

Guaranteed income: A tricky trade-off

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- The shift from defined benefit to defined contribution plans has diminished the role of lifetime income guarantees in retirement planning.
- Researchers and policymakers have suggested that annuities can serve as a source of guaranteed lifetime income for the defined contribution era, helping retirees manage the risk of outliving their assets.
- The math is clear. A certain income can leave retirees better prepared for an uncertain lifetime. But retirees' reluctance to annuitize suggests that the irrevocable decision to exchange liquid wealth for guaranteed income is about more than math. We highlight some of the hurdles.

As the lifetime paycheck once provided by defined benefit (DB) pensions disappears, researchers and policymakers have suggested that annuities can be a source of guaranteed income for the defined contribution (DC) era.¹ The math is compelling. The value of these insurance products is clear for those who live beyond life expectancy or through a period of poor returns. Annuities also deliver an obvious benefit to those who prioritize stable, predictable income in retirement.

But the math has had limited influence on investor behavior. Few retirees annuitize. A large body of research has explored the gulf between the theoretical value of guaranteed income and the reality of investor behavior—the so-called annuity puzzle. This research has supplied some pieces of the puzzle (the desire to leave a bequest, precautionary saving for a health care shock), but it remains unsolved. A reasonable conjecture: The prospect of trading a significant chunk of liquid wealth accumulated over a lifetime of labor for a contract with an uncertain payoff looms larger in people’s minds than in the models.

We start with a description of the annuities in our analysis. We then simulate retirement income and wealth at different ages to illustrate how guaranteed income affects retirement outcomes. We conclude with a review of data on annuity usage and what it suggests about guaranteed income’s perceived costs and benefits.

Annuities: Insurance by another name

Annuities are insurance. Insurance protects people from risks they would be unable to manage with their own financial resources. Retirees face the risk that an investment portfolio, combined with Social Security benefits, will be unable to support their income needs for life.

We examine two annuities that address this risk simply and directly: an immediate fixed income annuity (a single premium immediate annuity, or SPIA) and a deferred fixed income annuity (we use a qualified longevity annuity contract, or QLAC). Both guarantee a certain income for an uncertain lifetime.

- **Immediate fixed income annuity.** Buyers exchange a lump sum for guaranteed, regular payouts that begin soon after purchase. We assume that these contracts are irrevocable. Once retirees buy the contract, they no longer have access to those funds. Some insurers offer contracts with guaranteed minimum payouts or a refund to a beneficiary if the annuitant dies before the sum of payouts equals the amount paid for the annuity. These options reduce an annuity’s payouts.
- **Deferred fixed income annuity.** At retirement, buyers exchange a lump sum for payouts that begin in the future, as late as age 85. The QLAC is designed specifically for use with DC plans and traditional Individual Retirement Accounts. QLACs are irrevocable.

Notes on asset-return distributions

The asset-return distributions shown here represent Vanguard’s view on the potential range of risk premiums that may occur over the next ten years; such long-term projections are not intended to be extrapolated into a short-term view. These potential outcomes for long-term investment returns are generated by the Vanguard Capital Markets Model® (VCMM) and reflect the collective perspective of our Investment Strategy Group. The expected risk premiums—and the uncertainty surrounding those expectations—are among a number of qualitative and quantitative inputs used in Vanguard’s investment methodology and portfolio construction process.

IMPORTANT: The projections and other information generated by the VCMM regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. Distribution of return outcomes from the VCMM are derived from 10,000 simulations for each modeled asset class. Simulations are as of June 30, 2020. Results from the model may vary with each use and over time. For more information, see Appendix 1, “About the Vanguard Capital Markets Model,” on page 14.

¹ In 1975, 70% of private-sector workers actively participating in any kind of retirement plan participated in a defined benefit plan; by 2017, that figure was 14%, with the remainder participating in defined contribution plans (Employee Benefits Security Administration, 2021).

Because of the long deferral period between purchase and payout, deferred annuities provide larger payouts than immediate annuities, guaranteeing higher late-in-life income for the same purchase price. **Figure 1** compares the annual nominal payouts for a SPIA and QLAC for a 65-year-old male and a 65-year-old female.² It also shows the inflation-adjusted values of these payouts 20 and 30 years after the annuity purchase. (Payouts for males are higher than those for females because females have a longer life expectancy. The lower payouts for females reflect the greater cost of “longevity insurance” for this longer-lived group.)

A simple example demonstrates the protection provided by longevity insurance: On February 3, 2021, as detailed in Figure 1, a 65-year-old male could buy a \$100,000 SPIA, with no survivor benefits, that would pay him about \$5,800 a year for the rest of his life. Imagine instead that he invested \$100,000 in a hypothetical

vehicle offering liquidity and an average annual return of 2.8%, consistent with Vanguard’s June 30, 2020, 30-year median projection for the broad U.S. bond market. (Bond returns are a reasonable, but far from perfect, proxy for the returns embedded in an annuity.) Withdrawals of \$5,800 a year would exhaust the liquid assets in less than 23 years.

As with any insurance product, annuity economics depend on risk-pooling. In the hypothetical investment vehicle, the sustainability of \$5,800 withdrawals depends on the interest rate. With an annuity, the payout is a function of the investment returns expected by the insurer and the expected distribution of life spans among the annuity buyers. It also depends on the profit the insurer seeks to earn on the annuity and the competitive dynamics that determine the size of this profit.

