The Actuarial Profession
making financial sense of the future

Longevity Risk: Issues to be Considered

Steve Burgess, John Kingdom and Jemima Ayton

Disclaimer

This presentation is meant to promote discussion. It is not making any comments on standards or acceptable practice for practitioners and none of the content should be taken as prescriptive text

Agenda

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Introduction

The story so far

Demographic background

- Mortality rates: improving at an accelerating and faster-than-anticipated pace.
- One reason for this is the so-called 1925-1945 “cohort effect”.
- It is not clear how these trends will develop over time and whether other negative factors (such as obesity) will lead to a directional shift.

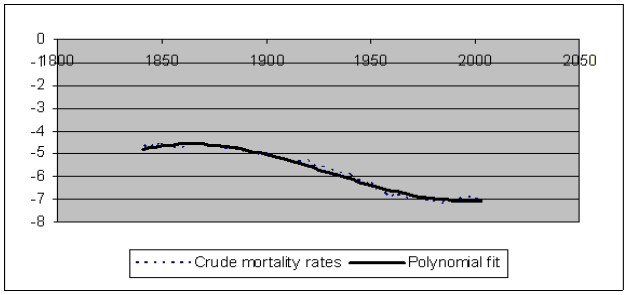
The story so far (cont)

- In more detail…
  - Trends in mortality improvements are not stationary over time.
  - Younger ages experienced larger improvements earlier on in time and vice versa for older ages.
  - Not taking this into account can lead to underestimating life expectancy and future improvements in mortality.

The story so far (cont)

- Date 'thresholds' seem to exist with:
  - Before date threshold: no improvements in mortality.
  - After date threshold: accelerating improvements, followed by decelerating improvements and eventually stable mortality rates.

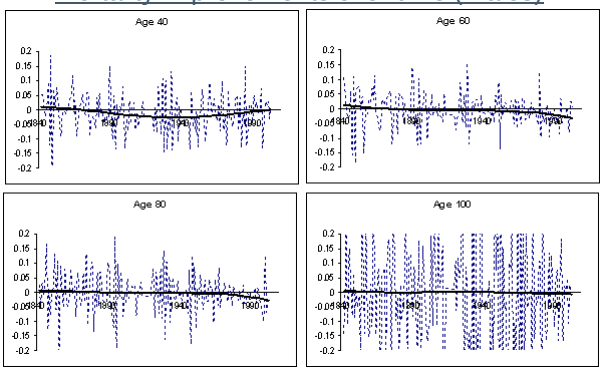
Population log mortality rate over time (males aged 50)



The story so far (cont)

- The graphs below show thresholds seem to occur at a later date for older ages.

Mortality improvements over time (males)



The story so far (cont)

- Improvements mainly due to people giving up smoking and technological advances e.g. more effective treatment for cancer.
- High mortality rates: eventually start to fall at an accelerating rate as the results of medical research are exploited.
- Low mortality rates: difficult to improve by much e.g. no room for improvement at 0.05%.
- Improvements start later for older ages – more research is required to understand why.

The story so far (cont)

How to allow for mortality improvements?

- Recent indications are that the medium cohort projections may be underestimating future improvements in mortality.
- Many practitioners have responded by imposing a 'floor' (i.e. minimum improvement level) onto the MC and/or using the (modified) long cohort (LC)
- We are now seeing a move by some firms away from the 'MC + floor' approach into more advanced stochastic modelling (perhaps gearing up for Solvency 2)
- Firms should be considering a range of possible outcomes rather than a single mortality projection
- Will the new CMI papers (38 & 39) encourage a final move away the cohort projections?

