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LONGEVITY RISK: AN ESSAY

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**SPECIAL REPORT
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Introduction

Over the last century, life expectancy has increased significantly. This increase has underscored the need for efficient retirement planning. Nevertheless, a key difficulty when planning for retirement is that individuals do not know how long they will live. Hence, they need to account for the possibility of living longer than expected and exhausting their assets as a result (“longevity risk”).¹

This essay focuses on three main themes that are central to longevity risk and, therefore, to retirement planning. The first is “*How do individuals perceive their life expectancy?*” This theme will focus on older individuals and consider not only how long people expect to live but the uncertainty around their estimates. It also explores how their perceptions might affect longevity risk, as well as how the landscape has changed in the wake of COVID-19.

The second theme is “*What are the strategies to deal with longevity risk?*” This section will consider how individuals try to protect themselves from outliving their resources through self-insurance, reliance on institutions, and formal insurance. Self-insurance options include precautionary savings and particular drawdown strategies, as well as holding certain assets, especially the house, in reserve. Institutional options include employer-provided defined benefit (DB) pensions and Social Security. Formal insurance options cover a variety of lifetime income products such as tontines and annuities.

The final theme of this paper is “*Why don’t individuals insure against longevity risk?*” The prominent question here is the “annuity puzzle,” the observation that demand for private annuities that guarantee lifetime income is much lower than predicted by economic theory. The many proposed explanations of this puzzle can be broadly divided into “rational” and “irrational” reasons. Rational reasons include such factors as bequest motives, loading costs, or adverse selection. Behavioral factors that could dissuade individuals from buying annuities include mistaken beliefs about their lifespan or over-valuing money in the present compared to the future. The paper ends with some results from new surveys aimed at answering some of the questions regarding longevity risk left unaddressed in the literature.

¹ A broader definition of longevity risk is: the risk of running out of assets while still alive. To stay focused on longevity and insurance against longevity, in this essay we restrict longevity risk’s definition to running out of assets due to a longer than expected lifespan.

The rest of the paper proceeds as follows. Sections 2 through 4 review the literature on the three themes, respectively. Section 5 highlights some areas that are not well understood and can be addressed by surveys of retirement investors and financial advisors. Section 6 briefly describes our new surveys. Section 7 presents results from the surveys addressing the open questions in the literature. Section 8 concludes that a large share of retirement investors with investable assets over \$100,000 value annuities above the prevailing market price for such products, but logistical impediments to actually buying these products seem to play a large role in preventing more widespread take-up of guaranteed lifetime income products.

Theme 1: How Do Individuals Perceive Their Life Expectancy?

To effectively plan for retirement, individuals must form beliefs about how many retirement years they will have to finance. Significant errors could lead them to exhaust their resources while they are still alive, or it could make them consume much less than what they could have.² In practice, many individuals worry less about the risk from longevity itself than the risk of running out due to other reasons, like long-term care expenses or market declines; however, research suggests that the risk of curtailed consumption due to longevity itself is the largest risk facing retirees.³

The rest of this section reviews the literature on how individuals view their life expectancy and the degree of uncertainty surrounding their perceptions. Finally, it discusses how these perceptions might affect longevity risk.

Life Expectancy

Life expectancy refers to how many years individuals will live, on average, while the expected remaining lifespan is the additional years people should expect to live, on average, given their current age. An important nuance is to what specific population the expectation applies. For example, life expectancy at a typical retirement age, such as 65, is clearly higher than life expectancy at birth, even as remaining life expectancy is lower. Furthermore, multiple

² McGarry (2022).

³ Hou (2020) and Greenwald Research (2023).

studies have documented that longevity varies significantly by demographic group, with consistent and growing gaps by education,⁴ income,⁵ and race.⁶

Table 1 shows the life expectancy for U.S. adults at age 65 from Arapakis et al. 2021.⁷ On average, a man alive at 65 is expected to live 17.5 more years, while a woman is expected to live 21.0 more years. Beyond the gender averages, life expectancy varies significantly by permanent income, health state, and marital status.

Table 1. *Remaining Life Expectancy by Permanent Income, Health Status, Marital Status, and Gender for Households Whose Head Was 65 in 2000*

Permanent income percentile	All ^a	Men			Women		
		Nursing home	Bad health	Good health	Nursing home	Bad health	Good health
All men	17.5						
All women	21.0						
All couples (oldest survivor)	24.8						
<i>Individuals</i>							
10	18.1	4.1	15.3	17.5	7.3	18.7	20.2
50	20.7	4.9	17.0	19.4	8.7	20.5	22.0
90	21.0	4.9	17.4	19.9	8.8	21.0	22.5
<i>Couples (oldest survivors)^b</i>							
10	22.5	9.4	22.0	23.2			
50	25.0	11.3	24.0	25.2			
90	25.5	11.5	24.6	25.7			

^a Averages are taken over initial health found in the data. Results indexed by permanent income (PI) percentile are taken over the associated PI quintile.

^b Health-specific results for couples are based on the assumption that the spouses have the same health at age 65. *Source:* Arapakis et al. (2021).

Subjective Life Expectancy

These statistics on objective life expectancy do not necessarily reflect how individuals perceive how long they will live. Evidence from multiple studies suggests that many individuals,

⁴ Meara, Richards, and Cutler (2008); Bound et al. (2014); Leive and Ruhm (2021); and Wettstein et al. (2021).

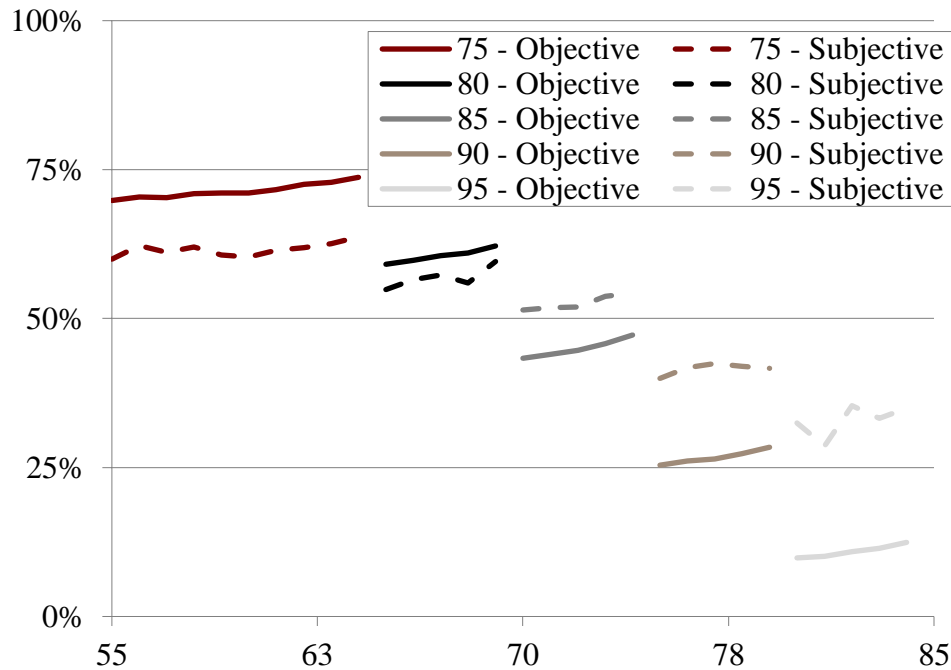
⁵ Chetty et al. (2016).

⁶ Brown (2002) and Sasson (2016).

⁷ These numbers differ from Social Security life tables due to sampling variation in the dataset on which the estimates were based.

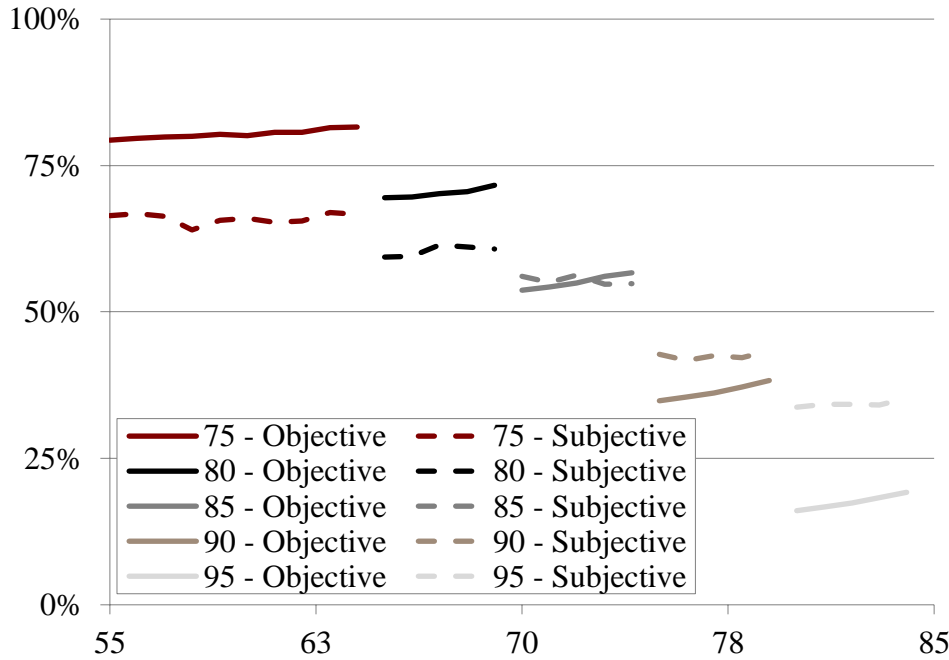
particularly in their fifties and sixties, are pessimistic about their survival probabilities. This pattern is evident in Figures 1 and 2, showing the mean subjective survival probabilities, and the equivalent probabilities obtained from U.S. life tables for men and women, respectively. In both figures, the horizontal axes are the respondents' age, and the vertical axes are the probabilities of surviving to future ages. The dashed lines indicate subjective probabilities and the solid lines are the actual probabilities. When a solid line is above the corresponding dashed line, individuals – on average – are pessimistic about their survival probabilities.

