A CMI model parameterisation for mortality improvements in the Netherlands

16 September 2024

1. **What does the mortality trend in the Netherlands look like over the past 40 years? How does this compare to the UK?**
2. **How to parameterise the CMI model for Netherlands data and how this compares to the AG 2022 model?**
3. **Key considerations for appropriately projecting mortality improvements in light of the pandemic, with a focus on incorporating views of medical experts.**

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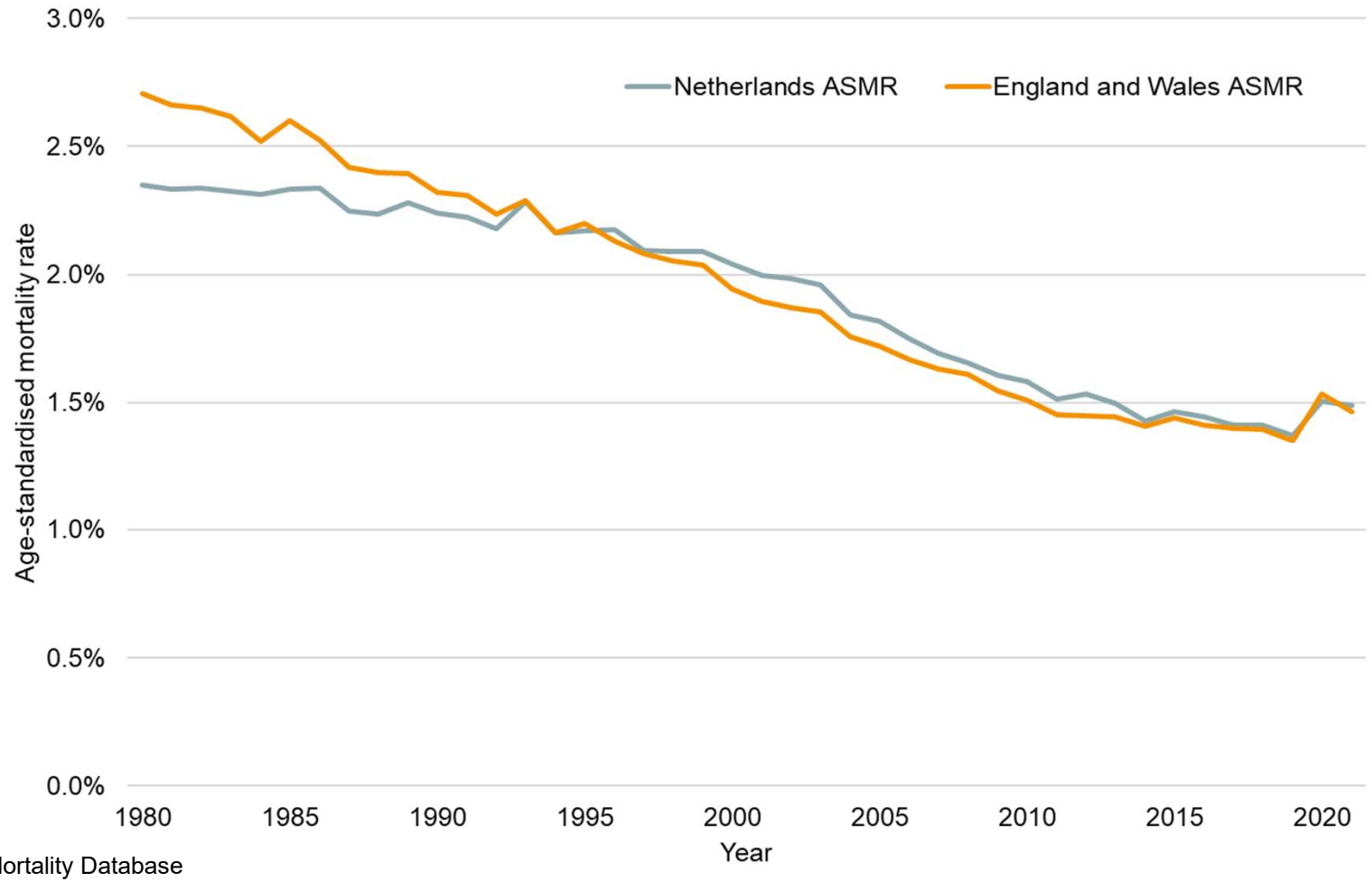
Mortality trends in the Netherlands

Looking over the last 40 years: Males 20-100



Source: Human Mortality Database

Mortality rates in the Netherlands have followed a similar trend to England and Wales decreasing over the last 40 years but with a slowing rate of decrease since 2010.

Mortality trends in the Netherlands

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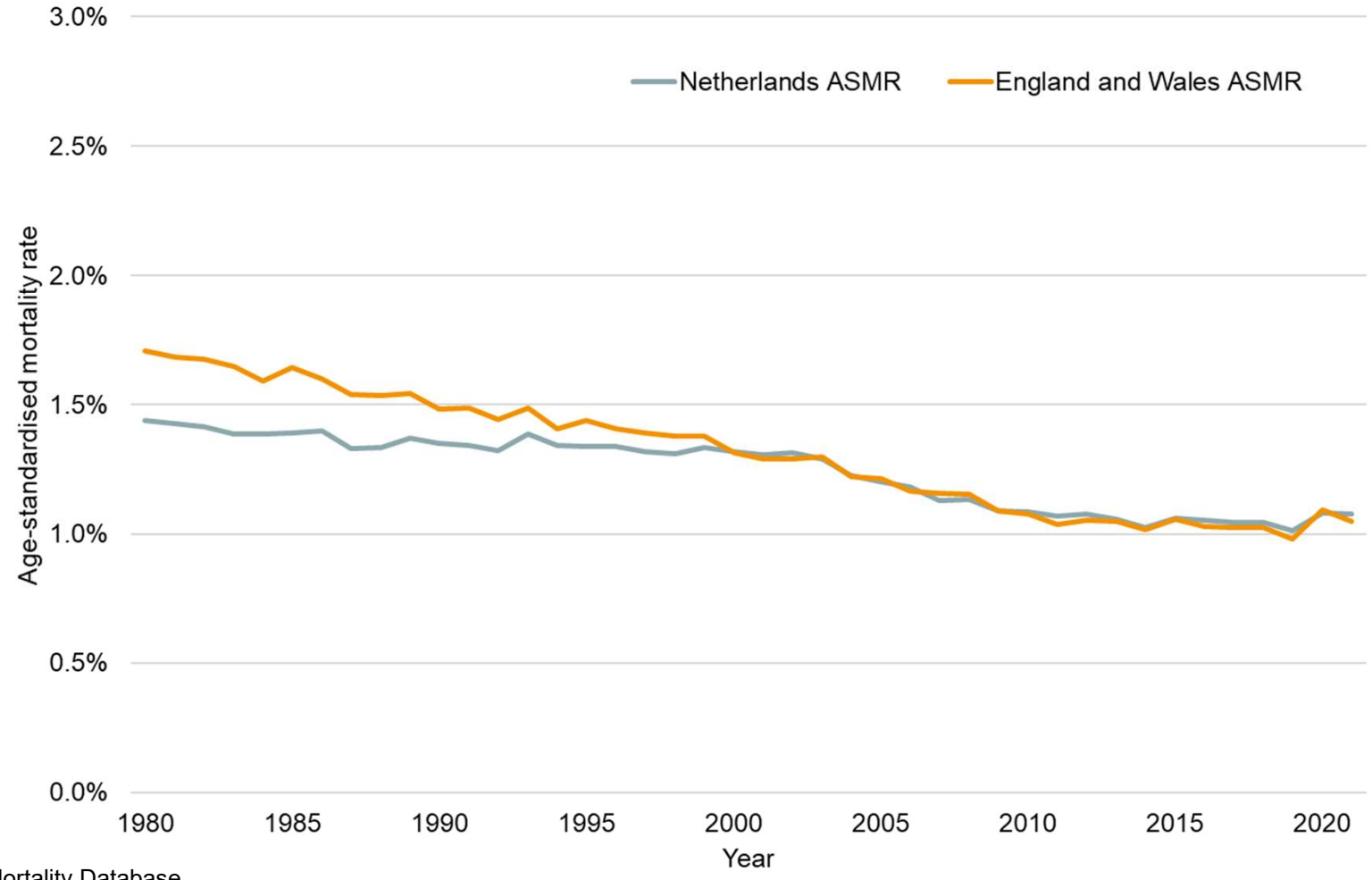

