The Actuarial Profession
making financial sense of the future

Open Forum: Mortality Projections
Gordon Sharp and Neil Robjohns

The latest CMI Model and discussion of current practice

9 Dec 2010 [London] and 19 Jan 2011 [Edinburgh]

Open Forum: Mortality Projections

Programme

- 17.30 Welcome and introduction
  - Chair: Gordon Sharp, KPMG LLP
- 17.35 Presentation
  - The latest CMI Mortality Projections Model, CMI_2010
  - Speaker: Neil Robjohns, Barnett Waddingham LLP
- 18.15 Discussion
  - Current and possible future practice in setting mortality improvement assumptions for insurers and pension schemes
- 19.00 Close.

The CMI Mortality Projections Model: CMI_2010

Agenda

- Background and overview of the Model
- 2010 update: CMI Working Paper 49 and CMI_2010
- Default values for Core parameters of CMI_2010
- Change arising from incorporation of data for 2009
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The CMI Mortality Projections Model
Background and overview of the Model

Background and motivation

- Interim Cohort Projections valued as a common currency
- But are significantly and increasingly out-of-date
- CMI Working Party established in 2008 to produce a projection model which:
  - reflects the latest experience on trends in mortality;
  - is relatively straightforward to understand and describe;
  - allows users the flexibility to modify projections to suit their own views and purpose; and
  - can be regularly updated over time to reflect emerging experience.

The CMI Mortality Projections Model
Background and overview of the Model

Key development stages and outputs

- Published in June / July 2009 for Consultation
  - A prototype version of the CMI Model: CPMv0.0
  - CMI Working Paper 38: Part I – Outline
  - CMI Working Paper 39: Part II – Detailed Analysis
- Launch of the CMI Model, November 2009:
  - CMI Working Paper 41: Feedback on the consultation
  - Updated version of the Model: CMI_2009
  - Updated User Guide (with documentation of default values)
  - Updated Parameter Sensitivity Test results spreadsheet
  - Webinar, 8th December 2009.

The CMI Mortality Projections Model
Background and overview of the Model

The Structure of the Model

- Project annual rates of mortality improvement
  - Relatively simple; accessible; flexible
  - Not a mathematical model of mortality fitted to data
- Deterministic projection driven by user inputs
  - Initial rates of mortality improvement
  - Long-term rate(s) of mortality improvement
  - Speed & pattern of convergence
  - Split projection by age or by year-of-birth cohort
- Core and Advanced parameter layers.

The CMI Mortality Projections Model
Background and overview of the Model

Core parameter layer

- Allows users to focus on two simplified parameters:-
  - A Long-Term Rate of Mortality Improvement
  - A Constant Additional Rate of Mortality Improvement
- Default values are applied to other parameters.

Advanced parameter layer

- Gives users considerable flexibility; allowing specification of:-
  - Initial Rates of Mortality Improvement
  - Cohort and Age/Period components of Initial Rates (by individual age & birth cohort)
  - Long-term Rates of Mortality Improvement (by individual age & birth cohort)
  - Period of Convergence (by individual age & birth cohort)
  - Proportion of Convergence remaining after Mid-point (by individual age & birth cohort)
  - Base Rates of Mortality.

The CMI Mortality Projections Model
Background and overview of the Model

Research on mortality improvement rates: main conclusions

- England & Wales Population Data
  - Clearly shows 2 major features of mortality change
    - Persistent year-of-birth cohort peaks and troughs; most notable peak for 1931 cohort
    - A general increase over the last 15 years across a wide age-range
  - So model age/period and cohort components.
- Insured & Pensioner Data
  - Lower data volumes reduce clarity of observations
    - Unable to distinguish between concurrent features
    - Much more difficult to interpret trends
  - So base defaults for Model on population data.

The CMI Mortality Projections Model
Background and overview of the Model

Research on mortality improvement rates : round-up

- Evidence no longer supports 1926 cohort feature of the ICPs
- Step 2 years inside edge of data to reduce estimation uncertainty
- Variety of features of mortality improvement
  - cohorts (25+ yrs; above age 40);
  - age/period (typically shorter)
- Improvement rates tend to run to zero for age 100+
- No clear picture on trends by social class
- Even 25-year averages of improvement rates vary significantly.

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The CMI Mortality Projections Model
2010 Update

Approach for maintenance and development of the CMI Model

- Limited Annual Updates
  - Core default for Initial Rates of Mortality Improvement
  - Incorporate each successive year's population data
  - Late October ? (dependent on ONS publication dates)
- Periodic General Reviews
  - Review structure and all default parameters
  - Avoid potential confusion / disruption of frequent change
  - Do 'when necessary' (maximum interval of 5 years)
  - Continuing feedback from users is encouraged!

The CMI Mortality Projections Model 2010 Update - Launch of CMI_2010

An updated version of the Model & User Guide

- Updated Initial Rates of Mortality Improvement for 2009 data
- Replace mortality table ILT05-07 with ILT07-09
- No other material change from CMI_2009.

