



Optimal Retirement Income Solutions in DC Retirement Plans Phase 1: Baseline, Interim Results and Commentary

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SOCIETY OF ACTUARIES

Acknowledgments

Authors:

- Steve Vernon, FSA, svernon@stanford.edu
- Dr. Wade Pfau, wade.pfau@theamericancollege.edu
- Joe Tomlinson, FSA, CFP, joetmail@aol.com

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Carol Bogosian

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Don Fuerst

Cindy Levering

Sandy Mackenzie

David Manuszak

Betty Meredith

Andrew Peterson

Richard Pretty

Anna Rappaport

Steve Siegel

Jody Strakosch

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Project Goals

- Illustrate an analytical framework using stochastic forecasts and efficient frontiers for hypothetical retirees, for determining retirement income generators (RIGs) that could be offered in a DC retirement plan.
- Determine the RIGs or combination of RIGs that could be considered optimal according to specified criteria.
- Encourage plan participants, plan sponsors, and advisors to adopt a portfolio approach to developing retirement income strategies.
- Follow up prior SOA/SCL 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*
- See Appendix A for definition of certain terms, and see above report for additional definition of terms and descriptions of RIGs.

Summary of Analyses

- Phase 1 analyzes RIGs that are currently available in DC retirement plans and are straightforward to implement. Phase 1 establishes a baseline for comparing to future phases.
- Phases 2, 3 and 4 will analyze more complex retirement income solutions, to determine if additional complexity improves projected outcomes and can be justified by delivering more effective results.
 - Phase 2: Use retirement savings to enable delaying Social Security benefits.
 - Phase 3: Combine longevity annuities with systematic withdrawals.
 - Phase 4: Protect retirement income in the period leading up to retirement with deferred income annuities and GLWBs.
- This is the interim report for Phase 1. When the analyses for all phases have been completed, a final report will integrate all four phases.

Summary of Analyses

- Analyze various retirement income solutions for three hypothetical retirees:
 1. Single female retiring at age 65 with \$250,000 in assets.
 2. Married couple both age 65, retiring with \$400,000 in assets.
 3. Married couple both age 65, retiring with \$1,000,000 in assets.
- 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.

Summary of Analyses (continued)

- Starting 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.
- Phase 1: 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).
- See Appendix B for details on methods, assumptions on hypothetical retirees, and capital market assumptions. Assumptions regarding expected returns and inflation reflect the low-interest rate environment prevalent in 2014 and 2015.
 - Arithmetic mean real return: 5.1% for stocks, 0.3% for bonds.
 - Arithmetic mean inflation rate: 2.1%.
 - Annuity purchase rates in April, 2014.
- This report displays the values graphically. For a table of the values underlying the graphs, visit: <http://longevity3.stanford.edu/phase1.htm>

Executive Summary of Results and Conclusions

- The prior SOA/SCL report showed that DC plan sponsors can help retirees generate lifetime retirement income by offering low-cost solutions.
- A definition of “optimal” is really an expression of the priorities of various retirement planning goals. Different definitions of “optimal” produce different solutions that can be considered optimal.
- The analyses in this report focus on the tradeoff between maximizing lifetime retirement income and providing access to wealth. Other goals may also be important and can influence 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.

This report shows analyses that address these considerations as well.

Executive Summary of Results and Conclusions (continued)

- When selecting RIGs to generate retirement income from savings, retirees face a tradeoff between two goals:
 1. Maximizing expected lifetime income, and
 2. Access to savings during retirement.
- RIGs that pool longevity risk (annuities) provide higher expected lifetime retirement income than investing approaches that self-fund longevity risk.
 - Dedicating more savings to annuities increases expected lifetime retirement income and guarantees that retirees cannot outlive their income, but 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.
 - Dedicating more savings to investing solutions increases accessible wealth and potential inheritances, but decreases expected lifetime retirement income. Note, however, that there will be little or no inheritances if retirees outlive their savings.

Executive Summary of Results and Conclusions (continued)

- Many retirees may not need to utilize the extremes of exclusive retirement income solutions.
 - 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.
 - The existence of guaranteed lifetime income from Social Security and a portion of savings dedicated to an annuity can enable remaining assets to be invested 100% in equities, if retirees could tolerate the volatility in income from invested assets.

Executive Summary of Results and Conclusions (continued)

- With a systematic withdrawal plan 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 systematic withdrawal 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.

Executive Summary of Results and Conclusions (continued)

- The analyses in this report can be used to quantify the impact of deploying alternative retirement income strategies that meet different goals.
- 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.”
- 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.

Executive Summary of Results and Conclusions (continued)

- 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.
- Traditional annuities produce higher *expected* average retirement income (median result of stochastic forecast) than SWP strategies, due to longevity pooling. SWP strategies produce higher expected incomes under *favorable* investment scenarios, confirming a result from the prior SOA/SCL report.
- Projected retirement incomes are increased significantly – by 25% to 34% or more -- by delaying retirement from age 65 to 70.

Phase 1 Retirement Income Solutions

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.

Note: 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.

Phase 1 Retirement Income Solutions

(continued)

Note: The classic “four percent” rule – withdrawing a fixed dollar amount regardless of investment returns – was not included. The prior SOA/SCL report showed this method failed (savings were exhausted) in unfavorable investment scenarios.

Stand-alone annuities:

- Inflation-adjusted single-premium immediate annuity (SPIA)
- Fixed SPIA
- SPIA with 3% growth factor
- VA/GLWB (Asset allocation: 60% equities/40% fixed income)

Packaged solutions:

- 70% of savings to each systematic withdrawal approach with all previous asset allocations, 30% to each annuity approach.
- GLWB annuities were not included in packaged solutions.

Defining Optimal with Retirement Income Efficient Frontiers

- For a particular retirement income solution, efficient frontiers illustrate the tradeoff between two retirement income objectives.
- Many 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).

Defining Optimal with Retirement Income Efficient Frontiers

- We used two types of efficient frontiers.
 - Efficient frontier #1: Emphasize retirement income.
 - Efficient frontier #2: Illustrate tradeoff between amount of expected retirement income and accessible savings.
- Stochastic forecasts produce retirement income projections under a range of expected, unfavorable and favorable scenarios.

Defining Optimal with Retirement Income Efficient Frontiers

- “Optimal” is in the eye of the beholder
 - Different definitions of optimal will produce different solutions that could be considered optimal.
- Other possible analyses of optimal could consider:
 - Volatility in 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.

Details on Efficient Frontier #1

- Participant's most important goal: Maximize lifetime income that maintains purchasing power.
 - Tradeoff: Return vs. risk, defined in terms of retirement income.
- 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.
- Rationale: An inflation-adjusted SPIA represents a guaranteed lifetime income with inflation-protection. Analyze if another solution can be expected to generate a higher amount of annual income by assuming some additional risk compared to the SPIA.

Details on Efficient Frontier #1 (continued)

- 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, then the annuity will produce higher amounts of income. If the withdrawals are too aggressive, then eventually the assets will decline significantly and resulting income will also fall short relative to the inflation-adjusted annuity.
- See Appendix B for details on the methods used for the efficient frontiers and stochastic forecasts.

Hypothetical Retiree #1

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

- Annuity product pricing (annual income as a percent of assets at the beginning of retirement):
 - Inflation-adjusted SPIA: 4.82%
 - Fixed SPIA: 6.76%
 - SPIA with 3% growth rate: 4.88%
 - GLWB: 5%
 - Above rates in effect during April, 2014 for institutionally priced GLWB products and using competitive annuity bidding for SPIAs.

- Capital market assumptions for SWP modeling shown in Appendix B.

Commentary on Efficient Frontier #1

- SPIAs produce highest amount of income with lowest amount of risk, defined as shortfall of expected income relative to an inflation-adjusted SPIA under the 10th percentile stochastic forecast.
- SPIA with 3% growth factor produces somewhat higher expected income than inflation-adjusted SPIA, but assumes very modest risk.
- The next best solutions are partial annuitization strategies.
 - Partial annuitization strategy producing highest expected average income is 30% of assets to SPIA increasing 3% and 70% to SWP using 7% withdrawal strategy with 100% allocation to equities, but produces a pattern of decreasing income. SWP with RMD strategy withdrawal rate is close behind on expected average income, and produces more level pattern of income (see Appendix E).

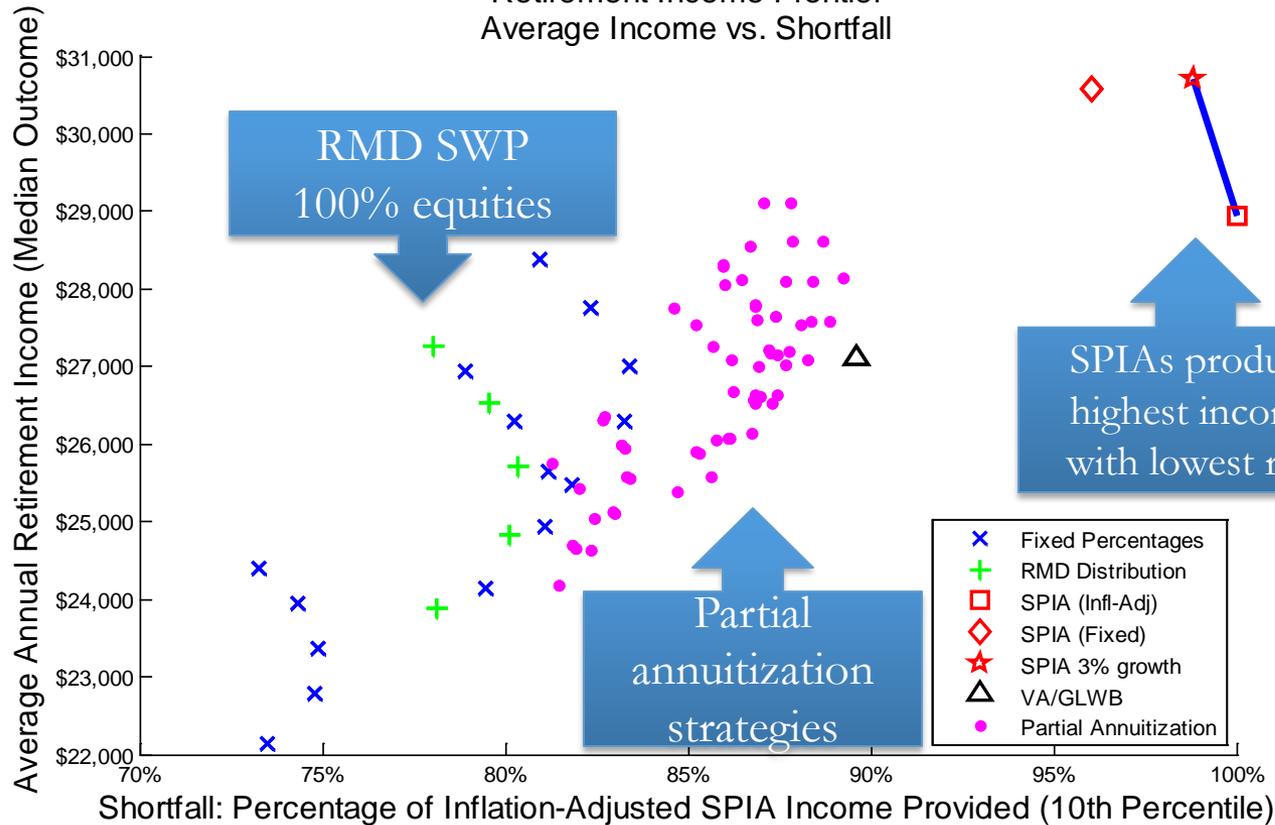
Commentary on Efficient Frontier #1 (continued)

- Compared to annuities, generally SWPs produce lower average 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 have more risk.