Figure 1. Two flavors of guaranteed fixed income: immediate (SPIA) and deferred (QLAC)

		Premium	Nominal annual payout	Inflation-adjusted value of annual payout (year 20)	Inflation-adjusted value of annual payout (year 30)
Male	SPIA—Payouts start at age 65	\$100,000	\$5,788	\$4,381	\$3,652
	QLAC—Payouts start at age 85	100,000	33,212	25,141	20,957
Female	SPIA—Payouts start at age 65	100,000	5,432	4,114	3,428
	QLAC—Payouts start at age 85	100,000	28,375	21,480	17,905

Notes: The annuity payout reflects a single premium immediate annuity with no survivor benefits for a 65-year-old male and a 65-year-old female and a qualified longevity annuity contract with no survivor benefits and a 20-year deferral period for a 65-year-old male and a 65-year-old female. Annuity quotes from Hueler Companies are as of February 3, 2021. Vanguard’s inflation forecasts assume average annual inflation of 1.40% over the 20-year period and 1.55% over the 30-year period.

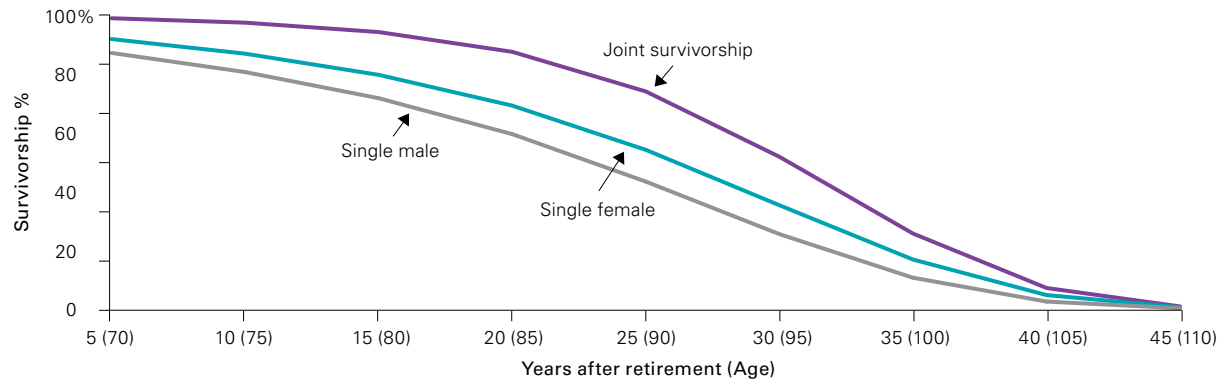
Sources: Vanguard and Hueler Companies.

² Horneff, Maurer, and Mitchell (2016) found that modest allocations to a QLAC (8% to 15% of retirement savings) improved outcomes for most retirement savers.

The risk-pooling element is the most straightforward. Buyers include many individuals who die at different ages. Payouts for those who live longer include both investment returns and “longevity credits” funded by

those who die sooner. **Figure 2** shows the probability that a single 65-year-old male, a single 65-year-old female, or at least one member of a 65-year-old male/female couple will be alive at later ages.

Figure 2. Probabilities that a man aged 65, a woman aged 65, or half of a 65-year-old male/female couple will be alive at later ages



Sources: Vanguard calculations, based on the Society of Actuaries 2014 Individual Annuity Mortality Tables with improvements through 2018.

What if my annuity provider goes under?

An annuity is a contract with an insurance company, subject to the risk that the insurer will default. This risk is real. During the 2008–2009 global financial crisis, insurance companies with large annuity liabilities experienced financial distress (Kojien and Yogo, 2015). Failures have nevertheless been rare. From 2008 to 2015, six small life insurance and annuity providers, in an industry made up of more than 800, entered into receivership (Lankford, 2015; NOLHGA, 2019).

Insurance companies are regulated by the states, which have guaranty laws and funds designed to protect policyholders in the event of a provider’s insolvency. All states promise to protect the present value of contracts up to

\$250,000. Some protect as much as \$300,000. A small number cover as much as \$500,000 (NOLHGA, 2019). Even so, insolvency has cut payouts in the past. In 1991, after California regulators took control of Executive Life—then California’s largest life insurance company—44,000 retirees received 70% of their promised annuity payouts for 13 months (U.S. General Accounting Office, 1993).

Regulators review insurers’ financial strength, as do ratings agencies Moody’s Investors Service, Standard & Poor’s, and A.M. Best. Buyers can limit provider risk by contracting with (potentially multiple) highly rated companies.

Annuities: The math

We illustrate the costs and benefits of annuitization with a series of investment simulations. For ease of discussion, we present the results for a single 65-year-old male. In theory, the cost of guaranteed income should be the same for men and women, with the different payouts reflecting an actuarially fair adjustment for the different life expectancies. Even so, some research (Babbel, 2008) finds that the combination of lower payouts over a longer time horizon makes annuities less expensive for women. If so, our analysis can be considered a conservative base-case estimate of the potential costs and benefits of the longevity protection provided by an income guarantee. Quantitative results would differ for females, but the broad patterns from our analysis apply to men, women, and couples of any gender. Our simulations are based on these assumptions:

- The investor retires with \$1 million. We compare outcomes for a retiree who uses 25% of these savings to buy an annuity and 75% to invest in a portfolio of 60% U.S. stocks and 40% U.S. bonds with the outcomes for a retiree who invests \$1 million in a 60/40 portfolio. (Note: Our choice of a 25% annuity allocation is meant simply to illustrate the impact of meaningful annuitization. It is by no means an optimized allocation.)
- The investor targets annual pre-tax retirement income of \$40,000, adjusted for inflation, to supplement Social Security benefits. This spending is consistent with financial planning research on sustainable portfolio withdrawal rates over a 30-year period (Bengen, 1997).

