



Adding the Income Dimension

By Peng Chen and James X. Xiong¹

A new framework allows advisors to fully examine a portfolio's sustainable income levels and the risks of it coming up short.

The large number of soon-to-be retiring baby boomers. The paradigm shift away from defined benefit pensions to defined contribution pensions. Long life expectancies. Uncertainty surrounding Social Security benefits. No wonder retirees face such tough decisions about retirement spending.

Many retirees who must rely on their own personal savings in retirement seek out help from financial advisors to manage their portfolio in the retirement-income phase. And those advisors traditionally have developed asset-allocation portfolios by constructing efficient portfolios for various risk levels based on mean variance efficient frontier (MVO).² Depending on a retiree's risk tolerance, the advisor chooses one of the efficient portfolios in which to place the client's savings. After that, both advisor and client hope for the best.

We think there is a better way.

The key consideration is the recognition that retirement investors care more about income than about portfolio returns. But MVO only considers a portfolio's risk-return trade-off in terms of returns; it does not consider the risk-return trade-off of the retiree's main concern—a portfolio's ability to generate sustainable income streams. Although MVO is widely accepted in academic and finance circles as the golden standard for developing

asset allocations, its effectiveness in retirement-income planning is inherently limited.

To more effectively evaluate the risk-reward trade-off of retirement-income patterns generated by different portfolios, we developed a new retirement-income efficient frontier framework to complement the traditional MVO framework.³ In this new setting, we can fully examine a portfolio's sustainable income levels and the risks of it coming up short. We can also evaluate the roles of various asset classes and investment strategies, such as principal-protected equity-linked CD products and variable annuities with lifetime guarantee minimum withdrawal benefits (VA+GMWB).

A New Retirement Framework

A traditional efficient frontier consisting of stocks and bonds only considers the risk-return trade-off in portfolio returns, not the portfolio's ability to generate sustainable income levels. In addition, as our earlier research found, it does not consider one of the major risks that investors face during retirement—longevity.

On the other hand, the downside protections offered in some new investment strategies—such as principal-protected strategies and VAs with lifetime GMWB—imply a skewed income and return distribution in the corresponding combined portfolios.

The Traditional Mean-Variance Frontier



Our new efficient frontier framework is able to account for these considerations, because the new retirement-income efficient frontier is generated using a Monte Carlo simulation technique.⁴ Hence, we can model these unique distribution properties in the analysis and not be restricted to the traditional mean and variance measures. We believe that the combination of the traditional MVO and the new retirement-income efficient frontier is much more effective in evaluating retirement-income portfolios.

The new retirement-income efficient frontier is established using average sustainable income versus shortfall income level against the target income level. The average sustainable income level is the annual income that can be sustained at the 50th percentile over the target horizon (e.g., 30 years). More precisely, it is the median sustainable income level.

The shortfall income risk is defined as the shortage of income compared to a target income at the fifth percentile for the same given investment horizon. The fifth percentile is chosen to represent the “worst” market performance scenario for the portfolio. This shortfall income risk is closely related to the well-known value-at-risk (VAR) concept, which has emerged as one of the financial industry’s premier risk-management techniques. VAR is an estimate of the loss that we expect to be exceeded with a given level of probability (e.g., 5%) over a specified time period. Likewise, shortfall income provides valuable information about the tail of the retirement-income distribution, which effectively captures the option features embedded in investment strategies, such as VA+GMWB.

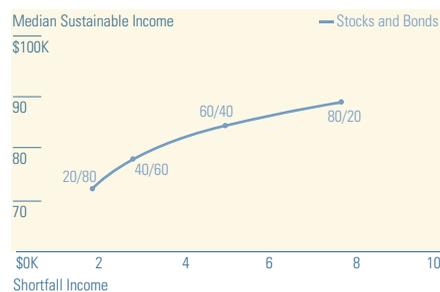
These two income measurements depict a more complete picture than the traditional efficient frontier.⁵ The other key advantage of the new efficient frontier is that it is customized to each individual investor’s financial circumstance, time horizon, target income level, portfolio risk level, and retirement portfolio balance. This advantage is essential. The retirement circumstances of any individual are unique—his or her portfolio analysis should reflect that.

