



**Massi De Santis, PhD**  
Vice President  
Dimensional Fund Advisors

## RESEARCH MATTERS

August 2016

# The Value of Aligning Investments and Risk Management to Your Goals

Most investors begin with an investment goal. The goal helps define key risks, the right risk management, and how to monitor performance. For example, a primary goal of retirement planning is to provide consumption in retirement using accumulated savings. A key risk is uncertainty about how much consumption can be sustained. Managing this uncertainty requires measuring investment performance in consumption units as opposed to dollar or account values. A risk management strategy that attempts to reduce this uncertainty is also required.

Consider Tom, an investor planning to retire in 10 years. He is saving to fund retirement consumption—a cash flow stream—starting in 10 years. To plan his retirement, he cares about the lifetime cash flow he can reasonably expect from his current and future savings. Tom estimates he will need \$50,000 per year in retirement. To know if he is on track to reach this goal, he needs to translate his account balance into consumption units.

This information is crucial for success as it gives Tom a yardstick to measure retirement readiness and to monitor progress towards his consumption goal. Using information from a retirement income calculator, Tom believes he is

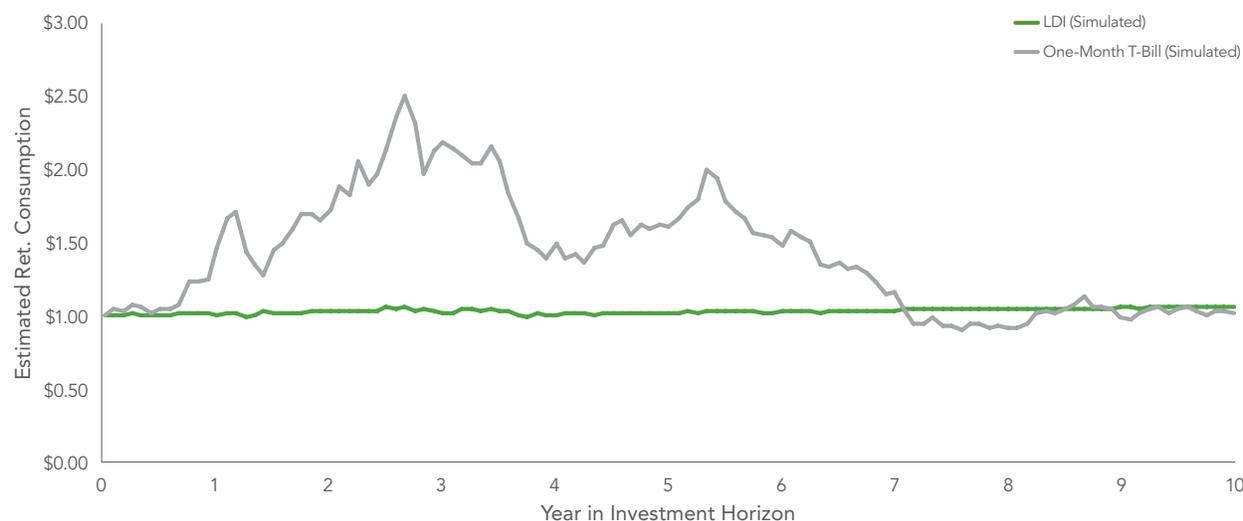
on track for the goal. The key question is: how will the estimate of \$50,000 in consumption evolve over the next 10 years? The income estimate today is meaningful to Tom (i.e., helps him plan for retirement) only if it is unlikely to fluctuate a lot in the future. For that to happen, Tom needs an investment that reduces uncertainty of his future retirement consumption over time.

We show that a risk management strategy tied to Tom's retirement consumption goal may effectively reduce this uncertainty, giving Tom confidence about his retirement plan. We also show that strategies like capital preservation, which are not tied to Tom's goal, can generate volatile estimates of future consumption and reduce the usefulness of the estimates. In addition, they generally lead to less efficient risk/return tradeoffs.