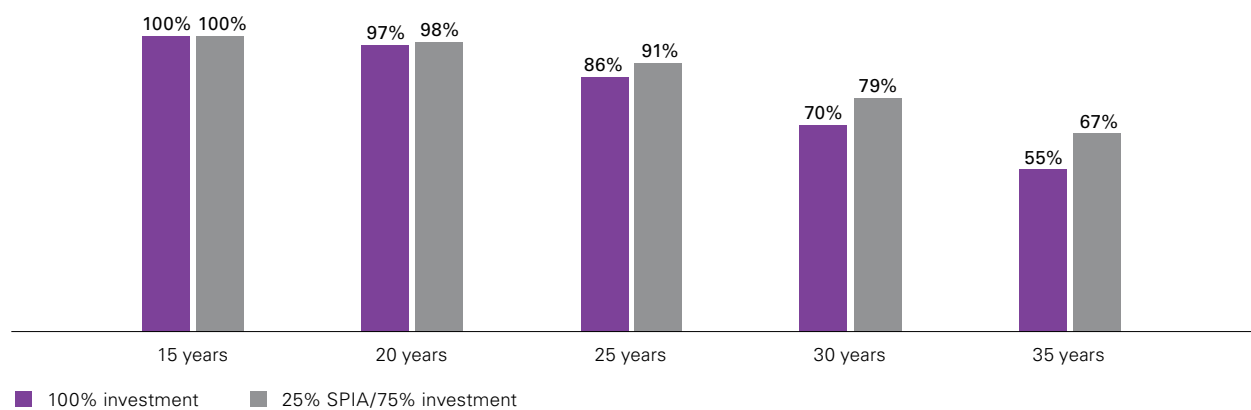
- The investor holds the \$1 million in retirement savings in a tax-deferred account such as a traditional Individual Retirement Account (IRA) or 401(k) plan. Distributions from the investment portfolio and payouts from the annuity purchased with these savings are fully taxable.

We analyze the financial impact of annuitization on income and wealth through retirement. We start with an analysis of an immediate income annuity (a SPIA). We then compare SPIA outcomes with those for a deferred income annuity (a QLAC). In this comparison, we annuitize a smaller percentage of the retirement savings to reflect regulatory limits on QLAC purchases.

Income

Figure 3 shows the effect of partial annuitization on an investor's success in meeting a \$40,000 real spending target at different time horizons. In the first 20 years after retirement, a period consistent with a 65-year-old male's life expectancy, both the annuitized and investment-only approaches are equally effective at meeting the spending target. As the time horizon increases, guaranteed income improves the chance of meeting it. At 35 years, for example, the initial \$1 million investment portfolio has a 55% chance of meeting the target. The combination of the initial \$1 million split between a \$250,000 SPIA and a \$750,000 investment portfolio has a 67% chance of meeting it.

Figure 3. Projected success rates in meeting a \$40,000 spending target diverge over time



Notes: The asset allocation for the investment portfolio is 60% U.S. stocks and 40% U.S. fixed income. See "Index simulations" in Appendix 1 for more detail on these asset classes. The forecast success rates in meeting the \$40,000 real spending target are based on 10,000 simulations of Vanguard's return projections for 15 to 35 years. The annuity payout is based on the quote for a SPIA, with no survivor benefits, for a 65-year-old male on February 3, 2021.

Sources: Vanguard and Hueler Companies.

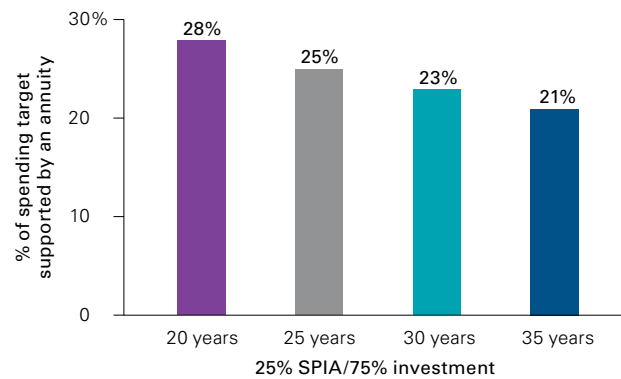
More notable than an annuity's impact on success rates is its ability to limit shortfalls from the income target. When the investment portfolio is depleted, it generates no income. (Investors would, of course, moderate their spending long before the portfolio was exhausted. We use an inflexible spending strategy to highlight differences between investment and insurance.) In the simulations in which withdrawals fall short of an inflation-adjusted \$40,000, the combination of a SPIA and an investment portfolio replaces some of this income. At 35 years, an investor who annuitizes 25% of the initial savings generates 21% of the inflation-adjusted target (Figure 4).

As retirees consider guaranteed income, they need to weigh both the success rates for an income objective at older ages and the probability that they'll live to participate in those success rates. At 35 years, the 65-year-old retiree in our simulations turns 100. The probability that he will be alive is about 11%, as shown in Figure 2. And this probability is based on the population of annuitants, who tend to live longer than the general population.

Liquid wealth

The purchase of an income annuity immediately reduces liquid wealth. But an income annuity can enhance wealth for retirees who live to very old ages. This outcome is a function of annuity math. As the time period extends, the implied return on an annuity increases, potentially exceeding that of investment assets such as bonds. After 20 years, \$100,000 used to purchase an immediate annuity with an annual payout of \$5,800 has produced an internal rate of return equal to a nominal 1.5% per year. But after 35 years, those payments represent a 4.6% internal rate of return. And after 40 years, for those blessed with Methuselean life spans, the return rises to 5%.