Efficient Frontier Analysis #1: Emphasize Retirement Income

Hypothetical Retiree #1: Single female age 65 with \$250,000

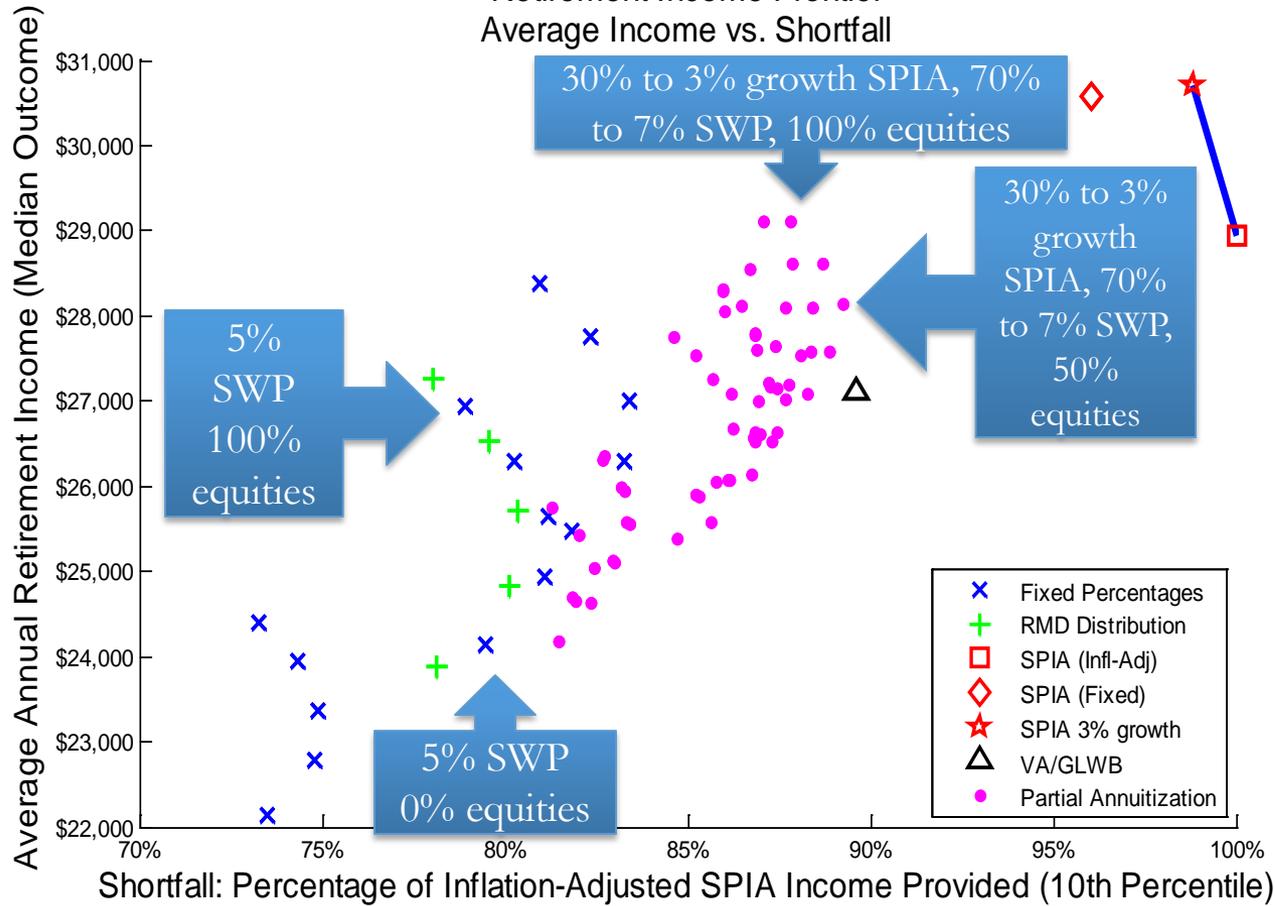
Figure
Retirement Income Frontier
Average Income vs. Shortfall



Efficient Frontier Analysis #1: Emphasize Retirement Income

Hypothetical Retiree #1: Single female age 65 with \$250,000

Figure
Retirement Income Frontier
Average Income vs. Shortfall



Commentary on Efficient Frontier #1

Regarding SWPs

- For a given asset allocation, SWP with 7% withdrawal rate produces highest amounts of average income with lowest risk (risk defined as shortfall against inflation-adjusted SPIA).
- SWP with 7% withdrawal rate and 50% allocation to equities produces the lowest risk, although expected income is lower compared to other SWP strategies.
 - Keep in mind risk is defined as shortfall of retirement income relative to inflation-adjusted SPIA, so lower withdrawal rates produce higher risk with this definition.
- Each given SWP produces a curve pattern, with 100% to equities producing highest expected average income, and 50% to equities producing lowest risk. Allocations of 0% and 25% to equities produce lower retirement income with a higher level of risk, compared to an allocation to equities of 50%.

Commentary on Efficient Frontier #1

Regarding Other Retirees

- Efficient frontier analyses for other hypothetical retirees show similar patterns with same conclusions regarding optimal solutions. Married couples with increased starting assets, single female with lower starting assets, and retiring at age 70 don't change conclusions about optimal solutions. See Appendix C for results.

Additional retirees

- Married couple both age 65, retiring with \$400,000 in assets
- Married couple both age 65, retiring with \$1,000,000 in assets
- Repeat analysis for all three hypothetical retirees retiring at age 70 with same level of assets shown above, to see how optimal solutions might change.
- Repeat analysis for single female retiring at age 65 with \$100,000 in assets, to see how optimal solutions might change.

Commentary on Efficient Frontier #1

Regarding Postponed Retirement

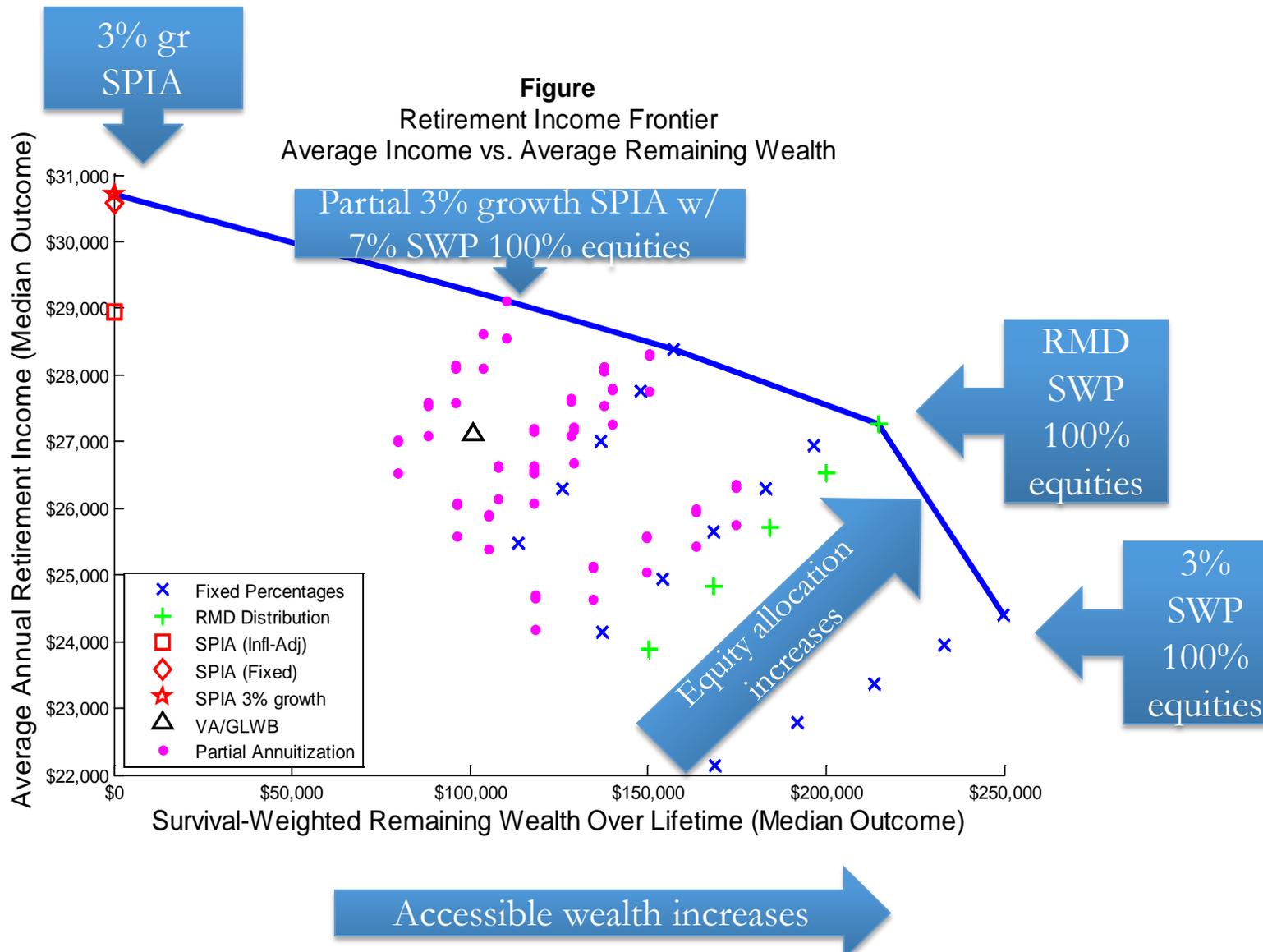
- Comparing age 65 with age 70 retirement shows substantial increase in the average annual income along the efficient frontier (estimated increase due to postponement is understated in these analyses; using the same assumed starting assets is equivalent to assuming no investment return or additional 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 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%).
- Reasons: Social Security benefits are increased for delayed commencement, and retirement savings need to generate income for five fewer years.

Details on Efficient Frontier #2

- Goal is to balance amount of expected retirement income with amount of expected accessible savings throughout retirement.
- Measure of return (Y-axis): Average annual real retirement income from 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.
- Rationale: Many participants are hesitant to devote substantial resources to irrevocable annuities, and desire some access to savings and/or legacy. These participants may be willing to accept reduced retirement income in exchange for access to savings.

