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# Optimizing Retirement Income Solutions in Defined Contribution Retirement Plans

A Framework for Building Retirement Income Portfolios

Dr. Wade Pfau

Joe Tomlinson, FSA, CFP®

Steve Vernon, FSA

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## Stanford Center on Longevity (SCL)

The mission of the Stanford Center on Longevity is to redesign long life. The Center studies the nature and development of the human life span, looking for innovative ways to use science and technology to solve the problems of people over 50 in order to improve the well-being of people of all ages. Additional information and research reports may be found at:

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## Society of Actuaries (SOA) Committee on Post-Retirement Needs and Risks

The Society of Actuaries is an educational and research organization for actuaries. The Society of Actuaries would like to acknowledge the work of its Committee on Post-Retirement Needs and Risks for its role in this research. The Committee's mission is to initiate and coordinate the development of educational materials, continuing education programs and research related to risks and needs during the post-retirement period. Individuals interested in learning more about the committee's activities are encouraged to contact the Society of Actuaries at 847-706-3500 for more information. Additional information and research reports may be found at:

<https://www.soa.org/research/research-projects/pension/research-post-retirement-needs-and-risks.aspx>

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This report displays the values graphically. For tables of the numbers underlying the graphs for Phases 1 and 2, visit:

- <http://longevity3.stanford.edu/phase1.htm>
- <http://longevity3.stanford.edu/phase2.htm>

# OVERVIEW AND PROJECT GOALS

We believe the next step in the transition from defined benefit to defined contribution (DC) retirement plans is for DC plans to offer retirement income programs that retirees can use to convert their account balances to periodic retirement income\*. This will help improve financial outcomes and retirement security for workers, and helps employers better manage an aging workforce by enabling workers to plan more effectively and confidently for retirement.

This report helps plan sponsors, advisors, and retirees achieve these goals by demonstrating an analytical framework and criteria for helping them evaluate and compare a variety of possible retirement income solutions. Our goal is to further understanding of how to use various retirement income generators (RIGs) to meet specific retirement planning goals.

Over the last 50 years, modern portfolio theory has been developed to analyze, allocate, and select investments for constructing diversified investment portfolios. We build on this substantial framework by applying portfolio concepts and terms to the drawdown phase, to help construct diversified portfolios of retirement income.

*We support constructing diversified retirement income portfolios that meet a retiree's unique goals and circumstances, allocating savings among common retirement income classes.*

Many retirees and practitioners do not use a diversified portfolio approach for developing retirement income strategies. In many situations, commonly available RIGs are overlooked or not considered. Some practitioners only offer strategies that are familiar to them or restrict themselves to solutions that are offered by specific financial institutions, while others rely on impressions or rudimentary analyses. To address the challenge of generating retirement income from savings, we're inspired by the motto of the Society of Actuaries:

*"The work of science is to substitute facts for appearances and demonstrations for impressions."*  
– John Ruskin

The specific goals of this project are to:

- Inform plan participants, plan sponsors, and advisors about a portfolio approach to developing retirement income strategies. Retirees would diversify their savings among a handful of RIGs that each have distinct characteristics and meet different goals and objectives. Retirees would strike a thoughtful balance between different risk/reward goals that are expressed in terms of retirement income.
- Recommend that DC retirement plan sponsors conduct a disciplined and organized approach for developing and implementing a retirement income program. An important part of this effort is to articulate the criteria for selecting the retirement income generators (RIGs) and retirement income solutions that will be offered in their plans or through facilitated IRA rollovers. This report provides examples for DC plan sponsors and advisors to consider.
- Illustrate an analytical framework using stochastic forecasts and efficient frontiers that will help retirees and their advisors make informed retirement income allocation decisions. This framework analyzes outcomes for three hypothetical retirees to help identify the RIGs or combination of RIGs that could be considered optimal according to specified criteria. DC plan sponsors can use such a framework for building retirement income strategies using a portfolio approach.

\*"Retirement income" as used in the report includes distributions from DC retirement plans, and is not to be confused with dividend or interest income from stocks and bonds.

This project follows up our prior SCL/SOA report that analyzed the characteristics of stand-alone RIGs: *The Next Evolution in Defined Contribution Retirement Plans: A Guide for DC Plan Sponsors to Implementing Retirement Income Programs*.<sup>1</sup>

This project has four phases. Phase 1 develops the framework for using a portfolio approach to developing retirement income strategies, and establishes a baseline for comparing to future phases. Phases 2, 3 and 4 analyze more complex retirement income solutions than Phase 1, to determine if the additional complexity improves projected outcomes and can be justified by the potential to deliver more favorable results.

Here are details on the solutions analyzed under each phase:

- Phase 1 develops the framework for constructing diversified retirement income portfolios. It analyzes RIGs that can currently be offered in DC retirement plans and are straightforward to implement.
- Phase 2 examines solutions that use retirement savings to enable delaying Social Security benefits.
- Phase 3 reviews solutions that combine qualified longevity annuity contracts (QLACs) with systematic withdrawals.
- Phase 4 analyzes solutions that protect retirement income in the period leading up to retirement with deferred income annuities and guaranteed lifetime withdrawal benefits (GLWBs).

Interim reports have been prepared for each phase and can be found on the SCL and SOA websites, as follows:

- <http://longevity3.stanford.edu/optimal-retirement-income-solutions-in-defined-contribution-retirement-plans/>
- <https://www.soa.org/Research/Research-Projects/Aging/optimal-retirement-income-solutions.aspx>

This report integrates the findings and conclusions from the Interim Reports, to help plan sponsors and their advisors consider the various goals, RIGs, and retirement income solutions that were analyzed in all four phases. This report references the analyses from the interim reports, but does not replicate all of these analyses. The Interim Reports provide many more details on our analyses for all four phases and should be used in conjunction with this report.

Appendix A contains a definition of certain terms used in this report. Appendices B, C, and D describe the assumptions and methods used for our analyses.

# EXECUTIVE SUMMARY OF RESULTS AND CONCLUSIONS

One of the biggest retirement planning challenges for workers is deciding if they have accumulated sufficient retirement savings in order to retire. To address this challenge, we suggest that retirees deploy a significant portion of their savings to generate reliable retirement income to meet their ongoing living expenses, and set aside the remainder of savings for unexpected emergencies, discretionary expenditures, and significant one-time purchases.

With this strategy, an important retirement planning task is to build reliable sources of income to partially or fully replace a worker's paycheck from employment. While they're working, their regular paycheck imposes a financial discipline that guides their spending for basic and discretionary living expenses. It's natural and familiar for retirees to continue the discipline of a regular paycheck once they've retired.

*This report develops a framework and analyses that can be used for optimizing retirement income solutions, using criteria defined by retirees and advisors.*

Deciding how to deploy savings to generate retirement income, and estimating the amount of savings that is needed to generate target amounts of retirement income, is a task that is beyond the interest or skill of many retirees. *The Next Evolution*<sup>1</sup> SCL/SOA report showed that DC plan sponsors can help retirees develop reliable retirement income solutions by:

- Conducting the analyses and due diligence to devise retirement income strategies.
- Offering a limited menu of RIGs that retirees can elect, increasing the chance that a retirement income solution will be successfully implemented.
- Delivering low-cost, institutionally-priced retirement income solutions with the potential to increase retirement incomes by 10% to 20%, compared to retail retirement income solutions.

## *Essential criteria for evaluating retirement income generators (RIGs):*

- *Amount of income*
- *Access to savings*
- *Pre- and post- retirement protection*
- *Potential for increases to address inflation*
- *Lifetime guarantee*

Developing a retirement income strategy often entails balancing and trading off competing goals. *The Next Evolution*<sup>1</sup> SCL/SOA report recommends that plan sponsors develop criteria for evaluating and comparing potential RIGs to offer in their plan, including:

- Amount of initial income provided, and amounts of retirement income expected to be paid over the lifetime of the retiree and potential beneficiaries. This information helps retirees compare potential retirement income solutions.
- Access to savings. Can savings be accessed after retirement income has started?
- Pre-retirement protection. Can the amount of retirement income be influenced by investment volatility or changes in interest rates before retirement?
- Post-retirement protection. After retirement, is the retirement income protected from decreases due to asset declines or overly aggressive withdrawal strategies?
- Post-retirement increase potential. After retirement, is there a potential for the retirement income to increase in order to address inflation risk?
- Lifetime guarantee. Is this income guaranteed for life no matter how long the retiree lives?

This report develops a framework and analyses that can be used for optimizing retirement income solutions that focus on the criteria listed above. The intention is to help DC plan sponsors decide which RIGs to offer and to help retirees and their advisors develop specific retirement income solutions.

We use stochastic forecasts, efficient frontiers, and projections of retirement incomes throughout retirement for three hypothetical retirees. These analyses are described further in the pages that follow, and Appendix B summarizes details on our assumptions and methods. This project also shows analyses that illustrate the expected pattern of retirement income over a retiree's lifetime.

For a particular retirement income solution, efficient frontiers illustrate the tradeoff between two retirement income objectives. We used two types of efficient frontiers:

- Efficient Frontier #1: Emphasize retirement income, illustrating the tradeoff between the level of income and risk, both measures expressed in terms of retirement income.
- Efficient Frontier #2: Illustrate the tradeoff between the amount of expected retirement income and accessible savings throughout retirement (a measure of liquidity).

For this purpose, “accessible savings” means the retiree can withdraw savings from the RIG to apply elsewhere – for example, for emergencies, to deploy to another RIG, or for mid-course corrections to adjust to different life circumstances and priorities.

This report defines optimal solutions using the above measures. *Different definitions of “optimal” produce different solutions that can be considered optimal. As a result, any definition of “optimal” is really an expression of the priorities of various retirement planning goals.*

This report focuses on the financial considerations for designing retirement income solutions; it's important to consider the behavioral implications as well. We recommend that plan sponsors, retirees, and their advisors prepare definitions of optimal that best fit their circumstances, considering both financial and behavioral issues. Retirees may also want to integrate their strategies for developing retirement income and planning for long-term care (for a discussion on this topic, see the section *How Retirees and Advisors Can Use These Analyses*).

Retirees, plan sponsors, and advisors may also want to consider the following criteria for developing retirement strategies:

- Inheritance potential. Are remaining assets at death available for a legacy?
- Investment control. Who controls the investment of retirement savings?
- Withdrawal control. Who controls the amount of withdrawals from savings for retirement income?

These considerations may become more important as retirees age into their eighties and beyond, and are discussed further in the *Next Evolution*<sup>1</sup> SCL/SOA report.

## **Phase 1: A portfolio approach to retirement income**

This phase focuses on straightforward RIGs that can currently be made available in DC plans, including single premium immediate annuities (SPIAs), guaranteed lifetime withdrawal benefit (GLWB) annuities, and systematic withdrawal plans (SWPs) using invested assets. Within a DC retirement plan, a SWP can be implemented as an administrative feature using the plan's investment funds.

Here are some key conclusions from our analyses and projections:

- RIGs that pool longevity risk (SPIAs) provide higher expected lifetime retirement income than investing approaches that self-fund longevity risk. As a result, dedicating more savings to annuities guarantees that retirees cannot outlive their income and increases expected lifetime retirement income (measured as the median result from the stochastic forecast of annual average retirement income). But devoting savings to annuities reduces accessible wealth and potential inheritances throughout retirement.
- RIGs that invest savings provide access to unused savings throughout retirement, whereas annuities generally do not provide such access. As a result, dedicating more savings to investing solutions increases accessible wealth and potential inheritances, but decreases expected lifetime retirement income. Having access to savings provides flexibility and the ability to make mid-course corrections throughout retirements that can last 20 to 30 years or more. Note, however, that there will be no further income and no accessible wealth and inheritances if retirees outlive their savings due to living a long time and/or poor investment experience.
- GLWBs are hybrid solutions that both guarantee lifetime retirement income through longevity pooling and provide access to savings. These products project less lifetime retirement income than SPIAs and less accessible wealth than pure SWP strategies, but may represent a reasonable compromise between competing retirement income goals.

*Retirement income generators (RIGs) that pool longevity risk provide higher expected lifetime retirement income than investing approaches that self-fund longevity risk (as modeled in this report).*

Other goals may also be important and can influence the definition of optimal solutions and the decision to select a particular retirement income solution, such as:

- The expected pattern of changes in retirement income – over time, can it be expected to increase or decrease, or keep up with inflation?
- The expected volatility in retirement income in response to capital market fluctuations.
- The chance of retirement incomes falling to inadequate levels.

*RIGs that invest savings provide access to unused savings throughout retirement, whereas many annuities generally do not provide such access.*

The interim reports illustrate analyses that address these considerations as well.

*Many retirees may not need to utilize the extremes of exclusive retirement income solutions.* For example, retirees may not need to annuitize all of their retirement savings, since Social Security already provides a source of guaranteed lifetime retirement income using longevity pooling. On the other hand, retirees may not need to have access to all of their wealth throughout retirement. If wealth is accessed and spent, it is no longer generating retirement income.

*An effective compromise may be retirement income solutions that dedicate a portion of savings to annuities and remaining assets to investing solutions to realize the advantages of each approach.* Our analyses show that the existence of guaranteed lifetime income from Social Security and a portion of savings dedicated to an annuity can justify remaining assets to be invested significantly in equities, provided retirees can tolerate the potential volatility in income from invested assets.

The analyses in this phase show the following results with respect to systematic withdrawal plans (SWPs):

- With a SWP that calculates retirement withdrawals as a fixed percent of remaining savings (endowment method), higher percentages produce higher initial retirement income, but they use up savings faster and produce steeper declines in expected future retirement income, compared to using lower percentages (an example of pay me now or pay me later). Some retirees may value higher income in the initial years of their retirement, consuming savings at a faster rate. Others may prefer to consume savings at a slower rate, with the goal of holding some savings in reserve for needs in the later years of retirement, such as for long-term care expenses.
- A SWP based on the IRS required minimum distribution (RMD) produces more level patterns of real retirement income (adjusted for inflation) compared to endowment strategies that use a fixed percent of remaining savings.

*Social Security income and guaranteed annuities can be considered the “bond” part of a retirement income portfolio, potentially allowing the remainder of savings invested significantly in equities using a systematic withdrawal plan (SWP) to generate retirement income.*

Our analyses did not include the classic “four percent” rule – withdrawing an inflation-adjusted dollar amount regardless of investment returns. *The Next Evolution*<sup>1</sup> SCL/SOA report showed this method failed (savings were exhausted) in unfavorable investment scenarios.

The analyses in Phase 1 can be used to quantify the impact of deploying alternative retirement income strategies that meet different goals. For example:

- Retirees who want a guaranteed lifetime income from an insurance company can choose between a traditional single premium immediate annuity (SPIA), with no access to savings and no potential for growth due to capital market performance, or a GLWB annuity with access to savings and potential for growth. The “price” for the GLWB features is reduced expected annual average retirement income, and these analyses can be used to estimate this “price.”

For example, for Retiree #1 (65 year-old single female with \$250,000 in savings), devoting all savings to purchasing a SPIA with a 3% annual growth factors results in a total projected average real retirement income of \$30,701 with no accessible wealth. Devoting all savings to a GLWB annuity results in a projected annual income of \$27,111, a reduction of \$3,590 or 11.7% compared to the SPIA. However, the GLWB has a projected average real accessible wealth of \$100,831 over the retirement period. Both income projections include Social Security benefits. In both cases, the average retirement incomes shown are the medians of the average annual retirement income from the stochastic forecast.

- Similarly, a systematic withdrawal plan (SWP) also provides access to savings with the potential for growth in income due to capital market performance. Again, the “price” for these advantages compared to a traditional SPIA is reduced expected annual average retirement income, and these analyses can be used to estimate this “price.” Also consider that SWPs do not guarantee income for the life of a retiree.

To continue the example for Retiree #1, using a SWP based on the IRS required minimum distribution and 100% allocation to stocks results in a projected annual income of \$27,266, a reduction of \$3,435 or 11.2% compared to the SPIA. However, the RMD-SWP has a projected average real accessible wealth of \$214,681 over the retirement period, whereas there is no accessible wealth with the SPIA.

- A retiree who uses a SWP, either as a stand-alone strategy or as part of a partial annuitization strategy, can increase the expected average amount of retirement income by increasing the allocation of assets to equities. However this will increase the expected year-to-year volatility in retirement income. By showing expected annual retirement incomes for various asset allocations under SWPs and partial annuitization strategies, these analyses help quantify the “price” to be paid for reducing expected volatility in retirement income that’s caused by capital market fluctuations.

To continue the example for Retiree #1, using the RMD-SWP and 100% allocation to fixed income investments results in a projected annual income of \$23,876, a reduction of \$3,390 or 12.4% compared to a 100% allocation to equities. Projected average accessible wealth for the 100% allocation to fixed income investments is \$150,173, a reduction of \$64,508 or 30.0% compared to 100% allocation to equities.

