



Continuous Mortality Investigation

Institute and Faculty of Actuaries



Outlook for mortality improvements

Discussion hosted by SIAS and the CMI Mortality Projections Committee

15 May 2024

Staple Inn Hall, London

The views expressed in this presentation are those of the presenters and not necessarily those of their employers, the CMI or the Staple Inn Actuarial Society.

Agenda

- **Welcome and introduction**
 - Cobus Daneel (CMI)
- **Recent mortality, CMI_2023, and future plans**
 - Neil Robjohns (CMI)
- **Outlook for mortality improvements**
 - Dan Sherratt (Isio)
 - Stephen Courquin (RGA)
- **Discussion**

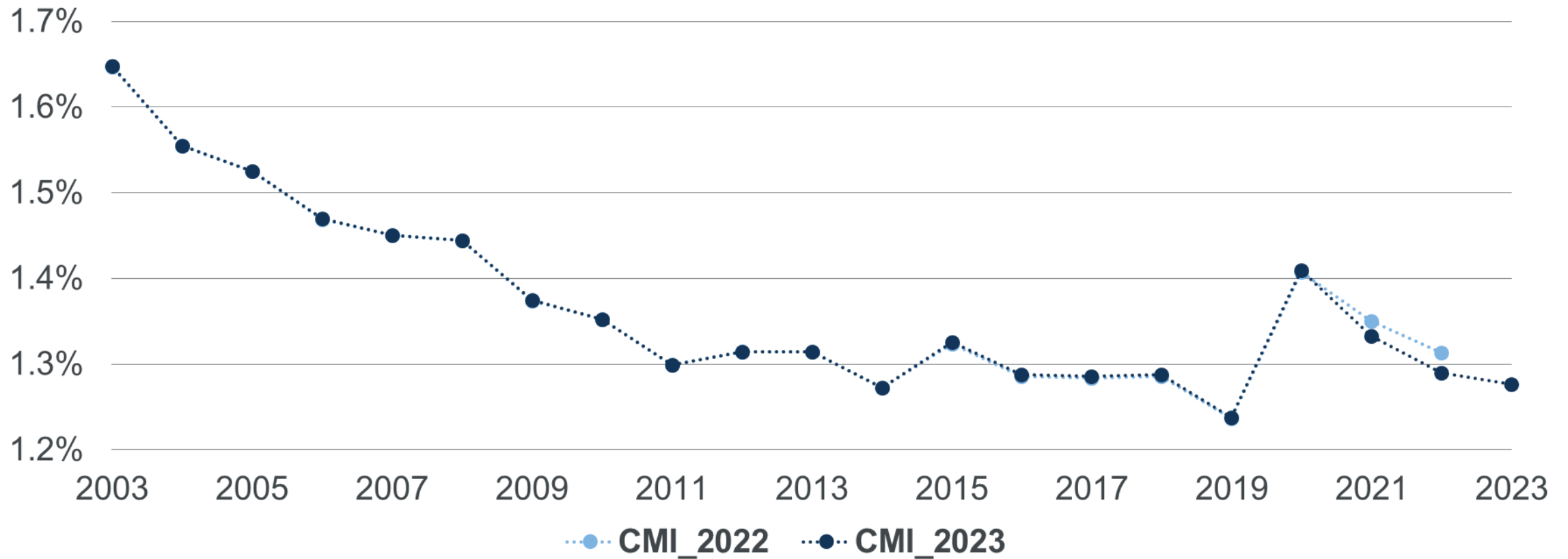
Recent mortality, CMI_2023, and future plans

Neil Robjohns

CMI Mortality Projections Committee

Annual mortality

Age-standardised mortality rates (ASMRs) for England & Wales – ages 20-100, unisex

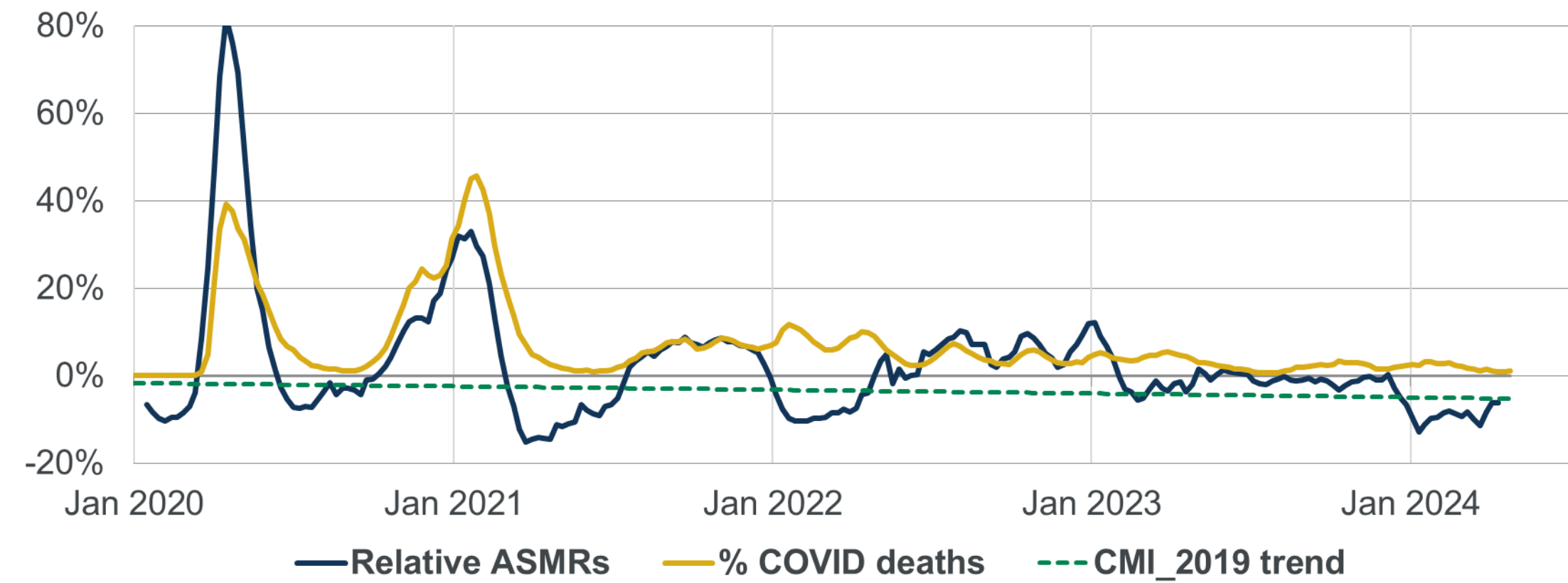


Source: CMI Working Paper 183, based on ONS data



Recent weekly mortality

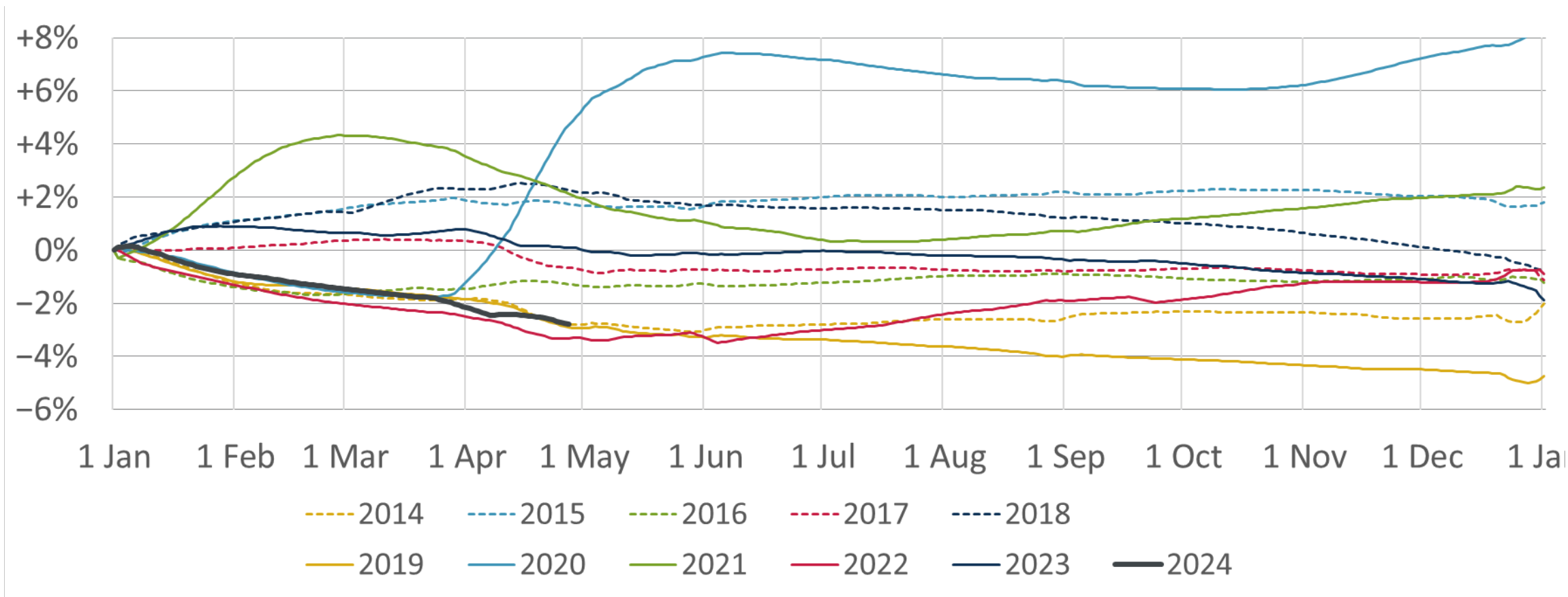
Smoothed (five-week average) ASMRs relative to the 2015-2019 average



Source: CMI calculations based on ONS data. Data to week 17 of 2024. Unisex, ages 20-100.

Recent weekly mortality

Cumulative ASMRs relative to the 2014-2023 average



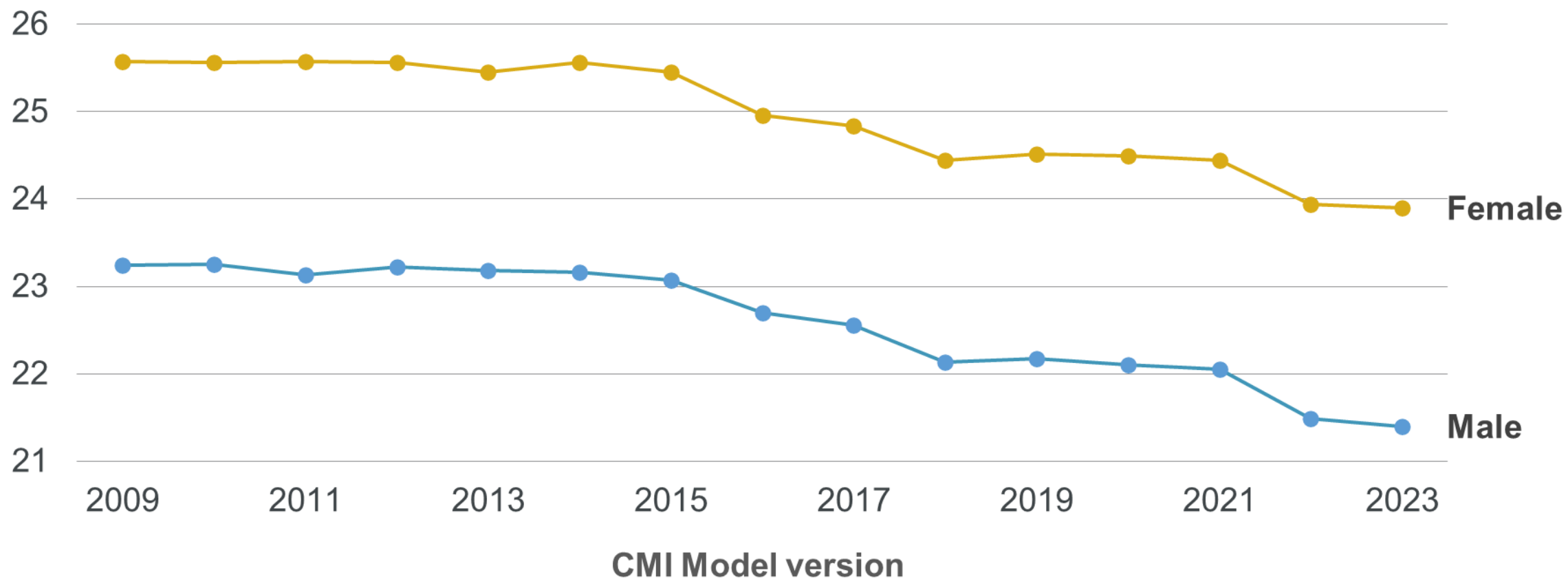
Source: CMI mortality monitor, week 17 of 2024. Unisex, ages 20-100.