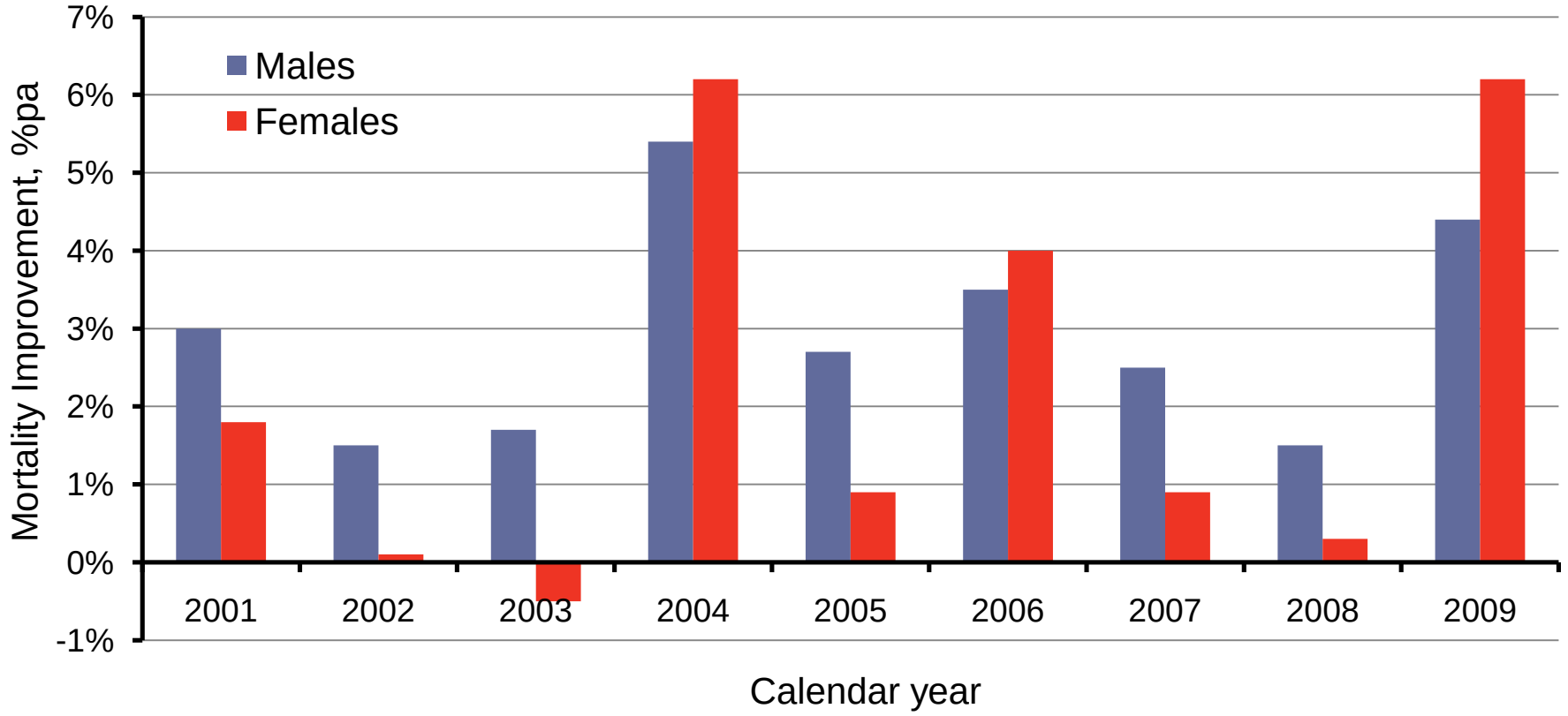
CMI Working Paper 49

- Sets out updates to derivation of default Core parameter values
- Analysis of the effect of adding data for 2009
- High-level parameter sensitivity analysis
- Discussion of other issues linked to the update.

The CMI Mortality Projections Model 2010 Update - Launch of CMI_2010

Crude annual mortality improvement rates

Population of England & Wales; age 18-102; age standardised



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The CMI Mortality Projections Model
Default values for Core parameters of CMI_2010

Initial Rates of Mortality Improvement

- Informed by recent observed experience
- Use E&W population data to 2009; estimate rates for 2007
- Estimate age/period and cohort components
- Maintained methodology used for CMI_2009.

Long Term Rates of Mortality Improvement

- No default parameter values set - User input required!
- Use combination of long-term data, models and expert opinion
- See also research presented in CMI Working Papers 38 and 39.

The CMI Mortality Projections Model
Default values for Core parameters of CMI_2010

