The Actuarial Profession
making financial sense of the future

# CILA II

# The CMI Mortality Projections Model

Richard Willets
Chairman, CMI Mortality Projections Model working party

Staple Inn Hall, London; 5th October 2009

# Agenda

- Introduction & Background
- An Overview of the Model
- The Consultation Exercise
- The Effect of Adding Data for 2008
- Next Steps

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# CMI Interim Cohort Projections

- Published in 2002;  based on data to 1999
- Inevitably becoming increasingly out-of-date
- Still in near universal use for many applications
  - Often with adjustments (%s, combinations, floors, ..)
  - But reflect very different pattern from recent data
  - Difficult to judge for reasonability
  - Short & Medium Cohort now imply rapid tail-off in rates of improvement in future mortality

# Recent Research - CMI & Others

- CMI looked for stochastic projection model
  - P-spline – but vulnerable to edge effects
  - Lee-Carter – but poor fit to UK data (cohort effects)
  - No projections in “00” Series tables
- CMI Library of Mortality Projections
- Many other approaches & models developing
  - Stochastic models; Mortality by Cause; By Disease

# Towards a New Model

- Perceived Advantages of Interim Cohort Proj$^{ns}$
  - They offer a common currency
  - They can be easily modified
  - They can be applied to any base mortality table
- But significantly out-of-date

# Working Party Goal

- To produce a projection model which shares the desirable features of the Interim Cohort Projections, but also:
  - 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.

# Members of the Working Party

- Richard Willets (chair)
- Adrian Gallop
- Joseph Lu
- Brian Wilson
- Neil Robjohns (secretariat)

# Acknowledgements


- The CMI records its thanks to the Actuarial Profession for a research grant which was used to fund the initial development of the Model.

# Working Party Deliverables

- 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
  - A User Guide for CPMv0.0
  - Sensitivity tests results spreadsheet
- Consultation on the Model and its potential uses
  - Closed on 31 August 2009
  - CMI response and CPMv1.0 planned for October 2009