### **RISK DEPENDS ON THE GOAL**

Let's add more detail to Tom's problem. Assume the retirement goal is defined as a monthly check for 25 years starting in 10 years when he reaches age 65. Without loss of generality, assume his goal is \$1 per month. Consider two investment strategies. The first strategy attempts to match the duration of the 25-year cash flow (the monthly

**Exhibit 1: Estimated Retirement Consumption, LDI vs. One Month T-Bill**  
 January 1979–January 1989



Lines in the plot represent a 10-year history of estimated consumption over the investment window. The first period is Jan. 1979–Jan. 1989. Consumption is estimated by dividing the wealth level by the cost of a \$1 cash flow for 25 years starting at the end of the period. Wealth level is simulated using returns on one-month T-bills from Morningstar, and a simulated LDI strategy that matches the duration of the \$1 cash flow stream for 25 years. Simulations are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. Results may vary with each use and over time. These hypothetical incomes are used for discussion purposes only and are not intended to represent, and should not be construed to represent, predictions of future incomes or returns. Actual incomes may vary significantly. See the Disclosures for details.

check from age 65 to age 90). This is called a liability-driven investment strategy or “LDI”.<sup>1</sup> The second strategy manages the volatility of the account balance by rolling over one-month US Treasury bills over the 10-year horizon. As a good capital preservation instrument, the T-bill strategy may be perceived as low risk. But is it low risk if the goal is retirement consumption?

As an example, consider the 10-year period from January 1979 to January 1989, and assume at the beginning of the period Tom has just enough savings to expect the \$1 consumption stream.<sup>2</sup> Exhibit 1 illustrates the evolution of Tom’s estimated consumption over the period from the two investment strategies.

The estimate using the LDI strategy is fairly stable. This strategy gives Tom the clarity and confidence he needs to plan for retirement. While estimates for both strategies begin and end at about the same level, the estimate using the T-bill strategy is highly volatile. The annualized volatility of the estimate is 2.9% for the LDI strategy and 20.7% for the T-bill strategy. The maximum monthly drop in the LDI strategy is 3.2% while in the T-bill strategy it is

16%. Also notice the T-bill strategy’s large peak-to-trough loss of 64% between years 3 and 8.

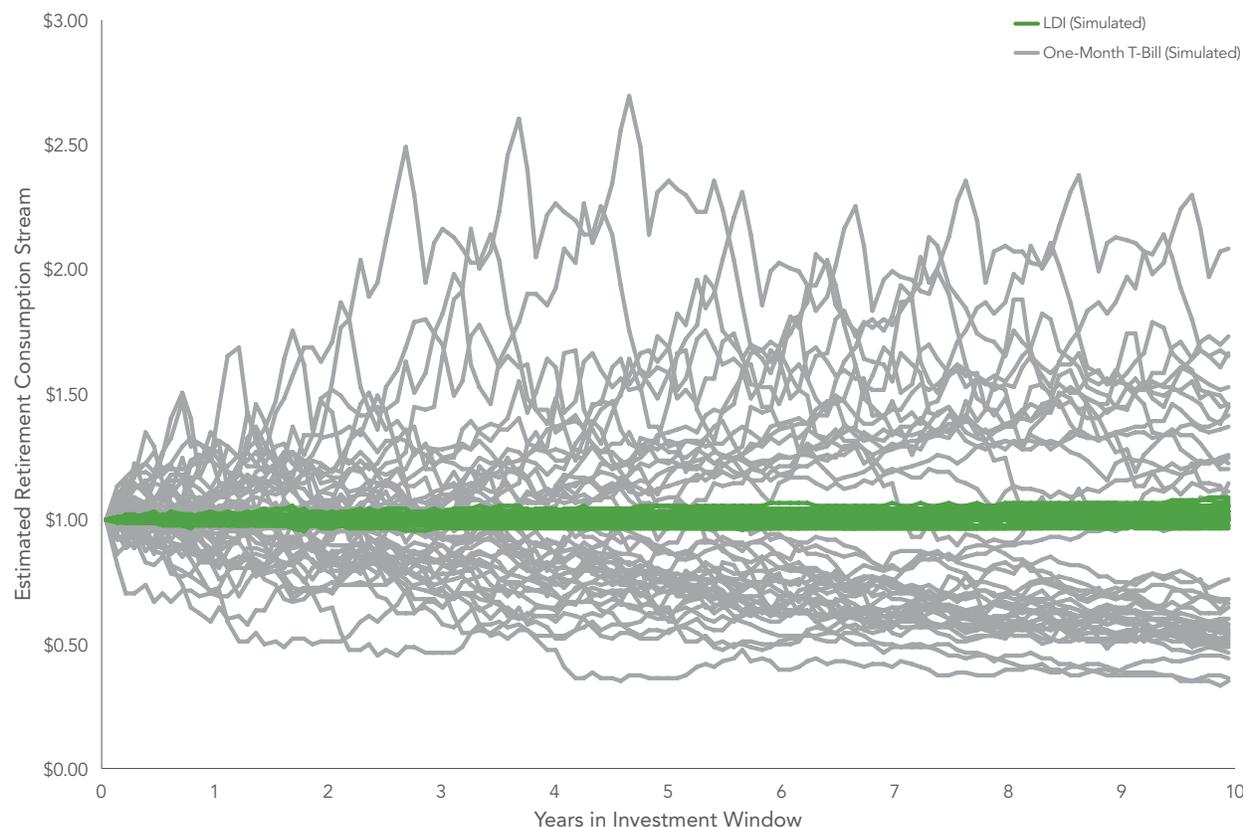
This pattern is not unique to the T-bill strategy. Any strategy that attempts to reduce volatility using short-to intermediate-term fixed income, when the goal is a long-term liability like retirement consumption, will not be as effective as the LDI strategy.<sup>3</sup>