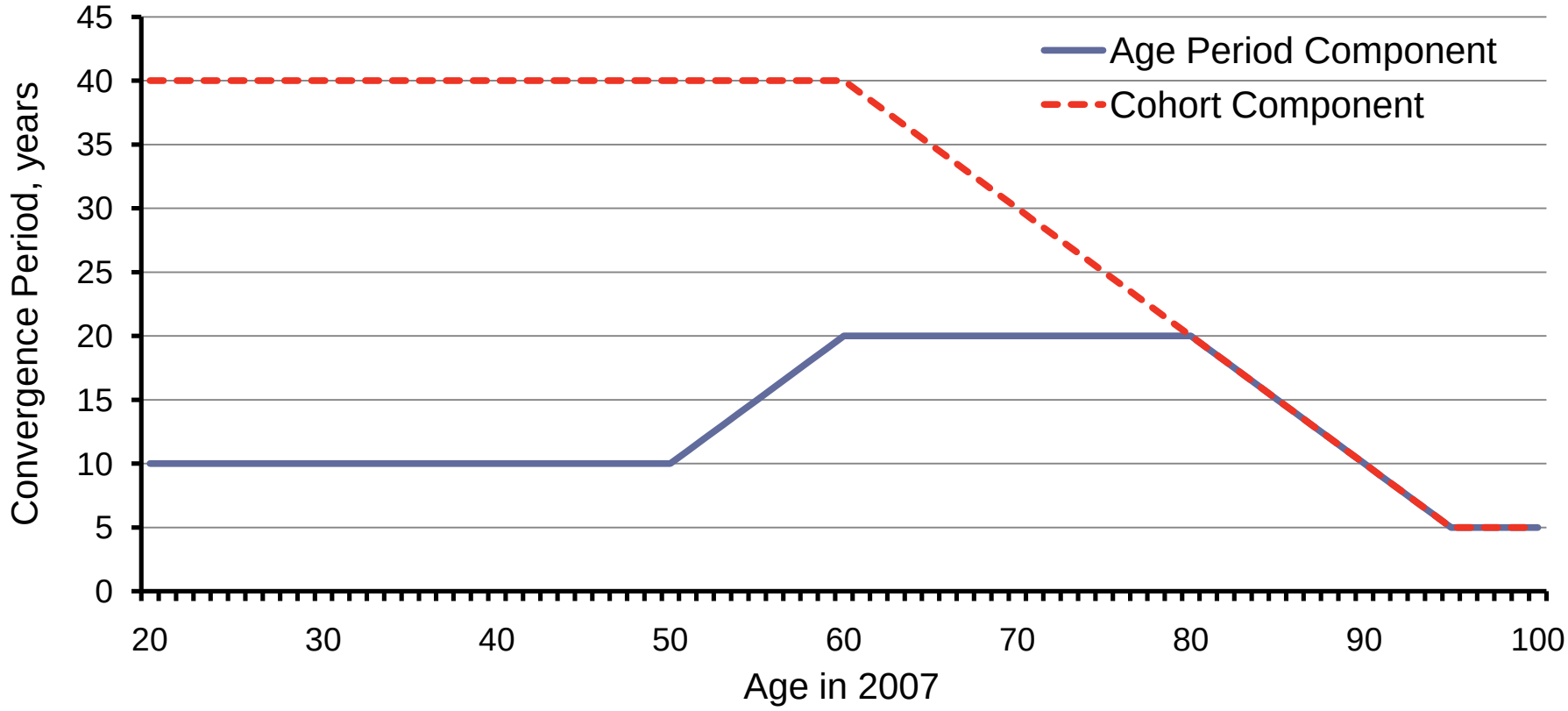
Convergence Period

- Maintain pattern set by CMI Working Party
  - Originally based on qualitative research
- Age/Period component
  - Maintained period (shift start and end forward by 1 year)
  - Re-sets the period by taking a fresh view on emerging trends
- Cohort Component
  - Maintained rule: period runs to age 100, but min = 5, max = 40
  - So reduces by 1 year for 1912 to 1946 birth cohorts

The CMI Mortality Projections Model
Default values for Core parameters of CMI_2010

Period of Convergence

Core parameter values in CMI_2010



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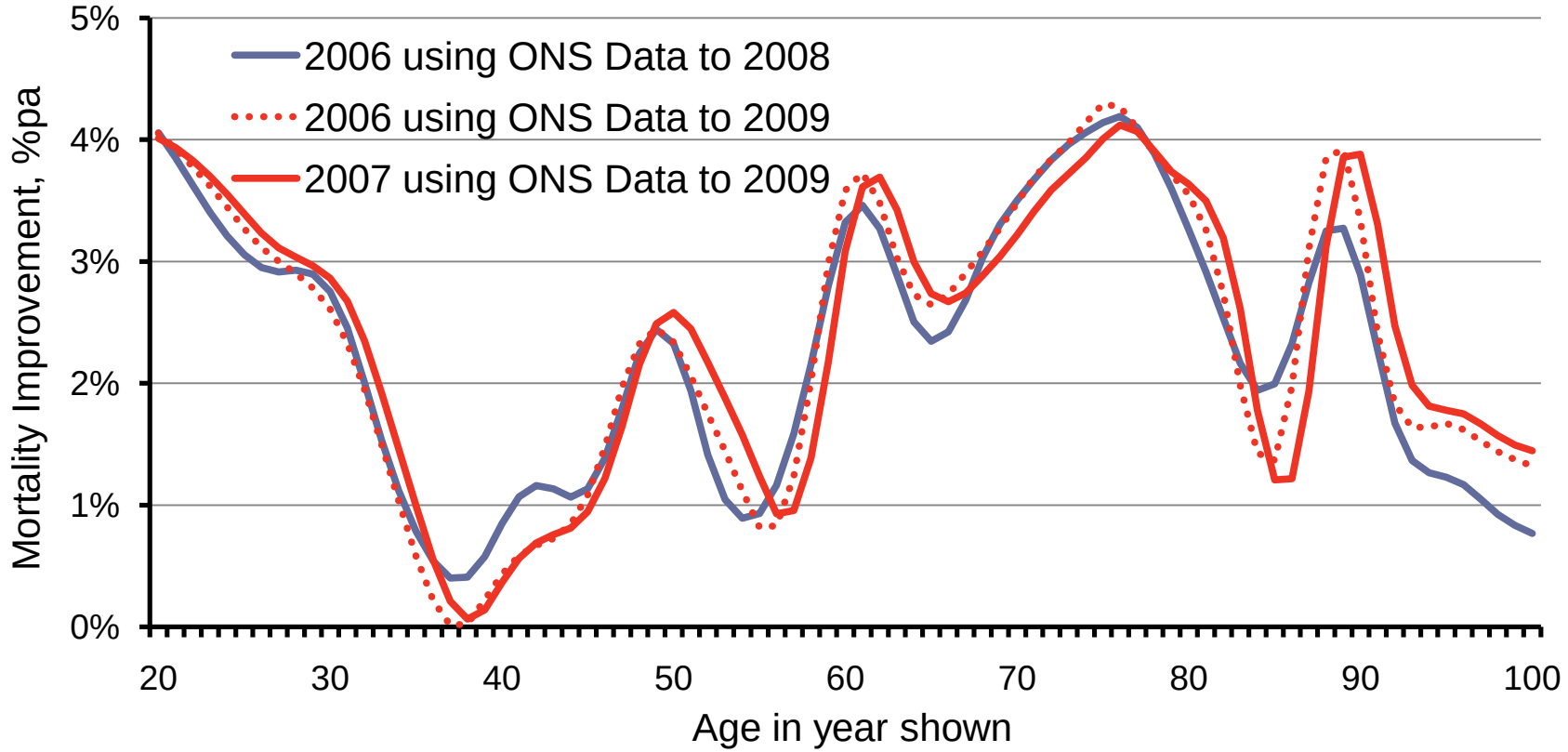
The CMI Mortality Projections Model
Change arising from incorporation of data for 2009