CMI_2023

- CMI_2023 uses mortality data to 31 December 2023 with population data which reflects results of the 2021 census
- 2022 and 2023 data is given 15% weight in the Core version, following consultation
 - 2020 and 2021 data given 0% weight – not indicative of future mortality
 - 2019 and earlier given 100% weight
- Cohort life expectancies at age 65 in CMI_2023 compared to CMI_2022 are around
 - five weeks lower for males and
 - two weeks lower for females

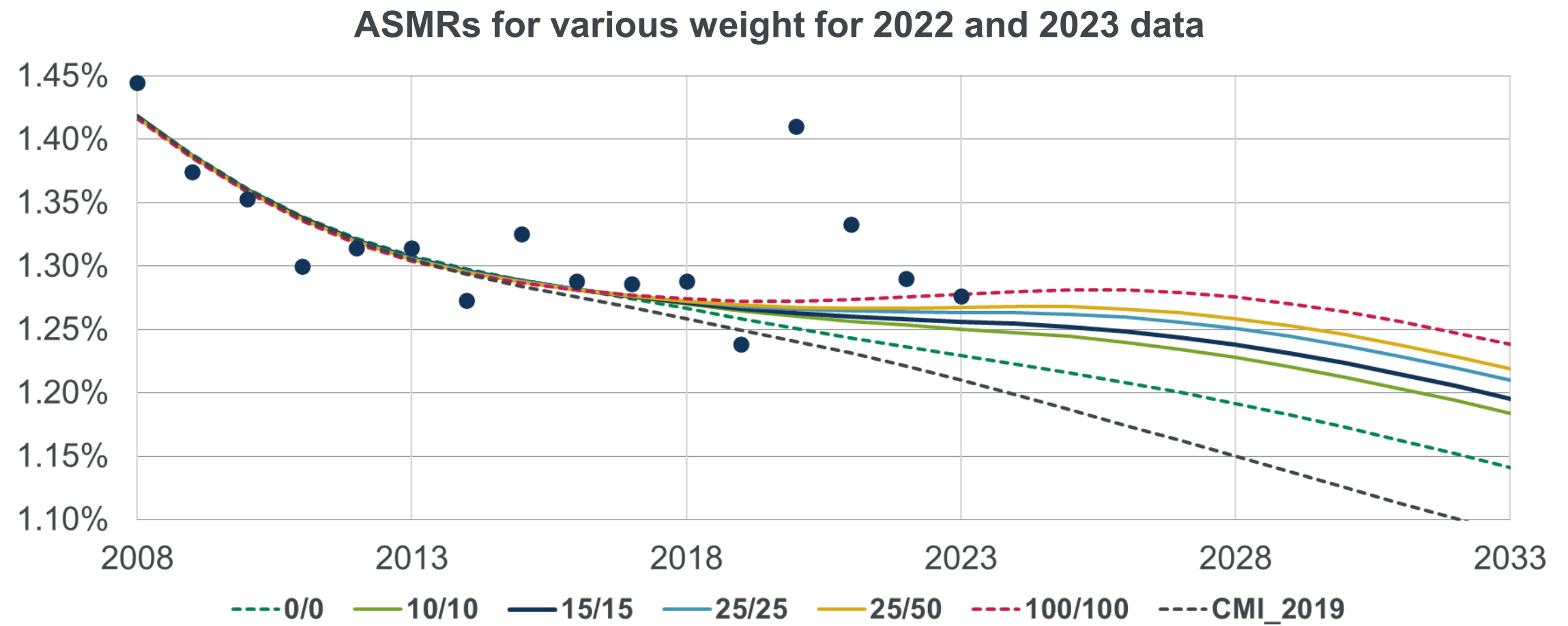
Progression of cohort life expectancy

Age 65, CMI Model, S4PxA, illustrative long-term rate of 1.5% p.a.



Source: CMI_2023 press release

Impact of weights on CMI_2023



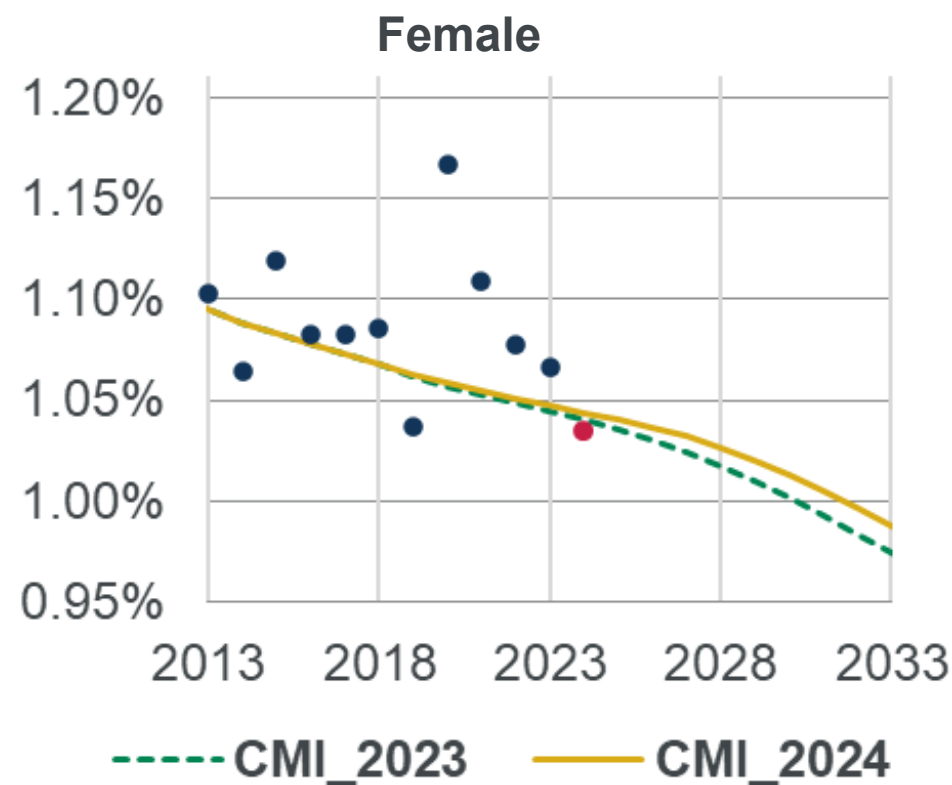
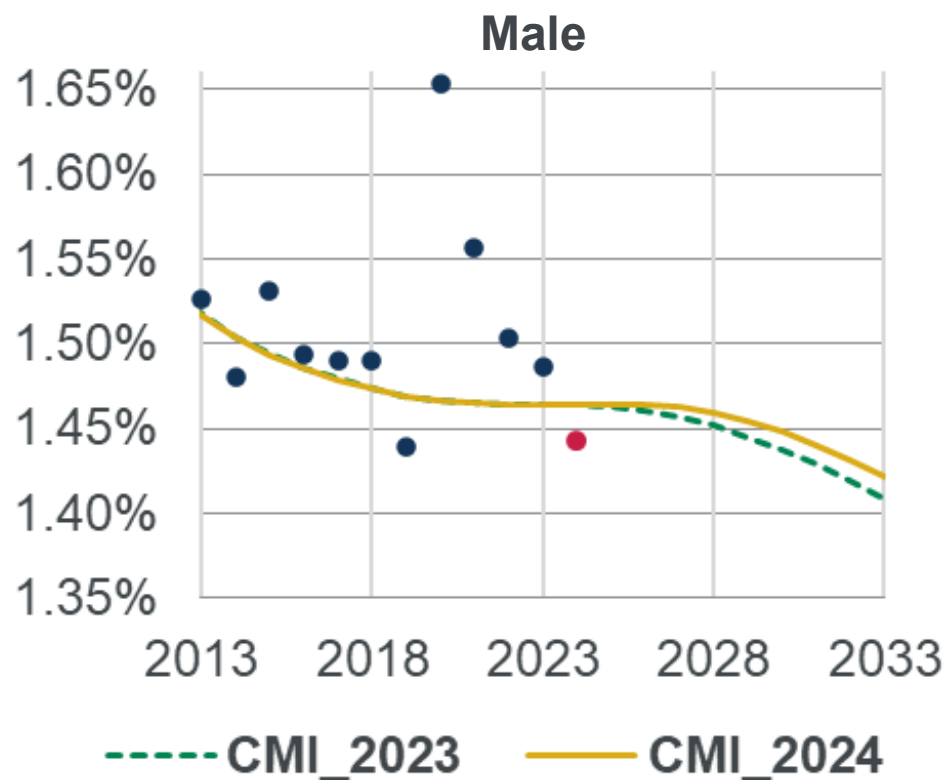
Source: CMI Working Paper 183, updated for 15/15 weights and CMI_2019 comparator. Unisex, ages 20-100.

CMI_2023 – parameter choices

- Consultation results showed that:
 - most insurers/reinsurers preferred 10% weights for 2022 and 2023; but
 - most consultants/others preferred higher weights – typically 25% or more
- We encourage users to consider which parameters to use, particularly:
 - weights – to reflect the impact of the pandemic
 - initial improvements – to reflect the composition of their population
 - long-term rate – to reflect the impact of the pandemic and other factors

Illustrative business-as-usual CMI_2024

+3% mortality improvement in 2024 and 20% weights for 2022-2024 data



Source: CMI Working Paper 188

Plans for CMI_2024

- Weights trending back towards 100% would likely lead to a further fall in life expectancy in CMI_2024, unless there is a significant mortality improvement in 2024
- We are reviewing of a range of options, including possible structural changes, before deciding on methods and parameters for CMI_2024 and later versions
- The aim is to ensure that the Model will respond in a robust and more predictable way across a reasonable range of future mortality scenarios

Future plans

- Weekly mortality monitoring continues for the time being
- Fourth survey benchmarking use of the Model by insurers/reinsurers
 - Issued in April 2024, with results in June 2024
- “Interim update” working paper, with various analyses to assist users of the CMI Model – by December 2024
- Aim to publish CMI_2024 in March 2025
 - Likely to consult on weights and methods in the autumn

Outlook for mortality improvements

Dan Sherratt
Isio

SIAS Meeting 15th May 2024

Dan Sherratt
Associate Director, Isio



isio.

Question



How well do you think
you truly understand
how the CMI model
works?

Introduction

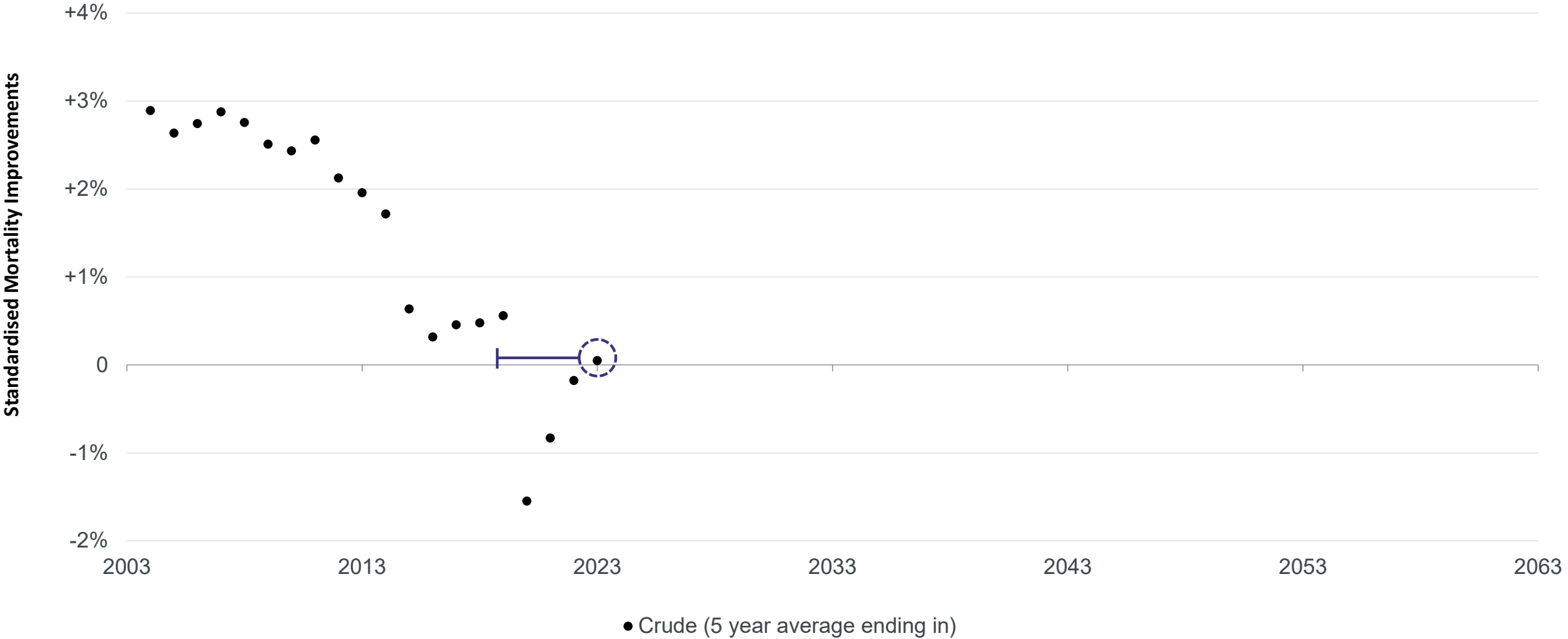
- As a consulting actuary we rarely (if ever) set assumptions – assumptions are set based on our advice by lay users
- They must make an informed choice on those assumptions
- The model isn't predictive – it cannot take a view on the future. It relies on users to set it up appropriately, or make separate adjustments, to do so.
- It's essential that we can support lay users in ultimately making assumption choices
- The consultation response split is interesting – and could be driven by differences in use case

The CMI Mortality Projections Committee encourages users to consider the appropriate parameterisations for their use case. We must not assume that the core parameters are the “correct” ones to use.

