How Big Is Longevity Risk?

By Bob Collie, FIA

In a defined contribution pension arrangement, individual retirees are subject to both investment risk (i.e., uncertainty about what their investment returns will be) and longevity risk (uncertainty about how long they will live). Which of these risks is bigger?

The relative sizes of the risks change with age. For the typical investment strategy, investment risk is larger at younger retirement ages, but longevity risk becomes larger with time.

For example, the uncertainty associated with how long an 80-year-old will live is greater than the uncertainty associated with investment returns. However, the reverse is true for a 50-year-old.

What's more, at younger ages, the combined effect of longevity risk and investment risk is not much greater than the effect of investment risk alone.

These findings are relevant to the current debate on the provision of lifetime income to defined contribution (DC) plan retirees. In particular, these findings may help to clarify the role annuities can play in managing longevity risk.

Background

In a defined benefit (DB) arrangement, plan participants receive a known income throughout retirement that lasts as long as they do. Hence, the income they receive is not sensitive to fluctuations in market returns, nor is it affected by uncertainty about the future lifespan. Thus, in a DB plan, the retiree is shielded from both market risk and longevity risk.[1]

In a DC arrangement, the plan participant instead has an account balance and must decide how quickly to draw that money after retirement. This decision is difficult because individuals do not know how long they will live—or what their investment returns will be.

This article explores the size of these two sources of uncertainty. We start with a specific case of a 65-year-old female then extend to the more general case.

A 65-Year-Old Retiree—in a Certain World

Imagine a world in which both longevity and investment returns are known with certainty. Assume that in this hypothetical world investments return exactly 6 percent each year, and that a 65-year-old female who retires in 2014 will live for precisely 23.8 more years (which is her average life expectancy as implied by the Society of Actuaries' recently published RP-2014 table).

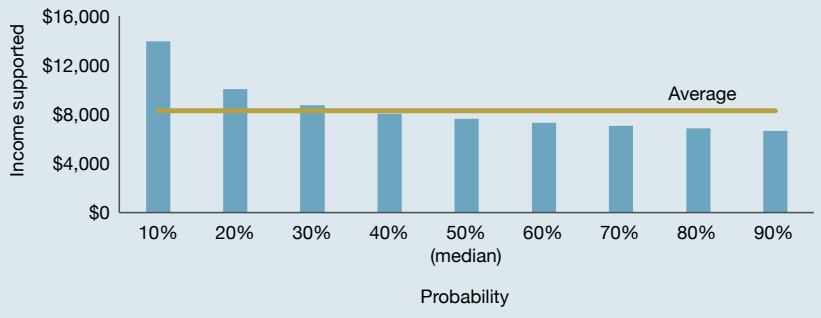
Because we know with certainty how long income will be required, and we know with certainty what the value of $1 invested today will be at every future point, it is fairly straightforward to calculate that a sum of $100,000 would generate annual income of $7,775 a year for this retiree. This figure represents our baseline result.

If Mortality Is Uncertain

Now imagine a second hypothetical world—that we might call the uncertain-lifespan world—in which investment returns are certain but longevity is unknown. The average annual income supported in the uncertain-lifespan world would be $8,304, and the median would be $7,616. The average lifespan of our retiree in this world is still 23.8 years, but there is now a 10-percent chance that she will live for 9.3 years or less, and hence that $100,000 would be sufficient to generate annual income of $13,944 for life. There is similarly a 10-percent chance that she will live 35.9 years or longer, in which case the annual income supported would be only $6,648. The latter figure is of more interest in the context of this analysis, because it is an unexpectedly long life—not an unexpectedly short one—that represents a financial threat.

As shown in figure 1, these amounts are noticeably skew. If the retiree outlives average life expectancy, the cost of funding lifetime income increases, but the additional

Figure 1: The Impact of Uncertainty in Longevity



payments are far in the future, so they are fairly small in today's dollars.

We see that, for the 65-year-old retiree, introducing longevity risk (but not investment risk) reduces the income that is generated (at a 90-percent probability) from $7,775 to $6,648, a 14-percent penalty.