Our Phase 1 analyses also prepared rough estimates of the potential advantages to delaying retirement; projected retirement incomes are increased significantly – by 25% to 34% or more -- by delaying retirement from age 65 to 70.

*The Next Evolution<sup>1</sup> SCL/SOA report showed that traditional annuities (SPIAs) and GLWB annuities produce higher expected incomes under unfavorable investment scenarios compared to SWP strategies, due to the guarantees. SWP strategies produce higher expected incomes under favorable investment scenarios.*

The analyses in this report focus on retirement income that can be generated through employer-sponsored DC plans. When developing a retirement income portfolio, retirees and their advisors may also want to consider other potential sources of retirement income, such as income from defined benefit plans, reverse mortgages that deploy home equity, annuity or life insurance policies held outside tax-qualified retirement accounts, and charitable gift annuities.

## **Phase 2: Use savings to enable delaying Social Security benefits**

Using retirement savings to enable delaying Social Security benefits increases projected average retirement incomes for all retirement income solutions studied. Our projections assumed retirement at age 65, with the retiree withdrawing from savings the amounts sufficient to replace the Social Security benefits that are being delayed to age 70. The estimated amounts needed to replace Social Security benefits between ages 65 and 70 were assumed to be set aside at age 65 and invested in cash investments.

These projections show that average annual income for specific retirement income solutions on the efficient frontiers increased by 2% to 6% compared to Phase 1 solutions that started Social Security benefits at age 65. These findings are consistent with other analyses (see *The Next Evolution<sup>1</sup>* report previously mentioned).

*Retirement savings devoted to SWPs with substantial fixed income investments might be better deployed by enabling the retiree to delay starting Social Security benefits.*

When risk is defined as minimizing the shortfall of retirement income relative to target income, the above increase in average annual income can be realized with roughly the same amount of risk. When access to wealth is an important goal, the above increase in annual income could be realized with roughly the same average amount of accessible wealth.

Solutions not on the efficient frontier realized even greater increases in retirement income, and were closer to the efficient frontier, when retirement savings were used to delay Social Security benefits.

- Using retirement savings to enable delaying Social Security benefits is more effective than other methods of generating retirement income – it's an efficient use of savings.
- SWP strategies that are on or close to Efficient Frontier #2 invest 100% of available assets in equities, assuming significant stock market risk with the expectation of higher returns. SWPS with substantial fixed income investments produce lower expected annual average retirement income; as such, a strategy to delay Social Security benefits has a greater potential for increasing expected average retirement income. Note there is no stock market risk associated with using savings to enable delaying Social Security benefits, as modeled in this report.

Continuing the example for Retiree #1, the RMD-SWP strategy with 100% allocation to fixed income investments is well below the efficient frontier. This strategy results in a projected real average annual income of \$23,876 with average accessible wealth of \$150,173. These results assume Social Security benefits start at age 65. Instead, if Retiree #1 used a portion of savings to enable delaying Social Security benefits to age 70, the projected average annual income is \$26,799, an increase of \$2,932 or 12.3%. Projected average accessible wealth under the delay strategy is \$105,199, a decrease of \$44,974 or 29.9%.

The reason why delaying the start of Social Security income increases projected retirement income is that the increase factors used by Social Security to adjust benefits (called “delayed retirement credits” or DRCs) are more generous to retirees than a pure actuarial increase. DRCs are set by law and can only be changed by legislation. DRCs have not been adjusted to reflect the current low interest rate environment and recent improvements in mortality.

Note that the above conclusions are based on the assumption that the retirees we modeled experience mortality according to the Society of Actuaries' RP-2014 Mortality Tables Draft for Healthy Annuitants. Individuals who expect much higher mortality than these rates might not benefit by a strategy to delay Social Security benefits, while individuals with lower expected mortality may have a greater benefit from such a strategy.

### **Phase 3: Combine qualified longevity annuity contracts (QLACs) with SWPs**

A QLAC is a type of deferred income annuity (DIA) that delays the start of income until an advanced age such as 80 or 85. Using a portion of retirement savings to purchase a QLAC has received much attention lately, including Treasury guidance in 2014 that defines a QLAC and exempts it from IRS required minimum distribution (RMD) rules. Appendix E summarizes the key features of this guidance on QLACs.

The potential attraction of a strategy that combines SWPs and QLACs is to try to realize the best features of both systematic withdrawals and annuities. To achieve this goal, a large portion of assets remain invested to generate retirement income and are accessible and liquid. A relatively small portion of initial assets are devoted to the QLAC to guarantee a lifetime payout, no matter how long the retiree lives.

Phase 3 analyzes a key question: Can SWP/QLAC strategies produce higher expected income with the same amount of risk or accessible wealth, compared to other strategies that try to realize the best features of SWPs and annuities (namely, SWP/SPIA combinations or GLWB annuities)?

Key decisions are the portion of initial retirement assets to devote to the QLAC, and the withdrawal method and asset allocation used by the SWP. To work most effectively, these strategies may need to be packaged by a qualified financial advisor or the retirement plan.

We analyzed the following two approaches to combining SWPs with QLACs:

1. The SWP exhausts savings by a specified advanced age, for example age 80 or 85. This report uses age 85 for this purpose. After age 85, the retiree receives income just from the QLAC. In this report we call this strategy “20-year spend-down+QLAC.”
2. The SWP is intended to generate retirement income for the life of the participant, and is not expected to stop at any specified age. After age 85, the retiree would receive income from both the QLAC and invested assets. In this report we call this strategy “lifetime SWP+QLAC.”

*Our analyses indicate that integrated SWP/QLAC strategies may be able to increase expected lifetime retirement income for the same amount of risk or accessible wealth. However, these strategies are “easier said than done.” They do not lend themselves well to being assembled by retirees who do not have training in structuring retirement income solutions. A substantial challenge is avoiding significant increases or decreases in income between ages 84 and 85.*

*Integrated SWP/QLAC strategies may require the involvement of a skilled advisor to construct and monitor throughout retirement.*

To minimize these potential increases or decreases in income, most likely the SWP/QLAC strategies will require frequent monitoring and adjustments to the SWP withdrawal amount and/or asset allocation by the retiree or an advisor. SWP/QLAC strategies may not be appropriate for retirees who don’t want to frequently revisit their retirement decisions.

In addition to the SWP/QLAC strategies listed previously, other possible uses of QLACs include:

- A combination of both approaches listed previously.
- Some retirees might just want to define the absolute minimum amount of retirement income they need at an advanced age as a form of insurance against living a long time. They would then work or draw on financial assets until that age, and would be willing to tolerate the potential disruption in income at the advanced age.
- Buy a deferred annuity with an earlier starting age, such as age 75, and work and/or deploy minimum required withdrawals from savings until that age.
- Layer additional income from a QLAC at the advanced age, to help pay for increased medical services, living support, and/or long-term care services.

Key challenges for retirees and their advisors include:

- Determining the percentage of initial assets devoted to the QLAC.
- Developing a SWP withdrawal and asset allocation approach that minimizes disruptions in the amount of income between ages 84 and 85.
- Deciding whether to purchase a QLAC that pays a death benefit before age 85, producing lower retirement income.

Key challenges and decisions for plan sponsors include:

- QLACs pose communication challenges due to the potential for disruptions in income between ages 84 and 85, and if there is no pre-85 death benefit.
- Should plan sponsors just make QLACs available to plan participants and their advisors to utilize on their own, or should they attempt to package SWPs and QLACs into an integrated retirement income solution for retirees to elect?
- Any type of annuity presents a challenge to explain to participants, and QLACs may provide an additional communications challenge. Due to the complexity of QLACs, plan sponsors who offer QLACs may want to offer the option for accessing financial advisors who are qualified to provide advice on QLACs.

## Phase 4: Strategies to protect retirement income before retirement

There has been considerable interest in strategies to protect retirement income from decreasing in the five to ten years preceding retirement, as a result of the stock market crash of 2008-2009 and subsequent decline in interest rates and economic activity. Many older workers experienced substantial declines in their account balances, and found that their reduced account balances generated retirement income at reduced rates compared to the period immediately before the economic downturn, due to lower rates of interest and dividend payments on stocks. Many of these workers were forced to delay their retirement, while others who were laid off may have had no choice but to retire on reduced retirement incomes.

In October, 2014, the Treasury Department issued guidance intended to enable plan sponsors to offer deferred annuities to older participants within target date funds (TDFs) without violating nondiscrimination requirements. This guidance increased interest in strategies to protect retirement income in the period leading up to retirement.

*Many target date funds remain vulnerable to stock market crashes and may not offer satisfactory protection in the period leading up to retirement.*

Phase 4 analyzes key questions:

- What strategies can older workers adopt to protect their retirement incomes in the period leading up to retirement?
- Can plan sponsors offer investing and retirement income solutions to help their older workers achieve this goal?

We analyzed the following strategies to protect retirement income in the period leading up to retirement:

- Invest in target date funds that reduce exposure to stocks as the worker ages, then employ a systematic withdrawal plan (SWP) to generate retirement income
- Buy deferred income annuities (DIAs)
- Invest in guaranteed lifetime withdrawal benefit (GLWB) annuities

As noted in our Next Evolution<sup>1</sup> report, the above solutions are readily available to employer-sponsored retirement plans, although currently the annuity options described above are not widely offered.

TDFs remain vulnerable to stock market crashes and may not offer down-market protection in the period leading up to retirement.

- According to one study,<sup>2</sup> the vast majority of assets in TDFs employ a “through” methodology, with an average allocation to stocks of 49% at age 65.
- With such a TDF, a stock market decline of 50% could result in roughly a 25% decline in the value of the TDF.
- During the 2008-2009 stock market crash, many TDFs targeting near-retirees experienced losses in the above order of magnitude.<sup>3</sup>
- Many systematic withdrawal schemes, such as the IRS required minimum distribution (RMD) or four percent rule, apply a target percentage to the amount of retirement savings at retirement. In this case, a drop in the value of savings has a one-to-one corresponding decrease in the amount of initial income at retirement. As a result, a 25% decline in savings at retirement translates into a 25% drop in retirement income that’s generated by these savings. If assets don’t recover their value subsequent to such a decline, then the resulting decrease in retirement income will continue throughout retirement.
- Our projections verify this continued vulnerability of many TDFs.

Our projections show that fixed DIAs offer the best protection against the possibility that an unfavorable economic scenario will result in retirement income being much less than expected, compared to the other RIGs and strategies that we analyzed. DIAs deployed at age 55 offer the most protection, although a ladder approach (purchasing small amounts of a DIA each year) produces projected results that are almost as favorable as buying the DIA at age 55.

*Ideally retirees would not defer their retirement income allocation decisions until retirement, and would adopt strategies to protect a portion of income in the period leading up to retirement.*

However, many workers will not want to invest all their savings in a DIA, since a DIA does not have liquidity throughout retirement, a desirable feature of SWPs. In addition, using a DIA results in reduced upside potential when market returns are favorable, compared to using TDFs with SWPs.

As of the writing of this report, DIAs are not widely offered in employer-sponsored retirement plans. Many plans offer in-service distributions to workers who had attained age 59-1/2, and a retiree who wants to purchase a DIA could do so through an IRA rollover.

An alternative to investing in a DIA during the period leading up to retirement is to invest a portion of retirement savings to intermediate and long-term bonds (or mutual funds), and then purchase a single premium immediate annuity (SPIA) at retirement. The goal is the appreciation or depreciation in these assets due to interest rate changes will be approximately the same magnitude as related changes in annuity pricing. Such a strategy requires sophistication from a near retiree (or an advisor) and may not deliver the same eventual income as a DIA. However, this strategy may give the near retiree more flexibility and liquidity, particularly if the near retiree is uncertain about the timing of retirement.

The Phase 4 analyses suggest that ideally older workers should not defer retirement income decisions until they retire. Instead, it's recommended that older workers start planning for the types of RIGs they will deploy to generate retirement income five to 10 years before retirement. Part of their planning would include deciding whether to deploy strategies to protect a portion of their retirement income and assets during this period.

### **A potential desirable strategy**

The results of all four phases support the potential desirability of a strategy discussed throughout this report:

- Cover essential retirement living expenses with guaranteed sources of lifetime retirement income, such as Social Security, and deferred, immediate, or GLWB annuities purchased with a portion of retirement savings.
- Cover discretionary living expenses by investing remaining savings and using a SWP to generate retirement income.

This strategy also helps boost retirees' income if market returns are favorable, and it addresses a common behavioral investing challenge. Many investors tend to panic and sell equities during market downturns, and downturns can be particularly alarming to retirees who are no longer working and contributing to their savings. A substantial amount of history, however, indicates that the best strategy is to remain invested and ride out market downturns. The above strategy helps retirees remain invested if they are confident that they can meet their basic living expenses even during market downturns.

## Additional considerations for optimizing retirement income solutions

The two efficient frontiers analyzed in this report estimate the average annual amount of retirement income and average accessible wealth over the retirement period, under the median (expected) scenario of the stochastic forecast. For a particular retirement income solution, the placement on the efficient frontier may not be the only relevant consideration; other scenarios, goals and alternative analyses could influence whether a particular solution is considered optimal.

For example, if the efficient frontier included *unfavorable economic scenarios* instead of the median scenario, *annuity solutions would look more favorable*. On the other hand, if the efficient frontier used *favorable economic scenarios*, *investing solutions would look more favorable*.

Our prior report *The Next Evolution in Defined Contribution Retirement Plans*<sup>1</sup> compared results for various RIGs under different economic scenarios.

The expected pattern of annual retirement income to address inflation is another consideration. Higher withdrawal rates under SWPs produce higher starting incomes but declining real amounts over time, compared to lower withdrawal rates – an example of “pay me now or pay me more later.”

The RMD SWP produces amounts of retirement income that are more level over time, compared to SWPs based on a fixed withdrawal percentage.

Note there is evidence that retirees spend less money as they age, both in nominal and real terms. For some retirees, this might justify retirement income solutions that are level in nominal terms (a fixed SPIA) or even decline in both real and nominal terms (an aggressive SWP strategy).

*This report focuses primarily on the financial considerations for developing retirement income strategies. Retirees, plan sponsors, and advisors may want to consider behavioral issues as well.*

The efficient frontier analyses in this report focus on the financial considerations for designing retirement income solutions; there are important behavioral issues that may need to be considered as well. For example, the efficient frontier analyses provide support for significant equity allocation to invested assets if a portion of retirement income is guaranteed by Social Security and annuities; nevertheless, retirees and advisors may still feel uncomfortable with a high equity allocation to remaining assets with the resulting potential for volatility in frequently reported account values. In this case, a lower allocation to equities can be justified to address important behavioral considerations.

The results presented in this report reflect the specific circumstances of the hypothetical employees and the assumptions used to produce the stochastic forecasts. Different employees and alternative assumptions will produce different results.

Ideally retirees, plan sponsors, and advisors would articulate and prioritize important retirement income goals and objectives, and then select the analyses that demonstrate how various retirement income solutions meet these goals and objectives. This report illustrates possible analyses that can be used for this purpose, but we acknowledge that there are many other possible analyses that may be useful.

# SUMMARY OF ANALYSES

Phases 1, 2, and 3, analyze various retirement income solutions for three hypothetical retirees:

- Retiree #1: Single female retiring at age 65 with \$250,000 in assets.
- Retiree #2: Married couple both age 65, retiring with \$400,000 in assets.
- Retiree #3: Married couple both age 65, retiring with \$1,000,000 in assets.

For the Phase 4 analyses, we assumed that Retiree #1 would be a single female with \$180,000 in assets at age 55, and Retiree #2 would be a married couple with \$300,000 at age 55. These asset values were chosen to be consistent with assumed age 65 asset values for Phases 1, 2, and 3, assuming average investment returns after age 55. No additional contributions were assumed to be made after age 55.

We assumed the retirees dedicated the above asset values to generating retirement income. Most likely, retirees will want to devote additional assets for an emergency cushion and for significant one-time purchases.

We also conducted the following Phase 1 sensitivity analyses:

- Repeat the analyses for all three hypothetical retirees retiring at age 70 with the same level of assets shown above.
- Repeat the analyses for a single female retiring at age 65 with \$100,000 in assets, to see how optimal solutions might change.

For each hypothetical retiree, we projected retirement incomes under the various retirement income solutions described below. For these projections, we used capital market assumptions regarding expected returns and inflation reflecting the low-interest rate environment prevalent in 2014, 2015, and early 2016, as follows:

- Arithmetic mean real return: 5.1% for stocks, 0.3% for bonds.
- Arithmetic mean inflation rate: 2.1%.
- Annuity purchase rates in April, 2014, resampled for comparison in December, 2014 and July, 2015.