Today

- Why conceptually the weighting parameters cause difficulties
- Why this pushes us towards higher weightings
- Why the specific parameterisation might not matter

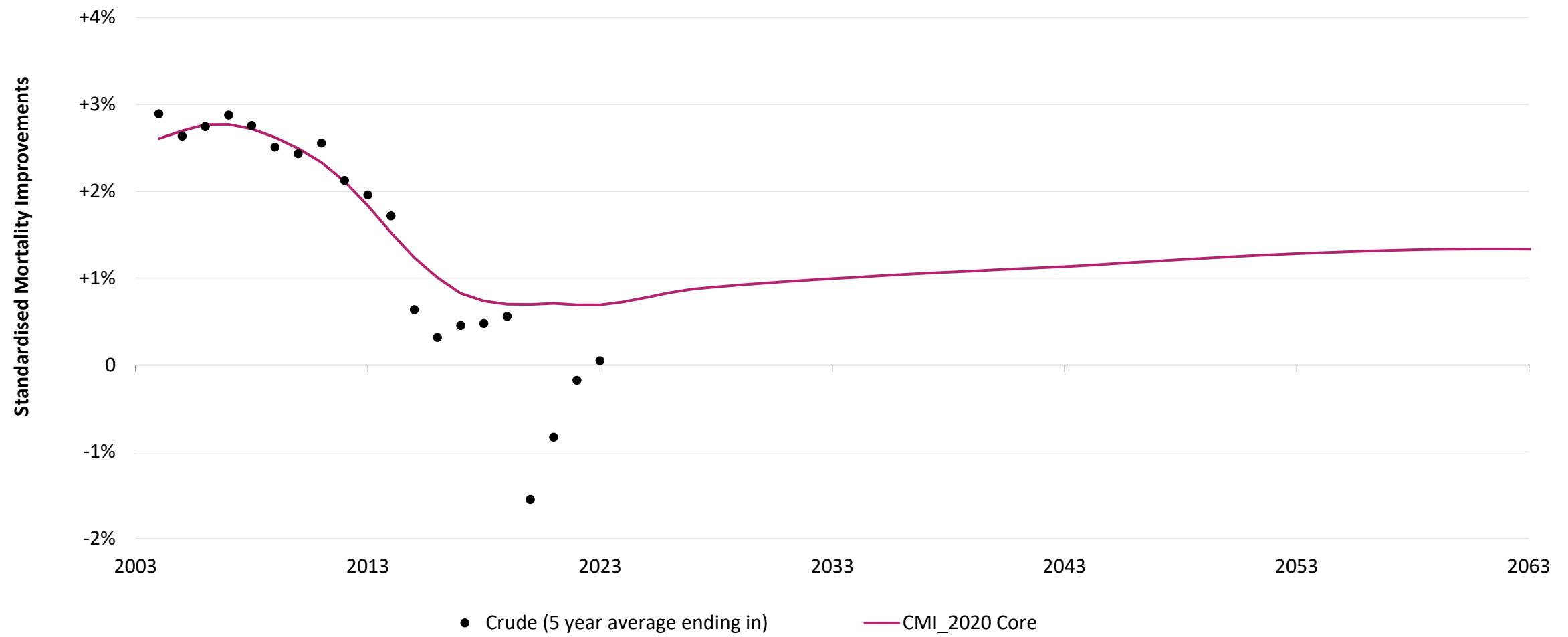
Model parameters: Baseline



Model parameters: Baseline

Explanation to the lay user:

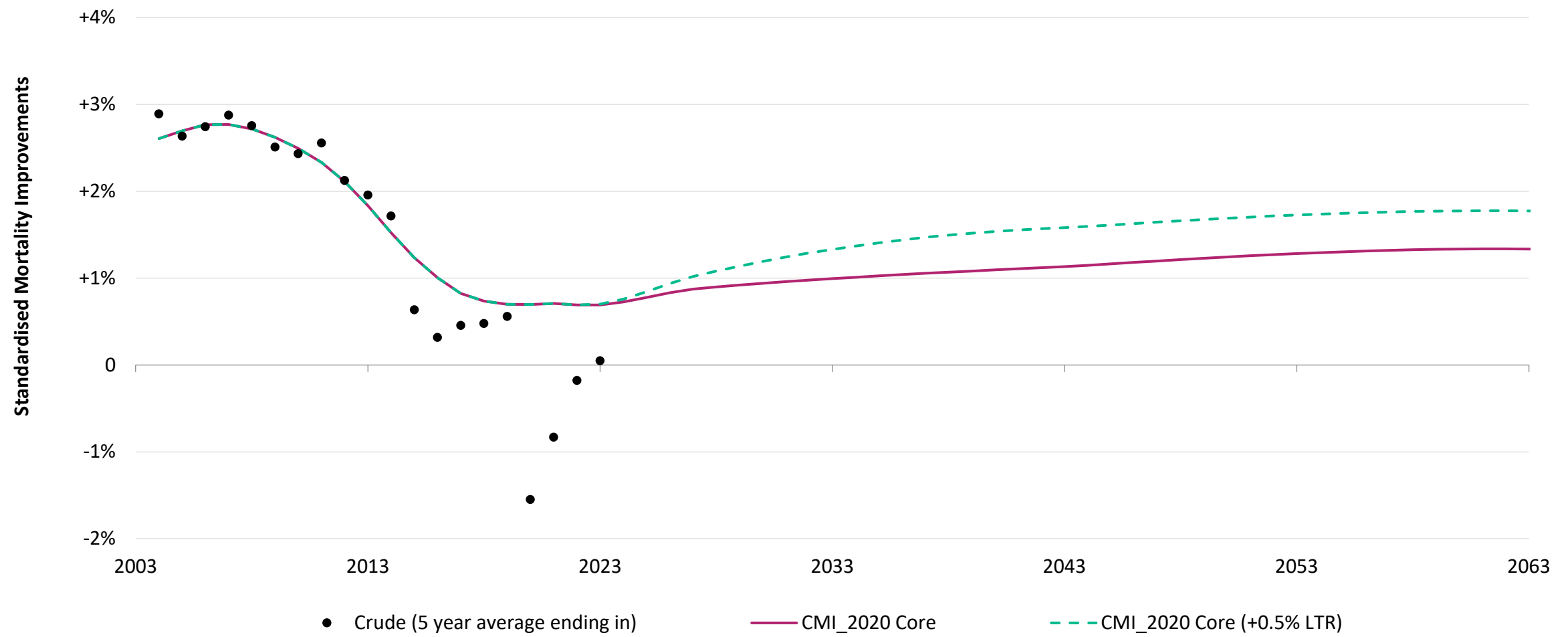
The model smoothes through known historic improvements and projects off towards a set future long-term trend rate



Model parameters: Long-term rate (“LTR”)

Explanation to the lay user:

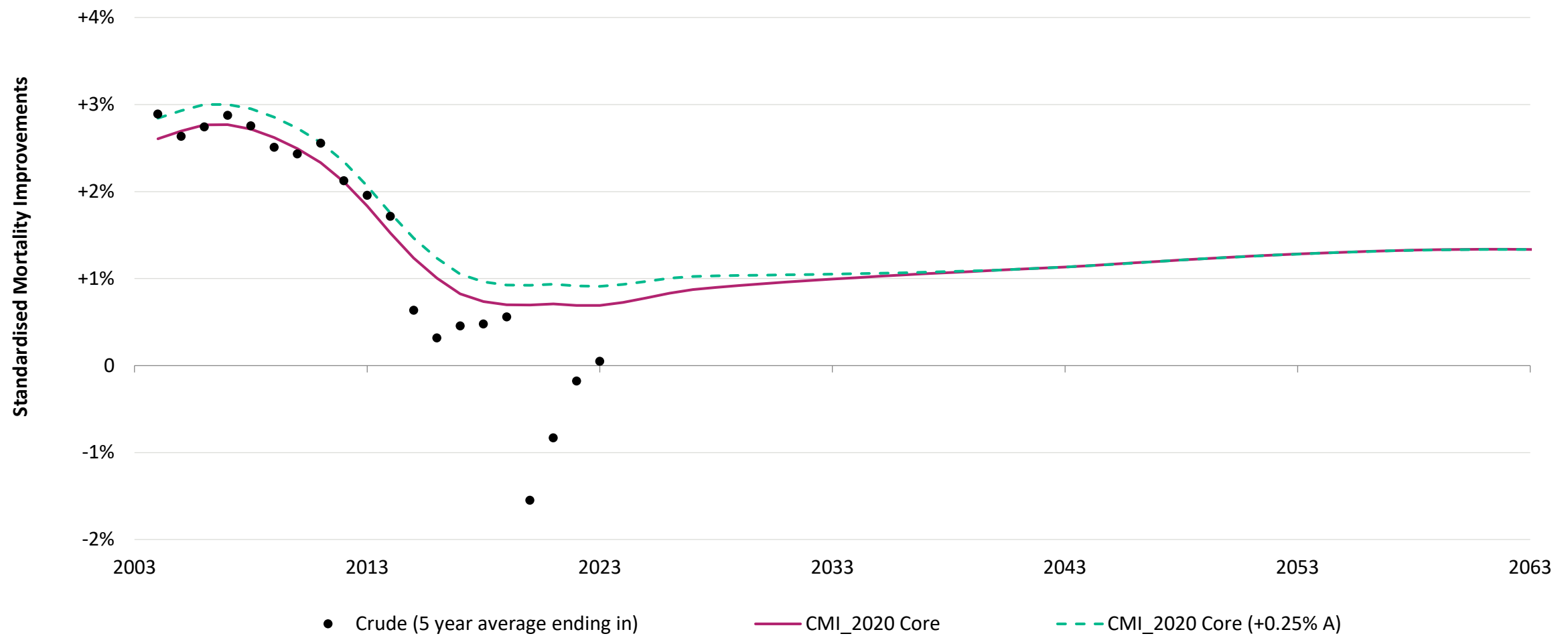
We can fit to the past but the future is uncertain, for prudence we can increase the rate of improvement we trend towards in the future



Model parameters: Initial addition (“A”)

Explanation to the lay user:

If you believe your membership has improved faster than the general population then we can add a margin for that – which decays over time



Model parameters: Smoothing (“S”)

- The smoothing parameter (and other fitting functions within the model) is the logarithm of a hyperparameter:

$$S_{\kappa} = \log_{10} \lambda_{\kappa}$$

- This is used within the model to achieve smoothness through regularisation penalties:


$$\text{Penalty}(\alpha_x) = \lambda_{\alpha} \sum_x (\nabla_x^3 \alpha_x)^2 = \lambda_{\alpha} \sum_x (\alpha_x - 3\alpha_{x-1} + 3\alpha_{x-2} - \alpha_{x-3})^2$$

$$\text{Penalty}(\beta_x) = \lambda_{\beta} \sum_x (\nabla_x^3 \beta_x)^2 = \lambda_{\beta} \sum_x (\beta_x - 3\beta_{x-1} + 3\beta_{x-2} - \beta_{x-3})^2$$

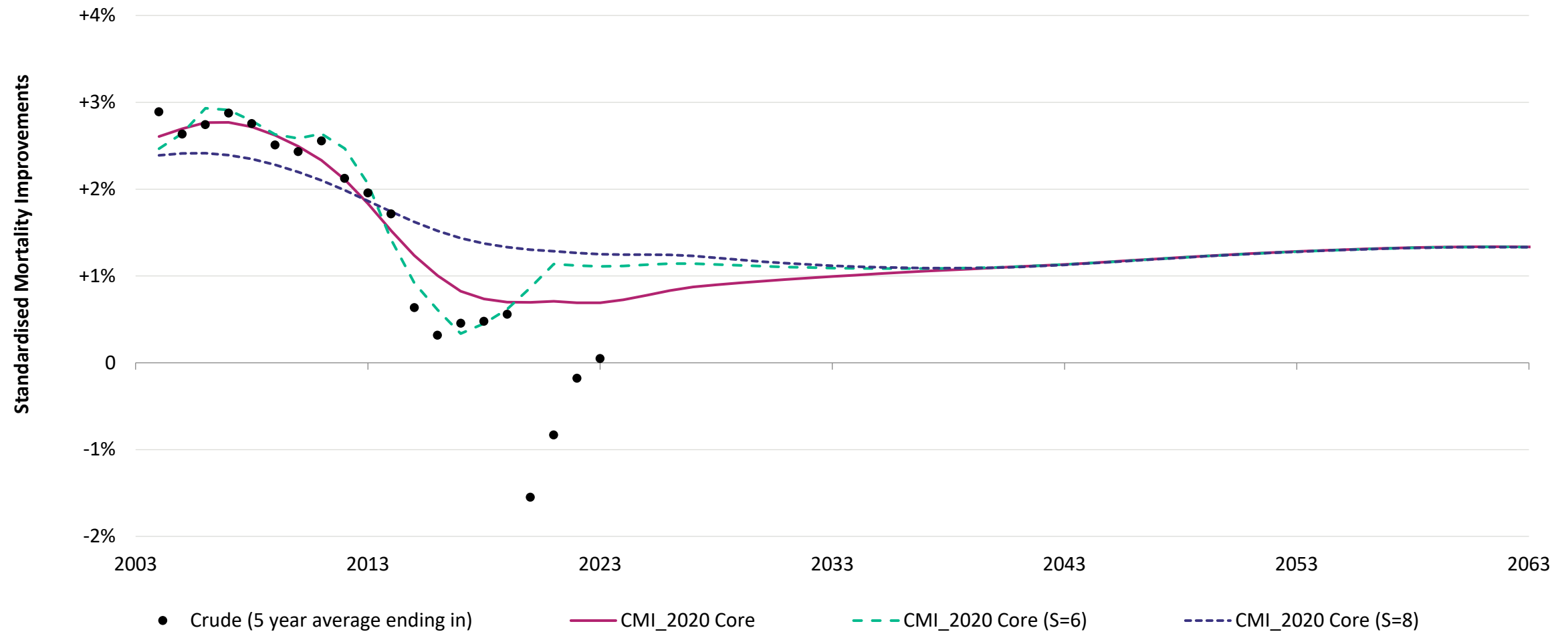
$$\text{Penalty}(\kappa_t) = \lambda_{\kappa} \sum_t (\nabla_t^2 \kappa_t)^2 = \lambda_{\kappa} \sum_t (\kappa_t - 2\kappa_{t-1} + \kappa_{t-2})^2$$

$$\text{Penalty}(\gamma_c) = \lambda_{\gamma} \sum_c (\nabla_c^3 \gamma_c)^2 = \lambda_{\gamma} \sum_c (\gamma_c - 3\gamma_{c-1} + 3\gamma_{c-2} - \gamma_{c-3})^2$$

Model parameters: Smoothing (“S”)