Figure 4. An annuity replaces some target spending when the investment portfolio is depleted



Notes: The asset allocation for the investment portfolio is 60% U.S. stocks and 40% U.S. fixed income. See "Index simulations" in Appendix 1 for more detail on these asset classes. The forecast success rates in meeting the \$40,000 real spending target are based on 10,000 simulations of Vanguard's return projections for 20 to 35 years. The annuity payout is based on the quote for a SPIA, with no survivor benefits, for a 65-year-old male on February 3, 2021.

Sources: Vanguard and Hueler Companies.

At age 70, five years after retirement, the investor who annuitizes 25% of his retirement savings has about \$200,000 less in liquid wealth than a peer who chooses not to annuitize. Beyond age 90, however, the tables turn (Figure 5). When the 65-year-old retiree reaches 100, the value of the investment-only portfolio is \$66,000. The annuity/investment combination has liquid wealth of \$221,000.

Figure 5. An annuity immediately reduces liquid wealth but can enhance wealth over long horizons



Notes: The asset allocation for the investment portfolio is 60% U.S. stocks and 40% U.S. fixed income. See "Index simulations" in Appendix 1 for more detail on these asset classes. The forecast success rates in meeting the \$40,000 real spending target are based on 10,000 simulations of Vanguard's return projections for 5 to 35 years. The annuity payout is based on the quote for a SPIA, with no survivor benefits, for a 65-year-old male on February 3, 2021.

Sources: Vanguard and Hueler Companies.

Immediate (SPIA) versus deferred (QLAC)

Unlike a SPIA, the QLAC in our simulations makes no payouts until 20 years after purchase. This deferral period has two implications. First, the investment portfolio must support the entire \$40,000 in real spending over the first 20 years of retirement. Second, the income generated by \$1 of a QLAC is much higher than the income generated by a SPIA. The \$1 used to buy a QLAC has 20 years to compound in the insurer's investment account. The payout is also enhanced by 20 years of longevity credits.

We limit the annuity purchase for both the SPIA and the QLAC to \$135,000, the amount of IRA or DC assets that qualify for favorable tax treatment in 2021 (Internal Revenue Service, 2019). In February 2021, a \$135,000 QLAC generated almost \$45,000 in annual income (nominal) after a 20-year deferral period. A \$135,000 SPIA, by contrast, generated a little less than \$8,000 in annual income (nominal), starting immediately. Both contracts are for a 65-year-old male, with no survivor benefits.

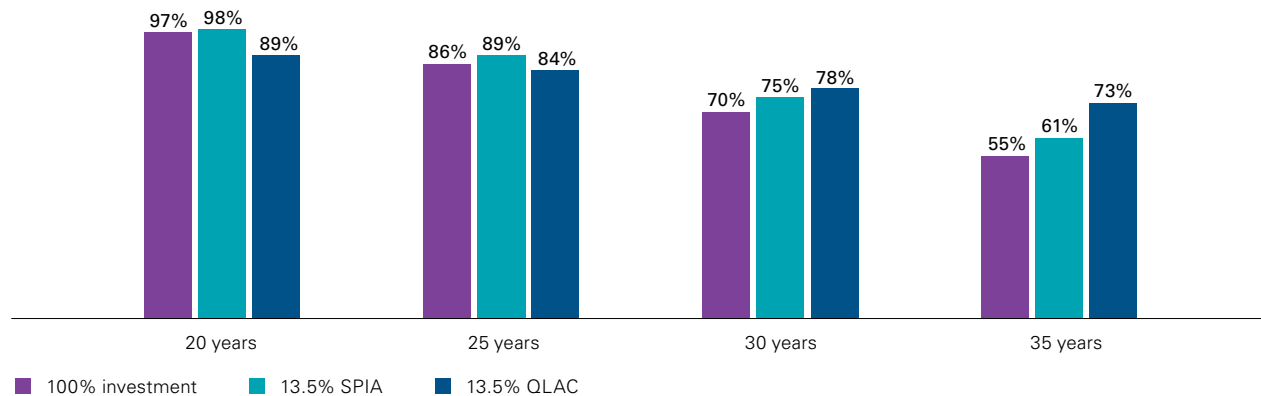
Again, we analyze the financial impact of annuitization on income and wealth at different ages in retirement.

Income

Over periods of up to 25 years, the combination of a SPIA and an investment portfolio produces the best chance of meeting the \$40,000 real spending target; the combination of a QLAC and an investment portfolio produces the lowest. All success rates are high, as shown in **Figure 6**. (At 15 years, not shown in Figure 6, the simulated success rates of all three strategies hover near 100%.)

At longer horizons, when the QLAC's payouts can meet much of the \$40,000 target, a QLAC leads to the highest success rates. At 35 years, the combination of a QLAC and an investment portfolio has a 73% chance of meeting the real spending target. The SPIA-investment portfolio combination has a 61% chance and the investment-only strategy a 55% chance.

Figure 6. A SPIA can enhance success rates in the first 25 years of retirement; a QLAC provides a bigger boost later



Notes: The asset allocation for the investment portfolio is 60% U.S. stocks and 40% U.S. fixed income. See "Index simulations" in Appendix 1 for more detail on these asset classes. The forecast success rates in meeting the \$40,000 real spending target are based on 10,000 simulations of Vanguard's return projections for 20 to 35 years. The annuity payout is based on the quote for a SPIA, with no survivor benefits, for a 65-year-old male on February 3, 2021.