These assumptions are intended to analyze and compare retirement income solutions under the economic environment prevalent in 2014, 2015, and early 2016. It is possible to construct assumptions based on different historical periods that would produce significantly different projections than the results in this report. Plan sponsors, retirees, and advisors will want to consider the assumptions and methods that are most appropriate for their circumstances.

We used these assumptions to produce stochastic forecasts of retirement income projections under a range of expected, unfavorable and favorable scenarios. See Appendix B for details on methods, assumptions about hypothetical retirees, and capital market assumptions.

We analyzed the following retirement income solutions in Phases 1 and 2:

- Stand-alone systematic withdrawal plans (SWPs) (Stock allocations: 0%, 25%, 50%, 75%, 100%):
  - Annual retirement income equals 3% of remaining assets at the beginning of each year (roughly equal to investment income, preserving principal)
  - Retirement income equals 5% of remaining assets, approximating a “middle of the road” strategy that draws down principal
  - Retirement income equals 7% of remaining assets, approximating a strategy that draws down principal aggressively

- Withdrawals based on IRS required minimum distribution (RMD) rules, which calculate retirement income each year by dividing remaining assets by remaining life expectancy at each age, using mortality tables specified by the IRS. Qualified retirement plans and deductible IRAs must comply with this rule once the retiree attains age 70-1/2. For this purpose, we assumed a withdrawal rate of 3.5% before age 70-1/2.

Notes on SWP solutions:

1. SWPs based on 3%, 5%, and 7% withdrawal rates will violate the IRS RMD rules at age 70 for a 3% SWP, age 79 for a 5% SWP, and age 86 for a 7% SWP. At these ages, retirees would need to withdraw the RMD and invest the excess of the RMD over the withdrawal strategy.
  2. The classic “four percent” rule – withdrawing an inflation-adjusted dollar amount regardless of investment returns – was not included. *The Next Evolution*<sup>1</sup> SCL/SOA report showed this method failed (savings were exhausted) in unfavorable investment scenarios.
- Stand-alone annuities:
    - Fixed SPIA
    - SPIA with 3% growth factor
    - Inflation-adjusted single-premium immediate annuity (SPIA)
    - VA/GLWB (Asset allocation: 60% equities/40% fixed income)
  - Packaged solutions: 70% of savings to each systematic withdrawal approach with all previously stated asset allocations, 30% to each annuity approach. GLWB annuities were not included in packaged solutions.

We selected a subset of the above retirement income solutions for Phase 3 analyses, to provide comparisons to solutions that combine SWPs and QLACs. These solutions are described further in the section summarizing the Phase 3 analyses.

For Phase 4 analyses, we analyzed retirement income solutions that protect retirement income in the period leading up to retirement, including:

- Remaining invested in a target date or balanced fund, and using a SWP to generate retirement income
- Purchasing deferred annuities at age 55 or 60
- Purchasing a deferred annuity ladder between age 55 and 65
- Purchasing a GLWB annuity at age 55 or 60

These solutions are described further in the section summarizing the Phase 4 analyses.

In all cases, we assumed that savings have been accumulated pre-tax, and are fully taxable in retirement (in other words, we assumed no participation in Roth accounts). All projections of retirement income are gross amounts, before income taxes.

# DEFINING OPTIMAL WITH RETIREMENT INCOME EFFICIENT FRONTIERS

For a particular retirement income solution, efficient frontiers illustrate the tradeoff between two retirement income objectives. For each hypothetical retiree described previously, different retirement income solutions are plotted as points on an X/Y graph, and the two retirement objectives are expressed as two dimensions on the graph. The efficient frontier is the set of highest points on the Y axis (vertical axis) for a given value on the X axis (horizontal axis).

We used two types of efficient frontiers:

- Efficient Frontier #1: Emphasize retirement income and define return and risk in terms of retirement income.
- Efficient Frontier #2: Illustrate the tradeoff between amount of expected retirement income and accessible savings (a measure of liquidity).

Different definitions of optimal will produce different solutions that could be considered optimal; as a result, “optimal” is in the eye of the beholder. Other possible analyses of optimal could consider:

- Volatility in the retirement income amount from year to year.
- The chance that savings will be exhausted.
- The chance that retirement income could fall below a specified threshold.

Plan sponsors should define criteria for optimal solutions that best meet their participants’ goals and characteristics. Similarly, retirees and their advisors should also define criteria for optimal solutions that meet a specific retiree’s goals and circumstances.

## Details on Efficient Frontier #1

For this analysis, we assumed that the retiree’s most important goal is to maximize lifetime income that maintains purchasing power. In this case, the tradeoff that we measure is the potential return vs. risk, both defined in terms of retirement income, as follows:

- Measure of return (Y-axis): Average annual real retirement income from the retirement income solution under the median stochastic forecast throughout retirement. This average is calculated using the projected amount of income at each future age, multiplied by the probability of survival to each future age and adjusted for projected inflation.
- Measure of risk (X-axis): Average annual amount of real income shortfall throughout retirement relative to an inflation-adjusted SPIA under the unfavorable economic scenario, adjusted for survival probabilities.

The rationale for the risk measure is as follows: An inflation-adjusted SPIA represents a guaranteed lifetime income with inflation-protection. Retirees will want to balance the retirement income that is expected under the median scenario with a particular strategy vs. the amount of retirement income under an unfavorable scenario. We analyze whether various strategies for generating retirement income (RIGs) can be expected to generate a higher amount of annual income by assuming some additional risk compared to the SPIA.

Note that there are other measures of risk that may be reasonable to use, such as the probability of running out of money. This report purposely analyzes RIGs that have no chance of running out of money – annuities and systematic withdrawal strategies where the annual withdrawal is a percentage of remaining assets. With such systematic withdrawal strategies, however, it is possible that the amount of withdrawal can decrease substantially, a risk that is addressed in this report.

Note that with the measure of risk used in this analysis, there are two ways that a particular SWP can develop shortfalls compared to an inflation-adjusted annuity. If withdrawals are too conservative, they will generate less income than the annuity. If the withdrawals are too aggressive, then eventually the assets will decline significantly, with income falling short relative to the inflation-adjusted annuity.

## **Details on Efficient Frontier #2**

We assumed that the retiree's goal is to balance the amount of expected retirement income with the amount of expected accessible savings throughout retirement. In this case, the tradeoff that we measure is the potential return, defined in terms of retirement income vs. the potential accessible wealth, as follows:

- Measure of return (Y-axis): Average annual real retirement income from the retirement income solution, adjusted for the probability of survival to each future age (same as Efficient Frontier #1).
- Measure of accessible wealth (X-axis): Average amount of real accessible savings throughout retirement under the median stochastic forecast, adjusted for the probability of survival to each future age.

Accessible wealth is the amount of savings that a retiree could withdraw from a RIG at each point in time and deploy to other purposes. The resulting average real accessible wealth projections represent a measure of liquidity that a retiree might have throughout retirement.

Our rationale for the above measures is as follows: Many participants are hesitant to devote substantial resources to irrevocable annuities, and desire some access to savings during retirement and/or for a legacy at death. These participants may be willing to accept reduced retirement income in exchange for access to savings.

# PHASE 1 KEY RESULTS AND COMMENTARY

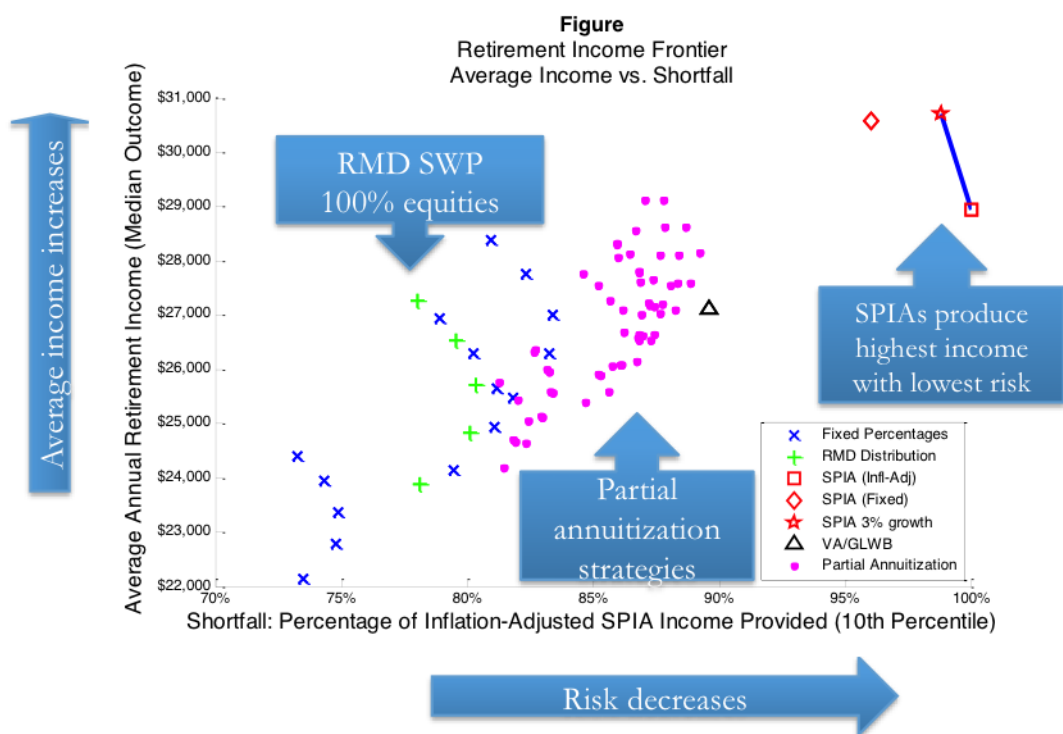
This phase focuses on straightforward RIGs that can currently be offered in DC plans, including single premium immediate annuities (SPIAs), guaranteed lifetime withdrawal benefit (GLWB) annuities, and systematic withdrawal programs (SWPs) using invested assets.

All Phase 1 cases assume retirement at age 65 unless noted otherwise. All cases include estimated Social Security benefits that start at the same time as the retirement income solution (called a parallel Social Security claiming strategy).

## Commentary on Efficient Frontier #1: Focus on Retirement Income

Figure 1 shows retirement income solutions on and below Efficient Frontier #1 for Retiree #1 (single female age 65 with \$250,000 in retirement savings).

**Figure 1**  
**Efficient Frontier Analysis #1: Emphasize Retirement Income**  
**Hypothetical Retiree #1: Single Female Age 65 with \$250,000**



Here are some conclusions from interpreting Figure 1:

- Single premium immediate annuities (SPIAs) produce the highest amount of expected average income with the lowest amount of risk, defined as the shortfall of expected income relative to an inflation-adjusted SPIA under the 10th percentile stochastic forecast.
- A SPIA with a 3% growth factor produces somewhat higher expected income than an inflation-adjusted SPIA, but assumes very modest risk.
- Solutions producing the next highest amounts of average retirement income are partial annuitization strategies. The partial annuitization strategy modeled that produces the highest expected average income is 30% of assets to a SPIA increasing 3% and 70% to systematic withdrawal program (SWP) using 7% withdrawal strategy with 100% allocation to equities. However, this strategy produces a pattern of decreasing income.
- A partial annuitization strategy using a SWP with the RMD strategy withdrawal rate is close behind on expected average income, and produces more level pattern of income (see Appendix E of the Phase 1 Interim Report).

Compared to annuities, SWPs generally produce lower average expected annual retirement income with higher risk (defined in this case as average shortfall of income relative to inflation-adjusted SPIA). Some SWP strategies produce higher income than GLWBs or some partial annuitization strategies, but assume more risk as defined for Efficient Frontier #1.

Here are some conclusions regarding strategies that exclusively rely on SWPs:

- For a given asset allocation, a SWP with 7% withdrawal rate produces highest amounts of average income with lowest risk (risk defined as shortfall against inflation-adjusted SPIA).
- A SWP with 7% withdrawal rate and 50% allocation to equities produces the lowest risk, although the expected income is lower compared to other SWP strategies.

Keep in mind risk is defined as shortfall of retirement income relative to an inflation-adjusted SPIA, so lower withdrawal rates produce higher risk under this definition.

The Phase 1 interim report contains additional explanations of the results, and shows the efficient frontier analyses for Retirees #2 and #3, which show similar patterns with the same conclusions regarding optimal solutions as for Retiree #1. Married couples with increased starting assets, single female with lower starting assets, and retiring at age 70 don't change conclusions about optimal solutions.

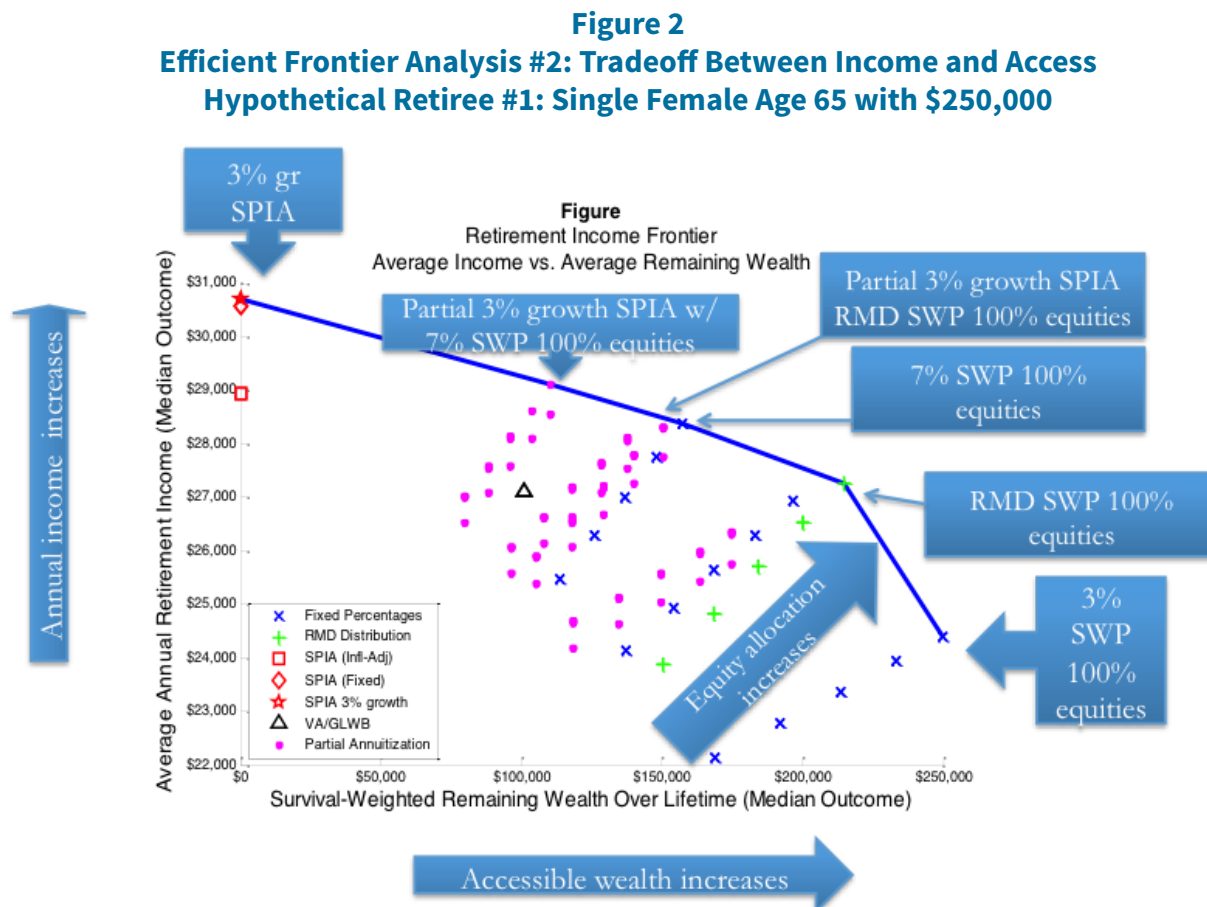
The Phase 1 interim report also compares starting retirement income at age 65 to starting at age 70, and shows a substantial increase in the average annual income along Efficient Frontier #1. The estimated increase due to postponement is understated in these analyses, since using the same assumed starting assets is equivalent to assuming no investment return or additional contributions between ages 65 and 70.

- Single female with \$250,000 in assets increases average annual income by a range of \$9,058 to \$9,328 (increase of 30% to 31%), depending on the solution along the frontier.
- Married couple with \$400,000 in assets increases annual income by a range of \$15,905 to \$16,948 (increase of 30% to 34%).
- Married couple with \$1,000,000 in assets increases annual income by a range of \$22,611 to \$25,220 (increase of 25% to 30%).

The reasons for these results are that Social Security benefits are increased for delayed commencement, and retirement savings need to generate income for five fewer years.

## Commentary on Efficient Frontier #2: Tradeoff Between Income and Access

Figure 2 shows retirement income solutions on and below Efficient Frontier #2 for Retiree #1 (single female age 65 with \$250,000 in retirement savings).



Here are solutions that lie on the efficient frontier:

- A 3% growth SPIA produces the highest average annual income with no accessible wealth.
- A SWP with a 3% withdrawal amount and 100% stock allocation produces the highest amount of expected average accessible wealth and the lowest average amount of retirement income.
- A partial annuitization solution on the frontier is 30% of savings to a 3% growth SPIA and remaining assets invested 100% in stocks with a 7% SWP.

Alternative analyses show that higher allocations to annuities produce other solutions on the efficient frontier, trading off expected average income for accessible wealth.

SWP solutions that lie on the efficient frontier are a 7% withdrawal rate, RMD, and 3% withdrawal rate, all with 100% in stocks. With all SWP solutions, higher equity allocations produce higher average amounts of projected income and accessible wealth.

Guaranteed lifetime withdrawal benefits (GLWBs) do not project as favorably as partial annuitization strategies with high allocations to equities.

The following solution just below the efficient frontier may also be desirable:

- 30% of assets devoted to a 3% growth SPIA and remaining assets invested 100% in stocks with RMD SWP (this solution is labeled on Figure 2). This RIG produces a point very close to the 7% SWP with 100% equities (a point on the frontier), with a more level pattern of retirement income and higher amount of lifetime guaranteed income (through partial annuitization).

This result provides evidence that factors other than strict adherence to the placement on the efficient frontier should be considered when developing retirement income strategies.

For partial annuitization strategies, the presence of Social Security and a SPIA enables higher equity allocation with remaining assets.

Starting retirement income at age 70 instead of age 65 produces substantial increases in average annual income on Efficient Frontier #2, similar in percentage terms as increases for Efficient Frontier #1. See the Phase 1 Interim Report for details.

Table 1 illustrates the tradeoff between average income and average accessible wealth along the efficient frontier (or close to the frontier).

**Table 1**  
**Illustrating Tradeoff Between Income and Accessible Wealth**  
**Single Female with \$250,000 in Assets**

| Hypothetical retiree #1                                                    | Phase 1 Results       | Difference from Prior Row |
|----------------------------------------------------------------------------|-----------------------|---------------------------|
| 3% growth SPIA<br>- Ave income<br>- Ave accessible wealth                  | \$30,701<br>\$0       | N/A                       |
| Partial annuitization strategy*<br>- Ave income<br>- Ave accessible wealth | \$28,324<br>\$150,276 | (\$2,377)<br>\$150,276    |
| SWP RMD/100% equities<br>- Ave income<br>- Ave accessible wealth           | \$27,265<br>\$214,681 | (\$1,059)<br>\$64,405     |
| SWP 3% WR/100% equities<br>- Ave income<br>- Ave accessible wealth         | \$24,391<br>\$249,637 | (\$2,875)<br>\$34,956     |

\*30% of savings to 3% growth SPIA, 70% to RMD SWP with 100% stock allocation

Comparing the extreme points of Efficient Frontier #2, full annuitization with the 3% growth SPIA has no accessible wealth and average annual income of \$30,701, which is \$6,311 higher (+26%) than the average income of \$24,391 produced by the 3% SWP with the highest amount of average accessible wealth (\$249,637).

Keep in mind that these results are based on the median results from the stochastic forecasts; the results would be different if we compare favorable or unfavorable investment scenarios.

The efficient frontier analyses for Retirees #2 and #3 show similar patterns with same conclusions regarding optimal solutions. See the Phase 1 Interim Report for more details.

Appendix E of the Phase 1 Interim Report illustrates analyses that can be used to compare the patterns of retirement income strategies. These analyses compare 3%, 7%, and RMD SWPs with a 50% allocation to stocks, showing the 10th, 25th, 50th, 75th, and 90th percentiles of estimated real annual incomes under the stochastic projections, for Hypothetical Retiree #2. The results are summarized below for the 50th percentile:

- The 7% SWP shows a rapid decline in real income, starting with total average annual real income of \$61,547 per year, declining to \$50,648 after 10 years and \$43,070 after 20 years.
- The 3% SWP shows a much more gradual decline, starting with average real income of roughly \$45,547 per year, declining to \$44,141 after 10 years and \$42,631 after 20 years.
- The RMD SWP shows a modest increase in real income, starting with average real income of about \$46,450 per year, increasing to about \$47,577 after 10 years and \$48,416 after 20 years.

The different percentiles of these forecasts can also be used to assess the volatility of a particular retirement income strategy, and the amounts of retirement income that the various RIGs might deliver under alternative economic scenarios.

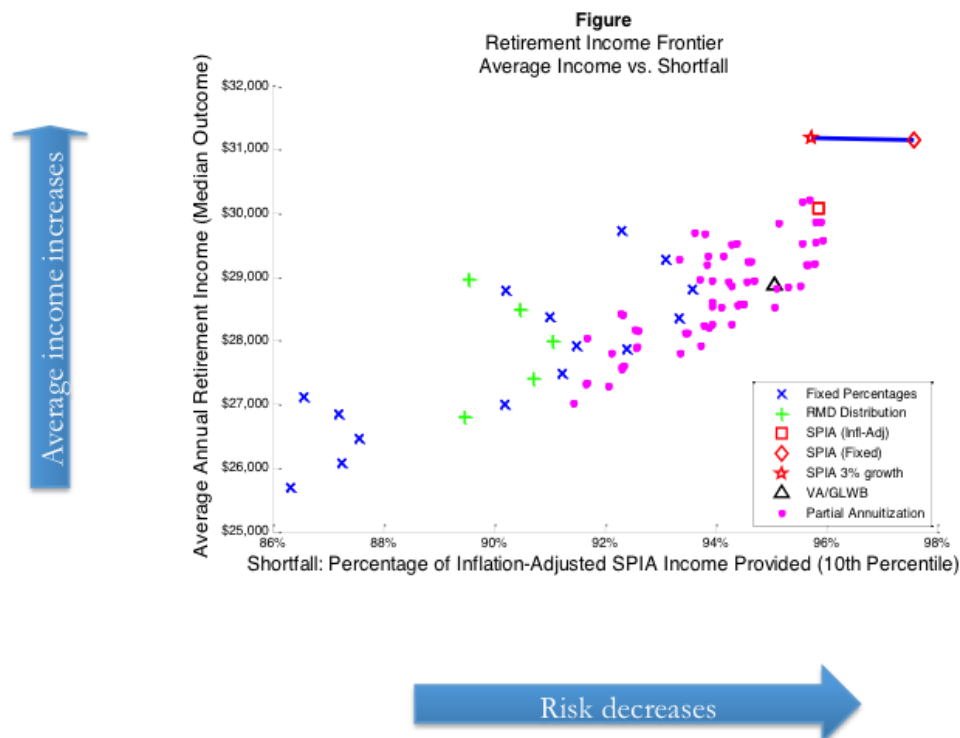
# PHASE 2 KEY RESULTS AND COMMENTARY

This phase analyzes whether using savings to enable delaying Social Security benefits results in improved projected outcomes. All Phase 2 cases assume Social Security benefits for the primary worker are delayed until age 70 but retirement still starts at age 65 (serial Social Security claiming strategy). Retirement savings are tapped to replace the Social Security benefits that could have been paid for the primary worker from age 65 to 70. Remaining savings are deployed at age 65 to generate retirement income using the same RIGs as analyzed for Phase 1.

## Commentary on Efficient Frontier #1: Focus on Retirement Income

Figure 3 shows retirement income solutions on and below Efficient Frontier #1 for Retiree #1 (single female age 65 with \$250,000 in retirement savings).

**Figure 3**  
**Hypothetical Retiree #1: Single Female Age 65 with \$250,000**  
**Phase 2: Use Retirement Savings to Delay Social Security to Age 70**



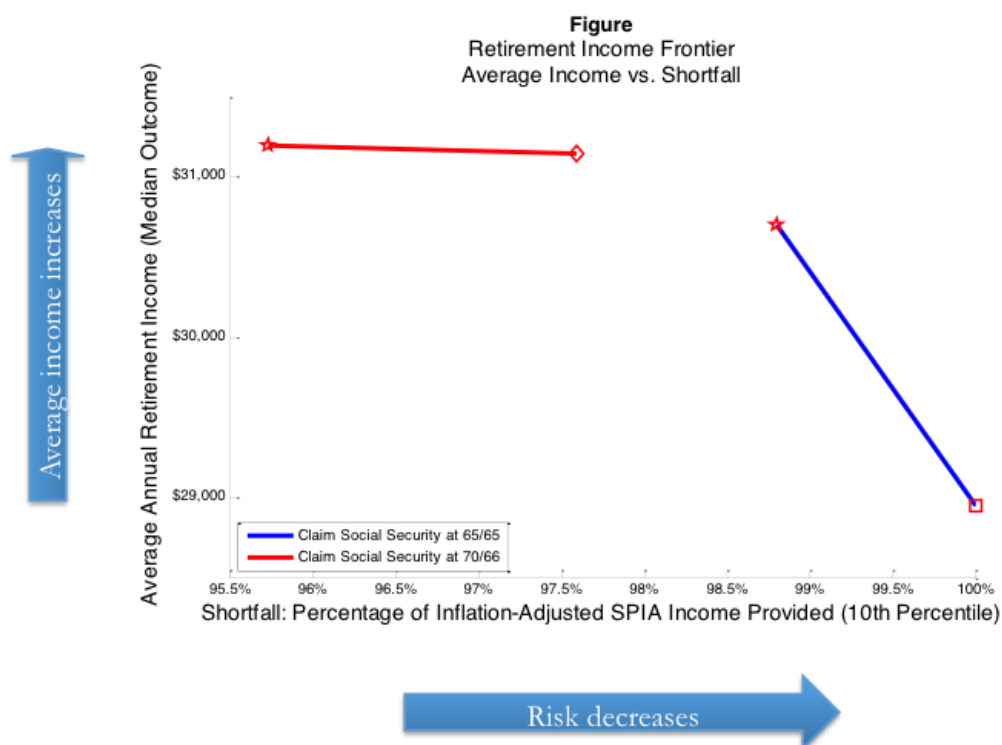
Here are some conclusions from interpreting the above graph:

- Consistent with Phase 1, solutions on the efficient frontier are single premium immediate annuities (SPIAs). The conclusions about optimal retirement income solutions under Phase 2 with remaining savings after funding delayed Social Security are virtually the same as conclusions for optimal retirement income solutions for total savings under Phase 1.
- Using a portion of retirement savings to enable delaying Social Security benefits improves outcomes for all retirement solutions analyzed, even for solutions not on the efficient frontier.
- Comparing Figures 1 and 3 demonstrates that solutions not on the efficient frontier are closer to the efficient frontier in Phase 2 compared to Phase 1. For these solutions, higher average income is delivered with less risk. The rationale is that savings are being used more efficiently to “purchase” higher Social Security benefit at very favorable rate. Fewer assets are deployed into solutions that are considered to be less efficient.

For retirement income solutions using invested assets, Phase 2 entails taking money that might have been invested in stocks and using it to delay taking Social Security. As a result, investing solutions with a high allocation to stocks show a lower improvement between Phases 1 and 2, compared to investing solutions with a low allocation to stocks. As a result, the farther off the efficient frontier a particular solution is in Phase 1, the more it makes sense to use retirement savings to enable delay taking Social Security benefits. Retirees who are not comfortable with high allocations to stocks may have more to gain by a strategy that uses retirement savings to delay Social Security benefits.

Figure 4 compares Efficient Frontier #1 for Phase 1 solutions (parallel Social Security claiming strategy) to Phase 2 solutions (serial Social Security claiming strategy). See Figure 3 for a legend of the symbols.

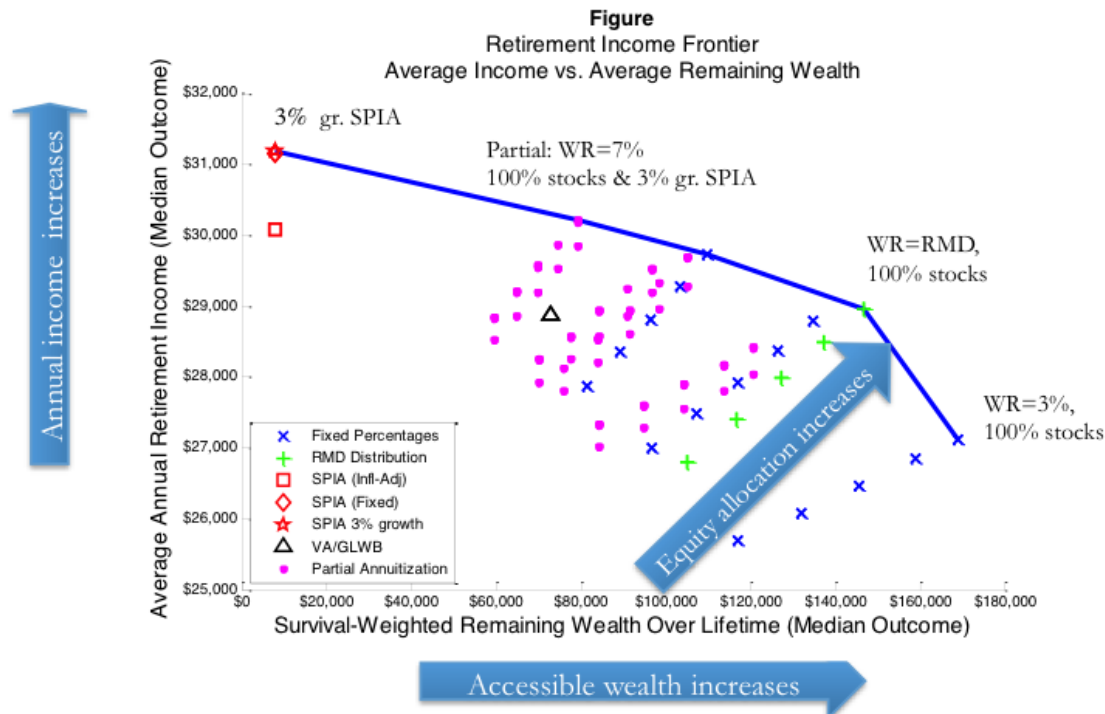
**Figure 4**  
**Hypothetical Retiree #1: Single Female Age 65 with \$250,000**  
**Comparison of Efficient Frontiers Phases 1 and 2**



## Commentary on Efficient Frontier #2: Tradeoff Between Income and Access

Figure 5 shows retirement income solutions on and below Efficient Frontier #2 for Retiree #1 (single female age 65 with \$250,000 in retirement savings).

**Figure 5**  
**Hypothetical Retiree #1: Single Female Age 65 with \$250,000**  
**Phase 2: Use Savings to Delay Social Security**



For each specific retirement income solution, Phase 2 solutions produce higher average annual retirement incomes, but less accessible wealth, compared to Phase 1 solutions. Devoting retirement savings in the first five years of retirement to replace Social Security benefits consumes savings, but this use of savings to increase Social Security benefits can be viewed as a very favorable “annuity purchase rate” that boosts average annual income.

These results are illustrated by Table 2, which compares average retirement income and average accessible wealth under Phase 1 (start Social Security at age 65) and Phase 2 (delay Social Security until age 70) for three specific retirement income strategies.

