

A Feasible Blueprint for Meeting the Challenges of Funding Retirement

Robert C. Merton, School of Management Distinguished Professor of Finance,
MIT Sloan School of Management, Resident Scientist, Dimensional Holdings, Inc.

2019

Robert Merton provides consulting services to Dimensional Fund Advisors LP, in his capacity as Resident Scientist of Dimensional Holdings Inc. This document is deemed to be issued by Robert Merton in his capacity as School of Management Distinguished Professor of Finance at the Massachusetts Institute of Technology. For institutional use and for informational purposes only. Not for use with the public. Not for redistribution.

Global Challenges to Retirement Funding

Employee's Responsibility

Don't know how much to save and have limited investment knowledge

Retirement Income Uncertainty

Need an income goal and risk management of that goal

Product Indecision

Difficulty deciding between solutions – guarantees vs liquidity

Increasing Longevity

Savings need to last longer

What is a Good Retirement Goal?

“An inflation-protected income for life that allows you to sustain the standard of living you enjoyed in the latter part of your working life.”

Key Design Principals to Achieve a Good Retirement

1

Set **replacement income** as the goal for retirement

2

Address risks relevant to the goal: **income shortfall**, not return volatility

3

Deliver an asset allocation strategy to manage **retirement income risk**

4

Make efficient use of all **dedicated retirement assets**

5

Offer **personalization** based on one's retirement account characteristics

6

Take account of changes in both **market and personal** circumstances

7

Be **effective** even for those who are **completely unengaged**

8

Supply **only meaningful information** and offer **actionable choices** to improve outlook

9

Offer **robust, scalable and low cost** investment strategies

10

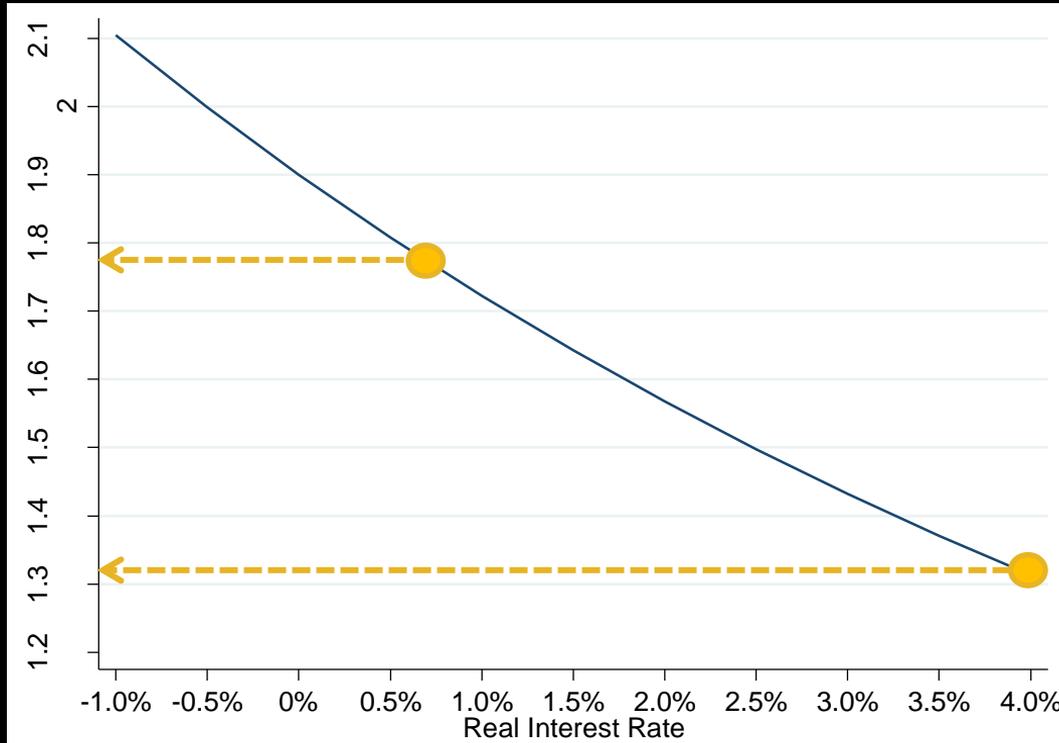
Offer **seamless transition** and **payout flexibility** at retirement

How is this Approach Different?