Explanation to the lay user: 

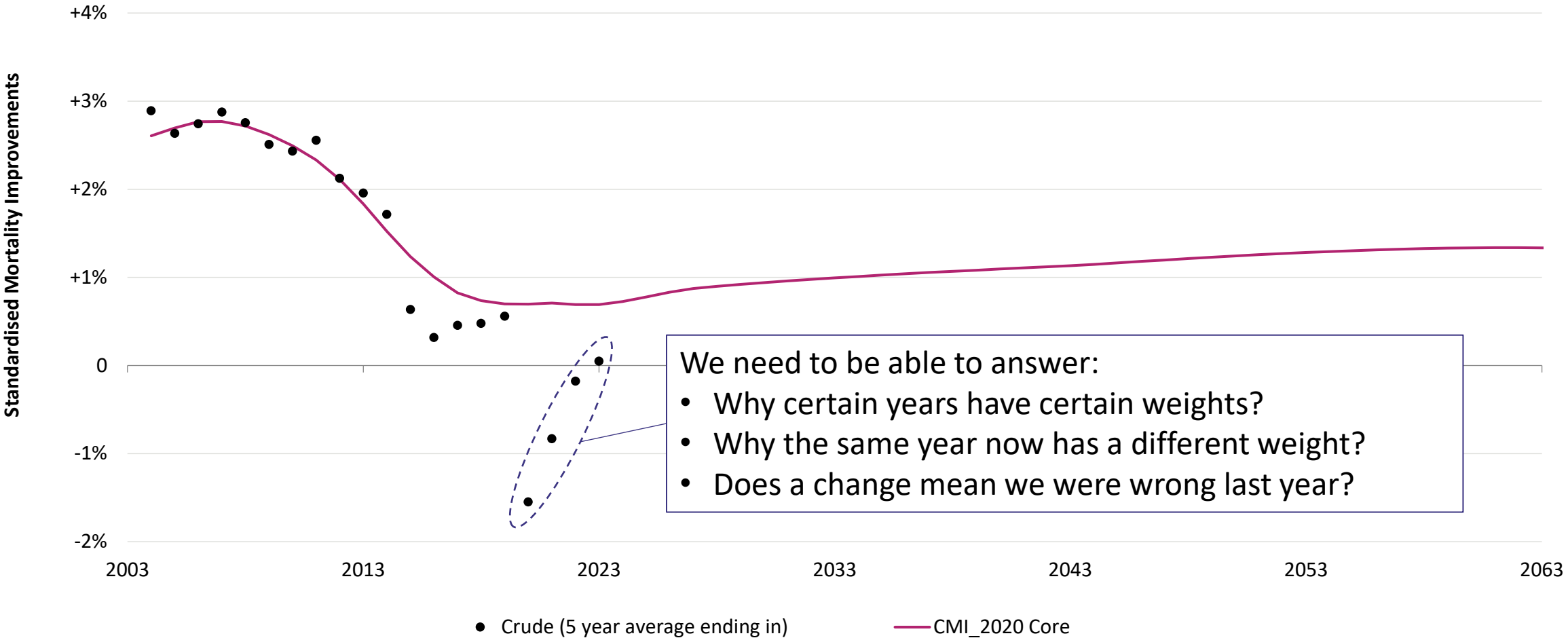
How reactive the model is to new data – the lower the smoothing the more reactive, and more influential the most recent data is



Model parameters: Weightings

Explanation to the lay user:

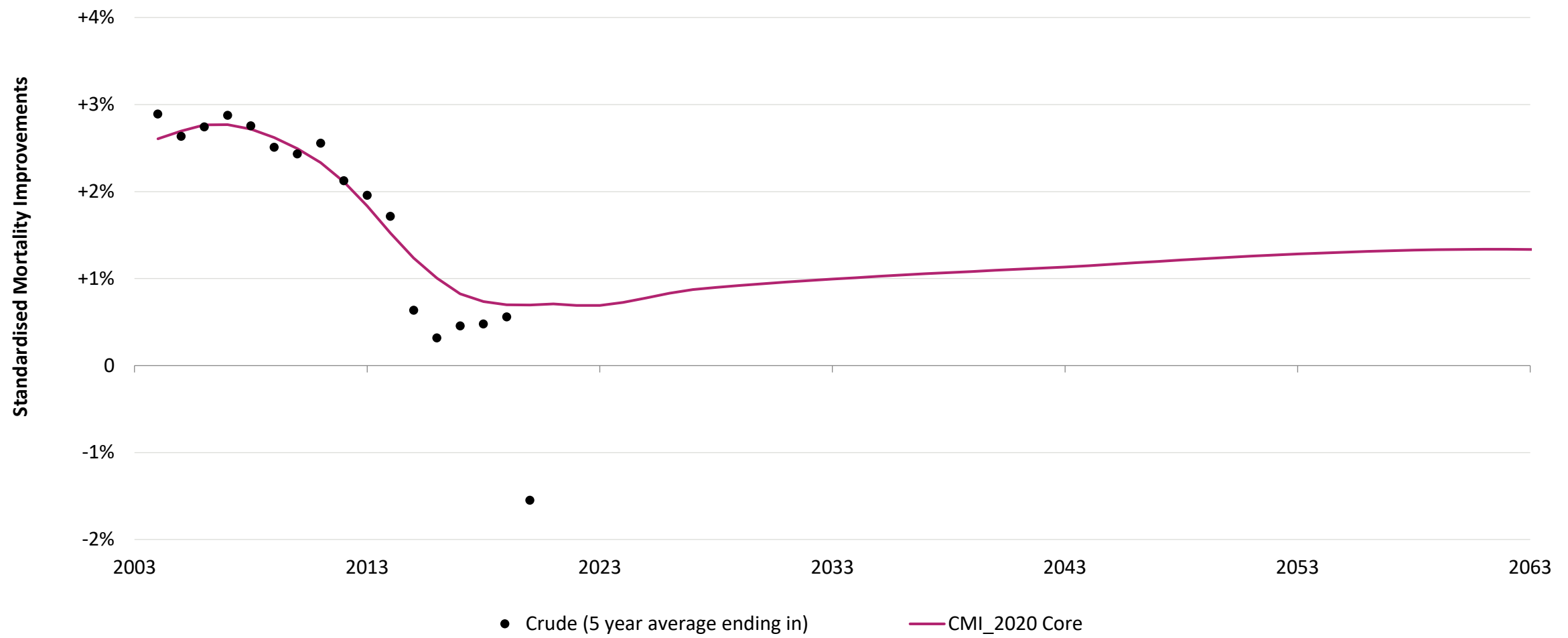
How sensitive the model is to the data from that specific year during the smoothed fitting process



Model parameters: Weighting (2020)

Explanation to the lay user:

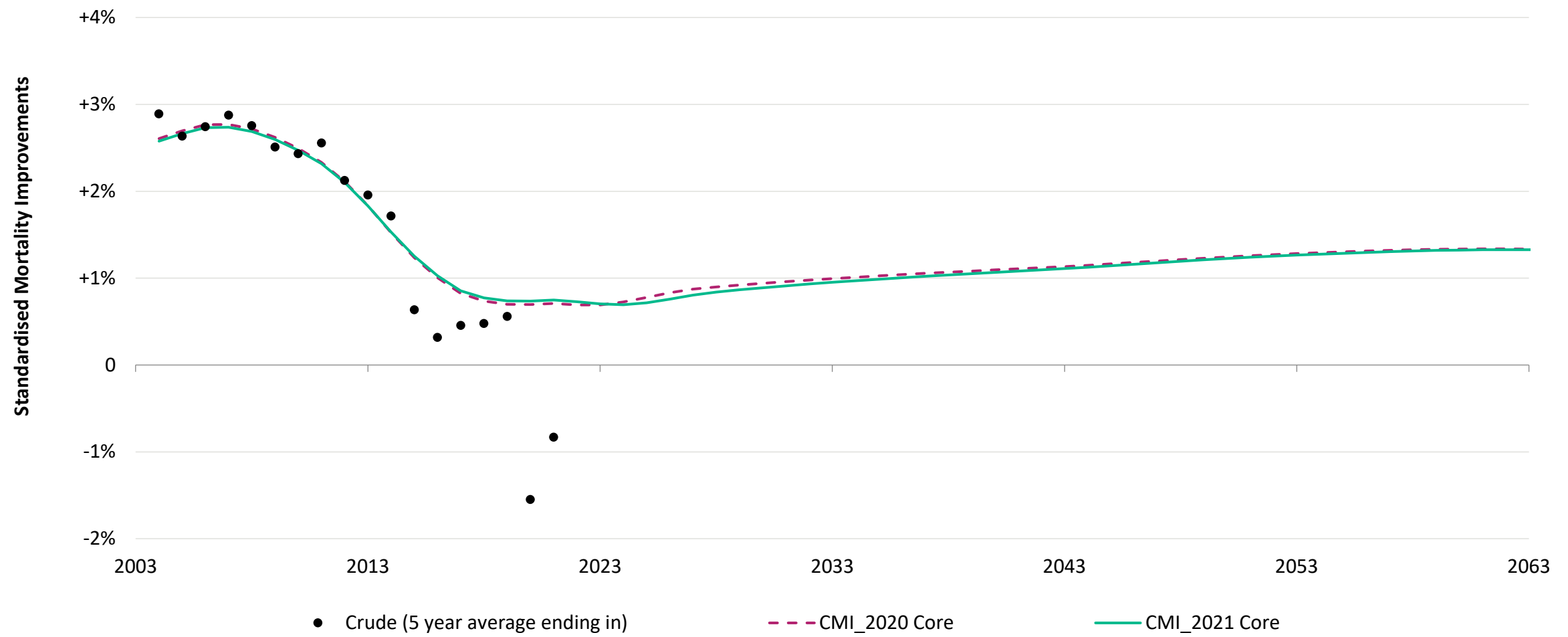
The impact from the pandemic is known but we don't expect that to happen each year so no to very low weighting makes sense



Model parameters: Weighting (2021)

Explanation to the lay user:

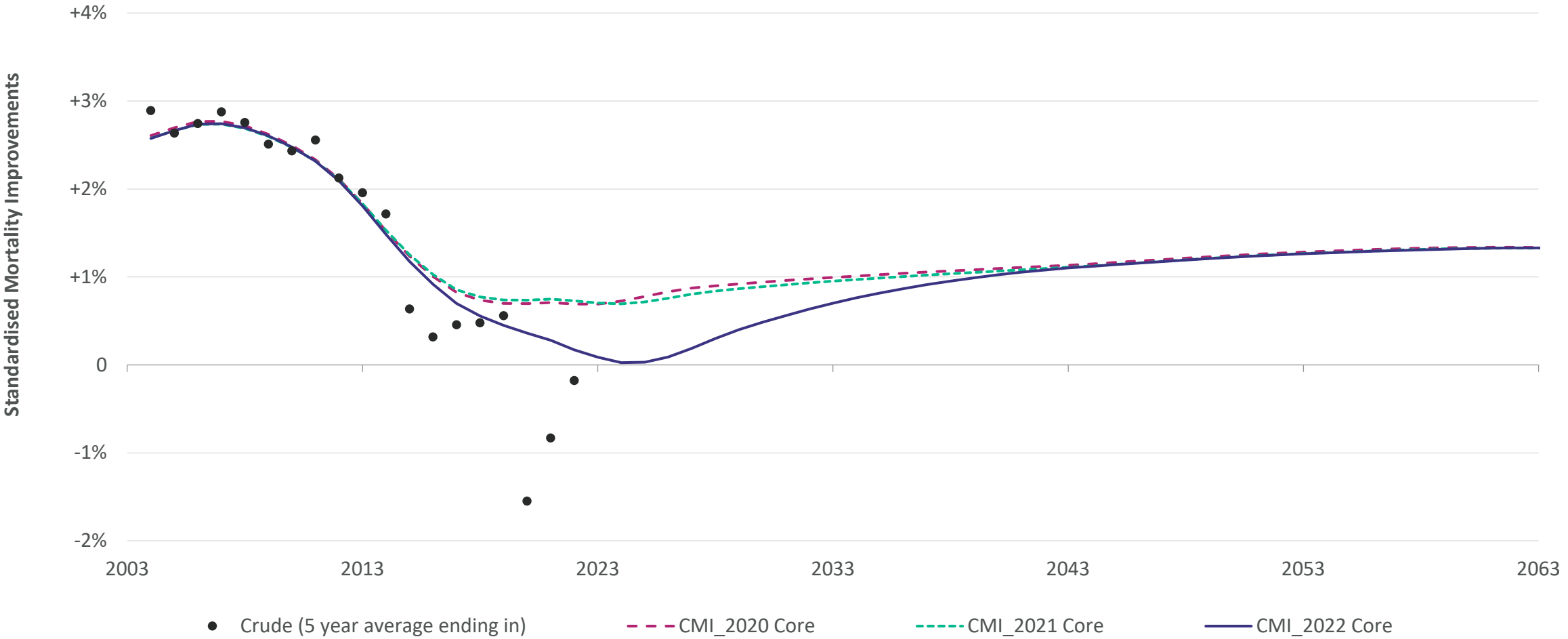
Similarly for 2021 – the actual figure is well out of “normal” boundaries so no to very low weighting makes sense



Model parameters: Weighting (2022)

Explanation to the lay user:

Still higher mortality experience than “normal” but lower volatility – some weighting justified as this could be indicative of the future



