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Continuous Mortality Investigation

Working Paper 55

The CMI Mortality Projections Model, CMI_2011

September 2011

Executive Summary

In November 2009 the CMI published a new mortality projections model, denoted 'CMI_2009'. In November 2010, an updated version of the model, CMI_2010, was published alongside CMI Working Paper 49. The Model has now been updated again and CMI_2011 has been published alongside this paper together with its User Guide.

The structure of the CMI_2011 Model is identical to that of the previous versions; however, the default parameters contained in the Model have been updated to reflect the publication of England & Wales population mortality data for calendar year 2010.

The CMI Mortality Projections Committee has changed its process of working with the population data published by the ONS. To allow earlier release of the updated Model, the CMI now seeks to mirror the calculation algorithm used by the ONS to produce high-age population estimates rather than waiting for the ONS to publish that part of the required data. Any loss of accuracy from this approach is expected to be minimal and to be considerably outweighed by the benefits of releasing the Model earlier. Further details of this change of process are set out in CMI Working Paper 54.

This Working Paper illustrates the impact of incorporating data for 2010. The change in the smoothed P-spline estimates of the annual rates of mortality improvement, resulting from extending the dataset, is discussed. The overall results of projections, expressed in terms of expectations of life, from CMI_2011 are compared with those from CMI_2010.

At an aggregate level, mortality rates fell more slowly from 2009 to 2010 than in the previous year. All-age standardised mortality falls of 2.7% for males and 1.1% for females followed the unusually large drop (4.4% and 6.5%) from 2008 to 2009. It remains difficult to draw conclusions regarding the current trajectory of rates of mortality improvement.

The default Initial Rates of Mortality Improvement are higher than those published in CMI_2010 at the youngest and oldest ages, for both males and females, but the comparison is more complex between ages 40 and 90 with estimates higher at some ages and lower at others. The revised estimates show some modest shape changes by age, particularly for males where the profile of the main 1931-centred cohort feature has altered with improvement rates reduced for ages 65 to 80 and the cohort peak possibly spreading to slightly later ages / earlier cohorts.

Core Projections generated by the CMI_2011 Model produce expectations of life which are generally slightly lower than those produced by CMI_2010 (with other parameters held constant) for males, and slightly higher for females.

Sample projected annuity values and expectations of life are included in the paper to illustrate the sensitivity of CMI_2011 to the key parameter, the Long-Term Rate of Mortality Improvement. The relative significance of the sensitivity of CMI_2011 to other parameters is essentially unchanged from that of earlier versions of the Model, but such tests are not illustrated in this paper.

Overall, the CMI believes that the CMI_2011 Model has shown a smooth evolution from the CMI_2010 Model. The paper illustrates that the degree of change between the two versions is small compared to the sensitivity to the Long-Term Rate of Mortality Improvement.

Contents

1. Introduction

1.1. Background

In November 2009 the CMI published a new mortality projections model, denoted 'CMI_2009'. The Model was released in response to the continuation of significant year-on-year increases in life expectancy, and to concerns over the continued widespread use, albeit with modifications, of the Interim Cohort Projections which inevitably became increasingly out-of-date.

In producing the Mortality Projections Model, the CMI sought to develop a model which:

- reflects the latest experience on trends in mortality;
- is relatively straightforward to understand and describe;
- allows users the flexibility to modify projections tailored to their own views and purpose; and
- can be regularly updated over time to reflect emerging experience.

The release of the CMI_2009 Model followed a consultation on the prototype Model, which was issued alongside two Working Papers: CMI Working Paper 38 provided an overview of the Model and set out specific questions for the consultation; CMI Working Paper 39 detailed further analysis to help inform the setting of parameter values for the Model.

CMI Working Paper 41 summarised the responses to this consultation and also provided details of the updated default parameters in the CMI_2009 Model to reflect the publication of England & Wales population data for calendar year 2008.

In November 2010, an updated version of the Model, CMI_2010, was published alongside CMI Working Paper 49. The structure of the CMI_2010 Model was identical to that of CMI_2009; however, the default parameters were updated to reflect the publication of England & Wales population mortality data for calendar year 2009.

The Model has now been updated again and CMI_2011 has been published alongside this paper together with its User Guide.

1.2. Changes from CMI_2010

The structure of the CMI_2011 Model is identical to that of the two previous versions, CMI_2009 and CMI_2010.

The principal purpose of this annual update of the Model is to incorporate 2010 population mortality data into the default Core parameters for the Initial Rates of Mortality Improvement. Other changes have been kept to a minimum:

- The naming convention has been updated to refer to CMI_2011
- The default Calculation Date on the [Sample EoL & Annuities] worksheet has been changed to 31/12/2011.

These changes are described in more detail in section 6 of the CMI_2011 User Guide, whilst the impact of the updated ONS data is discussed in section 3 of this paper.

The CMI Mortality Projections Committee has changed its process of working with the population data published by the ONS. To allow earlier release of the updated Model, the

CMI now seeks to mirror the calculation algorithm used by the ONS to produce high-age population estimates rather than waiting for the ONS to publish that part of the required data. Tests based on prior years' data have led the CMI to conclude that any loss of accuracy from this approach is minimal and is considerably outweighed by the benefits of releasing the Model earlier each year. The intention to change the approach was set out in CMI Working Paper 54, together with further details of the process. All the feedback received to the proposal was supportive.

The Committee has previously indicated that it would undertake a wider review of the Model's structure and parameterization when this is felt necessary, in particular to take account of how the Model is being used in practice. It was envisaged that a general review would be carried out every five years at the latest to include areas such as the end-year of the projections (which has been retained as 2130 in CMI_2011, but will clearly need to be updated in due course). Given that this is the third "live" version of the Model, the Committee expects to consider the timing and nature of this review during the coming year, perhaps with a formal consultation following the release of CMI_2012.

1.3. The Scope of this Working Paper

Sections 2 to 4 of this paper follow the same layout as CMI Working Paper 49. This enables ready comparison of the 2011 update to the Model with the 2010 update.

Section 2 describes the shape of the Initial Rates of Mortality Improvement in 2008 for the Core parameter layer of CMI_2011. This provides an update to the research and data underpinning CMI_2009, detailed in Appendix A to the CMI 2009 User Guide, and CMI_2010, summarised in Section 2 of CMI Working Paper 49.

Section 3 discusses the effect of adding data for calendar year 2010 whilst the impact on sample expectation of life values is shown in Appendix A.

Section 4 illustrates the sensitivity of CMI_2011 to the key parameter, the Long-Term Rate of Mortality Improvement.

1.4. Feedback on this paper

As the changes made in the latest version of the Model are limited, the CMI is not undertaking a consultation exercise on these revisions.

Feedback is always welcome, though, and any comments on this Working Paper and the Model can be sent via e-mail to projections@cmib.org.uk or in writing to: CMI, Cheapside House, 138 Cheapside, London, EC2V 6BW. Such comments will be considered for future work.

Initial views on the scope and timing of a wider review of the Model's structure and parameterization that might inform the Committee's thinking are also invited.

2. Derivation of Default Values for the Core Parameter Layer

The approach used to derive the default values for CMI_2011 is essentially unchanged from that used for CMI_2009 and CMI_2010. This section comprises updated figures and charts for the new, extended dataset, with a brief accompanying commentary.

2.1. Initial Rates of Mortality Improvement

2.1.1. Initial Aggregate Rates of Mortality Improvement

The default tables for Initial Rates of Mortality Improvement cover calendar years 1991 to 2008 and contain values for individual ages, separately for males and females. These rates represent the total rate of improvement by age, year and gender before any split into Age/Period and Cohort Components and are referred to as 'aggregate' rates in papers relating to the Model.

These rates of improvement were derived using a P-spline age-cohort model fitted to ONS data for the population of England & Wales, for ages from 18 to 102, for the period 1961 to 2010. As well as providing the smoothed data from which to estimate 'current' rates, this approach automatically also provides rates for earlier years on a consistent basis.

The 'current' (initial) rates of mortality improvement are taken as those for calendar year 2008, that is: $r_{x,2008} = 1 - \{ q_{x,2008} \div q_{x,2007} \}$. The first year of the projection is therefore assumed to be 2009. This reflects the previously confirmed view that 2 years inside the edge of the available data is the latest year for which sufficiently robust estimates of rates of mortality improvement may be made at present.