Efficient Frontier Analysis #2: Tradeoff Between Income and Access

Hypothetical Retiree #1: Single female age 65 with \$250,000



Commentary on Efficient Frontier #2

- Points along the efficient frontier:
 - 3% growth SPIA produces highest average annual income with no accessible wealth.
 - Systematic withdrawal plan with 3% withdrawal amount and 100% stock allocation produces highest amount of accessible wealth and lowest average amount of retirement income.
 - Partial annuitization solution on frontier is 30% of savings to 3% growth SPIA and remaining assets invested 100% in stocks with 7% SWP.
 - Alternative analyses show that higher allocations to annuities produce other solutions on the efficient frontier.
 - SWP solutions on frontier are 7% withdrawal rate, RMD, and 3% withdrawal rate, all with 100% in stocks.
- With all SWP solutions, higher equity allocation produce higher average amounts of projected income and accessible wealth.
- GLWBs do not project as favorably as partial annuitization strategies with high allocations to equities.

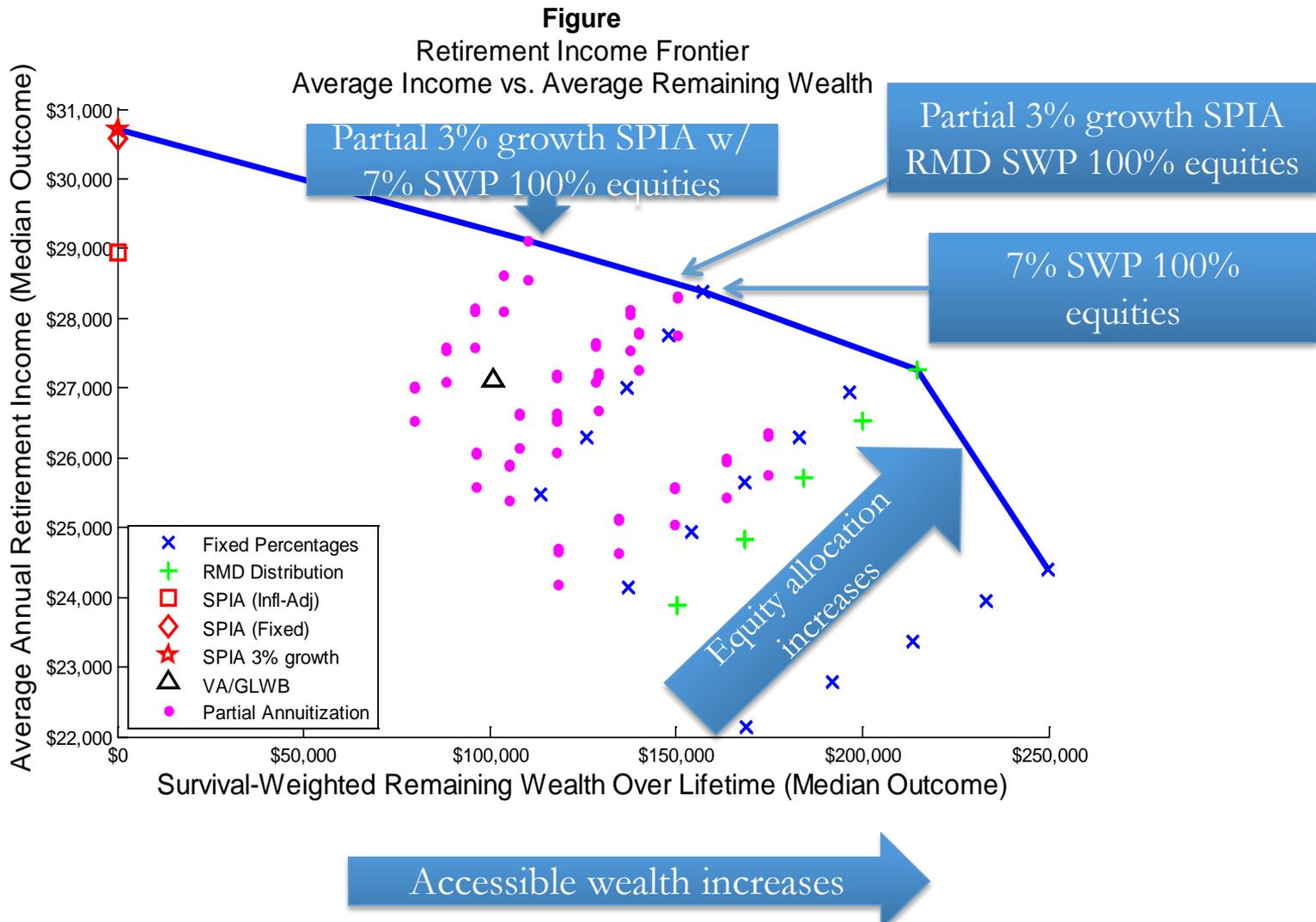
Commentary on Efficient Frontier #2

(Continued)

- Solutions just below the efficient frontier may be desirable (see graph on next page). This provides evidence that factors other than the placement on the efficient frontier should be considered when developing retirement income strategies.
- Partial annuitization solution close to frontier is 30% of assets devoted to 3% growth SPIA and remaining assets invested 100% in stocks with RMD SWP. RMD SWP produces a more level income pattern and higher accessible wealth, compared to the 7% SWP with partial annuitization (a point on the efficient frontier).
- The RMD/partial annuitization solution also 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).
- For partial annuitization strategies, presence of Social Security and SPIA enables higher equity allocation with remaining assets.

Efficient Frontier Analysis #2: Tradeoff Between Income and Access

Hypothetical Retiree #1: Single female age 65 with \$250,000



Commentary on Efficient Frontier #2

(Continued)

- Comparing retirements at age 70 instead of age 65 produces substantial increases in average annual income, increases ranging in similar magnitude in percentage terms as Efficient Frontier #1.
- The table on the next page illustrates the tradeoff between average income and average accessible wealth along the efficient frontier (or close to the frontier).
- Comparing the extreme points of the efficient frontier, full annuitization with the 3% growth SPIA has no accessible wealth and average annual income of \$30,701, \$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).

Commentary on Efficient Frontier #2

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 - Ave income - Ave accessible wealth	\$30,701 \$0	N/A
Partial annuitization strategy* - Ave income - Ave accessible wealth	\$28,324 \$150,276	(\$2,377) \$150,276
SWP RMD/100% equities - Ave income - Ave accessible wealth	\$27,265 \$214,681	(\$1,059) \$64,405
SWP 3% WR/100% equities - Ave income - Ave accessible wealth	\$24,391 \$249,637	(\$2,875) \$34,956

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

Commentary on Efficient Frontier #2

Regarding Other Retirees

- Efficient frontier analyses for other hypothetical retirees show similar patterns with same conclusions regarding optimal solutions. See Appendix D for results.
 - Married couple age 65 with increased starting assets and single female with lower starting assets don't change conclusions about optimal solutions.
 - One more partial annuitization strategy is on the efficient frontier for retirements at age 70 for the single female.

Additional retirees

- Married couple both age 65, retiring with \$400,000 in assets
- Married couple both age 65, retiring with \$1,000,000 in assets
- Repeat analysis for all three hypothetical retirees retiring at age 70 with same level of assets shown above, to see how optimal solutions might change.
- Repeat analysis for single female retiring at age 65 with \$100,000 in assets, to see how optimal solutions might change.

Other Considerations for Optimal Retirement Income Solutions

- The two efficient frontiers analyzed here estimate the average annual amount of retirement income and average accessible wealth over the retirement period, under the median scenario of the stochastic forecast. Within the solutions analyzed here, other goals and alternative analyses could influence the choice of a particular solution.
- 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* compared results for various RIGs under different economic scenarios.

Other Considerations for Optimal Retirement Income Solutions (continued)

- The expected pattern of annual retirement income to address inflation is one such 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 decline in real or nominal terms (an aggressive SWP strategy).

Other Considerations for Optimal Retirement Income Solutions (continued)

- Appendix E compares 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 projection, for Hypothetical Retiree #2. The results summarized below are 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.

How Plan Sponsors Can Use these Results

- 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.
- DC plan sponsors could offer retirement income solutions that are on or close to the efficient frontiers of these analyses.
 - Also offer variations on retirement income solutions that have appropriate reasons for not being on the efficient frontier, such as the goal to provide a more level stream of income or reduce volatility of retirement income.

How Plan Sponsors Can Use these Results (continued)

DC plan sponsors could help meet the varying goals of participants as described on the previous page by offering the following 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%, and 6%. As a practical matter for 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 (the subject of Phase 2 analyses).

How Plan Sponsors Can Use these Results (continued)

DC plan sponsors could help meet the varying goals of participants as described on the previous page by offering the following RIGs:

- The ability to custom-mix SPIAs and SWPs in whole percentages, for “do-it-yourselfers” or individuals working with advisors.
- 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.
- Design a default retirement income solution that might meet the needs of many employees.

How Plan Sponsors Can Use these Results (continued)

Plan sponsors can help participants make informed decisions by communicating the salient features of the various retirement income solutions. Here are suggestions about the features to communicate:

- 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.
- Whether assets can be accessed for any reason, such as long-term care expenses or emergencies.

How Plan Sponsors Can Use these Results (continued)

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*, 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 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 SOA/SCL report titled *Foundations in Research for Regulatory Guidelines on the Design & Operation of Retirement Income Solutions in DC Plans*. This latter report uses guidance under ERISA Section 404(c) on the investment menu as a template for structuring a program of retirement income.

How Retirees and Advisors Can Use these Results

- Develop retirement income solutions to meet individuals' goals, using solutions along the efficient frontiers as starting points for consideration. Apply portfolio thinking to the retirement period.
- As such, a desirable goal can be to develop a diversified portfolio of retirement income. To help diversify sources of retirement income, annuities and Social Security benefits have different properties compared to investing solutions.
- The purpose of the first efficient frontier is to demonstrate that annuities generally produce the highest amount of expected lifetime retirement income, 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.

How Retirees and Advisors Can Use these Results (continued)

- The second efficient frontier, showing the tradeoff between average retirement income and accessible wealth, might apply to most retirees.
- Retirees and their advisors can use these analyses to quantify the tradeoffs between different solutions, and evaluate the value of combination solutions.
- One possible approach for a combination solution is to cover basic living expenses with guaranteed, lifetime income sources such as Social Security benefits, together with using a portion of retirement savings to buy a low-cost annuity. The remainder of retirement savings would be invested with a SWP to generate retirement income to cover discretionary living expenses. The analyses in this report support a high allocation to stocks for the portion of savings devoted to the SWP.

How Retirees and Advisors Can Use These Results (continued)

- Another way to evaluate a combination solution is to start by expressing the desirable level of accessible wealth (more on this goal later). This would apply to retirees desiring a balance between accessible wealth and income.
- Look for solutions that deliver the highest expected amounts of lifetime retirement income for given amounts of accessible wealth.
- For SWP strategies, fine-tune the withdrawal rate to reflect the desire to consume savings sooner or later (pay me now or pay me later).

