Annuities: South African Challenges

Dipa Dass and Dr Sven Wiesinger
Hannover Re
Agenda

1. Hedging longevity risk

2. Estimating longevity
   i. Data available
   ii. Base mortality & mortality improvements

3. Conclusion
Introduction

• Pension liabilities held by pension funds, corporates or insurance companies

• Substantial longevity risks can be held outside of the insurance industry

• Corporates, insurers and pension funds often seek to lay off parts of the risks inherent in the liabilities
Longevity hedges: pension funds

• Buy-out
  • Assets and liabilities are transferred to an insurer
  • Scheme wound up
  • Insurer responsible for transferred risks

• Buy-in
  • Assets are used to buy an insurance policy
  • Longevity risk and a portion of the inflation and investment risks are transferred to the insurer

• Longevity swap
  • Pension fund retains the assets, pure longevity risk is transferred to the insurer
  • Regular exchange of premium and claims
Swap mechanics

- Insurer receives difference, if > 0
- Reinsurer receives difference, if < 0

Expected amount/number of survivors (fixed leg)

Actual amount/number of survivors (variable/floating leg)
Longevity hedges: individuals

- Investment-linked living annuities (ILLAs)
- Guaranteed/conventional annuities
- Enhanced/impaired/underwritten annuities
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Estimating longevity

• Two components:
  • Base mortality
  • Mortality improvements

• Need extensive data
# Data: SA vs the UK

<table>
<thead>
<tr>
<th>South Africa</th>
<th>UK</th>
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</thead>
<tbody>
<tr>
<td>Population data sources: census, Stats SA</td>
<td>Population data sources: census, ONS</td>
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<tr>
<td>Insured population data sources: ASSA/CSI</td>
<td>Insured population data sources: IFA/CMI</td>
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<tr>
<td>1843: Seventeen Offices’ Table</td>
<td>1900 – 1920: Immediate annuitants</td>
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<td>Since 1924: continuous data collection</td>
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<td>1948: annuities with a guaranteed term; pensioners under life office pension schemes</td>
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Studies and tables: SA

- Insured population:

- General population:
Studies and tables: the UK

<table>
<thead>
<tr>
<th>Series Base Mortality Tables</th>
<th>Experience Period</th>
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<tbody>
<tr>
<td>&quot;S2&quot; series</td>
<td>2004-2011 experience from UK self-administered pension schemes</td>
</tr>
<tr>
<td>&quot;S1&quot; series</td>
<td>2000-2006 experience from UK self-administered pension schemes</td>
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<td>&quot;00&quot; series</td>
<td>1999-2002 experience from UK insurance companies</td>
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<tr>
<td>&quot;92&quot; series base mortality tables and projections</td>
<td>1991-1994 experience from UK insurance companies</td>
</tr>
<tr>
<td>&quot;80&quot; series base mortality tables and projections</td>
<td>1979-1982 experience from UK insurance companies</td>
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<tr>
<td>FA 1975-78</td>
<td>1975-1978 experience from UK insurance companies</td>
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<tr>
<td>A1967-70, A1967-70(5), PA(90), a(90)</td>
<td>1967-1970 experience from UK insurance companies</td>
</tr>
<tr>
<td>A1949-52</td>
<td>1949-1952 experience from UK insurance companies</td>
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<tr>
<td>a(55)</td>
<td>1946-1948 experience from UK insurance companies</td>
</tr>
<tr>
<td>A1924-29</td>
<td>1924-1929 experience from UK insurance companies</td>
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</tbody>
</table>
SA-specific challenges

Population Mortality Ratios: All provinces (males and females) relative to the Western Cape

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Longevity - base

• Two Components
  • Base mortality (today)
  • Mortality improvements (future dynamic)

• Base Mortality
  • Industry experience
  • Graduated tables
  • Own experience
  • For pension blocks: experience of underlying business

• … can be difficult enough on its own!

• Mortality Improvements
  • Main topic below
Mortality improvements: definition

- Definition: \( i_{x,t} := 1 - \frac{q_{x,t}}{q_{x,t-1}} \), where \( q_{x,t} \) is mortality rate for age \( x \), year \( t \)

- Example:
  - last year: \( q_{65,t-1} = \frac{1}{100} \)
  - this year: \( q_{65,t} = \frac{0.95}{100} \)
  - improvement: \( i_{65,t} = 1 - \frac{0.95}{1} = 0.05 = 5\% \)

- “Improvement of +5% means that mortality rate has become 5% better (lower)!”
One approach from the UK

- Lots of data => can use statistical analysis for projections
- **Example:** CMI-Tool, based on component decomposition

*Projection from CMI-Tool, 2012 version, “white-collar” males, using fixed Long Term Rate = 2%*
One suggestion for SA

• **Idea:** General structure based on two assumptions

• For illustration in this presentation: example situation

  • blue-collar pensions block
    (e.g. occupational pension for industry workers)