The derived estimates of aggregate Initial Rates of Mortality Improvement for calendar year 2008 are shown in Figure 1.

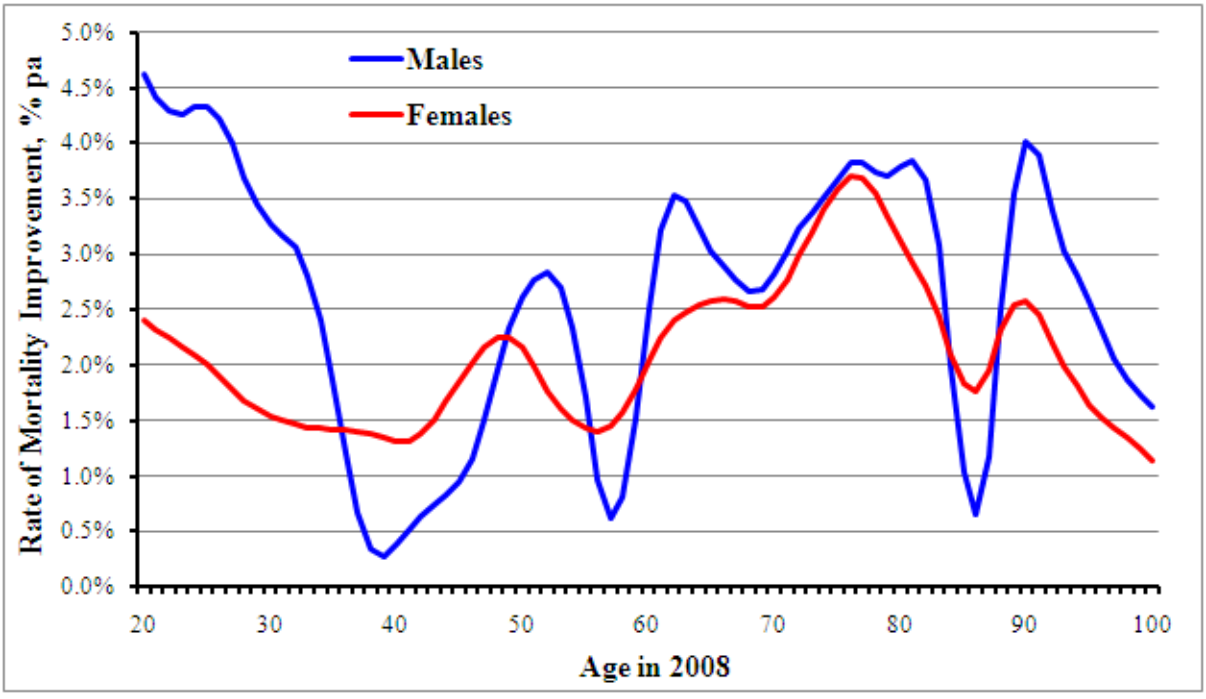

Figure 1: Estimated aggregate Initial Rates of Mortality Improvement; 2008

2.1.2. Split of Initial Rates into Age/Period Component and Cohort Component

The Model design incorporates splitting Initial Rates of Mortality Improvement into two components: Age/Period and Cohort Components. This approach has been retained for CMI_2011. This section illustrates the split of aggregate Initial Rates of Mortality Improvement into the two components for CMI_2011.

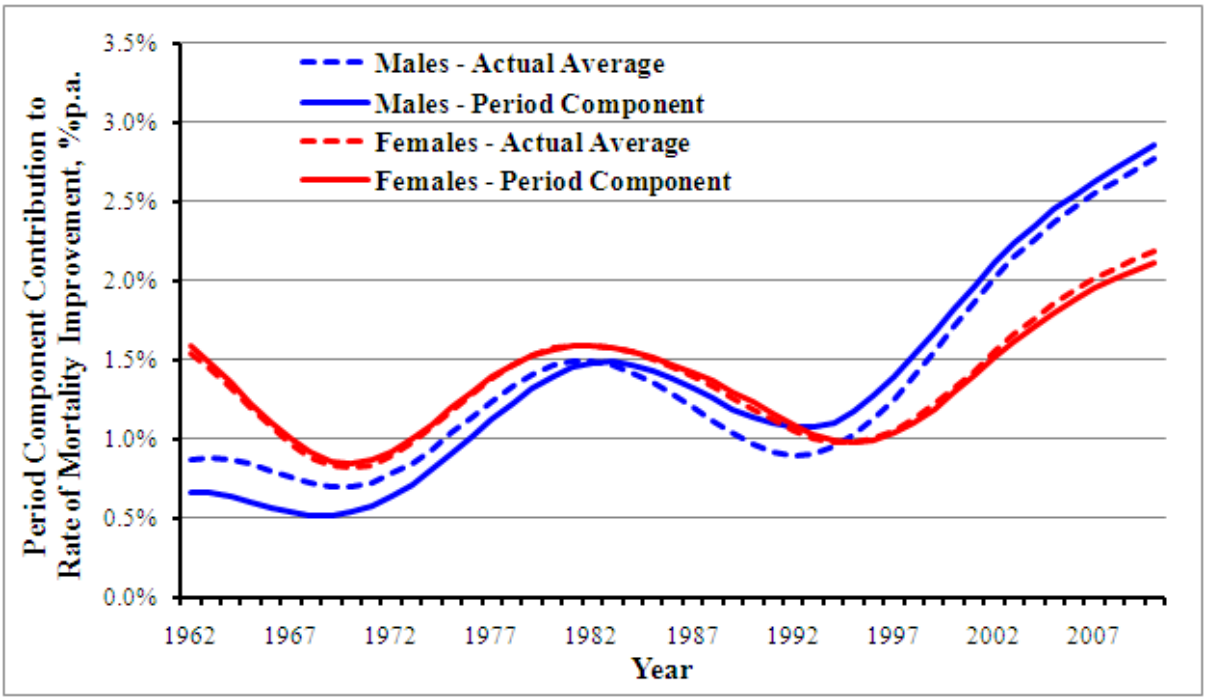

Figure 2: Comparison of the Period Components derived in APC Model with the All-Age Average Rates of Mortality Improvement

Figure 2 shows the period components derived from the Age-Period-Cohort (APC) model and compares them with the actual average (across ages 18 to 102) rate of improvement by calendar year. The close match between the APC model period component and the actual averages reflects the constraints applied (which are unchanged from CMI_2009 and CMI_2010; see section A1.2 of the CMI_2009 User Guide).

Figures 3 and 4 show the age, period and cohort components from the fitted APC models, for males and females respectively. Also shown are the residual errors.

Reasonableness checks were performed on the age, period and cohort components, for example by comparison with analysis of the underlying population data and with those in the two previous versions of the Model. The residual errors were allocated in an identical manner to previous Model versions – the errors below age 30 were allocated to the Age/Period Component and those above age 60 to the Cohort Component, with a linear transition in between. In addition, the fitted Cohort Component was constrained to be zero near the edges of the data and in particular up to age 30 (as there are too few years' data, and too much 'noise' in the data at young ages, to form a safe conclusion on cohort components).