**Table 2**  
**Comparing Phase 1 and 2 Results for Retiree #1**  
**Single Female with \$250,000 in Assets**

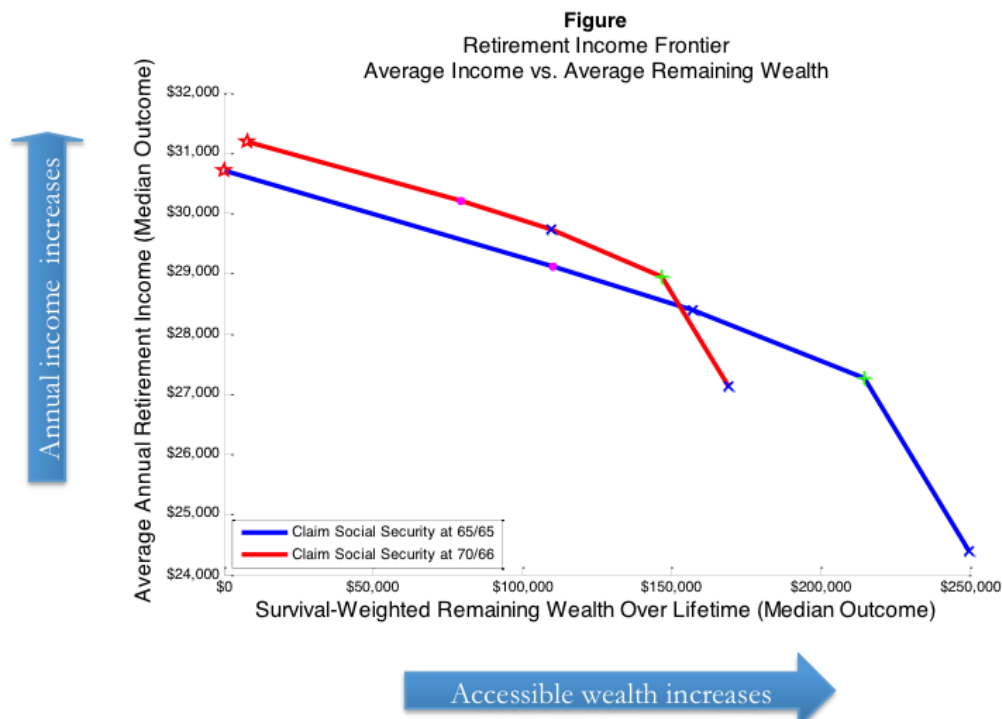
For each retirement income solution, Phase 2 solutions produce higher average annual retirement incomes, but less accessible wealth.

| Hypothetical retiree #1         | Phase 1<br>Start SS age 65 | Phase 2<br>Delay SS | Difference |
|---------------------------------|----------------------------|---------------------|------------|
| Partial annuitization strategy* |                            |                     |            |
| - Ave income                    | \$28,324                   | \$29,696            | \$1,372    |
| - Ave accessible wealth         | \$150,276                  | \$105,053           | (\$45,223) |
| SWP RMD/75% equities            |                            |                     |            |
| - Ave income                    | \$26,537                   | \$28,498            | \$1,961    |
| - Ave accessible wealth         | \$199,856                  | \$137,243           | (\$62,613) |
| SWP 3% WR/75% equities          |                            |                     |            |
| - Ave income                    | \$23,942                   | \$26,846            | \$2,904    |
| - Ave accessible wealth         | \$233,154                  | \$159,001           | (\$74,153) |

\*30% of savings to 3% growth SPIA, 70% to RMD SWP with 100% stock allocation

Figure 6 compares Efficient Frontier #2 for Phase 1 solutions (parallel Social Security claiming strategy) to Phase 2 solutions (serial Social Security claiming strategy). See Figure 5 for a legend of the symbols.

**Figure 6**  
**Efficient Frontier Analysis #2: Tradeoff Between Income and Access**  
**Hypothetical Retiree #1: Single Female Age 65 with \$250,000**  
**Comparison of Phases 1 and 2 Efficient Frontiers**



A close look at Figure 6 shows that a Phase 2 strategy can increase average annual income with the same approximate average amount of accessible wealth. For example:

- Phase 2: 7% SWP with 100% stock allocation (blue cross on red line)
  - Average income: \$29,739
  - Average accessible wealth: \$109,865
- Phase 1: Partial annuitization strategy (pink dot on blue line)
  - Average income: \$29,127
  - Average accessible wealth: \$110,086
- In this example, average annual income is increased by \$612 (2.1%), with only a \$221 decrease in average accessible wealth.

Another potential benefit of the Phase 2 strategy is that the “insurance company” from which a retiree is “buying” the annuity is the federal government. This avoids the commonly expressed concern about insurance company bankruptcy. A concern considered by many analysts to be unfounded due to the low level of insurance company bankruptcies and existence of guarantees by state guaranty associations, but nevertheless is often cited as a reason not to buy an annuity. An alternative perspective might argue, however, that Social Security benefits are not riskless due to the program’s current funding challenges.

As with Efficient Frontier #1, retirement income solutions that are well below the efficient frontier show higher increases in expected retirement income by using savings to enable delaying Social Security benefits, compared to retirement income solutions close to the efficient frontier. Retirees who are not comfortable with high allocations to stocks benefit more from the strategy to use savings to enable delaying Social Security benefits.

The Phase 2 Interim Report also contains analyses for Retirees #2 and #3, both representing married couples. The specific analyses assume worker benefits for the lower-earning spouse are delayed until age 66. Retirement savings are tapped to replace the Social Security benefits for the primary worker that could have been paid from age 65 to 70, and to replace the benefits for the lower-earning spouse that could have been paid from age 65 to age 66. These Phase 2 analyses show similar improvements in projected outcomes as described previously for Retiree #1.

Due to recent legislative changes, after May 1, 2016 the above scenario could only be realized if the spouse earned a Social Security benefit on the spouse’s own earnings record. Under these legislative changes, the benefit for nonworking spouses (the spousal benefit that’s based on half of the primary worker’s benefit) must be delayed until the worker starts his or her benefits. In this case, to enable a delay Social Security strategy, a worker with a nonworking spouse would need to tap more retirement savings to replace the nonworking spouse’s benefit from age 66 to age 70, compared to the scenario with a working spouse described above. This would reduce the advantage of a delay strategy for a worker with a nonworking spouse.

The authors believe that the scenario modeled, where both spouses work, represents a common situation for older workers approaching their retirement years. As such, plan sponsors may want to offer payout options in their DC plans that enable a married worker to delay Social Security benefits. Retirees and their advisors will need to analyze the specific circumstances of each retiree to determine if a delay strategy might deliver potential advantages.

## PHASE 3 KEY RESULTS AND COMMENTARY

Phase 3 analyzes solutions that combine systematic withdrawal plans (SWPs) with qualified longevity annuity contracts (QLACs) to determine if such strategies can extend the efficient frontiers compared to the Phase 1 baseline strategies described previously. We analyzed 36 SWP/QLAC combinations that are deployed at age 65; we did not combine Phase 3 strategies with Phase 2 strategies that use savings to enable delay of Social Security benefits.

Our efficient frontier analyses assumed that 15% of initial assets were devoted to a QLAC. We believe that most retirees would not want to dedicate more than this amount to an illiquid QLAC (although we do not have any survey or other data that supports this belief). We also assumed no pre-85 death benefit, which is another reason why retirees might be hesitant to devote more than 15% of initial assets to a QLAC.

However, we also projected retirement incomes with 10% and 20% of starting assets devoted to a QLAC, to better understand the issues with designing a smooth transition in retirement income between ages 84 and 85. Pages 41-48 of the Phase 3 Interim Report contain these analyses.

We analyzed two types of SWP/QLAC combinations:

- SWP stops at age 85 (“20-year spend-down + QLAC”)
- SWP extends beyond age 85 (“lifelong SWP + QLAC”)

Here are the 20-year spend-down + QLAC solutions we analyzed:

- Annual income is  $1/n$  applied to remaining assets each year,  $n$  is years remaining until age 85.
- Asset allocations for SWP are 0%, 50%, and 100% to stocks.
- Three types of QLACs are analyzed: fixed dollar amount, income is increased by 3% annually after age 85, and income is adjusted for inflation after age 85.

Here are the lifelong SWP + QLAC solutions we analyzed:

- SWPs have 0%, 50%, and 100% allocation to stocks.
- Three SWP programs analyzed that apply a percentage to remaining assets each year to calculate the SWP retirement income for the year: 5%, 7%, and IRS required minimum distribution (RMD).
- Same three types of QLACs as described above.

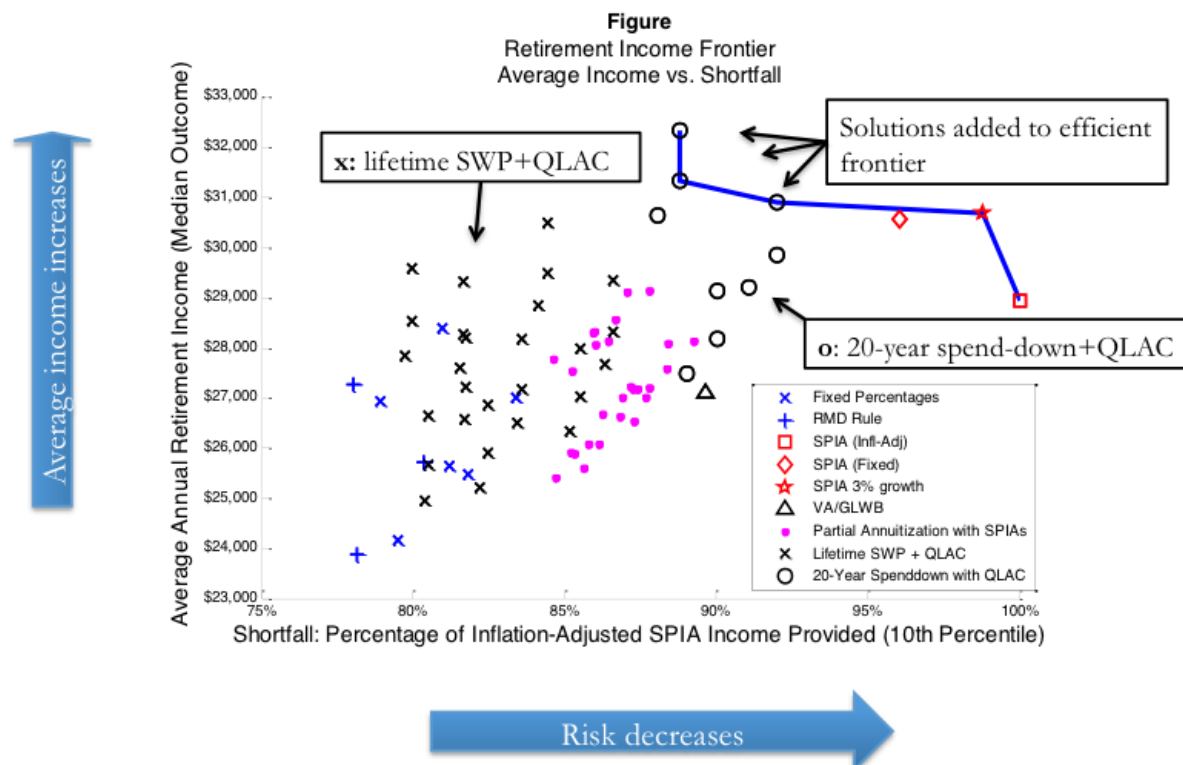
## Commentary on Efficient Frontier #1: Focus on Retirement Income

Figure 7 compares Efficient Frontier #1 for selected Phase 1 solutions to Phase 3 SWP/QLAC solutions. The Phase 3 solutions are represented as follows:

- Black circles show the 20-year spend-down+QLAC solutions
- Black x's show the lifetime SWP+QLAC solutions

Colored symbols represent Phase 1 solutions, plus the black triangle for GLWBs.

**Figure 7**  
**Hypothetical Retiree #1: Single Female Age 65 with \$250,000**  
**15% of Assets Devoted to QLAC**



A first glance of Figure 7 shows that many SWP/QLAC strategies provide higher retirement income with the same or lower amount of risk, compared to Phase 1 solutions that aren't on the efficient frontier. This is illustrated by the positioning of the SWP/QLAC strategies represented by black circles and x's, compared to Phase 1 strategies represented by pink dots, a black triangle, and blue crosses.

Compared to Phase 1, the Figure 7 shows that three SWP/QLAC strategies are added to the efficient frontier. These solutions provide higher expected average retirement income than the Phase 1 SPIAs on the efficient frontier, although they also project higher risk. The three SWP/QLAC strategies on the frontier are:

- 20-year spend-down with 100% equity stock allocation, combined with a 3% growth QLAC
- 20-year spend-down with 100% equity stock allocation, combined with an inflation-adjusted QLAC
- 20-year spend-down with 50% equity stock allocation, combined with a 3% growth QLAC

Note that for the SWP/QLAC solutions on the efficient frontier, our projections of retirement income show significant potential disruptions in retirement income between ages 84 and 85. In particular, two solutions on the efficient frontier assume a 100% allocation to stocks that can generate a highly variable amount of retirement income. These analyses are shown later in this report.

See Appendix D of the Phase 3 Interim Report for the efficient frontier graphs for Retirees #2 and #3. They produce similar results and conclusions as shown here for Retiree #1.

### **Commentary on Efficient Frontier #2: Tradeoff Between Income and Access**

Figure 8 compares Efficient Frontier #2 for selected Phase 1 solutions to Phase 3 SWP/QLAC solutions. It shows that many SWP/QLAC strategies provide higher retirement income with the same or higher amount of accessible wealth, compared to Phase 1 solutions that aren't on the efficient frontier. This is illustrated by the positioning of the SWP/QLAC strategies represented by black circles and x's, compared to Phase 1 strategies represented by pink dots, a black triangle, and blue crosses.

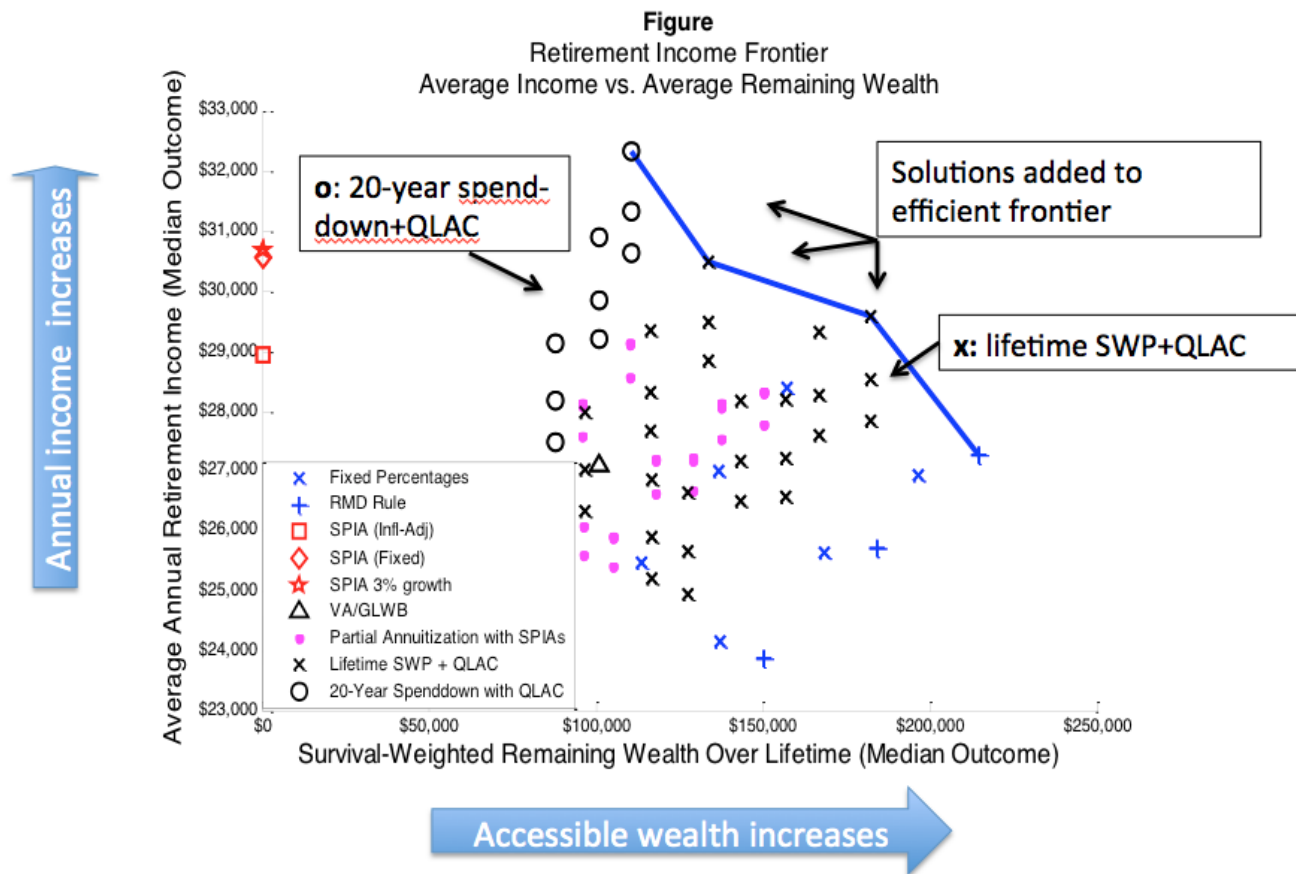
Three SWP/QLAC strategies extend the efficient frontier compared to Phase 1 strategies, by delivering higher projected average retirement incomes for similar amounts of expected average amounts of accessible wealth. The SWP/QLAC strategies on the efficient frontier are:

- 20-year spend-down with 100% equity stock allocation, combined with a 3% growth QLAC (note this solution is also on efficient frontier #1)
- 7% SWP with 100% equity stock allocation, combined with a 3% growth QLAC
- RMD SWP with 100% equity stock allocation, combined with a 3% growth QLAC

A common reason why these solutions extend the efficient frontier is the additional amount of savings invested in equities for SWP/QLAC solutions.