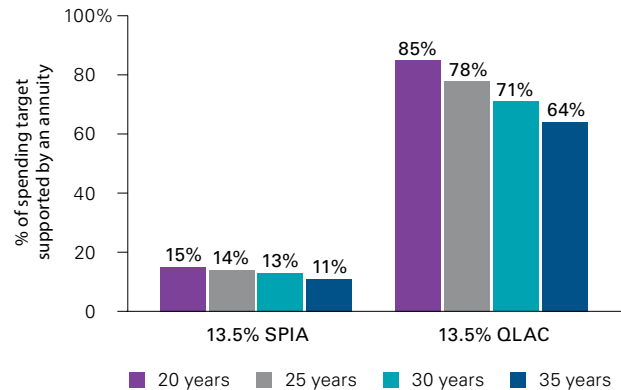
Sources: Vanguard and Hueler Companies.

And when the strategy falls short, the QLAC replaces a larger share of the target income than the SPIA, as shown in **Figure 7**. For example, after 35 years, in simulations that fail to support the \$40,000 inflation-adjusted spending target, the combination of the QLAC and investment portfolio replaces, on average, 64%—or about \$25,000—of the \$40,000 target. The SPIA replaces just 11%.

Liquid wealth

The income outcome emphasizes a QLAC’s value as longevity insurance. The same dynamic applies to analyses of wealth. Over periods of less than 25 years, the QLAC purchase leads to lower levels of liquid wealth, as shown in **Figure 8**. At 30 years, the calculus changes. The median wealth of a retiree who spends \$135,000 on a QLAC is about \$100,000 more than that of a retiree with no annuity. It’s about \$55,000 more than that of a retiree who annuitized 13.5% of his retirement savings with a SPIA. Between 30 and 35 years, the QLAC advantage accelerates.

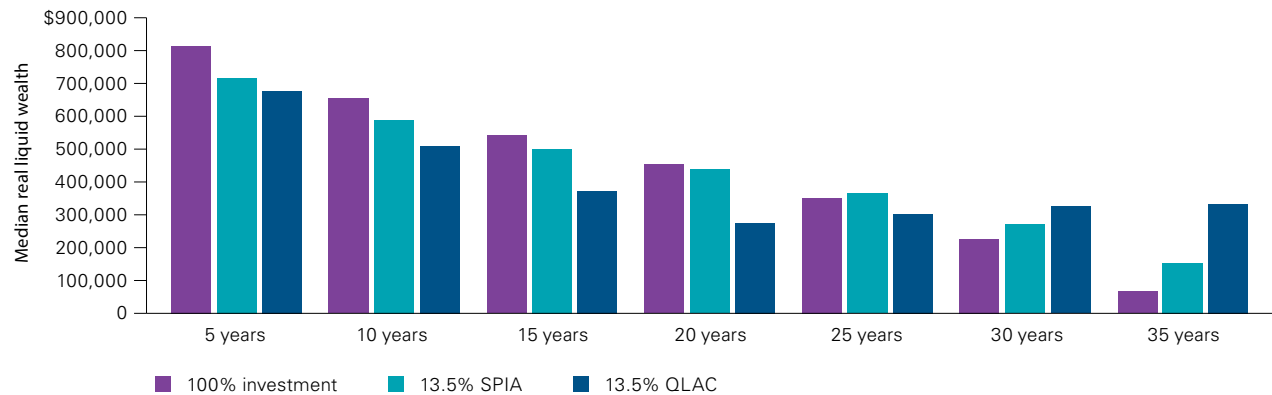
Figure 7. For long-lived retirees, a QLAC replaces a larger share of target spending than a SPIA



Notes: The asset allocation for the investment portfolio is 60% U.S. stocks and 40% U.S. fixed income. See “Index simulations” in Appendix 1 for more detail on these asset classes. The forecast success rates in meeting the \$40,000 real spending target are based on 10,000 simulations of Vanguard’s return projections for 20 to 35 years. The annuity payout is based on the quote for a SPIA, with no survivor benefits, for a 65-year-old male on February 3, 2021.

Sources: Vanguard and Hueler Companies.

Figure 8. A QLAC leads to a large reduction in liquid wealth early in retirement but can enhance wealth later



Notes: The asset allocation for the investment portfolio is 60% U.S. stocks and 40% U.S. fixed income. See “Index simulations” in Appendix 1 for more detail on these asset classes. The forecast success rates in meeting the \$40,000 real spending target are based on 10,000 simulations of Vanguard’s return projections for 5 to 35 years. The annuity payout is based on the quote for a SPIA, with no survivor benefits, for a 65-year-old male on February 3, 2021.

Sources: Vanguard and Hueler Companies.

An annuity's impact on asset allocation

Our simulations assume that the investor who buys an annuity maintains the same 60/40 asset allocation in the remaining investment portfolio as the investor who chooses not to buy an annuity. But when retirees replace investments subject to market risk with guaranteed income, they may be able to assume more risk in the remaining investment portfolio, even as their risk tolerance remains unchanged.

Such are the implications of the Vanguard Life-Cycle Investing Model (VLCM), a portfolio construction engine used to develop asset allocation glide paths for retirement investing. **Figure 9** compares the glide paths for two retirement investors: one who plans to use 20% of retirement savings to buy an annuity at retirement and one who plans to keep all retirement savings in an investment portfolio.