	Conventional Approach	New Approach
Investment goal	Wealth accumulation <i>No specified wealth goal</i>	Retirement income <i>Specified desired income goal</i>
Risk measure	Volatility of portfolio returns	Volatility of funded ratio <i>Income shortfall</i>
Success measure	Account balance size	Funded ratio <i>Relative to desired income goal</i>
Asset allocation strategy	Generic proportions <i>(Fixed or age-only based)</i>	Dynamic individualised <i>Based on age, income, funded ratio; focused on improving ratio</i>

Effect of Interest Rate Level on Retirement Funding

Hypothetical price of \$100,000 per year inflation-protected life income beginning at age 65



The cost of income moves with changing interest rates

From Wealth to Income

S&P STRIDE: The cost of Income Overtime



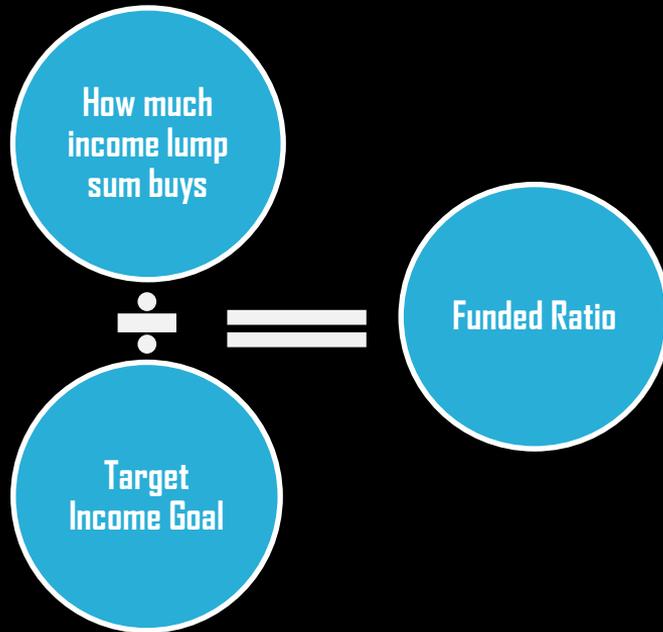
Cost of Income data from S&P Dow Jones Indices. See "S&P STRIDE Index Series Description and Disclosures" and "S&P Stride Index Series Hypothetical Performance Disclosure" in Appendix. Interest rates represented by the 10-year par yield published by the Federal Reserve System, statistical release H15.

Retirement Income vs Wealth Accumulation

Age now	Decline in Retirement Income (Funded Ratio) Between Highest Rate and Lowest Rate 2003-2016
65	-26%
60	-39%
55	-50%
50	-58%

- Large impact from interest rate changes
- US TIPS 10-year rates ranged between - 0.8% to 3.1% (2003-2016)
- This raises the cost of life income benefit
- As cost rises, the funded ratio falls

Retirement Income vs Wealth Accumulation



- Average duration needed to hedge an immediate life annuity is about 15 years
- DB managers and plan sponsors focus on the funded ratio in measuring success
- DC managers and regulators often emphasize wealth (price) over retirement income volatility
- To correct this, DC rules should report the funded ratio and its change

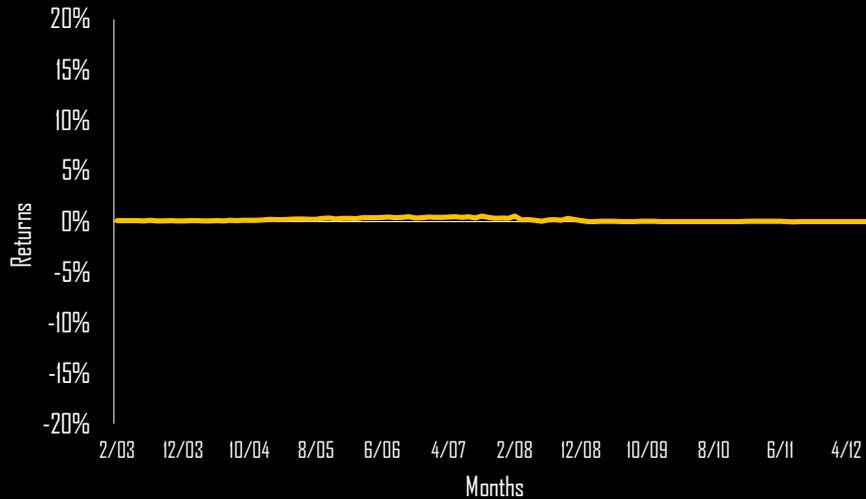
Wealth Preservation vs Income Preservation

