Recent Changes in Longevity and their Implications for the Insurance Sector

Daria Ossipova – Head of Longevity and Health R&D; SGL Chief Pricing Officer (interim)
Longevity risk

Historically, scientists have not foretold the continuous increase in average life expectancy

- Historically, numerous experts assumed there was a limit to the average human life expectancy (represented by horizontal lines); observations proved them wrong
- Over the past 150 years life expectancy has increased by one trimester every year on average

Experts have often underestimated progress in longevity

Life expectancy at 65 has started to change significantly only recently

Age components of changes in life expectancy in France

Insurance Industry realized the importance of longevity risk only in the 21 century…
The size of the potential market for longevity transfers is considerable, hence reinsurers must cautiously use their capabilities.

A vast longevity risk transfer potential

- 10 largest private pension fund schemes by asset size (in USD trillions)¹)

<table>
<thead>
<tr>
<th>Country</th>
<th>Asset Size (USD trillions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>~14.5</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2.5</td>
</tr>
<tr>
<td>Australia</td>
<td>1.8</td>
</tr>
<tr>
<td>Canada</td>
<td>1.5</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1.3</td>
</tr>
<tr>
<td>Japan</td>
<td>0.8</td>
</tr>
<tr>
<td>Switzerland</td>
<td>0.4</td>
</tr>
<tr>
<td>Germany</td>
<td>0.3</td>
</tr>
<tr>
<td>Mexico</td>
<td>0.3</td>
</tr>
<tr>
<td>Chile</td>
<td>5</td>
</tr>
</tbody>
</table>

- Considering approximately 60% of these pension funds are on defined benefits, a total of ~$16,000 billion carry longevity risk

- Throughout the past decade, about $200 billion obligations were transferred to the UK, and about $70 billion to the USA.

An existing longevity reinsurance market in the UK and North America

- Insurance solutions in amount of insured obligations (in USD billions)

<table>
<thead>
<tr>
<th>Year</th>
<th>United Kingdom</th>
<th>United States</th>
<th>Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2006</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2007</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2008</td>
<td>14</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2009</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>2010</td>
<td>14</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>2011</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>2012</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>2013</td>
<td>57</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>2014</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2015</td>
<td>31</td>
<td>31</td>
<td>31</td>
</tr>
</tbody>
</table>

- **United Kingdom**: Transactions covering all risks (buy-out or buy-in) or simply biometric (swap)

- **United States**: Transactions covering all risks (buy-out or buy-in)

- **Canada**: Recent swap transactions

¹) Source: Citi GPS : “The coming pension crisis” - Mars 2016)
UK longevity risk – where is it?

- UK has a long history of Defined Benefit pension schemes (usually Final Salary linked pensions) offered by employers.

- E.g. typical scheme offers pension equal to:
  - \( \text{(years of service) X Final salary / 60} \)

- **Approx. £2trillion of DB pensions liabilities**

- Over last couple of decades, shift to Defined Contribution (‘money purchase’) pensions

- **Approx. £0.5trillion of DC in-payment annuity liabilities**

- Both sources present opportunities for longevity reinsurance.
UK - Longevity Market Structural Overview

- Customer
  - Defined Benefit Pension Scheme
  - Defined Contribution Scheme
  - Bulk Annuity Insurer
  - Insurer (standard health annuity)
  - Insurer (underwritten annuity)

- Retailer
  - Investment Bank

- Packager
  - Capital Market Investor

- Wholesaler
  - Reinsurer
Reinsurance: Bulk annuity vs Swap

Swap

<table>
<thead>
<tr>
<th>Pension Scheme</th>
<th>Insurance Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular Claims (Actual annuities)</td>
<td>Regular Premiums (Expected annuities + margin)</td>
</tr>
</tbody>
</table>

Bulks annuity

<table>
<thead>
<tr>
<th>Pension Scheme</th>
<th>Insurance Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular Claims (Actual annuities)</td>
<td>Single Premium paid on day 1</td>
</tr>
</tbody>
</table>

Only longevity risk transferred

Longevity and asset risk transferred

Reinsurance is *usually* a swap for 100% QS of the longevity risk only regardless of whether the original risk transfer is a bulk annuity or swap.