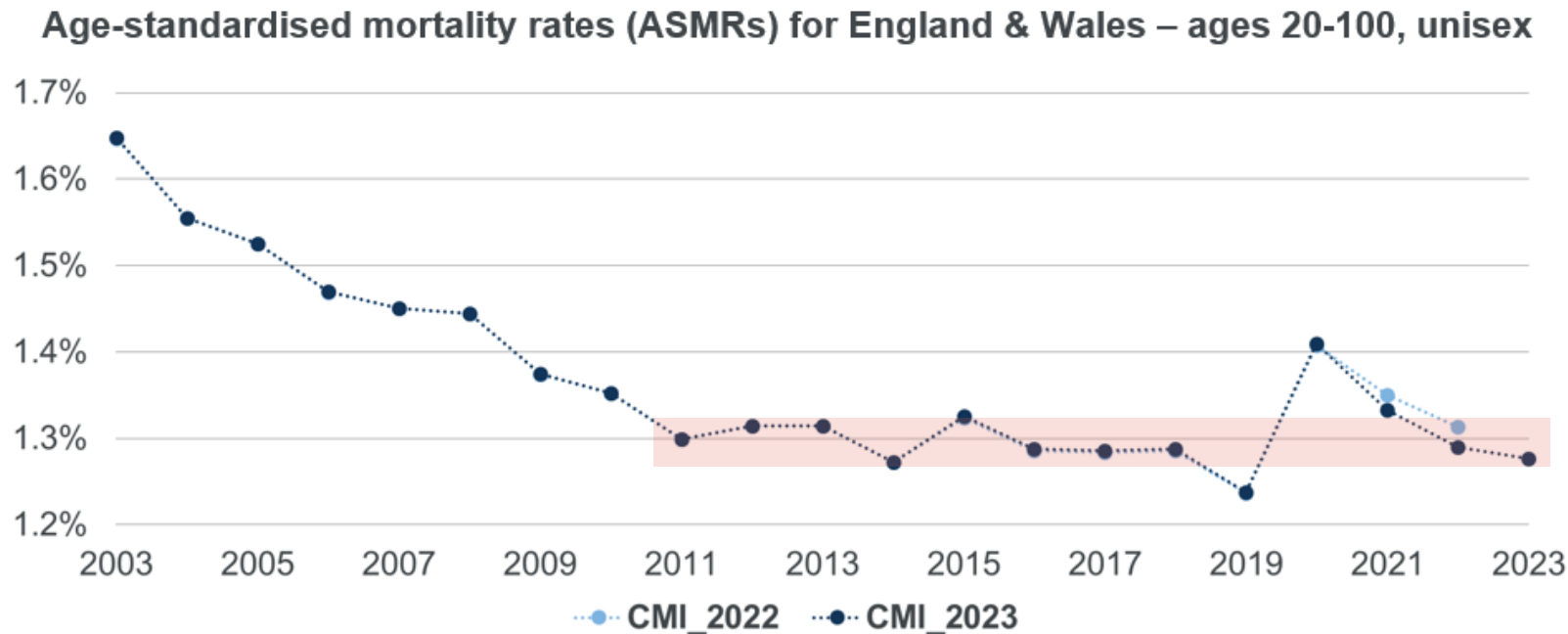
Model parameters: Weighting (2023)

Questions from the lay user:



- Is 2022 now “more normal” but less reliable?
- Is 2023 only 15% reliable?
- There isn’t much difference to the pre-pandemic period – why does that get 100% weighting?

- Information from the 2021 Census revised population estimates
- 2022 and 2023 experience was actually quite “normal” if we review back to the start of the 2010s
- But the core weighting for 2022 reduces from 25% to 15%, and 2023 is set at 15% as well



Source: CMI Working Paper 183, based on ONS data

Why were lower weightings proposed

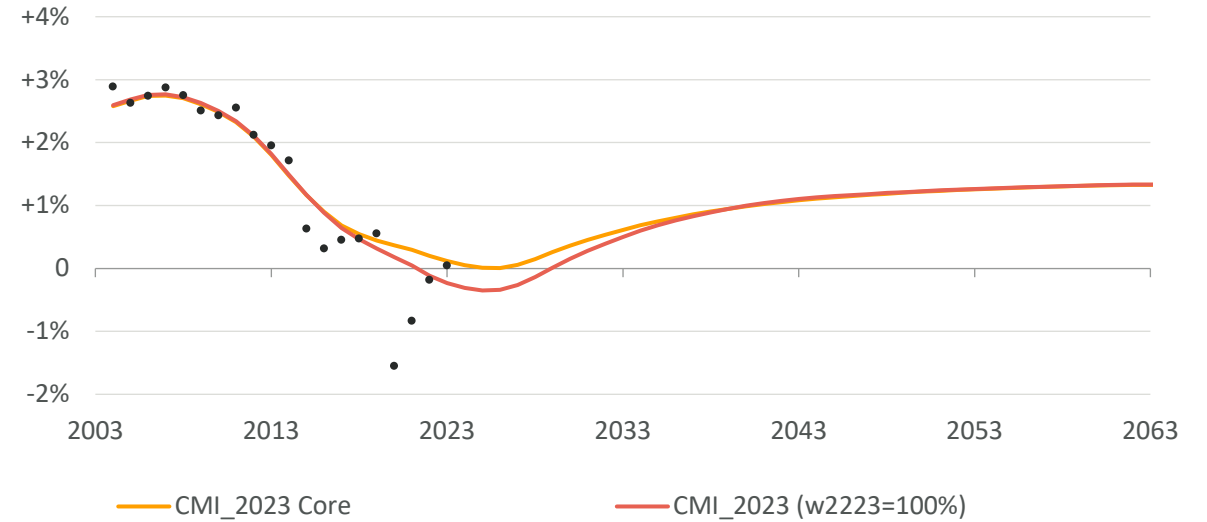
- Less about the data and much more to about trying to control model features
- Actual experience causes the model to produce turning points in the projection
- These features have been present in for a while now but the crossing of the 0% boundary is a feature of the core model since 2022

Model review:

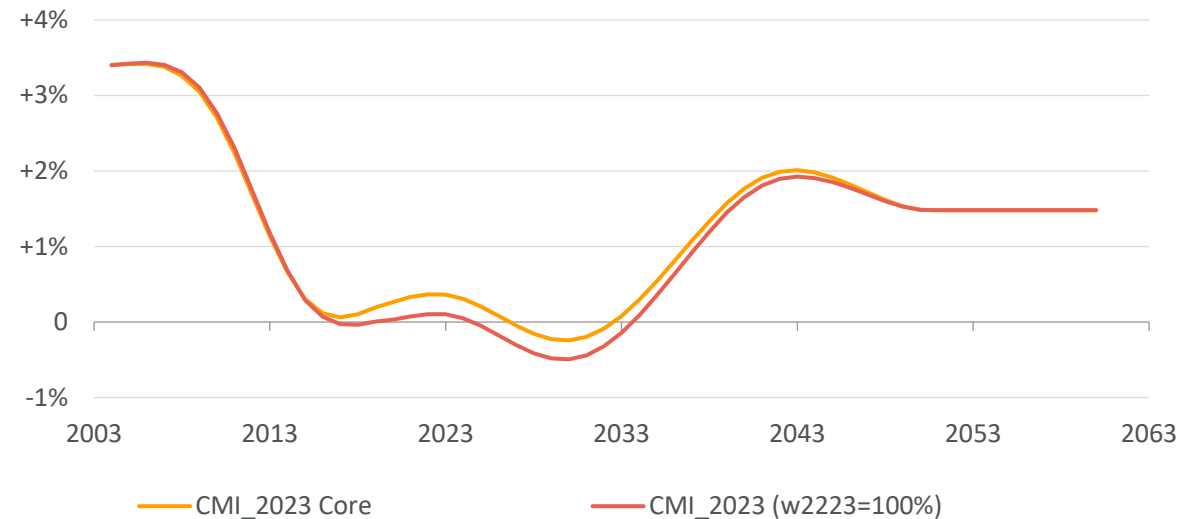
A model review has been announced which we welcome



Standardised Mortality Improvements

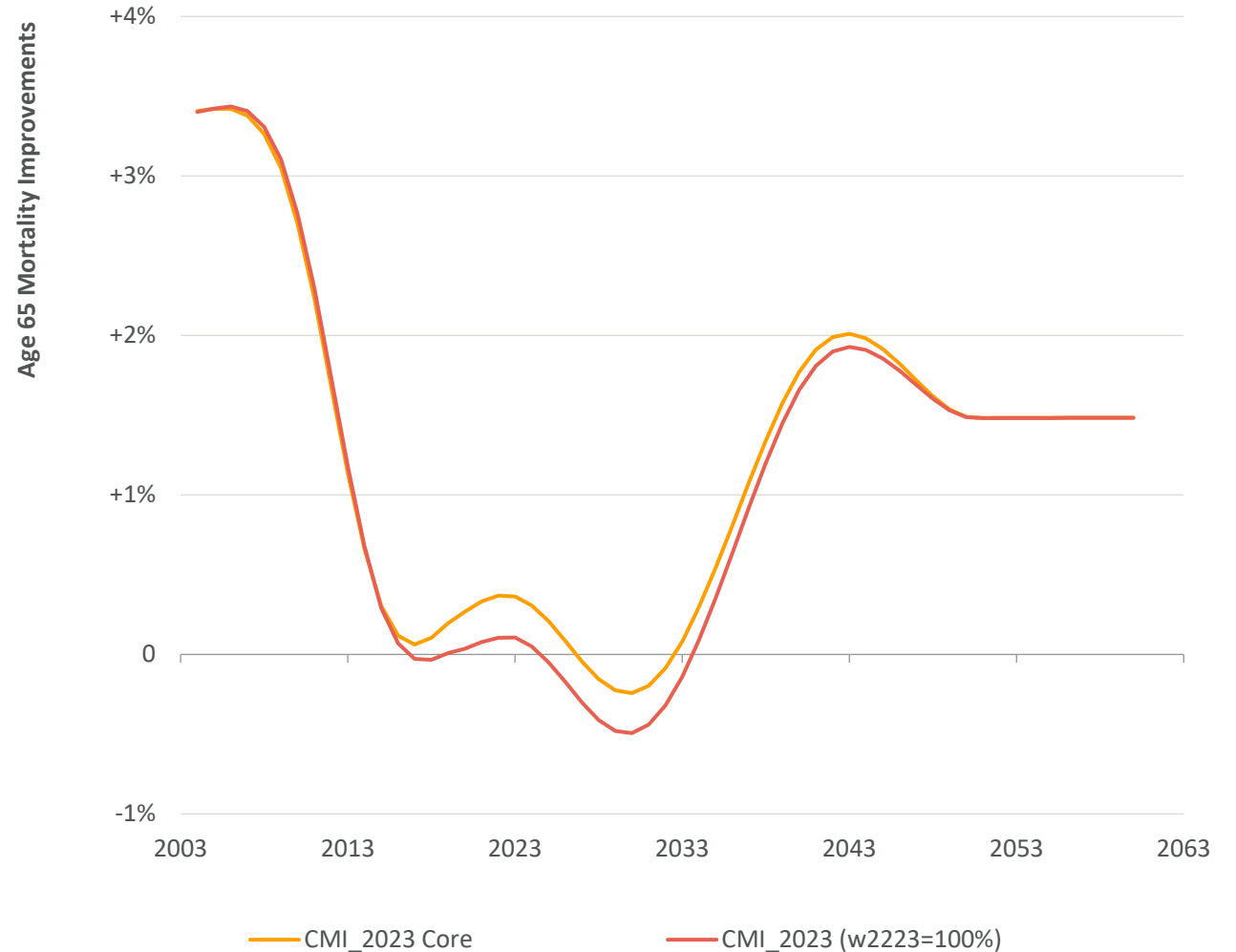


Age 65 Mortality Improvements



Why could higher weights be appropriate

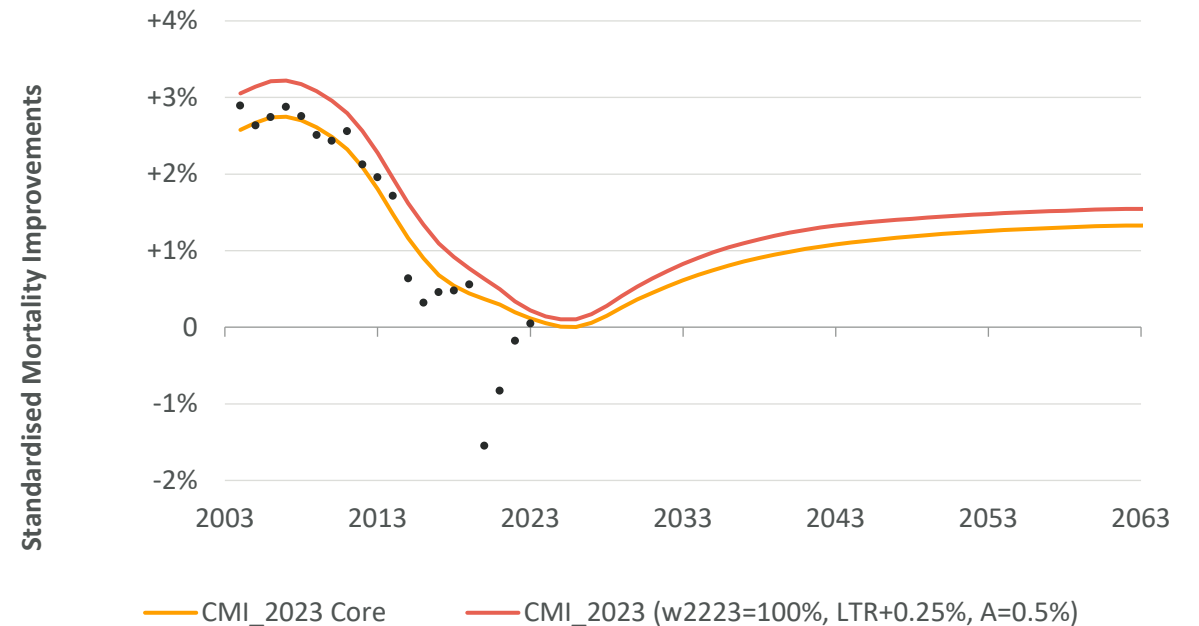
- If not now – then when?
- ASMRs are in a “normal” range, small (c.1%) liability/life expectancy difference between core and 100% weights
- Annual model release will require the same debate on weightings
- Moving to 100% now allows experience to come through
- Other factors, LTR & A, cause larger shifts – it’s where prudence has been typically applied and understood



Why could higher weights be appropriate

- Lay users mostly hear about headwinds – which are therefore easier for them to conceptualise
- Unknown societal/economic/health breakthroughs needed to move us back to the improvements seen in the 2010s
- This unknown should be being factored into your LTR – the precise changes over the next few years become less important in our work
- It's fairly typical to add caution through higher LTRs and initial additions
- This gives positive and rising future improvements – even with higher weights on 2022 and 2023 data

“What’s going to change, what are you forecasting that will lead the charge back up to 1.5% improvements each year?”