Comparison of assumptions currently used by firms

Pillar 1 assumptions

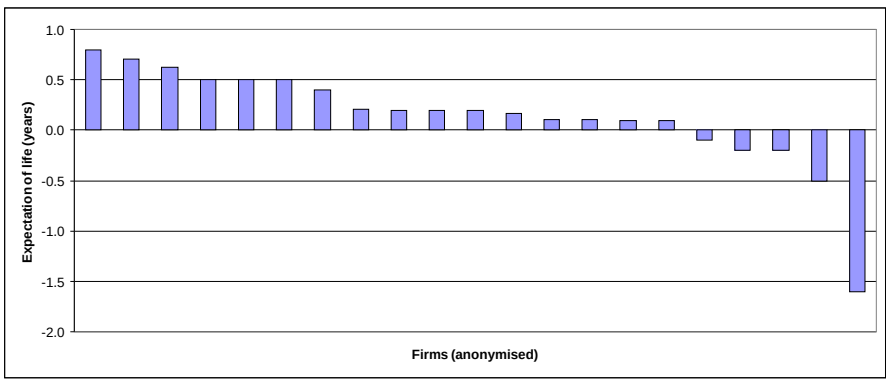
- Every year, we conduct an analysis of firms' mortality assumptions under Pillar 1
- Up to 31 December 2007, we had seen firms gradually strengthen their mortality assumptions.
- More specifically:
  - Expectations of life increased across the industry
  - We saw all firms covered by our survey abandon short cohort projections and opt for either medium or long cohort (or a combination of the two)
  - Most firms began to apply floors to the cohort projections. For example, as at 31 Dec 07, the average floor imposed (onto the MC) by firms (for males age 65) increased from 1.1% to 1.65% - and with it, the expectation of life increased by 0.9 years

Pillar 1 assumptions (cont)

- However, over the most recent year (i.e. to 31 December 2008), most firms did not strengthen their assumptions and a few firms actually had weaker assumptions than they had used previously
- As at 31 Dec 08, average expectation of life for a male aged 65 is 24.2 years compared to 24.1 years as at 31 Dec 07. This very small increase supports the conclusion of no real strengthening across the industry.
- Reasons for not strengthening further could include:
  - Firms believe they have sufficiently strengthened their assumptions
  - Lack of "new" research into longevity risk following a large number of papers around 2004/05/06

Pillar 1 assumptions (cont)

- Graph of changes in expectation of life (males age 65) between 31 Dec 2007 and 31 Dec 2008

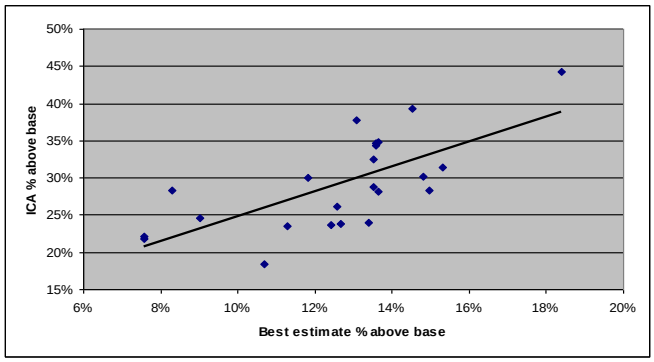


Pillar 2 assumptions

- We also conduct a survey of the mortality assumptions of firms under Pillar 2 on an annual basis and supplement this with additional data from ICA submissions
- Trends mirror Pillar 1 trends – while there has been a significant strengthening in recent years, this was not the case this year
- We currently compare firms' assumptions by the ratio of best estimate or ICA life expectancy (i.e. stressed life expectancy) to 'base' life expectancy (i.e. no future improvements)

Pillar 2 assumptions (cont)

- Under this measure, we see that there is no consensus amongst firms and assumptions vary significantly in strength. Graph below shows figures for males age 65.