How Retirees and Advisors Can Use these Results (continued)

- Determine if there are 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. This 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:

	<u>Average</u> <u>Income</u>	<u>Decrease</u>
• 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)

How Retirees and Advisors Can Use these Results (continued)

- Factors that might influence the need for accessible wealth throughout retirement:
 - Desire to leave a legacy with unused funds.
 - 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 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.
 - The desire to pay off a mortgage to reduce living expenses.
 - Ideally a retiree would have a separate reserve for emergencies, or unexpected or irregular expenses, such as home repairs, new cars, etc. If savings are accessed and consumed, they are no longer available to generate retirement income.

How Retirees and Advisors Can Use these Results (continued)

- Retirees and advisors may want to consider the threat of 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 by expected retirement income (a classic argument for insurance).
 - Retirees with substantial home equity might keep it in reserve to use as a source of funding long-term care, if needed.
 - Retirees who expect to rely on Medicaid for long-term care most likely will need to deplete assets; in this case, there won't be assets left to generate retirement income (a big problem if a spouse will survive the person needing care).

How Retirees and Advisors Can Use these Results (continued)

- Continued: Retirees and advisors may want to consider the threat of long-term care expenses when developing a retirement income strategy.
 - 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.
 - It may be too much to expect a retirement income solution to also solve the long-term care challenge, unless a retiree has substantial accessible retirement savings, well in excess of \$500,000. This would necessitate using other solutions, such as long-term care insurance or use of home equity.

Commentary on Analyses

- 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. Retail solutions would produce less favorable results than shown in this report.
- As such, 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.

Commentary on Analyses (continued)

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.

Appendix A

Definitions

- 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. Also called guaranteed minimum withdrawal benefit (GMWB).
- 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.

Appendix A

Definitions

- Single premium immediate annuity (SPIA) is an insurance product that guarantees a lifetime retirement income. 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.
 - 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 to calculate retirement income, and equals remaining assets divided by remaining life expectancy at each future age.

Appendix B: Assumptions

Table C.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	-0.6
Inflation	2.1%	2.0%	4.2%	-0.2	-0.6	1.0

Note: Above rates are lower than historical averages. Bond returns reflect low-interest rate environment, and stock returns reflect lower-than-historical premium over bond returns.

Mortality table for survival probabilities: Society of Actuaries' RP-2014 Mortality Tables Draft for Healthy Annuitants

Appendix B

Notes on Assumptions

- Assumptions for payout rates are representative of institutional pricing.
- SWP investment expenses: 50 bps
- GLWB investment and insurance expenses: 150 bps
- SPIA rates based on sex distinct pricing.

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 2015, which could result in annuity purchase rates increasing back to levels in April, 2014 or higher. The authors decided not to chase a moving target and retained the April, 2014 annuity purchase rates.

Appendix B

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.

Appendix B

Details on Efficient Frontier Calculations (continued)

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. Again, 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.

Appendix B: Hypothetical Retiree #1

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

- Annuity product pricing (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%
 - Above rates in effect during April, 2014 for institutionally priced GLWB products and using competitive annuity bidding for SPIAs. Retail products would produce lower payout rates resulting in lower retirement incomes.

Appendix B

Alternative Hypothetical Retiree #1

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

- Annuity product pricing (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%
 - Above rates in effect during April, 2014 for institutionally priced GLWB products and using competitive annuity bidding for SPIAs.

Appendix B: Hypothetical 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
- 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%
 - Above rates in effect during April, 2014 for institutionally priced GLWB products and using competitive annuity bidding for SPIAs.

Appendix B: Hypothetical 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
- 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%
 - Above rates in effect during April, 2014 for institutionally priced GLWB products and using competitive annuity bidding for SPIAs.

Appendix C

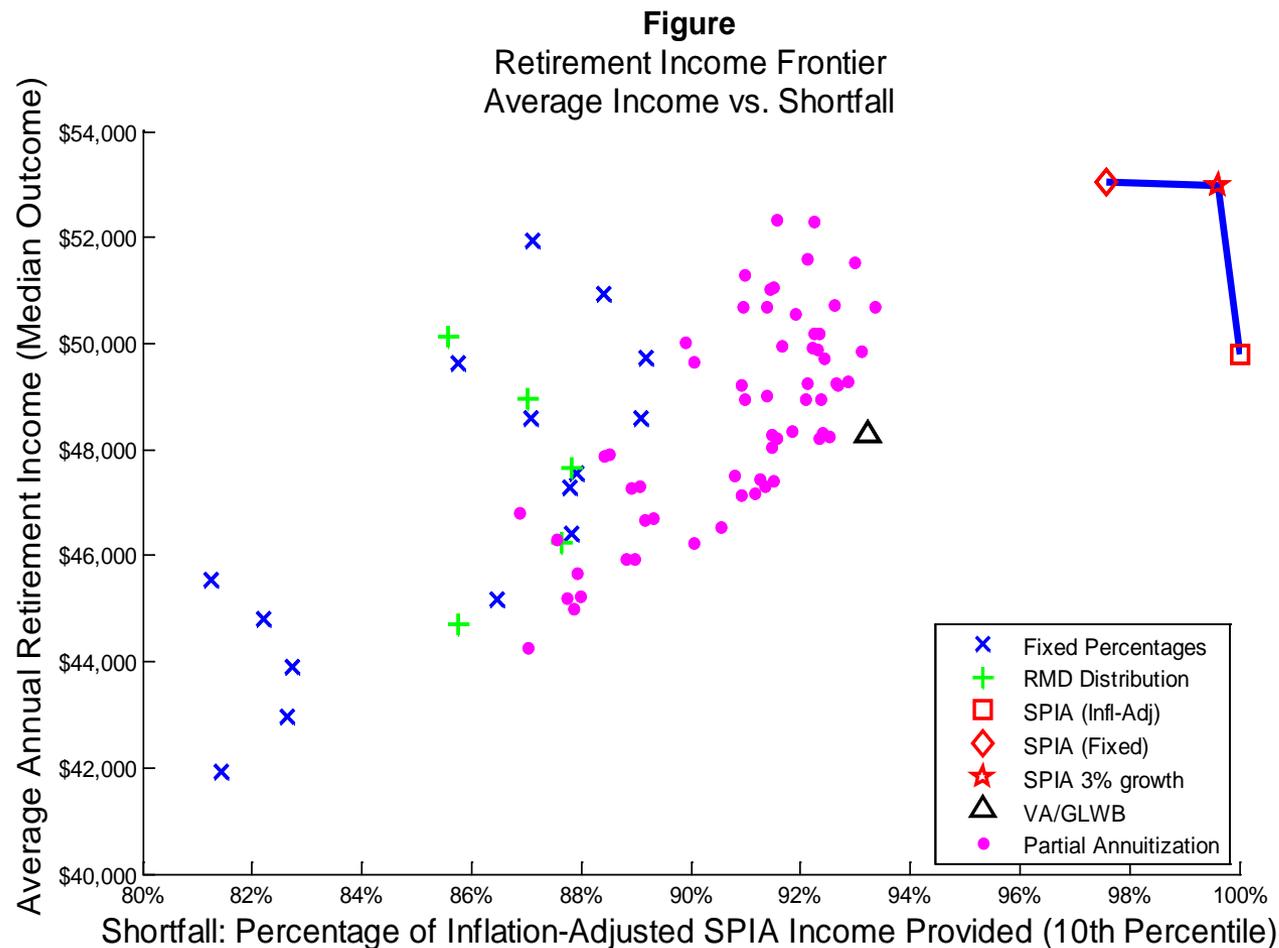
Efficient Frontier #1 Results for Additional Hypothetical Retirees

- Married couple both age 65, retiring with \$400,000 in assets
- Married couple both age 65, retiring with \$1,000,000 in assets
- Repeat analysis for all three hypothetical retirees retiring at age 70 with same level of assets shown above, to see how optimal solutions might change.
- Repeat analysis for single female retiring at age 65 with \$100,000 in assets, to see how optimal solutions might change.
- Note: For the graphs on the following pages, the axis scales change for different hypothetical retirees.

Appendix C

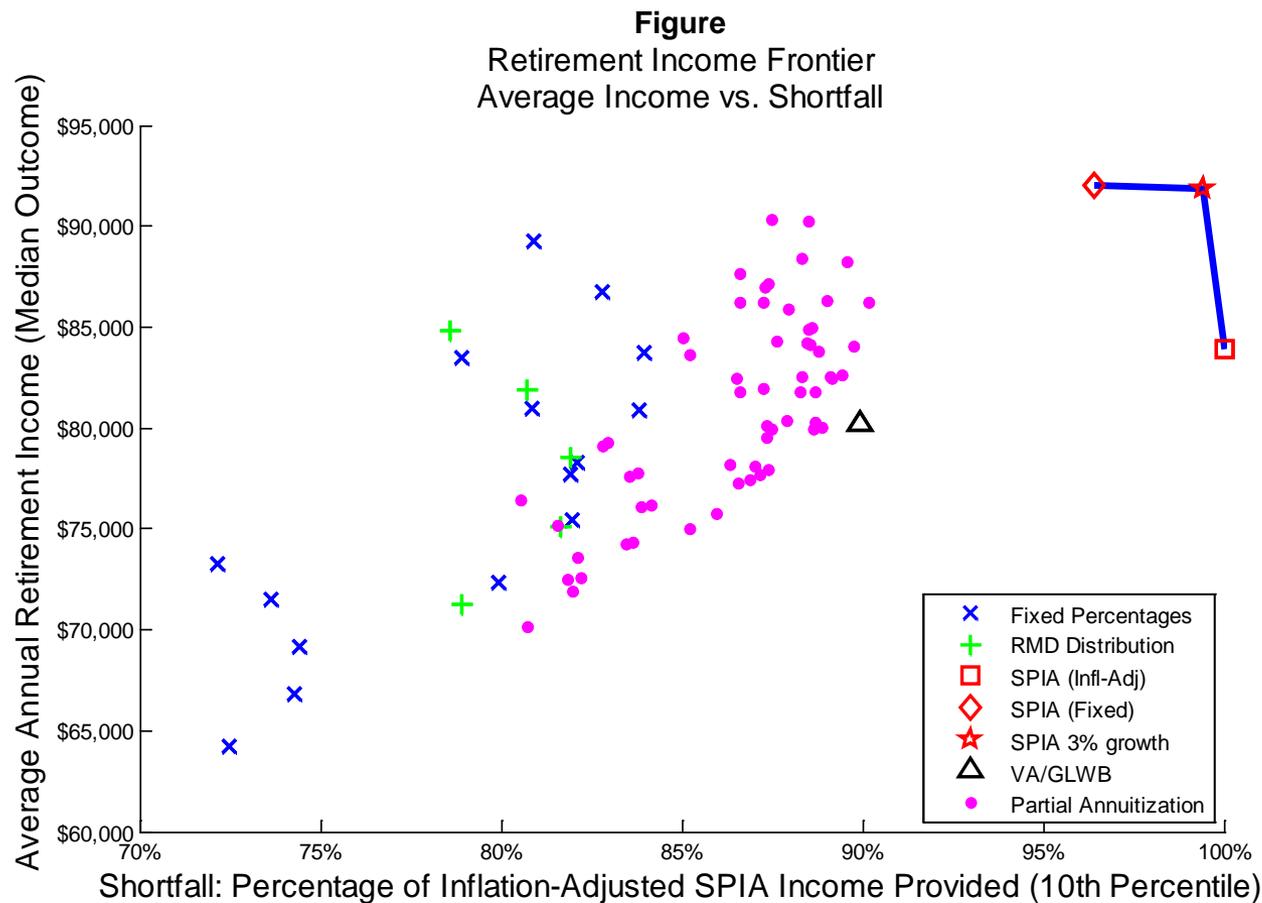
Efficient Frontier Analysis #1: Emphasize Retirement Income

