

# WHO SHOULD PURCHASE VARIABLE ANNUITIES AND HOW SHOULD THEY USE THEM?

BY LEORA FRIEDBERG, GUOXUAN MA, WEI SUN AND ANTHONY WEBB

Prominent among the financial risks that retirees face are longevity and investment risk. Longevity risk is the risk of living too long: this results in either outliving one's resources or having to reduce consumption continually in old age to stretch resources over one's continuing lifetime. Investment risk is the risk of a low return on investments: at younger ages, individuals have time to adjust (by saving more, cutting back on spending, or retiring later, for example) while waiting for returns to recover, but in old age, the margins for adjustment are few. One type of annuity, termed an immediate annuity, provides almost complete insurance against both risks: in exchange for a lump sum of wealth, a purchaser receives a lifetime income.<sup>1</sup> Theoretical calculations indicate that, inflation risk apart, the insurance provided by immediate annuities ought to be valued by risk-averse households facing an uncertain lifespan and uncertain investment returns (Friedberg and Webb 2022). However, take-up of immediate annuities in the private market is extremely low – which is the so-called annuity puzzle. In 2022, fixed immediate annuity sales in the United States totaled a mere \$5.9 billion.<sup>2</sup>

The academic literature has devoted extensive study to the annuity puzzle, attempting to resolve it in one of two ways. The first way is to incorporate research evidence, often obtained through simple experiments, about a range of mistakes that typical individuals tend to make in their financial decisions. For example, it has been demonstrated that many individuals overvalue lump sums relative to income streams and exhibit present bias. The second way is to incorporate a range of possible features in theoretical models that may reduce the value of annuities. For example, if individuals desire to leave a bequest, then bequests can function as

informal longevity insurance, since if one dies early it results in what is sometimes called an “incidental bequest” (Lockwood, 2012). And if one dies late, one can use the funds that would have been bequeathed to avoid a sharp drop in spending.<sup>3</sup> While those factors might well influence demand for annuitization, we focus on a simpler explanation that has largely been missing from the theoretical literature: that the annuity products that households actually buy may offer a more appealing trade-off between risk and return than that offered by immediate annuities. The annuity products that are common in the market are variable de-

1. The insurance is not quite complete because, following the withdrawal of inflation indexed immediate annuities from the market, the individual is exposed to inflation risk.  
2. U.S. Individual Annuity Sales Surveys, LIMRA Secure Retirement Institute.  
<https://www.limra.com/siteassets/newsroom/fact-tank/sales-data/2023/q2/2q-2023-annuity-sales-estimates-v-final.pdf>  
3. Many of these explanations have been reviewed for the Retirement Income Institute by Webb (2021a, 2021b).

ferred, fixed-rate deferred, fixed index, and registered index-linked annuities (which we collectively refer to as variable annuities) and often include an option to convert some of the asset into lifetime income. This may explain why variable annuity sales totaled \$102.9 billion and fixed index annuities \$79.8 billion in 2022, though the academic literature largely ignores those real-world products.

In contrast to an immediate annuity, a variable deferred annuity with a Guaranteed Lifetime Withdrawal Benefit (GLWB) rider functions as an investment vehicle (the variable annuity) with a *lifetime income option* (the rider), as the full taxonomies in Friedberg and Webb (2022) and Pfau (2019) explain.<sup>4</sup> The premium (that is, the amount used to purchase the annuity product) is invested in financial assets, typically stock and bond funds, and the policyholder enjoys the returns on those funds, minus fees and expenses. Registered index-linked annuities, which have become increasingly popular in the annuity market, further allow individuals to limit the exposure of their premium to market risk by choosing pre-set floors and/or ceilings for returns.<sup>5</sup> Attached to any of these products, a GLWB rider gives the policyholder the right, but not the obligation, to commence taking annual withdrawals from their invested assets at a date of their choosing.<sup>6</sup> The assets continue to earn market returns for as long as the assets remain, and in the event that GLWB withdrawals deplete the assets, whether because the policyholder lives longer than expected or investment returns have been poorer than expected, the insurance company steps in and makes the GLWB payments for the remainder of the policyholder's life.

