Final Report

Title: Fair Valuation of Modern Insurance Products Under GARCH-type Models: From Market Risk to Mortality Risk

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1. Achievements and Research Findings:

The progress of the project went well. We have obtained a number of interesting research outcomes which have given rise to several research papers. We have also made known our research results to a wider community including professional actuaries, academics and market practitioners by presenting them at the 2011 Australasian Actuarial Education and Research Symposium at Australian National University in December 2011, which was jointly sponsored by IAAust. Two major research results are summarized here.

(a) We have developed a new and practically useful model for pricing equity-linked annuities in the context of a class of Threshold GARCH (TGARCH) models. This class of models can incorporate two major stylized features of the empirical behaviour of long-term investment returns from equity indices, namely, conditional heteroscedasticity and regime switches. The conditional Esscher transform was used to develop the pricing methodology which provides a convenient way to select a pricing kernel and can be justified by some economic equilibrium arguments. We provide a comprehensive empirical analysis of the proposed pricing model and illustrate the practical implementation of the model based on simulation examples.

(b) We have developed a generalized GARCH-based stochastic mortality model with a view to incorporating conditional heteroscedasticity and conditional non-normality. These empirical features of mortality data are largely overlooked in a number of existing literatures in stochastic mortality modelling. To describe conditional non-normality, we adopt a double-exponential distribution which is capable of incorporating both the conditional skewness and heavy-tailedness features. For the practical implementation of our proposed model, we propose a user-friendly two-stage estimation scheme to estimate the unknown parameters of the double-Exponential GARCH-based mortality model, where at the first stage we employ the Quasi-Maximum Likelihood Estimation (QMLE) to estimate the GARCH structure while at the second stage we adopt the MLE to estimate the unknown parameters of the double Exponential distribution using residuals as input data. We also examine the forecasting performance of the proposed model and compare it with other models. We find that the double-Exponential GARCH model provides a reasonably good forecasts for future mortality developments.
2. Research Outputs and Their Dissemination:

Please find a list of research papers and their dissemination which are fully or partially supported by the grant as follows:

(a) Celeste Chai, Tak Kuen Siu and Xian Zhou (2012) Valuation of EIAs with the Threshold GARCH model. Submitted to a C1 Journal and Presented at the Australasian Actuarial Education and Research Symposium jointly organized by IAAust and ANU.