Using the suitable hedging asset given the goal

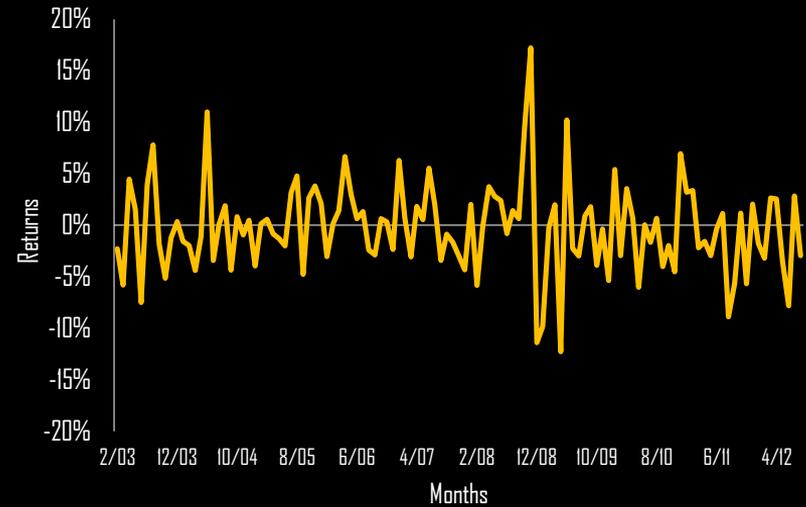
The volatility of T-bills is minimum risk when looking at it as an asset value

But it is high risk measured in income (funded-ratio units)

3-MONTH US T-BILL (USD)



3-MONTH US T-BILL (FUNDED-RATIO UNITS)



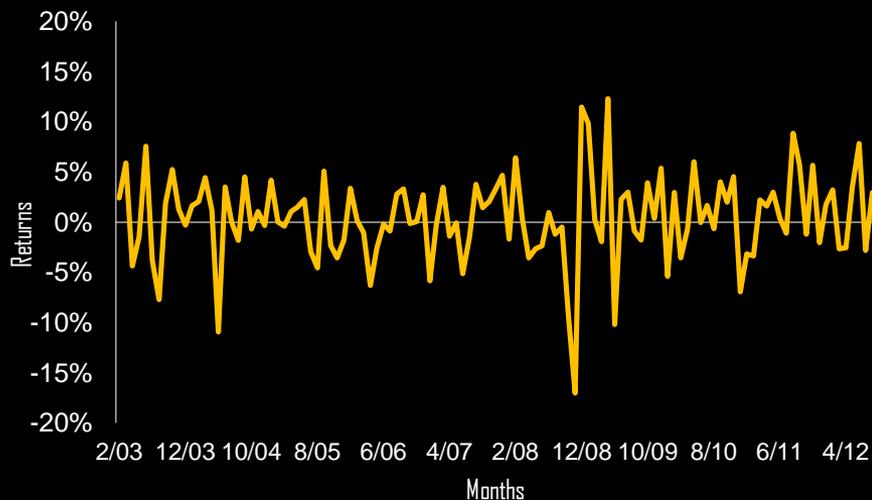
Income Goal Needs Different Risk Measure

Using the suitable hedging asset given the goal

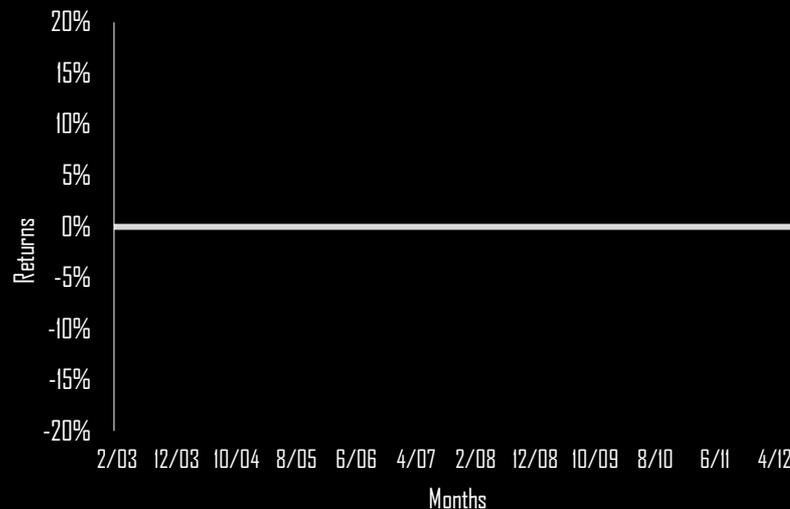
The volatility of life-income price is high risk when measured in terms of asset value.