Figure 1. *Objective and Subjective Probabilities of Living to Ages 75, 80, 85, 90, and 95 for Individuals of Each Age, Males*



Source: Arapakis and Wettstein (2023).

Figure 2. *Objective and Subjective Probabilities of Living to Ages 75, 80, 85, 90, and 95 for Individuals of Each Age, Females*



Source: Arapakis and Wettstein (2023).

Furthermore, the literature suggests that individuals incorporate known risk factors into assessing their subjective survival probabilities. For example, studies find that men report lower survival probabilities than women; the subjective probability of reaching age 75 rises with age, education, and better health status; and individuals reduce their survival probabilities as their health declines.⁸

One element that might contribute to incorrect beliefs about life expectancy is how the media covers this number. Typically, life expectancy is reported as life expectancy at birth.⁹ If this number is the one that sticks in people’s minds, they would underestimate their remaining expected years of life at retirement, around age 65.¹⁰ Another incorrect anchor that individuals

⁸ Hurd and McGarry (1995, 2002).

⁹ See, for example, Chokshi (2022) or Wernau and Kamp (2022).

¹⁰ This problem is a particular issue in the United States because of high mortality in youth and middle age (Case and Deaton 2020).

may apply is the age of death of their parents; empirically, however, parental age of death has been a poor predictor of an individual's mortality.¹¹

Impacts of the COVID-19 Pandemic

The pandemic may have affected how individuals perceive and react to longevity risk in multiple ways. First, the objective mortality risk has increased, at least in the short term.¹² Second, the salience of mortality may be higher due to the prominence of death in the public consciousness during and after the pandemic. Third, the pandemic may have had economic consequences that change the calculus around planning for longevity risk: a decline in savings among retirees due to early retirement¹³ could make annuities less attractive relative to maintaining residual liquidity; an increase in interest rates could reduce the attractiveness of deferred income like future annuity payments; and the recent increase in inflation may make non-inflation indexed annuities less attractive in particular. The results in Hurwitz, Mitchell, and Sade (2021) suggest that it is these latter economic forces that seem to be exerting more influence on annuitization choices in the near term.

Although the literature has documented that subjective and objective mortality may diverge, many gaps exist due to data limitations. Specifically, little is known regarding the *variance* of subjective longevity. Since this variance is the core of longevity risk, subjective beliefs about it could be key in understanding low annuity demand and some of the difficulties in retirement planning more generally. If individuals believe they will die with near certainty at a specific age, they would see no risk and, therefore, no advantage to insure against it.

Likewise, little is known about how financial advisors think about both life expectancy and the variation in lifespan within and across demographic and socioeconomic groups. Furthermore, how advisors and consumers think about “running out of money” is vague. Most Americans cannot literally run out of money because they have Social Security benefits; 40 percent of Americans derive more than half their income from Social Security.¹⁴

¹¹ Black et al. (2023).

¹² U.S. Social Security Administration (2023a).

¹³ Shah Goda et al. (2022) and Davis et al. (2023).

¹⁴ Dushi and Trenkamp (2021).

Theme 2: What Are Strategies to Deal with Longevity Risk?

This section considers the strategies individuals can adopt to protect themselves against longevity risk. These strategies include actions individuals can undertake on their own, such as holding assets, especially housing, in reserve and accumulating savings “cushions” of other sorts. Individuals can also use institutional features of the economy, like delaying Social Security claiming to increase lifetime income, and working in jobs that provide DB pensions. Finally, some strategies pool risk across many individuals, usually with the involvement of a formal insurer; these options include tontines and commercial annuities.

Self-Insurance Against Longevity Risk

The most readily available tool individuals have to avoid running out of resources is to simply acquire more resources. These extra savings may take many forms. Many individuals plan to simply work longer;¹⁵ academic research supports this strategy as particularly effective in mitigating the risk of running out of money in retirement.¹⁶

Some individuals and financial advisors speak of these precautionary savings as “cushions.”¹⁷ The formal meaning of cushions is not well-defined or even consistent across individuals. However, the idea generally means “erring on the side of caution” in different aspects of retirement planning. Thus, retirees and financial planners may plan for a lifespan in the upper range of typical longevity, assume a high level of consumption; and stress test their plans under scenarios with particularly poor market returns and high inflation rates.

Some of these approaches are more reasonable than others. As choices of planning horizons, maximal ages are often 90 or 95. While such ages certainly represent long lifespans, a substantial share of individuals will live even longer. Roughly one-quarter of men who are 65 years old in 2023 will survive past 90, and over a third of women will.¹⁸ Similarly, many financial advisors stress test retirement plans by allowing for the exhaustion of assets to occur in 10 percent of simulated market realizations. Thus, such “cushions,” at least in isolation, would no doubt result in high failure rates.

¹⁵ Franklin (2022a).

¹⁶ Munnell and Sass (2009) and Bronshtein et al. (2019).

¹⁷ Greenwald Research (2023).

¹⁸ U.S. Social Security Administration (2023b).

Overall, though, a general reliance on conservative assumptions in planning scenarios may afford reasonable protection against outliving resources. However, because of the informality of these self-insurance strategies, it is hard to evaluate their effectiveness – both in terms of how well they ensure against longevity risk and of how much consumption individuals forgo.

A particular form of cushion that likely has a more rational basis is the tendency for individuals to hold substantial equity in their home, rather than drawing it down. To a large extent, not tapping home equity can be rationalized by the large transaction costs of selling a house or taking out a reverse mortgage; however, many households explicitly hold onto their house as self-insurance.¹⁹

Certain drawdown strategies for assets in retirement are also aimed at avoiding the exhaustion of resources. Famously, the 4-percent rule of thumb has been touted as a secure way of pacing consumption to avoid exhaustion.²⁰ This strategy involves drawing down an inflation-indexed 4 percent of total assets per year in retirement. However, the 4-percent rule does not guide individuals on how to respond to unanticipated events (e.g., very large medical spending) or mortality risk rising with age.²¹ And, any strategy that does not respond to market conditions, particularly rates of return, would be highly exposed to sequence-of-return risk, in which the returns realized early in a withdrawal sequence have an outsized impact on long-run performance.²² Others have proposed variations of this constant percentage drawdown rate, but these alternatives generally suffer from the same shortcomings to some degree.

Another strategy popular with individuals is consuming only the returns (interest and dividends) on assets, leaving the principal untouched.²³ This form of “cushion” strategy certainly guarantees that assets will not be exhausted; however, it is a poor choice for three reasons. First, it ties consumption too tightly to the ups and downs of market performance. Second, it becomes completely unworkable in years when the market has negative returns. Finally, it allocates too much of household wealth to bequests, even for those households that are not very wealthy and likely do not intend to leave large estates.

¹⁹ Nakajima and Telyukova (2017).

²⁰ Bengen (1994).

²¹ Scott, Sharpe, and Watson (2009) and Milevsky and Huaxiong (2011).

²² Finke, Pfau, and Blanchette (2013).

²³ Greenwald Research (2023).

Another popular rule-of-thumb for drawdown that self-insures against longevity risk is to withdraw the Required Minimum Distribution (RMD). The RMD is a federal tax law governing withdrawals from tax-deferred retirement accounts; because contributions to such accounts are taxed at the time of withdrawal rather than when contributed, the RMD sets a limit on how long they can be deferred. The RMD rules require a withdrawal each year that is proportional to the life expectancy at that age, and is expressed in terms of the wealth in tax-deferred accounts.²⁴ Because RMDs are linked to current account balances and life expectancy, following the RMD withdrawal schedule leads to consumption that is responsive to market performance and to age-related mortality probabilities. These theoretical advantages have been shown to yield consumption paths that are fairly close to the optimal drawdown rate.²⁵ The RMD strategy has also proven very popular among retirees.²⁶

Institutional Protections from Longevity Risk

Individuals are not completely on their own in dealing with longevity risk. Several institutions exist in the United States (and elsewhere) aimed at mitigating this risk. Foremost among them is Social Security, which is structured as an inflation-indexed life annuity. In addition, some employers provide retirement benefits in the form of a life annuity, although the prevalence of such DB plans has declined markedly in the private sector over the past few decades.