The insurance provided by an immediate annuity comes at a cost not only of a loss of liquidity and reduction in bequest size but also of access to the higher expected returns (relative to alternatives) that continue

to be offered by equities – and this demand for equities is higher for individuals with greater Social Security income as a share of their retirement resources, because Social Security as an asset has investment characteristics similar to those of low-risk bonds.<sup>7</sup> On the other hand, the GLWB benefit must be less than the income provided by an immediate annuity, as a result of a no-arbitrage condition – in other words, because the GLWB benefit offers an *option* to convert assets into lifetime income at any later date, the price of converting those assets must be less advantageous relative to an immediate annuity, absent possible differences in mortality rates between purchasers of immediate and variable annuities. Balancing these two factors, less risk-averse households may be better off if, at the time of retirement, they purchase the partial insurance against investment and longevity risk provided by variable deferred annuities with a guaranteed living withdrawal benefit (GLWB) rider, rather than purchasing an immediate annuity of any size. This hypothesis is independent of the preferred tax treatment of variable annuity assets, which has its greatest value if purchased before retirement, when households face higher marginal tax rates than those anticipated post-retirement. The most catastrophic financial outcome for households that begin retirement with means is to both live longer than expected and experience poor investment returns, and it is this combination of outcomes that a variable annuity with a GLWB rider insures against.

## ANALYTICAL FRAMEWORK

Our approach builds on the general set of models used to evaluate immediate annuities and applies them to the more difficult problem of evaluating variable annuities.<sup>8</sup> We construct a model of optimal post-retirement spending and asset draw-down choices by a risk-averse individual. The individual faces an uncertain lifespan

- 
4. VAs offer the option to purchase other riders (Pfau, 2019), insuring other risks. As our focus is on insuring longevity risk, we defer study of other riders to future research. Meanwhile, the evolution of annuity products continues as Blanchett (2023) emphasizes. The latest offerings, involving what he terms “Protected Lifetime Income Benefits”, offer payouts that encompass more investment risk than those from GLWB riders.
  5. They pay annual interest equal to some percentage of the return (excluding dividends) calculated on some stock market index—for example, the S&P 500—subject to floors and ceilings. A typical floor is zero percent; if the floor is less than zero, the annuity is technically a variable index annuity.
  6. The exercise price of the GLWB option is a complicated function of both age and the “high-water mark” of the annuity value”. Should the household wish, the variable annuity itself can be surrendered for a lump sum.
  7. In the presence of an equity premium, most households should still annuitize at least partially, because most households hold some of their wealth in bonds, and the annuity would substitute for bonds. Nor can the equity premium explain the lack of demand previously for variable immediate annuities, an immediate annuity that is no longer available, where the income is related to the return on an underlying stock fund.
  8. Our model is most closely related to those of Mitchell, Poterba, Warshawsky, and Brown (1999), Brown and Poterba (2000), Dushi and Webb (2004), and Lockwood (2012), and though it does not consider married couples, as Brown and Poterba and Dushi and Webb do, it adds a bequest motive as Lockwood (2018) does. To understand how individuals should optimally use variable annuities, it also adds asset allocation decisions both in and out of the variable annuity, along with the optimal exercise age of the GLWB.

	Age of First Withdrawal	Guaranteed Payout Percentages <sup>24</sup>
	60-64	4.18%
	65-69	5.18%
	70-74	5.33%
	75-79	5.62%
	80+	5.7%
Annual Mortality and Expense and Administrative Charges	1.25%	
Underlying Account Fee for Investment Expenses	0.75%	
Annual Rider Fee	1.33%	
Rider Applies To	High-Watermark Benefit Base	

*Variable Annuity Parameters*

and uncertain stock market returns and decides whether to purchase a variable annuity (and the share of assets to devote to that purchase) with a GLWB or an immediate annuity, each having realistic fees. We further incorporate asset allocation decisions, both inside and outside of the variable annuity; the decision of when to convert annuity assets into lifetime income; and the luxury bequest motive that, in Lockwood (2012), reduces annuity demand. We focus on someone at age 65 who is retired, since this is when many households make decisions about their post-retirement assets, and we focus on asset levels corresponding to the upper part (though far from the top) of the asset distribution, since those are the households that stand to gain most from avoiding self-insurance. We then consider purchase decisions by men and women separately, which is important given women's greater longevity and unisex pricing of variable annuities (in contrast to immediate annuities).