Annual rates of mortality improvement, by age, year and data

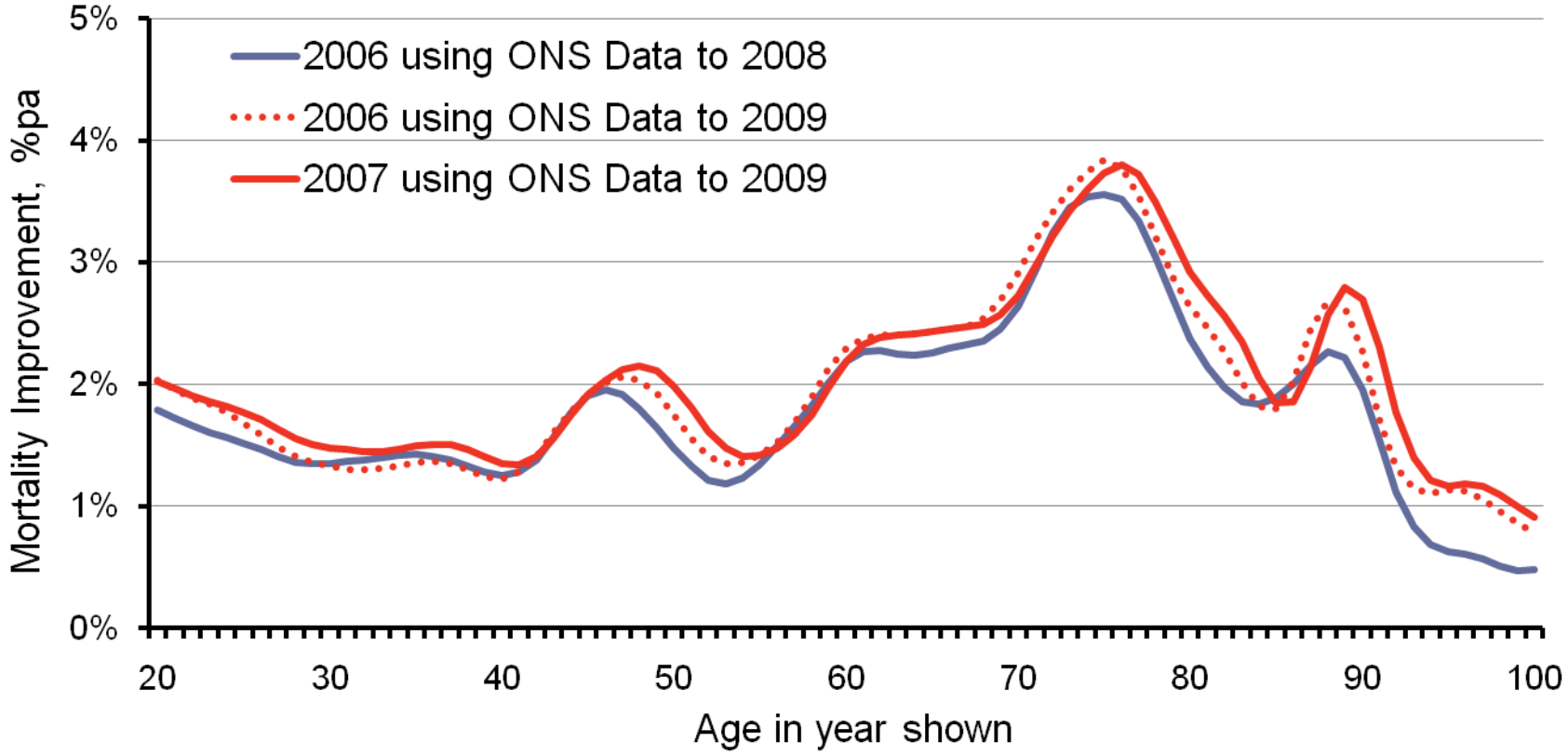
P-Spline models; population of England & Wales; males



The CMI Mortality Projections Model
Change arising from incorporation of data for 2009

Annual rates of mortality improvement, by age, year and data

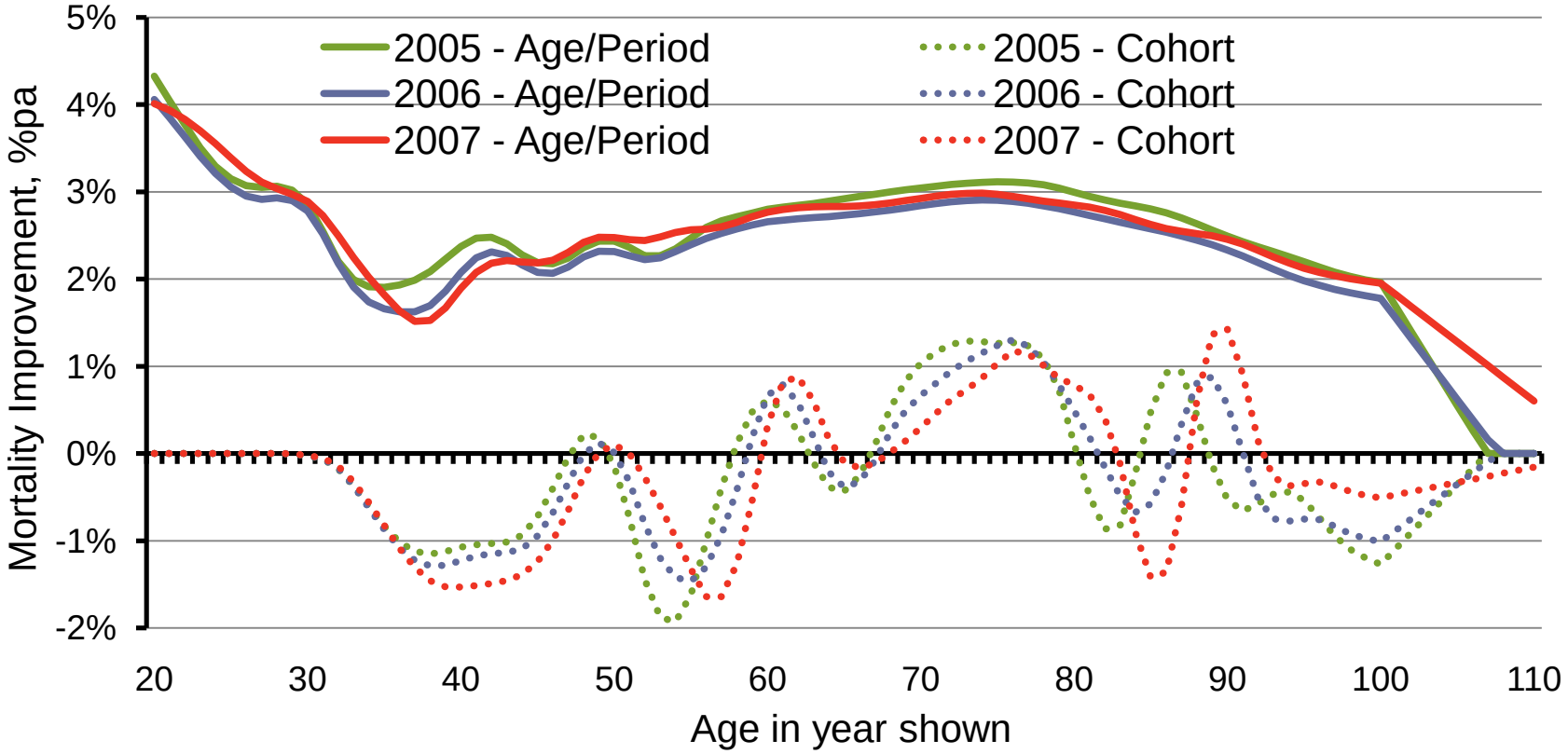
P-Spline models; population of England & Wales; females



