by standard deviation of return, but in terms of shortfall over a given liquidity horizon. New “shortfall optimal” portfolios are now identified as more efficient for decumulation. It is no surprise that portfolios that are efficient for wealth accumulation are not efficient for wealth decumulation, since the two investment problems are significantly different.

Figure 7: Wealth Decumulation Efficient Frontier (Static Allocations)

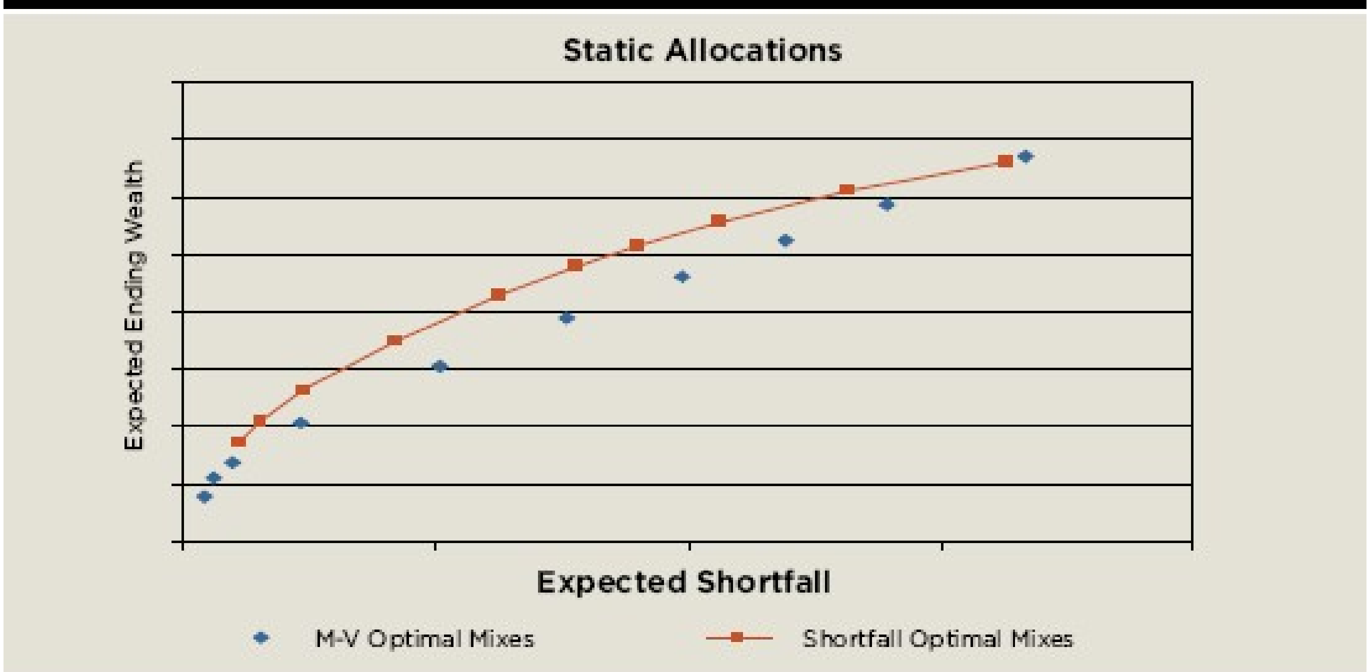


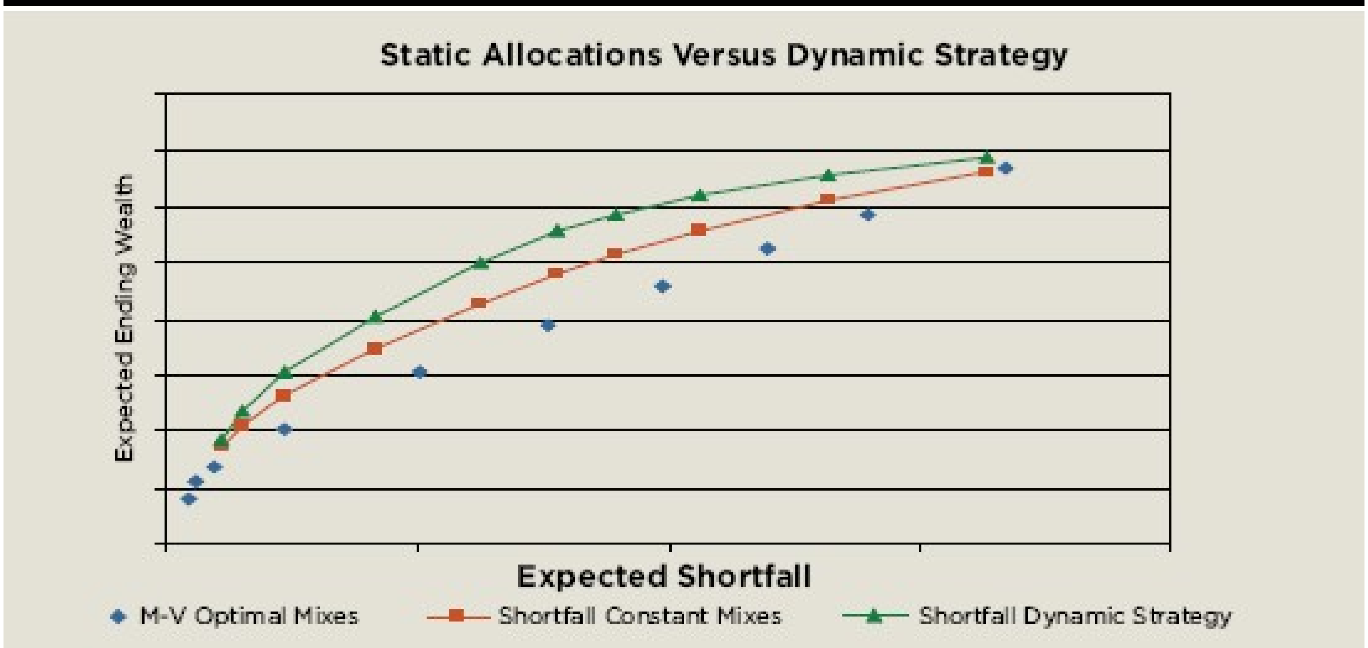
Figure 7 shows optimal *static* asset allocations for the portfolio. But are static portfolios truly optimal for the decumulation problem?

The answer is no because movements in the markets have a major impact on the amount of shortfall risk present in the portfolio over time. It makes sense, then, to alter the asset allocation over time to manage this risk. A 10 percent decline in value may increase shortfall risk substantially, perhaps necessitating a more conservative portfolio to reduce the risk level. A 10 percent increase in value may reduce shortfall risk, allowing for a more aggressive portfolio to serve the objective of growing wealth.

When little cash-flow risk is present, the objective function begins to act like the wealth-based mean-variance model. On the other hand, when substantial cash-flow risk is present, the objective function begins to take on more of the characteristics of a cash-flow matching model. A dynamic allocation strategy makes these adjustments when necessary. Since the optimal (utility maximizing) asset allocation is dependent on the value of the portfolio at any time, any static investment strategy will necessarily suffer lost utility due to its inability to respond to real-world changes.

Given any current level of wealth, time horizon, series of cash flows, cash-flow risk aversion, future wealth goal, wealth risk aversion, and capital market expectations, the goal is to find dynamic strategies that provide wealth/risk combinations that are superior to the optimal static strategy, shifting the efficient frontier up as shown in Figure 8. It makes no sense to take unrewarded risk, so dynamic strategies are compelling for retirees exposed and averse to cash-flow risk (this excludes those so wealthy or so frugal that they don't need to worry about outliving their money).

Figure 8: Wealth Decumulation Efficient Frontier (Dynamic Strategy)