It is helpful to lay out our baseline assumptions. We begin by considering a single male who has the annual mortality risk of annuity purchasers, and then later we do the same for a female.<sup>9</sup> The individual receives \$26,000 annually from Social Security (\$2,167 a month), the average amount for new retired worker

benefit claimants.<sup>10</sup> The individual also has \$400,000 in retirement accounts that may be used to purchase an annuity.<sup>11</sup> Our financial assumptions are based on recent data, and besides in some sensitivity analysis, we assume no inflation surprises. We assume bonds yield a real return of 2.34%, the yield on 10-year constant maturity Treasury Inflation Protected Securities in October 2023, higher than rates following the Great Financial Crisis but lower than historic rates.<sup>12</sup> We disfavor using historic stock returns because both the equity premium and the risk-free rate have likely declined in recent years (Diamond 1999, Graham Harvey 2015). Instead, we use an expected return equal to the inverse of the October 2023 forward price-earnings ratio on large capitalization stocks, giving an expected real return of 5.7%.<sup>13</sup>

Variable annuity characteristics vary considerably. We therefore rely on information about representative products while analyzing sensitivity to some important features. In our base case specification, we rely on the following market analysis conducted by Wade Pfau in March 2023 and relayed through personal communication.

Our base case does not include a constraint on the variable annuity asset allocation, this being considered in

9. We use mortality rates reported in the Society of Actuaries Annuity 2000 mortality table, projected using Projection Scale AA to yield mortality rates for a male or female born 1958.

10. Table 6.B3 Social Security Administration Annual Statistical Supplement 2022, increased by inflation to 2023 and rounded.

11. As a point of reference, retirement account balances in 2019 for households aged 65-74 had a mean value of \$494,000 and a median value of \$190,000 (The Fed - Table: Survey of Consumer Finances, 1989 - 2022 (federalreserve.gov)).

12. Federal Reserve Bank of St. Louis. Market yield on U.S. Treasury Securities at 10-year constant maturity, as of 4 October 2023. <https://fred.stlouisfed.org/series/DFII10>

13. Yardeni Research Inc. Stock Market Briefing: Selected Pes. October 12, 2023. <https://www.yardeni.com/pub/stockmktperatio.pdf>

our sensitivity analyses. Immediate annuity parameters are based on the average of prices observed on December 4, 2023, on the website of Blueprint Income.<sup>14</sup> Assumptions related to registered index-linked annuities are based on January 2024 data on call and put options involving the S&P 500. Registered index-linked annuities have no investment fees and we assume purchasers face the same GLWB fees as those applicable to traditional variable annuities.

We determine whether an individual should optimally purchase an annuity by calculating annuity-equivalent wealth, the factor by which the wealth of someone who is unable to purchase an annuity must be increased so that a risk averse individual is, in expectation, just as well off as the same individual with access to the annuity market. To illustrate, if an individual had age-65 financial assets of \$100,000 and the right to use up to (say) one-half of their wealth to purchase annuities, then annuity equivalent wealth of 1.2 implies that individual would be indifferent between \$100,000 plus the right to purchase annuities and \$120,000 without that right.<sup>15</sup> Annuity-equivalent wealth likely understates the value of annuities because we assume that the alternative is optimal drawdown of unannuitized wealth, a strategy that few, if any, households have the ability to compute.<sup>16</sup>

The model also shows how the value of variable annuities is affected by other financial decisions of individuals, to provide guidance on those decisions to purchasers and their financial advisors. The decisions facing the purchaser of a variable annuity are complex, as the individual must decide how much of their wealth to invest in an annuity. An individual who invests a large share in a variable annuity and ends up taking non-GLWB withdrawals to finance consumption will reduce the amount of their GLWB guarantees and in effect waste some of their GLWB premiums. The individual must also decide how to invest both variable annuity and non-variable annuity wealth. The insurance provided by the GLWB against bad investment outcomes may incentivize riskier investments in the variable annuity portfolio, subject to insurance com-

pany limits, and perhaps less riskiness of the non-variable annuity portfolio.