The volatility of life-income price is minimum risk when measured in terms of income

DEFERRED LIFE INCOME (USD)



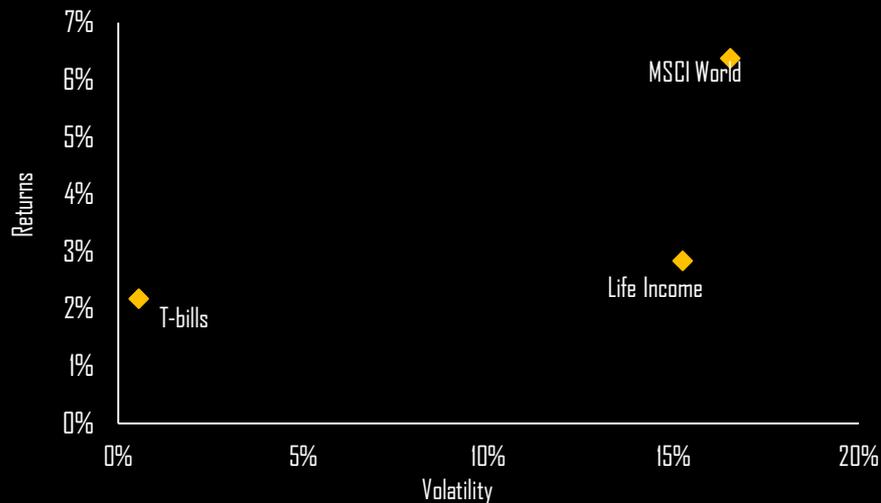
DEFERRED LIFE INCOME (FUNDED-RATIO UNITS)



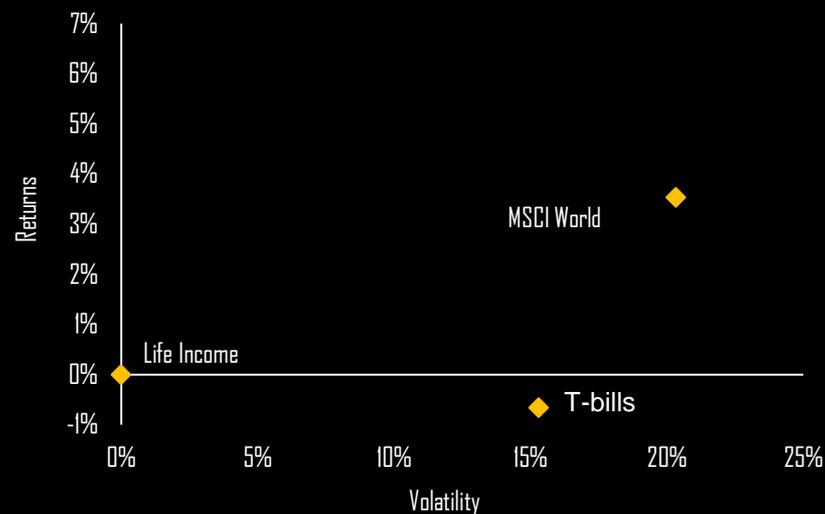
Risk & Return: Wealth vs Income Goal

Measuring the risk/return trade-off correctly

US DOLLARS



FUNDED-RATIO INCOME UNITS



Building the Solution

The Starting Point for Any Asset Allocation Strategy is its Goal

Glide Path

Apply lifecycle theory to consider the evolution of human capital and financial capital, where the investment strategy gradually grows more conservative over time.

Asset Classes

Offer a combination of assets that provide reasonable growth through diversified exposure to equities and the income risk management hedging asset.

Income Risk Management

Identify the balance of assets designed to reduce uncertainty relative to a member's goal for future retirement income.

Optimal Allocation Requires Integration of Sources

Create a personal balance sheet for each members that integrates all funding sources of retirement income.