If Investment Is Uncertain

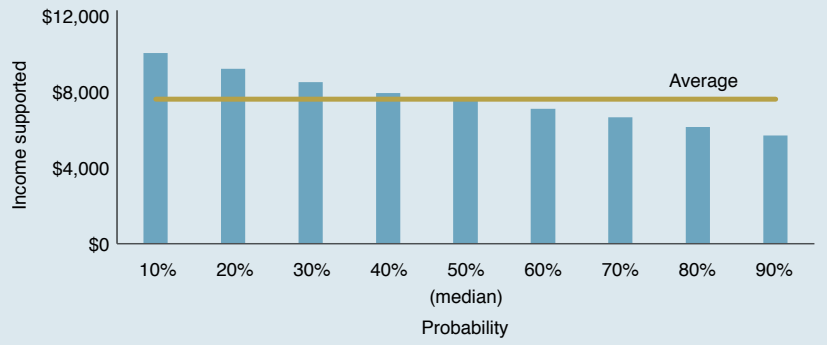
To put this penalty into more familiar terms, we can compare the uncertain-lifespan world to another hypothetical world, an uncertain-return world. In this world, lifespans are certain, but investment returns are not.

We begin with a simple and familiar version of uncertain returns, by replacing the 6-percent fixed return assumption with a normally distributed return. In this uncertain-return world, the time horizon is fixed at 23.8 years. For example, if we assume a standard deviation of 10 percent a year, then the income supported (at a 90-percent confidence level) would be $5,551, which represents a 29-percent penalty below the baseline level of $7,775 (see figure 2).

To arrive at a 14-percent penalty (equal to the penalty in the uncertain-lifespan world), we would need to set the standard deviation of the investments at roughly 5.2 percent. Hence, in this case longevity risk can be thought of as akin to a standard deviation of 5.2 percent in the investment portfolio. This is a low level of investment volatility compared to that in most actual portfolios, and it is roughly what might be expected from a portfolio allocated entirely to fixed income securities.[2]

Thus, the effect of the uncertainty around how long this retiree will live is comparable to the effect of a 5.2-percent standard deviation in investment returns. Because most investment portfolios have expected volatility that is above this level, we can conclude that longevity risk is smaller than investment risk in this case.

Figure 2: The Impact of Uncertainty in Returns (assuming 10% standard deviation in returns)



Note: Standard deviation is a statistical measure of the degree to which an individual value in a probability distribution tends to vary from the mean of the distribution. The greater the degree of dispersion, the greater the risk.

If Both Mortality and Investment Are Uncertain

To complete the picture for the 65-year-old female retiree, consider a fourth (still hypothetical) world, in which both investment returns and longevity are uncertain.

For example, if we assume a standard deviation of 10 percent in investment returns, along with an uncertain lifespan, then the level of income supported (at a 90-percent probability) falls to $5,209, a 33-percent penalty below the baseline. This penalty is larger than the 29-percent penalty associated with investment risk alone but not massively so. Indeed, the impact of introducing longevity risk is roughly equivalent to increasing the assumed standard deviation of returns from 10 percent to 11.5 percent.

In other words, the interaction of longevity and investment risk means that the combined impact of both forms of uncertainty is only a little more than the impact of investment risk alone in this example.

We summarize the results so far in table 1, adding also the equivalent results for a 65-year-old male retiree and for a male-female (second to die) joint life.

Variation with Age

The results above vary significantly at different ages. At younger ages, the majority of longevity risk is concentrated in the distant future. For example, the 10th- and 90th-percentile outcomes for a 65-year-old female were noted above as 9.3 and 35.9 years of retirement, so the long life is roughly four times longer than the short life. At age 50, that ratio would fall to 2.5 times longer; at age 80, it is 7.5 times.

Table 1: Income Generated—with 90% Confidence—by $100,000 in Four Hypothetical Worlds (age at retirement in 2014: 65)

	Female	Male	Joint life
Certain world	$7,775 (baseline)	$8,142 (baseline)	$7,213 (baseline)
Uncertain lifespan	$6,648 (–14%)	$6,784 (–17%)	$6,570 (–9%)
Uncertain returns (Stand Deviation = 10%)	$5,551 (–29%) (or –14% at 5.2% SD)	$5,891 (–28%) (or –17% at 6.1% SD)	$5,046 (–30%) (or –9% at 3.1% SD)
Uncertain lifespan and returns	$5,209 (–33%) (equiv. 11.5% SD)	$5,422 (–33%) (equiv. 11.9% SD)	$4,924 (–38%) (equiv. 10.6% SD)

This hypothetical example is for illustration only and is not intended to reflect the return of any actual investment.