The goal of Social Security and similar public pensions around the world is to guarantee some minimal standard of living for older individuals, and an annuity is the only way to provide this assurance for as long as they live.²⁷ While nearly all workers in the United States receive Social Security benefits in retirement, the variation in how much the program protects different individuals is large. Benefits are related to average earnings over a beneficiary's work history. Nevertheless, the percentage of average earnings replaced is determined by a progressive formula: for individuals retiring at their full retirement age (FRA), the replacement rates range

²⁴ RMDs are only required starting at a specific age. Until 2019 the age was 70.5, but recent legislation is set to gradually increase the starting age to 75 for those born in 1960 or later. The IRS' life expectancies may differ from those used by other agencies (such as the Social Security Administration) or private actuaries, and certain adjustments are made for households in which the spouses are more than 10 years apart in age.

²⁵ Sun and Webb (2013).

²⁶ Brown, Poterba, and Richardson (2022) and Franklin (2022b).

²⁷ Diamond (2004).

from 90 percent for the lowest earners to 28 percent for those at the top of the eligible earnings range (U.S. Social Security Administration 2023b).²⁸ Furthermore, the replacement rate in practice depends on the age of claiming because an actuarial adjustment is made to hold expected lifetime benefits roughly constant for an individual with average life expectancy.²⁹

Delaying claiming of Social Security benefits is, therefore, a possible strategy to increase guaranteed lifetime income. If the actuarial adjustment for delayed claiming is fair, in the sense that it makes expected lifetime benefits independent of the claiming age, later claiming still involves greater longevity insurance because the guaranteed level of benefits is higher. This outcome applies even if the actuarial adjustment is less than fair.

Nevertheless, the vast majority of beneficiaries claim their benefits before age 70, with a substantial majority claiming even before the FRA of 67.³⁰ It is likely that part of the reason is that many individuals are not capable of working until age 70 and have insufficient liquidity to postpone claiming without an ongoing source of income (Quinby and Wettstein 2023). However, even individuals who have the funds to postpone claiming may be deterred by the complication of calculating how much to draw down their accumulated assets.

One set of drawdown strategies that analysts have explored is the Social Security “bridge.” This approach allows workers to delay Social Security claiming even if they do not keep working, generally by using assets from retirement accounts. That is, workers accelerate withdrawals from their 401(k)s/IRAs in the first years of retirement to mimic their Social Security benefit and thereby postpone claiming. One example of such a strategy that employers could adopt on behalf of workers is explored in Munnell and Wettstein (2021) and Munnell, Wettstein, and Hou (2022).

Aside from helping workers increase their longevity risk protection by delaying Social Security, some employers take a more direct hand by providing a DB retirement plan. Such plans used to be the norm in both private and public sector employment; however a sharp decline in private sector DB plans has left such plans almost exclusively to the public sector.³¹

²⁸ Burkhalter and Chaplain (2023).

²⁹ This actuarial adjustment has been, in recent years, more than fair so that delaying claiming has provided increasing expected lifetime benefits for the average American (Biggs, Chen, and Munnell 2021).

³⁰ Deshpande, Fadlon, and Gray (2021).

³¹ Munnell, Haverstick, and Soto (2007); Poterba, Venti, and Wise (2009); and Siliciano and Wettstein (2021).

The disappearance of private sector DB plans has led to widespread worry that American workers are much less protected against longevity risk than they used to be. The increase in Social Security's FRA from 65 to 67 aggravated this problem further, and the looming concern regarding depletion of Social Security's retirement trust fund (projected to occur in 2033)³² has led to worry among the general public regarding the feasibility of relying on Social Security.³³ Thus, the main way individuals can truly insure against longevity risk is by entering into formal insurance contracts.

Formal Insurance for Longevity Risk

Two broad categories of products can protect individuals from longevity risk: tontines and annuities. This discussion will cover the two categories in order of historical appearance, tontines followed by annuities.

Tontines protect against individual longevity risk by pooling it across many participants. Annuities are similar to tontines; however, they also provide additional insurance against systemic changes in mortality (which are unanticipated changes in the population average, rather than the individual mortality rates). This additional risk protection is achieved by bringing in an insurance company to bear the systemic risk, at the cost of loading fees.³⁴ Both of these products yield "mortality credits," additional returns to survivors from the assets of those who die.

Tontines have a long history.³⁵ They fell out of favor in the United States following the Armstrong Commission in New York State in 1905, due to severe mismanagement that led to the tontines of the day being deemed illegal by the state's regulators. However, recently academics have taken a renewed interest in tontines for two main reasons. First, tontines should theoretically be cheaper than annuities because, as noted, they do not insure against systemic longevity risk (or market risk) as a typical annuity would. Second, and relatedly, tontines do not require the involvement of a third-party insurer, which may reduce management costs as well as address some distrust of insurance companies among the general public.

Despite the paucity of actual tontine products on the market today, many existing retirement systems have a tontine-like quality in that benefits are somewhat dependent on the

³² U.S. Social Security Administration (2023a).

³³ Luttmer and Samwick (2018) and Quinby and Wettstein (2021).

³⁴ Wettstein (2018).

³⁵ Ransom and Sutch (1987); Milevsky and Salisbury (2015); and Li and Rothschild (2020).

mortality experience of the beneficiaries. For example, the CREF variable annuity adjusts payments in response to both market and mortality experience.³⁶ Similarly, the Swedish public pension system also allows for adjustments in benefit payments due to unexpected variation in cohort mortality.³⁷

Regarding commercial annuities, many such products are available on the private market in the United States. The most basic one is the single-premium immediate annuity (SPIA), involving a one-time transfer of a premium from a consumer to an insurer in exchange for a stream of payments guaranteed for that single consumer's life, starting immediately. Variations of this basic structure involve deferrals in the start date of the payments; escalation of the payments (with a fixed adjustment for cost-of-living); joint-and-survivor benefits at different levels; guarantee periods (such as payments continuing for 10 years even if the annuitant dies) and death benefits; variable annuities linked to the performance of some underlying investment; combinations of annuities with other insurance products like long-term care insurance; and others.³⁸

Deferred annuities have received particular attention from insurers, policymakers, and academics in recent years as an option that could appeal to consumers. Numerous studies have found that such annuities have desirable theoretical properties and may provide a compromise between the desire to ensure longevity risk and consumers' desire to avoid high premiums.³⁹ Because these products focus on eliminating the tail risk of exceptionally long life while shortening the total payout period, they tend to be substantially cheaper than SPIAs while still providing considerable longevity protection.

The main disadvantage of deferred annuities relative to SPIAs is that individuals miss out on mortality credits in the deferral period. This loss of mortality credits is a common shortfall of many alternatives to SPIAs. Notably, guarantee periods and death benefits, which are popular choices among consumers, provide less of the advantages attributed to annuities by academics.

The most consistent finding in the literature regarding annuities is that take-up is low. Hosseini (2015) finds that less than 4 percent of retirement assets in the United States are

³⁶ Although adjustments due to mortality have been small historically (Goodman and Richardson 2014).

³⁷ See, for example, Palmer (2000).

³⁸ Period certain annuities, which are not life contingent and simply provide a stream of payments over a fixed number of years, also exist but are not really longevity insurance products at all.

³⁹ Horneff, Maurer, and Mitchell (2020); Wettstein et al. (2021); Munnell, Wettstein, and Hou (2022); and Horneff, Maurer, and Mitchell (2023).

annuitized. Those who do buy annuities tend to be wealthier and longer-lived.⁴⁰ Even accounting for differential life expectancy, risk aversion, and financial literacy, women have higher annuity demand than men. This pattern contrasts with the findings in Wettstein et al. (2021), who find that men would benefit more from annuities because the variance of their mortality is higher. Similarly, those with lower education stand to gain more from annuitization than those with higher education, and Black annuitants would benefit more than White ones.⁴¹

Theme 3: Why Don't Individuals Insure Against Longevity Risk?

Since Yaari's (1965) seminal paper, annuity contracts have been a central theme in retirement research and retirement planning. Yaari's result is important enough to be stated in full: under some standard restrictions on preferences,⁴² consumers with no bequest motives who only face uncertainty about their time of death should *fully* annuitize their assets if an actuarially fair annuity is available.

The intuition behind Yaari's result is simple: an annuity is a wrapper that can be put around any investment product; and it dominates any alternative investment regardless of market performance because of mortality credits above and beyond returns. For example, instead of investing in a 60/40 portfolio of stocks and bonds, a consumer can allocate 60 percent of his assets to a variable annuity invested in stocks, and 40 percent to a fixed annuity invested in bonds, getting the same return as the 60/40 portfolio *plus* the mortality credit.

