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## Proof that SPIAs Still Make Sense

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*Even when interest rates are low, adding a lifetime income annuity to a fund portfolio 1) reduces the risk of portfolio ruin, 2) increases current income, and, 3) if the portfolio is shifted toward equities, can enhance the client's legacy.*

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Today's near-retirees face not only the usual risks associated with market volatility and longevity but also a lower average savings rate than previous generations and the reduced availability of traditional pensions. To ensure that they can sustain an acceptable standard of living in retirement and not run short of funds, they need new solutions.

One option is to add a source of income that they cannot outlive. In their landmark 2001 article in *The Journal of Financial Planning* ("[Making Retirement Income Last a Lifetime](#)") John Ameriks, Bob Veres and Mark Warshawsky found that adding a life-contingent income annuity to a retirement portfolio reduces the rate that the portfolio will "fail" or go to zero.[1]

We ask if the benefits of lifetime income annuities persist today, when low interest rates have made annuity payout rates significantly lower than in 2001. Using annuity price quotes from CANNEX,[2] we measure the effects of annuitizing between zero and 30% of a retirement portfolio. We create a conceptual "retirement income frontier" that traces the trade-off between the *sustainability of retirement income* and *expected financial legacy*, using a framework established by Moshe Milevsky of Toronto's York University.[3]

We'll show that the 2001 results are in fact still valid: When a client buys an annuity with part of her savings, the sustainability of her income improves. While this improvement comes at a cost to her financial legacy, that cost can be overcome if she rebalances the rest of her portfolio to match her overall risk profile (i.e., with a shift toward equities).

These results are produced for three reasons: the annuity income stream can't be outlived; the pooling of longevity risk through the annuity enhances the retiree's income (via "mortality credits"); and the retiree offsets the conservative effect of the annuity by taking more risk with the balance of her savings. The results hold true whether she's a conservative, balanced or aggressive investor.

### **"Annuitizing a portfolio:" What and how?**

First, let's review what is meant by "annuitizing" (part of) a portfolio. In this article, we

mean using a portion of retirement savings to purchase a single premium income annuity, or SPIA. While the SPIA is often overlooked in retirement income planning, it can provide a tremendous boost to the overall sustainability of a client's retirement: For a one-time premium, the SPIA provides a lifetime of income. (Thus it functions like a workplace defined benefit pension.)

Despite the benefits it can offer, the SPIA is frequently shunned by clients and advisors alike. Why? The purchase decision is irreversible and thus the asset, although it produces income, is illiquid. This point of view, however, overlooks both the mortality credits that retirees acquire from pooling their assets, which provide a greater yield than products with similar levels of guarantee; and the lifetime nature of the SPIA income, which provides a hedge against an unknown and potentially longer-than-expected lifetime.

Ultimately, while a reliable source of retirement income may be replicated with investments in fixed income products, a SPIA provides a higher income than other non-pooled, non-life-contingent assets or products do. Given the SPIA's relative advantages, the low take-up of lifetime income annuities by retirees is known as the "annuity puzzle"—a riddle that academics and practitioners have pondered for decades.

### **Portfolio sustainability: Do SPIAs still help?**

In this article, we will explore the impact of adding a SPIA on our client's Retirement Sustainability Quotient (on one hand) and her Expected Financial Legacy (on the other). Our conceptual retirement income frontier will trace out the trade-off between these competing outcomes—increased sustainability or increased financial legacy.

We assume that the client has her financial assets consolidated in either a managed account (a portfolio of stocks, bond, ETFs, mutual funds or any combination thereof) or some combination of managed account and a SPIA, in which the annuitized portion provides a pension-like lifetime income starting at retirement. We further assume that our client understands what her inflation-adjusted (assuming 2% inflation) future income needs will be and that she buys a cost of living-adjusted SPIA. In our analysis, the client coordinates withdrawals from her managed account with her annuity payment to match her desired spending amount.

We define retirement income sustainability as a function of first, the fraction of income annuitized and secondly, the "lifetime ruin probability" of the managed account. The lifetime ruin probability, in turn, is the probability that the investment portfolio will be fully

depleted while the retiree is living.

Mathematically, the Retirement Sustainability Quotient (RSQ) takes the following form:

$$RSQ = (1 - p) (1 - fSPIA) + fSPIA = 1 - p (1 - fSPIA)$$

where  $p$  represents the ruin probability and  $fSPIA$  represents the ratio of the annuitized income to the client's desired income.

