Modelling the 1-in-200 Risks

Peter Ulrich and Chris Ordowich outline how solvency capital requirements compare using RMS scenario-based models versus the Solvency II standard formulas

20 AUGUST 2012 | PETER ULRICH AND CHRIS ORDOWICH

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Estimating economic capital for extreme risks is a key part of managing life insurance portfolios. In Europe, insurers are currently calibrating internal models in preparation for Solvency II compliance. Tail risks of life catastrophe arise from extreme events, such as pandemics or terrorist attacks. Because such events are rare, recent mortality experience data doesn't help with estimating the risk from future extreme events.

The extreme uncertainty limits of longevity risk arise from potential future developments in medical science, such as rapid progress in the management of cancer. Scientifically-based models can simulate the causes of extreme loss and provide the ability to quantify and understand these risks.

After market risk, the largest risk to life insurance undertakings under Solvency II is underwriting risk.[1] RMS recently conducted an analysis of Solvency II mortality-related risks focusing on four key life underwriting risks: life catastrophe, longevity, mortality, and the correlation between mortality and longevity risk. This analysis provides guidance on how risk capital requirements can vary for a representative but hypothetical UK life insurer (Sample Co.) utilising the RMS scenario-based models. These results are specific to Sample Co. and should not be generalised as they will vary depending on the size of the company, mix of business, geographic spread, and characteristics of the books of business.

Life Catastrophe: Life catastrophe risk is defined under Solvency II as risk that "stems from extreme or irregular events." There have been no recent UK life catastrophes, but events such as the 9/11 terrorist attack on New York in September 2001 and the 2009 influenza 'Swine Flu' pandemic, demonstrate that mass-fatality events can occur at any time.

We analysed life catastrophe risk to two Sample Co. portfolios: group life and whole life. The Solvency II standard formula for life catastrophe risk is the change in net asset value due to a mortality rate shock of 1.5 per 1000. The modelled loss rate at the 99.5th percentile considering these two books together is 0.9 per 1000, about 60% of the standard formula. The majority of this risk is driven by infectious disease but there is also material terrorism risk to the group life portfolio that depends on the clustering of that company's policies around potential terrorist targets. Illustrative Sample Co. 99.5th percentile life catastrophe scenarios include a recurrence of a virus with characteristics similar to the 1918 Spanish Flu or a large truck bomb detonated in Canary Wharf, London.

This 1-in-200 life catastrophe loss is specific to Sample Co. and will vary significantly for other companies. To test the sensitivity of these results, we varied the characteristics of Sample Co.'s life books within plausible ranges and recalculated probabilistic losses. Figure 1. illustrates the potential distribution of losses at the 99.5th percentile.

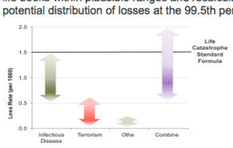

Figure 1: Life Catastrophe Loss Rate Sensitivity

Longevity and Mortality: We quantify longevity and mortality risk by modelling the causes of mortality improvement. This is a refinement of statistical projection models, which extrapolate past mortality trends into the future. A 'cause of improvement' approach uses an understanding of recent and historical drivers of change to structure projections of future mortality improvement, incorporating additional information about medical progress and lifestyle changes. The model generates scenarios of future mortality improvement driven by five vitagion categories including: Lifestyle, Medical Intervention, Health Environment, Regenerative Medicine, and Retardation of Ageing. See Figure 2.

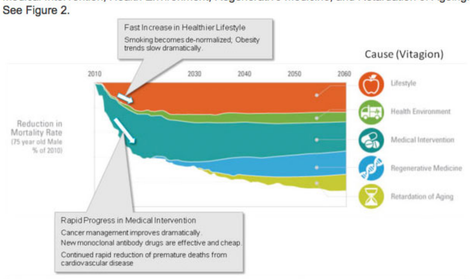

Figure 2: Illustrative Scenario of the 1-in-200 Level of Longevity Risk

We calculated the longevity Solvency II capital requirements for Sample Co's annuity portfolio using both the standard formula and our modelled loss distribution. The standard formula 99.5th percentile annualised increase in liability based on a 20% permanent decrease in mortality rates was about 5 percent. Using our Longevity Risk Model, we calculated the increase in liabilities to be about 3 percent, or about 60% of the standard formula amount. A variety of mortality improvement paths could combine to produce this. One potential scenario is one in which we experience rapid reduction of cancer mortality due to our increased knowledge of the human genome and the use of sophisticated bio-informatics to develop small molecule drugs that control the biological processes associated with cancer.
We conducted similar analyses for mortality risk to Sample Co's life books and found the modelled capital requirement to be about 95% of the standard formula shock of a 15% permanent increase in mortality rates. Such a scenario could occur if improvements in healthcare outcome metrics slowed to below half of the rate of the past 20 years. This could result from stagnating National Health Service (NHS) budgets combined with slower adoption of healthier lifestyles in the UK.

Mortality-Longevity Hedge: Solvency II recognises an offset between mortality and longevity risks. The strength of this offset depends on the similarity between the life and annuity portfolios. Portfolios with similar age profiles in the same countries will have stronger correlations. Figure 3 shows sample scatter plots of simulated mortality and longevity present value outcomes for three pairs of life and annuity products illustrating the lower correlation for less similar products.

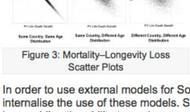

Figure 3: Mortality–Longevity Loss Scatter Plots

The Solvency II standard formula specifies a correlation of -25% between mortality and longevity to use when aggregating life underwriting risks. The modelled implied correlation at the 99.5th percentile of Sample Co.'s liability loss distribution is about -60%. However, this value can vary significantly depending on the country, age, gender, and other characteristics of the books of business. Sensitivities for these analyses are provided in our white paper.

In order to use external models for Solvency II, insurers must validate, document, and internalise the use of these models. Scenario-based models facilitate the process of validation by providing the ability to explore events at key points in the loss distribution. This allows users to understand what is driving losses at various risk levels. In addition, the ability of scenario-based models to provide risk estimates tailored to the specific traits of a company's business makes modelled results more actionable and thus more likely to be integrated into internal risk management processes. While the standard formula may only be used to estimate regulatory capital, modelled results could be used for a variety of other purposes, from underwriting to evaluating and pricing risk transfer options. This multi-use integration leads to a coherent risk management system.

The RMS study 'Mortality-Driven Risks: Calculating Capital Requirements for Solvency II' is available as a white paper: http://www.rms.com/liferisks/library/papers/

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