The optimal exercise decision of the GLWB is also complex. An individual who postpones the age at which they exercise the option increases the amount of their GLWB income, which they will receive for a shorter period. However, a strategy of choosing an exercise age to maximize the expected present value of lifetime income neglects the value of the additional longevity insurance purchased because of delay. As with the Social Security claiming decision, an individual who delays is, in effect, using the GLWB payments foregone to purchase additional longevity insurance.

## RESULTS

We find that at least partial annuitization, whether through an immediate annuity or a variable annuity with a GLWB rider, dominates no annuitization, and more so at higher levels of risk aversion. A bequest motive reduces but does not eliminate annuity demand but, unlike in Lockwood (2012), which has a model without investment risk or the equity premium. The upshot is that variable annuities with a GLWB option dominate not only no annuitization but also immediate annuities, no matter the level of an individual's risk aversion that we consider, because the variable annuity allows individuals to benefit from the equity premium while managing both investment and longevity risk.

When we consider further details, we find that for typical variable annuities, it is optimal to exercise the GLWB option immediately, at age 65, because the additional longevity insurance acquired because of delay is insufficient to compensate for delaying receipt. This is the case even though delayed exercise increases the amount of expected lifetime income. The optimal asset allocation within the variable annuity depends on the assumed level of the equity premium, and for plausible assumed levels, it will be optimal to select the largest permitted allocation to risky assets. Moving away from this optimal allocation, however, can substantially reduce the value of variable annuities, an

14. Blueprint income, a subsidiary of MassMutual, is an annuity marketplace that “offers a curated selection of the top 30 insurance companies” (Guaranteed Fixed & Income Annuities | Blueprint Income).

15. By design, annuity equivalent wealth can never be less than zero as the individual can decline the annuitization option.

16. In practice, households appear to follow arbitrary rules of thumb such as spending interest and dividends only. Only by chance will interest and dividends correspond to the optimal share of wealth to consume. Alternatively, they may follow the well-known 4% rule, which fails to respond to realized returns and therefore risks complete immiseration (Friedberg and Webb 2022).

important result for financial advisors to keep in mind. Incorporating taxes generally has little effect on the optimal strategy because only the wealthiest retirees pay significant income taxes after retirement.<sup>17</sup> We find that registered index-linked annuities can increase financial well-being, depending on the terms of the contract and the individual's beliefs and ability and willingness to bear risk.

## DISCUSSION

Our modeling shows that annuities improve household financial well-being in many circumstances, while the choice among annuity types depends on preferences – what advisors refer to as a household's ability and willingness to bear risk – and beliefs about future returns and inflation. Moreover, to maximize the benefit of variable annuities, households must make appropriate allocation and withdrawal decisions throughout the life of the annuity.

At the time of purchase, households must consider fees and benefits. Unlike immediate annuities, variable annuities are not a uniform product. Higher fees may purchase more valuable benefits – for example an ability to invest in riskier assets, a higher annuity rate, or a larger age-related increase in the annuity rate. All this points to the need for households to receive appropriate and continuing professional advice.