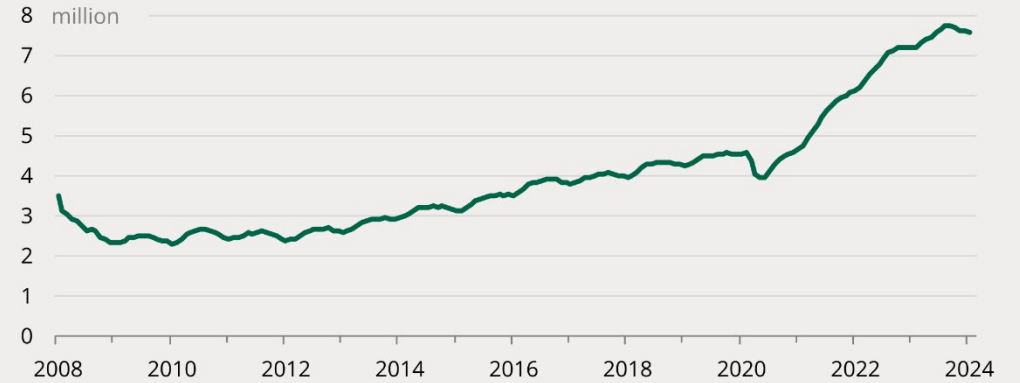


Why could higher weights be appropriate

The types of headwinds that lay users hear:

- Deaths involving Covid-19 are still happening – coupled with delayed identification and treatment of other conditions
- Unknown long-term effects of Long Covid
- NHS pressures & the need to increase functional capacity
- Still prevalent chronic health conditions – e.g. cardiovascular disease, sedentary lifestyles, rising obesity, rising alcoholism and associated disease/death
- Stagnating economic growth, the cost of living crisis, real terms falls in incomes

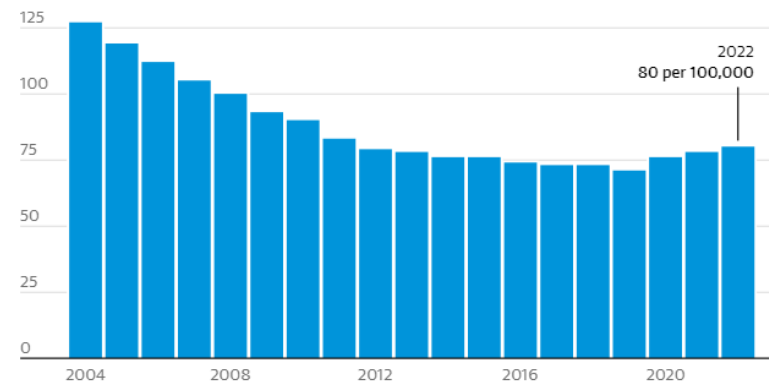
Waiting list for hospital treatment



Source : NHS England

Deaths from cardiovascular disease among under 75s in England reached 80 in every 100,000 people in 2022

Age-standardised mortality rate per 100,000 people



Guardian graphic. Source: British Heart Foundation

To conclude

- The CMI Mortality Projections Committee encourages users to consider the appropriate parameterisations for their use case
- It's clear that there are a wide range of views on what the “right” weighting parameters are
- There should be acceptance amongst us that deviating from the core parameters isn't immediately incorrect
- We should challenge ourselves to consider what's right for our purposes but also to keep in mind the big picture

End users need to understand conceptually what the various aspects of the model mean when they're setting assumptions, and the onus is on us to be able to translate these things into something tangible to aid in their understanding.

I welcome the announcement of a review of the model ahead of CMI 2024.

The information contained herein is of a general nature and is not intended to address the circumstances of any particular individual or entity. Although we endeavour to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. No one should act on such information without appropriate professional advice after a thorough examination of the particular situation.

Isio Services Limited is authorised and regulated by the Financial Conduct Authority FRN 922376

Outlook for mortality improvements

Stephen Courquin
RGA

CMI 2023

Deciding an appropriate weighting parameter

Stephen Courquin

Head of Actuarial Research, UK

15 May 2024



RGAA

CMI 2023 – Deciding an appropriate weighting parameter

Shameless plug & acknowledgments

- Ideas and work contained in this presentation can be found on the RGA website
- Authors:
 - Craig Armstrong
 - Ankush Appadoo
 - Tom Borrill
 - Tom Honeywell
 - Patrick Cheung
 - Stephen Courquin



[U.K. Mortality Projections: Practical implications of CMI proposals | RGA \(rgare.com\)](https://rgare.com)

Focus is on the weights but a wider discussion is needed

Key points before starting

- These slides focus on the debate around suitable weighting parameters when in the confines of the CMI model for pensioner aged lives
- There is a larger debate to be had given the uncertainty regarding future trends – All extrapolative models will find it hard to cope with recent years' data
- My comments are focused on population level mortality
- RGA does not derive assumptions via the CMI model but use it as a “common currency”
- The planned review of the CMI model in 2024 is very welcome

I have been asked here today to present the case for lower weights to be used in the CMI model.



Determining an appropriate weighting parameter – Focus on output

Focus on projected outcome from the model

Why I conclude that a lower weighting is appropriate:

1. How the projected improvements compare to historic periods
2. Implied excess in the future compared to current values
3. Features in the projections that are worth further investigation
4. Level of change in life expectancies being proposed compared to potential drivers of future improvements and level of uncertainty

High weightings produce the lowest improvements since the 1950s

Assessment (1) – Compare projected improvement rates to prior periods

Annualised E&W improvements over historic 10 year periods for 5 year age bands – **Males**

	60-64	65-69	70-74	75-79	80-84	85-89
1951 - 61	0.2%	0.2%	0.1%	0.4%	0.7%	0.8%
1961 - 71	0.9%	0.3%	0.1%	0.5%	0.9%	0.8%
1971 - 81	1.3%	1.6%	1.4%	0.8%	0.2%	0.7%
1981 - 91	2.4%	1.7%	1.7%	1.7%	1.4%	1.0%
1991 - 01	3.1%	3.4%	2.8%	2.1%	1.9%	1.1%
2001 - 11	2.9%	3.3%	3.5%	3.7%	2.7%	2.0%
2011 - 18	0.8%	0.8%	1.5%	1.0%	1.1%	0.5%

Projected annualised improvements from CMI_2023 with different weighting parameters – **Males**

Period	Weight	60-64	65-69	70-74	75-79	80-84	85-89
2020 - 29	0%	0.3%	0.6%	0.3%	0.4%	0.6%	0.5%
	10%	0.0%	0.3%	0.0%	0.1%	0.3%	0.2%
	15%	-0.1%	0.2%	-0.1%	0.0%	0.2%	0.1%
	25%	-0.2%	0.1%	-0.2%	-0.1%	0.1%	0.0%

2030 - 39	0%	1.3%	0.6%	0.5%	0.7%	0.6%	0.9%
	10%	1.2%	0.4%	0.4%	0.6%	0.5%	0.9%
	15%	1.1%	0.4%	0.4%	0.6%	0.5%	0.8%
	25%	1.1%	0.3%	0.4%	0.5%	0.5%	0.8%

2040 - 49	0%	1.8%	1.8%	1.3%	1.0%	1.0%	1.1%
	10%	1.8%	1.8%	1.3%	1.0%	1.0%	1.1%
	15%	1.8%	1.7%	1.3%	1.0%	1.0%	1.1%
	25%	1.8%	1.7%	1.3%	1.0%	1.0%	1.1%

2050 - 59	0%	1.5%	1.5%	1.5%	1.5%	1.4%	1.2%
	10%	1.5%	1.5%	1.5%	1.5%	1.4%	1.2%
	15%	1.5%	1.5%	1.5%	1.5%	1.4%	1.2%
	25%	1.5%	1.5%	1.5%	1.5%	1.4%	1.2%

High weightings produce the lowest improvements since the 1950s

Assessment (1) – Compare projected improvement rates to prior periods

Annualised E&W improvements over historic 10 year periods for 5 year age bands – **Females**

	60-64	65-69	70-74	75-79	80-84	85-89
1951 - 61	1.3%	1.4%	1.4%	1.4%	1.0%	0.8%
1961 - 71	0.9%	1.1%	1.1%	1.3%	1.5%	1.1%
1971 - 81	0.4%	1.0%	1.4%	1.4%	0.9%	0.9%
1981 - 91	1.4%	0.8%	1.1%	1.5%	1.6%	1.5%
1991 - 01	2.7%	2.7%	1.9%	1.3%	1.2%	0.7%
2001 - 11	2.3%	2.6%	3.0%	3.0%	2.1%	1.7%
2011 - 18	0.5%	0.8%	1.1%	0.8%	1.0%	0.2%

Projected annualised improvements from CMI_2023 with different weighting parameters – **Females**

Period	Weight	60-64	65-69	70-74	75-79	80-84	85-89
2020 - 29	0%	1.0%	1.0%	0.6%	0.5%	0.7%	0.8%
	10%	0.8%	0.7%	0.3%	0.3%	0.5%	0.6%
	15%	0.7%	0.7%	0.3%	0.2%	0.4%	0.5%
	25%	0.6%	0.6%	0.2%	0.2%	0.3%	0.4%
2030 - 39	0%	1.1%	1.0%	1.2%	1.1%	0.9%	1.0%
	10%	1.0%	0.9%	1.1%	1.0%	0.9%	1.0%
	15%	1.0%	0.9%	1.1%	1.0%	0.8%	1.0%
	25%	0.9%	0.9%	1.1%	1.0%	0.8%	1.0%
2040 - 49	0%	1.6%	1.5%	1.3%	1.3%	1.4%	1.3%
	10%	1.6%	1.5%	1.3%	1.3%	1.4%	1.3%
	15%	1.6%	1.5%	1.3%	1.3%	1.4%	1.3%
	25%	1.6%	1.5%	1.3%	1.3%	1.4%	1.3%
2050 - 59	0%	1.5%	1.5%	1.5%	1.5%	1.4%	1.3%
	10%	1.5%	1.5%	1.5%	1.5%	1.4%	1.3%
	15%	1.5%	1.5%	1.5%	1.5%	1.4%	1.3%
	25%	1.5%	1.5%	1.5%	1.5%	1.4%	1.3%

Using a driver-based approach to compare current & projected excess

Assessment (2) – Implied future excess versus a pre-pandemic benchmark

Extract from IFoA working party paper:

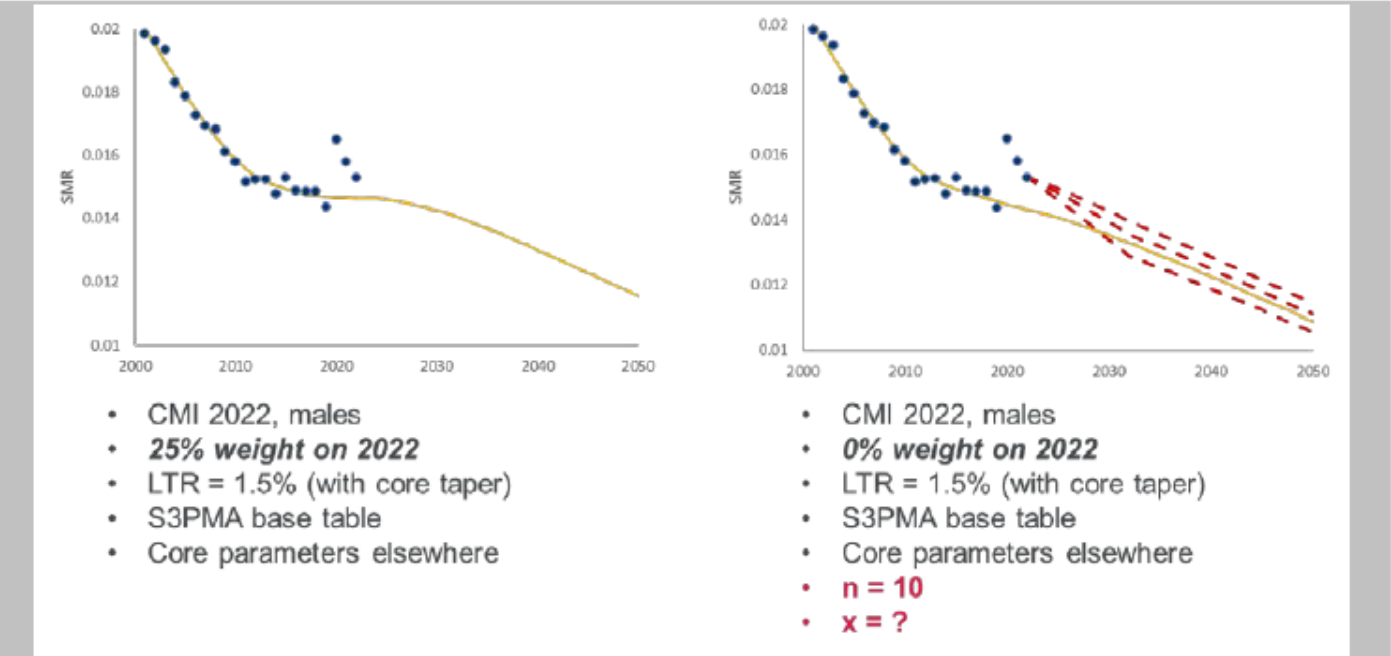


Figure 6. Post-pandemic versus pre-pandemic forecasts
Comparison of a post-pandemic forecast (left) to a pre-pandemic forecast with a driver-based approach to projecting excess deaths (right). See text for further details. Mortality rates are shown as being standardised by age for simplicity, but in reality adjustments would need to be made for each age.