This result seems exceedingly strong given observed annuitization rates. Empirically, only around 10 percent of older adults in the U.S. annuitize part of their assets, and virtually no one annuitizes *all* their assets. Such low voluntary annuitization rates have been documented in multiple countries.⁴³ This gap between Yaari's theoretical result and the very low empirical annuitization rates is known as the "annuity puzzle."⁴⁴

Yaari's result leans on strong assumptions, and explanations of the annuitization puzzle have called all of them into question. However, Davidoff, Brown, and Diamond (2005) show

⁴⁰ Mitchell et al. (1999).

⁴¹ The greater variance of mortality for Black individuals is also documented in Brown, Liebman and Pollet (2002) and Sasson (2016).

⁴² Specifically, preferences must have a time-separable expected utility representation.

⁴³ Mitchell, Piggott, and Takayama (2011).

⁴⁴ Modigliani (1986) and Ameriks et al. (2011).

that even weakening many of these assumptions would still lead to substantial annuitization, far in excess of empirical rates.⁴⁵

Reichling and Smetters (2015) argue that Yaari's result is even stronger than previously thought. They show that when consumers face fixed survival probabilities, annuities dominate alternative investment products.⁴⁶ Hence, in the absence of a bequest motive, Yaari's result is robust to multiple market imperfections not considered by Davidoff, Brown, and Diamond (2005), including income from Social Security benefits, intra-family risk sharing, moral hazard, and uncertain income.

In particular, a common claim is that annuities are not a good option for consumers in the presence of inflation risk. The absence of inflation-indexed annuities in the United States is thus proposed as an explanation of the annuity puzzle. However, when individuals do not need to consume their entire annuity payment in each period post-retirement, substantial annuitization is once again optimal because high early payments can be used to supplement low (in real terms) later payments.⁴⁷ Furthermore, if the main impediment to annuitization were the lack of inflation-indexed options, a "new" annuity puzzle would arise regarding why insurers do not offer such products.

Other explanations of the annuity puzzle abound. The main contenders, implicit in the original Yaari (1965) result, are that individuals have strong bequest motives or are liquidity constrained and worried about late-life shocks (such as long-term care). Other "rational" explanations revolve around adverse selection, loading costs, minimum annuity purchase requirements, crowd-out by government-provided annuities, and intra-family risk sharing. Furthermore, a number of theories of irrational explanations have been proposed for the puzzle such as present bias, subjective survival pessimism, and limited ability to comprehend the complex considerations involved in annuity contracts. The following sections go into greater depth regarding all these proposed explanations.

⁴⁵ Specifically, they consider two separate conditions. First, they find that full annuitization is optimal if no bequest motives exist, and markets are complete (i.e., there are no constraints on borrowing against future income) regardless of the technical assumptions on preferences and the availability of actuarially fair annuities. Second, they show that when markets are incomplete and bequest motives are present, there should still be substantial (albeit not full) annuitization, particularly among high-income households for whom Social Security is a small part of their retirement resources.

⁴⁶ Specifically, annuities state-wise dominate alternative investments.

⁴⁷ Peijnenburg, Nijman, and Werker (2016).

Rational Explanations of the Annuity Puzzle

Rational explanations include bequest motives, concern about the costs of late-life health shocks and long-term care, high prices resulting from adverse selection and loads, and the potential crowd out by government-provided annuities.

Bequest Motives. One clear reason to avoid purchasing life-contingent income is that individuals may wish to leave money to their heirs.⁴⁸ However, the extent to which individuals have bequest motives is unclear. Simply looking at the transfers from one generation to the next does not answer the question because, given the uncertainty surrounding the time of death, some bequests are sure to be incidental.⁴⁹ Hence, whether or not individuals have bequest motives has therefore been the focus of a great deal of research. This research has also been remarkably inconclusive.⁵⁰ Some papers find evidence of such bequest motives.⁵¹ Others find little evidence of it.⁵²

The truth is likely somewhere in the middle, with some bequests being intentional and others merely incidental. A review of the early literature on this topic found that intended bequests account for around 20 percent of total bequests (Gale and Scholz 1994). More recently, Kopczuk and Lupton (2007) estimate that elderly single households will end up bequeathing 80 percent of their wealth, with half of those bequests being intentional.

One partial reconciliation of these contradictory results is that bequests are a luxury good (Becker and Tomes 1979; Becker and Tomes 1986). Indeed, Lockwood (2018) argues that if only the wealthy wish to leave substantial bequests, a traditional lifecycle model can explain low annuitization rates, as well as low rates of long-term care insurance coverage.

Health, Medical Spending, and Long-Term Care Risk. Forward-looking individuals may avoid buying annuities due to bad health, medical spending, and long-term care needs. Negative health shocks have a dual role in reducing annuity demand: on the one hand, they increase

⁴⁸ For example, Lewis (1989) and Lockwood (2012).

⁴⁹ Abel (1985) shows that if individuals hold precautionary savings against outliving their resources, intra-cohort variation in time of death will lead some individuals to die without exhausting their assets, leading to incidental bequests.

⁵⁰ McGarry (2008).

⁵¹ Mariger (1987); Bernheim (1991a); Hong and Rios-Rull (2012); DeNardi (2015); and Franklin (2022b).

⁵² Hurd (1987); Hurd (1989); Hurd (2006); DeNardi, French, and Jones (2010); and Gan et al. (2015).

medical spending that has to be covered using liquid assets. On the other hand, they reduce life expectancy, which makes individuals want to move consumption forward and reduces their lifetime payouts from annuitization.⁵³

One of the most well-known explanations of the annuity puzzle is that health shocks in late life, particularly long-term care needs, can lead to large annual expenditures in excess of annuitized income that prompt a liquidity crunch. While lifetime income may be sufficient to cover these expenses, any one year of annuitized income is not sufficient. This mechanism is explored in many analyses of the annuity puzzle, such as Hubbard and Judd (1987) and Laitner, Silverman, and Stolyarov (2018).

Furthermore, precautionary saving against longevity risk interacts in complex ways with the various means-tested programs in the United States, especially Medicaid. Thus, many analyses find that individuals of modest means should choose to have neither substantial liquid wealth (which would fall afoul of asset tests) nor substantial annuitized wealth (which would trigger income tests) if they are likely to resort to Medicaid to finance long-term care.⁵⁴ Lockwood (2018) proposes the intuition that individuals may hold wealth in late life as self-insurance against both longevity and long-term care risk, and that this self-insurance is complementary with a desire to leave a bequest if bequests are a luxury good. Thus, these resources become a bequest if the individual turns out to have no need of them approaching death.

Adverse Selection and Loading Costs. Another key assumption in Yaari (1965) is that actuarially fair annuities are available. While subsequent work has shown this condition is not necessary for substantial annuitization to be optimal,⁵⁵ it is still true that the more expensive an annuity is, the less of it consumers should buy.

In practice, private annuities are not sold at actuarially fair prices. That is, in present value, the average consumer will receive annuity payouts that are lower than the annuity's premium. Mitchell et al. (1999) estimate that in 1995 the average 65-year-old would have received roughly 78 cents per dollar of premium, and the average 65-year-old annuitant would

⁵³ Reichling and Smetters (2015).

⁵⁴ Hubbard, Skinner, and Zeldes (1995); Brown and Finkelstein (2007); and Laitner, Silverman, and Stolyarov (2018).

⁵⁵ Davidoff, Brown, and Diamond (2005) and Reichling and Smetters (2015).

have received roughly 85 cents per dollar of premium.⁵⁶ These results suggest that adverse selection exists in the annuity market and that insurance companies impose significant costs. Wettstein et al. (2021) show that these deviations from actuarial fairness, also called “loads,” have remained roughly stable over time.

Adverse selection in the annuity market happens because of asymmetric information. While insurers use limited information – age, gender, and birth year – to price annuities, consumers have additional information on their health.⁵⁷ Multiple studies have documented adverse selection. For example, Finkelstein and Poterba (2004) find evidence of adverse selection in the U.K. annuity market, while Cutler, Finkelstein, and McGarry (2008) show that annuitants display less risky behavior.⁵⁸

Loads can also arise from additional insurer costs to cover marketing, corporate overhead, income taxes, contingency reserves, profits, and hedges against multiple risks (e.g., inflation risk, interest rate risk). Also, some risks cannot be hedged (e.g., unanticipated systemic mortality improvements, reinvestment risk) because of the absence of suitable matching assets, leading to further loading costs.⁵⁹

Multiple articles have evaluated the impact of adverse selection, with its additional loading costs, on annuitization rates. O’Dea and Sturrock (2023) find that it suppresses annuitization rates by roughly 40 percent. In contrast, Pashchenko (2013) finds that adverse selection has only a small impact on annuity demand. Indeed, even in the presence of realistic loads, almost all population subgroups would benefit from annuity purchases in a simple life-cycle model.⁶⁰

⁵⁶ See also Poterba and Warshawsky (1999) and McCarthy and Mitchell (2002).