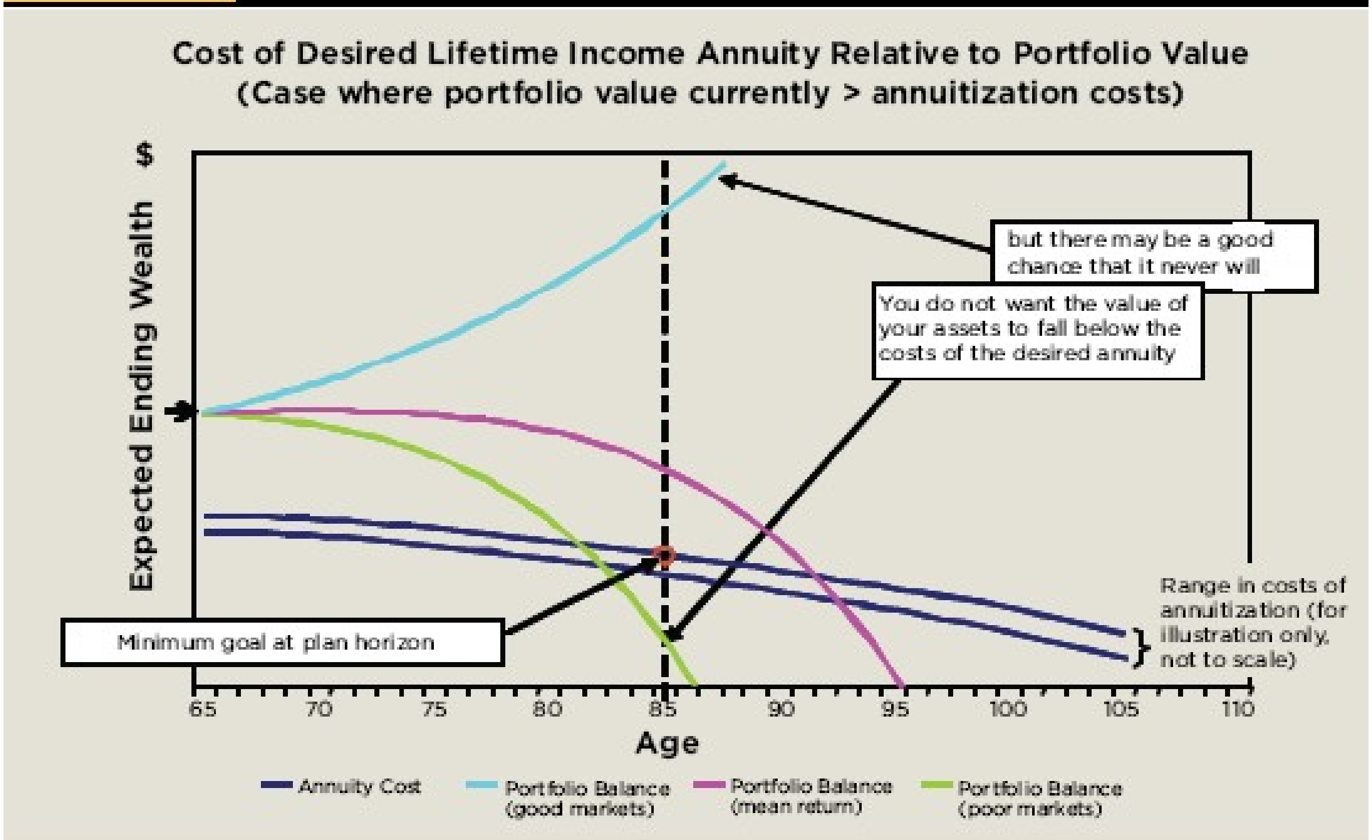
The illustrations shown here assume annual rebalancing of the static portfolios and annual resetting of the dynamic portfolio. But since the current level of wealth changes daily, shortfall risk also changes daily and thus the optimal allocation changes daily. Consequently, the more frequently the allocation is reset, the greater the benefit offered by a dynamic strategy. In the ideal world, it would be reset daily. But any resetting should take place only when the benefit exceeds transaction costs. In the real world, resetting the allocation would occur less frequently than daily and more frequently than annually.

A Practical Approach: Using an Annuitization Hurdle

Of course, dynamic strategies may be burdensome for some financial planners and advisors to implement, in which case they may outsource the portfolio management function to investment managers better equipped for the task. But regardless of the investment methodology, the framework still provides an intuitive and simple way for planners and advisors to assist their clients in retirement while avoiding the undesirable task of selecting a drop-dead date.

Figure 9 illustrates how the amount needed for continuing lifetime income can be viewed as an “annuitization hurdle.” Here, inflation-adjusted withdrawals are taken from a portfolio and potential paths for the portfolio value are displayed. Overlaid on these paths is the cost to annuitize a desired lifetime income stream if this annuity were to be purchased in any subsequent year. In other words, the first-year cost is for an annuity purchased at retirement, whereas the fifth-year cost is for an annuity purchased in the fifth year of retirement. Since life expectancy decreases with age, the cost to annuitize generally also decreases with age.