In this study, we made the following assumptions to form the case studies:

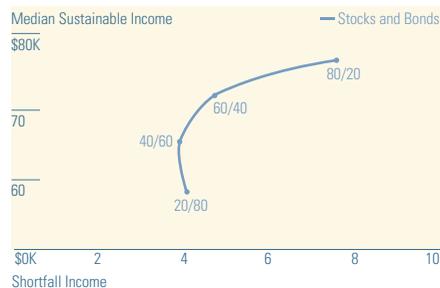
- ▶ Retirement age: 65.
- ▶ Retirement time horizons: 20 and 30 years.
- ▶ Target income level: \$50,000 for 30-year horizon; \$60,000 for 20-year horizon.
- ▶ Initial retirement portfolio balance at age 65: \$1 million.
- ▶ VA allocation: 80% assets in stocks and 20% in bonds.
- ▶ Fees of asset classes and investment strategies: based on industry average in Morningstar database.

To connect to the original efficient frontier, we took the four model portfolios (conservative, moderate conservative, moderate, and moderate aggressive) from the original mean

Retirement-Income Efficient Frontier, 20-Year Horizon



Retirement-Income Efficient Frontier, 30-Year Horizon



variance efficient frontier and plotted them in the retirement-income efficient frontier.

For the 20-year horizon, the conservative 20% stock/80% bond portfolio generates a median income level of roughly \$70,000 with a shortfall risk level about \$2,000 (target income is \$60,000). For the 30-year horizon, the conservative 20/80 portfolio generates a median income level of roughly \$60,000 with a shortfall level of \$4,000 (target income is \$50,000). In fact, the 20/80 portfolio in the 30-year horizon is inferior to the more aggressive 40% stock/60% bond portfolio using the median sustainable income and shortfall risk measures. And it is no longer on the efficient frontier; the 40/60 portfolio generates a higher amount of sustainable income with less shortfall risk level. This is because the portfolio needs to generate enough return to sustain the income levels for a longer horizon. Therefore, the most conservative portfolio with most allocation to

A New Frontier

The standard efficient frontier does not consider two dimensions crucial to retirement income: average sustainable income and shortfall income. To more effectively evaluate the risk-reward trade-off of retirement-income patterns, a new efficient frontier for retirement income had to be created. Ibbotson’s new frontier is now able to:

- ▶ Model investment strategies that offer nontraditional payoff distributions, such as principal-protected products and VA+GMWB.
- ▶ Consider each individual investor’s own financial circumstances, such as target income level and investment time horizon.

fixed income is not able to generate required returns to meet the income target.

The traditional mean-variance efficient frontier and the retirement-income efficient frontier share some similarities. Stock portfolios dominate the upper part of both efficient frontiers; bond portfolios dominate the lower part. In other words, stock portfolios are able to generate higher median income than bond portfolios, but typically with higher shortfall risk. Yet the two efficient frontiers are also different. The retirement-income efficient frontier and portfolio efficiency depend not only on return and risk, but also on the horizon and target income amount. The traditional efficient frontier, meanwhile, does not consider the portfolio balance or target income.

Modeling Nontraditional Payoff Distributions

One advantage of the new efficient frontier is the ability to model investment strategies that offer nontraditional payoff distributions, such as principal-protected products and VA+GMWB.

In this section, we analyze the impact of adding these nontraditional investment strategies into retirement-income portfolios on the sustainable median and shortfall income levels.



A principal-protected strategy offers investors the ability to participate in the upside of the equity market, with downside protection that guarantees the return of principal after a certain investment period.⁶ In exchange for the downside protection, investors give up some upside and liquidity for a period of time or pay an annual fee.

Retirement-Income Efficient Frontier with Principal Guaranteed Products, 20-Year Horizon



Intuitively, we'd expect that the impact of a principal guarantee product would most significantly be felt on the conservative portfolios on the lower end of the efficient frontier, because of these products' ability to improve the returns of conservative portfolios without causing principal losses. We reallocated some of the fixed-income allocations in each of the four model portfolios to equity-linked CDs (ELCD). The figure above shows that the portfolios with allocations to principal-protected strategies are able to provide higher median income with slightly higher shortfall risk for conservative (20/80) and moderate conservative (40/60) portfolios.