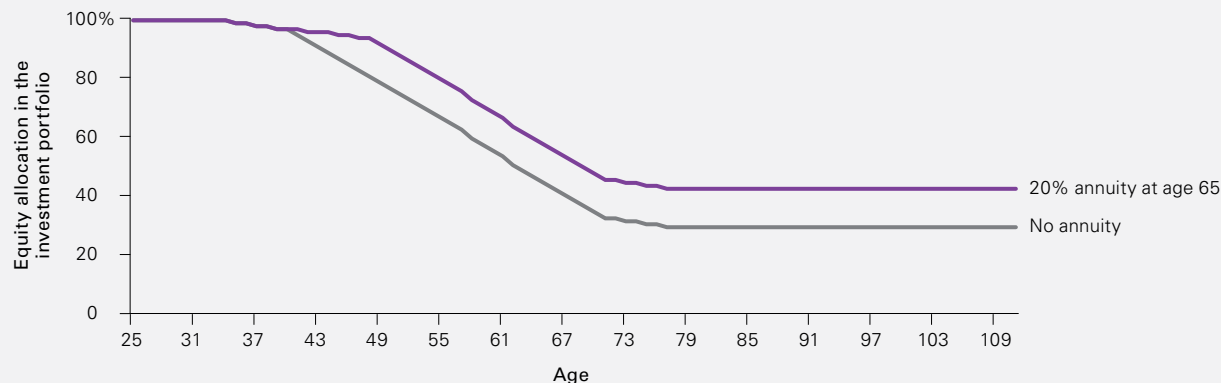
In both cases, the investors join the workforce at age 25 and contribute to target date retirement portfolios, with an asset allocation glide path calibrated to an expected retirement age of roughly 65. We keep all model inputs—income, risk aversion, sensitivity to short-term losses—constant. The only difference is the intended allocation to annuities. (Note: Because asset allocation changes over time in the VLCM-derived portfolios, we can't compare success rates and liquid wealth with

those from the other simulations in this paper. We use the VLCM simply to illustrate the impact of an annuity on the remaining portfolio's asset allocation.)

The VLCM finds the asset allocation glide path that maximizes the expected lifetime utility of spending and wealth (Aliaga-Díaz et al., 2021). Utility is an abstract concept, mainly used in economics literature. A utility function allows researchers to compare any two outcomes and determine the preferred one. Using utility functions, we aim to identify the single best asset allocation glide path among thousands of possibilities in light of investor goals, preferences, and a strategy's expected risk and return.

This analysis suggests that if two investors are equally risk-averse, the one who allocates 20% of retirement savings to an annuity will prefer a higher equity allocation in the investment portfolio than the retiree who chooses not to annuitize. That result is not a surprise. The annuity behaves more like fixed income than equity. When 20% of the original retirement savings is intended for an annuity, a portfolio allocated 60% to equities and 40% to fixed income, for example, will be comparable to a portfolio/annuity combination with an effective 48% allocation to equities and 52% to fixed income. The VLCM responds to this change by raising the portfolio's equity exposure.

Figure 9. Partial annuitization boosts the capacity to take risk in the remaining investment portfolio



Notes: Glide paths are derived from VCMM simulations as of June 30, 2020. The annuity payout is based on the quote for a SPIA, with no survivor benefits, for a 65-year-old male on February 3, 2021.

Sources: Vanguard and Hueler Companies.

Annuities: The hurdles

The attractiveness of the outcomes detailed in our simulations depends on investor preferences. Classic life-cycle models of consumption (Yaari, 1965) assume that people prefer stable levels of consumption throughout their lives. Because any individual's life span is uncertain, these models suggest that annuities improve investor welfare by converting accumulated savings into stable lifetime income.

And yet few people buy annuities. Hurd and Panis (2006) found that only 7% of workers who retired from a job with a DC plan used these savings to buy an annuity. More recently, Brown, Poterba, and Richardson (2019) examined participants in DC plans managed by the Teachers Insurance and Annuity Association (TIAA), established by Andrew Carnegie in 1918 to safeguard the financial security of educators. Throughout its history, TIAA has made annuitization the norm. Until 1989, in fact, participants were required to annuitize plan balances in order to receive plan payments. And as recently as 2000, 54% of these retirees chose some form of annuity when they began receiving payments. Since then, norms have changed. By 2017, only 19% of retirees chose an annuity as their initial mode of receiving plan benefits.

Some of the gap between annuity purchases predicted by life-cycle consumption models and reality can be explained by models that incorporate preferences such as precautionary saving for a health- or long-term care shock (Ameriks et al., 2011) or a strong bequest motive (Lockwood, 2018). Many retirees also have less demand for more annuitization given various preexisting sources of annuitized wealth such as Social Security, Medicare entitlements, and (potentially) their homes, which can produce liquidity and income through a sale that yields gains for investment or a reverse mortgage. And a few retirees still have traditional pensions. The pooling of mortality risk within families—formal or informal support arrangements among family members—may also reduce annuity demand (Kotlikoff and Spivak, 1981).

Behavioral and emotional biases are another explanation. Gazzale and Walker (2009) attribute low annuity demand to an “endowment effect”—a reluctance to trade a familiar asset that retirees already own for a resource of similar value that they don't. Even so, these extensions of the classical models of life-cycle consumption suggest a role for annuities that retirees have been reluctant to act on.

Fear of regret

Our simulations make it easy to imagine psychological hurdles to annuitization. Longevity risk cuts two ways. Annuities are attractive as income protection for a long life, but anxiety-provoking at the possibility of a shorter life and the exchange of liquid assets for an illiquid contract with an uncertain payoff. As Figures 5 and 8 demonstrate, an annuity purchase, SPIA or QLAC, leads to an immediate decline in the liquid wealth accumulated over a lifetime of labor.