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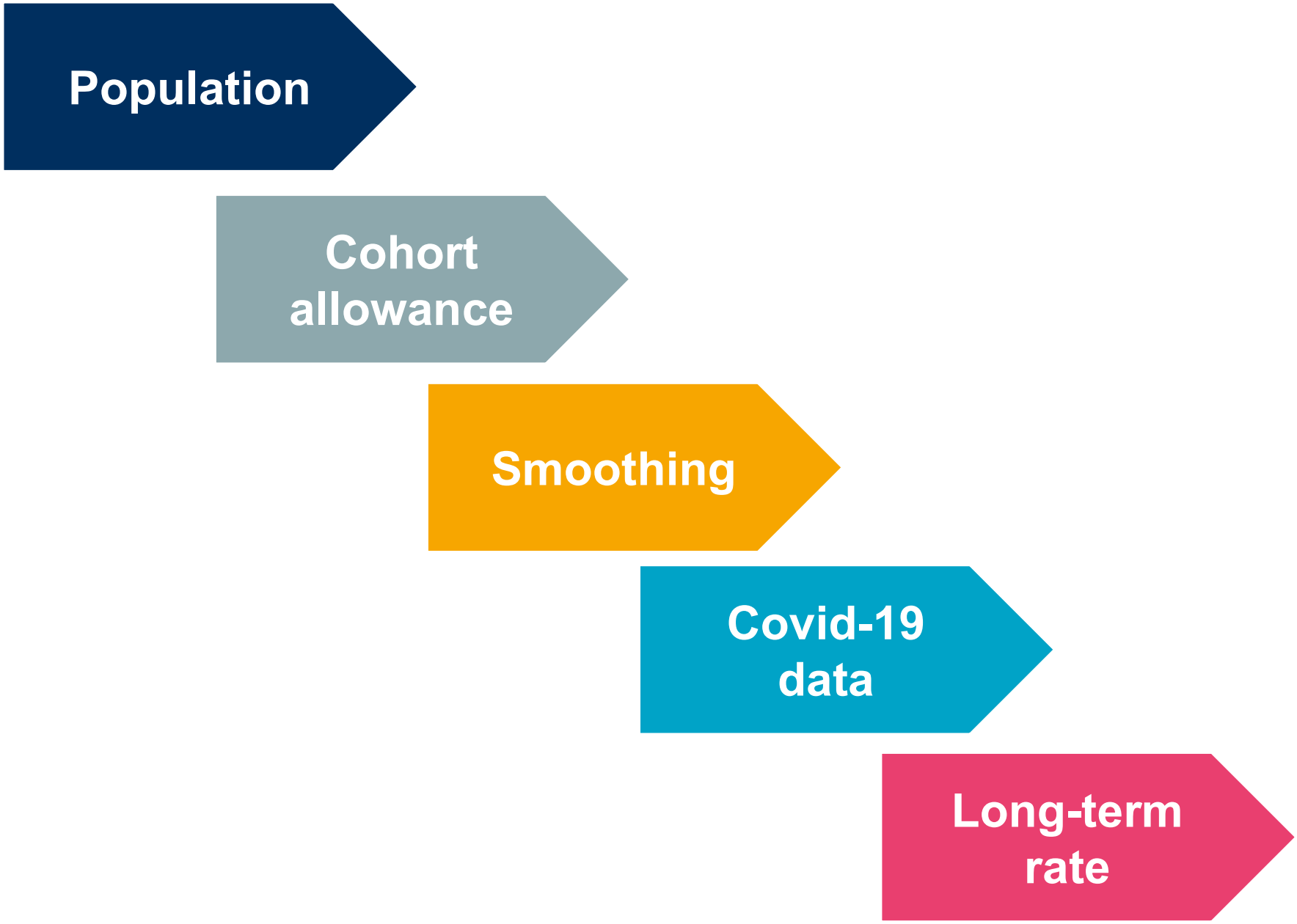
Key differences between AG 2022 and CMI 2023

Difference	AG 2022 model	Core CMI 2023 model	CMI 2023 model parameterised for Netherlands data
Data used	• Calibrated to Netherlands data, as well as 13 other European countries • Fitted to 1970-2021	• Fitted to England and Wales data • Fitted to 1983-2023	• Fitted to Netherlands data • Fitted to 1983-2023 • 2022 and 2023 provisional data from STMF database[1]
Cohort effects	• No explicit allowance made for cohorts	• Model identifies cohorts in the data	• Model identifies cohorts in the data
Covid-19 allowance	• Temporary effect added to model for ages 55+ based on excess mortality in 2020 and 2021	• 2020 and 2021 excluded • 15% weight applied to data over 2022 and 2023	• 2020 and 2021 excluded • Illustrated here with both 0% and 100% weight on 2022 and 2023 data
Long-term rate	• Age-specific, based on past data • Quick convergence	• Parameter input • Linear taper; age 85 to 110 • Convergence over age-dependent period (20 years for ages 60-80)	• Parameter input • Linear taper; age 80 to 100 • Convergence over an age-dependent period (20 years for ages 60-80)

[1]The Short-Term Mortality Fluctuations ("STMF") database is a provisional dataset from by the Human Mortality Database (HMD).

Key parameter inputs chosen for CMI 2023 model

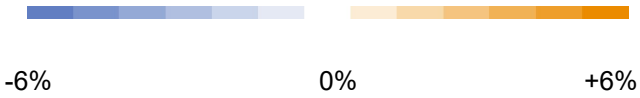
User specifies inputs to define projection and fit



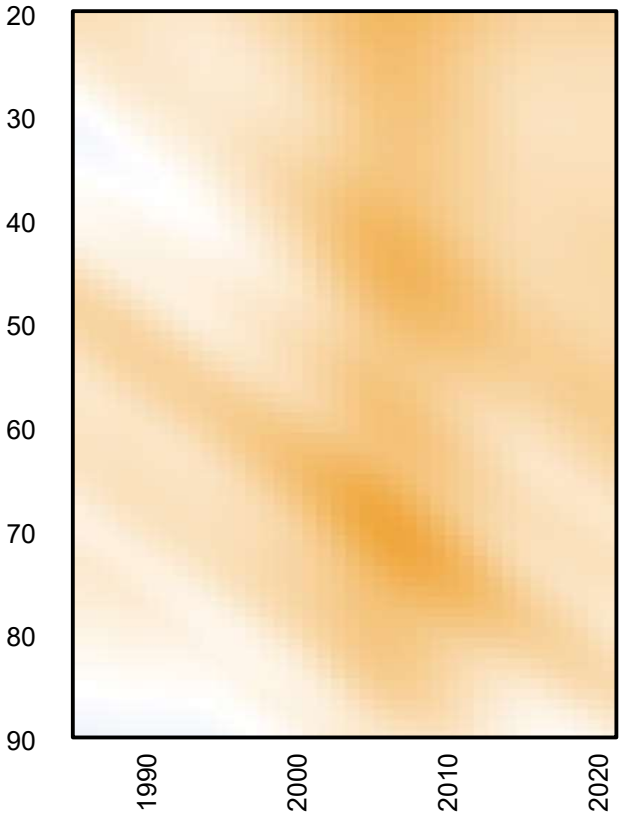
Parameterising the CMI 2023 model

We have fitted the CMI model to Netherlands data only

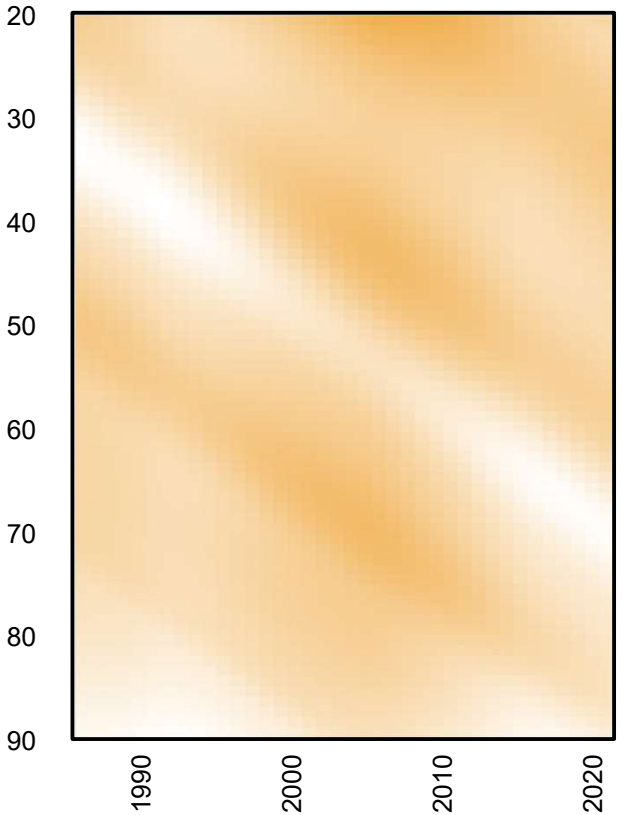
Population



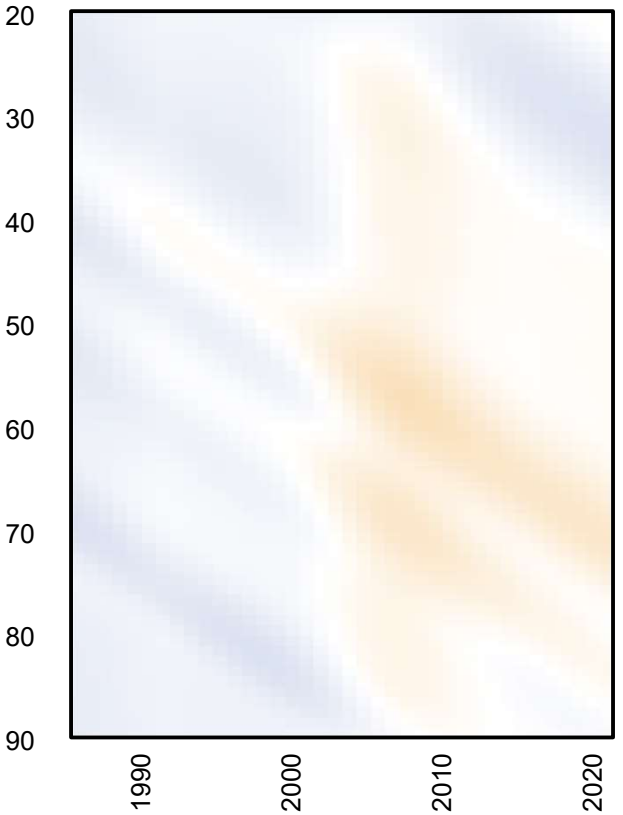
Fitted to Netherlands data



Fitted to European data



Difference (Netherlands – Europe)