Hypothetical Retiree #2: Married couple age 65 with \$400,000



Appendix C

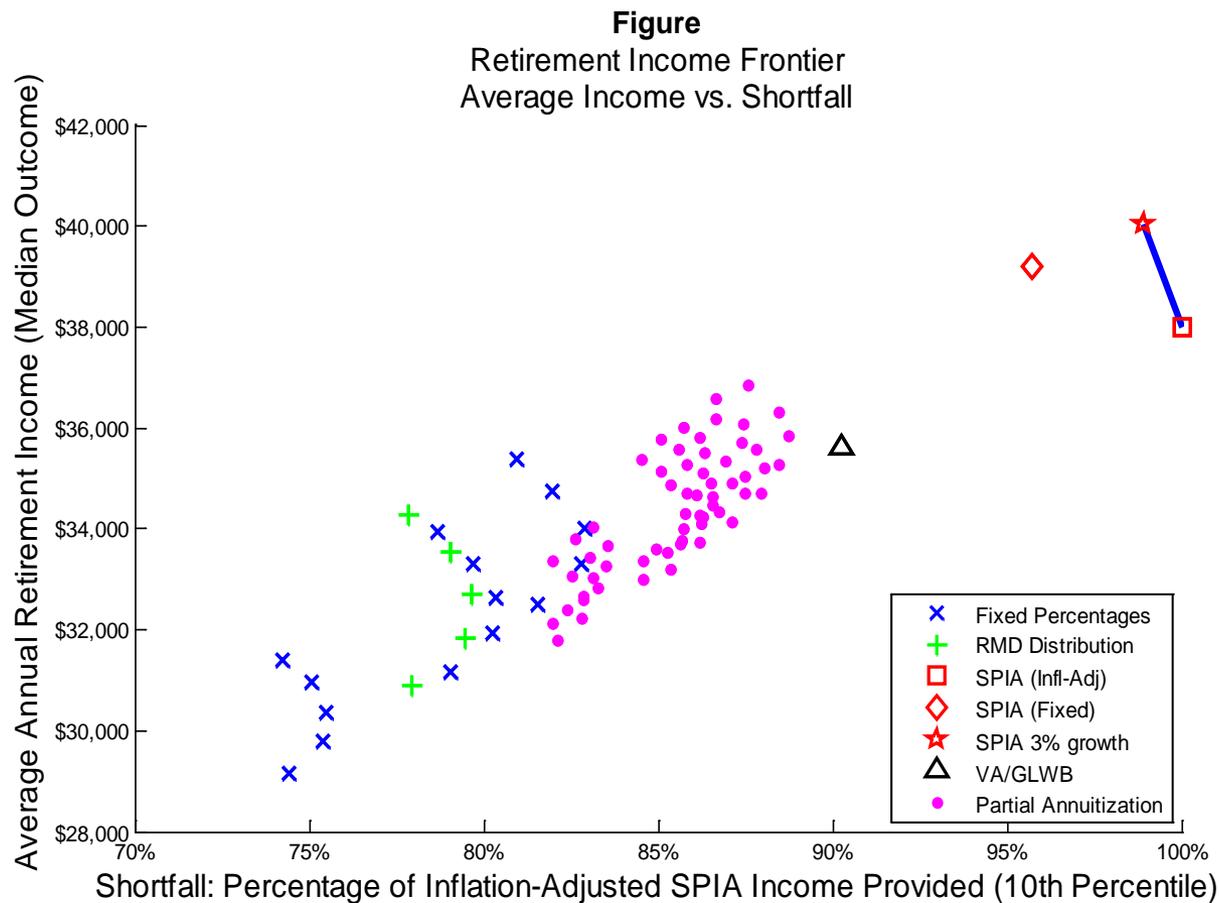
Efficient Frontier Analysis #1: Emphasize Retirement Income Hypothetical Retiree #3: Married couple age 65 with \$1,000,000



Appendix C

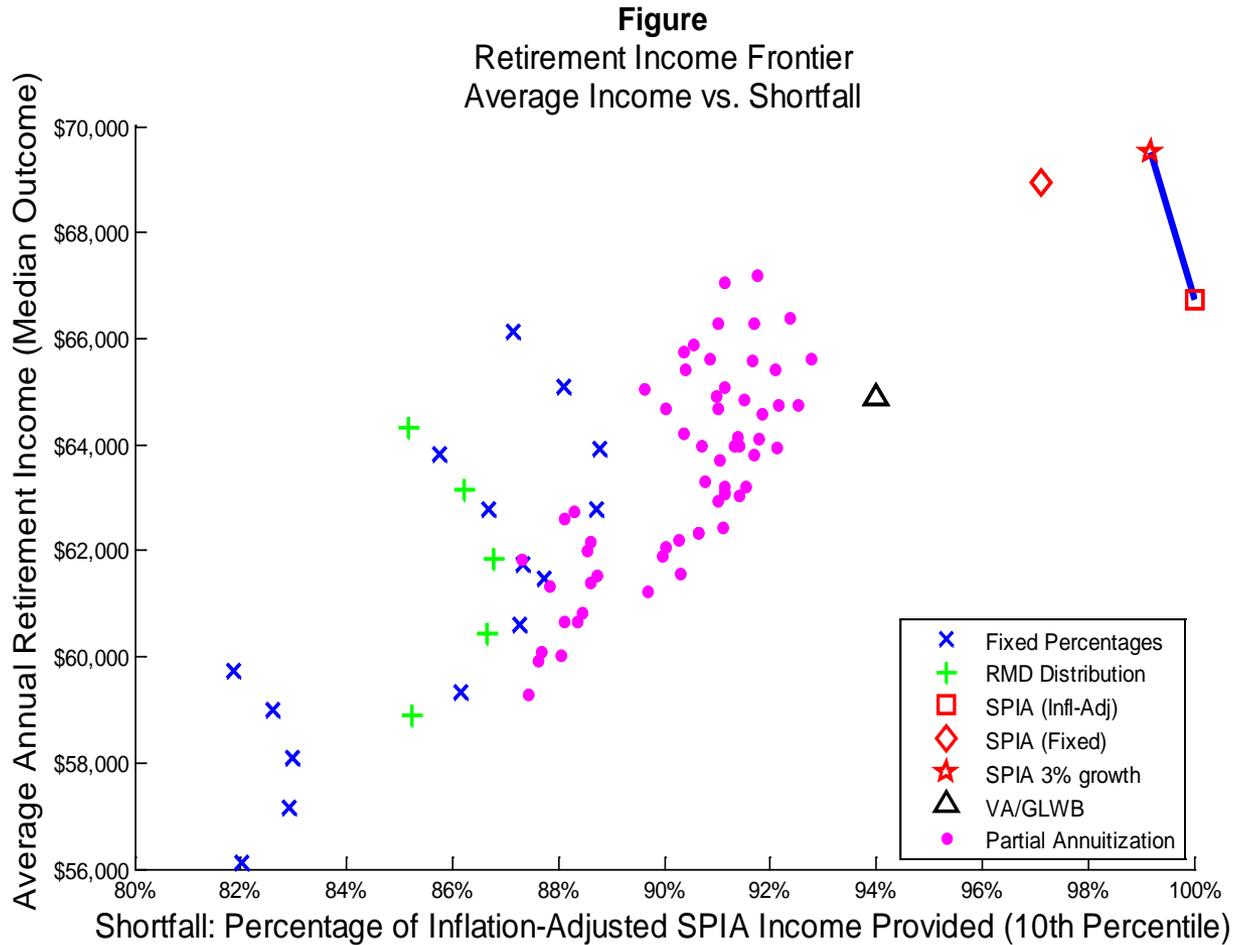
Efficient Frontier Analysis #1: Emphasize Retirement Income