The CMI Mortality Projections Model
Change arising from incorporation of data for 2009

Age/Period and Cohort components of mortality improvement

by age and year; population of England & Wales; males



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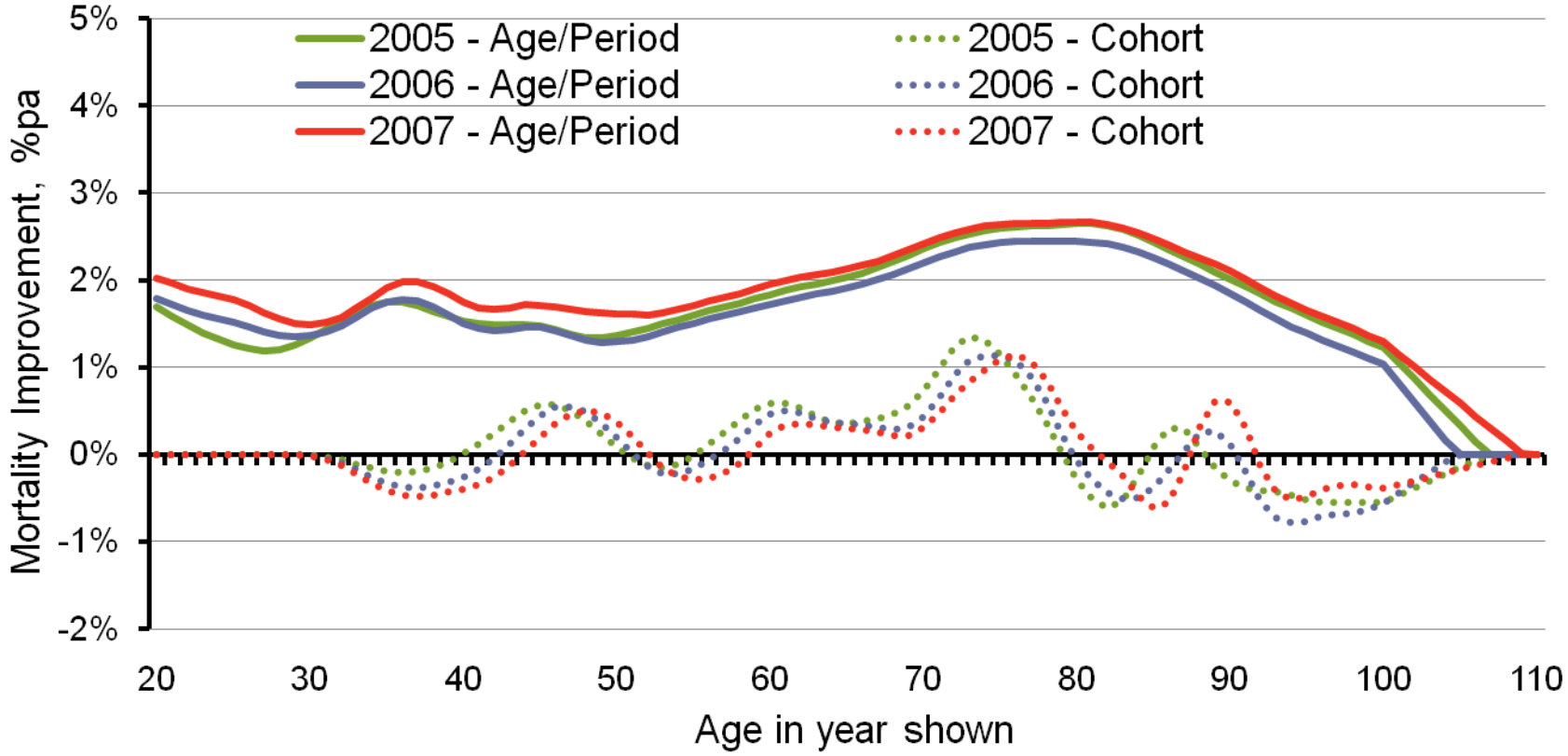
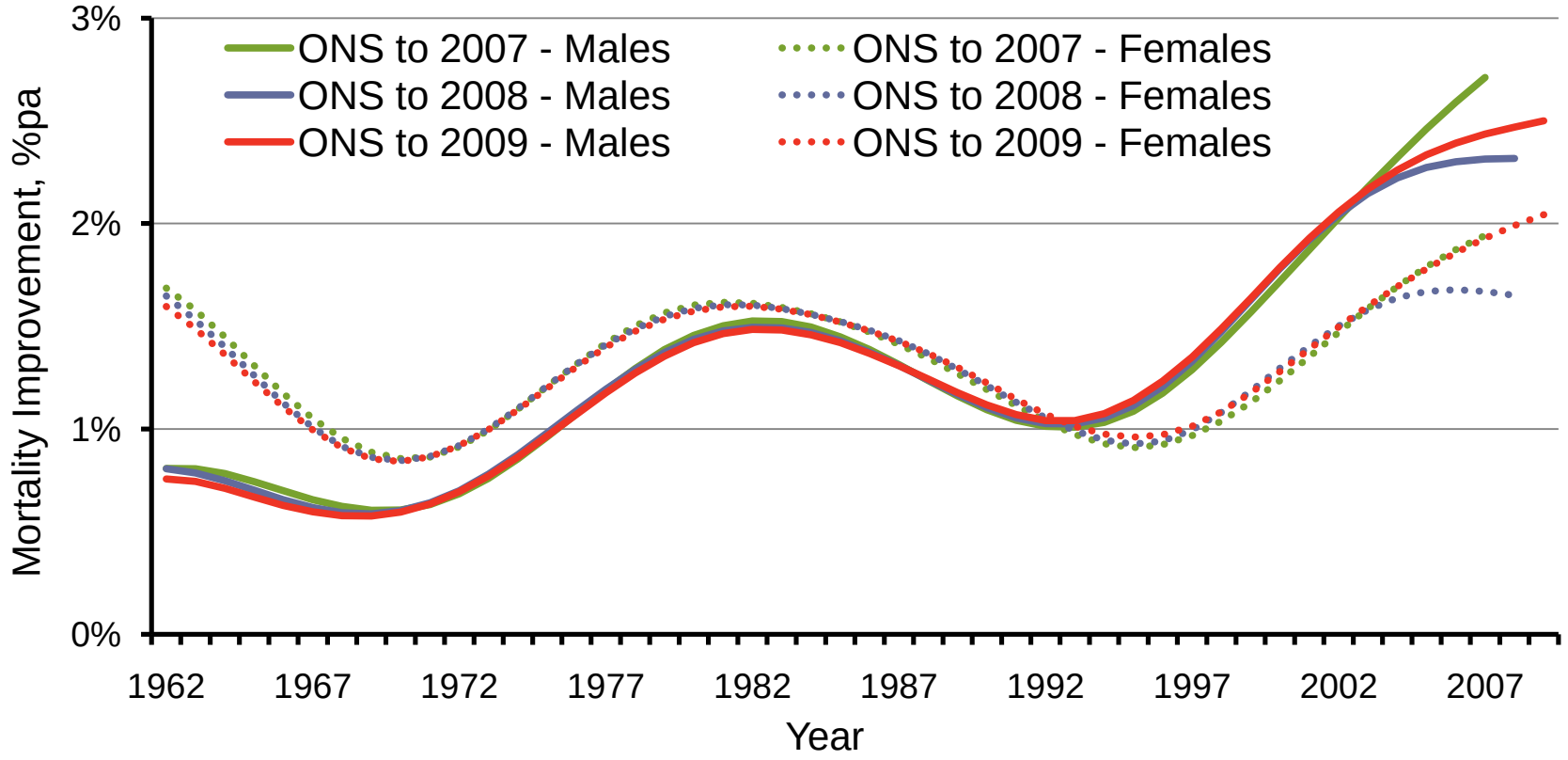