⁵⁷ A growing body of evidence also shows that selection in insurance markets can have multiple dimensions. In the annuity context, both private knowledge of health and private knowledge of risk attitudes can influence demand. If more risk-averse individuals tend to annuitize more and are also more careful in other aspects of their life, they may have greater-than-average life expectancy for both those reasons (Finkelstein and McGarry 2006; Khwaja, Sloan, and Salm 2006; and Cutler, Finkelstein, and McGarry 2008).

⁵⁸ Einav, Finkelstein, and Schrimpf (2010) find evidence of adverse selection in the choice of a guarantee period in the U.K. private annuity market, and that this adverse selection leads to a welfare loss equivalent to 2 percent of annuitized wealth.

⁵⁹ Blake (1999) and Silverman and Theodore (2016).

⁶⁰ Wettstein et al. (2021).

Crowd-Out by Government-Provided Annuities. The old-age insurance element of the U.S. Social Security program is, as noted above, fundamentally an annuity.⁶¹ Designing the payouts as a life annuity has many advantages: the payments function as income, providing individuals a seamless transition to retirement; the mortality credits from annuitization allow more generous benefits than contributions alone would provide; public provision of such annuity benefits means relatively low administrative costs; and the mandatory nature of the annuity circumvents many potential behavioral impediments to annuitization.⁶²

Of course, the public provision of such an annuity means Social Security might crowd out private annuities. Substantial evidence of some crowd-out exists.⁶³ While Social Security crowd-out alone is insufficient to explain the annuity puzzle, in combination with other impediments it could explain a substantial share of the shortfall of annuitization.⁶⁴ In particular, Pashchenko (2013) finds that crowd-out of private annuities can be large, alongside a lack of incremental annuitization, because most private annuities require a minimum purchase and the bulk of mid- and low-wealth household assets are held in illiquid form – namely, housing. Similarly, Hosseini (2015) finds that Social Security can aggravate adverse selection in the private annuity market by crowding out particularly high-mortality individuals.

Intra-Family Risk Sharing. Individuals may insure against longevity risk by pooling risk within the family. The intuition here is that, while one person’s time of death is very uncertain, the time of death for the final member of a couple is less uncertain, and for the final member of a household even less so.⁶⁵ Indeed, some estimates find that the informal longevity insurance within families can substitute for 70 percent of the benefits of formal insurance.

Nevertheless, taking the extra step of explaining why households would not prefer to gain the benefits of full insurance requires reliance on additional explanations of the annuity puzzle. Kotlikoff and Spivak (1981) conjecture, for example, that adverse selection and loading costs can make informal insurance preferable to a formal annuity.

⁶¹ Structuring retirement benefits as an annuity has a long history, dating at least to Bismarck in 1889 (U.S. Social Security Administration, n.d.).

⁶² Diamond (2004).

⁶³ Bernheim (1991a).

⁶⁴ Diamond (2004). The choice of annuitization of Social Security can be seen as little more than a default distribution of accumulated benefits which can be undone by individuals wishing to increase their bequests by the appropriate purchase of life insurance (Townley and Boadway 1988 and Bernheim 1991b).

⁶⁵ Kotlikoff and Spivak (1981) and Kotlikoff, Shoven, and Spivak (1986).

Irrational Explanations of the Annuity Puzzle

Possible irrational explanations include people's bias toward the present, pessimism about how long they will live, and annuities being described as an investment option rather than a tool to insure against longevity risk.

Present Bias. One class of explanations for the annuity puzzle is present bias, where individuals' discount rates are *inconsistent* across time. That is, individuals discount the transition between the present and the near future more heavily than discounting the transition between the near future and a more distant future. Examples of this type of model include hyperbolic and quasi-hyperbolic discounting,⁶⁶ diminishing impatience,⁶⁷ and evolutionary models of discounting.⁶⁸

When individuals display this type of bias, the deferred nature of annuity payments is perceived as less valuable than the premium required to purchase the annuity, even if it is actuarially fair. However, this effect would be present even for a rational individual using a subjective discount rate higher than the one used by the annuity provider in calculating the annuity stream.

A second implication unique to the *biased* nature of individuals in these models is that even if these individuals perceive the annuity as fair in the abstract, such dynamically inconsistent individuals will always put off purchasing the annuity. At every point in time, present-biased individuals might feel that, even if buying an annuity is a good idea, it would be better to wait until tomorrow to do so.

Survival Pessimism. As noted above, a growing body of evidence shows that many individuals are unduly pessimistic about their longevity. Figures 1 and 2 show that individuals are on average pessimistic about their survival probabilities during the years that most people make irreversible annuitization decisions (i.e., claiming Social Security benefits or purchasing commercial annuities). This pessimism may make annuitization less attractive, making

⁶⁶ Laibson (1997).

⁶⁷ Halevy (2008).

⁶⁸ See, for example, Robson and Samuelson (2009). Relatedly, some evidence suggests that individuals are more patient in anticipation of larger payoffs. This type of discounting could also represent a solution to the annuity puzzle, if annuities are seen as disaggregating a large chunk of consumption in late life into smaller increments throughout life, leading to "impatience" with respect to those payments (Noor and Takeoka 2022).

individuals underestimate the years they have to live and, therefore, their lifetime payouts from annuitization.⁶⁹

Theoretical work has shown that annuitization rates can be very low in a lifecycle model with pessimistic survival expectations.⁷⁰ However, empirical evidence suggests that survival pessimism has a small impact on annuitization. Arapakis and Wettstein (2023) find that a one-year increase in subjective life expectancy increases the chance of receiving income from a commercial annuity by less than 0.1 percent.⁷¹

In a related context, some papers have looked at the impact of subjective mortality on Social Security claiming, which is equivalent to purchasing additional Social Security annuities.⁷² Hurd, Smith, and Zissimopoulos (2004) find that subjective survival beliefs have a small impact on the Social Security claiming age. Bairoliya and McKiernan (2021) also find a small impact but argue that it is heterogeneous across the population. Bresser (2021) finds that responses to pension reforms are smaller in a model with heterogeneous subjective mortality expectations than they are with expectations obtained from a life table.

Framing. Another potential irrational explanation of the annuity puzzle is that individuals use an investment frame when considering annuities rather than a consumption frame. In other words, individuals see annuities as investments meant to yield income rather than as insurance products guaranteeing consumption.⁷³ Under this hypothesis, consumers see the low expected present discounted value of typical annuities (sometimes called their “money’s worth”) and determine that these are poor investments relative to other potential investments, such as equities. In this view, the very advantage of an annuity is perceived as a disadvantage:

⁶⁹ See Hamermesh (1985) for an early discussion about survival pessimism and annuitization.

⁷⁰ O’Dea and Sturrock (2023).

⁷¹ Hurwitz, Mitchell, and Sade (2022) find that, in a randomized control trial, providing information about life expectancy and the probability of surviving to very old age did increase annuitization preferences, but only among individuals who had underestimated longevity to begin with.

⁷² Note that, in this context, the adjustment for delayed claiming is more than actuarially fair in favor of the consumer.

⁷³ Brown et al. (2008).

that the annuity will last as long as one lives, i.e., its longevity insurance, is seen as a source of risk since the payouts are contingent on an inherently uncertain outcome: continued survival.⁷⁴

What this view does not account for is that annuities are insurance contracts, not investments, and thus they offer consumption when it is most needed (when the annuitant is alive). Brown et al. (2008) show that when individuals are presented with annuities in an insurance frame, most prefer the annuity to a savings account; in contrast, when the annuity is framed as an investment, most prefer the savings account. Similar sensitivity to framing was also found in Munnell and Wettstein (2021).

Open Questions

This essay so far has focused on three themes that are central to longevity risk. The first—*“How do individuals perceive their life expectancy?”*—addresses whether subjective mortality expectations are pessimistic, optimistic, or whether they are updated over time according to events that could affect one’s life expectancy. Although some information on subjective survival beliefs is available for certain future ages, usually 10-15 years ahead, no information is available about uncertainty around this expectation. Also, little information is available about how financial professionals perceive mortality risk and whether their perceptions vary from objective risks.

The second theme—*“What are the strategies to deal with longevity risk?”*—assesses the strategies that individuals can follow to insure against longevity risk. Although individuals have multiple ways to protect themselves from outliving their resources (e.g., through self-insurance, reliance on institutions, and formal insurance), little information exists on what financial professionals advise their clients.