Common terminology for bulk annuities:
- *Buy-in* – A bulk annuity bought and held by a pension scheme as an asset
- *Buy-out* – A bulk purchase of individual annuities distributed to pension scheme members
Reinsurance pricing

Reinsurance price = Best Estimate liabilities + Cost of capital + Expenses

Uncertainty linked to longevity risk components & operational risk

L - mortality level

T - mortality trend
Longevity risk is composed of 3 components; trend is the most material

- **Trend risk**: Risk that mortality rates improve faster than expected
- **Level risk**: Risk of an inaccurate assessment of current mortality rates
- **Volatility risk**: Risk of volatile mortality rates due to insufficient mutualisation, heterogeneous portfolio

\[
\text{Longevity risk} = \text{Trend risk} + \text{Level risk} + \text{Volatility risk}
\]
Volatility: influence of portfolio heterogeneity

### Pension amount

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>3,180</td>
<td>4,348</td>
<td>5</td>
<td>91,188</td>
</tr>
<tr>
<td>Males</td>
<td>4,463</td>
<td>5,416</td>
<td>5</td>
<td>75,013</td>
</tr>
</tbody>
</table>

### Distribution of amounts

- 1% of the highest pensions account for 8% of the total volume
- 5% of the highest pensions account for 27% of the total volume
- 10% of the highest pensions account for 41% of the total volume
L - mortality level component: influence of portfolio heterogeneity

- Split the portfolio into homogeneous sub-groups:
  - Generally pension size is a good proxy to social class,
  - Keep the number of subgroups limited in order to maintain results significant,
  - Check against external datasets (ex. mortality by postcode).

- Example: 5 subgroups based on pension size. A/E ratio in lives and in amounts

<table>
<thead>
<tr>
<th>Pension size</th>
<th>A/E (lives)</th>
<th>A/E (amount)</th>
<th>Nb of deaths</th>
<th>Exposure (lives)</th>
<th>Exposure (amount)</th>
<th>% total (lives)</th>
<th>% total (amount)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 3 749</td>
<td>114%</td>
<td>112%</td>
<td>1 812</td>
<td>56 189</td>
<td>85 mln</td>
<td>67%</td>
<td>26%</td>
</tr>
<tr>
<td>3 750 – 7 499</td>
<td>98%</td>
<td>98%</td>
<td>263</td>
<td>15 220</td>
<td>81 mln</td>
<td>18%</td>
<td>24%</td>
</tr>
<tr>
<td>7 500 +</td>
<td>88%</td>
<td>85%</td>
<td>158</td>
<td>11 891</td>
<td>165 mln</td>
<td>14%</td>
<td>50%</td>
</tr>
<tr>
<td>0 – 2 999</td>
<td>101%</td>
<td>102%</td>
<td>665</td>
<td>26 978</td>
<td>31 mln</td>
<td>73%</td>
<td>31%</td>
</tr>
<tr>
<td>3 000 +</td>
<td>86%</td>
<td>72%</td>
<td>115</td>
<td>9 879</td>
<td>70 mln</td>
<td>27%</td>
<td>69%</td>
</tr>
</tbody>
</table>
T - Trend: Drivers of mortality are evolving

Historical demographic regimes
- Prevalence of infectious diseases
- Significant fluctuations due to epidemics, famines (bubonic plague - mid. XIV century)
- High mortality

Receding of infectious pandemics
- The epidemics become rare
- Infectious diseases back off
- Mortality declines, fluctuations decrease

Cardio-vascular revolution
- Reduction infectious diseases contribute little to the increase of life expectancy
- Cardio-vascular diseases become the main driver of mortality decrease
- Society diseases make less deaths

A new stage?
- Mortality reductions at increasingly older ages
- Treatment and prevention of cerebrovascular diseases
- Greater attention paid to the health of the elderly

Not all countries undergo the stages at the same time, speed, or even order
T- Trend. A combination of advanced quantitative and qualitative analysis methods is needed to evaluate longevity risk.

Trends by cause of death

Mortality improvements based on age/birthyear

Qualitative analysis: understanding the numbers

Numerical analysis: determining the factors of change
More complex methods are being developed to include informed judgments

- We decompose the mortality into CoD proportions and CoD mortality densities.
- This approach offers better performance and interpretability.