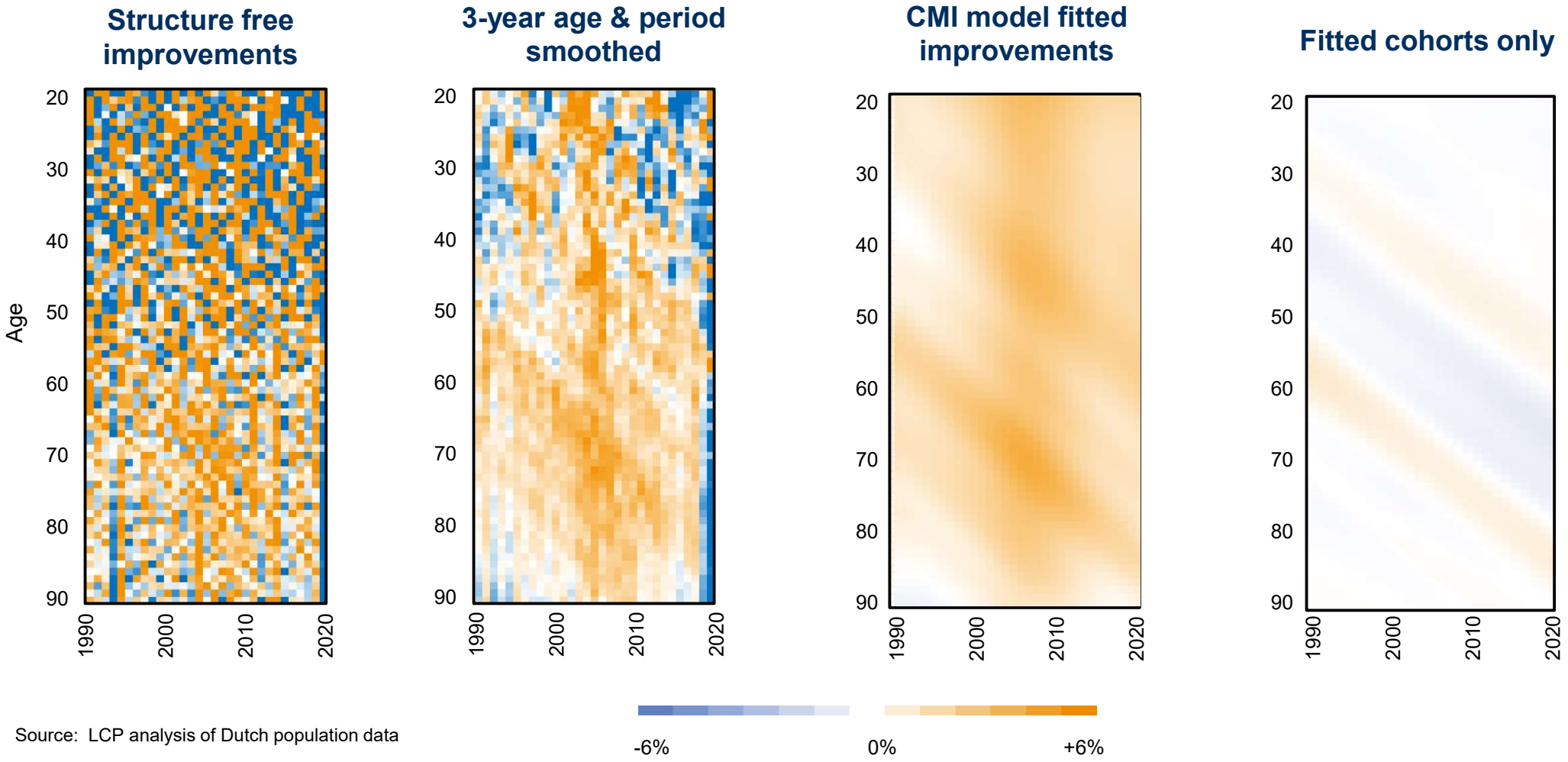
Source: LCP analysis, males only illustrated

Fitting the CMI 2023 model to the same European dataset that the AG 2022 model uses reveals similar cohort patterns compared to the Netherlands data, albeit with a stronger period effect between 2000 and 2010 for the Netherlands data.

Parameterising the CMI model

Fitted improvements and cohorts - Males

Cohort allowance



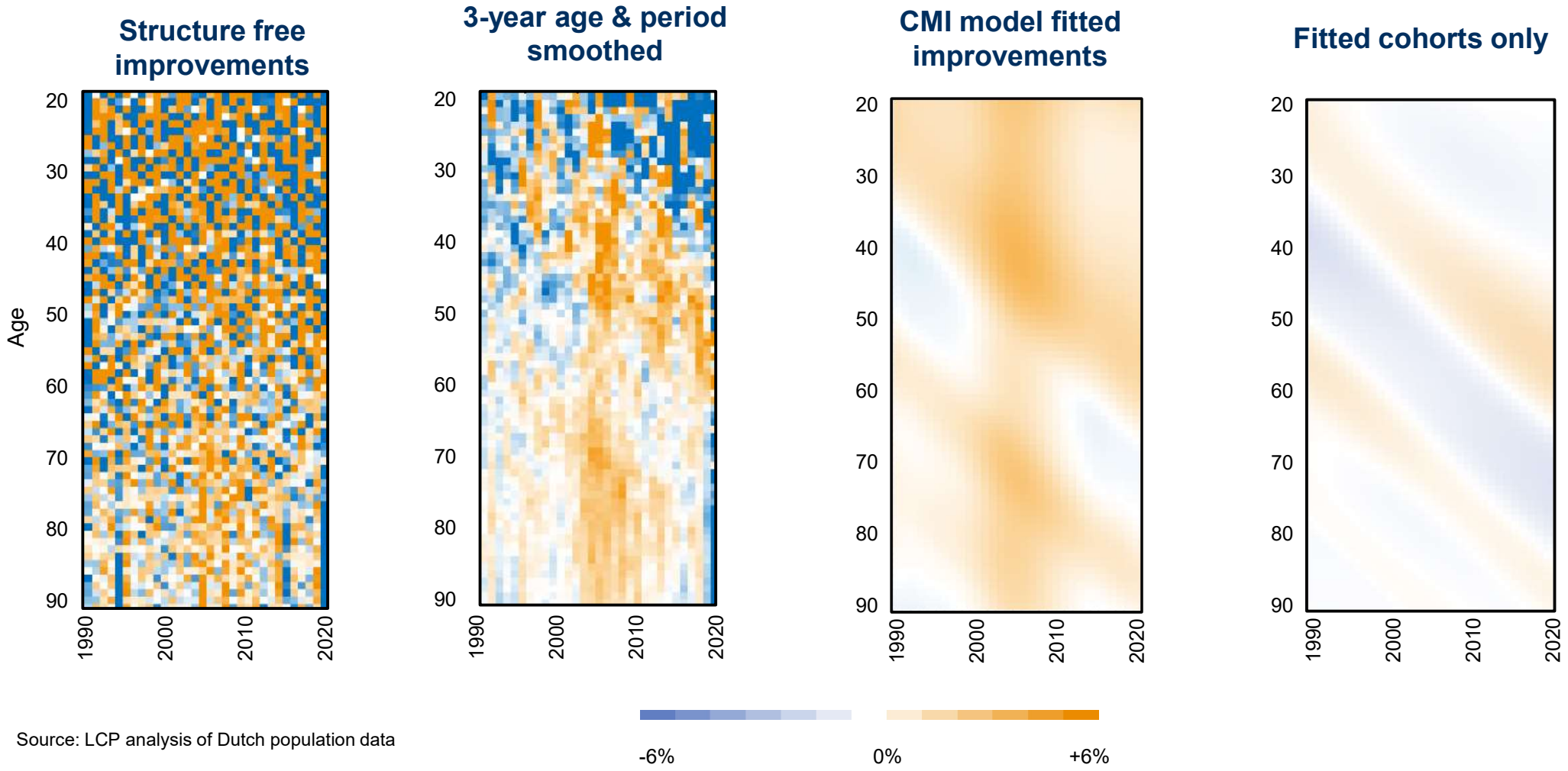
Source: LCP analysis of Dutch population data

The CMI model identifies cohorts in Dutch population data.
These are less pronounced than cohorts seen in data for England and Wales.