In the above equation, we measure retirement sustainability as the weighted average of the success probabilities ("success" defined as the cases in which the retirement income portfolio supports the desired withdrawals during the client's lifetime). The annuity, by its very nature, has a ruin probability of zero (assuming no default risk of the insurance company); while the investment account has a "non-zero" ruin probability.[4]

As always in finance, there is an economic trade-off. If an annuity has no death benefit or refund feature, the added retirement sustainability it produces can come at the cost of a smaller "Expected Financial Legacy," which is the wealth that the client will be able to leave to heirs.

We define Expected Financial Legacy (EFL) more formally as the expected value of the funds left over upon the retiree's death, measured in today's dollars. Technically, we calculate our client's EFL by aggregating the present value of the probability-of-death-weighted account balances over time.\*

Together, the two concepts of Retirement Sustainability and Financial Legacy form a frontier that helps us to better understand and model the trade-off between income sustainability and financial legacy introduced by the inclusion of life annuities.

### **Modelling legacy and sustainability along the Retirement Income Frontier**

Now, on to our model. In our case study, given the illiquidity of the SPIA, and the irreversibility of the SPIA purchasing decision, we limit the allocation to SPIAs to 30% of our client's initial wealth. With the remaining (non-annuitized) portfolio, we consider three kinds of asset allocation models: conservative, balanced, and aggressive.

We also consider two approaches:

First Approach: SPIA + No Change to Asset Allocation ("SPIA + No Change")

In approach one, we assume our client maintains their asset allocation (whether conservative, balanced or aggressive) even after purchasing the annuity. That is, we do not adjust the allocation of the managed assets in response to the annuity purchase.

#### Second Approach: SPIA + Modified Asset Allocation (“SPIA + Modified Portfolio”)

In our second approach, we proportionally adjust asset allocations within the client’s managed account, taking the allocation to the SPIA into account. The entire retirement portfolio then conforms to the original risk profile of our retiree (conservative, balanced or aggressive). That is, we change the asset allocation of our client’s investments once the client has purchased an annuity, viewing the annuity purchase as a bond-like allocation on the balance sheet.

In our analysis, we use a stochastic modelling approach. It incorporates two separate sources of uncertainty (namely, market returns and remaining lifetime) to explore how adding a single premium income annuity to a range of “traditional” investment portfolios affects both retirement income sustainability and financial legacy. (A similar analysis could be carried out with other types of income annuities, such as deferred income annuities, or even variable or fixed indexed annuities.)

While the Retirement Sustainability and Financial Legacy calculations can be carried out using Monte Carlo simulations, we chose to use the numerical and analytic methods that are available in QWeMA NumeRlcs®, a set of analytic tools which equip financial specialists to explore and solve questions in retirement income planning.[5]

From a technical point of view, for our analysis, market dynamics are stochastically modelled and we assume that asset returns are normally distributed so that asset prices follow a lognormal distribution. Finally, in modelling our client’s remaining lifetime, we use the Gompertz-Makeham Mortality model calibrated to RP2000 actuarial tables for calculating retiree life expectancy that are readily available from the Society of Actuaries.[6]

In our case study, the client is a 65-year old healthy female retiring immediately. She desires to spend 5% of her initial wealth annually, adjusted in subsequent years for inflation, which we assume is 2%. We consider three asset allocation models to perform our analysis, namely:

- Conservative portfolio: 30% equity and 70% fixed income
- Balanced portfolio: 60% equity and 40% fixed income
- Aggressive portfolio: 70% equity and 30% fixed income

All calculations are performed on an initial wealth value of \$1 which allows us to scale the client’s legacy value by her initial wealth.

Our model’s capital market parameters are based on J.P. Morgan Asset Management’s 2016 Long Term Capital Market Assumptions.[7] We chose U.S. Large Cap equity returns and U.S. investment-grade corporate bonds for the equity and fixed income returns, respectively. We assumed the long-term borrowing cost was 2.5%.

Tables 1 and 2 summarize the capital market assumptions used in the case study and the return and volatility assumptions for our three (conservative, balanced and aggressive) portfolios.

