Index-based Longevity Hedging – The Netherlands Experience

… or “what did the Dutch ever do for us?”

Alan J Rae, Senior Partner, Longitude Solutions
Life Convention | Liverpool | November 2018
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- Introduction
- Deals to date in The Netherlands
- Hedge Structure
- Index Construction
- Commutation Design
- Solvency 2 Capital Relief
- The future?
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Introduction

• In response to Solvency 2, the three largest Dutch Life insurers transacted Index-Based Longevity Hedges
  • Large proportion of deferred annuity liabilities and high perceived swap prices (or non-existent)
  • Deals were initially brokered by 2 Investment Banks, but both are no longer active in this area
  • Longitude Solutions was formed to fill this void and was advisor on the 2017 Dutch index-based trade between NN Group and Hannover Re
  • However, UK insurers have not yet transacted on an index basis, although we know that some have seriously considered it

Can UK insurers continue to do full Swaps with the same few Reinsurers?
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Bulk Annuity Deals in Last 10 Years by Country

Source: Artemis
# Dutch Index Based Longevity Transactions

<table>
<thead>
<tr>
<th>Sponsor</th>
<th>Provider</th>
<th>Solution</th>
<th>Size</th>
<th>Date</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aegon</td>
<td>Deutsche Bank</td>
<td>capital markets longevity swap</td>
<td>€12bn</td>
<td>Feb-12</td>
<td>Read more</td>
</tr>
<tr>
<td>Aegon</td>
<td>Canada Life Re</td>
<td>longevity swap &amp; reinsurance</td>
<td>€6bn</td>
<td>Jul-15</td>
<td>Read more</td>
</tr>
<tr>
<td>Delta Lloyd</td>
<td>RGA Re</td>
<td>index-based longevity derivative</td>
<td>€12bn</td>
<td>Jun-15</td>
<td>Read more</td>
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<tr>
<td>NN Group</td>
<td>Hannover Re</td>
<td>index-based longevity hedge</td>
<td>€3bn</td>
<td>Nov-17</td>
<td>Read more</td>
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*Source: Artemis*
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Swap (Quota share) vs. Hedge (Stop Loss)

Uninsured /hedged

“Uncapitalised” downside

Downside covered by SCR

Upside potential

50% Longevity Swap

Finite Longevity Risk Cover (Out-of-The-Money)

99.5th

[y]th

Percentile

[x]th

50th

SCR Reduction

SCR Reduction

Equivalent q, shock

0%

5%

15%

20%

Upside retained!
Choosing Attachment & Exhaustion Points

- Hedge pays out linearly between the Attachment and Exhaustion Points
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Index Construction – A priori Distribution of TPV

• Total Payments Valued @ t=n (e.g., 20)
  • TPV = Accumulated Payments Value to n
    + Future Payments Value after n
    = APV+FPV
    = L  (in Andrew Cairns notation)

• Model Points (Your portfolio)
  • sex/ age
  • retirement age
  • etc

• Experience Ratio (Your experience)
  • Sex / Age
  • Can assume change over time

• Stochastic Population Mortality Projection from t=0 (e.g. Lee Carter, M7-M5, etc....)
  • Parameters derived from historic population improvements (e.g. last 40 years)

• Distribution of TPV calculated using
  • Model Points
    • {Stochastic Population Mortality Projection} *
      {Experience Ratios}
Index Construction – A priori Distribution of Hedge Payout

- Choose Attachment Point & Exhaustion Point, e.g.,
  - AP = 50th percentile
  - EP = 90th percentile

- Use distribution of TPV to express these as money amounts
  - Hedge counterparties may not share your view on distribution of future mortality

- TPV = APV + FPV

- Payout = TPV – AP
  - Min = 0
  - Max = Notional = EP - AP

- Distribution of Hedge Payout

- Expected “Loss” (for hedge counterparty) = Payment back to insurers
Index Construction – A Posteriori Calculation of Hedge Payout

- Actual Population Mortality $t=1-20$ is known and multiplied by pre-agreed Experience Ratio to
  - calculate APV
  - Roll forward model points

- Project Population mortality from $t=20$ using the same Stochastic Population Mortality Projection, BUT

- Parameters re-derived from historic and hedge period population improvements (e.g. last 40 years = 20 years before hedge + 20 years experience during hedge)

- FPV calculated using rolled forward model points and Experience Ratio * central path from re-parameterised stochastic population mortality projection

  \[ \text{TPV} = \text{APV} + \text{FPV} \]

  \[ \text{Payout} = \text{TPV} - \text{AP} \]
  - Min = 0
  - Max = Notional = EP-AP
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20-year Index Hedge + Commutation

Projected Mortality Rates = re-parameterized commutation taking account mortality experience during the risk period
10-year Index Hedge + Commutation

More Risk in Commutation & Greater Basis Risk

Projected Mortality Rates = re-parameterized commutation taking account mortality experience during the risk period
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S2 Capital Relief

• Valuation of Hedge
  • $V(0) = PV \text{ Expected Payout} - PV \text{ of Premiums} + \text{ Risk Margin charged by Hedge Counterparty}$
    [= 0 if using IFRS derivative rules to “mark to market”]
  • $V(n) =$Payout dependent on mortality scenario; $0 < V(n) < \text{Notional (} = \text{EP-AP)}$
  • $V(t) =$ moves from $V(0)$ to $V(n)$ and path is scenario dependent

• SCR Calculation
  • SCR Reduction = $V^{99.5th}(1) - V(0)$
  • [Include PV of Expected Payout only - as Market to Market adjustment is a “risk margin”]
  • Basis Risk
    • either demonstrate it is not material or no relief under Standard Formula
    • Calculate basis risk haircut to capital relief in Internal Model

• RM Calculation
  • Index Hedge is a Derivative not Reinsurance so no direct RM reduction [in standard formula]
  • Mark to Market value captures Hedge Counterparty RM as Asset so impact not significant
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(Re)Insurers are subject to significant capital requirements (Solvency 2), and exposed to undiversifiable trend risk from longevity liabilities.

- Hedging this risk can transform an (re)insurer’s business into a more profitable and sustainable model.
  - Return on Capital
  - Return on Risk
  - Concentration of Risk

- To date, longevity risk hedging has been dominated by a few large life-reinsurers with little participation from the capital markets.
Both tools are useful. They accomplish similar things. You have to select the right tool for the job!
More precise hedging instruments

- Actual Mortality Rates
- Historical Mortality Rates
- Projected Mortality Rates = re-parameterized commutation taking account mortality experience during the risk period

Longer Risk Period = More Risk Transfer

Continued Innovation & Greater Precision

More precise hedging instruments
Market segmentation may exist in the longevity market. Recent experience has shown longevity upside has value.
Fully-collateralized Notes Reduce Credit Risk

- Insurer
- Unrated Investors
- SPV / Trust

Hedge Payout

Hedger’s Premium

Note Purchase Price

Note Payout

AAA-rated, liquid collateral
What did the Dutch ever do for us?
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