Overview of Longevity De-Risking and Longevity Risk Capital

Joint Networking Event
PRMIA and Actuarial Profession
17 December 2011

Emma McWilliam

Agenda

- Market Background on Longevity De-Risking
- Solvency II, Longevity Risk Capital and Diversification
- Benchmarking Assumptions
- Conclusions
“Governments must wake up to the cost of longevity”, argues UK think tank, ILC-UK

Pension Assets in OECD Countries 2011

Source: OECD Pension Market In Focus No.9, September 2012

Phoenix transfers £5bn annuity book to Guardian

Pension Corp hedges £300m in Munich Re deal

Swiss Re completes first longevity trend bond

BA completes £1.3bn buy-in with Rothesay Life

Aegon signs £12bn longevity swap with Deutsche Bank

Hannover reinsures L&G £1bn longevity swap

Prudential Financial signs pension transfer agreement with General Motors Co.

L&G buys £390m of reinsurance from RGA

Pacific Life completes £300m longevity reinsurance

JP Morgan hedges workers’ longevity risk

Verizon Sends $7.5 billion in Pension Funds to Prudential Financial

ITV signs £1.7bn pensions longevity deal

Rolls-Royce in £3 billion longevity swap with Deutsche Bank
The UK Insured Annuity Market

Total UK Mathematical Reserves for Annuities in Payment

Key Drivers for Insured Annuity Transactions

Key de-risking drivers have included:

- Capital efficiency and company restructuring
- Concerns over future improvements
- Economic capital
- Uncertainty over Solvency II

**BUT, Who continues to retain the risk?....**
Major Types of Insured Annuity Bulk Solutions

Bulk De-Risking Solutions

- Part VII Transfer (*Buy-out*)
- Single Premium Reinsurance (*Buy-in*)
- Longevity Reinsurance / Swap
- Longevity Bonds

Typical Risk-Takers

- Insurers / Reinsurers
- Insurers
- Reinsurers
- Capital Markets
- Reinsurers / Capital Markets

*Example Corporate Pension Scheme Risking Parallel Solution

Major Bulk Insured Annuity Transactions*

<table>
<thead>
<tr>
<th>Date</th>
<th>Risk From</th>
<th>Risk To</th>
<th>Size</th>
<th>Deal Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>Pension Insurance Corporation</td>
<td>Munich Re</td>
<td>£0.3 bn</td>
<td>Longevity swap</td>
</tr>
<tr>
<td>2012</td>
<td>Phoenix</td>
<td>Guardian Financial Services</td>
<td>£5 bn</td>
<td>Part VII Transfer**</td>
</tr>
<tr>
<td>2012</td>
<td>Aegon</td>
<td>Deutsche Bank</td>
<td>Notional £12 bn</td>
<td>Longevity swap</td>
</tr>
<tr>
<td>2011</td>
<td>Legal &amp; General</td>
<td>RGA</td>
<td>£0.4 bn</td>
<td>Longevity swap</td>
</tr>
<tr>
<td>2011</td>
<td>Rothesay Life / Paternoster</td>
<td>Prudential Retirement</td>
<td>£0.5 bn</td>
<td>Longevity swap</td>
</tr>
<tr>
<td>2011</td>
<td>Rothesay Life / Paternoster</td>
<td>RGA</td>
<td>£1.1 bn</td>
<td>Longevity swap</td>
</tr>
<tr>
<td>2010</td>
<td>Rothesay Life</td>
<td>PacLife Re</td>
<td>£0.3 bn</td>
<td>Longevity swap</td>
</tr>
<tr>
<td>2010</td>
<td>Paternoster</td>
<td>Rothesay Life</td>
<td>£2.8 bn</td>
<td>Part VII Transfer</td>
</tr>
<tr>
<td>2010</td>
<td>Swiss Re</td>
<td>Kortis</td>
<td>£0.05 bn</td>
<td>Longevity Bond</td>
</tr>
<tr>
<td>2009</td>
<td>Credit Suisse</td>
<td>PacLife Re</td>
<td>£0.3 bn</td>
<td>Longevity Swap</td>
</tr>
<tr>
<td>2009</td>
<td>Rothesay Life</td>
<td>PacLife Re</td>
<td>£0.5 bn</td>
<td>Longevity Swap</td>
</tr>
<tr>
<td>2009</td>
<td>Aviva</td>
<td>RBS/Partner Re</td>
<td>£0.5 bn</td>
<td>Longevity Swap</td>
</tr>
<tr>
<td>2008</td>
<td>Abbey Life</td>
<td>PacLife Re plus others</td>
<td>£1.3 bn</td>
<td>Longevity Swap</td>
</tr>
<tr>
<td>2008</td>
<td>Friends Provident</td>
<td>Swiss Re</td>
<td>£1.7 bn</td>
<td>Reinsurance</td>
</tr>
<tr>
<td>2008</td>
<td>Standard Life</td>
<td>Canada Life</td>
<td>£5.7 bn</td>
<td>Reinsurance</td>
</tr>
<tr>
<td>2008</td>
<td>Canada Life</td>
<td>JP Morgan</td>
<td>£0.5 bn</td>
<td>Longevity Swap</td>
</tr>
<tr>
<td>2008</td>
<td>Lucida</td>
<td>JP Morgan</td>
<td>£0.1 bn</td>
<td>Longevity Swap</td>
</tr>
</tbody>
</table>

*Based on press releases only, excludes private transactions. **Planned Part VII transfer
Agenda

- Market Background on Longevity De-Risking
- Solvency II, Longevity Risk Capital and Diversification
- Benchmarking Assumptions
- Conclusions

SII: Standard Formulae Longevity Stress

- 1-in-200 standard stress is 20% immediate and permanent reduction in annuitant mortality (QIS 5: 20%, QIS 4: 25%)
- Longevity tail “events” arguably manifest themselves via a long term increase in mortality improvement rates, rather than one-off shock
- Internal models will consider shocks to both the level and trend of mortality rates (and volatility)
REVEAL™ Case Study

- Case study of 50,000 annuitants using longevity risk projection system, REVEAL™, to illustrate relative size of SCR and risk margin for longevity:

Under the stochastic “Internal Model” approach taken in the case study, the resulting longevity capital requirement was over 10% lower than under the Standard Formula requirement.