It is important to realize that with our efficient frontier analyses, the best performing SWP/QLAC strategies devote 15% of assets to a QLAC and invest the remaining 85% of assets to a SWP invested 100% in stocks. Such a strategy has a much higher overall asset allocation to stocks than the partial annuitization strategies analyzed in Phase 1 (those devoted 30% of assets to a SPIA). This is one reason why the SWP/QLAC strategies analyzed in the efficient frontier analyses may appear to deliver higher expected average retirement incomes for similar amounts of risk or accessible wealth, compared to Phase 1 strategies. Retirees may not feel comfortable with high allocations of savings to stocks, and assuming lower allocations to stocks reduces the amount of expected average retirement incomes with a SWP/QLAC strategy.

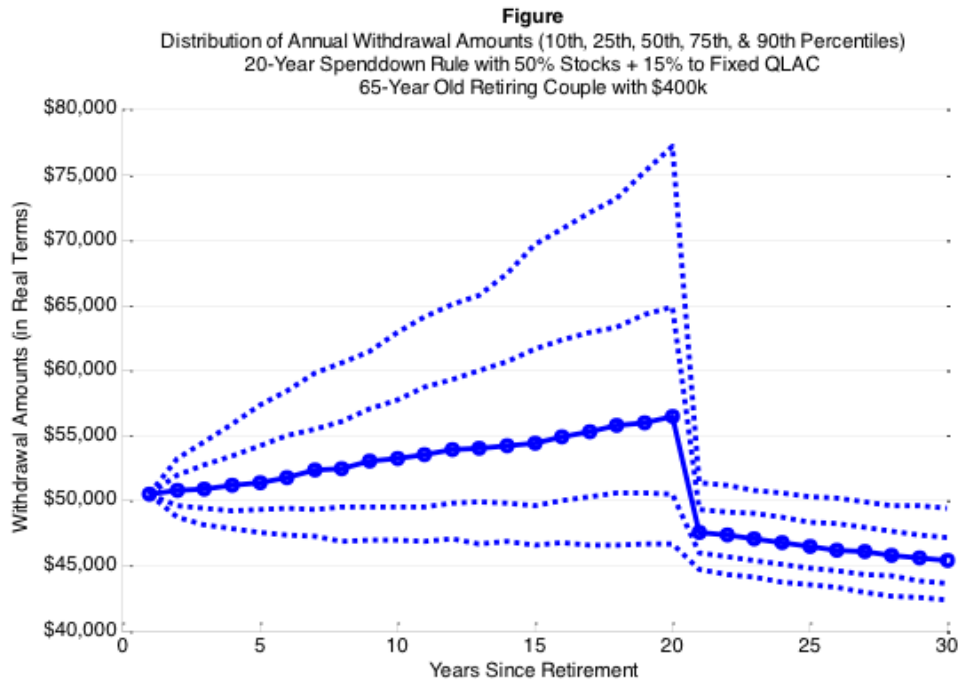
**Figure 8**  
**Retiree #1: Single Female Age 65 with \$250,000**  
**15% of Assets Devoted to QLAC**



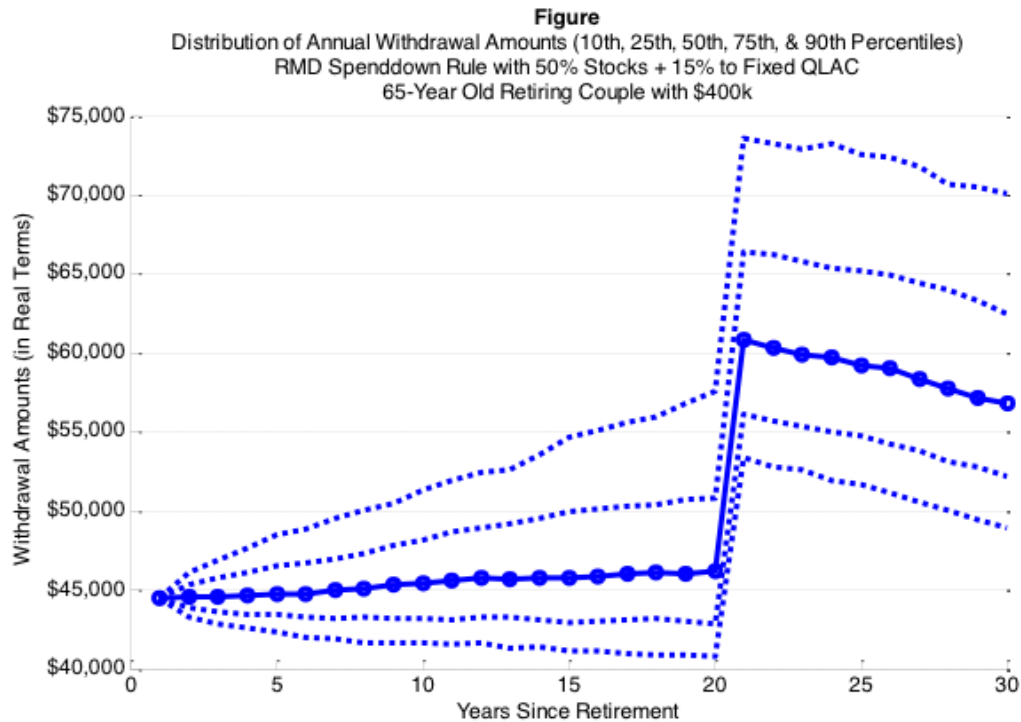
The position on the efficient frontier should not be the only criteria for assessing the suitability of a retirement income strategy. The pattern of expected retirement income is also an important factor. Figures 9 and 10 show projected retirement incomes for 30 years of retirement for selected SWP/QLAC strategies, to illustrate potential discontinuities in income between ages 84 and 85. The results show the retirement incomes under the 10th, 25th, 50th, 75th, and 90th percentiles of a stochastic forecast, to illustrate the potential range of retirement incomes.

The projections are for Retiree #2, the 65 year-old couple with \$400,000 in assets at retirement. All projections assume a 50% asset allocation to equities for SWP strategies. Assuming a higher allocation to stocks increases expected retirement incomes for the 20 years preceding age 85, while also increasing the range of possible incomes under the various percentiles described previously.

**Figure 9**  
**20 Year Spend-down using 15% of Assets Devoted to QLAC**



**Figure 10**  
**Lifetime RMD Strategy + QLAC Using 15% of Assets**



The Phase 3 Interim Report shows additional graphs for different SWP strategies, asset allocations, and initial amount of assets devoted to the QLAC. All these graphs show the same potential for discontinuities between ages 84 and 85.

The SWP/QLAC strategy with the least amount of discontinuity (not shown) devoted 15% of initial assets to a QLAC, and for the remaining 85% of assets, 60% was devoted to a 20 year spend-down SWP strategy and 40% devoted to an RMD strategy. The purpose of this analysis isn't necessarily to advocate that a plan sponsor offer such a blended strategy in a retirement plan; such a strategy might be difficult to package in a generalized manner for a broad range of plan participants. Instead, it demonstrates that it could be possible to use a SWP/QLAC strategy that produces a tolerable transition at age 85 using mid-course adjustments in withdrawal strategies and/or asset allocations. Most likely such adjustments would require a qualified retirement advisor or a very well-informed retiree.

### **Comparing SWP/QLAC strategies to SPIAs**

One of the most straightforward methods to generate an income payable for life is to purchase a SPIA, which was analyzed extensively in the Phase 1 baseline analyses. One common objection to a typical SPIA is that there is no liquidity and no access to savings once the SPIA has been purchased. Another possible objection is if there is no death benefit payable if both the retiree and joint annuitant (if applicable) die prematurely, although this objection can be addressed with a period certain and life annuity.

It's possible to construct a SWP/QLAC strategy that provides access to savings until age 85, guarantees a retirement income that the retiree can't outlive, pays unused funds to beneficiaries if the retiree dies before the advanced age, and provides relatively stable amounts of retirement income. However, the resulting amount of income will be less than the income from a SPIA, which helps quantify the cost of the desired liquidity. The Phase 3 Interim report contains analyses that quantify this cost of liquidity as a reduction in annual income ranging between 13% and 20%.

## PHASE 4 KEY RESULTS AND COMMENTARY

Phase 4 analyzes retirement income solutions that protect retirement income in the period leading up to retirement. Phase 4 analyzes various retirement income solutions for two hypothetical near-retirees:

1. Single female age 55 with \$180,000 in assets, who will retire at age 65
2. Married couple both age 55 with \$300,000 in assets, who will retire at age 65

The above asset values were chosen to be consistent with assumed age 65 asset values for Phases 1, 2, and 3, assuming average investment returns after age 55. Above asset values are assumed to be dedicated to generating retirement income, and do not include separate assets devoted to a safety cushion for unexpected emergencies. No additional contributions are assumed to be made after age 55.

We assumed that these near-retirees would use a portion of retirement savings to protect retirement income from capital market downturns with the following strategies:

- Invest 100% of assets in a target date fund (TDF) at age 55, and use systematic withdrawals to generate retirement income beginning at age 65. The withdrawal method is the IRS required minimum distribution (RMD-SWP). Repeat for a balanced fund with a constant 65% allocation to stocks. These serve as baselines to compare to other strategies. Most TDFs are constructed assuming the retiree will remain invested throughout retirement and use a SWP to generate retirement income.
- Invest 100% of assets at age 55 in a fixed deferred income annuity (DIA) commencing at age 65.
- Invest 100% of assets at age 60 in a fixed DIA commencing at age 65. From age 55 to 60, assets are invested in a TDF. Repeat for a balanced fund with a constant 65% allocation to stocks.
- Assets are invested in a TDF until age 65, and then purchase a fixed single premium immediate annuity (SPIA) at age 65 with 100% of assets at that time. Repeat for investing from age 55 to 65 in a balanced fund with a constant 65% allocation to stocks.
- Assume 100% of assets are invested in a guaranteed lifetime withdrawal benefit (GLWB) annuity at age 55. At age 65, the contract provisions determine the annual income (assumed payout rates are 5% for a single retiree, 4.5% for a couple). Assume 60% of savings invested in stocks.
- Assume 10% of assets at each age between 55 and 64 are used to purchase a fixed DIA starting at age 65 (laddered DIA). Remaining assets are invested in a TDF until age 65. Repeat for a balanced fund with a constant 65% allocation to stocks.
- Assets are invested in a TDF until age 65, and then purchase a fixed SPIA at age 65 with 30% of assets at that time (partial annuitization). Use RMD-SWP to generate retirement income with remainder of assets. Repeat for a balanced fund with a constant 65% allocation to stocks.
- Assume 30% of assets at age 55 are used to purchase a fixed DIA starting at age 65 (partial annuitization). Remaining assets are invested in a TDF until age 65. Use RMD-SWP with remaining assets at age 65 to generate income at age 65. Repeat for a balanced fund with a constant 65% allocation to stocks.
- Assume 30% of assets at age 60 are used to purchase a fixed DIA starting at age 65 (partial annuitization). Remaining assets are invested in a TDF until age 65. Use RMD-SWP with remaining assets at age 65 to generate income at age 65. Repeat for a balanced fund with a constant 65% allocation to stocks.

The DIAs, SPIAs, and GLWBs modeled in Phase 4 are described in Appendix A. Appendices B and C describe assumed pricing for these products, and the expenses and asset allocation for GLWBs. There can be many variations among these products with respect to features, pricing, and asset allocation that might differ from the products modeled in this report.

Table 3 summarizes results from the stochastic forecasts that illustrate the possible range of retirement incomes. In particular, a significant decrease between the income expected by a worker at the anticipated retirement age and the income realized under an unfavorable economic scenario can result in delayed retirement or retiring under undesirable circumstances.

Table 3 compares projected retirement income at age 65 for four retirement income solutions under the 50th percentile (representing the expected retirement income) and the 10th percentile (representing the unfavorable scenario). The projections are for hypothetical retiree #2, the 55 year-old couple with \$300,000 in assets.

Table 3 shows that DIAs result in more projected predictability and less uncertainty in retirement incomes, and result in the greatest protection in income in the period leading up to retirement, compared to using investing solutions with TDFs during this period.

**Table 3**  
**DIAs Reduce the Potential Decrease in Retirement Income at Age 65**  
**Due to Unfavorable Economic Scenarios**

Projected annual real retirement income at age 65

| Retirement income strategy                             | Expected (50 <sup>th</sup> percentile) | 10 <sup>th</sup> percentile | Percentage Difference |
|--------------------------------------------------------|----------------------------------------|-----------------------------|-----------------------|
| TDF with RMD-SWP at age 65                             | \$11,604                               | \$7,285                     | -37.2%                |
| 100% of savings to purchase DIA at age 55              | \$22,500                               | \$19,019                    | -15.5%                |
| TDF until age 60, then 100% of savings to purchase DIA | \$22,010                               | \$15,226                    | -30.8%                |
| TDF until age 65, then 100% to purchase SPIA           | \$21,655                               | \$13,595                    | -37.2%                |
| All savings to laddered DIA between ages 55 and 64     | \$22,369                               | \$17,350                    | -22.4%                |

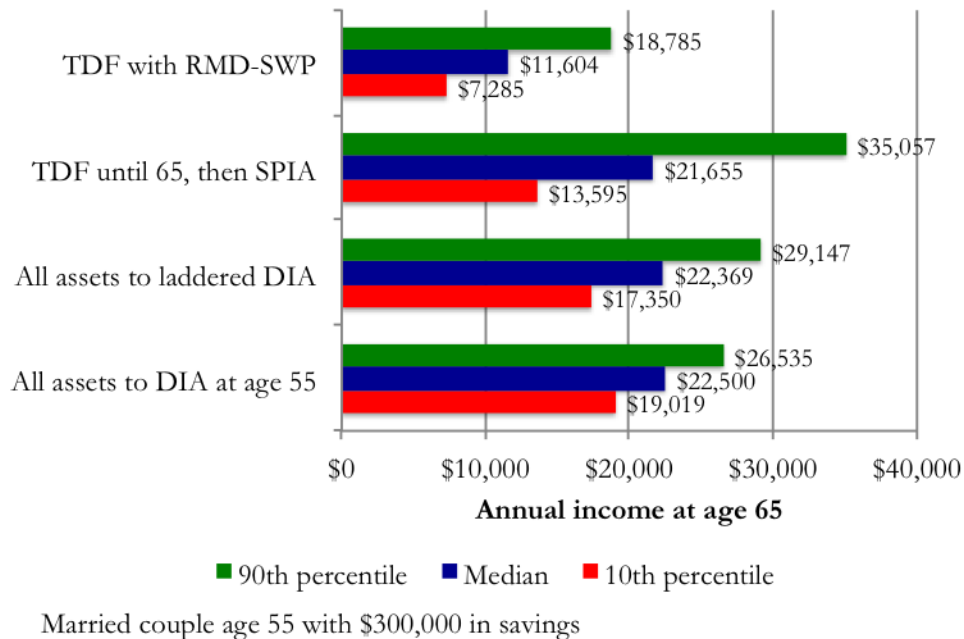
Married couple with \$300,000 in assets at age 55

The above analysis considers just the downside potential of certain retirement income strategies. This is important considering the common behavioral economics phenomenon that people experience the pain of losses more than the enjoyment of gains.

When developing a retirement income portfolio, however, retirees and their advisors might also consider both the downside and upside potential. Figure 11 shows the range of possible initial retirement incomes at age 65 for various retirement income solutions, under the 10th, 50th, and 90th percentiles of the stochastic forecasts. This graph is for the married couple at age 55 with \$300,000 in assets.

- This shows that investing in a TDF until age 65, and then using either an RMD-SWP or SPIA to generate retirement income, produces the widest percentage range between the favorable and unfavorable outcomes.
- DIAs result in the narrowest range between the highest and lowest amounts of real annual retirement incomes, expressed in percentage terms. Most or all of the differences in real incomes for the DIA strategies result from different scenarios for inflation.

**Figure 11**  
**Investing All Assets in TDF until Age 65 Shows Widest Range of Possible Outcomes in Retirement Incomes at Age 65 when Expressed as Percentage**



The above results support a strategy where older workers approaching retirement consider the minimum amount of retirement income for which they need relative certainty, and deploy a program of purchasing DIAs to secure that income. They could then invest their remaining assets to cover discretionary living expenses that require less certainty, and for which they may be willing to accept investing risk for upside potential.

A laddered approach to purchasing DIAs has a few advantages:

- From a behavioral perspective, it allows an older worker to make a series of incremental decisions, rather than one “all or nothing” decision.
- It allows the older worker to dollar-cost-average their annuity purchases, which mitigates vulnerability to interest rate swings.