ASSETS

Defined-Contribution Pension Plan

Defined-Benefit Pension Plan

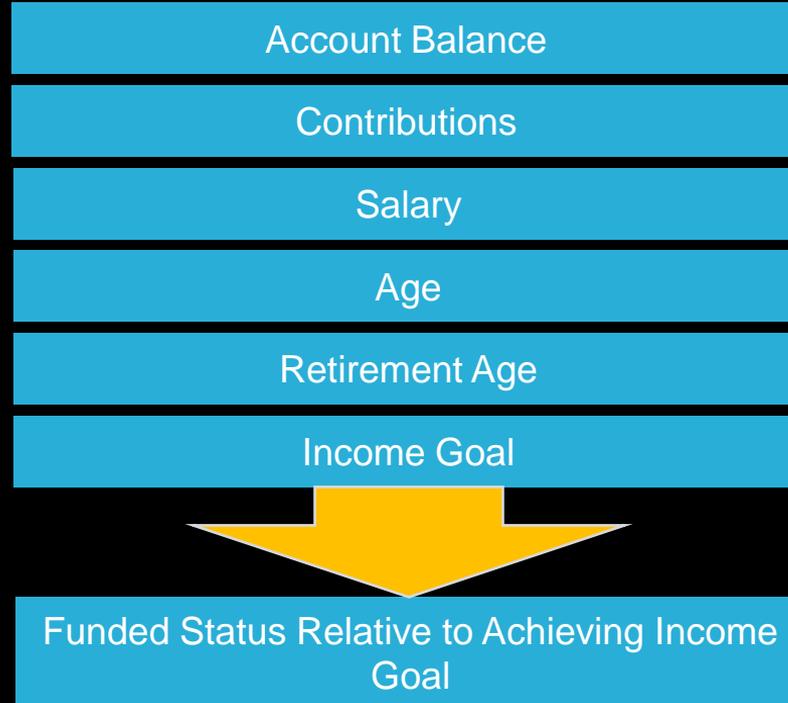
Government Minimum Pension

Projected Future Contributions
("Human Capital")

