

Stochastic modelling of mortality and its connection with financial markets

Helena Aro* Teemu Pennanen†

Abstract

The uncertain future development of mortality and financial markets affects the operation of every life insurer. In particular, the joint distribution of mortality and investment returns is crucial in pricing and hedging of mortality linked bonds and other life insurance products. This paper proposes simple stochastic models that are well suited for numerical analysis of life insurance products that cannot be hedged with traditional techniques of mathematical finance. The models are calibrated with an extensive data set covering six countries and 56 years. Statistical analysis supports the known dependence of old-age mortality on GDP which, in turn, is connected to many sectors of financial markets. Our models provide a simple quantitative formulation of such connections. Particular attention is paid to the long-term development of mortality rates, which is an important issue in life insurance markets.

Keywords: Stochastic modelling, mortality, investment returns.

*Department of Mathematics and Systems Analysis, Aalto University, haro@math.hut.fi

†Department of Mathematics and Statistics, University of Jyväskylä, teemu.pennanen@tkk.fi