Ideally an older worker would decide the amount of income they ultimately want to receive from an annuity at retirement, and prorate the annuity purchases each year until their target retirement age to end up with the targeted amount of annuity income. Note that laddered purchases of DIAs within retirement plans are relatively uncommon at the writing of this report, but that the Treasury guidance referenced previously enables such a feature.

We prepared the same stochastic forecasts and efficient frontiers as described previously for Phases 1, 2, and 3, with one exception. We did not include Social Security benefits since we wanted to focus on the efficacy of various strategies to protect income in the period leading up to retirement.

Here are key results from Efficient Frontier #1, which focuses on retirement income, and are summarized on pages 21-25 of the Phase 4 Interim Report:

- Buying a fixed DIA at age 55 produces the highest amount of average annual real income expected at age 65, with also the highest amount of average annual income under the unfavorable scenario. This DIA also produced the lowest drop in income between the expected and unfavorable scenarios, measured on a percentage basis, as shown later in this report.
- The next most favorable solutions are, in order:
  - Laddered approach to buying a DIA between age 55 and 64 (roughly 10% of assets are used to purchase a DIA at each age)
  - Invest in a TDF or balanced fund until age 60, then buy a DIA with 100% of assets
  - Invest in a TDF or balanced fund until age 65, then buy a SPIA with 100% of assets
- Partial annuitization solutions project higher average real retirement incomes than RMD-SWP solutions, both under the expected and unfavorable scenarios.
- For all solutions that invest savings, either before or during retirement, the balanced fund invested 65% in stocks projects slightly higher retirement incomes than the TDF, due to the higher allocation to stocks compared to the TDF allocation.
- For the partial annuitization solutions that devote 30% of assets to an annuity, purchasing the DIA at age 55 projects the highest amount of average annual income under both the expected and unfavorable scenarios.
- The laddered approach to partial annuitization devotes approximately 3% of assets at each age between 55 and 64 to buy a DIA that starts at age 65. Remaining assets are invested in a TDF, and use the RMD-SWP to generate income at age 65. This solution represents one possible implementation of the Treasury guidance described earlier in this report regarding TDFs. This solution projects the second-highest amount of average annual income under both the expected and unfavorable scenarios.
- For the partial annuitization solutions, projected retirement incomes were higher using a balanced fund with 65% of assets devoted to stocks, compared to investing in a TDF.
- Partial annuitization solutions with DIAs project higher retirement incomes than a GLWB. This helps quantify the cost of liquidity, a feature of GLWBs but not of DIAs.

Here are key results from Efficient Frontier #2, which focuses on the tradeoff between retirement income and accessible wealth, and are summarized in pages 28-30 of the Phase 4 Interim Report:

- All of the solutions that annuitize all assets by age 65 produce higher average annual retirement incomes than partial annuitization or SWP solutions, but there is no accessible wealth beyond age 65. This helps quantify the cost of liquidity, and was addressed in our Phase 1 report.
- Partial annuitization solutions produce higher average annual retirement incomes than pure SWP solutions, but lower accessible wealth.
- Solutions that use the balanced fund invested 65% in stocks project higher retirement incomes than solutions that use TDFs.
- Partial annuitization solutions project higher retirement incomes and higher accessible wealth over retirement than the GLWB.

Our Phase 4 Interim Report includes graphs that show the results of the analyses for Efficient Frontiers #1 and 2.

Appendix E of the Phase 4 Interim Report also contains projections of retirement incomes for a 30-year retirement, using the same format as Figures 9 and 10. These forecasts can be used to determine the general pattern of retirement income (level or decreasing on a real basis, after adjusting for inflation). These forecasts can also be used to assess the potential volatility of a specific retirement income solution. Retirement income solutions with wider variation between the 10th and 90th percentiles are more likely to have retirement incomes that fluctuate, compared to solutions with narrower variation between these extreme outcomes. These graphs demonstrate that solutions using an RMD-SWP with TDF start with lower retirement income compared to solutions that use annuities, and they have the widest range in possible outcomes, but they are more likely to keep up with inflation.

# HOW PLAN SPONSORS CAN USE THESE ANALYSES

DC plan sponsors can address the varying needs of their retirees by packaging retirement income solutions that address different retirement planning goals, such as:

- A retirement income that's guaranteed for life, no matter how long the retiree lives.
- A retirement income that provides access to savings in case of significant needs, such as long-term care expenses.
- A retirement income that has the potential for growth, to address inflation risk.
- A retirement income that won't decrease if investments perform poorly.

When designing a retirement income program, DC plan sponsors will want to weigh the administrative and communication burdens of various RIGs and retirement income solutions vs. their potential advantages. DC plan sponsors could help meet the varying goals of participants described above by starting with a straightforward retirement income program that offers the following basic RIGs:

- The ability to purchase SPIAs that are fixed, inflation adjusted, or adjusted by a growth factor such as 3%.
- An installment payment feature that implements a SWP with a few different withdrawal strategies, together with a few different funds with varying asset allocations.
- Withdrawal strategies could be the IRS RMD, or use fixed percentages such as 3%, 4%, 5%, or 6%. As a practical matter for tax-qualified plans, after age 70-1/2 the RMD would override the fixed percentage if the RMD results in a higher withdrawal amount.
- A period certain payout to enable delaying Social Security benefits, as analyzed in Phase 2.

*The transition from defined benefit to defined contribution retirement plans won't be complete until many DC plan sponsors offer their retiring employees a carefully designed and communicated retirement income menu that complements the plan's investment menu.*

Because it may be desirable for retirees to devote a portion of savings to guaranteed solutions and a portion of savings to investing solutions, a basic retirement income program could also help by packaging retirement income solutions. Here are a few examples:

- A handful of packaged combinations of SPIAs and SWPs together with appropriate investment funds, for retirees who want to choose among a limited menu of solutions.
- The ability to custom-mix SPIAs and SWPs in whole percentages, for “do-it-yourselfers” or individuals working with advisors.
- A designed default retirement income solution that might meet the needs of many employees.

The above RIGs and packaged retirement income solutions are readily available to most DC plans.

DC plan sponsors who have the resources to analyze and implement more complex retirement income solutions could consider adding the following RIGs:

- GLWBs that can offer both guaranteed lifetime retirement income and access to savings throughout retirement.
- QLACs to meet specialized needs and circumstances, such as workers who can afford to delay the retirement income until an advanced age or retirees who want to plan for a boost in retirement income when they might be experiencing increased costs for medical and long-term care.
- Deferred income annuities or GLWBs to enable older workers to protect their retirement income from investment volatility in the period leading up to retirement.

- Target date funds that transition a portion of fixed income assets into deferred annuities for workers approaching retirement, as envisioned by recent Treasury guidance.

Plan sponsors that don't want the administrative complexity of the above solutions could allow workers over age 59-1/2 to initiate in-service distributions and roll over the assets to IRAs at financial institutions that offer these solutions.

Plan sponsors might also consider offering life, disability, and long-term care insurance through an employee benefit portal as part of their retirement offerings.

To narrow down the possible choices of RIGs and packaged retirement income solutions, DC plan sponsors could start with retirement income solutions that are near the efficient frontiers of these analyses. They could also consider offering retirement income solutions that have valid and documented reasons for not being on the efficient frontier, such as the goal to provide a more level stream of income, reduce volatility of retirement income, or address common behavioral investing challenges.

Plan sponsors can help participants make informed decisions by communicating the salient features of the various retirement income solutions, including:

- the amount of initial retirement income,
- the expected pattern of increases or decreases in future income, and the circumstances when income could increase or decrease,
- whether the income is guaranteed for the life of the participant (and spouse or beneficiary, if applicable),
- whether the method of generating income can be modified after the income starts, and if yes, the procedures for making such changes, and
- whether assets can be accessed for any reason, such as to pay for long-term care expenses or emergencies.

Plan sponsors may want to offer a retirement planning service that explains the above concepts to older workers approaching retirement and guides them to appropriate decisions.

An important concern for plan sponsors is their exposure to fiduciary liability when selecting and communicating retirement income solutions to offer plan participants. As discussed in the report *The Next Evolution in Defined Contribution Retirement Plans*,<sup>1</sup> ERISA requires plan sponsors to act in the best interests of plan participants, which the courts have characterized as requiring fiduciaries to engage in a prudent decision-making process.

One goal for this report is to demonstrate processes and analyses that a plan sponsor and/or advisor could conduct as part of the prudent decision-making process. For more details on the relevant fiduciary issues, see the above report, and the related SCL/SOA report titled *Foundations in Research for Regulatory Guidelines on the Design & Operation of Retirement Income Solutions in DC Plans*.<sup>4</sup> This latter report uses guidance under ERISA Section 404(c) on the investment menu as a template for structuring a program of retirement income. It also contains a discussion on designing default retirement income solutions.

Some plan sponsors may decide not to offer retirement income programs in their DC plans for various reasons. These plan sponsors may still want to familiarize themselves with the analyses and concepts presented in this report, to help them understand how their retiring employees might use the investment options in their plans to generate retirement income and to optimize their Social Security income. They may also want to understand the issues with target date funds as older employees approach retirement.

For an in-depth discussion of various issues with designing and implementing a retirement income program in a DC plan, including analyses of stand-alone RIGs and a glossary of terms, see the report *The Next Evolution in Defined Contribution Retirement Plans*.<sup>1</sup>

# HOW RETIREES AND ADVISORS CAN USE THESE ANALYSES

Retirees and their advisors can develop a diversified portfolio of retirement income that has a reasonable chance of providing reliable lifetime income and meets the retiree's specific goals and objectives. Left to their own devices, retirees tend to exhibit two distinct strategies to generate retirement income:

1. Spending their savings too rapidly, at a rate that most likely will cause them to outlive their savings, or
2. Conserving savings for a rainy day, often withdrawing just the required minimum distribution (RMD) from IRAs and 401(k) accounts.

Neither strategy seems optimal – retirees and their advisors can use the analytical framework in this report to find a middle ground between the two extremes described above.

Annuities and Social Security benefits have different properties compared to investing solutions using SWPs. Our analyses demonstrate that annuities generally produce the highest amount of expected lifetime retirement income for the RIGs analyzed in this report and the assumptions we used, due to the pooling of longevity risk. Retirees whose exclusive focus is guaranteed lifetime retirement income may want to consider a substantial investment in annuities. However, many retirees have other goals in addition to just producing the maximum amount of expected retirement income.

For example, many retirees may want to balance the goals of maximizing expected retirement income and the wealth that is accessible throughout retirement. Retirees and their advisors can use the analyses in this report to quantify the tradeoff between these two goals, and evaluate solutions that combine annuities and SWPs.

Retirees will want to know if their expected retirement income is sufficient to cover their basic and discretionary living expenses. If not, armed with estimates of potential shortfalls, they can make informed lifestyle decisions about adjusting their budgets for living expenses, continuing to work, and leaving realistic legacies.

One possible approach for a combination solution is to cover essential living expenses with guaranteed, lifetime income sources such as Social Security benefits and income from defined benefit plans (if available), together with using a portion of retirement savings to buy a low-cost annuity. A SWP would be applied to the remainder of retirement savings to generate retirement income to cover discretionary living expenses. The financial analyses in this report support a high allocation to stocks for the portion of savings devoted to the SWP, although behavioral considerations may call for moderate equity allocations.

For SWP strategies, retirees may want to fine-tune the withdrawal rate to reflect the desire to consume savings sooner or later (pay me now or pay me later).

Solutions along the efficient frontiers can be starting points for consideration. However, there can be valid reasons for refining and selecting solutions that aren't on the efficient frontier, such as the desire to reduce volatility in income. For example, one solution close to Efficient Frontier #2 devotes 70% of savings to a RMD SWP with 100% allocation to equities, and 30% to a 3% growth SPIA. For Retiree #1 (65 year-old female with \$250,000 in savings) this solution produces a total annual average income of \$28,324 per year.

Shown below are the projected annual incomes for reduced allocation to equities for assets devoted to the SWP:

|                  | Average<br>Income | Decrease  |
|------------------|-------------------|-----------|
| • 100% equities: | \$28,324          | NA        |
| • 75% equities:  | \$27,810          | (\$514)   |
| • 50% equities:  | \$27,222          | (\$1,102) |
| • 25% equities:  | \$26,569          | (\$1,755) |
| • 0% equities:   | \$25,914          | (\$2,410) |

Factors that might influence the need for accessible wealth throughout retirement include:

- The desire to leave a legacy with unused funds.
- The desire to pay off a mortgage to reduce living expenses.
- Building a reserve for long-term care. (Note that annual costs can potentially range from \$50,000 to \$100,000, so substantial accessible assets would be needed to fund periods of care lasting a few years or more. If a retiree has purchased long-term care insurance or is holding home equity in reserve for that event, there could be less of a need for accessible wealth.)

If savings are accessed and consumed, they are no longer available to generate retirement income. As a result, ideally a retiree would have a separate reserve for emergencies, or unexpected or irregular expenses, such as home repairs, new cars, etc.

Retirees and advisors should consider the risk of significant long-term care expenses when developing a retirement income strategy. Buying long-term care insurance turns a highly uncertain and potentially ruinous expense into a more predictable stream of premiums that can be budgeted and paid for with expected retirement income (a classic argument for insurance). If retirees don't purchase long-term care insurance, retirees with substantial home equity might decide to keep home equity in reserve to use as a source of funding long-term care, if needed.

Medicaid is a last resort for obtaining long-term care. However, retirees who expect to rely on Medicaid for long-term care most likely will need to deplete most or all of their assets; in this case, there won't be assets left to generate retirement income (a critical problem if a spouse survives the person needing care).

Another possibility would be to devote a portion of assets to a SPIA, to boost expected lifetime income, and devote remaining assets to a SWP with accessible assets. For assets devoted to generating income with a SWP, use a low withdrawal rate (3% or investment earnings only) with a high allocation to equities to increase the projected amount of assets in later years when long-term care expenses are most likely. In this case, retirees still run the risk of depleting assets for a surviving spouse if the first spouse needs care.

Unless a retiree has substantial accessible retirement savings, well in excess of \$500,000 (\$1,000,000 for couples), it may be too much to expect a retirement income solution to also solve the long-term care challenge. This would necessitate using other solutions, such as long-term care insurance or use of home equity.

Our Phase 2 analyses show that in most cases, retirees can increase expected lifetime retirement income by using retirement savings to enable a strategy to delay the start of Social Security benefits until age 70. The exceptions to this suggestion include retirees with an extreme desire for liquidity and accessible wealth, or retirees (and spouse or partner if applicable) in very poor health.

In essence, the increase in Social Security by delaying the start of benefits can be viewed as buying an annuity from the U.S. government at a very favorable rate.

There are two common situations that deserve special attention.

- Retirees who use SWPs to generate retirement income and invest substantial amounts of assets in fixed income investments, in particular, should consider a strategy to delay Social Security benefits. The Phase 1 solutions that came the closest to delivering the same amount of projected retirement income as Phase 2 solutions were those solutions with 100% of SWP assets invested in equities. Such strategies assume substantial investment risk, whereas there is no investment risk with a strategy to delay Social Security benefits.
- Retirees using retail SWP investments or retail annuity products should consider first devoting a portion of assets to delay Social Security. Our analyses use institutional pricing for comparing SWP and annuity strategies, and illustrate a significant advantage for the delay strategy. The improvement in projected outcomes for a delay strategy will only increase when comparing to retail investment and annuity solutions.

Our Phase 3 analyses of QLACs show that they may be advantageous in limited circumstances, as follows:

- The retiree (and advisor) has the expertise to build a SWP/QLAC combined strategy, and they are ready and able to continuously monitor the SWP withdrawal and asset allocation throughout retirement in the period before the QLAC starts.
- The retiree wishes to work until the advanced age when the QLAC starts.
- The retiree wants to build in an increase in retirement income at an age when medical and long-term care costs might increase.

Our Phase 4 analyses show that retirees and their advisors should consider strategies to protect a portion of retirement income in the period leading up to retirement, either through the purchase of deferred income annuities (DIAs) or guaranteed lifetime withdrawal benefits (GLWBs). These RIGs could be used to cover essential living expenses in retirement.

Retirees and their advisors should be aware of the risks of remaining fully invested in target date funds right up to the retirement date with the expectation of using SWPs in retirement to generate income. Our analyses suggest that this latter strategy has the potential for significant declines in retirement income due to stock market declines. As a result, this strategy might be considered only to generate retirement income over and above a floor of guaranteed income.

Retirees and their advisors will want to compare the retirement income solutions available through the employer-sponsored retirement plan to solutions available through IRAs with financial institutions. In some instances, employer-sponsored retirement plans offer low-cost institutional pricing with the potential to increase retirement income. On the other hand, financial institutions have the potential to offer retirement income solutions that aren't available within employer-sponsored retirement plans. For example, many employers don't offer annuities in their plans, and retirees who wish to purchase an annuity may need to roll over assets to an IRA.