Parameterising the CMI model

Fitted improvements and cohorts - Females

Cohort allowance



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Parameterising the CMI model

Smoothing of age, period and cohort effects

Smoothing

The core CMI2023 model uses smoothing parameters to fit appropriate mortality rates and improvements considering the age, period and cohort terms.

As the Netherlands dataset is smaller than the core CMI 2023 dataset (England and Wales), smaller parameter values are required to give a consistent level of smoothing.

Summary of smoothing parameters adopted for Netherlands data

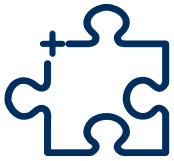
	Age smoothing (rates) "S_α"	Age smoothing (improvements) "S_β"	Period smoothing "S_κ"	Cohort smoothing "S_γ"
Core CMI2023 model	7.0	9.0	7.0	7.0
Parameterised model for Netherlands data	6.4	8.4	6.4	6.4

Parameterising the CMI model

Allowance for Covid-19 data

Covid-19 data

Mortality rates over 2020 and 2021 were exceptional due to direct impacts of the Covid-19 pandemic. Mortality rates since 2021 have remained elevated compared with the pre-pandemic trend.



In the core version of the CMI 2023 model 0% weight is given to 2020 and 2021, and 15% weight to 2022 and 2023.

It is a subjective choice as to the weights. Arguments can be made for higher or lower weightings than the core model.

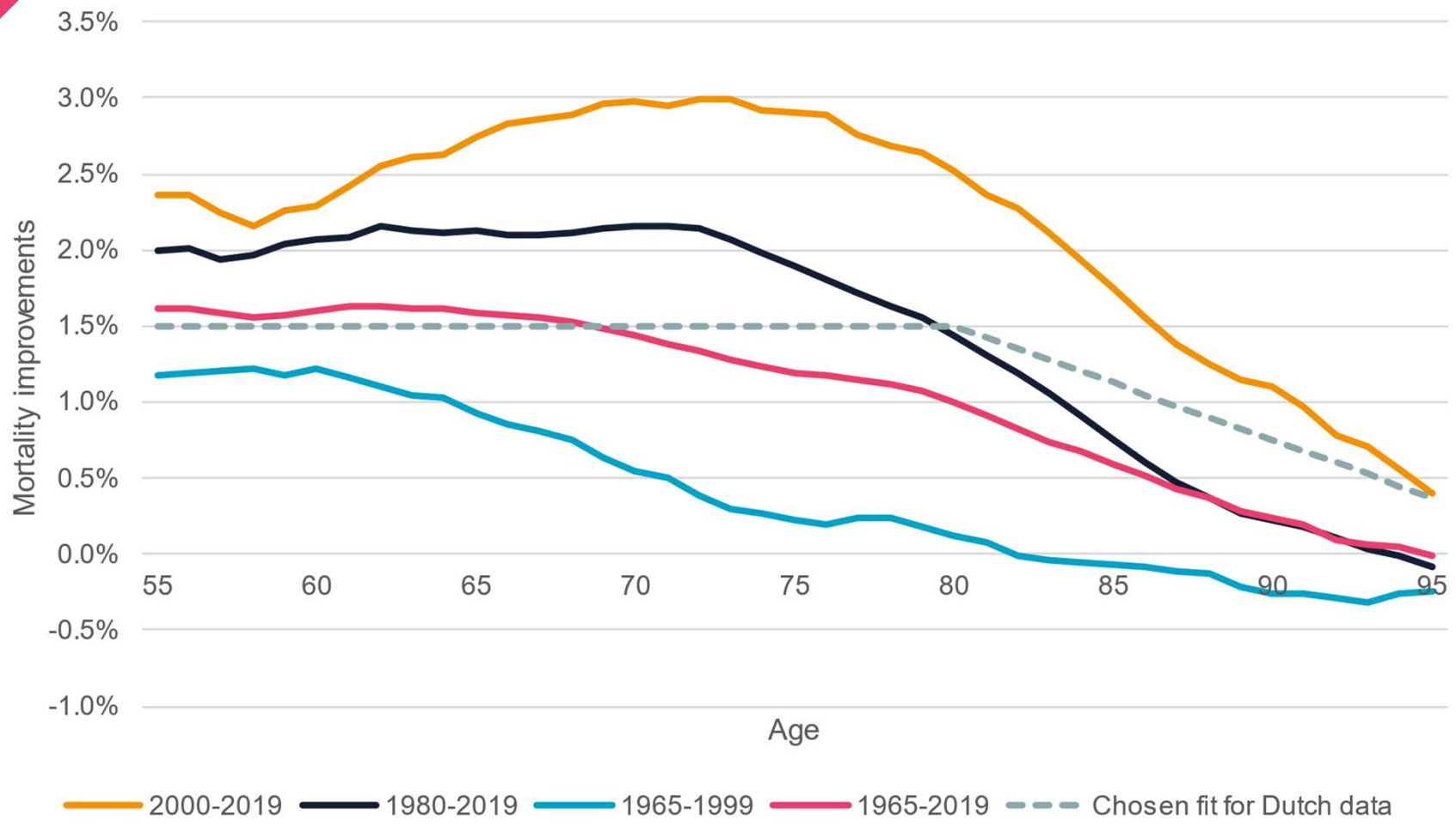
We have illustrated 0% and 100% weight on 2022 and 2023 mortality data to show the variety in the output of the model.

Parameterising the CMI model

Long-term rate and taper - males

Long-term rate

Historical annual mortality improvements by age (5-year age smoothing)



Source: LCP analysis of Netherlands data from Human Mortality Database

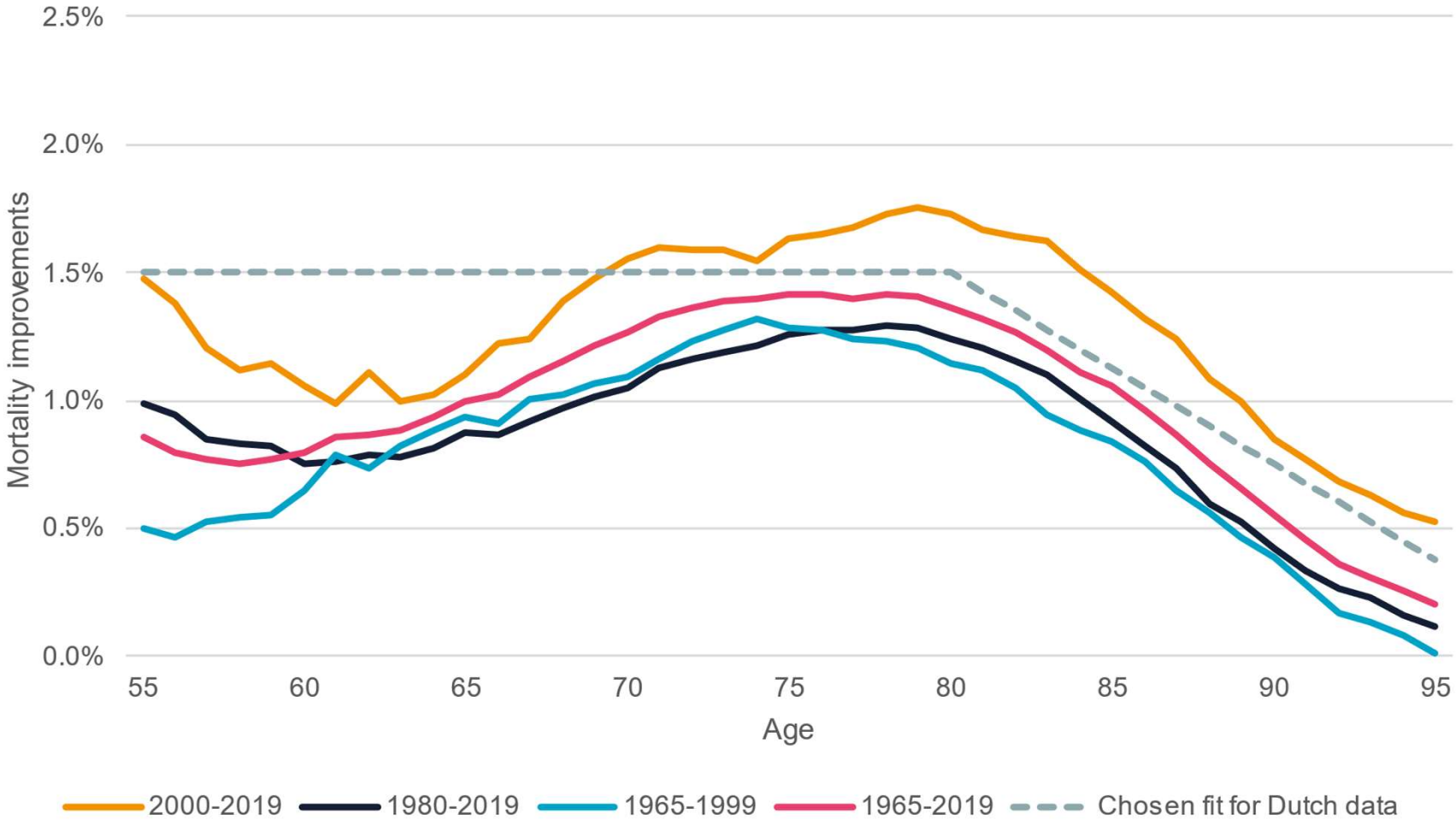
Historical mortality improvements in the Netherlands suggest an appropriate long-term rate of 1.5% pa, linearly tapering to 0% pa from ages 80 to 100