Table 1. Capital Market Assumptions

Asset Returns & Volatility Assumptions		
Fixed Income	Return	4.5 %
	Volatility	6.5 %
Equity	Return	8.1 %
	Volatility	15.5 %
Correlation Coefficient		26.0 %
Portfolio Management Fees		1.0%
Long Term Discount Rate		2.5%

Table 2. Portfolio Return (Net of Fees) & Volatility of Returns Assumptions

	Annual Return	Volatility of Returns
Conservative Portfolio	4.6 %	7.3 %
Balanced Portfolio	5.7 %	10.3 %
Aggressive Portfolio	6.0 %	11.5 %

We consider the impact of an annuity purchase on the client’s retirement sustainability and financial legacy if she annuitizes up to 30% of her initial wealth - and we calculate and

display the outcomes for no annuitization and annuity purchases using 5%, 10%, 15%, 20%, 25% and 30% of her initial wealth. For the annuity purchase, we used the average of the A.M. Best’s A++ rated quotes, obtained from CANNEX, for a healthy 65-year-old female annuitant. This gives us a quote of \$410 per month (\$4,920 annually or 4.92% on the \$100,000 purchase) for a \$100,000 purchase, indexed at 2%.[\[8\]](#)

We’ll start with the SPIA’s impact on the sustainability and legacy of a conservative portfolio, then move on to the balanced and aggressive portfolios.

Table 3. Results for a Conservative Portfolio

	Allocations to Investment Account & SPIA		SPIA + No Change		SPIA + Modified Portfolio	
	Investment Account	SPIA	Retirement Sustainability	Financial Legacy	Retirement Sustainability	Financial Legacy
<b>1</b>	100 %	0 %	74.0 %	0.214	74.0 %	0.214
<b>2</b>	95 %	5 %	75.2 %	0.203	75.6 %	0.206
<b>3</b>	90 %	10 %	76.4 %	0.191	77.3 %	0.197
<b>4</b>	85 %	15 %	77.6 %	0.180	78.9 %	0.189
<b>5</b>	80 %	20 %	78.8 %	0.169	80.4 %	0.180
<b>6</b>	75 %	25 %	80.0 %	0.157	82.0 %	0.172
<b>7</b>	70 %	30 %	81.2 %	0.146	83.5 %	0.163

**[Figures 1 and 2. Comparison of SPIA + No Change vs. SPIA + Modified Portfolio: Conservative Allocation; Sustainability & Legacy vs. Annuity Allocation \(Conservative\).](#)**

Table 4. Results for a Balanced Portfolio

	Allocations to Investment Account & SPIA		SPIA + No Change		SPIA + Modified Portfolio	
	Investment Acc’t	SPIA	Retirement Sustainability	Financial Legacy	Retirement Sustainability	Financial Legacy
<b>1</b>	100 %	0 %	79.4 %	0.260	79.4 %	0.260
<b>2</b>	95 %	5 %	80.4 %	0.247	80.6 %	0.250
<b>3</b>	90 %	10 %	81.3 %	0.233	81.7 %	0.239
<b>4</b>	85 %	15 %	82.3 %	0.219	82.8 %	0.227
<b>5</b>	80 %	20 %	83.3 %	0.206	83.8 %	0.216

<b>6</b>	75 %	25 %	84.2 %	0.192	84.7 %	0.203
<b>7</b>	70 %	30 %	85.2 %	0.178	85.6 %	0.191

**Figures 3 and 4. Comparison of SPIA + No Change vs. SPIA + Modified Portfolio: Balanced Allocation; Sustainability & Legacy vs. Annuity Allocation (Balanced).**

Table 5. Results for an Aggressive Portfolio

	Allocations to Investment Account & SPIA		SPIA + No Change		SPIA + Modified Portfolio	
	Investment Account	SPIA	Retirement Sustainability	Financial Legacy	Retirement Sustainability	Financial Legacy
<b>1</b>	100 %	0 %	80.0 %	0.269	80.0 %	0.269
<b>2</b>	95 %	5 %	80.9 %	0.255	81.0 %	0.257
<b>3</b>	90 %	10 %	81.8 %	0.241	82.0 %	0.245
<b>4</b>	85 %	15 %	82.8 %	0.227	82.9 %	0.233
<b>5</b>	80 %	20 %	83.7 %	0.213	83.7 %	0.220
<b>6</b>	75 %	25 %	84.6 %	0.199	84.5 %	0.207
<b>7</b>	70 %	30 %	85.6 %	0.185	85.3 %	0.193

**Figures 5 and 6. Comparison of SPIA + No Change vs. SPIA + Modified Portfolio for an Aggressive Allocation; Sustainability and Legacy vs. Annuity Allocation (Aggressive).**

**Takeaways**

Annuities can increase the sustainability of a client’s retirement portfolio, both when the asset allocation within the investment portfolio is unchanged (i.e., when the addition of the bond-like annuity makes the overall portfolio more conservative), and when the asset allocation is rebalanced so that, with the annuity, it matches the client’s original risk profile.