Hypothetical Retiree #1: Single female age 70 with \$250,000



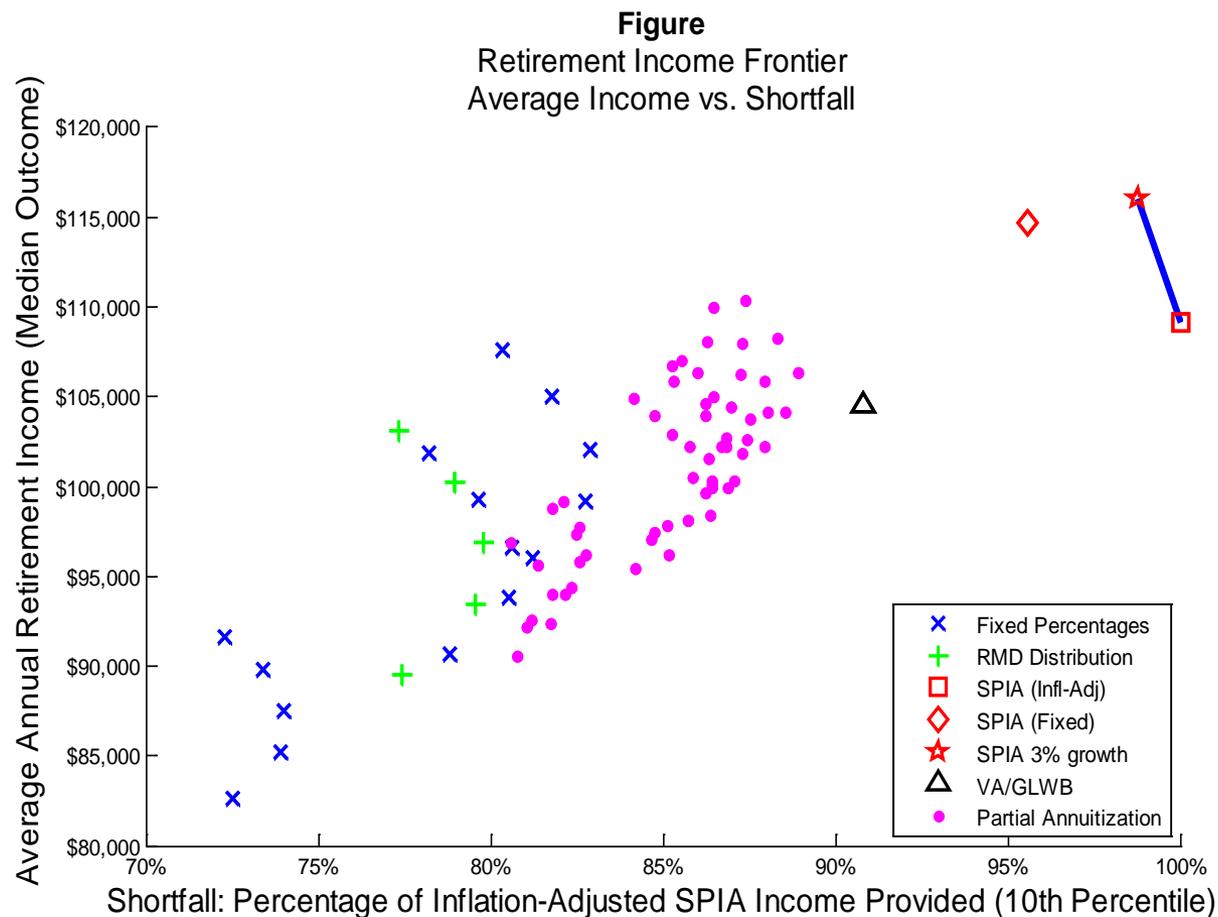
Appendix C

Efficient Frontier Analysis #1: Emphasize Retirement Income Hypothetical Retiree #2: Married couple age 70 with \$400,000



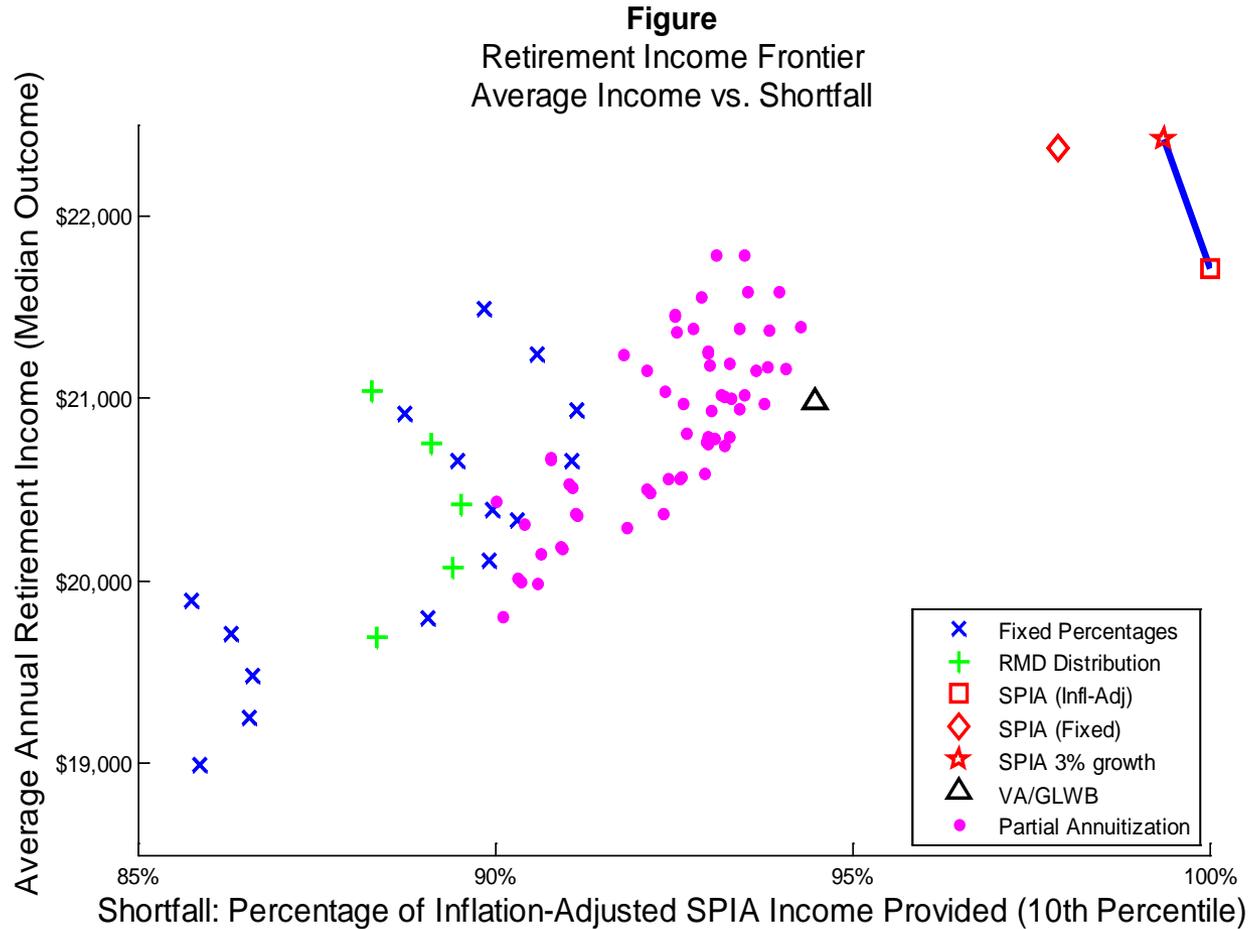
Appendix C

Efficient Frontier Analysis #1: Emphasize Retirement Income Hypothetical Retiree #3: Married couple age 70 with \$1,000,000



Appendix C

Efficient Frontier Analysis #1: Emphasize Retirement Income Hypothetical Retiree #1: Single female age 65 with \$100,000



Appendix D

Efficient Frontier #2 Results for Additional Hypothetical Retirees

- Married couple both age 65, retiring with \$400,000 in assets
- Married couple both age 65, retiring with \$1,000,000 in assets
- Repeat analysis for all three hypothetical retirees retiring at age 70 with same level of assets shown above, to see how optimal solutions might change.
- Repeat analysis for single female retiring at age 65 with \$100,000 in assets, to see how optimal solutions might change.
- Note: For the graphs on the following pages, the axis scales change for different hypothetical retirees.

