The Demand for Annuities with Stochastic Mortality Probabilities

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Traditional economic theory suggests that households without a bequest motive should fully annuitize their assets. Annuities dominate all non-annuity investments since annuities produce a mortality credit – derived from the pooled participants who die and forfeit their assets – in addition to the return from the underlying asset. If an investor wanted to invest in bonds then a fixed return annuity invested in bonds would produce the bond yield plus the mortality credit. If an investor wanted to invest in stocks then a variable return annuity invested in stocks would produce the same realized yield plus the mortality credit. Annuities could, therefore, significantly increase welfare, especially if risk averse households are not able to manage mortality risk in other ways.

Since Yaari's seminal paper on the issue in 1965, annuity theory and the operation of annuity markets have received considerable attention in the literature, especially since true life annuities are uncommon. As is well known, Yaari's model assumed costless and complete markets. In practice, however, annuities are not fairly priced: premiums incorporate sales charges as well as adjustments for adverse selection. In addition, other sources of longevity pooling exist that might crowd out some of the demand for annuities, including Social Security, defined-benefit pensions, and even marriage. Moreover, people might face liquidity constraints after annuitization. Still, the apparent under-annuitization of resources is not well understood, even after this volume of past research, and is commonly referred to as “the annuity puzzle.”

In this paper, we adopt the Yaari framework, but allow for the mortality survival probabilities themselves to be stochastic, which is quite natural and consistent with an investor’s health status evolving over time. Rather than adding restrictions to the Yaari model, we simply relax an existing implicit constraint by allowing for non-fixed probabilities over the lifecycle. We otherwise leave the Yaari model unfettered. Insurers and households have the same information. There are no loadings. Households do not face any binding “liquidity constraints,” an often cited (albeit unmotivated) reason for incomplete annuitization.

Stochastic mortality introduces valuation (or principal) risk, much like a long-term bond. Applying the model, if households are sufficiently impatient, a long-term traditional annuity no longer dominates other investment options, and the optimal level of annuitization falls below 100%. A model with stochastic mortality probabilities also provides a mechanism by which additional frictions in the market can smoothly reduce annuity demand, something that does not exist in a model with deterministic probabilities. Even the role of bequests because more meaningful with stochastic survival probabilities, particularly since bequest motives likely vary with wealth.

To be clear, we don't intend our model to explain market behavior or a broad range of stylized facts about annuity markets. Many puzzles remain – especially regarding annuity contract design – which
may be better explained with behavioral models. We simply argue that the optimal baseline annuitization rate in a fully unconstrained Yaari model can fall below 100%.

Our analysis is at least consistent with both industry research and academic experimental evidence which indicates that households view annuities as increasing their risk rather than reducing it. In our model, even with rational expectations, annuities can delivery both a larger expected consumption stream and more risk relative to bonds. As a result, a greater level of risk aversion can produce less annuitization. In contrast, with deterministic survival probabilities, the mortality pooling provided by an annuity provides more consumer surplus at higher levels of risk aversion.

In our empirical simulations of the model, we find that it is optimal for most households to not annuitize any wealth upon retirement (particularly with Social Security), even if they face no liquidity constraints. The more risk averse the household, the more they should invest in bonds. Wealthier households, on the other hand, should annuitize if they have no bequest motives.

The full working paper is available on our website www.nber.org/programs/ag/rrc/books&papers.html as paper NB12-10.

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