Is there anything special about 1979–1989? The period is one example of a 10-year span where the estimates from the two strategies start and end at approximately the same value of \$1. Generally, we expect the final estimate to be higher or lower than \$1. To analyze the variability over different 10-year periods, we can repeat the experiment. Using available interest rate data between 1962 and 2015 we have 44 overlapping 10-year periods: 1962–1972, 1963–1973, and so on. Exhibit 2 plots estimated consumption for all of the 10-year periods.

The pattern is clear. In all 10-year periods, the LDI strategy is relatively stable. The T-bill strategy is a rollercoaster. While not constant, under the LDI strategy the distribution

1. Duration is related to the average maturity of the cash flow to which is referred. Technically, it is defined as the sensitivity of the present value of the cash flow stream to its yield. It is commonly used to estimate the sensitivity of bonds, bond portfolios, or liabilities to interest rates.  
 2. Below we explain how these estimates can be computed using interest rates. This will also explain how Tom can determine he has enough to meet the \$1 goal.  
 3. See Massi De Santis, “Retirement Planning: An Introduction to Liability Driven Investing” (white paper, Dimensional Fund Advisors, 2016).

**Exhibit 2: Estimated Consumption over Last 10 Years Prior to Retirement**



*Each line in the plot represents a 10-year history of estimated consumption over the investment window. The first period is Jan. 1962–Jan. 1972; the second period is Jan. 1963–Jan. 1973, and so on. Consumption is estimated by dividing the wealth level by the cost of a \$1 cash flow for 25 years starting at the end of each period. Wealth level is simulated using returns on one-month T-bills from Morningstar, and a simulated LDI strategy that matches the duration of the \$1 cash flow stream for 25 years. Simulations are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. Results may vary with each use and over time. These hypothetical incomes are used for discussion purposes only and are not intended to represent, and should not be construed to represent, predictions of future incomes or returns. Actual incomes may vary significantly. See the Disclosures for details.*

of retirement consumption estimated at retirement (10 years later) is concentrated around \$1. The range is between \$0.97 and \$1.09. The median is \$1.01. For the T-bill strategy, besides the obvious variation over the 10 years, the range of outcomes at retirement, from \$0.35 to \$2.09, is very wide. The median outcome of \$0.67 is well below \$1, so lower than the median under the LDI strategy. Why? The LDI strategy is a long-term bond portfolio that matches the duration of the goal. Because yield curves have been upwardly sloped on average, short-term debt instruments like T-bills are expected to have lower returns than long-term bonds. So, retirement consumption outcomes under the T-bill strategy can be expected to be more volatile and lower than under the LDI strategy.

How can Tom increase the likelihood of meeting his retirement consumption goal if a capital preservation strategy is his only option? He needs additional, precautionary savings. Generally, the less effective the risk management available, the more savings are needed. The value of an effective risk management strategy is that it reduces the need for precautionary reserves.

**WHY THE DIFFERENCE BETWEEN THE TWO APPROACHES?**

Remember, the goal here is a \$1 consumption stream every month for 25 years starting at retirement. At any point in time, this consumption goal is akin to a bond, and it could be replicated using a set of zero-coupon bonds maturing at each planned withdrawal date. This means the cost of the consumption goal today can be

estimated using current interest rates. This estimate can then be used by an investor to convert their account balance now into consumption later. Simply divide the accumulated balance by the cost of the consumption goal.

To construct Exhibit 2, we compute the growth of the T-bill strategy and the LDI strategy over each 10-year period. The LDI strategy is constructed by matching the duration of the consumption stream using a five-year discount bond and a 25-year discount bond. Both the LDI and the T-bill strategy start with the same initial investment (based on the cost of the consumption stream estimated at the beginning of the 10-year period). Then, using prevailing interest rates for every month in the sample, we divide the growth of wealth by the cost of consumption over time. This allows us to see how the estimated consumption stream evolves over the 10-year investment period.

