Longevity risk: a pension-scheme perspective

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1. About the speaker
1. About the speaker

- Consultant on longevity risk since 2005.
- Founded longevity-related analytics businesses in 2006:

  ![Longevitas](longevitas.co.uk)

  ![Mortality Rating](mortalityrating.com)

- Joint venture with Heriot-Watt in 2009:
2. Enhanced annuities
2. Enhanced annuities

- Should a scheme buy enhanced annuities for members in ill health?
2. Enhanced annuities

- Enhanced annuities give better rates for lives with shorter life expectancy.
- This market works well for individuals.
- Some companies market this as a way of reducing scheme liabilities.
- Unfortunately, this is often an illusion…
2. Enhanced annuities

- Consider a scheme of ten male lives aged 65.
- Mortality follows 100% of S1PA in aggregate.
- Scheme reserve is £671,000†, i.e. £67,100 for each life on average.

† £5,000 pension p.a., paid continuously and discounted at 3% p.a. No mortality improvements.
2. Enhanced annuities

- Assume that nine lives are healthy and follow 90% of S1PA.
- The tenth life is unhealthy and follows 262% of S1PA†.
- An enhanced annuity is purchased for the unhealthy life for £47,200.

† Life expectancy at 90% of S1PA is 18.9 years, while at 262% of S1PA it is 11.6 years.
2. Enhanced annuities

- Superficially, the scheme appears to have saved nearly twenty thousand pounds on this one member (£19,900 = £67,100 - £47,200).
- This appears to save around 3% of scheme liabilities (3.0% = £19,900 / £671,000).
2. Enhanced annuities

- The “saving” is an illusion.
- The remaining nine members are healthier than the old basis.
- Aggregate mortality is now 90% of S1PA, not 100%.
- The reserve for each of the remaining nine members therefore climbs from £67,100 to £69,300.
- The scheme reserve is now around £623,700 \((=9 \times £69,300)\).
- The difference between this and the starting reserve is £47,300, i.e. essentially the premium paid to the life insurer.
2. Enhanced annuities

- If both the insurer and the pension scheme are properly reserving, there is negligible benefit from selectively buying out ill-health lives.
- The scheme is under-reserved if it doesn’t strengthen its basis after such an exercise.
- Also, the mere fact that a scheme has conducted such an exercise can result in buy-out providers refusing to quote.
3. Individual risk
3. Individual risk

- What proportion of scheme liabilities are in a small number of hands?
- How does this drive risk?
- Should a scheme buy annuities for members with large benefits?
3. Concentration of risk

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Number of Members</th>
<th>Members with half of total pension</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>38</td>
<td>4</td>
</tr>
<tr>
<td>H</td>
<td>790</td>
<td>98</td>
</tr>
<tr>
<td>C</td>
<td>5,272</td>
<td>328</td>
</tr>
</tbody>
</table>

Largest scheme (C) pays 50% of all pensions to just 6% of members.

Source: Richards Consulting calculations using Prudential data.
3. Individual risk

- What impact does concentration have on scheme risk?
- What risk is posed from who dies when?
- What margin should be held to be confident of paying all benefits?
3. Individual risk

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Safety premium*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>75%</td>
</tr>
<tr>
<td>E</td>
<td>15.1%</td>
</tr>
<tr>
<td>H</td>
<td>4.0%</td>
</tr>
<tr>
<td>C</td>
<td>2.1%</td>
</tr>
</tbody>
</table>

Law of large numbers favours schemes with more members.

Source: Richards Consulting calculations using Prudential data.

*Safety premium is the extra funds above average in 10,000 simulations to ensure given probability of meeting all benefits in run-off according to S1PA without any future improvements. Benefit cashflows discounted at 3% per annum.
3. Individual risk

- Small pension schemes should buy out.
- Bigger schemes can reduce risk by buying out members with large benefits.
- For example, Scheme H’s 90% safety premium would fall from 8.3% to 4.4% if benefits were all equal.
4. Trend risk
4. Trend risk

- How much should a scheme reserve for trend risk?
4. Trend risk

- At the risk of stating the obvious, the future is unknown.
- This applies as much to mortality rates as to the level of the FTSE-100.
4. Mortality projections in the 20th Century

- Historically actuaries relied on deterministic scenarios.
- Often rates or improvements blending to a long-term value.
- Such models are called *expectations*.
- Cannot say how likely or unlikely such scenarios are.
- The CMI model is expectation-driven.
4. Mortality projections in the 21st Century

- Measuring uncertainty is now a key part of insurer regulations.
- A stress test ideally has a probability attached to it.
- Such tests and probabilities come from *stochastic projections*.
4. An illustration — back-testing

- Take a long data series.
- Discard latter years and fit projection model.
- Compare projected rates with what actually happened.

More on back-testing can be found on our blog
4. Back-testing: fit model to data to 1992

Source: Longevitas Ltd. ONS data, CMIR17
4. Back-testing: compare projections to actual data

Source: Longevitas Ltd. ONS data, CMIR17
4. Back-testing: data v. confidence intervals

![Graph showing the force of mortality at age 70 from 1960 to 2000, comparing observed mortality, Lee-Carter model, CMIR17 projection, and Lee-Carter 95% confidence intervals.]

Source: Longevitas Ltd. ONS data, CMIR17
5. Model risk
5. Model risk

- Confidence intervals show uncertainty about central projection
- What about uncertainty over the model?
- What if the projection model is not the right one?
5. Similar projections, different uncertainty

Source: Richards and Currie (2009), Figure 6
5. Different projections and intervals

Source: Richards and Currie (2009), Figure 5

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6. Conclusions

- Buying enhanced annuities often doesn’t help scheme finances.
- However, buying out large benefits *can* reduce risk.
- Stochastic models tell you about the impact of uncertainty.
- Never rely on just one projection model!
References

CMIB (Continuous Mortality Investigation Bureau) 1999 Report Number 17, Institute and Faculty of Actuaries

Richards, S. J. and Currie, I. D. 2009 Assessing longevity risk and annuity pricing with the Lee-Carter model, Faculty of Actuaries Sessional Meeting Paper, February 2009

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