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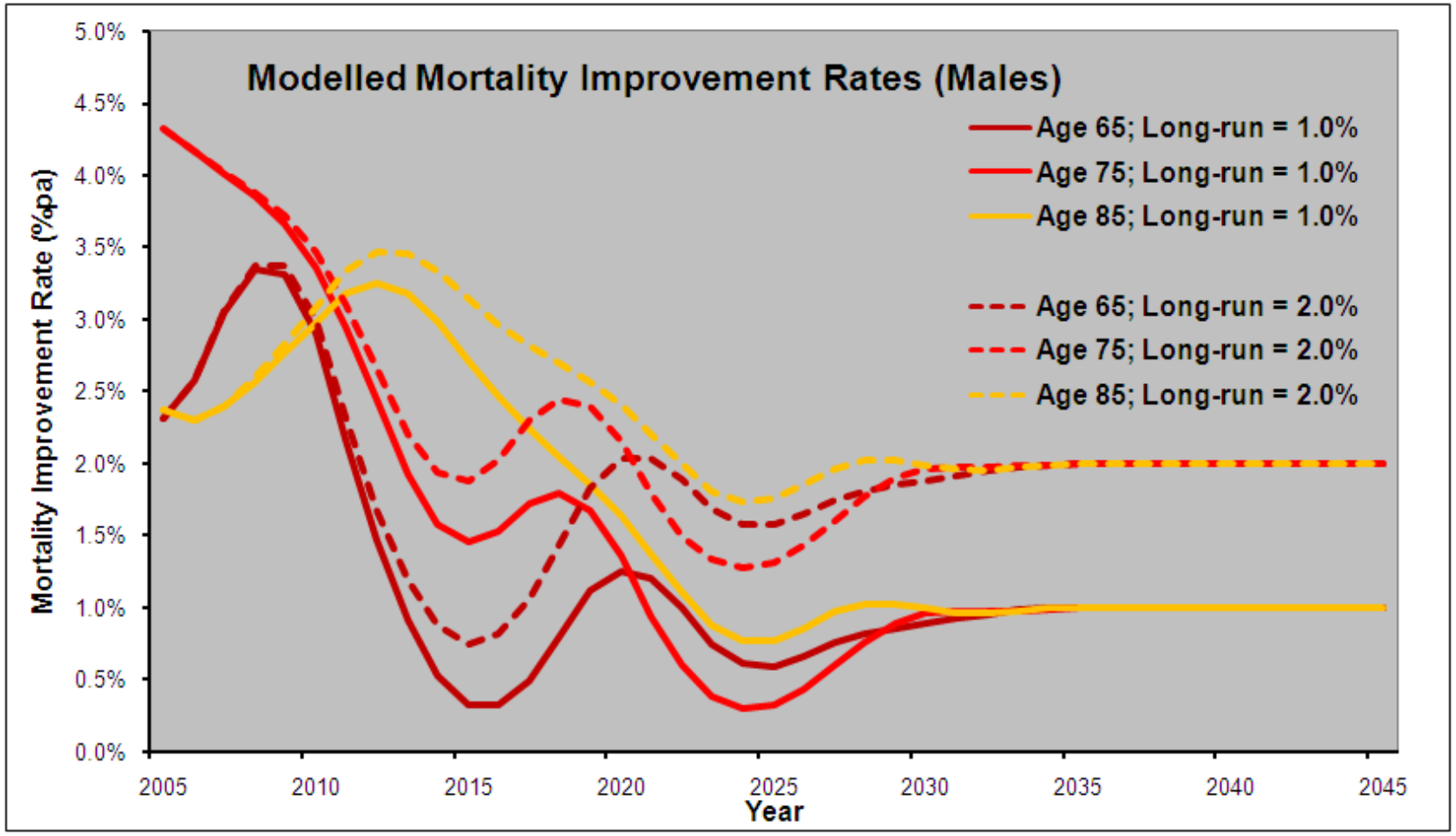
# Model Structure

- Project annual mortality improvement rates
  - 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

# Convergence to a Long-Term Rate

- In the short-term, the best guide to the likely pace of mortality improvement is the most recently observed experience
- In the long-term, the forces driving mortality change are likely to be very different; more subjective, better informed by expert opinion
- The Working Papers include research on:-
  - Mortality improvement by cause-of-death
  - Long-run average rates of change in a range of countries

# Convergence to a Long-Term Rate



# Advanced Parameter Layer

- Gives users considerable flexibility; allowing specification of:-
  - Initial Rates of Mortality Improvement
  - Cohort & Age/Period Components of Initial Rates
  - Long-term Rates of 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)
  - Initial Rates of Mortality

# Core Parameter Layer

- Allows users to focus on two simplified parameters:-
  - A Long-Term Rate of Mortality Improvement
  - A Constant Addition to Rates of Mortality Improvement
- Default values are applied to other parameters
  - Initial Rates derived from Eng&Wal population data
- 'Core Projections' – i.e. those produced using only the Core Parameter layer – can be described using a proposed naming convention

# Naming Convention

- Core Projections from version 0.0 of the Model can be given names of the following form:-

CPMv0.0 [a%] +c% {gender}

where:-

- a% = Long-Term Rate of Mortality Improvement
- c% = Constant Addition to Rates of Improvement for all ages and calendar years (omitted if zero)

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# Responses to the Consultation

- Meetings in Edinburgh & London
- 31 written responses received
- 24 addressed the specific consultation questions
  - Broad range of firms represented
  - Bias towards firms involved in pensions consultancy (14)
  - Life offices (7), Reinsurer (1), Banks (2)
  - No response from regulators or ‘non-actuarial’ groups
- 7 related to specific issues
- Responses will not be published in full
  - Summary will be provided; comments not attributed

# Responses to the Consultation

(a) Do you agree that the CMI should be producing such a mortality projections model for use by practising actuaries?