Because the consumption goal is akin to a long-term bond, its cost can change substantially as interest rates change. This implies that a stable account balance, achieved using short-term bonds, can result in a highly volatile consumption stream as shown in Exhibits 1 and 2. Short-term bonds, while appropriate for capital preservation, are risky if the goal is future consumption.

In contrast, the LDI strategy is designed to have the same sensitivity to interest rates as the consumption goal. Because of this design, its value moves in tandem with the cost of the goal. As the cost goes up (down), the value of the portfolio goes up (down) by a similar amount, and the result is a more stable estimated consumption.<sup>4</sup> In Exhibit 2, we used interest rates over the last 50 years to evaluate the performance of the two simulated strategies. Given the variation in interest rates observed in the sample period (see **Exhibit 3**), Exhibit 2 highlights the effectiveness and robustness of the LDI approach in managing risk for the goal as compared to the T-bill strategy.

### TAKEAWAYS

We believe that having the right risk management is crucial to a successful investment experience. As illustrated in Exhibit 2, the wrong risk management makes information about retirement readiness unclear. Tom cannot look at his estimated retirement income under the capital preservation strategy and deduce with any reasonable degree of confidence that he is on track for retirement.

Having the wrong risk management also leads to an inefficient risk/return tradeoff for the goal. Notice that

**Exhibit 3: Nominal Interest Rates**  
January 1962–December 2015



Source: Board of Governors of the Federal Reserve System, Statistical Release H15.

4. For more on the LDI approach see Massi De Santis, "Retirement Planning: An Introduction to Liability Driven Investing" (white paper, Dimensional Fund Advisors, 2016).

because the distribution of outcomes is wider, Tom would need additional savings if using the capital preservation strategy in order to achieve his desired level of consumption with the same likelihood as the LDI strategy. Generally, the more imperfect the hedging instrument used, the greater the amount of savings required to achieve a desired goal. This issue carries over when growth assets are introduced in a

portfolio. Having the right risk management will lead to a more efficient risk/return tradeoff for the goal.

We believe that with a goals-based risk management approach like the LDI strategy, Tom's additional savings can be used to provide for current consumption, invested in growth assets to potentially fund a higher consumption later, or used for other investment goals.

---

This information is provided for registered investment advisors and institutional investors and is not intended for public use. Dimensional Fund Advisors LP is an investment advisor registered with the Securities and Exchange Commission.

For each 10-year rolling sample, we assume: Cost and duration of \$1 nominal consumption stream over time estimated using monthly yield curves. The wealth level at the beginning of the 10-year window (time zero) equals the cost of future consumption starting 10 years ahead, so the estimated consumption equals \$1. At any time "t" after time zero the estimated consumption equals the simulated wealth level divided by the cost of future consumption at time "t". The wealth level is simulated for the LDI strategy and short term debt using returns over each 10 year period: 1962–1972, 1963–1973, ..., 2005–2015.

Nominal returns on the simulated strategies: The simulated LDI strategy uses discount bonds with maturities of 7 and 25 years (constructed from the nominal yield curve), combined to match the duration of the consumption stream. Nominal yield curve from the Federal Reserve Board, statistical release H.15. The simulated short-term debt strategy is represented by returns on one-month Treasury bills, data from Morningstar.

Investing involves risk and possible loss of principal. There is no guarantee strategies will be successful.

Fixed income securities are subject to increased loss of principal during periods of rising interest rates. Fixed income investments are subject to various other risks, including changes in credit quality, liquidity, prepayments, call risk, and other factors. Inflation-protected securities may react differently from other debt securities to changes in interest rates.

A liability-driven investment (LDI) strategy is designed to focus on assets that match future liabilities. LDI strategies contain certain risks that prospective investors should evaluate and understand prior to making a decision to invest. These risks may include, but are not limited to, interest rate risk, counterparty risk, liquidity risk, and leverage risk.

**Simulated data disclosure: Simulations used in this paper are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. Results may vary with each use and over time. These hypothetical incomes are used for discussion purposes only and are not intended to represent, and should not be construed to represent, predictions of future incomes or returns. Actual incomes may vary significantly.**

All expressions of opinion are subject to change. This information is intended for educational purposes, and it is not to be construed as an offer, solicitation, recommendation, or endorsement of any particular security, products, or services.

dimensional.com