The CMI Mortality Projections Model
Change arising from incorporation of data for 2009

Estimated Period component of mortality improvement

1962 - 2009; population of England & Wales



The CMI Mortality Projections Model
Change arising from incorporation of data for 2009

Addition of data leads to revision of estimates

- Estimates slightly increased for recent improvement rates
- Revisions fall within expected range
- … and show methodology gives relatively stable results

Cohort EoLs increase on average by:

- around 0.3% to 0.7% for males
- around 0.5% to 1.5% for females
  - depending on spread of ages
- [+1% on long-term rate increases EoL by 5% at age 65].

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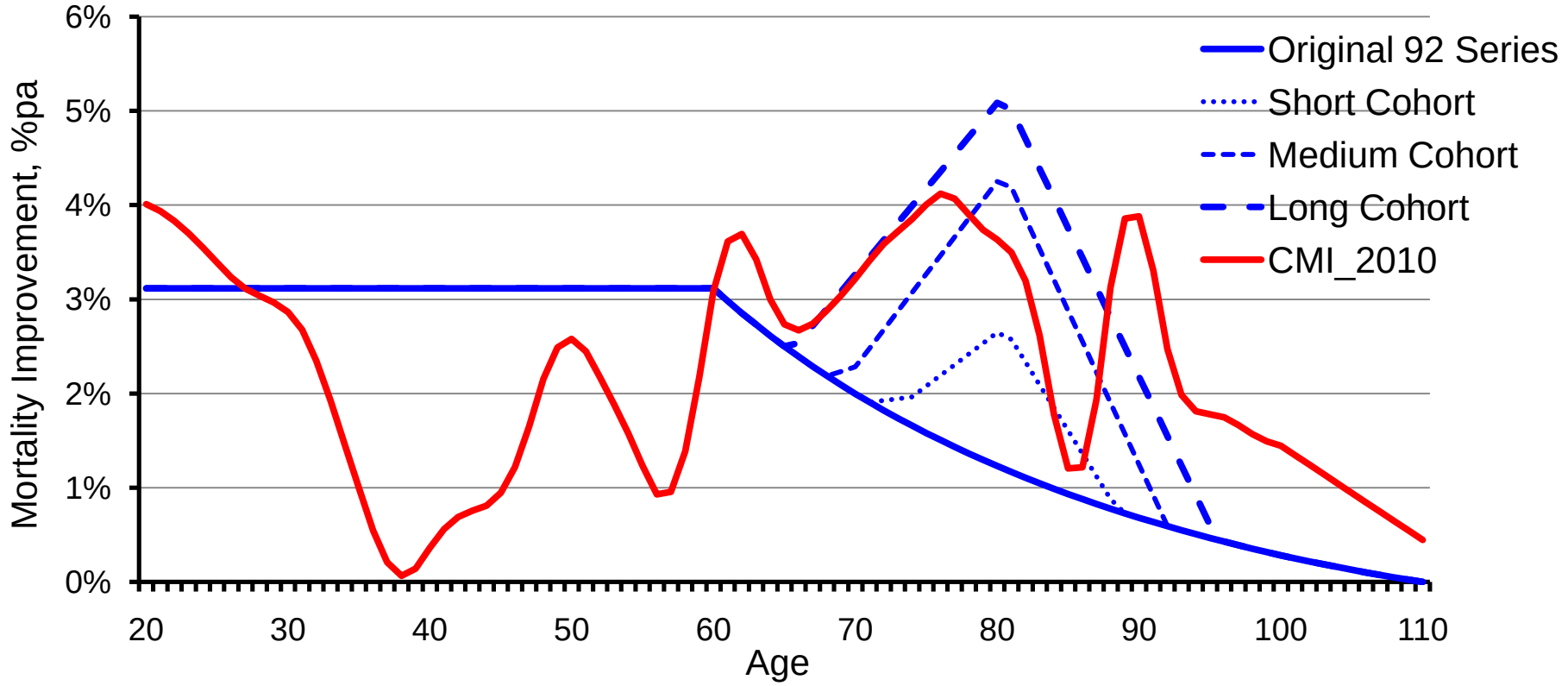
The CMI Mortality Projections Model
How do CMI_2010 Core Projections compare to ICP?