LIABILITIES

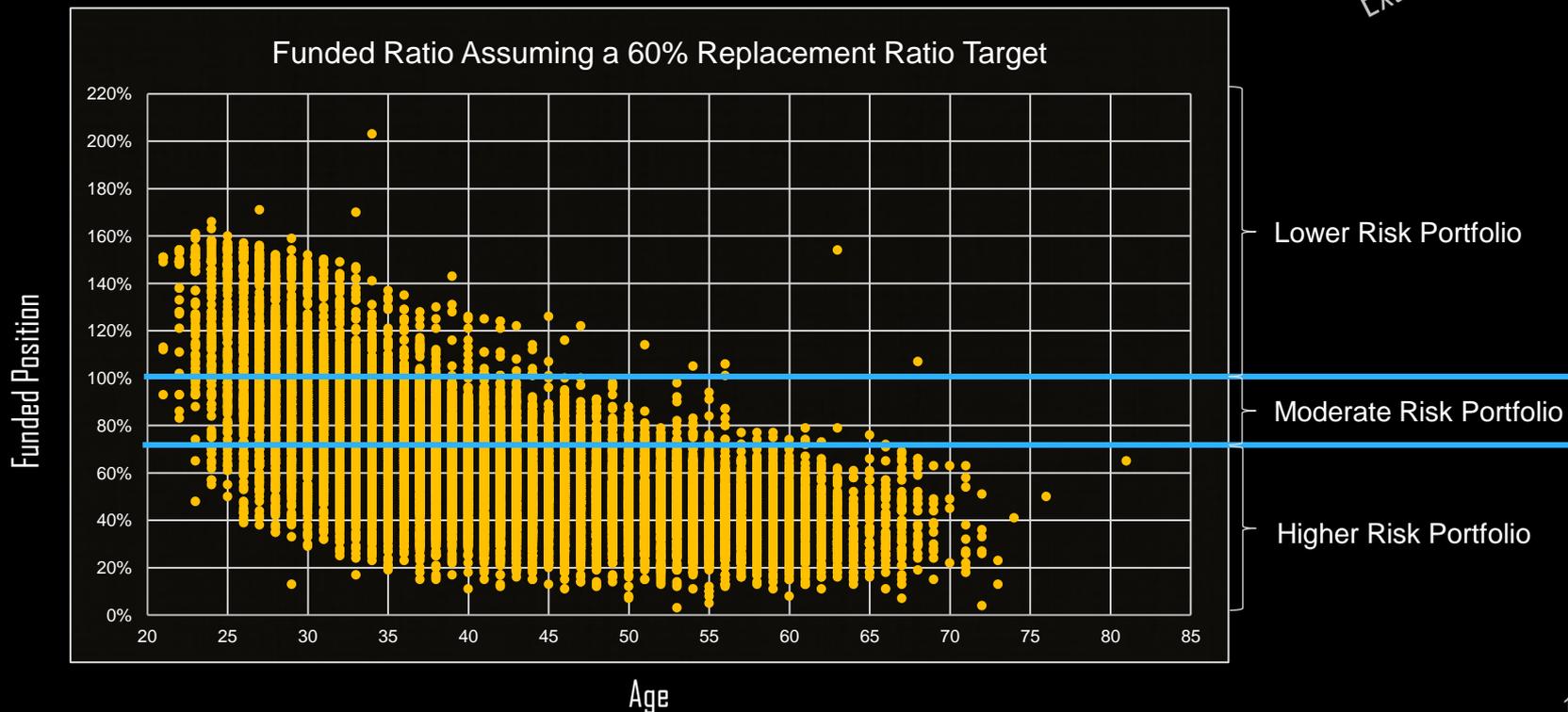
Retirement Income Goal

Customization of Dynamic Asset Allocation Based on Individual Circumstances



Members Receive a More Tailored Experience Based on How Close or Far Away They Are From Achieving Their Income Goal

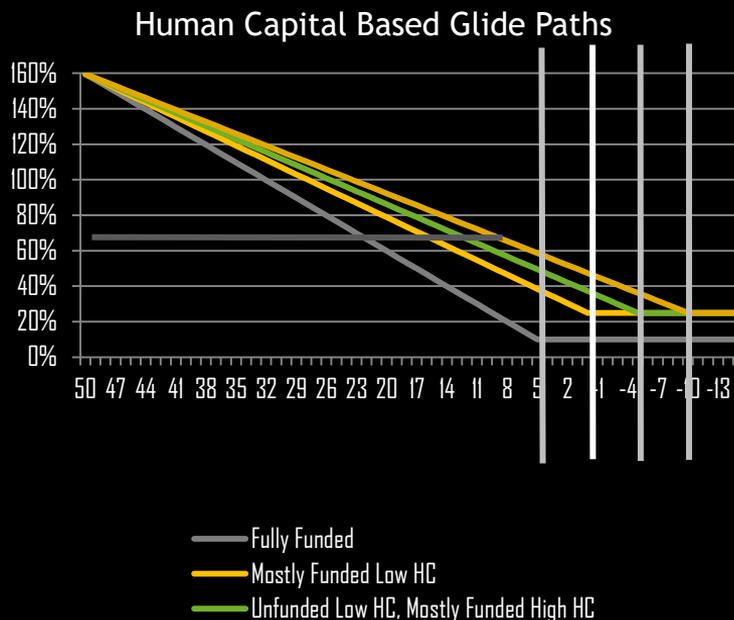
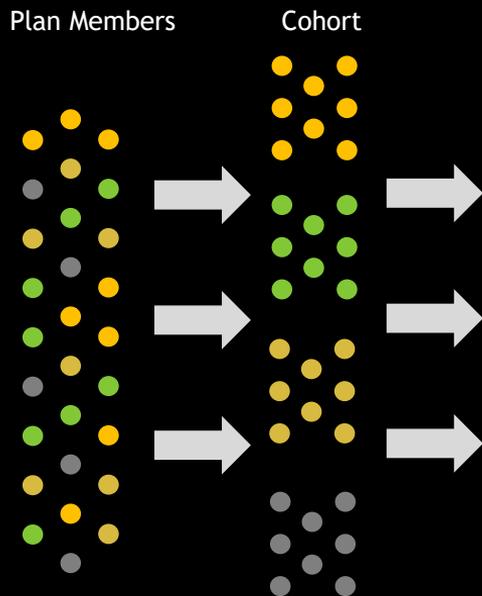
Example



Assessment of Member Dynamic Portfolio Allocation Driven by Changes in Market and Individual Circumstances

Allocation Based on Both Funding Ratio ("FR") and Human Capital ("HC")

Example



Once Engaged Only Provide Meaningful Information and Meaningful Choices: The Four Ways to Improve the Probability of a Good Retirement

1. **Save more** for retirement → lower lifetime consumption level
2. **Work longer** before retiring → shorter retirement time
3. Take more **investment risk** → face the consequences if that risk is realized
4. Improve the **income benefits** from accumulated retirement assets → annuities and equity-extraction from the house