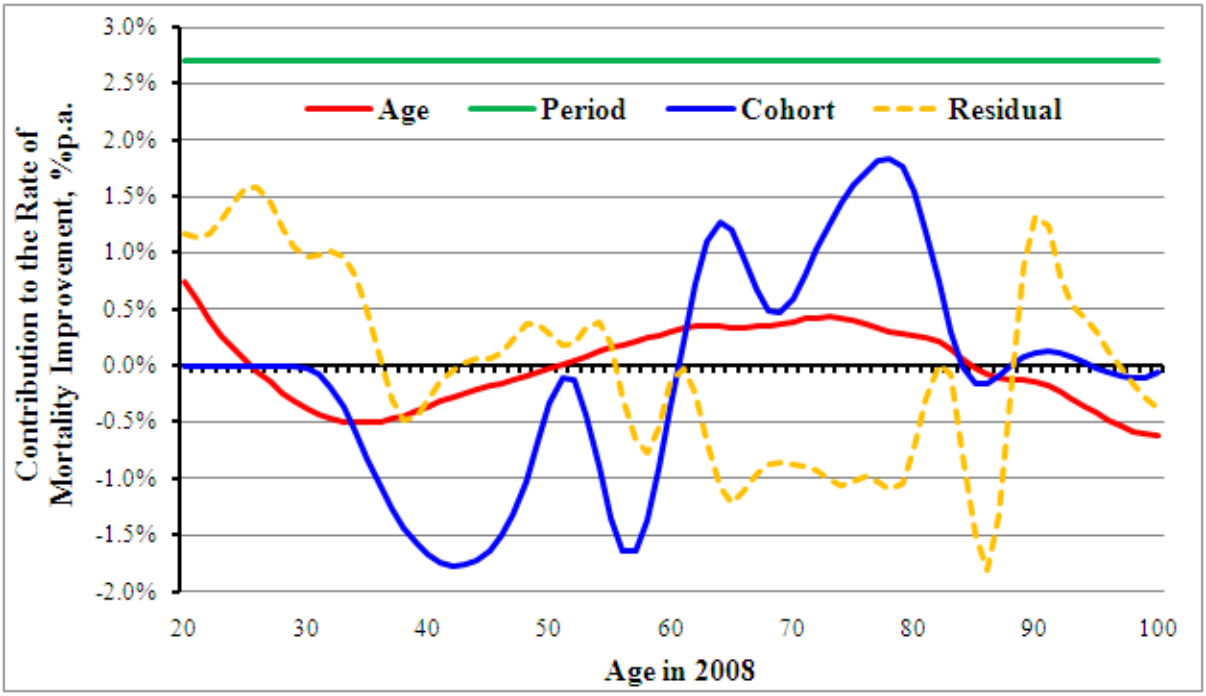

Figure 3: Results Derived from Fitted APC Model, Males; 2008 Age, Period and Cohort Components, plus Residual Errors

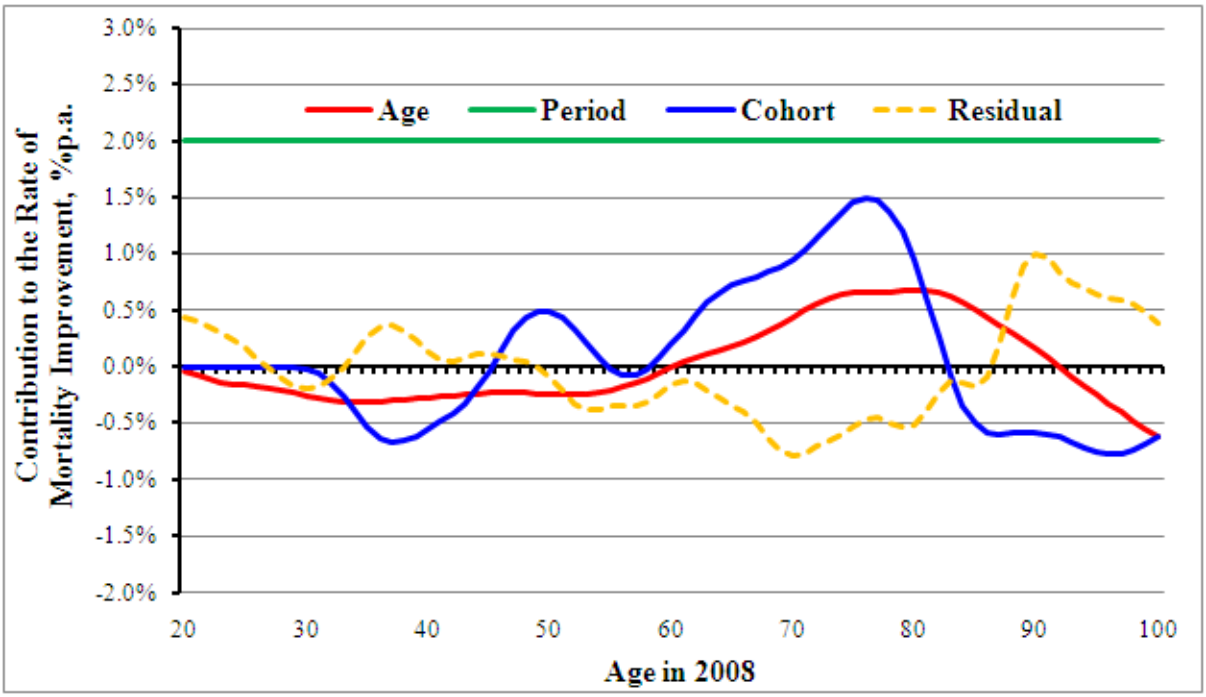

Figure 4: Results Derived from Fitted APC Model, Females; 2008 Age, Period and Cohort Components, plus Residual Errors

Figures 5 and 6 show the final derived Age/Period and Cohort Components of the Initial Rates of Mortality Improvement.

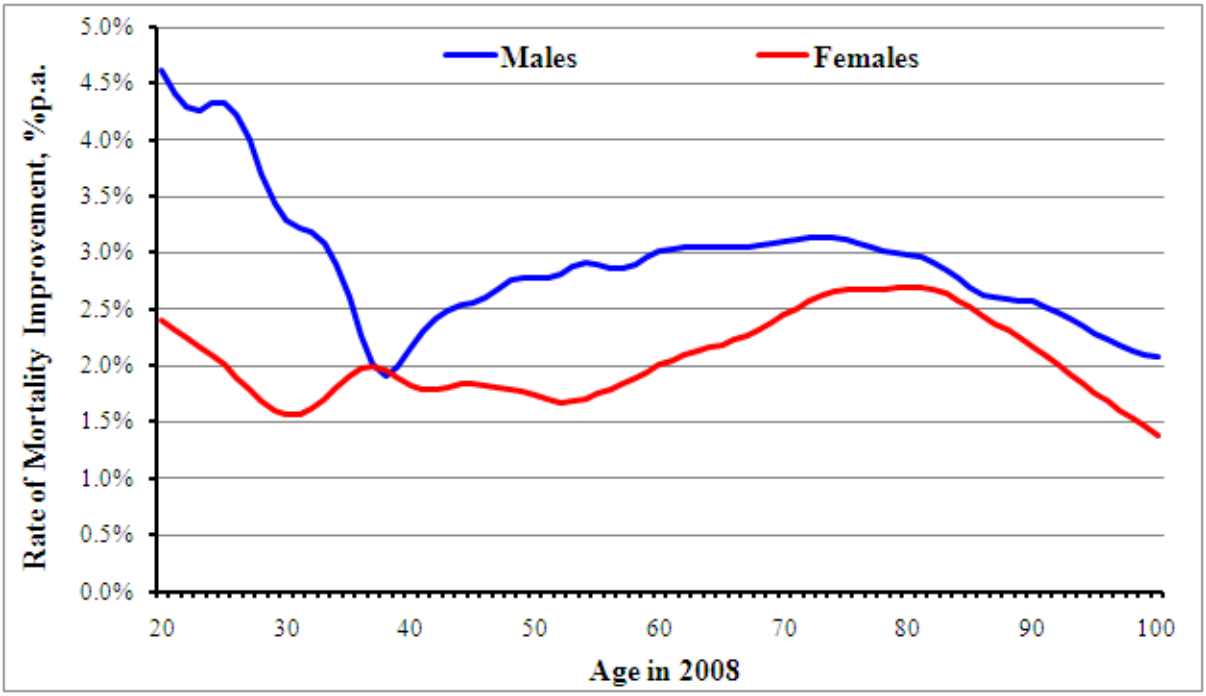

Figure 5: Estimated Age/Period Component of Initial Rates of Improvement; 2008

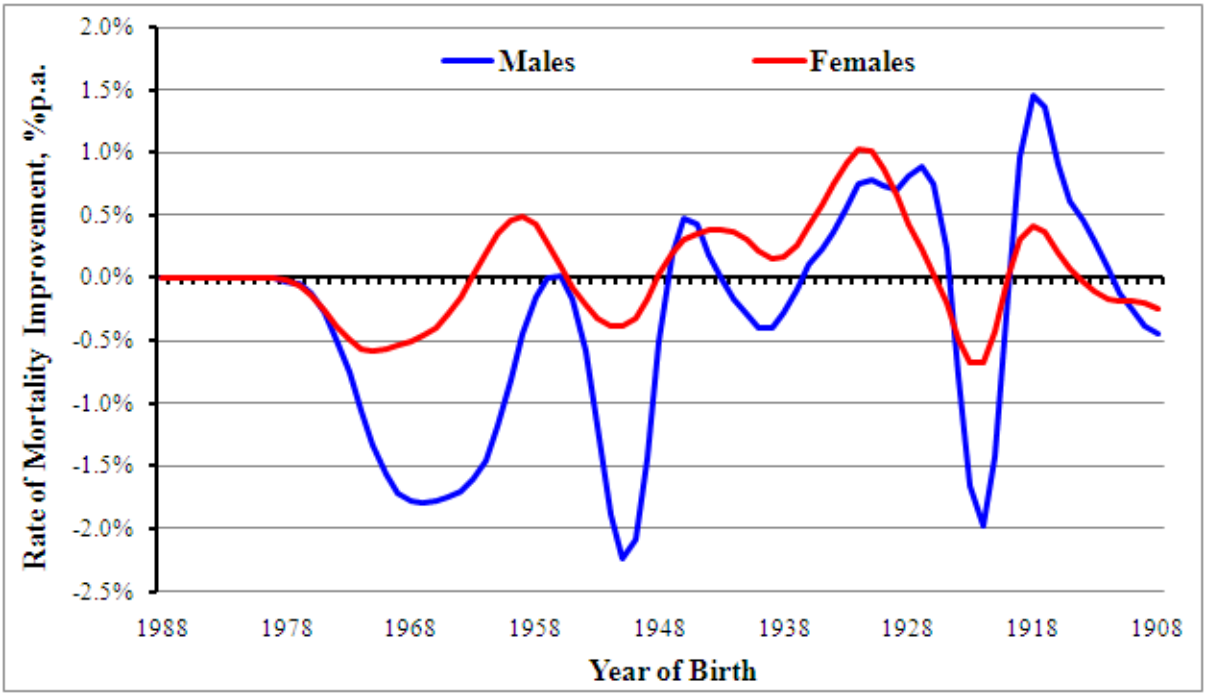

Figure 6: Estimated Cohort Component of Initial Rates of Improvement; 2008

2.2. Convergence

The Model assumes that Initial Rates of Mortality Improvement converge towards Long-Term Rates of Improvement. The convergence path is controlled by two sets of parameters:

- The Period of Convergence, and
- The Proportion of Convergence Remaining at the Mid-Point of the Convergence Period.

The convergence process is operated separately for Age/Period and Cohort components, and both sets of parameters may be varied by age and by year-of-birth cohort respectively for the two components.

The default value of 50% for the Proportion of Convergence Remaining at the Mid-Point of the Convergence Period has been retained in CMI_2011.

For the Convergence Period, the Committee again decided to maintain:

- the default parameter values for the periods of convergence for Age/Period Components in the CMI_2011 Model, and
- the approach taken to setting the default values for the periods of convergence for Cohort Components in the CMI_2011 Model. This approach assumes that the periods run to age 100, subject to a minimum of 5 years and a maximum of 40 years; as a result, the default periods of convergence for the Cohort Components have reduced by one year compared to CMI_2010 for year-of-birth cohorts from 1913 to 1947.

The default values are therefore unchanged from the pattern shown in Figure A.7 of the CMI 2009 User Guide, which illustrated the convergence periods by current age. (The question of whether to maintain the length of the convergence periods, moving the end-point on by one year, or to fix the end-point from which the Long-Term Rates of Improvement apply was discussed in the context of CMI_2009 – see section 2.11 of CMI Working Paper 41.)

As with all the default Core parameter values, users can change these periods using the Advanced parameters within the Model if they wish.

3. The Effect of Adding Data for Calendar Year 2010

3.1. Changes to the Population Dataset for England & Wales

Default values for Initial Rates of Mortality Improvement in the Core parameter layer of the CMI_2011 Model, issued alongside this paper, were derived from ONS data for the population of England & Wales, covering calendar years from 1961 to 2010. The base year for the projection in CMI_2011 is 2008. The corresponding dataset to 2009 was used in the CMI_2010 Model, with a base year of 2007.

To allow earlier release of this version of the Model, the Committee has changed its process of working with the population data published by the ONS. In previous years the ONS has provided a consolidated dataset of death registrations and population estimates, by single year of age from 0 to 104 and grouped for ages 105+ and by calendar year from 1961 to 2009. To construct the required dataset for use in parameterising CMI_2011, the CMI has extended and updated that dataset by using two separate component datasets issued by the ONS:

- 2010 death registrations data for England and Wales (ages 0 to 104, 105+)
- Mid-2010 population estimates for England and Wales (ages 0 to 89, 90+).

To complete the dataset, the CMI has sought to mirror the calculation algorithm used by the ONS to produce high-age (90+) population estimates, rather than waiting for the ONS to publish that part of the required data. Further details of this change of process are set out in CMI Working Paper 54.

The ONS has not made any changes so far in 2011 to prior year deaths or population estimates for ages up to 89. However, the iterative method used to derive the population estimates for ages 90+ leads naturally to some small changes 'rippling back' to earlier years at those ages. These changes do not have a significant impact on derived mortality rates, with the majority of changes to $m_{x,t}$ typically being within 1% (of $m_{x,t}$). Furthermore, tests based on prior years' data suggest that any loss of accuracy from the CMI's mirroring of the ONS calculations at high ages is minimal in the context of using the estimates in the Model.

The remainder of this section discusses the impact of this data extension on the Model. A similar discussion on the impact of adding 2009 data is contained in section 3 of CMI Working Paper 49 (and of adding 2008 data in CMI Working Paper 41). The impact on selected cohort expectation of life values is illustrated in Appendix A to this paper.

3.2. Observed Rates of Mortality Improvement to 2010

At an aggregate level, mortality rates fell more slowly from 2009 to 2010 than in the previous year. This is illustrated in Table 1, which shows crude annual mortality improvement rates for all-age mortality (ages 18-102, age-standardised using 2001 population estimates) for recent years.

Table 1 shows there is considerable variation in mortality from year from year, even at the all-age level for the population of England and Wales. It is therefore necessary to apply some form of smoothing mechanism over time in order to try to detect time trends.

Table 1: Observed Crude Annual Mortality Improvement Rates
England & Wales Population, ages 18-102

Year	Males	Females
2001	+3.0%	+1.8%
2002	+1.5%	+0.1%
2003	+1.7%	-0.5%
2004	+5.4%	+6.2%
2005	+2.7%	+0.9%
2006	+3.5%	+4.0%
2007	+2.5%	+0.9%
2008	+1.5%	+0.2%
2009	+4.4%	+6.3%
2010	+2.7%	+1.1%

For the avoidance of doubt, a positive value in Table 1 (and for the mean difference in Table 2) means that mortality rates have fallen.

3.3. Changes in Estimates of Current Aggregate Rates of Mortality Improvement

In order to calculate default values for initial rates of mortality improvement, P-spline age-cohort models were again fitted to the population dataset. As expected, the addition of a year's data does affect the fitted surface for earlier years. Table 2 shows two measures of the difference in estimated mortality improvement rates for recent years – the all-age mean difference, and the all-age mean absolute difference (calculated over the age range 18-102).

Table 2: Mean Difference and Mean Absolute Difference
in fitted P-spline model Estimates of Annual Rates of Mortality Improvement (%)
for the 1961-2010 dataset minus the 1961-2009 dataset
England & Wales Population, ages 18-102

Year	Mean Diff		Mean Absolute Diff	
	Males	Females	Males	Females
2001	-0.01	+0.00	0.14	0.06
2002	-0.01	+0.00	0.15	0.06
2003	+0.00	+0.00	0.15	0.07
2004	+0.02	+0.00	0.16	0.08
2005	+0.05	+0.01	0.17	0.09
2006	+0.08	+0.01	0.19	0.10
2007	+0.13	+0.01	0.22	0.11
2008	+0.17	+0.01	0.27	0.13
2009	+0.21	+0.00	0.33	0.15

For the avoidance of doubt, the value of +0.17 for the Mean Difference in Table 2 for males in 2008, for example, corresponds to an increase in the mean mortality improvement rate for that year from 2.46% p.a. using the 1961-2009 dataset to 2.63% p.a. using the 1961-2010 dataset.

For males, the differences are of similar magnitude to those illustrated in the corresponding table last year (see Table 2 of CMI Working Paper 49), whilst those for females are considerably smaller. For both they are smaller than the differences derived in the back-

testing of the prototype model (see section 3.1.2 of CMI Working Paper 39) and suggest there is nothing unusual about the development of the time-series data.

Figures 7 and 8 compare the estimates for mortality improvement rates in 2007 (in CMI_2010, based on ONS data to 2009) with revised estimates (based on data to 2010) for males and females, respectively. The estimates for 2008 (based on ONS data to 2010) are also shown. The revised estimates show some modest shape changes by age.

Whilst the estimated improvement rates at the youngest and oldest ages, for both males and females, are noticeably higher in the latest dataset, the comparison is more complex between ages 40 and 90 with estimates higher at some ages and lower at others. In particular, the profile of the main 1931-centred cohort feature for males has altered with improvement rates reduced for ages 65 to 80 and the cohort peak possibly spreading to slightly later ages / earlier cohorts.

The Committee has made no changes to the run-off patterns used at the oldest ages in CMI_2011, although the absolute values will be different and the higher values at age 100 will mean improvement rates now reach zero at a higher age than in CMI_2010.

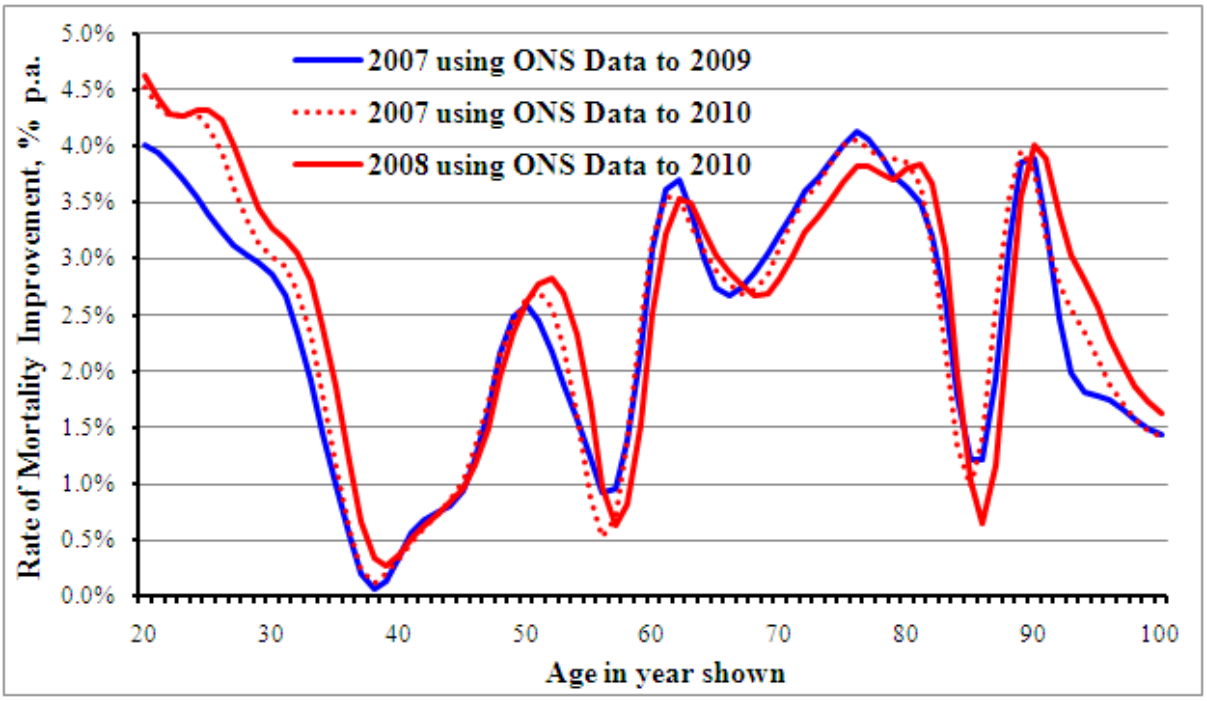

Figure 7: Estimated Aggregate Rates of Mortality Improvement, by age and dataset
Males, England & Wales Population
Estimates derived by fitting P-spline age-cohort models

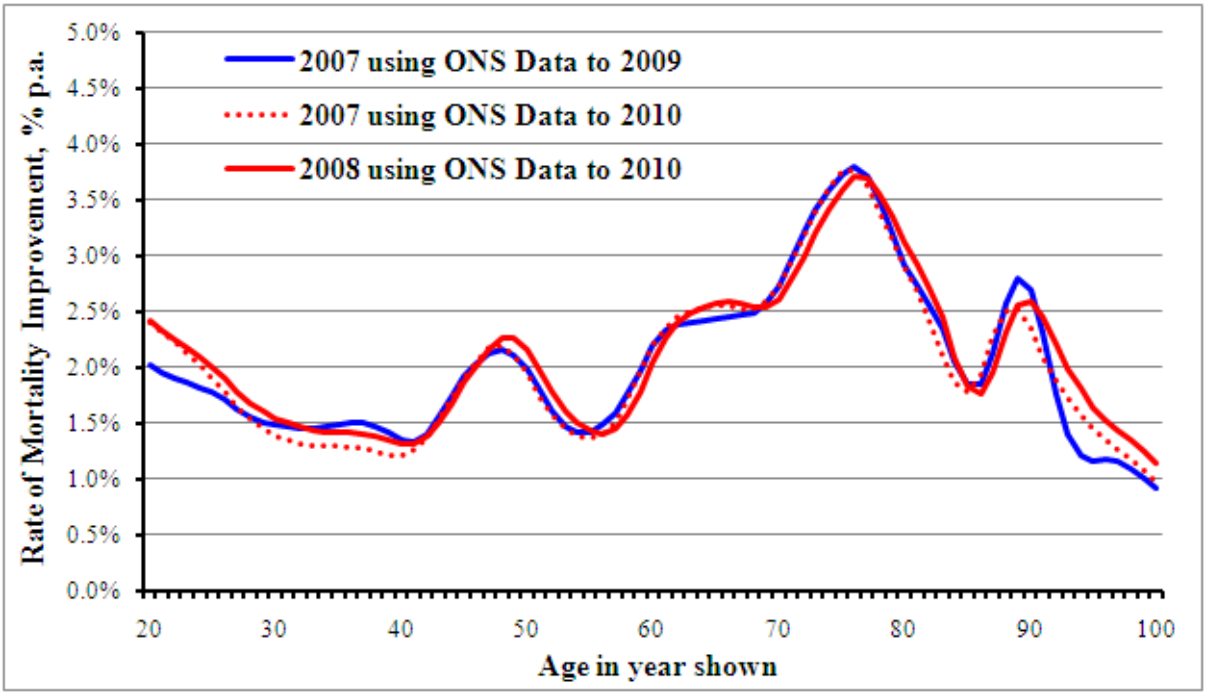

Figure 8: Estimated Aggregate Rates of Mortality Improvement, by age and dataset
Females, England & Wales Population
Estimates derived by fitting P-spline age-cohort models

Note that the x-axis for both Figure 7 and Figure 8 shows the age in the year the estimate relates to – 2007 or 2008 – hence there is a tendency for the improvements for 2008 to move one year to the right. (This applies also to the Cohort Components shown in Figures 9 and 10, below.)

3.4. Changes in Estimates of Components of Current Rates of Mortality Improvement

The Age/Period and Cohort Components for the 2008 Initial Rates of Mortality Improvement were again determined by fitting the Age-Period-Cohort (APC) model. The results are shown in Figures 9 and 10, together with the 2007 components used in CMI_2010.

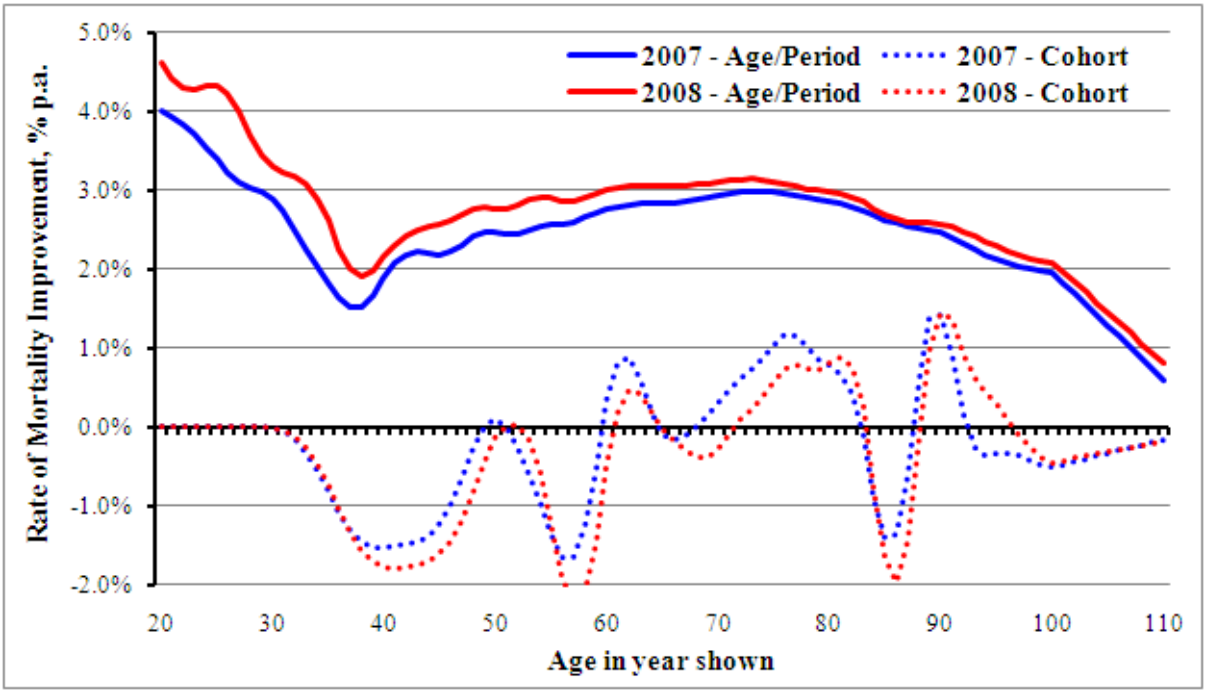

Figure 9: Estimated Age/Period and Cohort Components of Mortality Improvement, by age and dataset; Males, England & Wales Population
Estimates derived by fitting APC models to smoothed mortality improvement rates

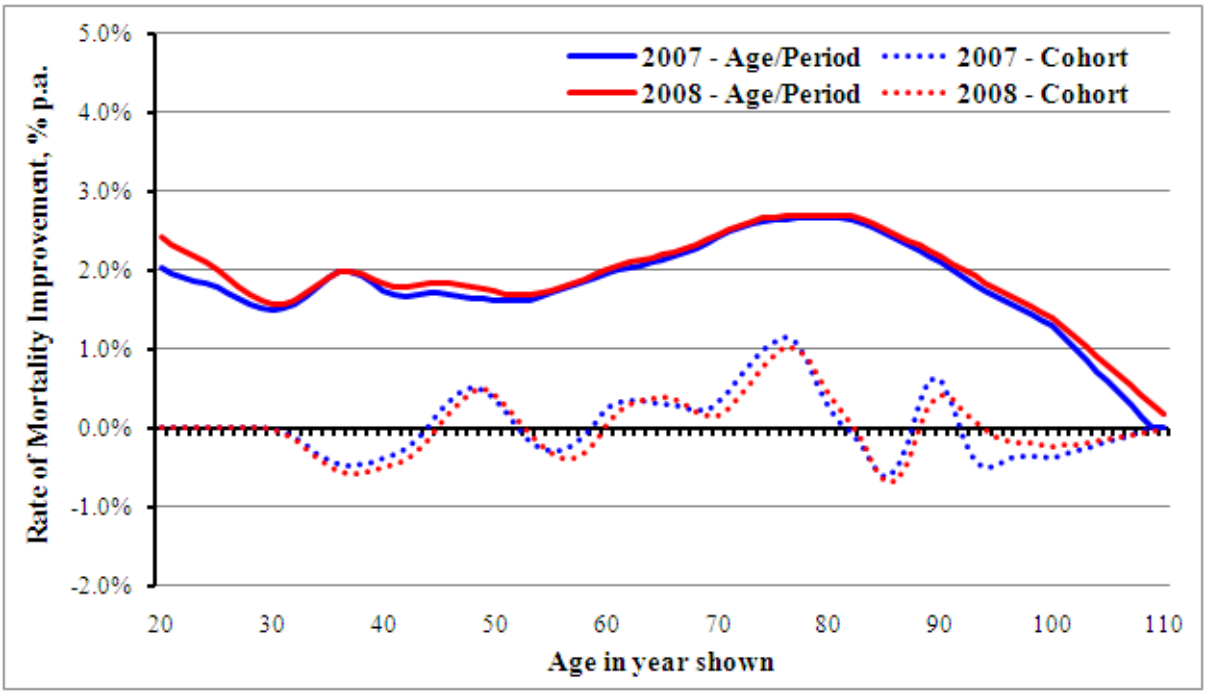

Figure 10: Estimated Age/Period and Cohort Components of Mortality Improvement, by age and dataset; Females, England & Wales Population
Estimates derived by fitting APC models to smoothed mortality improvement rates

Figure 11 illustrates how the Period Components have changed across the three "updates" to the Model to date. This degree of change, resulting from the addition of each year's data emphasises the difficulty in drawing sound conclusions regarding the current trajectory of rates of mortality improvement. Indeed, the lower trajectory apparent from including the 2008 data has been almost fully reversed by the 2009 and 2010 data for both males and females.

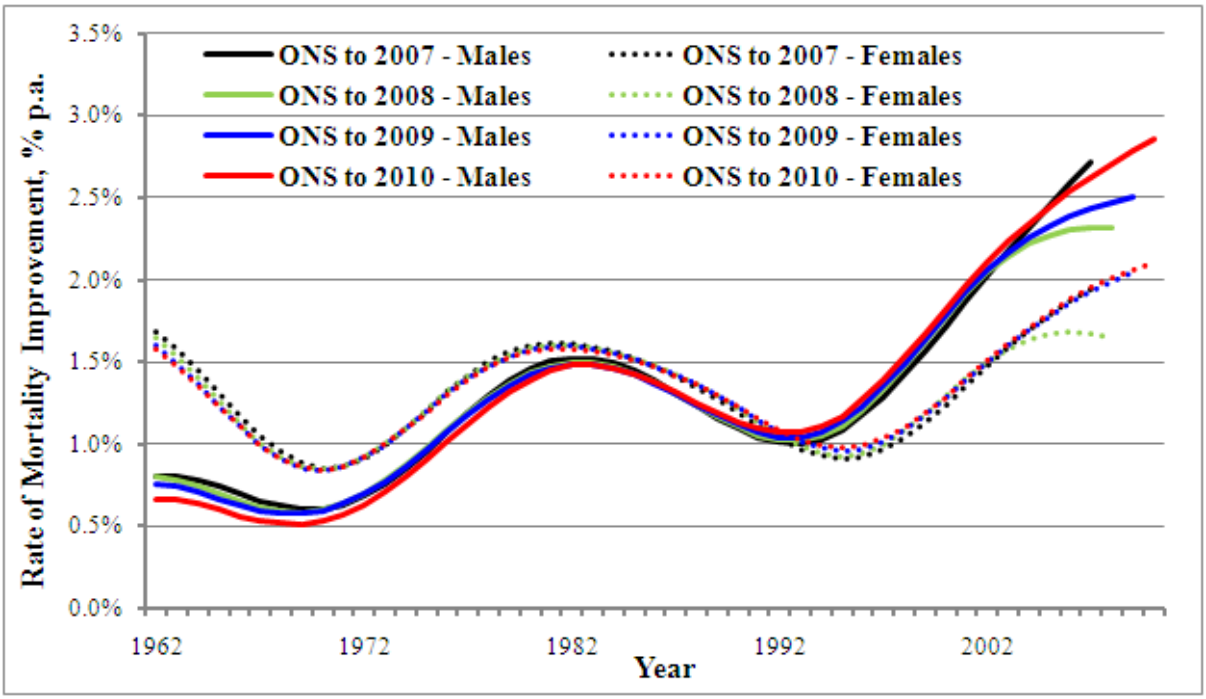

Figure 11: Period Component of the Rate of Mortality Improvement, by year, dataset, and gender; England & Wales Population
Estimates derived by fitting APC models to smoothed mortality improvement rates

3.5. Quantification of the Effect of Reflecting Data for 2010 in the Model

The CMI_2011 version of the Model, published alongside this paper, includes Core parameter default values for Initial Rates of Mortality Improvement as at 2008, derived using population data up to 2010 – that is, taking account of an extra year's observations in the underlying dataset compared with that used for the CMI_2010 Model.

The effect of this change is illustrated in Appendix A by comparing cohort expectation of life values at a range of ages, for males and females, using a Long-Term Rate of Mortality Improvement of 1.5% p.a. In summary, depending on the type of business under consideration, cohort life expectancies have:

- **decreased** by around 0.2% to 0.5% for **male** lives at most ages (but increased at ages above 85); and
- **increased** by around 0.1% to 0.3% for **female** lives at most ages (and by a little more at very high ages).

To put this in context, increasing the Long-term Rate of Mortality Improvement by 1% p.a. adds around 5% to cohort life expectancies at age 65.

4. Parameter Sensitivities

When CMI_2009 was issued, it was important that the sensitivity of the new Model to the various parameters was widely understood. In particular:

- Appendix B of the CMI_2009 User Guide contains a large range of sensitivities, illustrated relative to the Medium Interim Cohort Projection.
- A spreadsheet containing the results of a wider range of sensitivity tests was made available for download from the CMI pages of the Actuarial Profession's website.

These sources remain available to users who can, of course, also investigate sensitivities using the Model itself.

For the CMI_2010 and CMI_2011 updates to the Model, the relative significance of the sensitivity of results to the various parameters is essentially unchanged so that little value would be added by producing the full range of sensitivity tests updated for CMI_2011. However, some limited results are shown in this section to emphasise the sensitivity of results to the key parameter, the Long-Term Rate of Mortality Improvement. This analysis corresponds to section 4 of CMI Working Paper 49.

Figures 12 and 13 show sample projected single life annuity values and cohort expectations of life for males for various Long-Term Rates of Mortality Improvement in CMI_2011. All other parameter values are unchanged from their Core values in the Model. The annuity and expectation of life values are calculated on the following basis:

- The values are calculated as at 31/12/2011
- Annuities, based on payments of 1 p.a, are assumed to be payable yearly in advance using a net discount rate of 3.0% p.a.
- The expectation of life values are complete rather than curtate
- The values have been derived using S1PMA base mortality table at 01/09/2002 projected to 2008 using the past rates of mortality improvement contained in the Core parameter layer of the Model, and forward from 2008 using the rates of mortality improvement given by the various projections illustrated.

Note that the y-axes for Figures 12 and 13 do not start at zero.

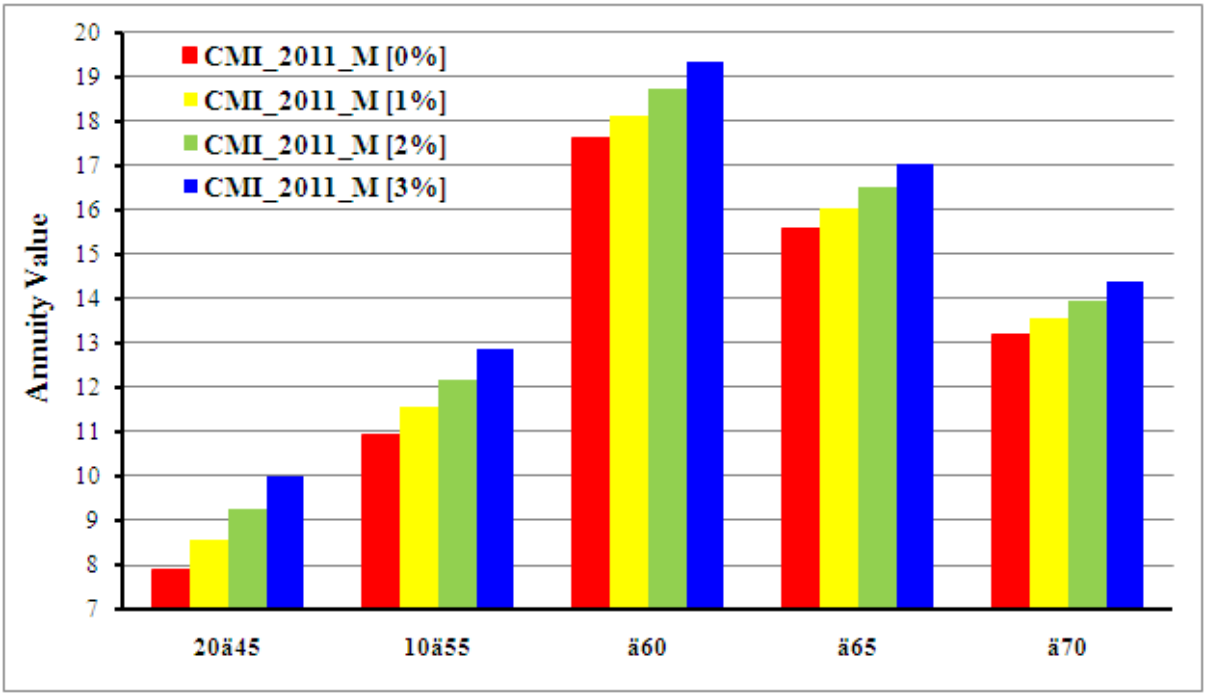

Figure 12: Variation in selected single life annuity values for males, for changes in assumed Long-Term Rate of Mortality Improvement.

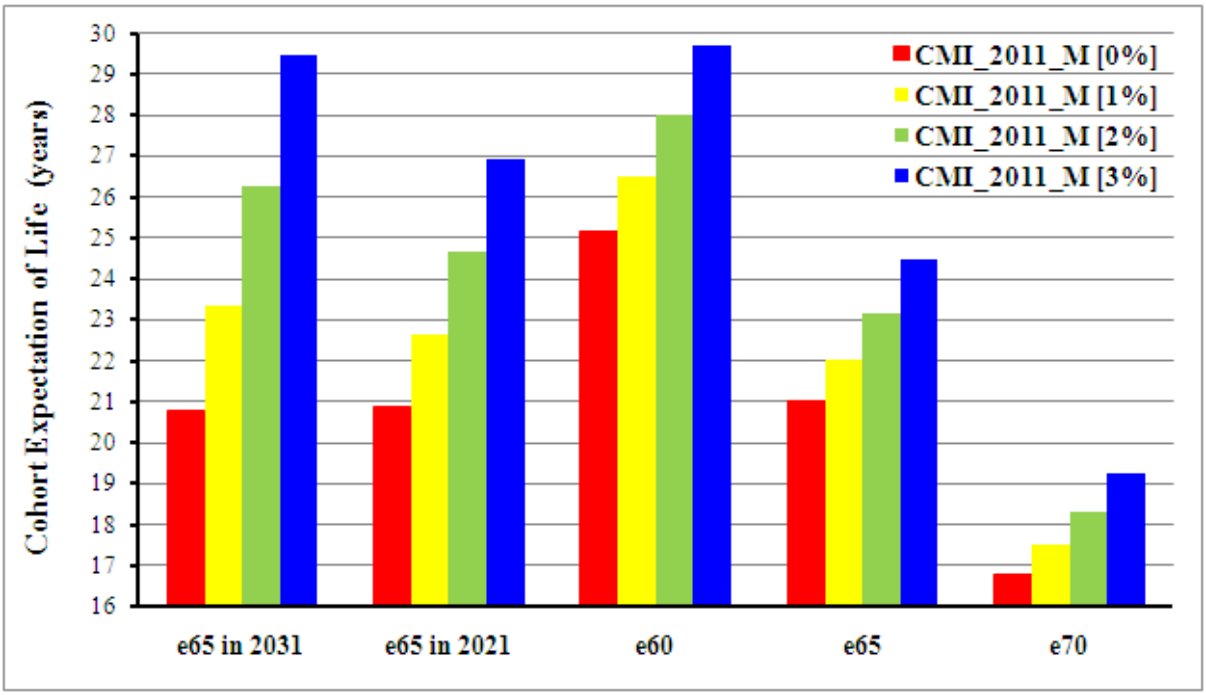

Figure 13: Variation in selected cohort expectation of life values for males, for changes in assumed Long-Term Rate of Mortality Improvement.