Parameterising the CMI model

Long-term rate and taper - females

Long-term rate

Historical annual mortality improvements by age (5-year age smoothing)



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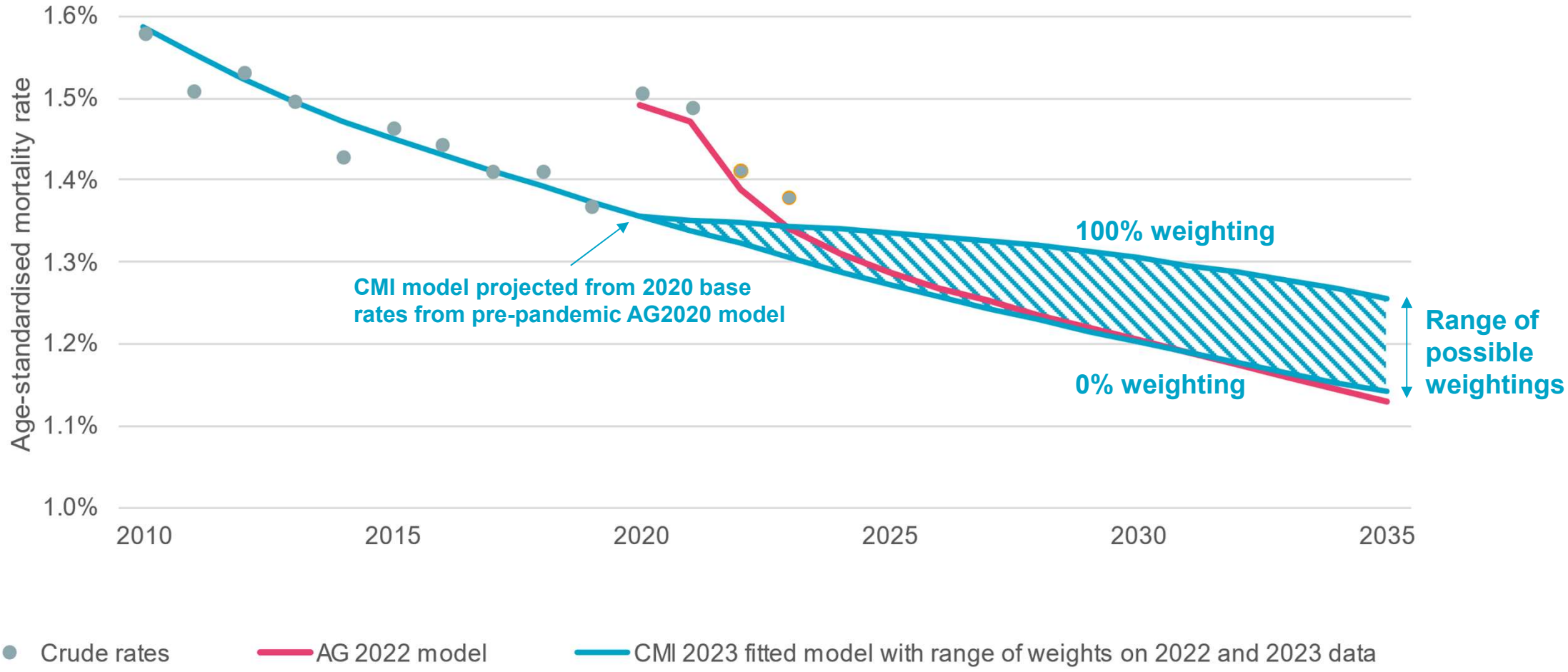
Key parameter inputs chosen for CMI 2023 model

User specifies inputs to define projection and fit

Population	Used Netherlands data only. Further adjustments may be needed if modelling subsets of society
Cohort allowance	Model identifies historical cohorts in the underlying data and projects these into the future
Smoothing	Consistent level of smoothing as core CMI model (fitted to England & Wales data), adjusted for size of data set
Covid-19 data	Model calibrated to mortality data excluding 2020 and 2021 (Covid years) and with a full range of weightings on 2022 and 2023 data illustrated
Long-term rate	1.5% pa for males and females Taper to nil from age 80 to 100

Projections of mortality rates

Comparison of projected mortality rates - Males

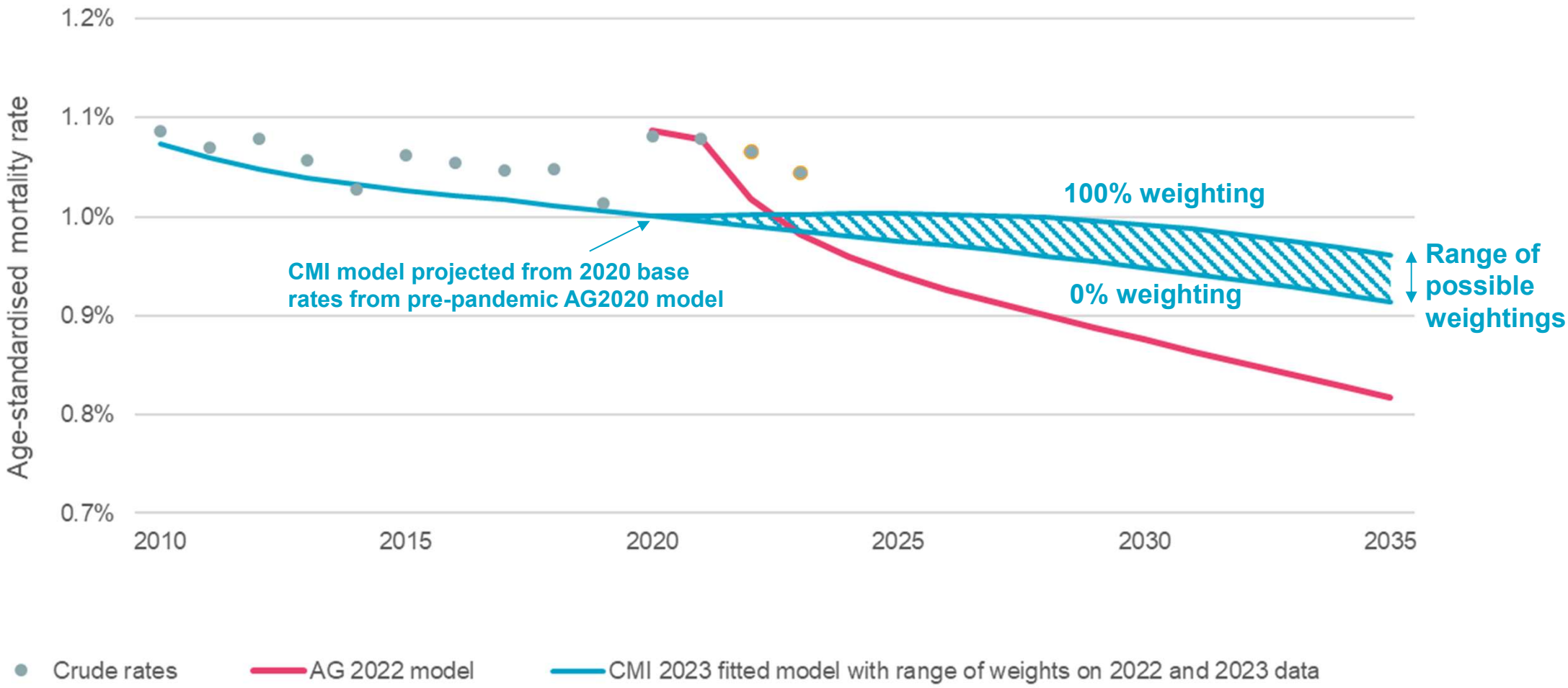


Source: LCP analysis, age-standardised over ages 20 to 100. Pre-2022 crude rates from the Human Mortality Database. 2022 and 2023 crude rates are estimated from provisional data from STMF database.

The AG 2022 model starts from Covid-affected years and has strong rebound to long-term trend.
The funnel in the CMI model shows the range of results dependant on the weight given to 2022 and 2023.