Improving expected returns for the same risk is always desirable, as is lowering costs for the same service or choice options

Post-Accumulation Flexible Spend-Down Strategies

These four components can be customised to individual needs

1

Guaranteed income for life

- Annuity
- Age Pension
- DB Pension

2

Conservative draw-down (minimum-risk income)

- Not guaranteed
- No longevity protection
- Provides liquidity
- Room for bequests

3

Desired income growth goal

- Targeted increase in income starts at specified date in retirement
- Invest in risk asset

4

Longevity insurance

- Deferred annuity

Key Features



Speaker Profile

Robert C. Merton is the School of Management Distinguished Professor of Finance at the MIT Sloan School of Management and John and Natty McArthur University Professor Emeritus at Harvard University. He was the George Fisher Baker Professor of Business Administration (1988–98) and the John and Natty McArthur University Professor (1998–2010) at Harvard Business School. After receiving a PhD in Economics from MIT in 1970, Merton served on the finance faculty of MIT's Sloan School of Management until 1988 at which time he was J.C. Penney Professor of Management. He is currently Resident Scientist at Dimensional Holdings, Inc., where he is the creator of Target Retirement Solution, a global integrated retirement-funding solution system.

Merton received the Alfred Nobel Memorial Prize in Economic Sciences in 1997 for a new method to determine the value of derivatives. He is past president of the American Finance Association, a member of the National Academy of Sciences, and a Fellow of the American Academy of Arts and Sciences.

Merton has also been recognized for translating finance science into practice. He received the inaugural Financial Engineer of the Year Award from the International Association for Quantitative Finance (formerly International Association of Financial Engineers), which also elected him a Senior Fellow. He received the 2011 CME Group Melamed-Arditti Innovation Award and the 2013 WFE Award for Excellence from World Federation of Exchanges. A Distinguished Fellow of the Institute for Quantitative Research in Finance ('Q Group') and a Fellow of the Financial Management Association, Merton received the Nicholas Molodovsky Award from the CFA Institute. He is a member of the Halls of Fame of the Fixed Income Analyst Society, Risk, and Derivative Strategy magazines. Merton received Risk's Lifetime Achievement Award for contributions to the field of risk management and the 2014 Lifetime Achievement Award from the Financial Intermediation Research Society. He received the 2017 Finance Diamond Prize from Fundación de Investigación, IMEF.

Merton's research focuses on finance theory, including lifecycle and retirement finance, optimal portfolio selection, capital asset pricing, pricing of derivative securities, credit risk, loan guarantees, financial innovation, the dynamics of institutional change, and improving the methods of measuring and managing macro-financial risk. Merton received a BS in Engineering Mathematics from Columbia University, a MS in Applied Mathematics from California Institute of Technology, and a PhD in Economics from Massachusetts Institute of Technology and honorary degrees from nineteen universities.
<http://robertcmerton.com/>

S&P STRIDE Index: Description Disclosures

In response to the need for income-focused benchmarks within defined contribution plans, on January 11, 2016 S&P Dow Jones Indices (S&P DJI) launched the S&P Shift to Retirement Income and Decumulation (STRIDE) Index Series.¹

The series features multi-asset class income-based indices tied to target retirement dates. Dimensional Fund Advisors worked collaboratively with S&P DJI to develop the glide path, inflation hedging, and duration hedging techniques used in these indices.

INDEX SERIES DESCRIPTION

The S&P Shift To Retirement Income and Decumulation (STRIDE) Index Series comprises twelve multi-asset class indices, each corresponding to a particular target retirement date. The asset allocation for each index in the series is based on a predetermined life-cycle glide-path. Each index is fully investable, with varying levels of exposure to equities, nominal fixed income securities and inflation-adjusted bonds.

The S&P STRIDE Index Series represents a strategy that builds a portfolio of assets to support a hedged stream of inflation-adjusted retirement income. The indices also provide a new framework for benchmarking target date funds that focus on delivering similar results. The indices are individually composed of asset class indices (an index of indices), and the index series includes target date years in five-year increments (vintages). Each index vintage covers a full life cycle of accumulation (during what are generally considered working years), and decumulation in retirement years. Beginning 20 years before each target date, the indices gradually re-allocate some of their weight from accumulation constituents to inflation-adjusted income constituents. This process is analogous to dollar cost averaging into income producing assets. The income portion consists of a duration-hedged combination of Treasury Inflation Protection Securities (TIPS) indices. The duration of the combined TIPS indices is matched monthly to the duration of a hypothetical retirement income cash flow stream that begins at the target date and lasts for twenty five years.