Illustration: SCR for Monoline Annuity Writer*

- Typical key risks for monoline annuity writers are:
  1. Widening of credit spreads
  2. Longevity

- Under standard formulae, longevity risk capital component increases as a % of total SCR as lives in the portfolio get older

- Diversification benefit is likely to be around 30% for a firm with a balanced annuitant age profile

*Assumes no new business for ease of illustration

Source: Milliman case study: Modelling Longevity Risk under Solvency II
**Solvency II: Standard Formulae Diversification**

**Latest Draft SII Life U/W Module Correlation Matrix**

<table>
<thead>
<tr>
<th></th>
<th>Mortality</th>
<th>Longevity</th>
<th>Disability</th>
<th>Life expense</th>
<th>Revision</th>
<th>Lapse</th>
<th>Life catastrophe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>1</td>
<td>-0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0</td>
<td>0</td>
<td>0.25</td>
</tr>
<tr>
<td>Longevity</td>
<td>-0.25</td>
<td>1</td>
<td>0</td>
<td>0.25</td>
<td>0.25</td>
<td>0</td>
<td>0.25</td>
</tr>
<tr>
<td>Disability</td>
<td>0.25</td>
<td>0</td>
<td>1</td>
<td>0.5</td>
<td>0</td>
<td>0.25</td>
<td>0</td>
</tr>
<tr>
<td>Life expense</td>
<td>0.25</td>
<td>0.25</td>
<td>0.5</td>
<td>1</td>
<td>0.5</td>
<td>0.5</td>
<td>0.25</td>
</tr>
<tr>
<td>Revision</td>
<td>0</td>
<td>0.25</td>
<td>0</td>
<td>0.5</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lapse</td>
<td>0</td>
<td>0.25</td>
<td>0</td>
<td>0.5</td>
<td>1</td>
<td>0.25</td>
<td>0</td>
</tr>
<tr>
<td>Life catastrophe</td>
<td>0.25</td>
<td>0</td>
<td>0.25</td>
<td>0.25</td>
<td>0</td>
<td>0.25</td>
<td>1</td>
</tr>
</tbody>
</table>

- Range of approaches exist on economic capital / internal model basis

**Optimising Risk Capital Through Product Mix**

- A significant volume of term business can be written with minimal or Life U/W capital requirement and vice versa

**Stand Alone vs Marginal Capital Increase**

- Marginal increase in capital requirement
- Standalone increase in capital requirement

Source: Milliman analysis
Agenda

- Market Background on Longevity De-Risking
- Solvency II, Longevity Risk Capital and Diversification
- Benchmarking Assumptions and Assessing Risk
- Conclusions

Pillar 1 Longevity Bases Benchmarking YE 2011

- Increasingly, annuity writers are using CMI projections for P1 valuations
- Best estimate assumptions typically set using a combination of approaches (e.g. analysis of own / industry / population experience) and blending using credibility theory (e.g. LCFT) as well as comparing to reinsurance rates
- Stochastic models such as P-Spline, Lee Carter models (eg APC) and CBD are used to understand potential range of outcomes
Benchmarking to Past Improvements

- Comparing implied equivalent annualised improvements can offer additional insight

**Equivalent Annualised Average Historical E&W Population Improvements by Age and Period up to 2010**

- Historical Average Annual Improvement Rate (%)
- Age: 55, 60, 65, 70, 75, 80, 85, 90
- Source: Milliman Analysis based on ONS raw data to 2010

Communicating Range of Outcomes

- Narrative scenario based stresses help to contextualise potential impact of range of medical advancements
- Own Risk and Solvency Assessment (ORSA) by Boards
- Capital Market Investors to understand potential downside

**Major Cause of Death by Age Group**

- Source: ONS, Milliman analysis

© Milliman Copyright 2012
Reasonableness of Stresses to be Tested

Equivalent Flat Uplifts to Future Improvements for Selected Cause of Death Elimination

- “1-in-200” Solvency II Longevity Risk Stress is broadly equivalent to the immediate elimination of approximately 65-75% deaths from Heart Disease

Conclusions

- The search for capital efficient de-risking solutions continues and these are increasingly critical to maintaining competitiveness
- Solvency II will impact the longer term capital requirements of annuity writers and active lobbying will continue
- There is an increased focus on robust processes for best estimate and stressed longevity assumptions
- The use of cause of death analysis enables the risks to better understood by management and investors
- Economic capital models for longevity risk are becoming increasingly sophisticated and are potentially diverging from Solvency II requirement to create own standard.
This presentation has been prepared for illustrative purposes only. It should not be further distributed, disclosed, copied or otherwise furnished to any other party without Milliman’s prior consent.

No reliance should be placed on the results or graphs presented herein and no inference made about the appropriateness of the different bases presented. In particular, independent verification and professional advice should be sought when establishing company bases and assumptions for the purposes of pricing, valuation and transaction purposes etc.

Actual experience may be more or less favourable than the assumptions and illustrations presented in this presentation. To the extent actual experience differs from these, so will actual results differ from those presented.

Emma McWilliam
emma.mcwilliam@milliman.com