Pillar 2 assumptions (cont)

- On average:
  - Firms' best estimate expectation of life is 12.5% above the base expectation of life
  - Firms' ICA expectation of life is 29% above the base expectation of life
  - By using ratios rather than comparing the absolute expectations of life we allow for differences between firms' base portfolios

Refinements to Pillar 1 and Pillar 2 work

- All assumptions will now be compared at year end (our Pillar 2 survey was previously as at 31 October each year)
- We will use a number of measures to compare assumptions between firms
- Firms will be compared at ages 65, 70 and 75 to allow for ageing annuity books
- We will look in more detail at assumptions used for females

Longevity Risk Issues

Risks to be considered when setting mortality assumptions

- Mis-estimation of base table
- Random volatility in actual future improvements i.e. confidence intervals around central projection
- Parameter uncertainty i.e. estimate for central projection not correct
- Data risk
- Model risk

Base table mis-estimation

- This is the risk that the base mortality estimate is incorrect (i.e. the mortality estimate based on actual experience in the portfolio)
- Firms typically allow for this as a % reduction in q_x rates
- It is difficult to give an average % used by firms as in many cases the initial mis-estimation risk will be combined with trend risk and an overall reduction to the qxs will be applied.

Random volatility

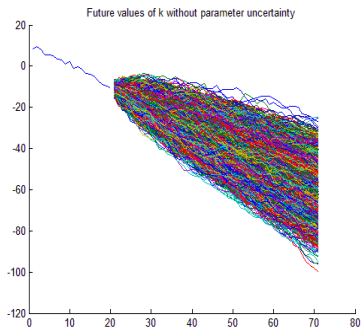
- This is the risk that your actual future mortality experience is worse than your best estimate – this does not mean that your best estimate is incorrect
- Improvements are very uncertain so we would not expect trend assumptions to be followed exactly over time
- Firms generally allow for this by either:
  - A further reduction to the q_x rates
  - An increase in the improvement factors and/or floors

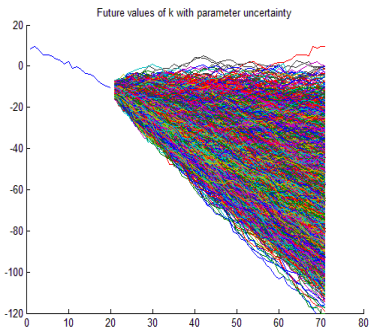
Parameter Uncertainty

- Parameter uncertainty refers to the risk that a model's estimated parameters do not accurately reflect their true value i.e. that the future trend has been incorrectly estimated.
- For example, in the Lee-Carter model, parameter uncertainty (in the estimated drift for the mortality index) accounts for a large part of risk in terms of possible realisable life expectancies and annuity values.
- This is because mis-estimating the this parameter has implications for 30-40 years of lifetime improvements.
- The effect therefore that parameter uncertainty can have on risk capital is very significant and should not be ignored.

Parameter Uncertainty (cont)

- This is illustrated in the figures below, which plot the range of possible values for the mortality index in the Lee-Carter model with and without parameter uncertainty:





Data risk

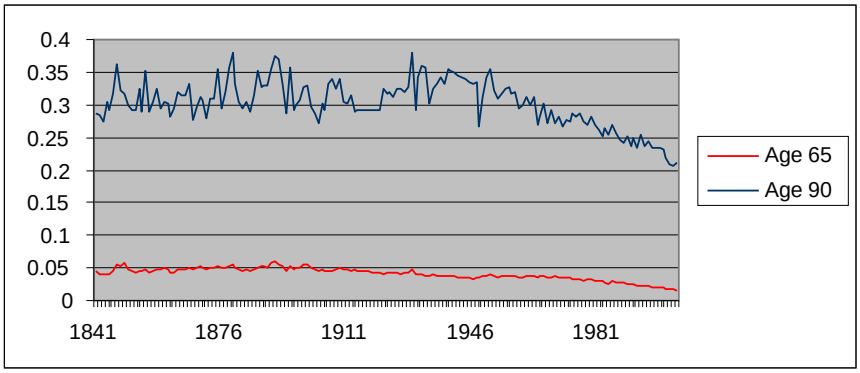
- Data risk arises from the data used to calibrate the mortality projection model
- Issues to consider:
  - What data sets are available?
  - What criteria defines a “good data set”?
  - What do you do if you don’t have enough internal data?
  - How should basis risk be allowed for?