FOR MORE INFORMATION

General: <http://us.spindices.com/index-family/multi-asset/sp-stride>

Index Series Methodology: http://us.spindices.com/documents/methodologies/methodology-sp-stride-index-series.pdf?force_download=true

Example and more data: <http://us.spindices.com/indices/multi-asset/sp-stride-glide-path-2005-index-total-return>

The S&P STRIDE INDEX is a product of S&P Dow Jones Indices LLC or its affiliates ("SPDJI"), and has been licensed for use by Dimensional Fund Advisors LP ("Dimensional"). Standard & Poor's® and S&P® are registered trademarks of Standard & Poor's Financial Services LLC ("S&P"); Dow Jones® is a registered trademark of Dow Jones Trademark Holdings LLC ("Dow Jones"); these trademarks have been licensed for use by SPDJI and sublicensed for certain purposes by Dimensional. Dimensional's Products, as defined by Dimensional from time to time, are not sponsored, endorsed, sold, or promoted by SPDJI, S&P, Dow Jones, or their respective affiliates, and none of such parties make any representation regarding the advisability of investing in such products nor do they have any liability for any errors, omissions, or interruptions of the S&P STRIDE Index.

Dimensional Fund Advisors LP receives compensation from S&P Dow Jones Indices in connection with licensing rights to S&P STRIDE Indices.

S&P STRIDE Index: Hypothetical Performance Disclosures

S&P STRIDE (the "Index") was launched on January 11, 2016. All information presented prior to the launch date is back-tested. Back-tested performance is not actual performance, but is hypothetical. The back-test calculations are based on the same methodology that was in effect when the index was officially launched. Complete index methodology details are available at www.spdji.com. It is not possible to invest directly in an index.

S&P Dow Jones Indices defines various dates to assist clients in providing transparency on their products. The First Value Date is the first day for which there is a calculated value (either live or back-tested) for a given index. The Base Date is the date at which the Index is set at a fixed value for calculation purposes. The Launch Date designates the date upon which the values of an index are first considered live; index values provided for any date or time period prior to the index's Launch Date are considered back-tested. S&P Dow Jones Indices defines the Launch Date as the date by which the values of an index are known to have been released to the public, for example via the company's public website or its datafeed to external parties. For Dow Jones-branded indices introduced prior to May 31, 2013, the Launch Date (which prior to May 31, 2013, was termed "Date of introduction") is set at a date upon which no further changes were permitted to be made to the index methodology, but that may have been prior to the Index's public release date.

Past performance of the Index is not an indication of future results. Prospective application of the methodology used to construct the Index may not result in performance commensurate with the back-test returns shown. The back-test period does not necessarily correspond to the entire available history of the Index. Please refer to the methodology paper for the Index, available at www.spdji.com for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations.

Another limitation of using back-tested information is that the back-tested calculation is generally prepared with the

benefit of hindsight. Back-tested information reflects the application of the index methodology and selection of index constituents in hindsight. No hypothetical record can completely account for the impact of financial risk in actual trading. For example, there are numerous factors related to the equities, fixed income, or commodities markets in general which cannot be, and have not been accounted for in the preparation of the index information set forth, all of which can affect actual performance.

The Index returns shown do not represent the results of actual trading of investable assets/securities. S&P Dow Jones Indices LLC maintains the Index and calculates the Index levels and performance shown or discussed, but does not manage actual assets. Index returns do not reflect payment of any sales charges or fees an investor may pay to purchase the securities underlying the Index or investment funds that are intended to track the performance of the Index. The imposition of these fees and charges would cause actual and back-tested performance of the securities/fund to be lower than the Index performance shown. As a simple example, if an index returned 10% on a US \$100,000 investment for a 12-month period (or US \$10,000) and an actual asset-based fee of 1.5% was imposed at the end of the period on the investment plus accrued interest (or US \$1,650), the net return would be 8.35% (or US \$8,350) for the year. Over a three year period, an annual 1.5% fee taken at year end with an assumed 10% return per year would result in a cumulative gross return of 33.10%, a total fee of US \$5,375, and a cumulative net return of 27.2% (or US \$27,200).