- Unanimously positive response!
- Rationale typically included:
  - The need to replace the Interim Cohort Projections
  - The need for a model (always) reflecting recent data
  - The value of the Model as a 'Common Currency'
  - A view that the CMI is uniquely placed for this initiative
- Clear mandate to proceed to 'final' version

# Responses to the Consultation

(b) Do you agree with the broad structure of the proposed Model?

- Strong & widespread support for basic structure
  - Two-level design caters well for a broad range of users
  - Blending over time, from current to assumed long-term rates of mortality improvement, is generally seen as intuitive and relatively easy to communicate
  - Majority support for deterministic model
- Maintain broad structure as it is
  - Some alterations suggested, no consensus for change

# Responses to the Consultation

(c) Do you have any comments or suggestions on the proposed structure of the Model?

- Two most common issues (minorities)
  - Convergence methodology (reflect recent trend?)
  - Need for measures of uncertainty
- Propose to maintain structure as per CPMv0.0
  - Both issues considered in detail in developing CPMv0.0
  - Both would add significant complexity to Model
- But encourage research to quantify uncertainty

# Responses to the Consultation

(d) Do you agree with proposed number (two) of parameters at Core level and the choice these Core parameters?

- Response broadly symmetrical around proposal
  - Add Parameter (convergence; high age LTR) 10
  - Agree with proposal 11
  - Remove Parameter (constant addition) 5
- Propose to maintain structure as per CPMv0.0
  - Results less sensitive to proposed extra parameters
  - Impossible to satisfy everyone!

# Responses to the Consultation

(e) Do you feel it would be useful to allow users to vary the long-term rate over time?

- Response split roughly 50:50
  - Some support for extra flexibility ...
  - ... but ‘nice to have’ rather than ‘must have’
  - Some concern that extra complexity not justified

- Propose to maintain structure as per CPMv0.0
  - Insufficient support to pursue extra flexibility in LTR

# Responses to the Consultation

(f) Do you have any comments or suggestions on the default values given to parameters?

- Many indicated broad support for proposed values
- But half of the responses raised specific issues:
  - Use of population, rather than insured / pensioner data
  - Default shape for convergence (50% at mid-point)
  - Tapering rates of mortality change to zero at high ages
  - Derivation of separate age/period & cohort components
- Propose to expand justification of approach / value

# Responses to the Consultation

(g) Do you have any comments or suggestions on the proposed naming convention?

- General support for proposed naming convention
  - and for informal naming of Advanced Projections
- Challenge set to find names:
  - with greater intuitive meaning (for non-actuaries)
  - with easier expression (more ‘catchy’)
- Naming convention to be considered further
  - Ideas welcome !

# Responses to the Consultation

(h) Do you anticipate you would use this Model in practice? If so, for what purpose would you use it?

- All respondents indicated they would use Model
  - 75% expect to use it directly to produce projections
  - 25% expect to use it indirectly as means of expressing, benchmarking and communicating projection bases
  - Insurer response weighted more strongly to indirect use

- Strengthens mandate to proceed to 'final' version

# Responses to the Consultation

(i) Do you have any thoughts on how the proposed Model should be developed in the future?

- Calls for further research, but no dominant topics:
  - Further future mortality scenarios by cause-of-death
  - Alternative data sets / analysis by socio-economic group
  - Analysis of drivers of mortality change (cohort features)
  - Further analysis to support setting long-term rate
  - Further research & development of stochastic models
- Support further research, but outside current scope

# Responses to the Consultation

(j) Should the CMI maintain the proposed Model as new data becomes available? If so, should this be each year, or at some lesser frequency?

- Strong demand for regular review; different timing:
  - Full annual updates 9
  - Annual review, but only update if material 7
  - Less frequent (2 to 5 years, average 3) 7
- Seek to balance timely review against new data, with desired stability for the model structure and for projections in common use

# Responses to the Consultation

(k) Do you have any other comments?