Projections of mortality rates

Comparison of projected mortality rates - Females



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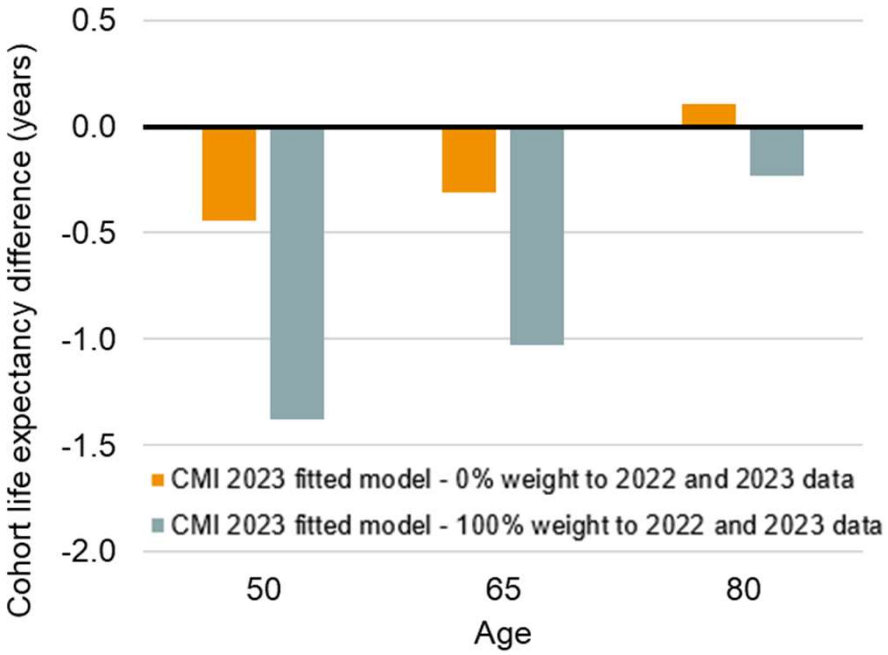
Comparison of models

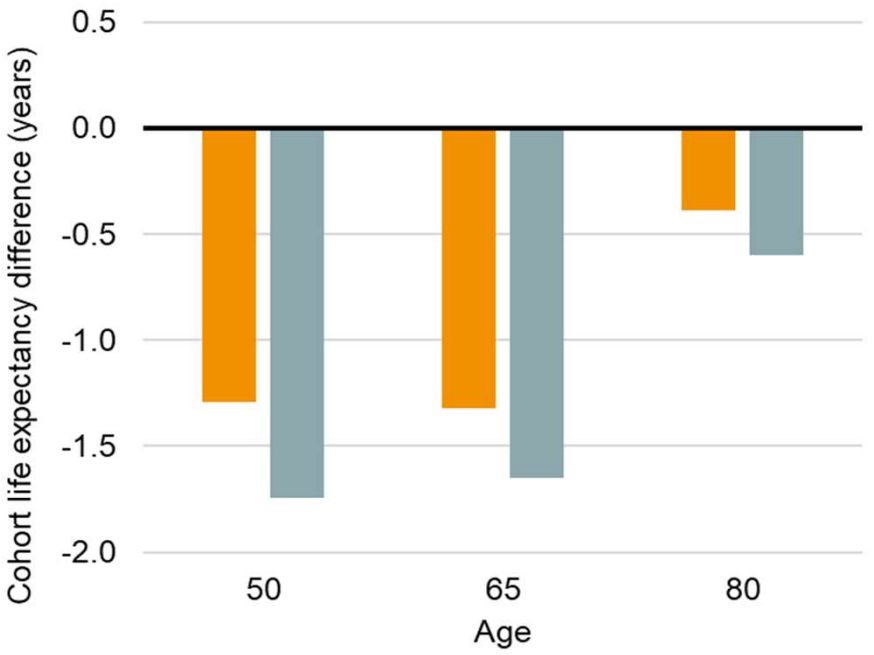
Resulting life expectancy differences relative to the AG 2022 model

Males



Cohort life expectancies (years) in 2024	AG 2022 model	CMI 2023 fitted model (w=0%)	CMI 2023 fitted model (w=100%)
Age 50	35.4	-1.3%	-3.9%
Age 65	20.5	-1.5%	-5.0%
Age 80	8.7	+1.2%	-2.6%

Females



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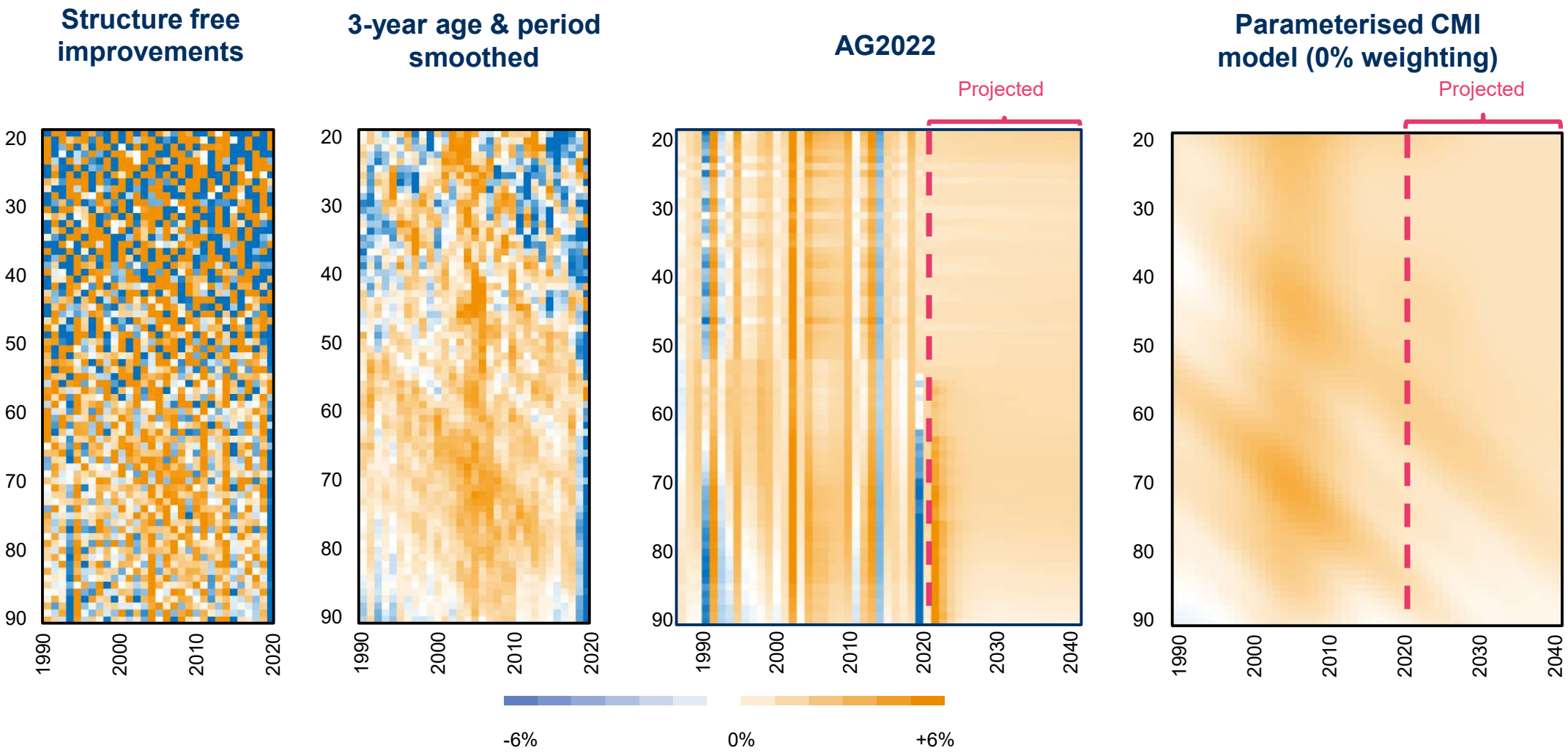
Age 50	38.4	-3.4%	-4.5%
Age 65	23.4	-5.7%	-7.1%
Age 80	10.3	-3.7%	-5.8%

The AG 2022 model generally gives higher life expectancy than under the parameterised CMI 2023 model. Life expectancies for females are materially lower at all ages if the CMI model is used.

Mortality improvements

Comparison of fitted historical and projected improvements - Males



Source: LCP analysis of AG 2022 model parameters and parameterised CMI 2023 model fitted to Netherland mortality data from the Human Mortality Database.

The CMI model projects forward historical trends and gradually reaches the long-term rate of improvement. There are cohorts with stronger and weaker improvements vs the AG2022 projection.