Males

Age	Initial 2023 excess	Remaining excess in 2033+		
		W=10	W=15	W=25
60	4.50%	4.00%	5.25%	6.75%
70	4.25%	3.75%	5.00%	6.50%
80	4.00%	3.00%	4.25%	6.00%

- A weighting of >15% implies a widening of the excess compared to current levels.
- When considering the drivers of the recent excess and how it has changed – is this reasonable?

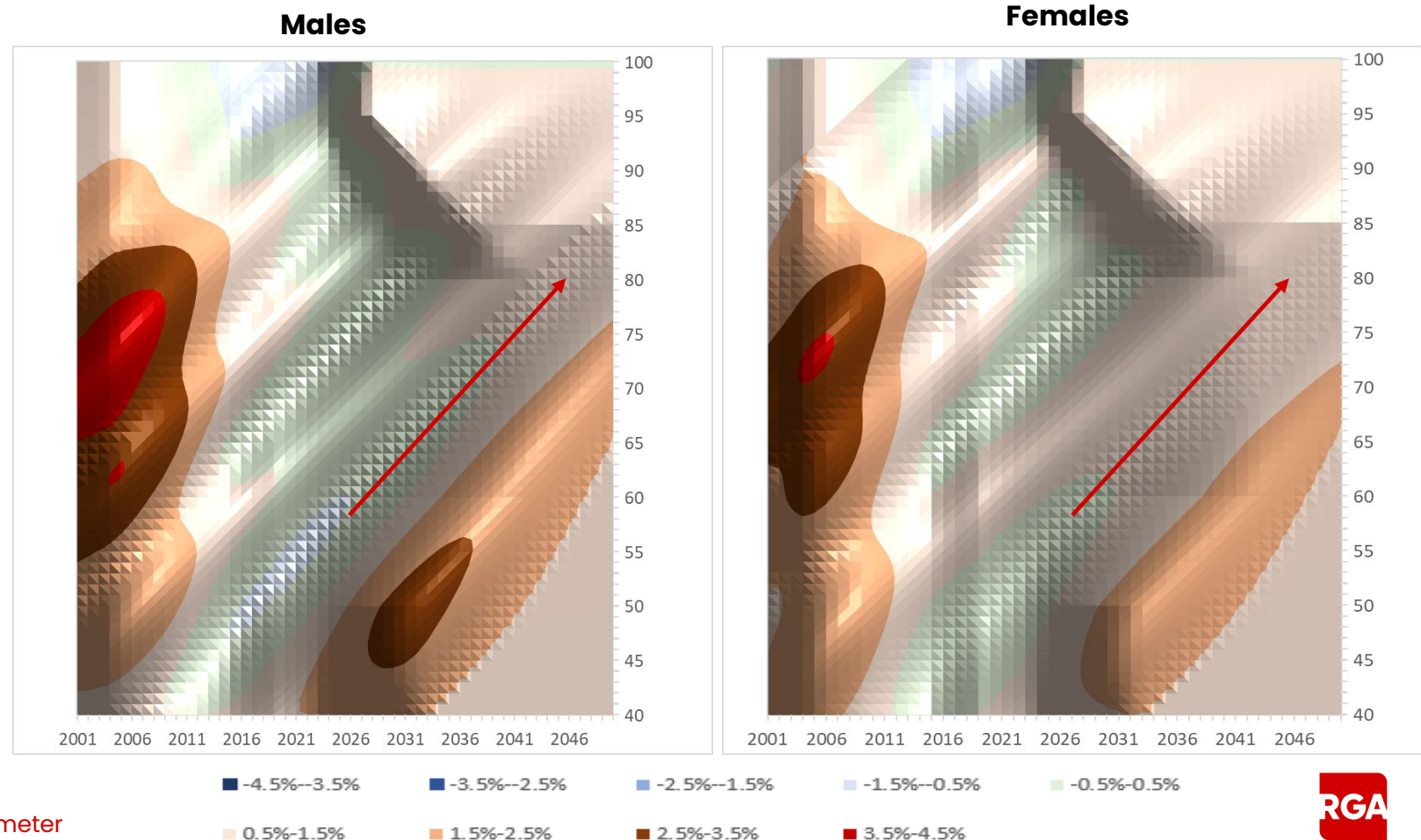
Source: [Setting biometric assumptions in a post-COVID world \(actuaries.org.uk\)](https://www.actuaries.org.uk)

Male improvements are materially influenced by younger cohorts

Assessment (3) – Questioning features of the projection

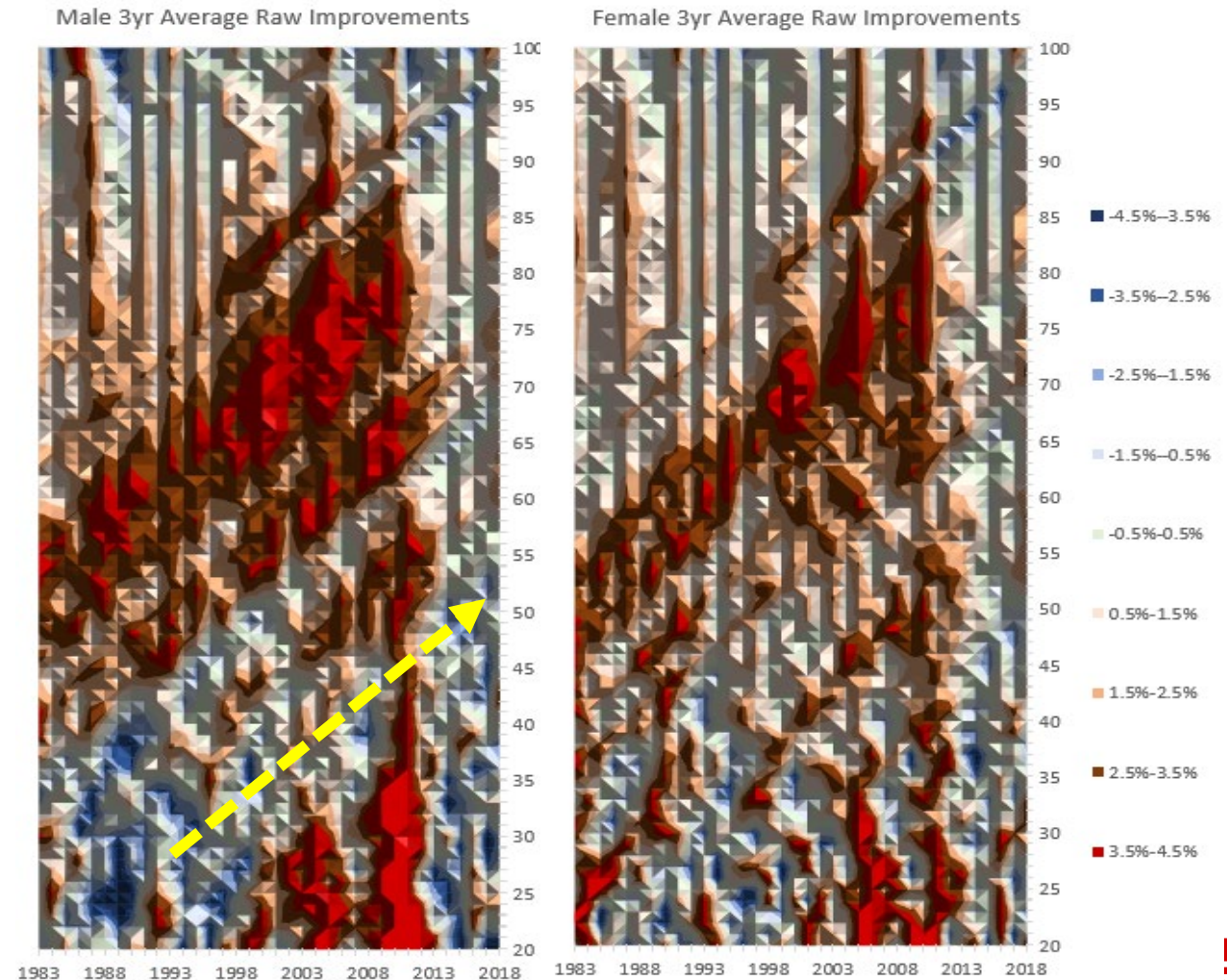
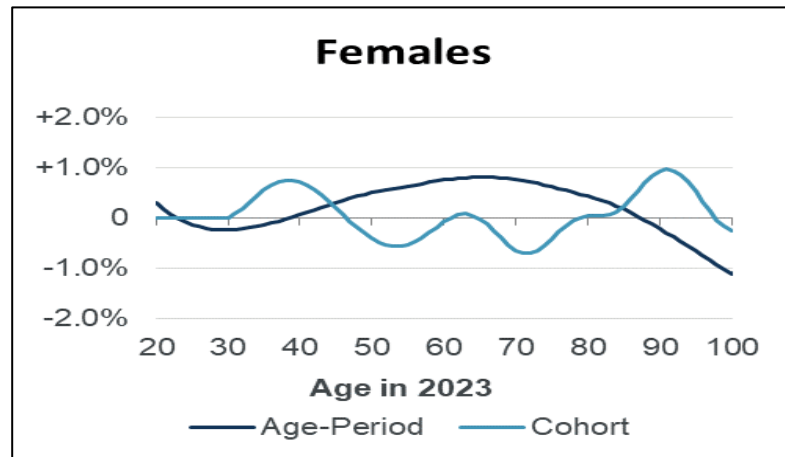
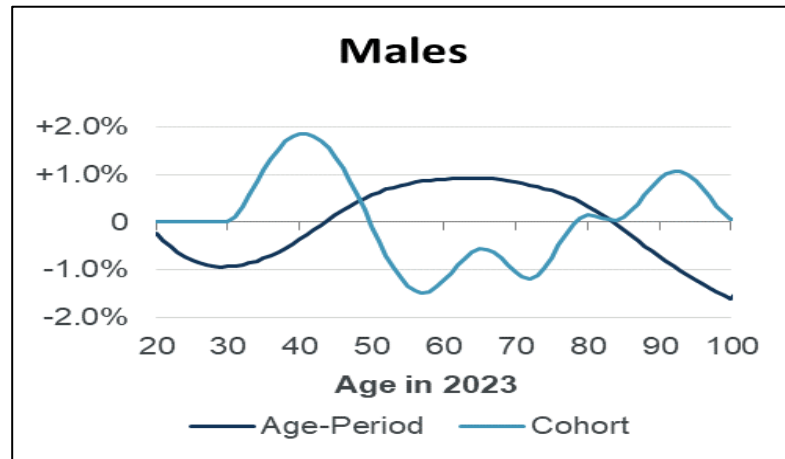
- Material difference in the male and female projections centred around those aged 57 in 2023
- Caused by large negative cohort parameter of around -1.5% at age 60 for males versus -0.4% for females
- Cohort parameters not impacted by the weighting but does impact projections

Heat Map of CMI_2023 Core improvements



Is the material influence of younger age cohorts appropriate?

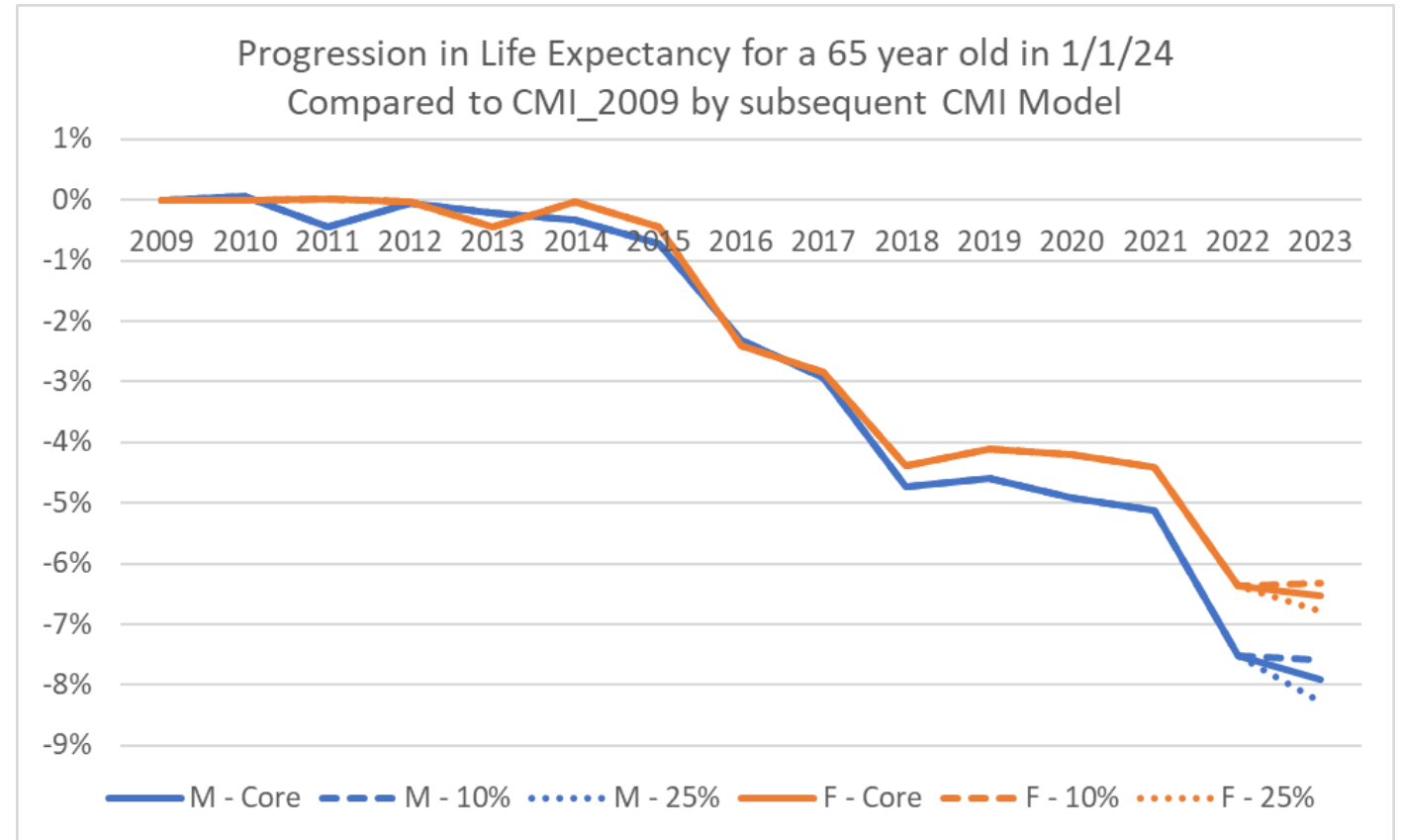
Assessment (3) – Differences in APC parameters