Projected mortality improvement rates for males in 2007

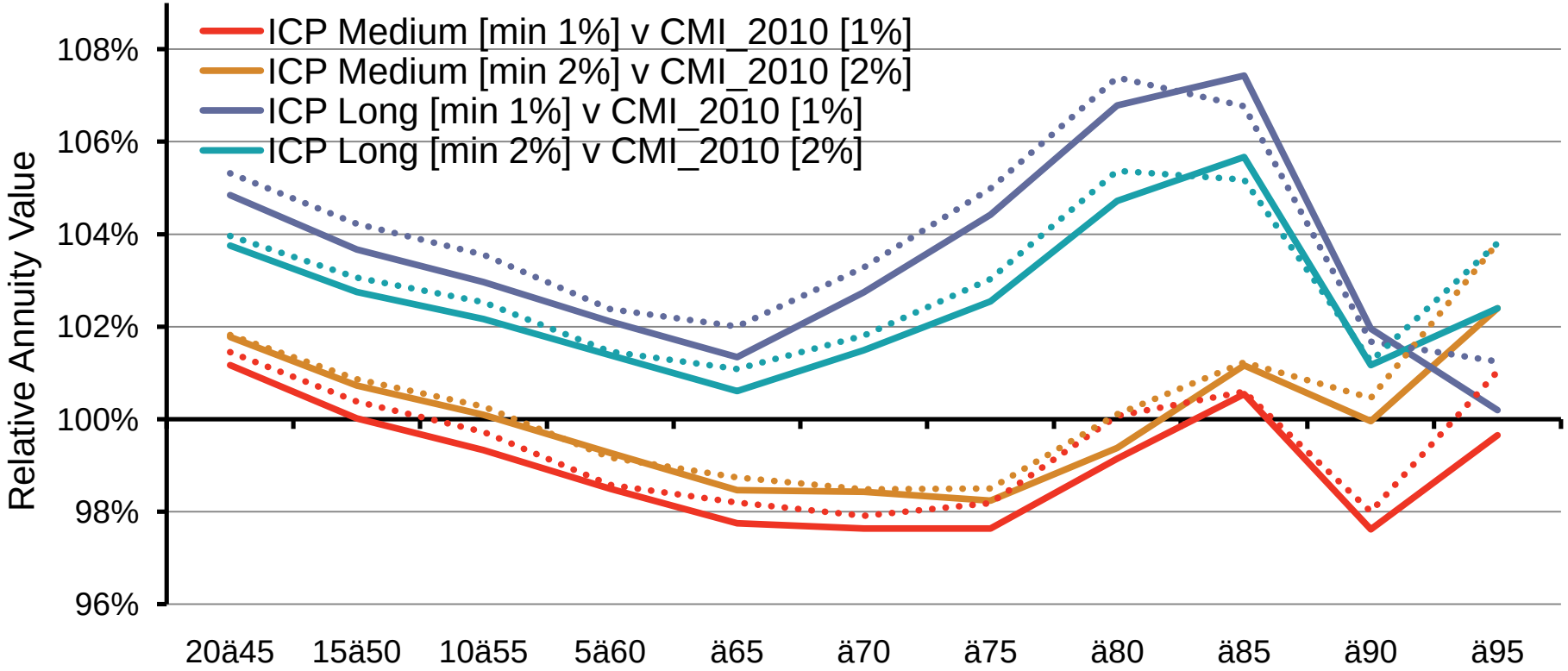
CMI_2010 uses estimated actual derived from E&W population data



The CMI Mortality Projections Model
How do CMI_2010 Core Projections compare to ICP?

Comparison of Projected Cohort Annuity Values

Males; age exact as at 31/12/2010; value at 3% p.a.
Base Mortality : 100% S1PMA for life aged x exact on 01/09/2002



Solid Lines: CMI_2010; value @ 31/12/2010; roll mortality forward using actual improvement rates to 2007, vary projection from 2008
Dotted Lines: CMI_2009; value @ 31/12/2009; roll mortality forward using actual improvement rates to 2006, vary projection from 2007

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The CMI Mortality Projections Model
Other Issues

Projection timing definition

- In CMI_2010 projection timing is defined by 3 dates (user input)
  - Base mortality rates
    - q_x at dd/mm/yy is probability of life aged x exact at dd/mm/yy dying before dd/mm/yy+1
  - Rates of mortality improvement
    - RMI = $1 - q'_x/q'_{x-1}$, so define in terms of date definition for underlying q'_x
    - Calendar year data (ONS, CMI) naturally leads to 01/01/yy definition
  - Calculation date (for annuity and expectation of life values)
- CMI Library of Mortality Projections
  - Equates timing of improvements with timing of base mortality
    - Originally set in line with appropriate timing definitions for ICPs (30/06/yy)
    - "00" series – 30/06/yy; S1 series – 01/09/yy

The CMI Mortality Projections Model
Other Issues

CMI P-Spline Model and Software

- Two potential issues identified with current CMI P-Spline model
  - Occasional failure to find optimal solution when fitting model
  - Overdispersion of population data relative to model
    - Overdispersion causes the model to under-smooth by year and by age
    - But correction not clear as non-random data features contribute to the overdispersion
- Further investigation showed
  - Satisfactory optimisation of models used for CMI_2010 (etc)
  - Allowing for overdispersion would not materially alter CMI_2010
  - But the issues may be more significant for P-Spline projections.