- A variety of issues were raised, including:
  - Interaction with the CMI Library of Projections
  - Some form of hind-casting / back-testing of the Model
  - Provision of further training for Users (Model & research)
  - Documentation to help users meet TAS-M
  - Release of underlying data and analysis tools
- All requests are currently being considered

# Summary of Consultation Responses

- Strong support for the Model
- Widespread intention to adopt / use the Model
- General support for broad structure of the Model
- Majority support for parameter default values set
- Calls for further / ongoing research
- Desire for annual review against emerging data …
- with stability for structure & benchmark projections

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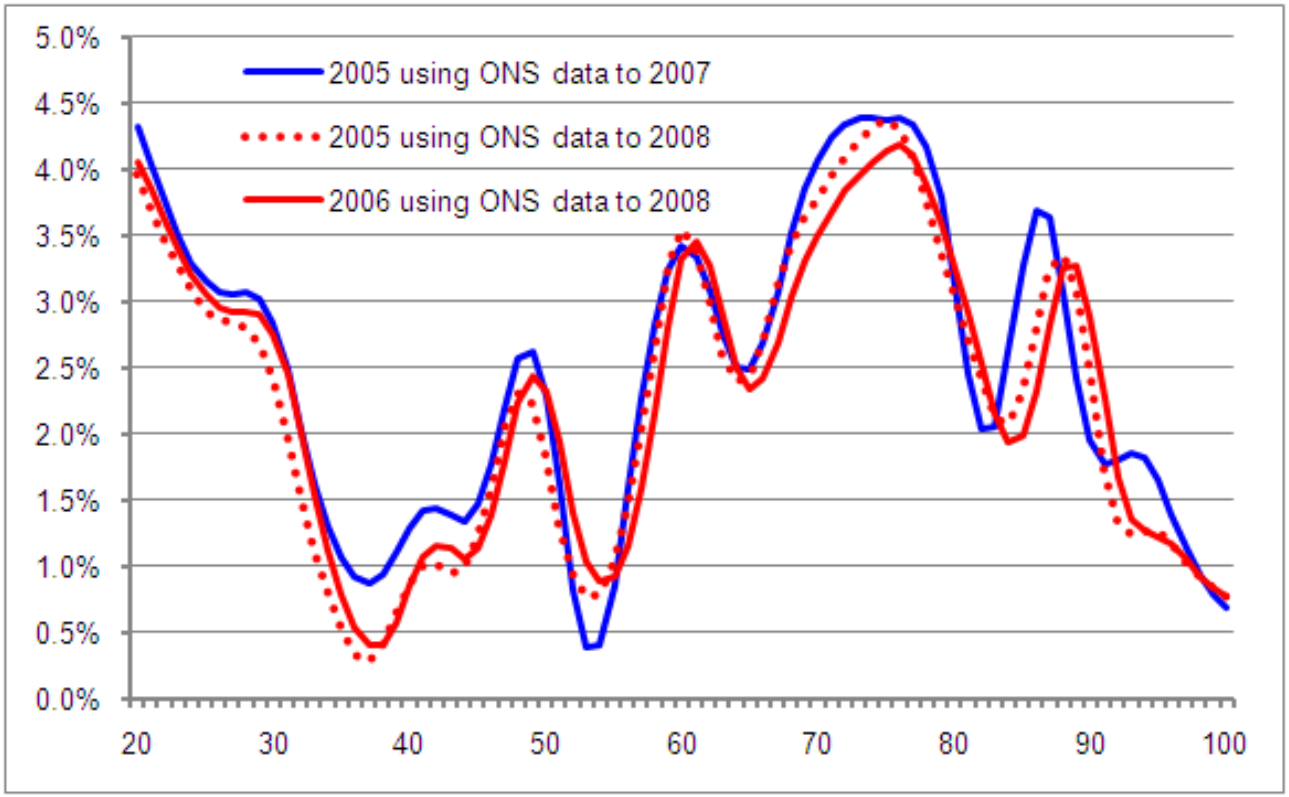
# Estimated Mortality Improvement Rates