Figure 9: Use of an Annuitization Hurdle

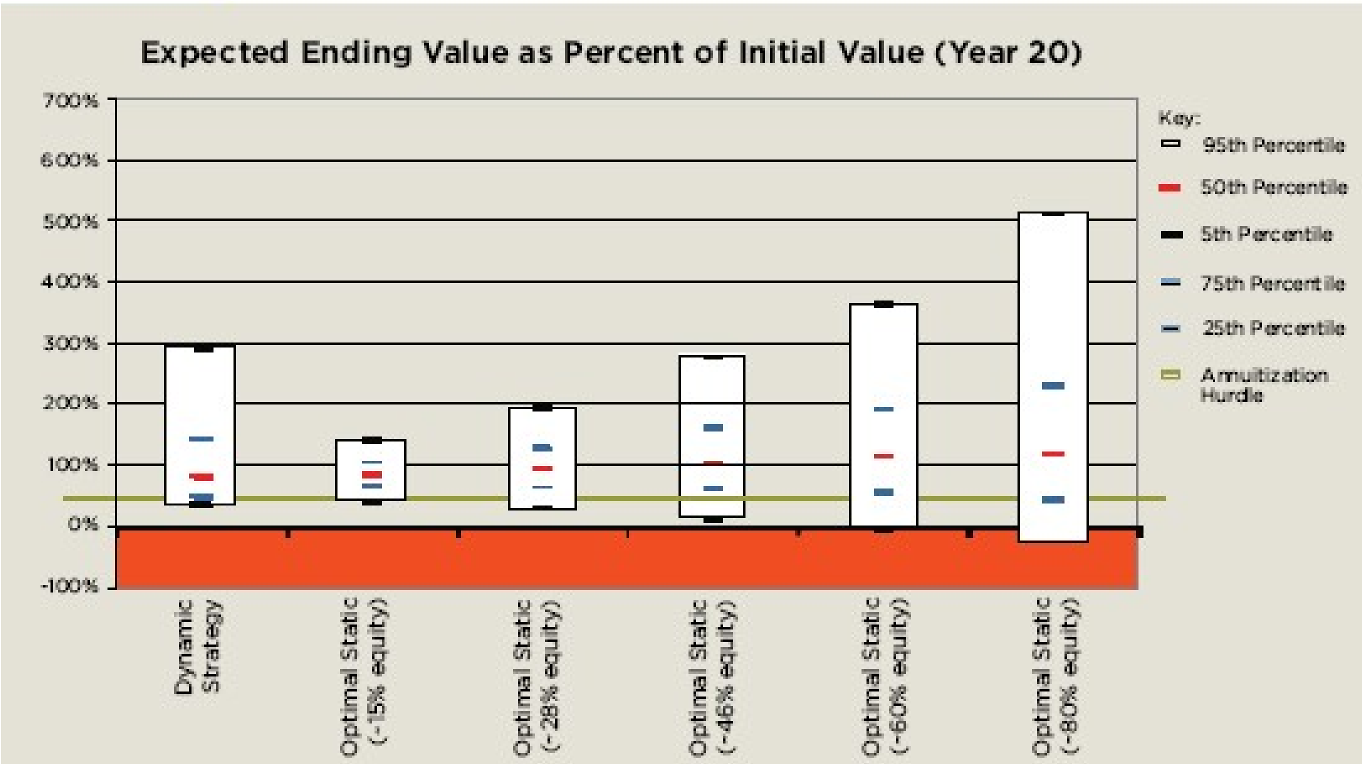


Investing in the capital markets involves risk and, as John Maynard Keynes might have put it, the markets may underperform your expectations longer than you can remain solvent. Many financial planning approaches use a portfolio value of *zero* as the threshold for plan success or failure (X percent chance your portfolio will last for Y years). This method considers failure to mean “financial ruin.”

In contrast, the portfolio decumulation framework uses the cost to annuitize as the threshold for success or failure (X percent chance your portfolio will last for Y years and still retain enough value to annuitize a guaranteed lifetime income). This method considers failure to mean "having to annuitize your assets before you really hoped to." For most retirees, this is a more comforting threshold to use than financial ruin. In Figure 9, shortfall occurs when the portfolio value drops below the cost to annuitize.

Combining the annuitization hurdle with a dynamic investment strategy relative to that hurdle tells a compelling story to the client. Figure 10 shows a range in possible outcomes after 20 years for a dynamic portfolio as well as optimal static portfolios of varying risk levels. The investment objectives in this hypothetical example include a 5 percent initial withdrawal rate in the first year that is subsequently adjusted for inflation. The lifetime annuitization hurdle is a projected range of values. Portfolio values below zero represent financial ruin, while values below the annuitization hurdle represent an inability to fund the desired annuity.

Figure 10: Comparison of Wealth Distributions



Dynamic strategies adjust the composition of the portfolio over time based on the current portfolio value, remaining cash flows, and annuitization hurdle amount. Figure 10 shows that the dynamic strategy works to meet the cash flow *and* the wealth (annuitization hurdle) objectives regardless of market performance, thereby actively managing longevity risk. It compresses the set of potential outcomes at the lower end of the range to stay above the hurdle, while preserving as much upside as possible.

Conclusion

The investment problems of accumulation and decumulation are significantly different, and therefore the investment model best suited for them must necessarily be different. Decumulation is a much more complex problem to manage. Logic dictates that retirement income solutions should leverage the best features of both investments and insurance. Given the many competing goals and the complex nature of the risks, the timing of the "invest or annuitize" decision is important to the overall success of any retiree's financial plan. The use of annuitization hurdles helps frame the problem in simple terms.

Traditional accumulation-based investment portfolios are suboptimal for this problem. Redefining the investment objectives and risks in the client's terms is critical. Dynamic strategies appear well suited to the problem of decumulating portfolios that must provide for lifetime income.

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Appendices