The CMI Mortality Projections Model
Other Issues

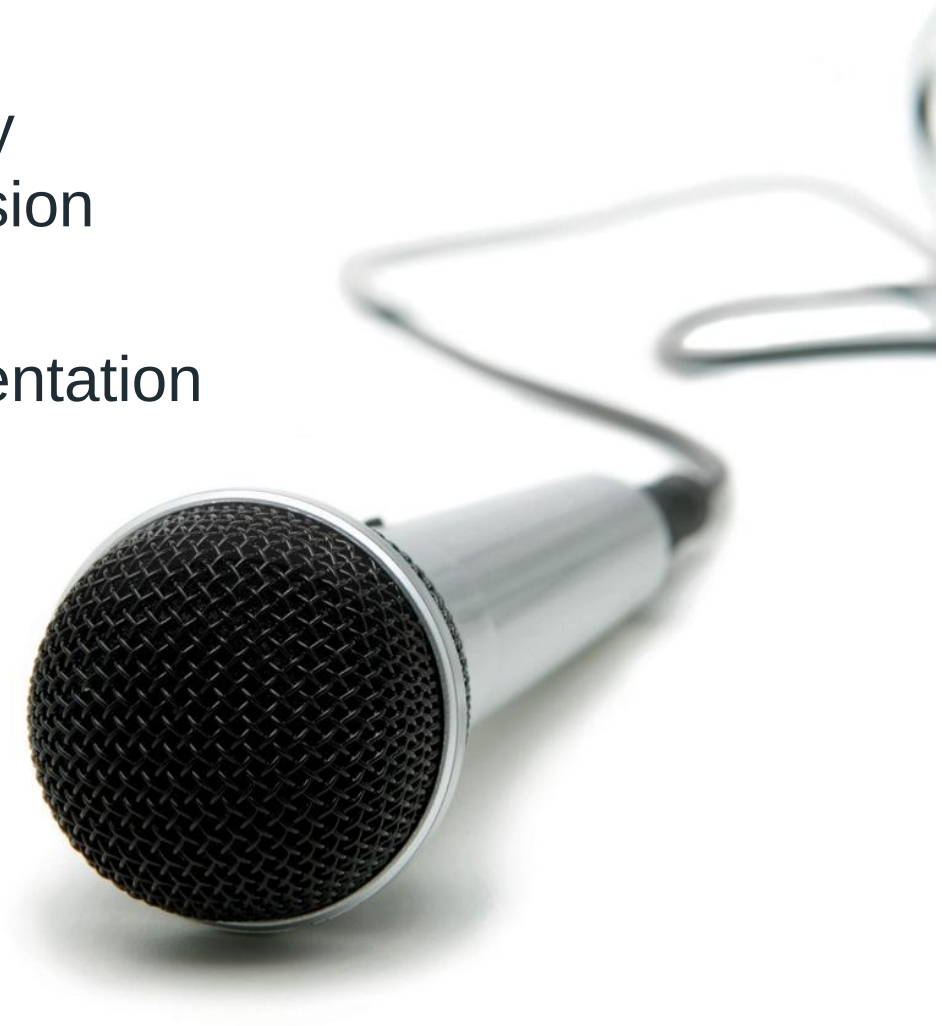
TAS - M

- The CMI has produced this Model in compliance with the principles in the Technical Actuarial Standard M: Modelling (April 2010) published by the Board for Actuarial Standards, regarding its construction, checking, and documentation
- Documentation of the Model, in addition to that in the Model itself, is contained in the User Guide and further information is detailed in the Working Papers referenced therein.

The CMI Mortality Projections Model: CMI_2010 Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the CMI.



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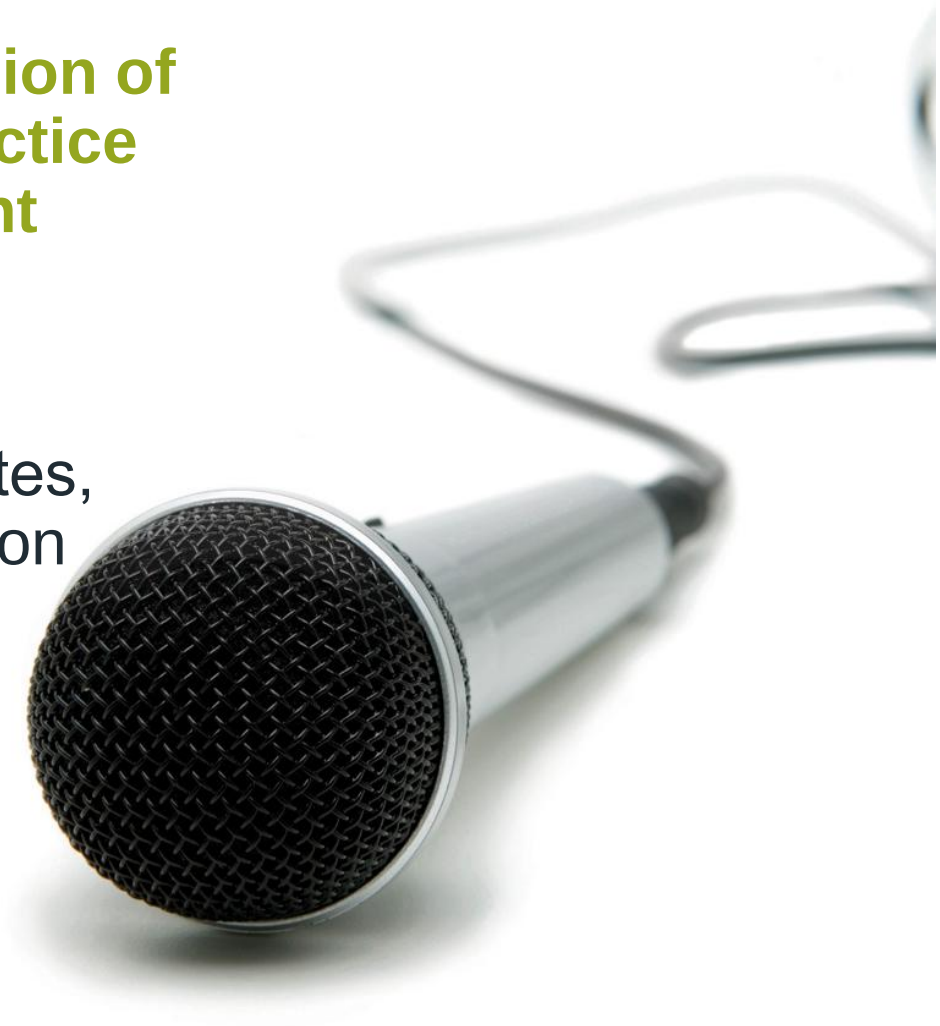
- 19.00 Close.

Open Forum: Mortality Projections
Discussion of current practice

The floor is yours - a discussion of current and possible future practice in setting mortality improvement assumptions for insurers and pension schemes.

We won't be taking any formal notes, but may well write up the discussion in an article for The Actuary, or for publication on the CMI web pages, but with no attribution of comments to any individuals.



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Thank you for your attention and participation

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