  • current base mortality is known
    but no indication for future dynamic
Assumption no. 1

• Longevity dynamics (medical situation, nutrition, support, education, ...) of well-off groups of population are similar between South Africa and the UK

• Consequence: For “white-collar” projection, need:
  • current “white-collar base mortality” for South Africa (industry data, own experience, ...)
    [example: use graduation from Annuitant Mortality 2001-2004 Report of CSI as white-collar mortality in 2004]
  • “white-collar improvement projection” to indicate future dynamic for this group
    [example: use CMI_2012 projection as illustrated before]
Structure: assumption no. 1

- Current Base Mortality (e.g. own experience, industry, ...)
- Projection for future mortality improvement dynamic in this group

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2014 Convention  knowing more  22-23 October, Cape Town
Comparison with blue-collar

• Ratio of “blue-collar” to “white-collar” mortality

((Example: UK ratio based on SAPS studies for “Self-Administered Pension Schemes” (CMI Bureau, Institute and Faculty of Actuaries, UK)))
Assumption no. 2

- Socio-Economic Development will significantly reduce South African “blue-collar” to “white-collar” discrepancy in mortality over the next 30 years

- [Example: Discrepancy will diminish to the ratio currently observed in the UK]
Structure: assumption no. 2

- Observed level of mortality in the Pensions Block
- Projected level of discrepancy remaining after 30 years of socio-economic development

mortality level

blue-collar

white-collar

2014
2044
Possible technical approach

• Have for each age group $x$ in our blue-collar group
  • $q_{x, 2014}$ (today’s base mortality, e.g. from experience data)
  • $q_{x, 2044}$ (2044 mortality, by construction with reference to white-collar projection)

• E.g. “geometric” approach: $i_x = 1 - 30 \sqrt[30]{\frac{q_{x, 2014}}{q_{x, 2044}}}$

(Produces improvements $i_x$ such that for each age $x$ we have $q_{x, 2044} = q_{x, 2014} \ast (1 - i_x)^{30}$.)
Structure: improvement dynamic

“Geometric” improvement dynamic (static improvements year-over-year)
Example: resulting numbers

- For the example pensions block: Geometric approach produces these annual improvements:

(Reverse-iterated improvements using the suggested structure and the “example” numbers illustrated before)
Example: sensitivities

- Consider the same approach but with other time frames replacing the “30 years” convergence period.

(Reverse-iterated improvements using the suggested structure and the “example” numbers illustrated before)
Structure: improvement dynamic

The choice of improvement dynamic may depend on the structure of the business under consideration.
Distributions of “age at death”

- Compare: Distribution of Numbers of Deaths (dx) using 2014-qx vectors

Projected Numbers of Deaths (based on period qx in 2014) from Initial Cohort of 10,000 Males aged 60
Distributions of “age at death”

- Compare: Distribution of Numbers of Deaths (dx) using projected 2044-qx vectors

**Projected Numbers of Deaths (based on period qx in 2044)**
from Initial Cohort of 10,000 Males aged 60
Historical evidence

• Sustained high-level mortality improvements have appeared before

• Typical for periods of pronounced socio-economic development
  • East Germany: “catch-up” after Re-Unification
  • Spain after 1950: “Spanish Miracle”
  • Taiwan throughout 2nd half of 20th century
Historical evidence

Mortality Improvements for East German Males

(based on data from the Human Mortality Database (HMD, www.mortality.org))
Historical evidence

(based on data from the Human Mortality Database (HMD, www.mortality.org))
Historical evidence

Mortality Improvements for Taiwanese Females

(based on data from the Human Mortality Database (HMD, www.mortality.org); development already started before 1973, but we don’t have earlier data)
General worldwide dynamic

- **Regions with lower life expectancy are catching up with higher life expectancy elsewhere**

(Data and Projections from UN Department of Economic and Social Affairs, Population Division: World Population Prospects: The 2012 Revision)
The difference it makes

- Relative changes in Net Present Value of lifelong annuity if annual improvements change from 1.5% to ...

(base qx: “blue collar” vector in 2014; escalation: 5%; interest rate: 7%)
Conclusion

• Realistic Valuation of Pension Business is crucial for pricing and long-term risk management

• Proposed mortality projection structure based on two fundamental assumptions:

  • “white-collar” mortality dynamics depend relatively little on whether the client lives in UK or South Africa
  • differences in mortality between socio-economic groups in South Africa will diminish significantly over next decades
Contact details

• **Dipa Dass**
  • Business Development Actuary
    Hannover Life Reassurance Africa Ltd, Johannesburg
  • dipa.dass@hannover-re.co.za

• **Dr Sven Wiesinger**
  • Assistant Actuary
    Life & Health – Biometric Analysis
    Hannover Rück SE, Hannover
  • sven.wiesinger@hannover-re.com