A rigorous economic calculation would include in wealth the capitalized value of future annuity payouts. But the decline in liquid wealth is salient and can present a psychological hurdle to annuitization. In our simulations, it will take at least 20 years (and more likely closer to 25) before the liquid wealth in a partially annuitized strategy is greater than the wealth in an investment-only approach. If financial market performance is strong, the time horizon grows longer; when performance is weak, it grows shorter.

This framing, of course, misunderstands the purpose of insurance. Few homeowners agonize over whether their home insurance premiums will pay off. Those who buy guaranteed income for an unexpectedly long life are paying for protection, not a payoff. But a shift from the risk-adjusted-return-maximizing mindset that dominates a worker's accumulation years to a risk-protection mindset in the spending years can be a struggle.

Financial advisors have responded to “annuity aversion” by developing strategies that address both the risk of outliving a portfolio and reluctance to make an irrevocable decision to annuitize. Some have developed fixed portfolio withdrawal strategies, based on historical simulations, that have sustained a portfolio over 30 years (Bengen, 1997). Others have developed “dynamic spending” strategies (Jaconetti et al., 2020) that make modest adjustments to portfolio withdrawals in response to market performance. When returns are poor, these strategies ratchet spending lower. When returns are strong, spending rises.

These strategies have proven effective at managing investment risk and improving a portfolio’s capacity to address longevity risk. But they’re not guarantees, and they’re not without cost. To protect portfolio longevity, retirees may need to accept unnecessarily low levels of consumption.

Empirical insights on annuity usage

Data from the Federal Reserve Board’s Survey of Consumer Finances (SCF) provide additional perspective on the use of annuities and the motives and preferences that govern it. This survey, conducted every three years, collects information on U.S. families’ wealth, income, and demographic characteristics. It also includes questions about bequest motives and risk aversion.

The survey shows that annuity use is low. And the use of fixed, immediate annuities such as SPIAs is lower still. (The survey makes it difficult to isolate QLACs, but use is no doubt low. In 2019, sales of deferred income annuities such as QLACs amounted to \$2.5 billion, one-fourth of SPIA sales [LIMRA, 2020]).

Wealthy investors are most likely to hold annuities, as detailed in **Figure 10**.³ But these annuities are mostly variable annuities—insurance/investment hybrids used to defer taxes on investment assets.

People with the lowest net worth make no use of immediate fixed annuities. There is modest use among those in the 50th percentile of the net worth distribution and higher.

Figure 10. Wealthier investors are more likely to hold annuities, but they mostly avoid immediate fixed annuities

Net worth percentile	Median net worth	All annuities	Immediate fixed annuities
Up to 25th	\$100	0.7%	0.0%
Above 25th up to 50th	39,640	1.1	0.0
Above 50th up to 75th	193,370	4.7	0.5
Above 75th up to 90th	609,000	13.8	0.6
Above 90th up to 95th	1,557,200	12.7	0.0
Above 95th	4,425,900	19.1	0.6
Total	97,700	5.3	0.3

Sources: Vanguard calculations, based on the 2016 Survey of Consumer Finances.

³ See Appendix 2 on page 15 for more details on SCF data and how we measure annuity holdings.

A strong bequest motive, consistent with Lockwood (2018), is associated with lower use of any kind of annuity, as shown in **Figure 11**. The interaction of net worth and risk aversion makes the relationship between risk aversion and annuity ownership ambiguous. **Figure 12** suggests that people who are more cautious about risk are more likely to hold income-producing immediate annuities, though this pattern doesn't prevail with the most risk-averse investors. The discrepancy might simply be a function of this group's significantly lower net worth.

Conclusion

Annuities protect retirees from longevity risk, serving as an effective substitute for the lifetime income once provided by DB plans. The simplest and most direct answers to longevity risk are immediate and deferred fixed income annuities (SPIAs and QLACs). Our simulations suggest that QLACs are more effective as insurance against longevity risk, replacing a larger share of target income at advanced ages. SPIAs, by contrast, allow for more income predictability and protection against poor financial market returns in the first few

years of retirement, when poor returns can threaten an investment portfolio's long-term viability (Khang and Clarke, 2020).

Annuity usage also depends on investor preferences. Theoretical life-cycle consumption models and empirical data indicate that the value of annuities is highest for those who prioritize predictable, guaranteed income. Even so, the generally low level of annuitization suggests that most investors forsake this guarantee to retain the financial flexibility for an uncertain future.

An alternative to income guarantees is portfolio withdrawal strategies that address the risk of outliving a portfolio by keeping withdrawals at conservative levels and potentially reducing spending when returns are poor. These strategies address retirees' reluctance to make an irrevocable decision to annuitize savings accumulated over a lifetime. But they aren't guarantees, and they're not without consequence. Retirees may need to accept an unnecessarily low standard of living. Annuities can mitigate this risk, but guaranteed income comes at a cost that retirees have proven reluctant to pay.

Figure 11. People with a strong bequest motive are less likely to hold annuities

Investors' attitude toward bequest	Average net worth	Share of investors with annuity		
		Any annuity	Deferred annuity	Immediate annuity
Not important	\$524,999	5.7%	4.9%	0.8%
Somewhat important	578,979	5.5	4.3	1.3
Important	628,364	5.8	4.4	1.4
Very important	925,540	4.2	3.5	0.7

Sources: Vanguard calculations, based on the 2016 Survey of Consumer Finances.