Annual Rates of Mortality Improvement, by age, 2005 & 2006
P-Spline models; Population of England & Wales; Males



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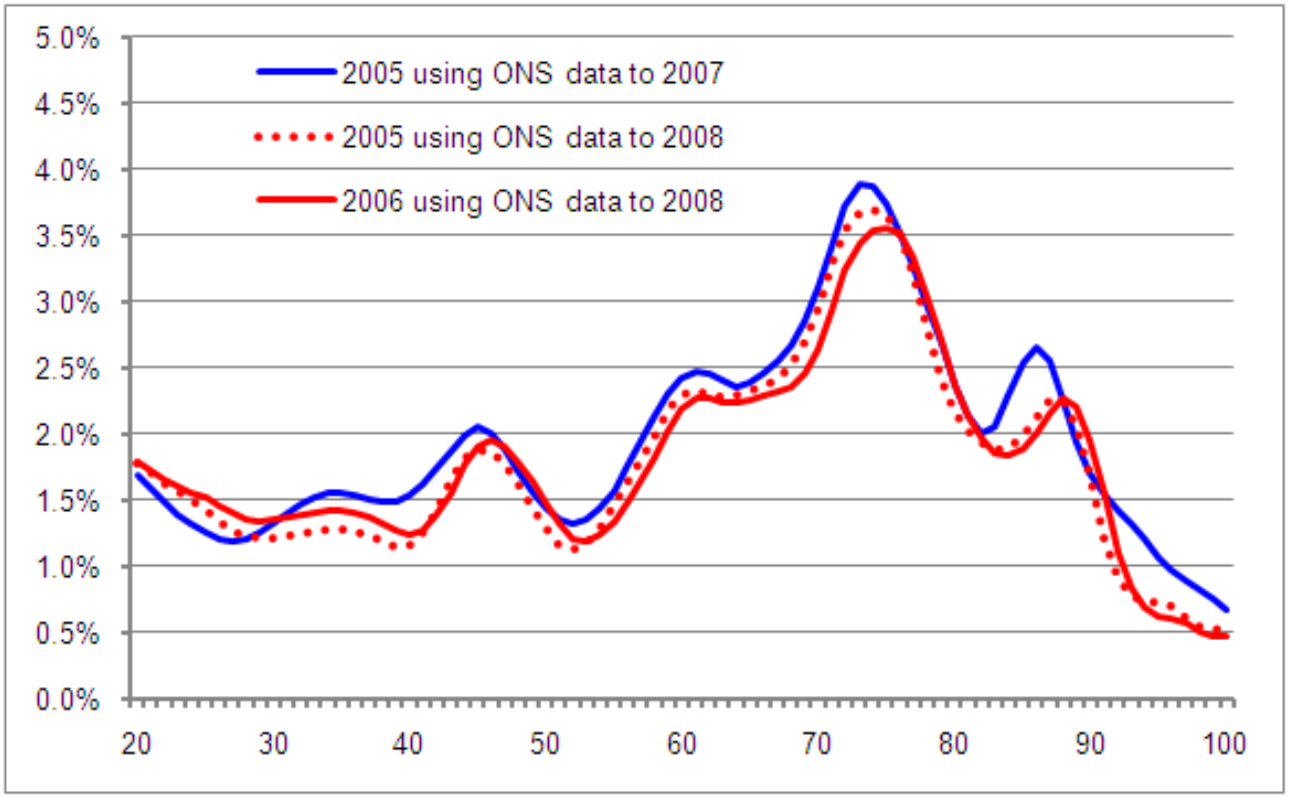
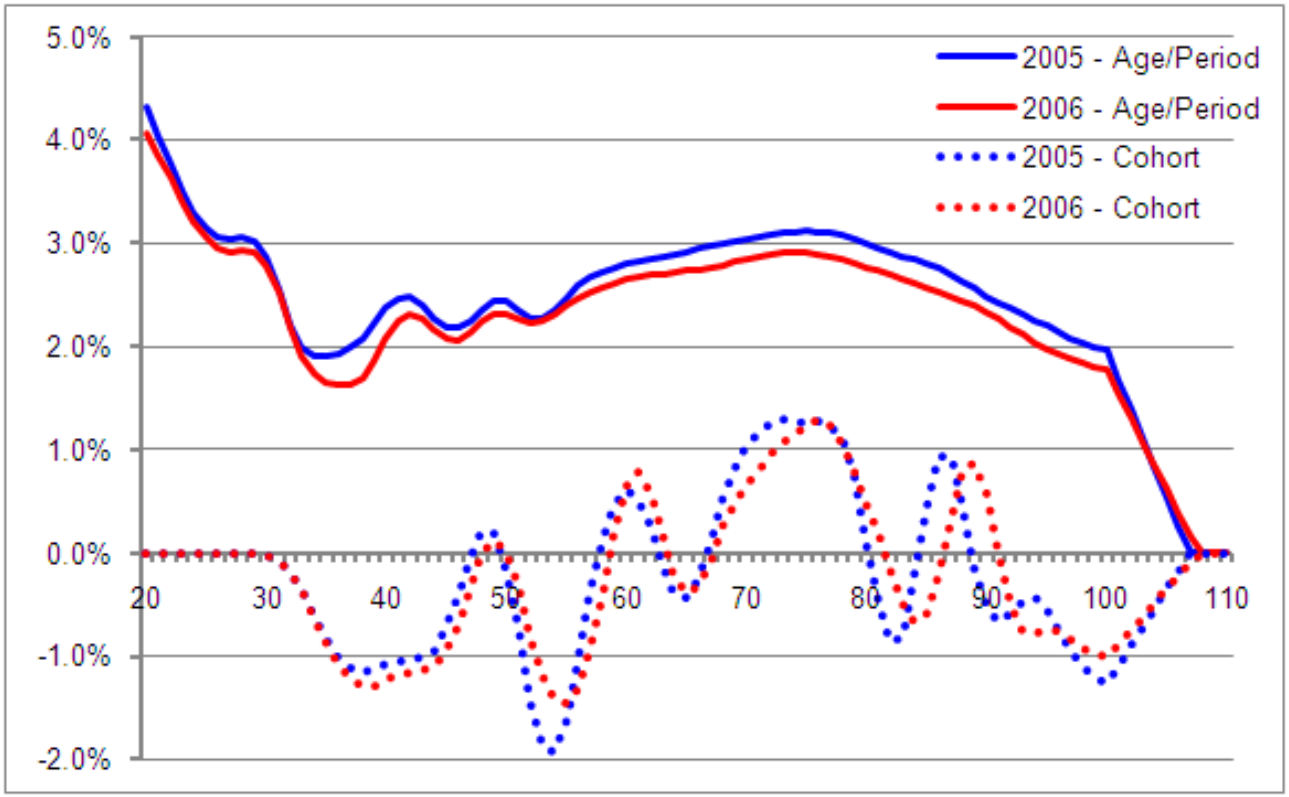