The analyses in this report focus on retirement income that can be generated through employer-sponsored DC plans. When developing a retirement income portfolio, retirees and their advisors may also want to consider all potential sources of retirement income, including:

- Defined benefit plans offer lifetime retirement income that's protected from capital markets, and if available, should be considered when assessing a retiree's amount of guaranteed lifetime retirement income.
- Similarly, annuity and life insurance policies held outside employer-sponsored retirement plans are potential sources of guaranteed, lifetime retirement income.
- Retirees with substantial home equity may want to consider using reverse mortgages, to provide additional periodic retirement income or coordinate with SWP programs to mitigate sequence of returns risk.
- Assets, benefits, and insurance policies held by spouses.

In addition, retirees with legacy objectives can consider charitable gift annuities as part of their retirement income portfolio.

The desire to leave a legacy may also influence their choice of RIGs. While this report does not include projections of legacy values, the online tables containing results for Phases I and 2 include projected average bequests at death for the RIGs analyzed:

- <http://longevity3.stanford.edu/phase1.htm>
- <http://longevity3.stanford.edu/phase2.htm>

# HOW FINANCIAL INSTITUTIONS AND ADVISORS CAN USE THESE ANALYSES

In April 2016, the Department of Labor promulgated regulations that require financial professionals who are providing advice to consumers with respect to their retirement accounts to act as fiduciaries. As such, their recommendations must be made in the best interest of their clients.

The analyses in this report can be used by financial institutions and advisors to help form recommendations for constructing retirement income portfolios that are in the best interest of their clients who are close to or in retirement. Such institutions and advisors will want to base their recommendations on analyses and data that demonstrate their recommendations best meet the specific goals and circumstances of each client.

Advisors and financial institutions can best serve their clients if they're able to recommend diversified retirement income portfolios with the potential to be allocated among different common retirement income classes, including Social Security benefits, invested assets, and annuities. Other assets and resources such as home equity and continued work might also be considered.

*Financial institutions and advisors may want a rigorous, documented approach to demonstrate they're recommending retirement income portfolios that best meet their clients' unique goals and circumstances.*

On their own, many retirees adopt planning horizons that are much shorter than their expected lifetimes. Advisors can add value to their clients by using the concepts in this report to develop retirement income portfolios that deliver retirement income throughout their clients' lives, no matter how long they live.

Ideally, financial institutions and advisors will want to understand each client's goals and circumstances that can influence the retirement income allocation decision, including:

- The desired amount of retirement income expected throughout retirement.
- The expected pattern of change in retirement income over time, for example, to keep pace with inflation.
- The amount of protection that's needed against decreases in retirement income due to investment losses and interest rate changes.
- The portion of income that the retiree wants to be guaranteed for life, no matter how long the retiree lives.
- The current health status and life expectancy of the retiree and spouse/partner, if applicable.
- The desired protection against the threat of long-term care, and the potential influence on the retirement income allocation decision.
- The specific needs and desires for liquidity and access to savings throughout retirement.
- The retiree's desires to leave a legacy upon death.

Each of these goals has the potential to conflict with other goals, so an important task for the advisor is to help the retiree prioritize and make tradeoffs among competing goals. The analyses in this report can help quantify the tradeoffs among competing goals, and to help quantify the "price" incurred by meeting a specific goal.

We suggest that financial institutions and advisors will want to demonstrate they've acted in the best interests of their clients by:

- using a disciplined and documented process to understand each client's goals and circumstances, and
- demonstrating how their recommendations for constructing a specific retirement income portfolio best meets these unique goals and circumstances by using an analytical framework and data.

*Such a process will be an improvement over using intuition and gut feel for making retirement income recommendations. Financial institutions and advisors who automatically exclude or overlook common retirement income classes will be at a disadvantage compared to professionals who can consider a broad range of retirement income classes when making retirement income allocation recommendations.*

# COMMENTARY ON ANALYSES FOR ALL FOUR PHASES

The results presented in this report reflect the specific circumstances of the hypothetical employees and the assumptions used to produce the stochastic forecasts. Different employees and alternative assumptions will produce different results. For example:

- Higher assumed real rates of return generally produce more favorable projections, and vice versa.
- Higher returns of stocks relative to bonds and annuity purchase rates will show more favorable projections for investing solutions, while lower returns of stocks relative to bonds and annuity purchase rates will show more favorable projections for insured solutions.
- For both investing and insured solutions, low-cost institutionally priced solutions were assumed. Higher-cost solutions would produce less favorable results than shown in this report.

As a result, the results from this report may or may not be generalized to other situations. Nevertheless, important insights may be gained from this report, and in particular, the methods used in this report can be used with alternative assumptions and the circumstances of other retirees.

The analyses in this report assume no risk of insurance company default. Retirees and advisors who want to address this risk should consider insurance company ratings and the limits of state guaranty associations. Consistent with the goal of developing a diversified portfolio of retirement income, retirees may want to consider diversifying annuity purchases among more than one insurance company.

One method to increase guaranteed retirement income from a source commonly assumed to be riskless is to increase Social Security benefits by delaying benefits, and Phase 2 addresses this strategy.

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# APPENDIX

## Appendix A: Definitions

- Deferred income annuity (DIA) is an insurance product that guarantees a lifetime retirement income beginning at a specified future age; typical starting ages are 65, 70, or 75, although later ages can be used (see QLAC below). The amount of income can be fixed in dollar terms, adjusted for inflation, or adjusted at a specified rate (such as 3% per year). Joint and survivor annuities continue income as long as one beneficiary is alive. The DIAs priced in this project are irrevocable after purchase.
- Guaranteed lifetime withdrawal benefit (GLWB) is an insurance product that acts like a systematic withdrawal plan that determines annual income as a specified percentage of assets and guarantees income for life. Future retirement income may increase with favorable investment performance but is guaranteed not to decrease with unfavorable performance. Retirees may also have access to remaining funds. GLWBs may also be called guaranteed minimum withdrawal benefits (GMWBs).
- Qualified longevity annuity contract (QLAC) is a deferred income annuity (DIA) that starts income at an advanced age, such as age 80 or 85. The QLACs priced in this project started income at age 85, and did not include a pre-age 85 death benefit. QLACs are not subject to the IRS required minimum distribution (RMD). A DIA must satisfy the QLAC requirements to be exempt from the RMD requirements.
- Retirement income generator (RIG) is a stand-alone mechanism that converts savings into retirement income.
- Retirement income solution can be a stand-alone RIG or a packaged combination of RIGs, where retirement savings are allocated among two or more RIGs.
- Single premium immediate annuity (SPIA) is an insurance product that guarantees a lifetime retirement income. The amount of income can be fixed in dollar terms, adjusted for inflation, or adjusted at a specified rate (such as 3% per year). Joint and survivor annuities continue income as long as one beneficiary is alive.
- Systematic withdrawal plan (SWP) invests retirement savings and uses a method for determining periodic retirement income; there is no lifetime guarantee and it is not an insurance product.
  - An endowment SWP calculates the annual retirement income as a fixed percentage of remaining assets at each future year.
  - RMD SWP uses the IRS required minimum distribution table to calculate retirement income, which equals remaining assets divided by remaining life expectancy at each future age.

## Appendix B: Assumptions and Methods

Table B.1. Assumptions Used for Stochastic Forecasts

| Real Returns |                 |                |                    | Correlation Coefficients |       |           |
|--------------|-----------------|----------------|--------------------|--------------------------|-------|-----------|
|              | Arithmetic Mean | Geometric Mean | Standard Deviation | Stocks                   | Bonds | Inflation |
| Stocks       | 5.1%            | 3.1%           | 20.0%              | 1.0                      | 0.1   | -0.2      |
| Bonds        | 0.3%            | 0.2%           | 7.0%               | 0.1                      | 1.0   | -.6       |
| Inflation    | 2.1%            | 2.0%           | 4.2%               | -0.2                     | -0.6  | 1.0       |

Note: The above rates are lower than historical averages. Bond returns reflect the current low-interest rate environment, and stock returns reflect a lower-than-historical premium over bond returns.

These assumptions are intended to analyze and compare retirement income solutions under the economic environment prevalent in 2014, 2015, and early 2016. It is possible to construct assumptions based on different historical periods that would produce significantly different projections than the results in this report.

Mortality table for survival probabilities: Society of Actuaries' RP-2014 Mortality Tables Draft for Healthy Annuitants. Note that this table excludes annuitants who are classified as disabled; it may include annuitants who are somewhat unhealthy but not disabled.

For the purpose of this report, annuity payout rates were sampled in April, 2014, using the Income Solutions annuity bidding platform. A sampling of annuity purchase rates in December, 2014, for Retiree #1, showed decreases in payout rates for immediate annuities resulting in dollar amount decreases in retirement incomes ranging from 2.7% to 4.3% compared to the rates used in this report. This was the result of interest rates declining from April to December of 2014. We sampled annuity purchase rates again in July, 2015, and the change in payout rates for immediate annuities compared to April, 2014 resulted in changes in the dollar amount of retirement incomes ranging from a decrease of 3.9% to an increase of 0.2%. This is the result of slight increases in interest rates during 2015.

Many analysts forecast additional increases in interest rates during 2016, which could result in annuity purchase rates increasing back to levels in April, 2014 or higher. For example, in December 2015, the Federal Reserve increased interest rates for the first time since the Financial Crisis. The authors decided not to chase a moving target and retained the April 2014 annuity purchase rates.

### Notes on Assumptions

- Assumptions for payout rates are representative of institutional pricing.
  - SWP investment expenses: 50 bps
  - GLWB investment and insurance expenses: 150 bps
- GLWB asset allocation is 60% stocks, 40% bonds.
- SPIA and DIA rates based on sex distinct pricing.
- All projected retirement incomes are fully taxable during retirement; projected incomes are gross amounts, before income taxes.

## Appendix B: Notes on Assumptions (continued)

Assumed asset allocation and glide path for the TDF in Phase 4 is based on the averages across fund families from the 2013 Morningstar Report on target date funds, as follows:

| Age | Equity allocation | Age          | Equity allocation |
|-----|-------------------|--------------|-------------------|
| 55  | 66.34%            | 65           | 47.86%            |
| 56  | 64.26%            | 66           | 46.04%            |
| 57  | 62.18%            | 67           | 44.22%            |
| 58  | 60.10%            | 68           | 42.40%            |
| 59  | 58.38%            | 69           | 41.98%            |
| 60  | 56.66%            | 70           | 41.56%            |
| 61  | 54.94%            | 71           | 41.14%            |
| 62  | 53.22%            | 72           | 40.72%            |
| 63  | 51.50%            | 73 and after | 40.30%            |
| 64  | 49.68%            |              |                   |

## Appendix C: Assumptions for Hypothetical Retirees

### Retiree #1

- Single female retiring at age 65
- \$250,000 of assets
- Social Security @ 65 = \$16,895/year

Annuity product pricing at age 65 (annual income as percent of assets at beginning of retirement):

- Inflation-adjusted single life SPIA: 4.82%
- Fixed single life SPIA: 6.76%
- Single life SPIA with 3% growth rate: 4.88%
- GLWB: 5%

Alternative Hypothetical Retiree #1 (Phase 1):

- Single 70-year old female
- \$250,000 of assets
- Social Security @ 70 = \$23,903/year

Annuity product pricing at age 70 (annual income as percent of assets at beginning of retirement):

- Inflation-Adjusted single life SPIA: 5.64%
- Single life fixed SPIA: 7.55%
- Single life SPIA with 3% growth rate: 5.7%
- GLWB: 5.75%

Phase 3 assumptions:

- Fixed QLAC starting at age 85: 51.04% (age 85 income equals 51.04% of age 65 assets)
- QLAC with 3% growth after age 85: 44.05%
- QLAC adjusted for inflation after age 85: 42.94%

Phase 4 assumptions:

- Single female retiring at age 65
- \$180,000 of assets at age 55
- No contributions assumed after age 55
- Rates for fixed DIA commencing at age 65:
  - Purchase age 55: 10.43%
  - Purchase age 60: 8.39%

## Appendix C: Assumptions for Hypothetical Retirees (continued)

### Retiree #2

- Married 65-year old couple
- \$400,000 of assets
- Social Security @ 65: \$22,493/year for primary earner, \$11,054/year for spouse
- Worker's Social Security @ 70: \$31,823
- Spouse's Social Security @ 66: \$12,054

Annuity product pricing (annual income as percent of assets at beginning of retirement):

- Inflation-Adjusted 100% J&S SPIA: 4.06%
- 100% J&S fixed SPIA: 6.02%
- 100% J&S SPIA with 3% growth rate: 4.29%
- GLWB: 4.5%

Phase 3 assumptions:

- Fixed 100% J&S QLAC starting at age 85: 34.58% (age 85 income equals 34.58% of age 65 assets)
- 100% J&S QLAC with 3% growth after age 85: 29.66%
- 100% J&S QLAC adjusted for inflation after age 85: 28.91%

Phase 4 assumptions:

- Married 55-year old couple with \$300,000 of assets
- No contributions assumed after age 55
- Rates for fixed DIA commencing at age 65:
  - Purchase age 55: 9.16%
  - Purchase age 60: 7.35%

### Retiree #3

- Married 65-year old couple
- \$1,000,000 of assets
- Social Security @ 65: \$29,042/year for primary wage earner, \$14,272/year for spouse
- Worker's Social Security @ 70: \$41,089
- Spouse's Social Security @ 66: \$15,564

Annuity product pricing (annual income as percent of assets at beginning of retirement):

- Same as Retiree #2 for all phases.

## Appendix D: Details on Efficient Frontier Calculations

The Y axis of both efficient frontiers is the average real retirement income weighted by the survival probability to each future age, labeled the average expected retirement income. This method starts by stochastically projecting the retirement income under a specific RIG to each future year, using a range of potential outcomes in capital markets and adjusted for projected inflation. As a result, the average income amounts are expressed in today's dollars.

For the purpose of calculating the average real retirement income, the median projected retirement income for each year was used. The median income amount for each future year is then multiplied by the probability that the retiree will survive from the initial retirement date to that future year. The resulting values are averaged over the retirement period to determine the average real retirement income weighted by survival probability.

One result of this methodology is that greater weight is placed on income received in earlier years of retirement compared to later years.

There was no discounting of future income amounts to the initial year of retirement. The rationale is that personal discount rates are difficult to define; even if it's possible to define such rates, they are most likely close to zero under the current interest rate environment.

The average real accessible wealth in Efficient Frontier #2 was calculated in the same manner as described above, except that remaining wealth under each RIG was projected stochastically to each future year. Remaining wealth is the amount that a retiree could withdraw from a RIG at each point in time and deploy to other purposes. The resulting average real accessible wealth projections represent a measure of liquidity that a retiree might have throughout retirement. Similar to the average real retirement income, greater weight is placed on accessible wealth in earlier years of retirement compared to later years.

Note that average accessible wealth as calculated here is different from average legacy at death. While the projected remaining wealth amounts would be the same, the average legacy at death would be weighted by the probability of dying at each future year. As a result, the average legacy at death would weight later years more than earlier years. For middle-income retirees, it was assumed that average accessible wealth would be more important than average legacy at death. High-income retirees may place a greater value on the average legacy at death.

## Appendix E: Key Features of Treasury Guidance on QLACs

- Funds devoted to a qualified longevity annuity contract (QLAC) must be applied in a qualified retirement plan or IRA.
- Assets devoted to a QLAC are exempt from the required minimum distribution (RMD) rules that apply to tax-qualified retirement plans or deductible IRAs. The RMD rules require minimum withdrawals starting at age 70-1/2 (with a few limited exceptions). Any funds remaining after purchasing a QLAC are subject to the normal RMD rules.
- The amount applied to a QLAC must not exceed the lesser of \$125,000 or 25% of the account balance. For the purpose of the \$125,000 limit, all qualified retirement accounts are included (IRAs, 401(k) accounts, etc.).
- The form of payment must be a life annuity that starts at an advanced age – it cannot be an investment product. Payments must commence by age 85.
- QLACs cannot be offered through a variable or index annuity. The payment amount must be fixed at the advanced age; a cost-of-living feature can apply after the advanced age.
- Generally there is no cash surrender value or death benefit if the participant dies before the advanced age, except that a lump sum return-of-premium death benefit is allowed even though that feature will reduce the amount of retirement income.
- Joint life QLACs are allowed to continue retirement income payments after the death of the primary retiree.

*“To the extent that individuals arrive at old age mentally sharp, physically fit, and financially secure, societies will thrive.”*

- Dr. Laura L. Carstensen, Founding Director, Stanford Center on Longevity

*“The work of science is to substitute facts for appearances and demonstrations for impressions.”*

- John Ruskin, Motto of Society of Actuaries



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