Figure 3: Variation with Age of Longevity Risk (expressed as equivalent level of investment volatility)

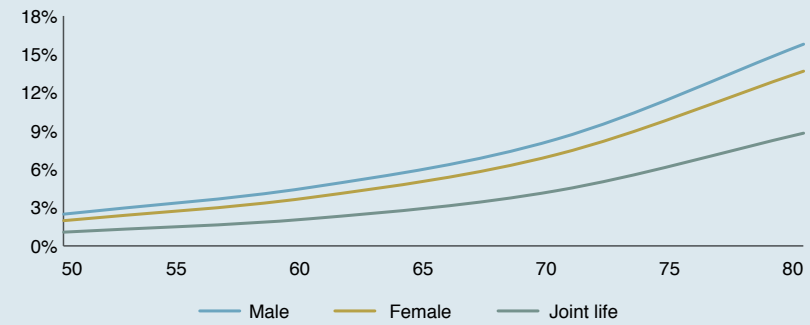
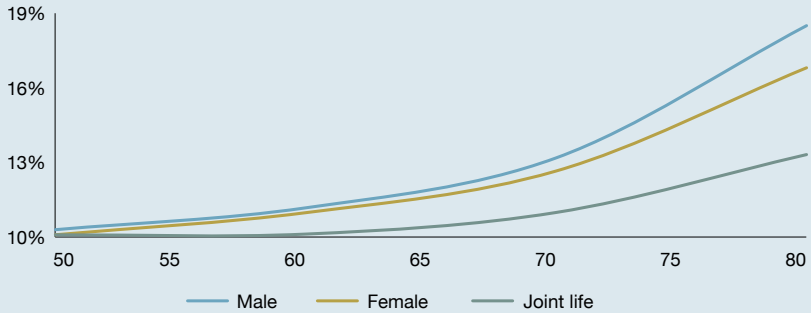


Figure 4: Variation with Age of Impact of Combination of Longevity Risk and 10% Investment Volatility



Investment risk, meanwhile, reduces slightly as the time horizon shortens.

Figure 3 shows the investment volatility that is equivalent to longevity risk at various ages, and figure 4 shows the investment volatility that is equivalent to the combination of longevity risk and 10-percent volatility. Both figures are based on the same approach used above.

For a 65-year-old retiree, we concluded above that:

- Longevity risk is smaller than typical levels of investment risk.
- The interaction of longevity risk and investment risk means that the combined impact of both forms of uncertainty is only a little larger than the impact of investment risk alone.

These conclusions hold even more strongly at younger retirement ages. Indeed, at the left end of the charts (age 50), longevity risk is essentially negligible when set alongside typical levels of investment risk.

However, the importance of longevity risk increases at older ages. For 80-year-olds, the uncertainty associated with how long they will live is equivalent to a fairly substantial level of investment risk.

Appropriate Management of Longevity Risk

There is currently a great deal of focus on the question of lifetime income for DC plan retirees. As noted above, the DC system does not automatically provide a stream of retirement income in the same way the DB system does. It is beyond the scope of this article to provide a detailed discussion of the various possible approaches to managing retirement income, but the relative impact of uncertainty in longevity and in investment returns is relevant to this debate.

The simplest vehicle available to individuals seeking to manage longevity risk is a fixed annuity contract. This provides a known income for life, in return for payment of an initial premium.[3] These annuities are not, however, pure longevity plays: They also represent an investment decision. The investment strategy that underpins fixed annuity contracts is, for regulatory and risk-management reasons, essentially a fixed income strategy.

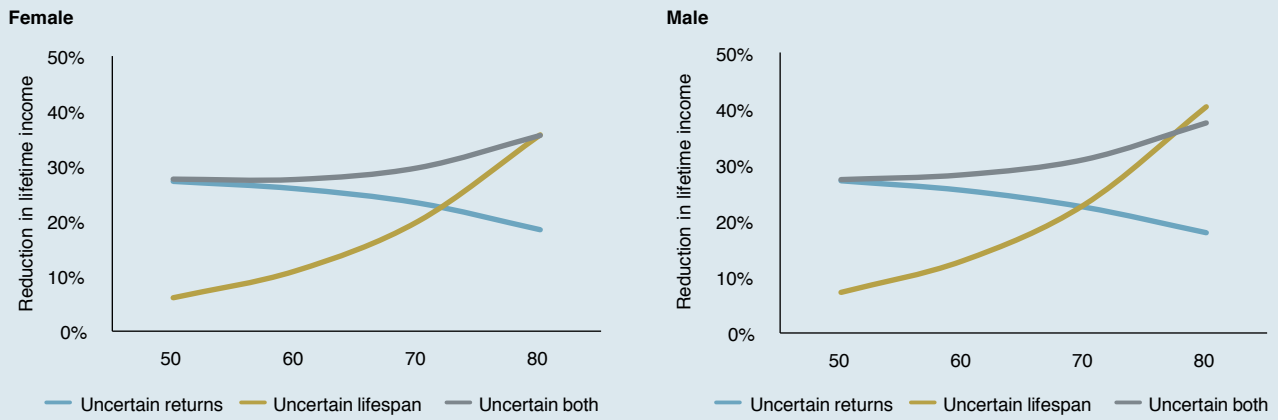
Any decision around the purchase of an annuity should therefore be judged both in terms of how it manages longevity risk and in terms of its impact on investment strategy. To the extent that investment risk is the dominant risk, the purchase of an annuity should therefore be thought of as an investment decision as much as a longevity-protection decision. Other forms of longevity protection, such as a variable annuity contract, have different implications for investment strategy, which may provide for a better fit to the typical retiree's needs.