Model Risk

- Model risk is the risk that the model being used to project future improvements in mortality is not correct. This is a very difficult risk to assess and reserve for.
- Some possible questions:
  - How should the model be chosen?
  - What criteria should it exhibit?
  - Should model used be stochastic or deterministic?
  - How different do we expect output from different models to be?
  - What about basis risk?
  - How should model risk be allowed for when valuing liabilities and calculating capital requirements?

ICA capital by age

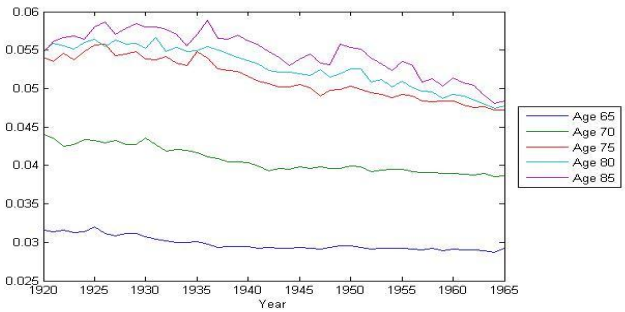
- At older ages, crude mortality rates are much more volatile at older annuitant ages (e.g. over 80) than they are for younger ages. This is shown in the graph below which plots mortality rates over time.



ICA capital by age (cont)

- The graph below plots the standard deviation of age-specific mortality rates divided by the mean over a period of 45 years.

- We can see that, for older ages, the standard deviation is much larger, not only in absolute terms (as implied by the previous slide) but also in relative terms. Furthermore, this ratio seems to decline as mortality rates improve over time:



ICA capital by age (cont)

- The effect of this is that binomial risk (random volatility risk) is much more important for older ages than it is for younger ages.
- Looking specifically at annuity business:
  - This risk could be quite significant for older annuity books.
  - However, the impact is lessened when reserving for annuities for younger ages due to the effect of discounting and fluctuations in mortality rates which tend to 'cancel each other out' over time.
- This effect could have a significant impact on ICA capital. More research however is needed to assess the overall impact.

ICA capital by social grouping

- Two different viewpoints
  - "Mortality rates have improved faster for higher social groupings due, among other things, to lifestyle and diet. Therefore, it is reasonable to expect this to continue".
  - "Mortality rates have not improved by much for lower social groupings and therefore there is more potential for improvement in the future".
- We would encourage firms to think about this issue further as it could have implications for the amount of capital that they are required to hold.

Any thoughts or questions?

Longevity Risk Transfer

- In recent times we have seen firms either:
  - Take out reinsurance contracts for longevity risk only
  - Enter into longevity swap transactions with investment banks
- Pension schemes are also beginning to transact in this area
- Will we eventually see a deep and liquid market in longevity risk?
- Will there be opportunities to transfer longevity risk on deferred annuity portfolios?

Longevity Risk Transfer (cont)

- Recent longevity risk transfer announcements

RSA Staff (DB) Pension Scheme	July 2009	£1.9bn. asset / longevity swap
Babcock Intl	May 2009	£500m longevity swap
Norwich Union	March 2009	£475m longevity swap
Canada Life	October 2008	$900m longevity hedge

Other issues

- The impact of a growing market in impaired annuities
  - How significant is the 'selection effect' whereby traditional annuity products are being sold to healthier policyholders year-on-year?
  - How are the risks in impaired annuities different to traditional annuity products?
  - Should ICA stresses differ?
- 'Common currency' for comparison of the strength of assumptions of different firms.
  - Currently we compare firms by dividing best estimate or ICA life expectancy with the 'base' life expectancy (i.e. life expectancy obtained when no improvements are assumed).
  - Going forward we are going to expand the number of measures used – any views?

Any further questions?

steve.burgess@fsa.gov.uk
+44 (0)20 7066 0226

john.kingdom@fsa.gov.uk
+44 (0)20 7066 1166

jemima.ayton@fsa.gov.uk
+44 (0)20 7066 2540

Life Actuarial Team
Retail Firms Division
Financial Services Authority
25 The North Colonnade
Canary Wharf
London E14 5HS