Appendix D

Efficient Frontier Analysis #2

Tradeoff Between Income and Accessible Wealth

Hypothetical Retiree #2: Married couple age 65 with \$400,000

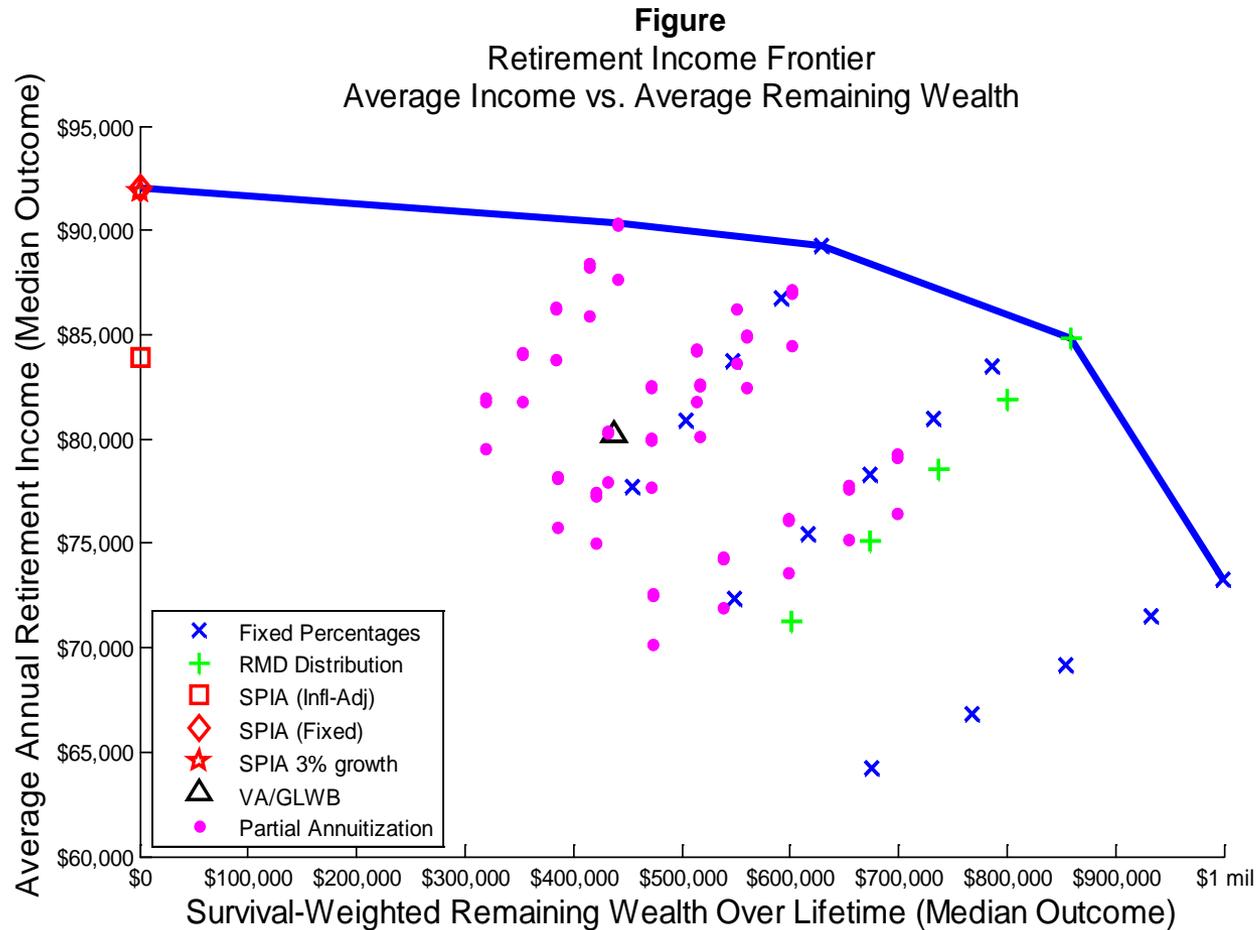


Appendix D

Efficient Frontier Analysis #2

Tradeoff Between Income and Accessible Wealth

Hypothetical Retiree #3: Married couple age 65 with \$1,000,000

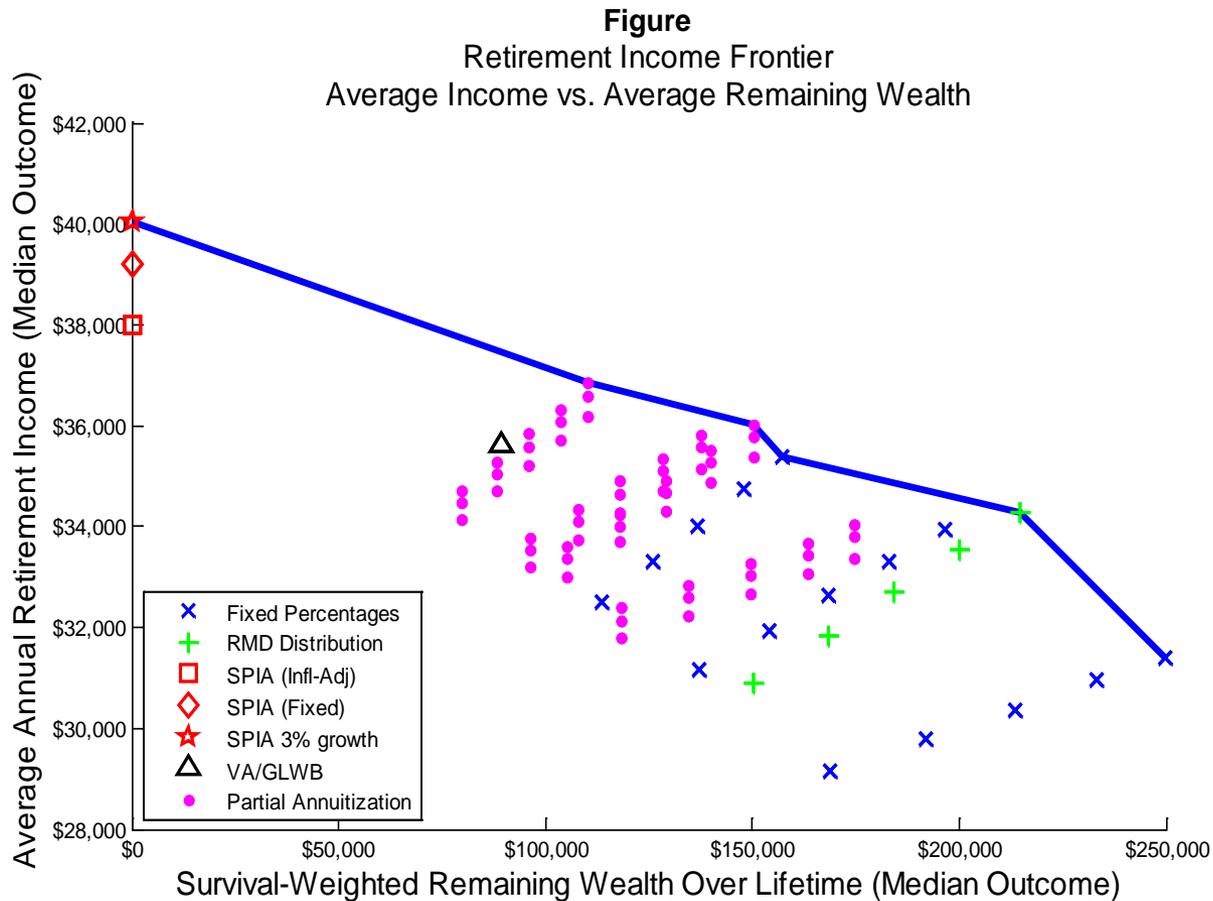


Appendix D

Efficient Frontier Analysis #2

Tradeoff Between Income and Accessible Wealth

Hypothetical Retiree #1: Single female age 70 with \$250,000

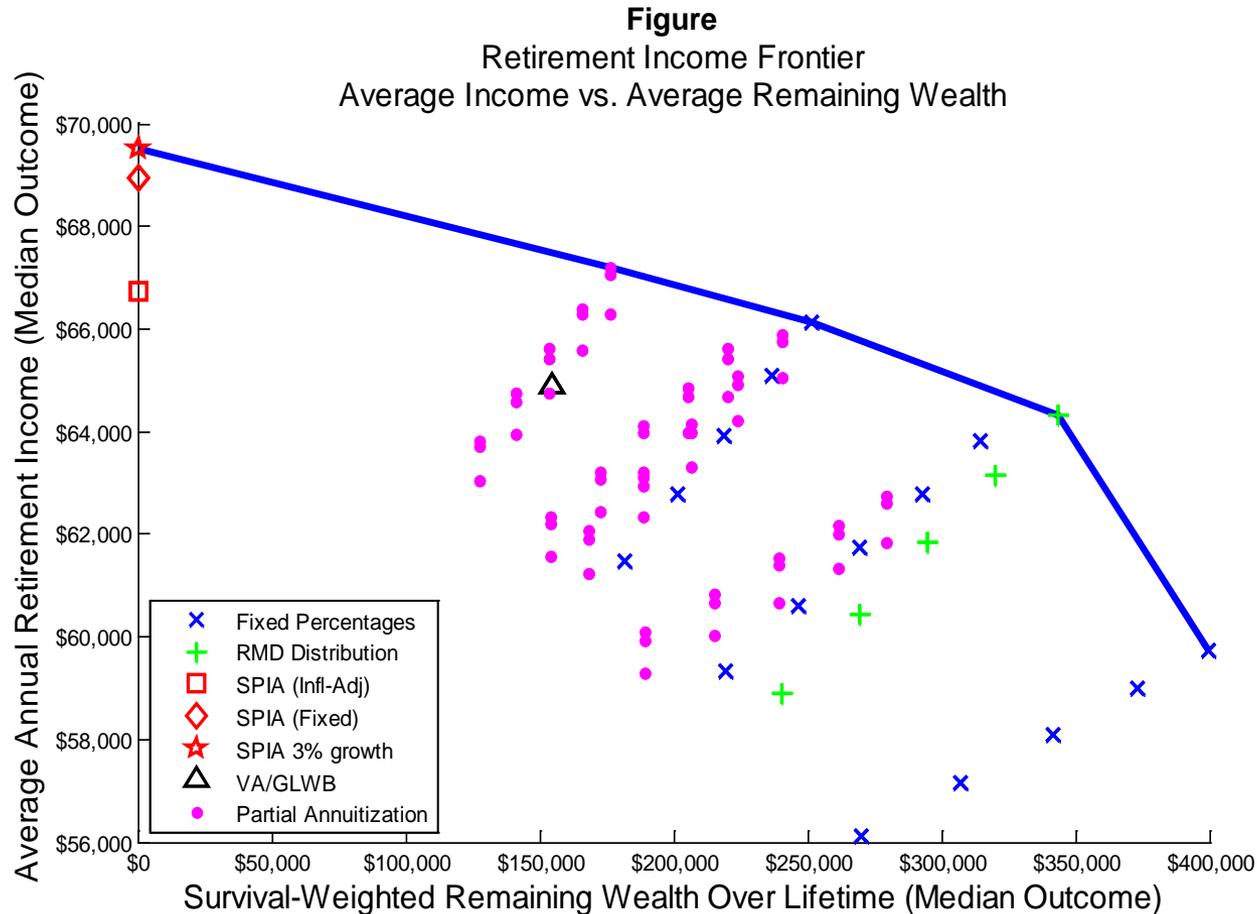


Appendix D

Efficient Frontier Analysis #2

Tradeoff Between Income and Accessible Wealth

Hypothetical Retiree #2: Married couple age 70 with \$400,000

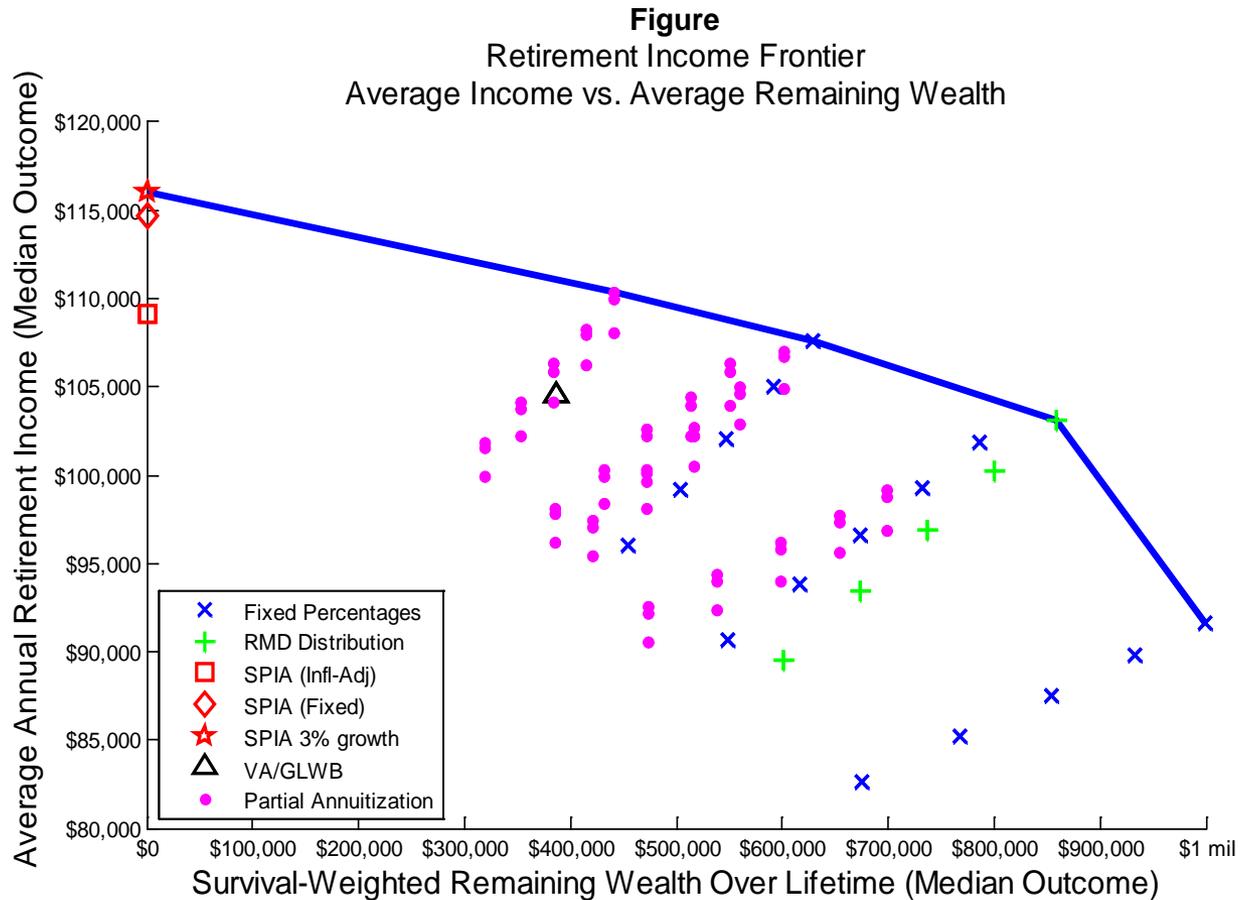


Appendix D

Efficient Frontier Analysis #2

Tradeoff Between Income and Accessible Wealth

Hypothetical Retiree #3: Married couple age 70 with \$1,000,000

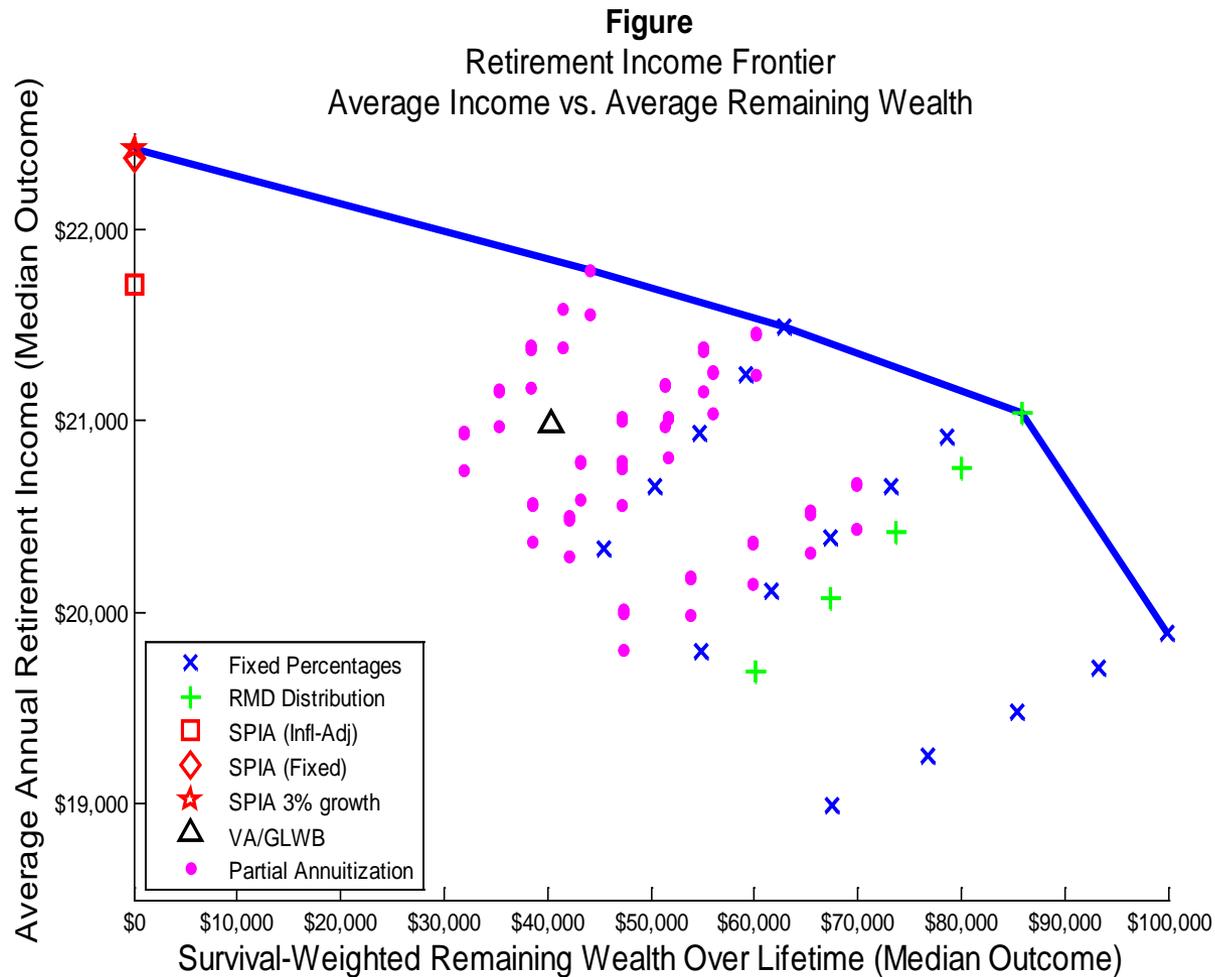


Appendix D

Efficient Frontier Analysis #2

Tradeoff Between Income and Accessible Wealth

Hypothetical Retiree #1: Single female age 65 with \$100,000



Appendix E

Projections of Range of Retirement Incomes for Selected Retirement Income Solutions

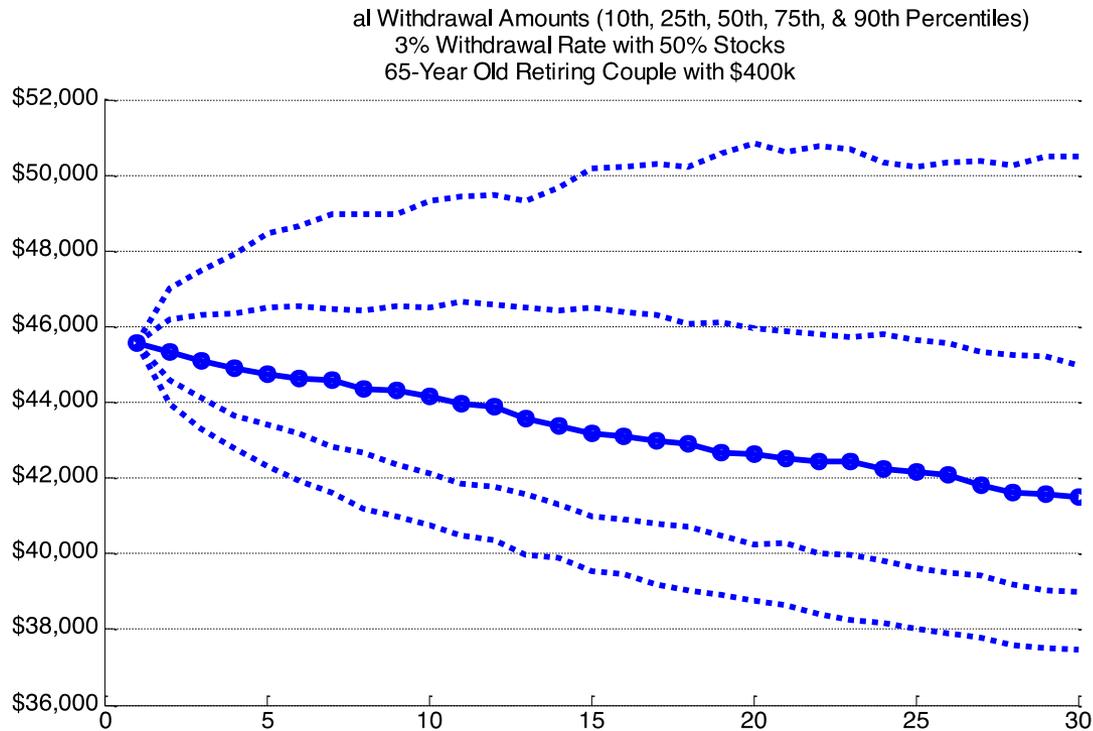