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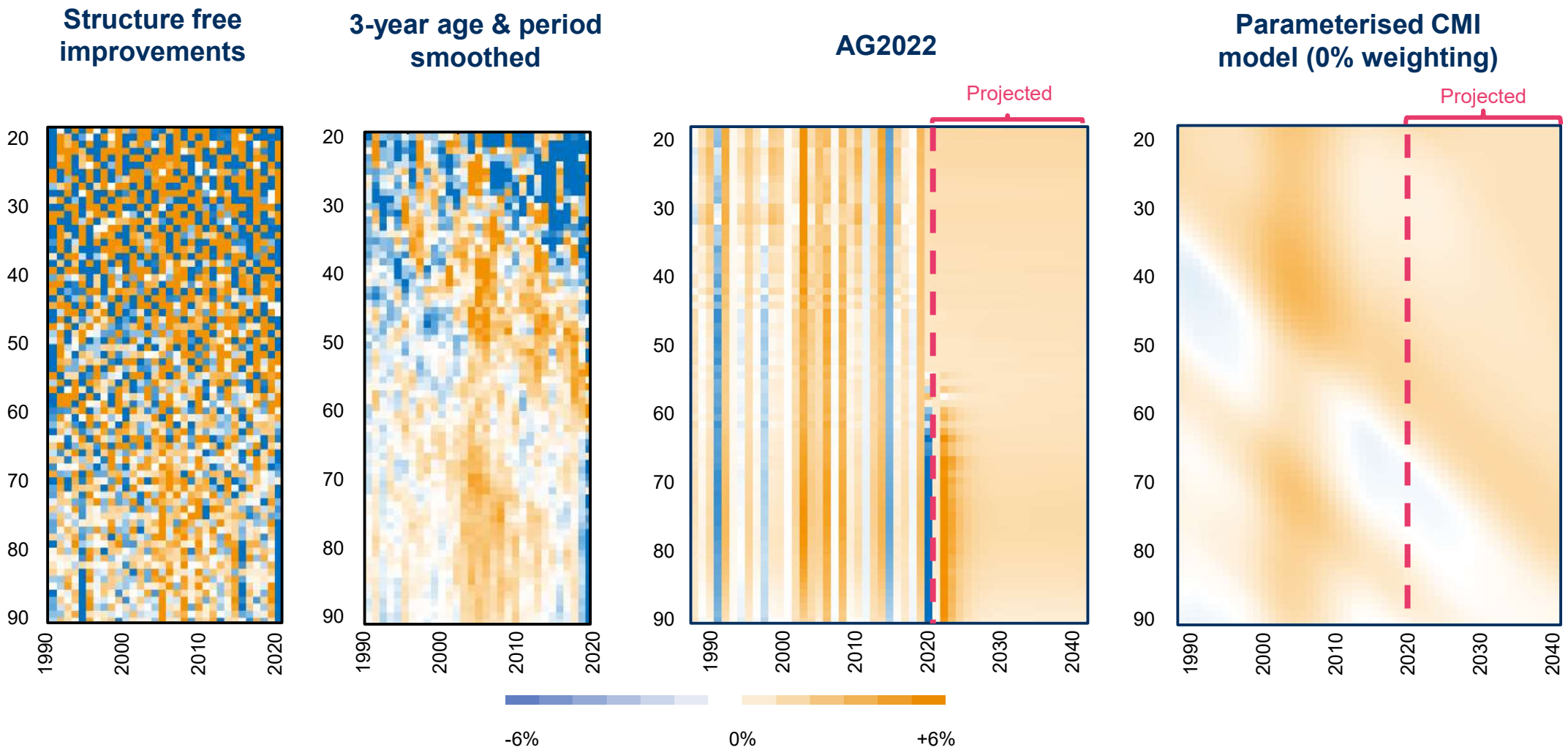

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How to allow for the pandemic?

Weight placed on recent data materially changes projections

The pandemic has materially changed the future outlook

How appropriate is it to project forward pre-pandemic trends?

How can we account for the impact of the pandemic in future?

Expert views

Alternative way to inform a view of the future

We are running a structured Delphi process to collate views of health and mortality experts.

The focus is to establish how the group believe all-cause mortality rates and mortality rates for major causes of death will develop in the Netherlands over 2024-2035.

We will identify and rank drivers of changes to mortality over this period.

- A structured process will be undertaken to capture the latest views of a range of experts including those with specific expertise of Dutch healthcare.
- The process will involve seeking views from epidemiologists, public health experts, medical doctors as well as two specialist actuaries.
- The process is designed to ascertain the experts' latest views on how all-cause mortality rates will develop over the next 10 years.
- The group will also be asked for their views on how mortality rates may develop for common cancers and several other major causes of death, and between different groups of individuals.

Expert views on the Netherlands

LCP are carrying out research using expert views on the Netherlands

- Analysis by cause of death
- Analysis by mortality driver
- Starting levels of mortality
- Differences between socio-economic groups
- Local views on mortality
- Progression of mortality rates in future

Drivers for UK mortality over the short-term

LCP powering possibility

Delays in urgent or routine care

Direct deaths due to future waves of Covid-19

Innovation / new treatments

Positive economic factors (higher social care funding, growth, etc)

Missed / delayed diagnosis & treatment

Climate change

Positive changes in lifestyle and behaviours

Alzheimer's and Dementia

Impact of long covid

Negative economic factors (recession, inflation, etc)

Antimicrobial resistance

Negative changes in lifestyle and behaviours

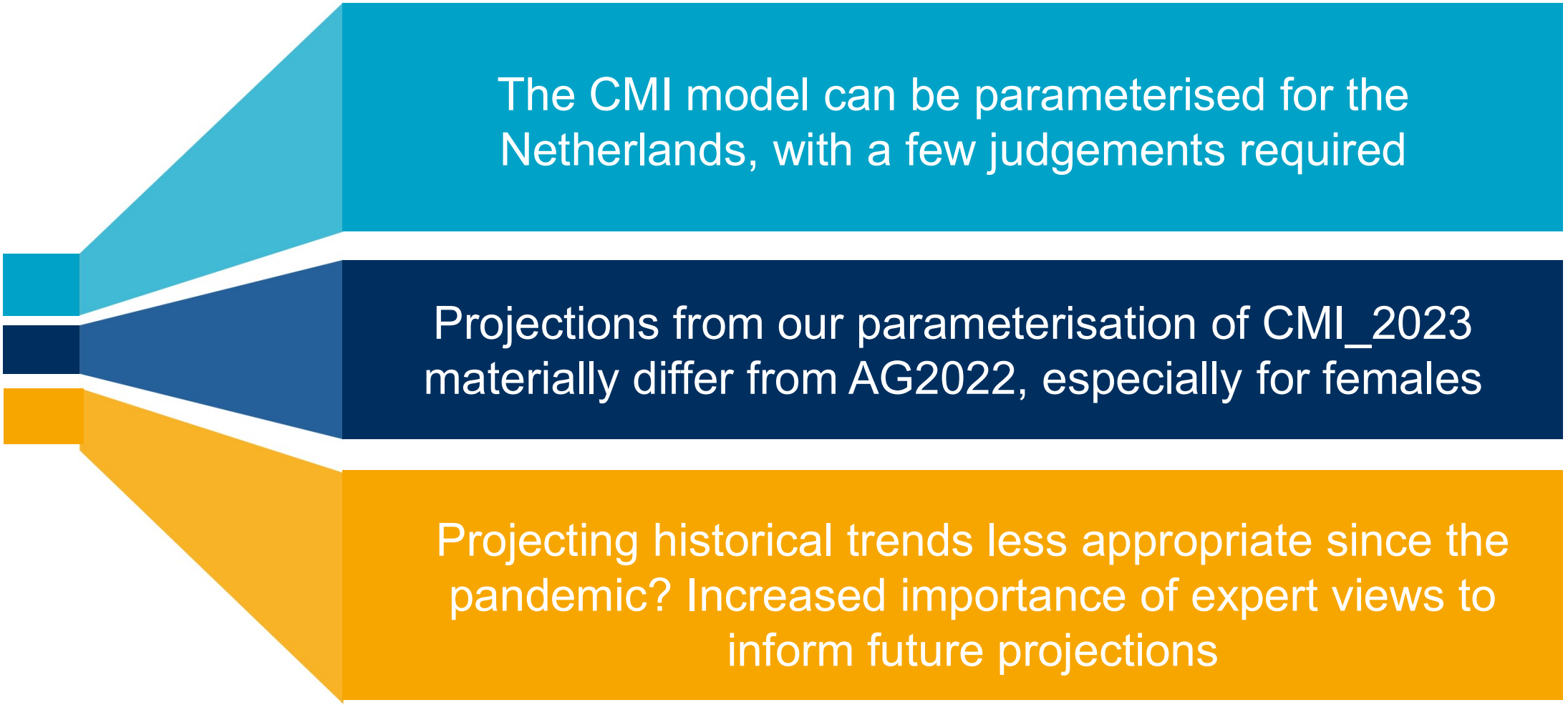
Influenza and non-Covid respiratory virus related deaths

Survivorship bias (mortality displacement / harvesting)

The main drivers for future changes in mortality are expected to be negative (blue), with delays in treatments and diagnosis expected to have the most impact.

This should be interpreted as relatively more "headwinds" against the historical backdrop of improvements, i.e. slower mortality improvements rather than increasing mortality.

Key takeaways



Contact us

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At LCP, our experts help to power possibility by navigating you through complexity to make decisions that matter to your business and to our wider society. We are powered by our desire to solve important problems to shape a more positive future. We have market leading capabilities across pensions and financial services, insurance, energy, health and analytics.

