

CEPAR Long Term Care and Longevity Insurance Workshop

(Hosted by CEPAR and PwC)

10th December 2014

Program

8.30	<i>Registration</i>
8.50 – 9.00	Welcome
9.00 – 9.45	Keynote Talk: Ermanno Pitacco (University of Trieste), 'Premiums for Long- term Care Insurance Products. A Sensitivity Analysis'
9.45 – 10.30	Adam Shao (CEPAR), 'Product Pricing and Solvency Capital Requirements for Long-term Care Insurance'
10.30-11.00	<i>Morning Tea</i>
11.00 – 11.45	Servaas van Bilsen (Tilburg University and NETSPAR), 'Valuation and Hedging of Variable Annuities in Pension Schemes'
11.45 – 12.30	Jonathon Ziveyi (School of Risk and Actuarial Studies, UNSW), 'Valuing Variable Annuity Guarantees on Multiple Assets'
12.30-1.30	<i>Light Lunch</i>

Abstracts

Title: Premiums for Long-term Care Insurance Products. A Sensitivity Analysis

Presenter: Ermanno Pitacco

This talk will cover long-term care insurance products, the biometric model, premiums, technical bases and illustrate with numerical examples and a sensitivity analysis based on mortality of the disabled.

Biography: Ermanno Pitacco is Professor of Actuarial Mathematics in the Faculty of Economics, University of Trieste and Academic Director of the Master in Insurance and Risk Management at the MIB School of Management of Trieste. He is an actuary and full member of the Istituto Italiano degli Attuari (Italy), affiliate member of the Institute of Actuaries (UK) and a member of Groupe Consultatif Actuariel Européen. He is Co-editor of the European Actuarial Journal and Associate Editor of the international journals, *Insurance: Mathematics & Economics*, *Decisions in Economics and Finance*, and *Insurance Markets and Companies: Analyses and Actuarial Computations*. He has published extensively in life and health insurance modeling and longevity risk management. Awards include the 1996 INA Prize for Actuarial Mathematics, from Accademia Nazionale dei Lincei and the 2011 Bob Alting von Geusau Memorial Prize, together with Annamaria Olivieri, for the best paper published in the ASTIN Bulletin in the category of actuarial approach for financial risks (AFIR).

Title: Product Pricing and Solvency Capital Requirements for Long-Term Care Insurance,

Authors: *Adam Wenqiang Shao* and Michael Sherris

This paper assesses premiums, reserves and solvency capital requirements for a wide range of long-term care insurance policy designs, including stand-alone policies sold to individuals in different health states, rider benefit policies (long-term care insurance combined with whole life insurance), and life care annuities (long-term care insurance combined with annuities) sold to individuals in different health states. Thiele's differential equation is used in deriving premiums and best-estimate reserves for generic long-term care insurance policies with no elimination period or maximum benefit period included. However to take into account typical product features, a simulation-based model is required to calculate premiums and reserves for policies with different combinations of elimination periods and maximum benefit periods. The elimination period is shown to be very effective in making stand-alone long-term care insurance more affordable, while the maximum benefit period is shown to be more effective in extreme loss control. Solvency capital requirements allowing for longevity risk and disability risk for different types of policies are then compared based on the Solvency II standard formula. The results show that rider benefit policies and life care annuities provide considerable capital reductions compared to stand-alone policies. Stand-alone policies sold to disabled individuals are shown to require lower capital

per unit premium compared to those sold to healthy individuals of the same age. These results provide insights that assist in the design of affordable long-term care insurance as well the capital efficiency for long-term care insurance providers.

Biography: Adam Wenqiang Shao is a research fellow at ARC Centre of Excellence in Population Ageing Research (CEPAR), based at University of New South Wales node. His PhD thesis is on pricing and risk analysis of reverse mortgage loans and long-term care insurance. His research interests include retirement product such as equity release products and long-term care insurance, longevity risk, house price modelling, and risk-based capital analysis.

Title: Valuation and Hedging of Variable Annuities in Pension Schemes

Authors: *Servaas van Bilsen* and Lans Bovenberg

This paper explores defined ambition pension schemes that provide (deferred) variable annuities to participants of a mutual insurer. These pension schemes allocate the various risks (i.e., interest rate, expected inflation and stock market risk) to the participants on the basis of complete contracts. We show how these variable annuities can be valued on the basis of market prices without model risk and how the mutual insurer can adopt the principle of liability-driven investment in the presence of stochastic liabilities. Market-consistent pricing is important for ensuring generational fairness and avoiding conflicts between the participants of the mutual insurer. We show that the costs of variable real annuities may be less sensitive to nominal interest rates than the costs of fixed nominal annuities, thereby reducing nominal interest-rate hedging. This is especially so if equity risk premia are stochastic and the lack of real assets causes financial markets to be incomplete.

Biography: Servaas van Bilsen is completing his PhD at Tilburg University on “Essays on Optimal Consumption and Portfolio Choice”. His research areas are in Pension Finance and Economics, Mathematical Finance, and Behavioral Economics.

Title: Valuing Variable Annuity Guarantees on Multiple Assets

Authors: *Jonathan Ziveyi* and Jose da Fonseca

Guarantees embedded variable annuity contracts exhibit option-like payoff features and the pricing of such instruments naturally leads to risk neutral valuation techniques. This paper considers the pricing of two types of guarantees; namely, the Guaranteed Minimum Maturity Benefit and the Guaranteed Minimum Death Benefit riders written on several underlying assets whose dynamics evolve under the influence of affine stochastic volatility processes. Within the standard affine framework for the underlying mortality risk, stochastic volatility and correlation risk, we develop the key ingredients to perform pricing of such guarantees. The affine nature of the model implies that the corresponding characteristic function for the

state variables is known in a closed form. We illustrate the methodology for two possible payoffs for the guarantees whose Fourier transforms are computed and combined with the characteristic functions so that resulting prices can be obtained through numerical integration. Using typical values for the parameters, an implementation of the model is provided and underlines the significant impact of the assets correlation structure on the guarantee prices.

Biography: Jonathan Ziveyi is a senior lecturer in the School of Risk and Actuarial Studies at UNSW Business School. He received his PhD in Quantitative Finance from the University of Technology Sydney where his thesis was on the evaluation of early exercise exotic options. His current research interests include longevity risk management, valuation of guarantees embedded in variable annuities, option pricing under stochastic volatility and modelling of high frequency financial markets data. His research output has been published in esteemed quantitative finance and actuarial journals such as *Insurance: Mathematics and Economics*, *Quantitative Finance* among others and has been presented at various international conferences.