The Impact of the Level of Biometric Guarantees on Mortality Indexed Annuities

Abstract

Pension plans offer means of securing ones income for the time when other sources of income become more and more unavailable. The very nature of these contracts is to feature a long time horizon for which the terms of payment may be fixed many years in advance. Guarantees found in pension plans can be roughly divided into financial and biometric guarantees, and products may offer any combination of these (or none). Yet, the developments in recent years have shown that there is substantial risk involved in both of these aspects, i.e. current low interest rates as well as longevity issues.

In the past we have seen that longevity projections have often been exceeded by the real development. With biometric guarantees promised many years in advance, this generates a potentially very high risk for life insurers, which is even amplified by low interests. Consequently, life insurers have to analyze and manage their longevity risk more carefully, since they might not be able to balance losses incurred by a change in mortality with high capital income.

We find suggestions for products which address these issues by (partially) transferring these risks back to the policyholder. Piggott et al. (2005) suggest indexed products, where payments are adjusted according to changes in mortality, as well as realized capital gains within a pool of annuitants. This approach is further studied in Qiao & Sherris (2013). Yet, the the full risk is held be the buyer of the insurance contract. Denuit et al. (2011) suggest to apply a cap and a floor on the mortality risk that is passed on to the policyholder and derive approximations for the mortality risk retained by the annuity provider.

In the present paper we investigate possibilities to include biometric guar-

antees into the design of indexed life annuity contracts. We use stochastic mortality models (e.g. affine, non mean-reverting) to assess the development of mortality over time. These models have been studied by Luciano & Vigna (2005) and shown to be both, analytically well tractable, as well as suitable to reflect observed mortality trends. We decompose the the capped mortality index into options and exploit the mortality models' structure to find pricing formulas for the considered contracts. Hence, we can compare contracts with different levels of guarantees and risk retention.

Furthermore, we study the risk that is incurred by the insurance company by issuing such contracts. A particular focus is put on two aspects: firstly, we study the implications of small portfolios, i.e. how much systematic or unsystematic risk is captured by mortality caps and floors. Secondly, we study how insurers can hedge the risk incurred by issuing policies based on a capped index and how the hedging requirements are influenced by changes in the cap-level.

Possible applications of contracts that feature a capped mortality index are not limited to life insurance companies that sell individual policies. These contracts may also be of particular interest for life reinsurers. The guarantee corridor provided by a cap and floor on a mortality index may be used as a non-proportional reinsurance contract on the longevity risk ceded by a life insurer.

Keywords: Longevity, Systematic Risk, Life Insurance, Actuarial Science

JEL: J11, G22

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