Basis risk in static versus dynamic longevity-risk hedging*

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April 13, 2015

Abstract

Life insurance companies' portfolios are affected by longevity risk, that they can hedge using mortality derivatives. Usually, OTC derivatives are written on the insured population, while non-OTC derivatives leave the insurance company exposed to so-called basis risk, because they are written on a reference population which does not coincide with the insured one. Also, actors seeking coverage with an OTC product build a full, static hedge, such as an s-forward or a longevity swap, while non-OTC derivatives are used in conjunction with a partial, dynamic hedge. In the first case the coverage is not changed over time. In the second case, coverage is partial, leaves the insurance company exposed to basis risk, and calls for adjustment over time. The main original contribution of our paper consists in providing a simple model for basis risk in longevity, by separating common and idiosyncratic risk factors. Longevity risk is represented through the so-called stochastic longevity, i.e. by an intensity of mortality which is itself a stochastic process. In order to keep the model tractable and to provide easy to implement hedges, we work in continuous time. In order to ensure positivity of the intensity and to have a longevity model which nicely couples with the modeling of interest rates, we assume that longevity follows a CIR process. Most importantly, basis risk is captured by a single parameter, that measures the comovement between the insured and the reference population. Once basis risk is modelled, the second important contribution consists in providing both static and dynamic, closed-form hedges. The static hedge entails the use of an OTC longevity swap, while the dynamic hedge is performed applying Delta-Gamma strategies through non-customized products. We compare their efficiency on a calibrated example, both when basis risk is negligible, and when it is not. We determine the cost of the static hedge which would "equate", up to a given quantile, the hedging error of the partial coverage. For each rebalancing frequency, introducing basis risk, we assess the error due to the unhedgeable component of longevity. Last, we explore sensitivity with respect to different assumptions on the rebalancing frequency.

Keywords: longevity risk, longevity derivatives, hedging, basis risk.
IME Congress Speaker: Clemente De Rosa.

*The Authors gratefully acknowledge financial support from the Global Risk Institute, Canada.

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