The final theme—*“Why don’t individuals insure against longevity risk?”*—concludes that demand for private annuities that guarantee lifetime income is much lower than predicted by economic theory. The literature, which has developed multiple explanations for this puzzle, mostly relies on theoretical models; causal evidence is scarce. Specifically, almost no

⁷⁴ Relatedly, this erroneous frame can also trigger a second behavioral bias, loss aversion (Kahneman and Tversky 1979 and Tversky and Kahneman 1991). When dying before “breaking even” with the annuity premium is viewed as a loss, and losses are particularly unpalatable to individuals, this risk of a loss outweighs the risk of outliving assets, which the annuity is meant to protect against. This behavioral tendency can also be thought of as “fear of regret,” where individuals worry about looking back as they approach a relatively early death and realizing they would have been better off not buying an annuity (Clark, Bupp and Khang 2021).

direct empirical evidence exists on how much the desires to leave a bequest and maintain liquidity may hamper annuity demand. All these open questions can be addressed in a suitably designed survey.

Surveys

To answer the open questions regarding longevity risk, Greenwald Research conducted two surveys. The first survey questioned 1,216 retirement investors with investable assets over \$100,000, and the second survey questioned 400 financial advisors.

The Retirement Investor Survey

The retirement investor survey asked various questions relevant to retirement, including demographics, subjective longevity, annuitization, housing, spending, and wealth. The participants were ages 55-95 and had over \$100,000 in savings, excluding real estate, DB pension plans, and the value of any business. Table 2 shows the sample's descriptive statistics.

Table 2. *Summary Statistics*

Variable name	Mean	S.D.
Age	70.68	10.50
Male	0.48	0.50
Single/no partner	0.34	0.47
White	0.84	0.37
Black	0.06	0.23
Asian	0.04	0.20
Other race	0.06	0.24
High school or less	0.13	0.34
Some college or trade school	0.43	0.49
College (4-year degree)	0.22	0.41
Graduate or professional degree	0.22	0.42
Observations	1,216	

The Financial Advisor Survey

The financial advisor survey asked financial professionals various questions about the subjects they discuss with their clients and the recommendations they make. Participants were selected based on the following characteristics. First, they had over \$30 million under

management. Second, they had more than 3 years of professional experience. Third, they made recommendations themselves to their clients. Fourth, over 50 percent of their income came from financial planning, investments, life insurance, and related products and services with individual clients, as opposed to employee benefits or other group products, health insurance, and property/casualty insurance. Fifth, they had more than 75 clients.

Addressing the Open Questions

The discussion that follows uses the surveys' results to address the open questions, starting with those linked to the first theme, "*How do individuals perceive their life expectancy?*"

Subjective Longevity

The survey asked a series of questions that allow the analysis to accurately characterize each individual's subjective life expectancy and the probability of living to very old age – the perceived right tail risk.

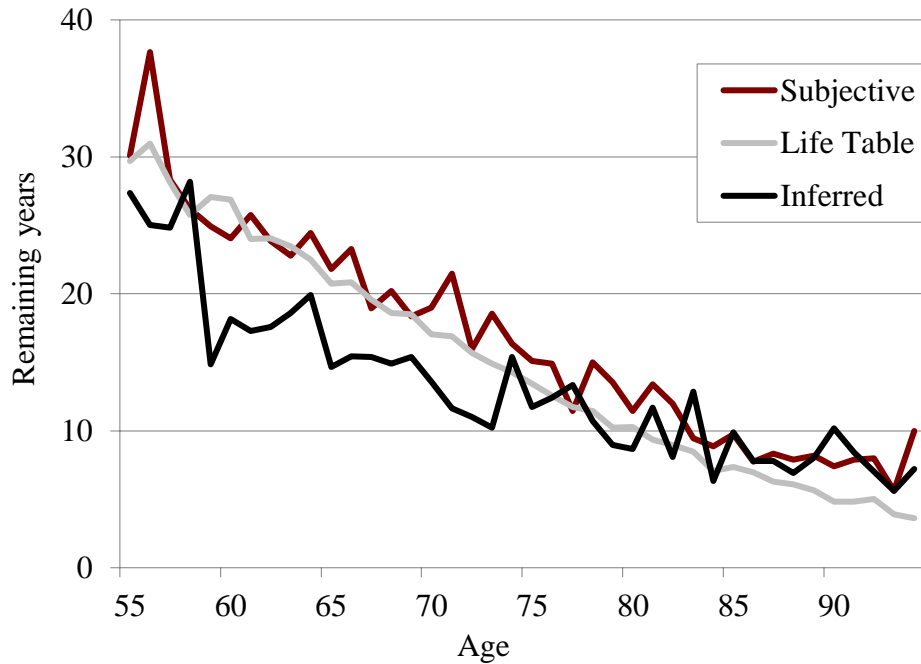
First, the survey asked how many more years each individual expects to live. Next, it asked for the subjective probability of living 10 fewer, 5 fewer, 5 more, and 10 more years from their stated remaining years of life. For example, if a 55-year-old individual states that he expects to live 30 more years, they are asked about the probability of living 20, 25, 35, and 40 more years. If the respondent states that his remaining years are less than 10 or 5, they are not asked the corresponding questions. This approach captures the subjective tail risk for each individual because the subjective probability questions will adjust around the individual's stated remaining years.

To estimate the subjective survival curve for each individual, the analysis follows the methodology of O'Dea and Sturrock (2021).⁷⁵ Figure 3 compares the average stated life expectancy, the average life expectancy calculated from the subjective survival curves, and the life expectancy calculated from objective life tables, which are based on birth year, age, race, and education.⁷⁶

⁷⁵ For more details, see Appendix 2.

⁷⁶ For the methodology for calculating life tables for these demographic groups see Wettstein et al. (2021).

Figure 3. *Subjective Life Expectancy, Life Expectancy Inferred from Subjective Survival Probabilities, and Objective Life Expectancy, for Individuals with Over \$100,000 in Investable Assets, by Age*



Source: Authors' calculations from the 2023 Greenwald Research survey.

The figure shows that when asked about probabilities, individuals tend to be pessimistic about life expectancy before the age of 75 and optimistic after that. This pattern mirrors findings reported in Figures 1 and 2. Nevertheless, when asked directly about their life expectancy, individuals tend to be approximately correct on average. The reason that the two measures of subjective life expectancy differ is that individuals younger than 80 tend to, on average, underestimate the probability of living to a very old age.

The tail probability of surviving to very old ages is particularly important in considering whether to purchase guaranteed lifetime income, since it is this tail risk that the products insure (see Hurwitz and Mitchell 2022). Since younger individuals are pessimistic about surviving to advanced old age, even though they are roughly correct regarding life expectancy, such pessimism is consistent with depressed demand for annuities as found in prior work.

The Advisors' Role in Insuring Longevity Risk

Next, the advisor survey is used to answer the open question of financial advisors' role in insuring longevity risk, which is linked to the second theme, "*What are the strategies to deal with longevity risk?*", as well as to the question of how advisors perceive longevity risk.

The advisor survey suggests that financial advisors know that their clients might live to very old ages and run out of money. Roughly 76 percent of advisors discuss the chance of living to advanced old age, such as age 95, with their clients. Regarding longevity risk, the survey indicates more than 90 percent of advisors are at least somewhat concerned that their clients will run out of money.⁷⁷

The survey also asked financial advisors to estimate the percentage of their clients that will run out of money if they live to certain ages.

Table 3. *Share of Advisors Believing that Over 50 Percent of Their Clients Will Run Out of Money if They Live to Various Ages*

Age	Percentage of clients
80	5%
85	4
90	8
95	17
Observations	400

Source: Authors' calculation from the 2023 Greenwald Research survey.

The survey shows that 17 percent of financial advisors believe that most of their clients will run out of money if they live to age 95 – despite the fact that a 55-year-old has a 7 percent chance of living to age 95 or more, a significant risk given the severity of the consequences. Note, further, that individuals who visit financial advisors have significantly more wealth than the average American and thus have lower chances of outliving their assets, implying this risk may be even more severe for individuals without a financial advisor.⁷⁸

⁷⁷ Less than 1 percent of the financial advisors are not concerned at all about their clients outliving their assets; 8 percent are not too concerned; 24 percent are somewhat concerned; 38 percent are concerned; 24 percent are very concerned; and 6 percent are extremely concerned.

⁷⁸ Even in the consumer survey that does not include individuals with less than \$150,000 in investable assets, the results suggest that the median individual who visits a financial advisor is in the \$500,000 to \$749,999 group of investable assets, while the median individual who does not visit one is in the \$200,000 to \$499,999 group.

Thus, the results of the financial advisor survey suggest that advisors are deeply concerned about many of their clients' ability to manage longevity risk. The only insurance solution to longevity risk available to retirees is guaranteed lifetime income. However, it appears that the vast majority of advisors rarely recommend such products to their clients. Specifically, 66 percent of advisors have recommended a guaranteed lifetime income product to less than 50 percent of their clients. Furthermore, when advisors do recommend an annuity product, many clients do not comply with that suggestion – the median advisor surveyed estimates that most of their clients do not follow advice to buy guaranteed lifetime income.

