MODELLING AND MANAGEMENT OF LONGEVITY RISK

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Plan

- Longevity risk
- Modelling
- Robustness
- Hedging longevity risk
What is longevity risk?

The risk that a group of pensioners survive, in aggregate, for longer than anticipated.

Objectives of work:

- Stochastic modelling of future mortality
  - Multiple populations
- Longevity risk measurement
- Reserving for longevity risk
- Longevity risk management
Modelling Genealogy

- APC model (M3)
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  - Currie/Richards (M4)
    - 2-D P-splines
  - Eilers/Marx P-splines
  - DDE
  - Hyndman et al.
  - Booth et al.
  - Lee-Carter (M1)
  - Renshaw-Haberman (M2)

- CBD-1 (M5)
- CBD-2 (M6)
- CBD-3 (M7)
- CBD-4 (M8)
- Multi-population
- Multi-population

Time
Modelling challenges

- Robust modelling of multiple populations
- Greater understanding of modelling assumptions and limitations
- Data
  - Volume: years + age range
  - Reliability: deaths and exposures

Much done, but work more needed on all fronts
Robustness

- Model fit to historical data
- Forecasts of future mortality rates
- Business decisions: e.g.
  - reserving
  - volumes of new business
  - hedging decisions
Customised vs Index-Based Hedges

Customised $\Rightarrow$ hedge linked to pension plan’s own mortality experience

Index-based $\Rightarrow$ hedge linked to e.g. national mortality index

$\Rightarrow$ population basis risk

e.g. $q$-forwards, $S$-forwards (www.llma.org)
Risk Management Decisions

Are pension plans getting the right advice?

Why have there been so few index-linked longevity transactions?
Barriers to growth of index-based hedges

- ?? Pension plan risk appetite ⇒ customised

- Consultants avoid consideration of index-based hedges:
  - assessment of basis risk *perceived* as difficult
  - assessment of sponsor’s risk appetite is difficult
  - communication of hedging solution *perceived* as difficult
  - reputational risk
A highly stylised example of good practice

Good ERM $\Rightarrow$ consideration of ALL options

Expected Utility $\leftrightarrow$ Risk Appetite

Options for risk management e.g.:

- no action
- individual buyouts (customised)
- bulk buyout (customised)
- longevity swap (customised)
- index-based swap e.g. $q$-forward
Longevity risk management options

Issues: size thresholds; fixed costs; basis risk; sampling risk

WARNING: this figure is about concepts – it has no scientific basis!!!!
Choosing between the options

Normalised Utility (Stylised!)

Issues: Varying unit price; Poisson risk; basis risk; risk aversion

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Discussion

- Index-linked hedges have great potential
- Index-linked hedges have greater potential for robustness problems
- But these can be overcome:
  - More robust multi-population models
  - Careful choice of hedging instrument and maturity
  - Robust hedging strategies

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References:


