



## CMI\_2017: the latest version of the CMI Mortality Projections Model

March 2018

### Summary

This Briefing note is issued alongside the latest version of the CMI Mortality Projection Model, CMI\_2017. The principal change from CMI\_2016 is to use more recent data (1977-2017 compared with 1976-2016). CMI\_2017 shows lower cohort life expectancies than the previous version, for example with reductions of around 2 months, for both males and females, at age 65.

### Notes

This Briefing note provides an overview of CMI\_2017, the latest version of the CMI Mortality Projections Model (“the CMI Model”). We hope this note will be useful to those who are presented with results from the CMI Model – such as pension scheme trustees and Non-Executive Directors of insurance companies. We strongly encourage actuaries using the CMI Model to formulate assumptions to refer to Working Paper 105 and the associated documentation.

A definitions section is included at the end of this note; defined terms are indicated in ***bold italics***.

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### About the CMI

The Continuous Mortality Investigation (CMI) provides authoritative and independent mortality and sickness rate tables for actuaries advising UK life insurers and pension funds.

The CMI operates as a private company which is wholly owned by the Institute and Faculty of Actuaries (IFoA). The company has a board of two directors, appointed by the IFoA, and an Executive Committee which oversees the CMI’s work. The CMI is funded by subscriptions from commercial users. Subscribers have access to all of the outputs produced by the CMI; these are also made available to academics and researchers for non-commercial use<sup>1</sup>.

A key area of the CMI’s work is to consider future changes in mortality experience, including the development and production of the CMI Model which is the focus of this note.

### Background to the CMI Model

Actuaries need assumptions about ***mortality rates*** in order to:

- set premium rates for life insurance and annuity contracts and then to ensure that insurance companies hold appropriate financial reserves to meet their liabilities; and
- manage the finances of final salary pension schemes that commit to pay members a pension throughout their retirement.

Actuaries often consider these assumptions in two stages – first assessing current mortality rates for that portfolio or pension scheme, perhaps reflecting its own recent experience, and then considering how these rates may change over time. The CMI Model relates only to the second stage.

Many UK pension schemes and insurance companies use the CMI Model either to set their assumptions of how mortality rates will change in future or as a “common language” to communicate assumptions that have been set by another method.

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<sup>1</sup> Details of how to access CMI\_2017, Working Paper 105 and the CMI’s other research can be found on the [CMI section of the IFoA’s website](#). The website also sets out current subscription fees which vary according to the size of the organisation, currently starting at £300 per qualified actuary for a small consultancy.



The CMI Model was introduced in 2009 and has been updated regularly since then:

- to take account of emerging mortality data, with its name (“CMI\_2017”) reflecting the last year of data used in the CMI Model; and
- occasional changes to reflect evolving thinking on the most appropriate methodologies.

## How the CMI Model works

The CMI Model is a model of **mortality improvements**, i.e. reductions in mortality rates from year to year. The CMI Model is based on mortality data for the general population of England & Wales<sup>2</sup>, published by the Office for National Statistics (ONS). We use population data, rather than datasets collected by the CMI, in order to have a consistent dataset over a long period and to reduce volatility by age. Exposure data is based on estimated mid-year populations, derived from decennial censuses, and the CMI makes some adjustments to it where the implied mortality rates are implausible.

Data for males and females are modelled separately, to take account of their different experience; both in terms of mortality rates and mortality improvements.

The CMI Model smooths historical mortality rates, to reduce the effect of volatility, to produce estimates of current mortality improvements by age and gender. It then blends between current and long-term future mortality improvements.

The CMI Model itself does not make an assumption for long-term mortality improvements; users need to make their own assessment about the long term, and different users will have different opinions. So the CMI Model is a framework for mortality assumptions, rather than giving a single answer.

As a minimum, users need to input the long-term rate of mortality improvement. Default values are provided for all the other variables. If none of these variables are changed, this is referred to as the “Core” version of the CMI Model.

## Interpreting results from the CMI Model

As noted above, the CMI Model is a framework to allow others to project mortality, rather than giving an answer itself. However when each version of the CMI Model is published, the CMI also publishes illustrative results, including **cohort life expectancies**, based on commonly-used assumptions. In particular, these life expectancy values depend on the initial mortality rates and on the chosen long-term rate of mortality improvement, as well as the CMI Model itself.

Cohort life expectancy is a subjective measure that depends on assumed future changes in mortality. Although cohort life expectancy, under typical assumptions, has been falling in recent years, this does not necessarily mean that people are living shorter lives but may reflect actuaries assuming lower rates of future mortality improvement.

## The dataset underlying CMI\_2017

CMI\_2017 is calibrated to data for ages 20-100 and calendar years 1977-2017. The previous version, CMI\_2016, was based on 1976-2016.

For the final year of the data, 2017, the CMI makes its own estimate of exposures and estimates deaths based on ONS provisional weekly deaths data. The method used to estimate deaths has changed slightly from that of CMI\_2016; this is the only change in method in the latest version of the CMI Model.

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<sup>2</sup> The CMI Model uses data for England & Wales only, as the relevant data is available earlier than for the whole of the United Kingdom. The CMI has previously demonstrated that the results of the CMI Model would be little different if data for the whole of the UK were used.

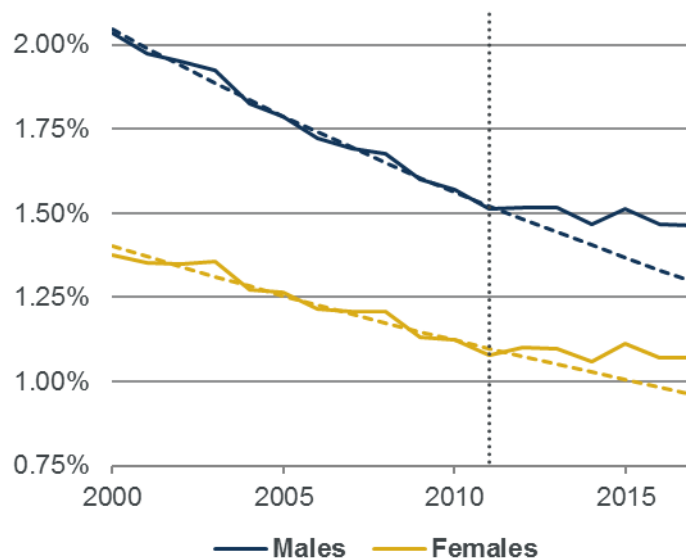


## Recent mortality improvements

Mortality improvements in the general population since 2011 have been much lower than in the earlier part of this century. The smoothed data underlying CMI\_2017 suggests that mortality improvements peaked some time ago with the highest improvements being seen in 2003 for males and 2005 for females.

As shown in Chart 1, **standardised mortality rates** (SMRs) showed fairly steady improvements of 2.7% per year for males and 2.2% per year for females between 2000 and 2011. Subsequent improvements have been much lower; the average mortality improvements over the six years since 2011 have been 0.5% per year for males and 0.1% per year for females – lower than in any other six-year period in the dataset underlying CMI\_2017. The implication of this is that SMRs for males and females in 2017 are 13% and 11% higher than would have been expected from extrapolating the trends in 2000-2011 (shown as dashed lines).

Chart 1: Standardised mortality rates, 2000-2017, males and females



**“...SMRs for males and females in 2017 are 13% and 11% higher than would have been expected from extrapolating the trends in 2000-2011...”**

There is considerable debate about the causes of this slowdown, whether low improvements will persist and for how long. The latest data provides increasing evidence that the low level of recent mortality improvements may be due to medium- or long-term influences, rather than just short-term events such as influenza in early 2015. However almost all users of the CMI Model expect that mortality will continue to improve, even if this is at a slower rate than in the first decade of this century.

## Initial rates of mortality improvement

Initial mortality improvements for the Core version of the CMI Model are lower in CMI\_2017 than in CMI\_2016, reflecting lower mortality improvements in 2017 than would have been expected, based on CMI\_2016. Initial mortality improvements are slightly higher for males than females at most pensioner ages but lower for males than females at the youngest ages.

There is still uncertainty about the appropriate level of initial mortality improvements both for the general population and when applying the CMI Model to other portfolios – such as insured annuitants or pension scheme members – and about how much emphasis should be placed on recent experience. Because of this, we encourage users of the CMI Model to consider the impact of different choices for the CMI Model’s parameters. In particular a new variable – the “period smoothing parameter” – that adjusts how responsive the CMI Model is to new data was introduced in the CMI\_2016 version.

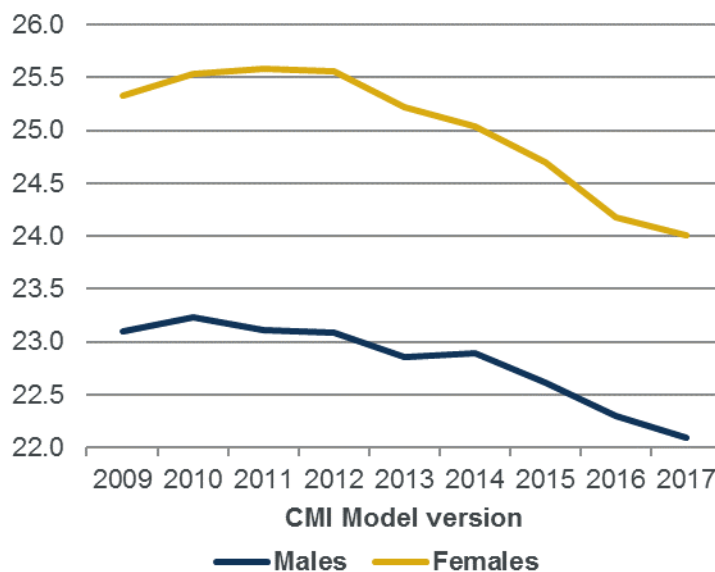


## The impact on life expectancies

The lower initial mortality improvements in CMI\_2017 lead to lower cohort life expectancies than in all previous versions of the CMI Model. Chart 2 shows cohort life expectancies as at 1 January 2018 at age 65 from each version of the CMI Model, using illustrative assumptions of:

- current mortality rates from the latest CMI tables based on pension scheme data; i.e. S2PMA for males and S2PFA for females; and
- a long-term rate of 1.5% per year

**Chart 2: Cohort life expectancies as at 1 January 2018 at age 65 from CMI\_2017 and earlier versions**



***“...CMI\_2017 has lower cohort life expectancies than in all previous versions of the CMI Model...”***

Life insurers are most likely to be interested in how CMI\_2017 compares with the previous version, CMI\_2016. The life expectancies at age 65, shown in the chart above, are around 2 months lower in CMI\_2017, for both males and females, at 22.1 years and 24.0 years, respectively.

In the context of triennial valuations, pension scheme trustees may also be interested in how CMI\_2017 compares with CMI\_2014. Here, the life expectancies at age 65 are 10 months lower for males and 12 months lower for females in CMI\_2017; reflecting the low improvements during the intervening years.



## Definitions

A **mortality rate** is the proportion of people, of a given age and gender, that are expected to die in the following year.

Because mortality rates vary by age and the age-profile of the population changes over time, actuaries and others interested in longevity often use a **standardised mortality rate** (SMR) as a measure of how mortality rates are changing across a range of ages. In Working Paper 105, and the figures quoted earlier in this note, we have used an age range of 20 to 100 and the 2013 European Standard Population as our “constant” age-profile.

A **mortality improvement** measures the reduction in mortality rates from one year to the next. (Note: actuaries typically refer to “improvements”, not “changes” because – over several years – mortality rates tend to fall. However mortality rates in a particular year can be higher than the previous year – perhaps due to a harsh winter or a flu epidemic – giving rise to negative improvements in that year.)

For example:

- Last year an actuary expected 100 of every 1,000 85-year old males to die within a year. This is a mortality rate of 10%.
- This year the actuary expects only 98 of every 1,000 85-year old males to die within a year. This is a mortality rate of 9.8%.
- This year's mortality improvement for 85-year old males is 2%, as they are 2% less likely to die within a year.

Life expectancy is a measure of how long – on average – someone of a particular age and gender will live. There are two different measures of life expectancy, which are sometimes confused:

- Period life expectancy only depends on past mortality rates. It is an objective measure that is often reported by the Office for National Statistics.
- **Cohort life expectancy** also depends on assumed future changes in mortality. It is a subjective measure, and is typically used by actuaries who need to use realistic assumptions about what may happen in the future. Consequently these values are generally used in the CMI's illustrations.

For example, for males aged 65, using the same assumptions as used in Chart 2 in CMI\_2017 at 1 January 2018:

- Period life expectancy is 20.8 years.
- Cohort life expectancy is 22.1 years.
- The cohort life expectancy is higher as it includes an allowance for mortality improvements in 2018 and beyond.

A change in cohort life expectancy does not necessarily mean that people are living longer or shorter lives now, and may just represent a change in views of future improvements. Such a change can also arise from a different view of the long-term rate of mortality improvement, as well as the version of the CMI Model.

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