How Much Are Individuals Willing to Pay for Annuities?

Finally, the questions linked to the third theme, “*Why don't individuals insure against longevity risk?*” are addressed. The survey included a randomized control trial module to determine how people with over \$100,000 of investable assets valued annuities and the extent to which bequest motives or liquidity concerns affect these valuations. For this exercise, the survey's participants were split randomly into three groups. Participants in each group were presented with a different variation of a Single Premium Immediate Annuity: a basic version (the control group), a version with survivor benefits (Treatment Group 1), and a version with an added liquidity clause (Treatment Group 2). In all three groups, the survey elicited the annuity's minimum annual payment, such that an individual would be indifferent between paying a premium of \$100,000 out of their savings or keeping their \$100,000. Specifically, the participants were first asked:

Imagine that you face the following two options regarding \$100,000 of your savings:

- 1) You can keep the **\$100,000** of savings as is, and use it however you like.*
- 2) You can buy a financial product that pays **\$Y** per year, for as long as you live.*

Further, if you die with less than \$100,000 paid out, your heirs will receive the remaining balance. (Group 2 only)

Further, if less than \$100,000 has been paid out, you will be able to withdraw the remaining balance, whenever you want, with suspension of future payments. (Group 3 only)

Which option do you prefer?

For this question, \$Y was an actuarially fair annual annuity payment based on the participant's age.⁷⁹ Individuals were led through a series of unfolding brackets of dollar amount ranges until they eventually provided a value of annual payment which would make them indifferent between that payment and their \$100,000 premium.⁸⁰

The results indicate that approximately 50 percent of the participants would be willing to buy a SPIA at the prevailing market prices when the survey was conducted.⁸¹ Figures 4 and 5 show the gender- and age-specific payment that a real basic SPIA would offer at the time the survey was conducted.⁸² Everyone with a valuation below the gray line would be willing to buy a SPIA at the prevailing market rate, and the pattern of a large share of respondents wishing to buy an annuity holds across gender and age.

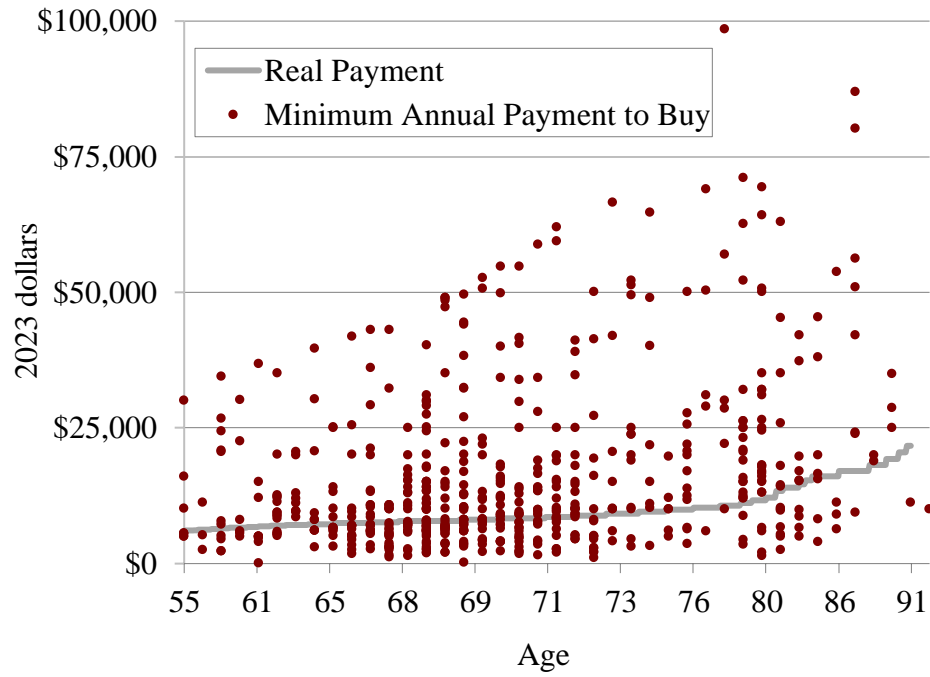
⁷⁹ Typical private annuities are similarly usually priced using only information on age (if purchased through an employer plan) or age and gender (for annuities purchased by individuals).

⁸⁰ Based on each participant's initial answer, the annual payment was either increased or decreased sequentially. For example, if someone preferred \$100,000 over \$Y, he was asked to choose between \$100,000 and \$1.5Y, and if he still preferred \$100,000, he was asked to choose between \$100,000 and \$2Y. If someone preferred \$Y over \$100,000, he was asked to choose between \$100,000 and \$0.5Y, and if he preferred \$0.5Y, he was asked to choose between \$100,000 and \$0.25Y. The questions would stop if the participant's valuation was bounded above and below. In the end, the participant had to use a scroll bar to select an exact value for \$Y between the upper and lower valuation bounds, which made them indifferent between keeping their money or selecting the annual payment. Participants who preferred \$100,000 over \$2Y had to choose a value between \$2Y and \$6Y, and participants who preferred \$0.25Y over \$100,000 had to choose a value between \$0 and \$0.25Y.

⁸¹ One reason why the experimental result might differ from the observed demand for annuities is that respondents were presented with a roughly actuarially fair annuity to start with, which may have led to anchoring. Nevertheless, an actuarially fair value is a reasonable anchor.

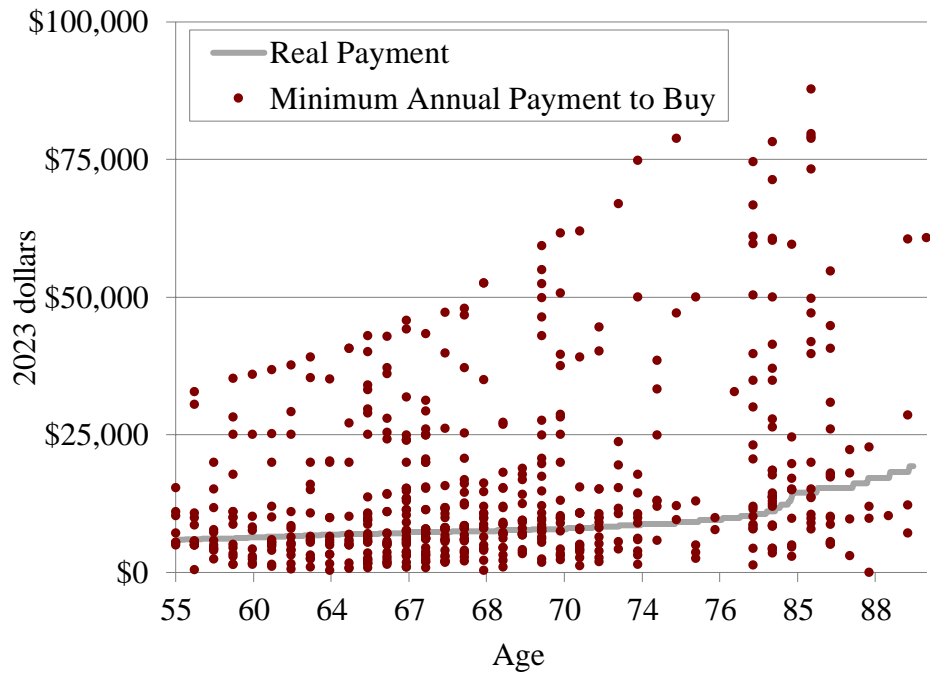
⁸² For accuracy, separating valuations by gender and age is important because those are the two characteristics priced by annuity providers. Thus, men and women, and individuals of different ages, face different prices for market annuities and have different expectations of remaining life years.

Figure 4. *The Minimum Required Annual Annuity Payment for a \$100,000 Premium, Males with Investable Assets of Over \$100,000*



Sources: Authors' calculation from the 2023 Greenwald Research survey and market annuity payouts in June 2023 from Immediateannuities.com.

Figure 5. *The Minimum Required Annual Annuity Payment for a \$100,000 Premium, Females with Investable Assets of Over \$100,000*



Source: Authors' calculation from the 2023 Greenwald Research survey and market annuity payouts in June 2023 from [immediateannuities.com](https://www.immediateannuities.com).

Furthermore, even before the portion of the survey with the unfolding brackets of possible annual payouts, more than half of each of the three treatment groups declare at the initial stage that they would buy the annuity. That is, at an actuarially fair price, over half of respondents would buy the annuity, and this share declines only slightly when we assess their final answer against real-world annuity quotes (which are less than actuarially fair).

In short, a large share of individuals has stated preferences for annuities that they could actually buy, and this share is far larger than the 12 percent of individuals with over \$100,000 in investable assets who buy annuities. Therefore, real-world frictions must drive the difference between the experimental results and individuals' actual behavior. In reality, potential annuity buyers must learn about the existence of these products, find a provider they trust, and go through a complex shopping and contracting process. That is, rather than individual preferences such as bequest motives, precautionary savings, or even irrational preferences like present bias, which have been studied as solutions to the annuity puzzle, more mundane impediments may lead many people to eschew these products.