Additionally, when the client purchases an annuity and modifies her portfolio to match her overall risk profile (the “SPIA + Modified Portfolio” cases), the legacy and sustainability of her strategy *both* improve—regardless of whether the investment allocation is conservative, balanced or aggressive. The annuity allocation, as an addition to the portfolio’s fixed income allocation, allows our client to take more upside exposure (more equities) within her

managed account without changing her original risk exposure.\*\*

The analysis presented so far is for a female aged 65. How do the results change at earlier or later ages? In Table 6 (click on link below), we show values for a female age 60, and age 70; compared to our original 65-year-old client.

**[Table 6. Results for additional ages \(Monthly SPIA income F60 = \\$353.60 and F70 = \\$472.05\)](#)**

We've shown that including a SPIA into an individual's retirement portfolio improves retirement sustainability. The annuity reduces the lifetime ruin probability of the investment account (increasing its sustainability) because the portfolio isn't burdened with higher withdrawals. While this improvement reduces the client's financial legacy, the reduction can be offset by rebalancing the portfolio to take the annuity purchase into account and allocating more to equities. This result persists even when interest rates (and annuity payout rates) are lower than in earlier periods, such as when Ameriks, Veres and Warshawsky conducted their study. (See [Figure 7](#).)

When designing retirement solutions, it helps to focus on the client's retirement goals. Is the client looking for a sustainable income, or is she interested in maximizing a potential legacy? Given that both market returns and longevity are random, we propose the use of the Retirement Sustainability Quotient and Expected Financial Legacy (RSQ and EFL) concepts to help advisors evaluate the costs and benefits of including annuities within a retirement income portfolio.

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\*Portfolio account balances may veer below zero; implying that the client, instead of leaving a financial legacy, is instead borrowing funds in retirement (possibly from the people who would otherwise be heirs!). In our examples, when borrowing is required we assume the cost is equal to the long-term interest rate—but we caution the reader that in the extreme (and in real-world scenarios), borrowing may not be available or the cost may be higher than our assumptions.

\*\*When the client has an aggressive investment portfolio, beyond a certain annuity allocation the "Modified Portfolio" strategy does not provide any additional benefit over the "No Change" strategy. (See the allocation of 10% to annuities in portfolios three and four on



Table 5, and note the sustainability and legacy scores for these two portfolios.) At a certain point, taking additional risk within the investment account exposes the client to more downside than can be overcome by further annuity purchases (not without moving the client away from an overall aggressive investment profile). Our hypothetical client obtains her highest sustainability scores in either of two ways: By annuitizing 30% of the initial portfolio while adopting a balanced portfolio allocation and modifying the portfolio to take the annuity allocation into account (Table 4), and by annuitizing 30% of the portfolio while adopting a conservative portfolio allocation without modifications (Table 5). Both strategies produce an RSQ score of 85.6%.

## Footnotes

[1] Ameriks, John and Veres, Robert and Warshawsky, Mark J., "Making Retirement Income Last a Lifetime," *Journal of Financial Planning*, December 2001. Available at SSRN: <http://ssrn.com/abstract=292259>

[2] CANNEX specializes in gathering, compiling and redistributing comparative information and calculations about products and services offered by financial institutions, including, in the U.S., guaranteed lifetime income products such as income annuities. Go to [www.cannex.com](http://www.cannex.com) for more information.

[3] See, for example, Peng Chen, Moshe Milevsky, "Merging Asset Allocation and Longevity Insurance: An Optimal Perspective on Payout Annuities," *Journal of Financial Planning*, June 2003. See [http://www.ifid.ca/pdf\\_workingpapers/WP2003JUN.pdf](http://www.ifid.ca/pdf_workingpapers/WP2003JUN.pdf).

[4] We note that our model could incorporate insurer credit ratings, or assume diversification via the purchase of annuities from various issuers. We have not included either of these as they are not central to our main message.

[5] More information on QWeMA NumERICs is available from CANNEX at [www.qwema.ca](http://www.qwema.ca)

[6] See <https://www.soa.org/research/experience-study/pension/research-rp-2000-mortality-tables.aspx>.

[7] Available at <https://am.jpmorgan.com/us/institutional/library/lcma-2016>

[8] Quotes obtained on December 30, 2015 from [www.cannex.com](http://www.cannex.com).