# Estimated Mortality Improvement Rates

Age/Period and Cohort Components of Mortality Improvement
By age; 2005 & 2006; Population of England & Wales; Males



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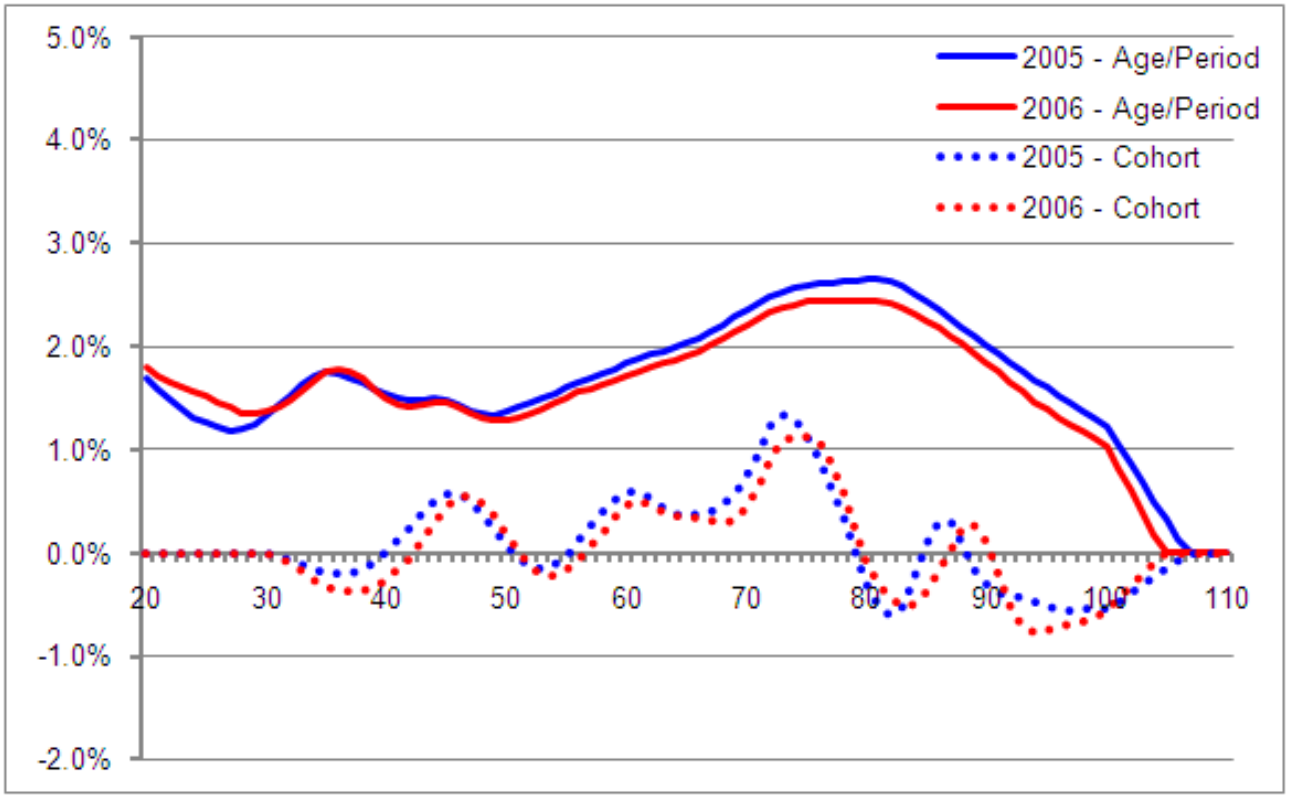
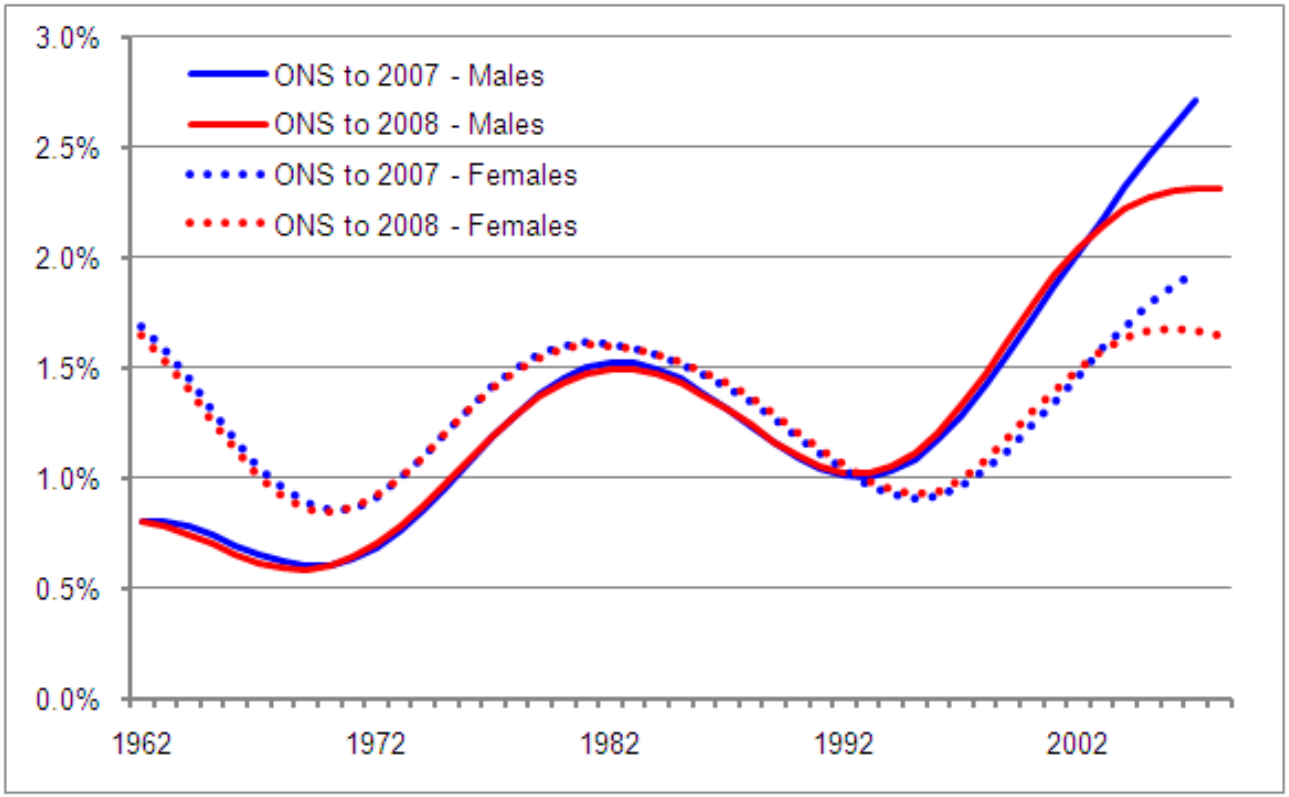


# Estimated Mortality Improvement Rates

Estimated Period Component of Mortality Improvement, 1962-2008
Population of England & Wales



# The Effect of Adding Data for 2008

- Addition of data leads to revision of estimates
  - Estimates slightly reduced for recent improvement rates
  - Revisions fall within expected range
  - … and show methodology gives relatively stable results
- Cohort EoLs fall on average by:
  - around 0.4% for males
  - around 0.7% for females
  - [+1% on long-term rate increases EoL by 5% at age 65]

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# Proposed Output (subject to further review in CMI)

- An updated version of the Model & User Guide
  - Updated for 2008 data, but no other material change
  - User Guide will include documentation of default values
- A Working Paper
  - Summary of feedback received through the consultation
  - Commentary, setting out working party responses
  - The effect of adding data for 2008
- Timing:  Late October / early November 2009

# Possible Future Research Work

- Key potential research topics include:
  - Quantifying uncertainty, including in initial rates
  - Alternative datasets - variation within the population
  - 'Hind-casting' / back-testing the Model
  - Further future mortality scenarios by cause-of-death
  - Analysis of drivers of mortality change (cohort features)

- May be advanced by the CMI and others

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