Alternatively, our findings might be taken as leading to the conclusion that for typical retirees it is better to ignore longevity risk in the first few years of retirement and address it later. That does not necessarily follow, however. Even though the risk that is being managed concerns mortality experience at advanced ages, steps can be taken to address that risk sooner rather than later.

Even at a younger retirement age, the threat to financial security that arises from uncertainty in longevity is a right-tail threat. That is to say, it is the possibility of the retiree living longer than the average lifespan that may result in financial strain. So it is the right tail—the possibility of outliving average life expectancy—on which the debate should focus.

Managing this right tail becomes more expensive as more time passes. To state the obvious: A lifetime annuity payable from age 85 is a considerably more expensive purchase at age 85 than at age 65. Yet, even at age 65, it is this right tail with which we are concerned. It is this line of thinking that has led to growing interest in deferred

Figure A1: Impact of Uncertainty on Lifetime Income



annuities[4] as a means of addressing longevity risk early in retirement, when it can be done more cost-effectively.

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Endnotes

1. There are other risks, however. For example, most DB arrangements in the United States are not linked to the cost of living, so their value can be eroded by inflation. The benefit also is contingent on the continuing ability of the plan to meet its obligations (backed, in the case of private-sector plans, by the Pension Benefit Guaranty Corporation).
2. Russell's standard capital market assumptions as of year-end 2014, for example, have an expected time series volatility on aggregate fixed income of 4.6 percent a year over the next 20 years.
3. Payments from annuities are subject to the claims-paying ability of the issuing insurance company.
4. Last year, the U.S. Department of the Treasury and the Department of Labor issued regulations that made qualifying longevity annuity contracts (or QLACs) more accessible to DC plan participants. These contracts provide lifetime income starting at an advanced age, such as 80 or 85. For an overview of these regulations, see "Qualifying Longevity Annuity Contracts: Frequently Asked Questions" (December 2014), available at DCIIA.org.

Appendix: The Impact of a More Complex Model of Investment Risk

In order to put longevity risk in terms that can be widely understood, we used a very simple form of investment risk above. More-sophisticated models of investment risk allow for fat tails in the distribution of outcomes, for variation over time in the volatility of asset returns and in the correlations between asset returns, and so on. (A fat-tailed distribution is one in which extreme outcomes occur with greater frequency than they would under a normal distribution with the same standard deviation.) Using Russell Investments' standard capital market assumption model (as of year-end 2014), we can extend the above analysis.

For example, if we assume a 50-50 allocation between global equities and broad market fixed income, then the level of income that would be generated in the uncertain-return world at the 90-percent probability level would be $5,295 for the 65-year-old female retiree (i.e., assuming a fixed term of 23.8 years). The median level of income supported would be $7,003 and the average $6,748.

Figure A1 shows how the impact of uncertainty changes with age.

The percentage shown is the shortfall of the income generated at the 90-percent probability level below the income generated at the 50-percent probability level. To ensure a like-for-like comparison at each age, the fixed return assumed in the uncertain-lifespan world was set so as to produce the same median level of income generated in the uncertain-return world; this fixed return varied from 3.3 percent to 5.3 percent, depending on the age of the retiree.

Under this model, the age at which longevity risk overtakes investment risk is around age 70 for both the female retiree and the male retiree. The overall pattern of the results is consistent with the findings of the simpler model, in that longevity risk appears relatively insignificant at younger ages but increases materially once retirees reach their 70s.

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