Working with CoD proportions and mortality densities provide high flexibility for Expert Judgments inclusion on CoD mortality dynamics. Below two examples:

1. Include the impact of an invention of vaccines or effects resulting from epidemics, by adding a constraint to the CoD proportion
2. Include the impact of new medical treatment delaying the age at death for a CoD, by shifting the density towards the right
Recent UK mortality improvements were lower than expected

Males mortality rates observed\(^1\) and projected

Key questions raised by the recent observations

- Is this phenomenon a coincidence or a structural change?
- What are the main reasons for this slowdown in Mortality Improvements?
- Does it impact our longevity book in the same manner as the national population?
- How should we reflect the recent observations in our best estimate (future and past improvements)?

This disruptive phenomenon requires the industry to challenge our view on the UK longevity.

\(^1\) Source: ONS
Analysis by Cause of Death

SMR\textsuperscript{1} by cause, persons aged 75+, E&W, 2001-2015

Most of the large gains in improvements between 2001 and 2010 were caused by the reduction in Circulatory deaths. Their proportion in total deaths is much lower now so further improvements can not make such significant impact any more in population mortality.

Dementia and Alzheimer’s disease experienced an increase in the past years, however this is partly caused by the aging population and changes in diagnosis practices (e.g. some mental illnesses were classified as Circulatory or Respiratory disease before).

Cancer and other causes remained on a similar level in the past 15 years.

There is no clear explanation on the improvements slowdown when looking at causes of deaths.

1) Age-standardised mortality rate
Behind the trend change: a structural issue

Winters partially explain the slowdown of mortality improvements

- In the 2012/2013 winter, mortality has been driven by the unusual length of the cold spell.
- The 2014/2015 winter was not unusually cold but the high mortality is believed to have been driven by the lower efficiency rate of the flu vaccine.

But they hide a bigger structural factor

- The early 2017 deaths figures (even if very provisional) show similar high mortality to the 2015 figures.
- Increasing mortality in the past five years is driven by the oldest age groups (85+).
- Whereas the opinion was split in the past, the industry now agrees that the recent slowdown is very unlikely to be a blip.
- The majority seems to point towards the NHS structural struggles such as the lack of funding and the clogged A&E during winter epidemics.

The slowdown seems to be a consequence of general population aging and the difficulties of the National Health System rather than the winters themselves.
The increasing needs of an ageing population

The population is getting older … … and costs multiply with age

The health and social care costs are increasing due to the ageing of the population.

1) Source: Health at Glance: Europe 2016, OECD
2) Source: February 9th & 10th 2017 Webinar, AON Hewitt
The funding of health and social care has become insufficient

A stagnating NHS budget …

... and decreasing social care spending

The evolution of the care spending is not matching the increasing needs of the ageing population.

Source: February 9th & 10th 2017 Webinar, AON Hewitt:
Office for National Statistics (ONS) 2014-based projections
Office for Budget Responsibility (OBR)
Fiscal Sustainability Report 2017
What is the Index of Multiple Deprivation?

An index of the Office of National Statistics allowing the ranking of the 32,844 neighbourhoods in England according to the following factors:

- Income: 23%
- Employment: 23%
- Education: 14%
- Health: 14%
- Crime: 9%
- Living environment: 9%
- Barriers to housing & services: 9%

The Office of National Statistics splits the published national deaths and exposures by decile of deprivation over 2001-2015.

1) UK Self-Administered Pension Schemes experience gathered by the Institute of Actuaries
2) Deprivation index calculated by the ONS
IMD geographical distribution across England

1) UK pension scheme experience gathered by the Institute of Actuaries
2) Deprivation index calculated by the ONS
2001-2015 UK Mortality Dynamics by Area

ONS is the national population mortality, i.e. aggregation of IMD1 to 5.

Flat line indicates that the subpopulation has similar trend to the national population. Increasing/decreasing line indicates that the subpopulation experiences lower/higher mortality improvements than the national population.

The graph relates to the female population, although the same observation applies to males.

The gap between the least and the most deprived has been widening over 2001-2015.
Overview of competitive landscape in UK - 2018

- Reinsurance transactions in excess of £30bn expected in the UK in 2018

- Virtually all reinsurers are pricing in lower improvement assumptions in the UK compared to 12-18 months ago – some more aggressively than others
  - Increased spread of reinsurer pricing than seen in past years
  - Winning line is back at 4-5% margin for mid to higher duration deals and 3-4% for low duration

- Some reinsurers continue to opportunistically look at asset plus longevity deals
THANK YOU!