Material impact on life expectancy when combined with earlier changes

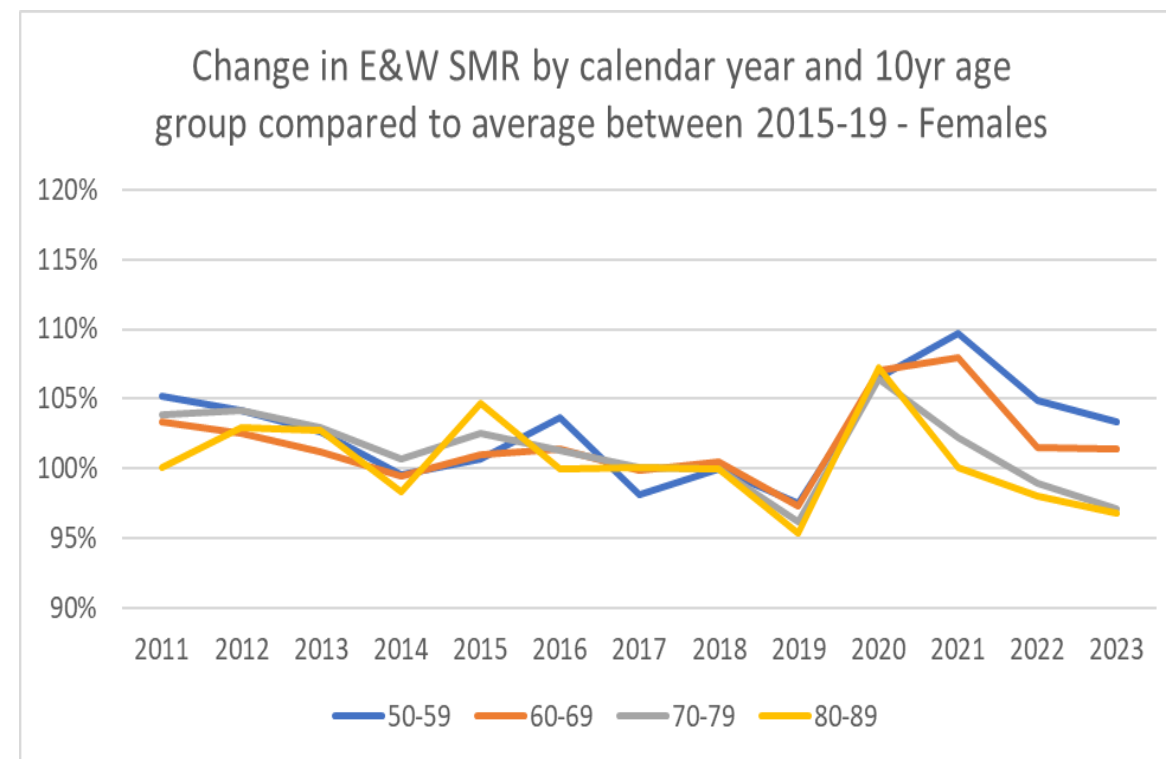
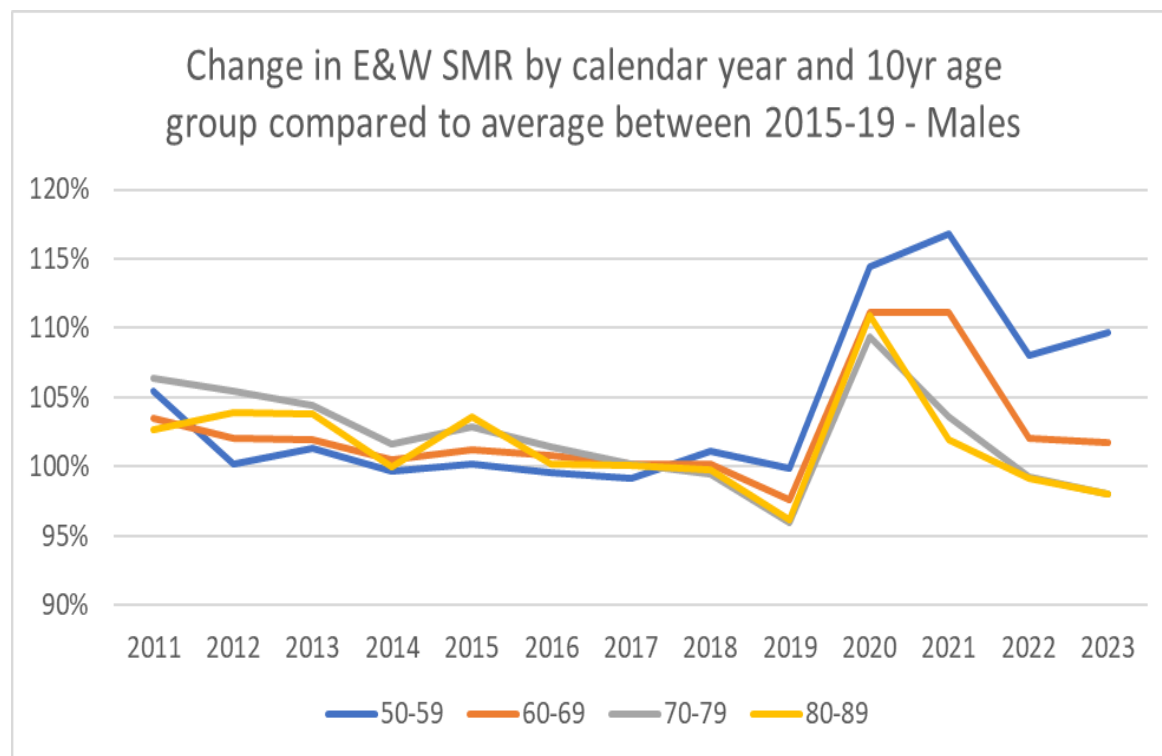
Assessment (4) – Impact vs uncertainty

- Relatively small difference in impact on life expectancy for 65 year old between using zero weight and 25% when considering CMI_2023 alone
- However, it is material when combined with the change implemented by CMI_2022
- However, indicators are mixed regarding direction of mortality in the post-pandemic era



2023 SMRs close to pre-pandemic estimates at key older ages

Assessment (4) – Impact vs uncertainty



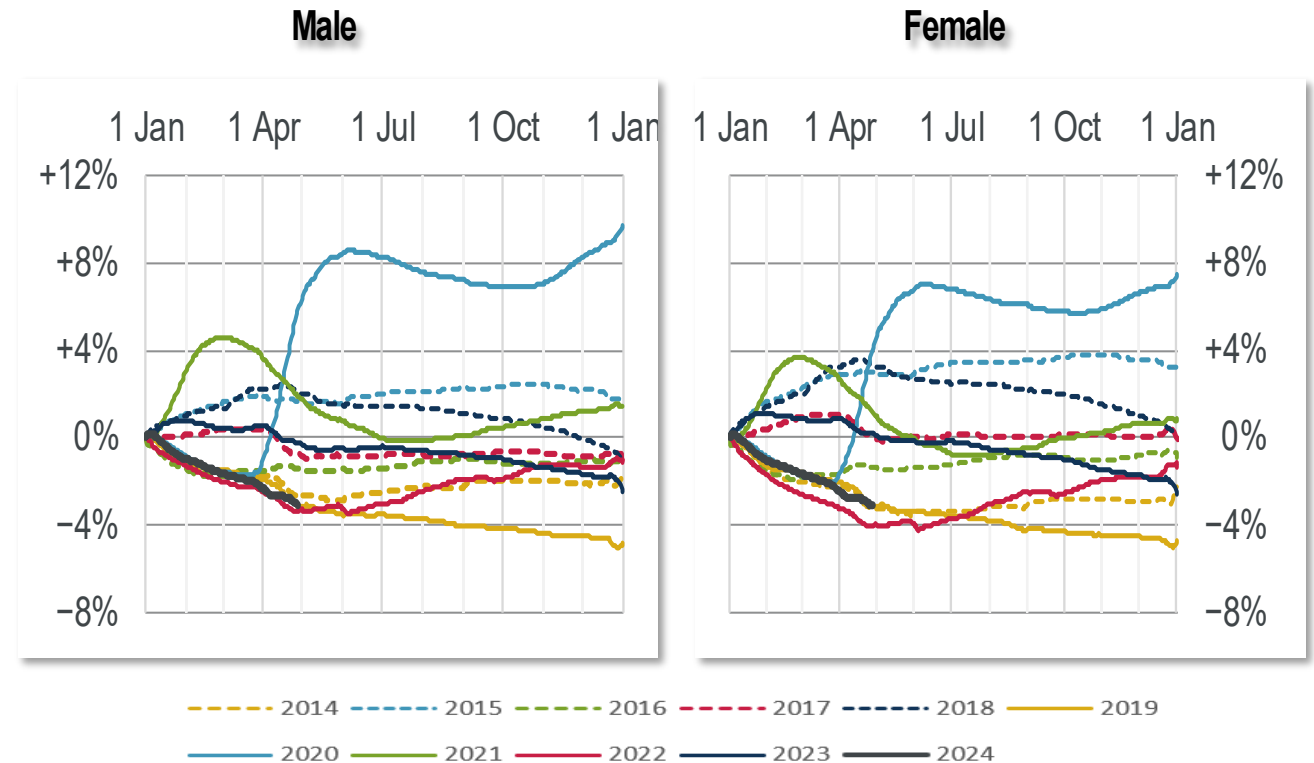
- Much of the higher mortality in 2022/23 compared to pre-2020 is in the age groups below 75
- SMRs at key ages for longevity are not far away from their pre-pandemic estimates

Early 2024 mortality looking lighter than 2023

Assessment (4) – Impact vs uncertainty

- Output from CMI mortality monitor software as at week 16 (SMR vs 10yr average)
- Older age experience, so far, is materially lower than the prior ten years
- Influenced by mild winter flu season
- Jury out to whether it will lead to material improvements in 2024 or not

Output from CMI Mortality monitor – Ages 65 to 100, week 17



Experience is evolving since the pandemic and it is materially different by age group

Short term headwinds replaced by medium term tailwinds?

Assessment (4) – Mortality improvement headwinds and tailwinds

Headwinds:

- NHS problems
- Ageing society
- Cost of living crisis
- Impact of increased levels of obesity

Tailwinds:

- Advances in genetic medicines
- Anti obesity medicines
- Multi cancer early detection tests
- Development of a universal flu vaccine
- Advances in dementia treatments
- Impact of AI on delivering new advances

Whilst the short term outlook for the UK is not great there are many potential sources of improvement in the future which raises doubts around projecting low rates of improvements well into the 2030s

To sum up

- CMI_2023 produces very low future improvements compared to historic periods – lower than any seen in the last 70 years.
- Higher weight parameters imply further material deterioration to the current excess (when comparing to pre-pandemic expectations that already anticipate low improvements)
- There are features of the projection, e.g. male vs female differences for younger cohorts, that require further investigation
- Higher weightings project low improvements well into the 2030s and hence imply low impact of medical advances – is this reasonable?
- The combination of CMI22 and CMI23 lead to a material change in life expectancies



Trusted partner.
Proven results.

©2024 RGA. All rights reserved.

No part of this publication may be reproduced in any form without the prior permission of RGA.

The information in this publication is for the exclusive, internal use of the recipient and may not be relied upon by any other party other than the recipient and its affiliates, or published, quoted or disseminated to any party other than the recipient without the prior written consent of RGA.



Questions



Comments

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



Continuous Mortality Investigation

Institute and Faculty of Actuaries

Continuous Mortality Investigation Limited
Registered in England & Wales (Company number: 8373631)
Registered Office: 1-3 Staple Inn Hall, High Holborn, London, WC1V 7QJ

Correspondence address: Cheapside House, 138 Cheapside, London, EC2V 6BW, United Kingdom
Email: info@cmilimited.co.uk
Tel: +44 20 7776 3820

Website: www.cmilimited.co.uk (redirects to www.actuaries.org.uk)

Continuous Mortality Investigation Limited ('the CMI') is wholly owned by the Institute and Faculty of Actuaries.

Disclaimer: This document has been prepared by and/or on behalf of Continuous Mortality Investigation Limited (CMI). This document does not constitute advice and should not be relied upon as such. While care has been taken to ensure that it is accurate, up-to-date and useful, CMI will not accept any legal liability in relation to its contents.

© Continuous Mortality Investigation Limited

15 May 2024