LCP locations

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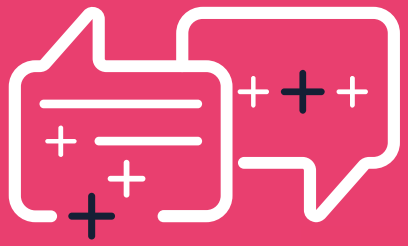
Appendix:

Comparison of projected mortality rates against AG2024 model



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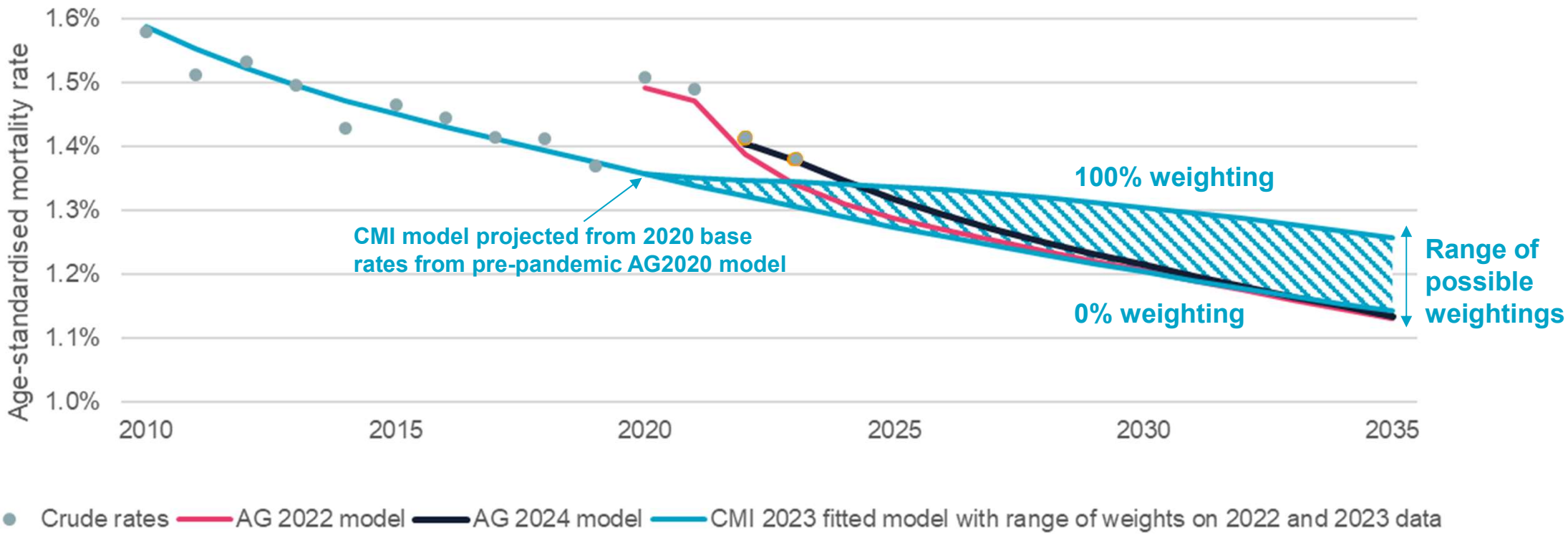

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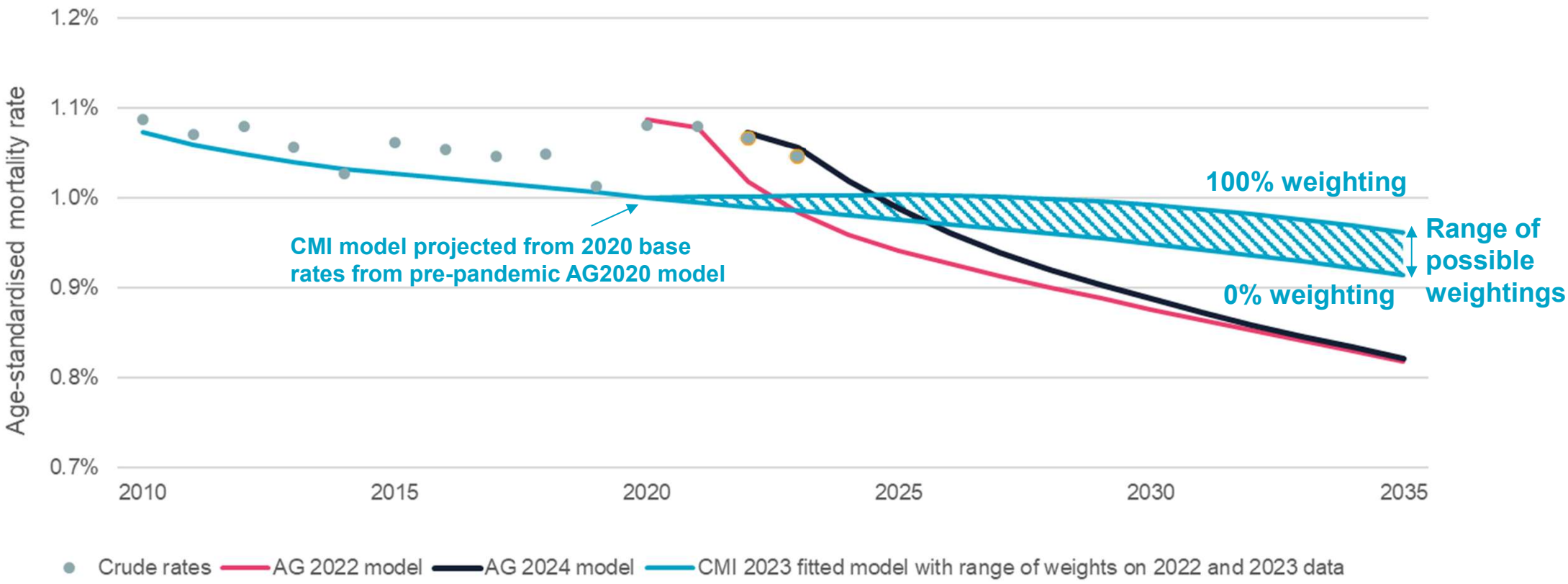

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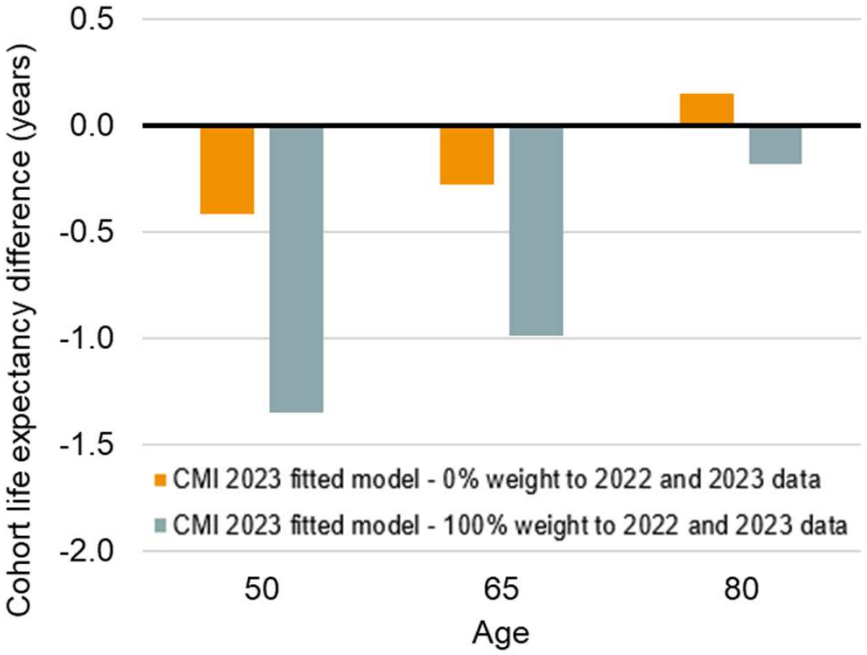

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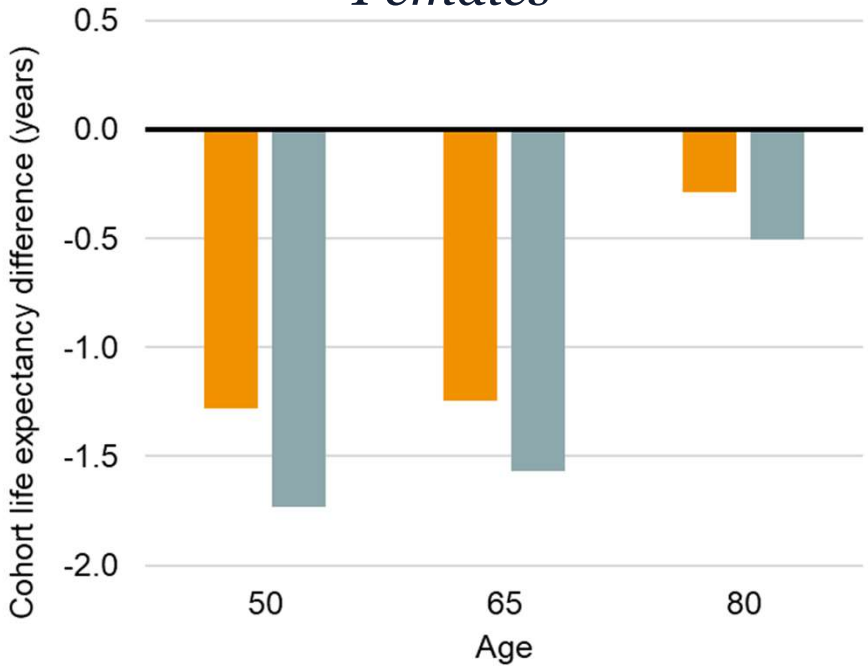

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