References

CMI Working Paper 38 "A Prototype Mortality Projections Model: Part One – An Outline of the Proposed Approach". (2009)

CMI Working Paper 39 "A Prototype Mortality Projections Model: Part Two – Detailed Analysis". (2009)

CMI Working Paper 41 "CMI Mortality Projections Model: Feedback on Consultation and Issue of 'CMI_2009' ". (2009)

CMI Working Paper 49 "CMI Mortality Projections Model: Feedback on Consultation and Issue of 'CMI_2010' ". (2010)

CMI Working Paper 54 "Advancing the release date of the CMI Mortality Projections Model". (2011)

User Guide for the CMI Mortality Projections Model - Model Name / Version: 'CMI_2009' (2009)

User Guide for the CMI Mortality Projections Model - Model Name / Version: 'CMI_2011' (2011)

All of the above may be accessed and downloaded from the CMI pages, under "Research and resources", on the UK Actuarial Profession's website; in particular:

- CMI_2011 and its User Guide are located alongside CMI Working Paper 55
- CMI_2010 and its User Guide are located alongside CMI Working Paper 49
- CMI_2009, its User Guide and the spreadsheet of parameter sensitivity tests are located alongside CMI Working Paper 41.

Appendix A. Sample Expectations of Life from the CMI_2011 Model

A relatively small number of changes have been made between the CMI_2010 Model and the current version, CMI_2011. These are summarized in section 1.2 of this paper and detailed in section 6 of the accompanying User Guide.

The principal change results from incorporating 2010 population mortality data into the default Core parameters for the Initial Rates of Mortality Improvement. The effect of adding in this latest year's data is described in section 3 and illustrated further in this Appendix by showing the impact of these changes on selected cohort expectation of life values.

Cohort expectation of life values, for males and females, for a large grid of model points, are compared for CMI_2011 and CMI_2010 on the following basis:

- Like-for-like Core Projections using a Long-Term Rate of 1.5% p.a.
- Base Rates of Mortality are the published S1PxA tables (for lives aged x exact on 01/09/2002)
- Calculation Date(s) are 31/12/year.

Tables 3 and 5 show the sample expectation of life values produced by CMI_2011, for males and females respectively; Tables 4 and 6 show the percentage change measured against the equivalent values produced by CMI_2010, for males and females respectively.

Tables 4 and 6 show that updating the Core parameters for Initial Rates of Mortality Improvement, to reflect the addition of a further year's observations on England & Wales population mortality experience, has resulted in small decreases in projected cohort expectation of life values for males below age 80, and small increases above age 85 for males and at all ages for females.

Table 3: Cohort Expectation of Life for Age x exact on 31/12/Year
Males ; Base Rates of Mortality = 100% S1PMA as at 01/09/2002
Core Projection: CMI_ 2011_M [1.5%]

Age, x	Year						
	2011	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**
20	70.20	70.96	71.70	72.43			
25	64.52	65.29	66.04	66.77	67.50		
30	58.85	59.62	60.38	61.13	61.86	62.58	
35	53.22	54.00	54.76	55.51	56.25	56.97	57.68
40	47.71	48.46	49.22	49.97	50.71	51.43	52.14
45	42.43	43.06	43.80	44.54	45.27	45.99	46.70
50	37.31	37.89	38.53	39.24	39.96	40.66	41.36
55	32.22	32.87	33.45	34.09	34.77	35.46	36.14
60	27.21	27.87	28.49	29.07	29.70	30.35	31.01
65	22.58	23.01	23.61	24.19	24.77	25.38	26.00
70	17.90	18.61	19.01	19.55	20.11	20.67	21.25
75	13.73	14.29	14.87	15.25	15.75	16.27	16.80
80	9.99	10.55	10.99	11.46	11.83	12.29	12.75
85	6.95	7.44	7.84	8.19	8.58	8.92	9.31
90	4.84	5.10	5.41	5.70	5.98	6.28	6.56
95	3.28	3.46	3.64	3.84	4.04	4.24	4.45
100	2.32	2.44	2.56	2.69	2.82	2.95	3.08

Table 4: % Change in Cohort Expectation of Life for Age x exact on 31/12/Year
Males ; Base Rates of Mortality = 100% S1PMA as at 01/09/2002
Core Projections: CMI_ 2011_M [1.5%] against CMI_2010_M [1.5%]

Age, x	Year						
	2011	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**
20	–0.1%	–0.1%	–0.1%	–0.1%			
25	–0.1%	–0.1%	–0.1%	–0.1%	–0.1%		
30	–0.2%	–0.2%	–0.2%	–0.1%	–0.1%	–0.1%	
35	–0.2%	–0.2%	–0.2%	–0.2%	–0.2%	–0.2%	–0.1%
40	–0.3%	–0.3%	–0.2%	–0.2%	–0.2%	–0.2%	–0.2%
45	–0.2%	–0.3%	–0.3%	–0.3%	–0.2%	–0.2%	–0.2%
50	–0.2%	–0.3%	–0.3%	–0.3%	–0.3%	–0.3%	–0.3%
55	–0.3%	–0.3%	–0.4%	–0.4%	–0.4%	–0.3%	–0.3%
60	–0.4%	–0.4%	–0.4%	–0.4%	–0.4%	–0.4%	–0.4%
65	–0.3%	–0.5%	–0.5%	–0.5%	–0.5%	–0.5%	–0.5%
70	–0.2%	–0.3%	–0.6%	–0.5%	–0.6%	–0.5%	–0.5%
75	–0.1%	–0.2%	–0.4%	–0.6%	–0.6%	–0.6%	–0.5%
80	0.2%	0.0%	–0.2%	–0.3%	–0.5%	–0.5%	–0.4%
85	0.7%	0.5%	0.2%	0.1%	0.0%	–0.2%	–0.1%
90	2.1%	1.7%	1.5%	1.3%	1.1%	1.0%	0.9%
95	2.2%	2.2%	2.0%	1.8%	1.7%	1.6%	1.5%
100	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	1.0%

Table 5: Cohort Expectation of Life for Age x exact on 31/12/Year
Females ; Base Rates of Mortality = 100% S1PFA as at 01/09/2002
Core Projection: CMI_ 2011_F [1.5%]

Age, x	Year						
	2011	2016	2021	2026	2031	2036	2041
20	72.03	72.75	73.46	74.15			
25	66.37	67.10	67.82	68.52	69.21		
30	60.74	61.49	62.22	62.93	63.63	64.30	
35	55.21	55.96	56.69	57.41	58.11	58.80	59.46
40	49.86	50.58	51.30	52.02	52.71	53.39	54.06
45	44.72	45.39	46.09	46.78	47.47	48.14	48.79
50	39.70	40.38	41.02	41.69	42.35	43.00	43.64
55	34.72	35.42	36.06	36.68	37.31	37.94	38.55
60	29.78	30.41	31.06	31.67	32.27	32.87	33.46
65	24.88	25.47	26.06	26.67	27.24	27.82	28.39
70	20.05	20.70	21.24	21.79	22.35	22.89	23.44
75	15.53	16.13	16.70	17.19	17.69	18.20	18.71
80	11.44	12.02	12.51	12.98	13.42	13.87	14.33
85	8.04	8.52	8.94	9.33	9.72	10.10	10.48
90	5.51	5.77	6.09	6.40	6.69	7.00	7.29
95	3.63	3.82	4.01	4.21	4.42	4.62	4.83
100	2.47	2.59	2.72	2.84	2.97	3.10	3.24

Table 6: % Change in Cohort Expectation of Life for Age x exact on 31/12/Year
Females ; Base Rates of Mortality = 100% S1PFA as at 01/09/2002
Core Projections: CMI_ 2011_F [1.5%] against CMI_2010_F [1.5%]

Age, x	Year						
	2011	2016	2021	2026	2031	2036	2041
20	0.1%	0.1%	0.1%	0.1%			
25	0.1%	0.1%	0.1%	0.1%	0.1%		
30	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	
35	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
40	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
45	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
50	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
55	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
60	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
65	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
70	0.2%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%
75	0.2%	0.2%	0.3%	0.3%	0.2%	0.2%	0.2%
80	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
85	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%
90	0.9%	0.8%	0.7%	0.7%	0.7%	0.7%	0.6%
95	1.1%	1.1%	1.0%	1.0%	0.9%	0.9%	0.9%
100	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%