- The pages that follow show the projected retirement incomes for each year over 30 years for Hypothetical Retiree #2 (couple age 65 with \$400,000 in savings) under the following percentiles under the stochastic forecast: 10th, 25th, 50th, 75th, 90th.
- These graphs are illustrative, and show just three different retirement income solutions (Social Security income is included).
- These forecasts can be used to determine the general pattern of retirement income (level or decreasing on a real basis, after adjusting for inflation). A level line keeps pace with projected inflation, while a declining line does not.
- 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.
- Note the scale of the vertical axis changes (showing amount of income).

Appendix E

Expected Pattern of Real Retirement Income

Hypothetical Retiree #2: Married couple age 65 with \$400,000

3% Withdrawal Rate with 50% Stocks

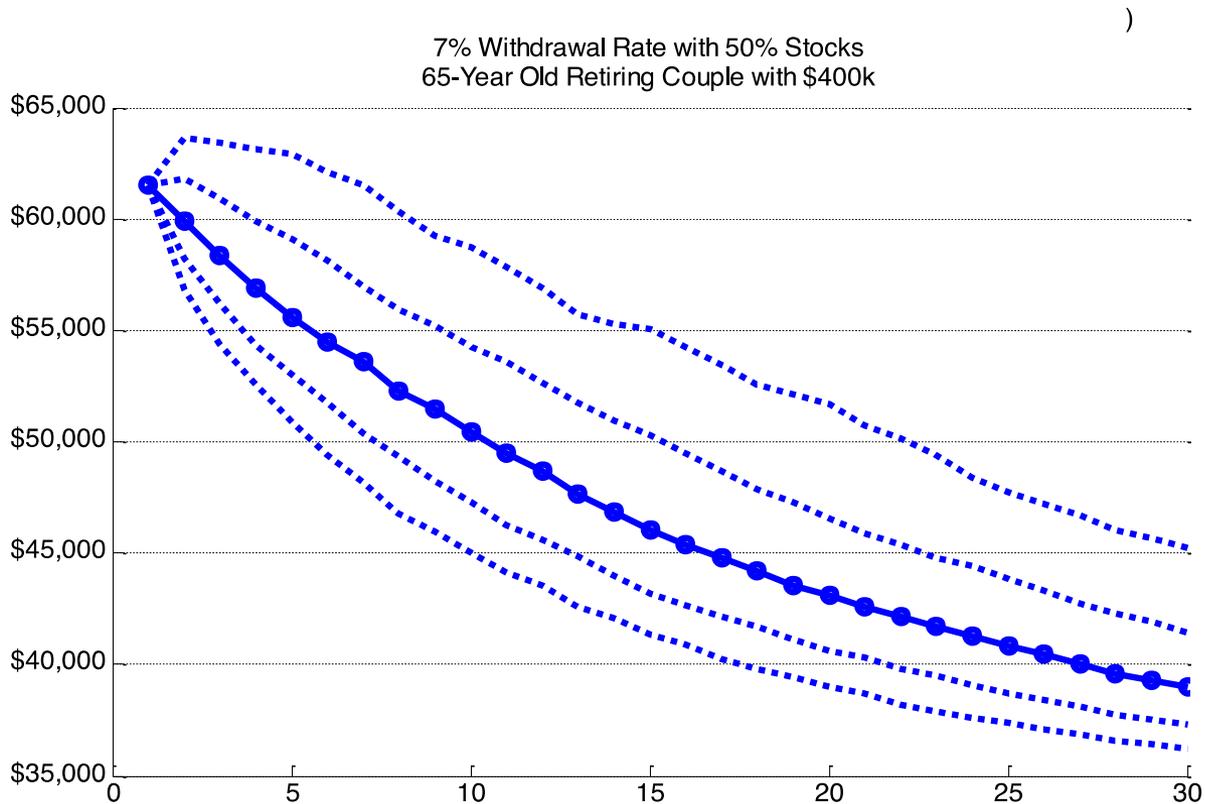


Appendix E

Expected Pattern of Real Retirement Income

Hypothetical Retiree #2: Married couple age 65 with \$400,000

7% Withdrawal Rate with 50% Stocks



Appendix E

Expected Pattern of Real Retirement Income

Hypothetical Retiree #2: Married couple age 65 with \$400,000

RMD Withdrawal Rate with 50% Stocks