Figure 12. The relationship between risk aversion and annuity use is unclear

Investors' attitude toward risk-taking	Average net worth	Share of investors with annuity		
		Any annuity	Deferred annuity	Immediate annuity
Risk-seeking	\$1,262,097	5.7%	4.9%	0.8%
Risk-taking	1,262,650	5.5	4.3	1.3
Risk-moderate	837,045	5.8	4.4	1.4
Risk-averse	238,802	4.2	3.5	0.7
Total		5.3%	4.2%	1.1%

Sources: Vanguard calculations, based on the 2016 Survey of Consumer Finances.

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Appendix 1. About the Vanguard Capital Markets Model

IMPORTANT: *The projections and other information generated by the Vanguard Capital Markets Model regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. VCMM results will vary with each use and over time.*

The VCMM projections are based on a statistical analysis of historical data. Future returns may behave differently from the historical patterns captured in the VCMM. More important, the VCMM may be underestimating extreme negative scenarios unobserved in the historical period on which the model estimation is based.

The VCMM is a proprietary financial simulation tool developed and maintained by Vanguard's primary investment research and advice teams. The model forecasts distributions of future returns for a wide array of broad asset classes. Those asset classes include U.S. and international equity markets, several maturities of the U.S. Treasury and corporate fixed income markets, international fixed income markets, U.S. money markets, commodities, and certain alternative investment strategies. The theoretical and empirical foundation for the Vanguard Capital Markets Model is that the returns of various asset classes reflect the compensation investors require for bearing different types of systematic risk (beta). At the core of the model are estimates of the dynamic statistical relationship between risk factors and asset returns, obtained from statistical analysis based on available monthly financial and economic data from as early as 1960. Using a system of estimated equations, the model then applies a Monte Carlo simulation method to project the estimated interrelationships among risk factors and asset classes as well as uncertainty and randomness over time. The model generates a large set of simulated outcomes for each asset class over several time horizons. Forecasts are obtained by computing measures of central tendency in these simulations. Results produced by the tool will vary with each use and over time.

Index simulations: The long-term returns of our hypothetical portfolios are based on data for the appropriate market indexes as of June 30, 2020.

The asset classes and their representative forecast indexes are as follows: for U.S. equities, the MSCI US Broad Market Index Global; for U.S. bonds, the Bloomberg Barclays U.S. Aggregate Bond Index.

About the Vanguard Life-Cycle Investing Model

The Vanguard Life-Cycle Investing Model (VLCM) is designed to identify the product design that represents the best investment solution for a theoretical, representative investor who uses target-date funds to accumulate wealth for retirement. The VLCM generates an optimal custom glide path for a participant population by assessing the trade-offs between the expected (median) wealth accumulation and the uncertainty about that wealth outcome, for thousands of potential glide paths. The VLCM does this by combining two sets of inputs: the asset-class return projections from the VCMM and the average characteristics of the participant population. Along with the optimal custom glide path, the VLCM generates a wide range of portfolio metrics such as a distribution of potential wealth accumulation outcomes, risk and return distributions for the asset allocation, and probability of ruin, such as the odds of participants depleting their wealth by age 95.

The VLCM inherits the distributional forecasting framework of the VCMM and applies to it the calculation of wealth outcomes from any given portfolio.

The most impactful drivers of glide-path changes within the VLCM tend to be risk aversion, the presence of a defined benefit plan, retirement age, savings rate, and starting compensation. The VLCM chooses among glide paths by scoring them according to the utility function described and choosing the one with the highest score. The VLCM does not optimize the levels of spending and contribution rates. Rather, the VLCM optimizes the glide path for a given customizable level of spending, growth rate of contributions, and other plan sponsor characteristics.

A full dynamic stochastic life-cycle model, including optimization of a savings strategy and dynamic spending in retirement, is beyond the scope of this framework.

Appendix 2. The Survey of Consumer Finances

The data sample analyzed in this paper comes from the 2016 wave of the SCF. This survey is based on roughly 6,200 households. All variables are measured for the full calendar year preceding the survey year, in this case calendar year 2015. All dollar amounts are adjusted to 2019 dollars. All summary statistics are calculated using the survey weights.

The “net worth” variable used in Figures 11, 12, and 13 is primarily from Bhutta et al. (2020) and is defined as the difference between the household’s gross assets and liabilities.⁴ For each household in the survey, the SCF provides a categorical variable “nwcat” that takes on one of the five integers from 1 to 5, corresponding to the net worth distribution group membership as follows: 1 for up to 25th percentile net worth, 2 for above 25th percentile up to 50th percentile, 3 for above 50th percentile up to 75th percentile, 4 for above 75th percentile up to 90th percentile, and 5 for above 90th percentile.

To gain more granular insights into the top-10%-net-worth households, we further break the top 10%—all households with the initial nwcat value of 5—into two groups based on the conditional median value of the group’s net worth: 5 for above the 90th percentile and below the median net worth of the group, and 6 for above the median. The households with nwcat value of 5 now represent the 90th to 95th percentiles in net worth distribution. The households with nwcat value of 6 belong to the top 5%.

The types of annuities investors hold are not directly reported in the survey. Instead, we use other detailed information on annuity holdings of survey respondents to infer the type of annuity. Investors who hold annuities that do not currently provide income are classified as having a “deferred annuity.” The remaining investors with annuities—who report some income from their policy—are classified as holding an “immediate annuity.” Among the holders of an immediate annuity, those whose annuity is invested solely in bonds are considered “fixed immediate annuity” holders, while the rest are classified as “variable immediate annuity” holders.

⁴ For details of the variables we do not define above, see Appendix 1: Survey Procedures and Statistical Measures in Bhutta et al. (2020).

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