Analysis of the demand for annuities with different characteristics can also shed some light on how much individuals value a product with survivor benefits or liquidity clauses. Each group's annuity has a different money's worth because of its added features. According to the market prices for age-55 annuitants on the Immediateannuities.com website, the annuity with survivor's benefits is worth approximately 8 percent more than the Basic SPIA, while values for the annuity with liquidity clauses span a range, depending on when the clause is activated (see Table 4).^{83,84}

Table 4. *Age 55 Money's Worth for Each Type of Annuity*

Annuity type	Money's worth
Basic SPIA	\$86,000
With survivor benefits	93,050
With liquidity clauses	[65,000 - 100,000]

Note: These numbers use the mortality probabilities of the full population, not restricted to having assets over \$100,000.

Sources: Authors' calculations and annuity rate data from immediateannuities.com.

Although participants in Groups 2 and 3 are offered products with objectively greater value, they are not willing to pay any more for these added benefits. Specifically, the average annual payment required to buy an annuity in Group 1 is \$16,452, and the difference in terms of annual payments in Groups 2 or 3 is not statistically significant from this base amount (see Table 5).⁸⁵

⁸³ The money's worth of the basic SPIA is consistent with estimates in prior literature, such as Mitchell et al. (1999) and Wettstein et al. (2021).

⁸⁴ The money's worth of the annuity with the liquidity clause is bounded, depending on when and if that clause is activated. The lowest money's worth is obtained by activating the clause just before exhaustion of the premium; the highest is obtained when the clause is activated immediately, yielding an immediate refund of the full premium.

⁸⁵ These equations are estimated without controls, but results are robust to dropping outliers or including controls such as age and gender. See Appendix Table A1. Although the constant is much higher than a payout consistent with current market prices, this value is driven by the older population, who have high annual payments due to their lower life expectancy, and to a smaller extent by outliers, as shown in Figures 4 and 5.

Table 5. *Dollar Differences in Required Annual Annuity Payment for a \$100,000 Premium, for Individuals with Investable Assets Over \$100,000, by Annuity Type*

Variable	Coefficient	Robust S.E.	P > t
Group 2	-307	12,758	0.810
Group 3	221	1,251	0.860
Constant	16,452***	858	0.000

Source: Authors' calculations from the 2023 Greenwald Research survey.

The fact that respondents were not substantially more willing to buy the annuity with the survivor benefit than to buy the basic SPIA suggests that individuals do not understand or value this particular benefit. Thus, even though these products may be relatively popular in reality, their existence may not increase the total size of the annuity market if part of the reason annuity demand is so low is that consumers are confused by the variety of products they face. More research on whether such products increase or decrease the total amount of annuitized income is warranted.

Finally, the results of the experiment also shed a little light on the connection between bequest intentions and annuity demand. One of the most consistent findings in the literature is that strong bequest motives should lead to lower annuity demand. Although, on average, the analysis above does not find a statistically significant difference in the valuation of SPIAs across the control and treatment groups in the experiment, one could expect that individuals who think that bequests are important would place a higher valuation on the Group 2 annuity (survivor benefits) than those who do not value bequests. To test for this relationship, we repeat the regression controlling for the interaction of the group and an indicator that takes the value “one” if the individual believes that leaving a bequest is important.

The results are in Table 6. Recall that these numbers represent the amount of annual payments a person requires to be indifferent to paying a \$100,000 premium; thus, higher numbers represent lower valuations. As expected, those who wish to leave a bequest also do not like the idea of buying a basic SPIA – as they require about \$9,000 as an annuity as opposed to \$5,400 for those with no bequest preference. Also as expected, individuals who believe leaving a bequest is important do value the annuity with survivors' benefits more (requiring only \$5,100 to buy the annuity, rather than \$9,000). Less intuitively, those who do not wish to leave a

bequest value the annuity with a survivor benefit even less than the basic SPIA.⁸⁶ Still, although the individuals with bequest motives are 70 percent of the sample, their valuations are not sufficiently high to make the group means statistically different overall (particularly given that those who do not intend to leave a bequest value the annuity with survivor benefits even *less* than the basic SPIA).

Table 6. *Dollar Differences in Required Annual Annuity Payment in Return for a \$100,000 Premium, for Individuals with Investable Assets Over \$100,000, by Annuity Type and Whether Leaving a Bequest Is Important*

	Bequests are not important	Bequests are important
Group 1	\$5,416	\$8,995
Group 2	9,944	5,099

Note: Values are for a 55-year-old male.

Source: Authors' calculations from the 2023 Greenwald Research survey.

Conclusions

The overview of the literature on longevity risk here highlighted some gaps in the existing literature: 1) subjective longevity expectations and specifically subjective tail risk; 2) the role that financial advisors might play in insuring against longevity risk and driving or suppressing annuity demand; and 3) the perennial annuity puzzle: why do people not annuitize more, when economic theory suggests they should? In this third area, the strength of bequest motives and demand for liquidity might be specific topics of debate.

The pattern of results suggests some explanations for the deviation between estimated valuations of annuities and real-world take-up. First, individuals seem to value annuities in the abstract to a level consistent with roughly half of retirees buying an annuity. This level of coverage would far exceed observed annuitization rates in the population. The results do not seem consistent with strong bequest motives or demand for liquidity driving this gap, because the gap remains even for products that explicitly address bequests and precautionary savings as concerns.

⁸⁶ This result could be because they interpret this product as bearing some cost above and beyond the basic SPIA, as it would in reality, even though in the experiment there was no such cost. Alternatively, some of the individuals who do not think leaving a bequest is important may even actively dislike the idea of leaving a bequest.

Most attempts to explain the annuity puzzle rest on individuals not wanting annuities. The survey results suggest that may be the case for half of individuals with investable assets over \$100,000. However, the results suggest some real-world frictions prevent many of the remaining individuals in this group from realizing their desires to buy lifetime income.

In particular, financial advisors do not seem to recommend annuities to many of their clients. If a client is unaware of the product or is advised not to buy it, these reasons could explain why few buy annuities even though they should value them more than their price in a simple experimental setting. Overall, the lack of advice from financial advisors to buy annuities may be a place to look for further solutions to the annuity puzzle.

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Appendix 1: Randomized Control Trial

Table A1. *Differences in Required Annual Annuity Payment in Return for a \$100,000 Premium, for Individuals with Investable Assets Over \$100,000, by Annuity Type, with Controls*

Variable	Coefficient	Robust S.E.	P > t
Age	-3143.147	910.6409	0.001
Age ²	26.01714	6.469012	0.000
Male	-734.5652	969.7216	0.499
Group 2	-1289.11	1196.578	0.282
Group 3	-708.5355	1137.242	0.533
Constant	106498.7	31768.04	0.001

Source: Authors' calculations from the 2023 Greenwald Research survey.

Appendix 2: Subjective Survival Curves

In addition to the survey's subjective probability questions, the analysis assumes that individuals believe that they are almost certain not to live past age 110; thus, the subjective probabilities of surviving to that age are equal to the relevant lifetable survival probabilities. For individuals who state that their life expectancy is over age 100, we replace age 110 with their life expectancy plus 20 years. By imposing this assumption, we obtain a maximum of five reports of subjective survival probabilities for each individual. The set of the five reports is denoted by $A_i = \{\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5\}$, where α_j is the age that individuals are asked to provide the subjective probability of surviving to. Also, $R_i(\alpha, z)$ denotes the subjective probability of surviving to age α for an individual i with age z (e.g. $R_i(110, 65)$ denotes the subjective probability of surviving to age 110 of a 65-year-old individual).

To ensure the computational feasibility of the problem, the functional form of the individual's subjective survival curves is assumed. Specifically, the function is a two-parameter Weibull distribution. The Weibull distribution is widely used in the epidemiological literature.

$$S(\alpha, \lambda_i, \kappa_i) = \exp\left[-\left(\frac{\alpha - z_i}{\lambda_i}\right)^{\kappa_i}\right], \quad \lambda_i, \kappa_i > 0$$

The two parameters (λ_i, κ_i) are estimated by fitting the Weibull distribution via nonlinear least squares for each person-year observation i in our sample.

$$(\hat{\lambda}_i, \hat{\kappa}_i) = \underset{\lambda_i, \kappa_i}{\operatorname{argmin}} \sum_{a \in A_i} I[a \neq \text{missing}] (R_i(a, z_i) - S(a, \lambda_i, \kappa_i))^2$$

One coefficient vector $\{\hat{\lambda}_i, \hat{\kappa}_i\}$ is estimated for each individual. Finally, using the function $S(a, \hat{\lambda}_i, \hat{\kappa}_i)$, subjective survival curves and subjective life expectancies are calculated.