## AUTHORS

*Leora Friedberg is Associate Professor of Economics and Public Policy at the University of Virginia.*

*Guoxuan Ma is Assistant Professor of Economics in the Research Institute for Global Value Chains at the University of International Business and Economics*

*Wei Sun is an Associate Professor at China Financial Policy Research Center and School of Finance, Renmin University of China.*

*Anthony Webb is Senior Fellow at the Schwartz Center for Economic Policy Analysis, The New School.*

## ACKNOWLEDGEMENTS

*We are grateful to Jason Fichtner, David Blanchett, and Wade Pfau for helpful input and to the Retirement Income Institute for generous funding. Wei Sun received funding supports by the Humanities and Social Sciences Research General Program of the Ministry of Education of the People's Republic of China (Grant No. 22YJA790052).*

17. Variable annuities offer the same tax treatment as tax-deferred retirement accounts. Therefore, they do not confer tax advantages if purchased within a tax-deferred account, and their tax advantages largely arise if purchased pre-retirement, which both lengthens the tax deferral period and allows the shifting of taxable income to a time period when marginal tax rates may be lower. However, effective marginal tax rates of retirees are a complicated function of income because of tax provisions affecting combined-income phase-out rules and Medicare income-tested premiums, potentially reducing the gains from deferral in retirement.

## REFERENCES

- Blanchett, David. 2023. "Protected Lifetime Income Benefits: The Next Generation GLWB." Retirement Income Institute Original Research #021-2023, June. [https://www.protectedincome.org/wp-content/uploads/2023/06/RP-21\\_Blanchett\\_v4.pdf](https://www.protectedincome.org/wp-content/uploads/2023/06/RP-21_Blanchett_v4.pdf) .
- Brown, Jeffrey R. and James Poterba 2000. "Joint Life Annuities and Annuity Demand by Married Couples." *Journal of Risk and Insurance*, 67(4): 527-53.
- Dushi, Irena, and Anthony Webb. 2004. "Household Annuitization Decisions: Simulations and Empirical Analyses." *Journal of Pension Economics & Finance*, 3(2), 109-143.
- Friedberg, Leora and Anthony Webb. 2022. A Primer on Annuities: What Economists and Financial Professionals Need to Know about Variable Annuities, Fixed Indexed Annuities, and Registered Index-Linked Annuities. Retirement Income Institute Original Research #008-2022, July. [https://www.protectedincome.org/wp-content/uploads/2022/07/RP-08-Friedberg-Webb\\_v5.pdf](https://www.protectedincome.org/wp-content/uploads/2022/07/RP-08-Friedberg-Webb_v5.pdf) .
- Graham, John R., and Campbell R. Harvey. 2015. "The Equity Risk Premium in 2015." Manuscript, [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2611793](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2611793) .
- Lockwood, Lee. 2012. "Bequest Motives and the Annuity Puzzle." *Review of Economic Dynamics*. Volume 15 No. 2. Pages 226–243.
- Lockwood, Lee. 2018. "Incidental Bequests and the Choice to Self-Insure Late-Life Risks." *American Economic Review* Volume 108, No. 9. Pages 2513–2550.
- Mitchell, Olivia, James Poterba, Mark J. Warshawsky and Jeffrey J. Brown. 1999. "New Evidence on the Money's Worth of Individual Annuities" *American Economic Review*, Vol. 89 No. 5.
- Pfau, Wade. 2019. Safety-First Retirement Planning: An Integrated Approach for a Worry-Free Retirement. Self-Published. ISBN 978-1945640063
- Webb, Anthony. 2021a. "What Lessons, If Any, Can Practitioners Apply From Academic Economists about the Role of Annuities in Post-Retirement Asset Decumulation?" Retirement Income Institute #003-2021, February. [https://www.protectedincome.org/wp-content/uploads/2021/08/RS981\\_LR-03-Webb-FN-AH-Feb3.pdf](https://www.protectedincome.org/wp-content/uploads/2021/08/RS981_LR-03-Webb-FN-AH-Feb3.pdf) .
- Webb, Anthony. 2021b. "What Can Scholarly Research Tell Us about Cognitive and Behavioral Impediments to Annuitization? Do These Impediments Vary with Race/Ethnicity and Gender?" Retirement Income Institute #006-2021, November. [https://www.protectedincome.org/wp-content/uploads/2021/12/E-06-Webb-FN-AH-PROOFED\\_8.25.21\\_Nov-2021.pdf](https://www.protectedincome.org/wp-content/uploads/2021/12/E-06-Webb-FN-AH-PROOFED_8.25.21_Nov-2021.pdf) .