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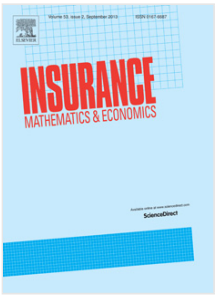

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Hedging mortality/longevity risks of insurance portfolios for life insurer/annuity provider and financial intermediary

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Abstract

In this paper, we propose two risk hedge schemes in which a life insurer (an annuity provider) can transfer mortality (longevity) risk of a portfolio of life (annuity) exposures to a financial intermediary by paying the hedging premium of a mortality-linked security. The optimal units of the mortality-linked security which maximize hedge effectiveness for a life insurer (an annuity provider) can be derived as closed-form formulas under the risk hedge schemes. Numerical illustrations show that the risk hedge schemes can significantly hedge the downside risk of loss due to mortality (longevity) risk for the life insurer (annuity provider) under some stochastic mortality models. Besides, finding an optimal weight of a portfolio of life and annuity business, the financial intermediary can reduce the sensitivity to mortality rates but the model risk; a security loading may be imposed on the hedge premium for a higher probability of gain to compensate the financial intermediary for the inevitable model risk.

Keywords: mortality risk; longevity risk; downside risk; hedge effectiveness; Lee-Carter model

1. Introduction

Recently the literature regarding mortality/longevity risks and their management has been growing rapidly. In practice, finding an effective method of hedging longevity/mortality risks has been also a matter of great urgency. Since pension plan, life insurance and annuity contracts often last for decades, the uncertainty about the future mortality rates can expose retirement programs, social security systems, life insurers and annuity providers to the threats of financial distress. According to Cocco and Gomes (2012), a defined benefit (DB) pension plan for a 65-year-old U.S. male would have needed 29% more wealth in 2007 than in 1970. Cowling and Dales (2008) point out that companies in the United Kingdom FTSE100 index undervalued their aggregate pension liabilities by more than 40 billion sterling pounds. In view of the limited capacity of reinsurance, several alternative approaches have been studied in the literature and applied in practice.

In this article, we propose two risk hedge schemes with which a life insurer (an annuity provider) can transfer mortality (longevity) risk of a portfolio of life (annuity) exposures to a financial intermediary in the capital market. Transferring mortality/longevity risks to the capital market is one of the approaches. Mortality-linked securities (e.g., longevity bonds, q-forwards, survivor swaps, annuity futures, mortality options, and survivor caps) have been proposed, for example, Blake and Burrows (2001), Lin and Cox (2005), Dowd et al. (2006), Denuit et al. (2007), Menoncin (2008), and Stevens et al. (2010). In practice, a mortality catastrophe bond (called Vita) was issued by Swiss Re for the first time in December 2003;

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