Longevity Indices and Pension Fund Risk

Paul Sweeting
University of Kent
Overview

- Limited tools exist for managing longevity risk
- Index-based swaps might help...
- ...but this means indices are needed
- What qualities should they have...
- ...and how might they be used?
Starting point

• J.V. Bailey wrote two influential papers in 1992
• These give the desirable qualities of *benchmarks*
• Most important lists the following characteristics:
  – Unambiguous
  – Investable
  – Measurable
  – Appropriate
  – Reflective of current investment opinion
  – Specified in advance
Changes needed

- Clearly these are not all relevant to longevity indices…
- …but many are…
- …though others need to be added…
- …so here’s the full list
Desirable qualities for longevity indices (I)

• Unambiguous
• Transparent
• Objective
• Measurable
• Timely
• Regular
• Appropriate
Desirable qualities for longevity indices (II)

- Popular
- Relevant
- Highly correlated
- Reflective of current hedging needs
- Stable
- Specified in advance
Using the indices

• Base swaps on index values at “model points”
  – Reduces the number of swaps needed (increasing liquidity)…
  – …but might give a reasonable degree of hedging

• Example – portfolio of annuitants:

<table>
<thead>
<tr>
<th>Age</th>
<th>60</th>
<th>70</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Term</td>
<td>20</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>30</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Government Bond Yield Curve
Longevity Surface
Swap structure

- Pension-based swaps
- Life assurance-based swaps
- q forward-based swaps
Approach used for comparison

- Mortality projection using CBD model M5
  \[
  \ln \left( \frac{q_{x+n}}{1 - q_{x+n}} \right) = \alpha_n + \beta_n (x - \bar{x})
  \]
- Model-point swaps
- Annuitant, life assurance portfolios, min age 60
- 60 year time horizon (so youngest member died)
- 100 simulations
- Swap portfolios fitted using OLS
(Surprising) results

- Tracking error for pension portfolios consistently 40% to 45% higher than life assurance portfolios
- Pension-based swaps always give the lowest tracking error
  - 2.250% to 0.141% for annuitants
  - 1.589% to 0.098% for lives assured
Reality check

• Pretty good...
• ...but recognise that the initial volatility is only 2%
• Asset volatility? 10%? 15%?
• “But longevity risk is an unrewarded risk”
• Is it? Only if your counterparty is also hedging...
• ...otherwise there’s a risk premium...
• ...and anyway, longevity risk *diversifies* market risk
Further work

- More complex mortality model
  - CBC M5 is neat, but not sophisticated enough
- Finite portfolio sizes
  - How good is the hedge for a 300 member scheme?
- Class-based projections
  - Different developments for annuitants, lives assured
- Realistic ages
  - Mainly younger lives assured
- Different numbers of swaps
  - Only worth doing when the above have been included
Contact Details

Paul Sweeting
University of Kent
+44 1227 823790
p.j.sweeting@kent.ac.uk