A VA+GMWB gives investors the ability to protect their retirement investments against downside market risk by allowing them to withdraw a fixed percentage (5%, in this paper) of the benefits base each year until death. The best aspect of this guarantee is that it protects annuitants against any nominal investment losses that would have been incurred without losing the benefit of upside gain. In exchange for this benefit, the annuitant pays an annual fee of 0.3% to 0.7%.

For a standalone VA+GMWB, the shortfall income is \$0 because the income is at least 5% of the initial investment of \$1 million (\$50,000). For the conservative 20/80 portfolio with the 30-year horizon, the income is only \$45,956 at the fifth percentile; thus, the shortfall income is \$4,044 (\$50,000 - \$45,956). However, in a combined 20/60/20 portfolio (the fixed-income allocation of 20% was replaced by 20% VA+GMWB in the conservative portfolio), the shortfall income declined to \$2,642.

Retirement-Income Efficient Frontier with VA+GMWB, 30-Year Horizon



The figure above shows that the three combined portfolios (20/60/20, 40/45/15, and 60/30/10) have higher average income levels than stand-alone traditional mutual fund portfolios. For conservative (20/80) and moderate conservative (40/60) portfolios, additions of VA+GMWB even lead to a reduction in shortfall income risk due to the guaranteed income feature in the VA+GMWB. In other words, adding VA+GMWB to the conservative and moderate conservative model portfolios enhances average income and reduces shortfall risk for investors needing roughly 5% from their portfolios to sustain retirement income for 30 years or more.⁷

Conclusion

Our new efficient frontier for retirement income has two dimensions: average sustainable income and shortfall income for a given horizon. The shortfall income risk captures the tail of the retirement-income distribution, similar to value-at-risk, which captures the tail loss for return distributions. Therefore, the new income frontier is able to incorporate both longevity

analysis and investment strategies with embedded options that provide nontraditional payout distribution. In addition, the new efficient frontier is able to take each individual investor's own financial circumstance into consideration, such as target income level and investment horizon.⁸

Because of these advantages, we believe that the new efficient frontier, used together with the traditional mean-variance efficient frontier, is more effective for helping financial advisors analyze the appropriate portfolio allocation for retirement-income purposes than the traditional mean-variance frontier alone. ■■■

Peng Chen, Ph.D., CFA, is president and chief investment officer of Ibbotson Associates.

James X. Xiong is a research consultant at Ibbotson.

Footnotes

- 1 This article is a version of the February 2008 Ibbotson Associates working paper "New Efficient Frontier for Retirement Income Portfolios." Please refer to the working paper for more details. The authors would like to thank Kevin Zhu, Thomas Idzorek, Roger Ibbotson, and Moshe A. Milevsky.
- 2 Harry Markowitz, "Portfolio Selection," *Journal of Finance*, September 1952, pp.77-91.
- 3 This new retirement efficient frontier framework is an extension of the work by Peng Chen and Moshe A. Milevsky, "Merging Asset Allocation and Longevity Insurance: An Optimal Perspective on Payout Annuities," *Journal of Financial Planning*, (June 2003): 64-72; and Peng Chen, Roger G. Ibbotson, Moshe A. Milevsky, and Ken X. Zhu, "Lifetime Financial Advice," CFA Institute Research Foundation Monograph (2007).
- 4 We run 5,000 simulation runs for each analysis.
- 5 We can also gauge the risk-reward trade-off of the portfolio using other measures instead of median income and shortfall level. The results are similar.
- 6 The principal-protected product is conceptually similar to buying a put on a portfolio. In this paper, we analyze an equity-linked CD product that matches the return of S&P 500 index price return and guaranteed principal return in seven years.
- 7 Investors needing much higher or much lower percentage of withdrawal from their portfolio to sustain retirement income would still benefit from including VA+GMWB; however, the benefit might not be as much as those illustrated in this paper.
- 8 The analysis here is based on nominal dollars; we also conducted inflation-adjusted studies in the full paper. The results are similar.