CLUB VITA
Ahead of the *longevity* curve

Thank you for joining us – the webinar will start shortly

Behind the curtain of the CMI projections model

Our flexible friend or overwhelming complexity?

Wednesday 3rd December 2025

7am PT / 10am ET / 3pm UK

linkedin.com/company/club-vita

www.clubvita.net

Today's panel

Co-chair

Erik Pickett FIA FSA

Actuary, Head of Content

Co-chair

Amy Walker FFA

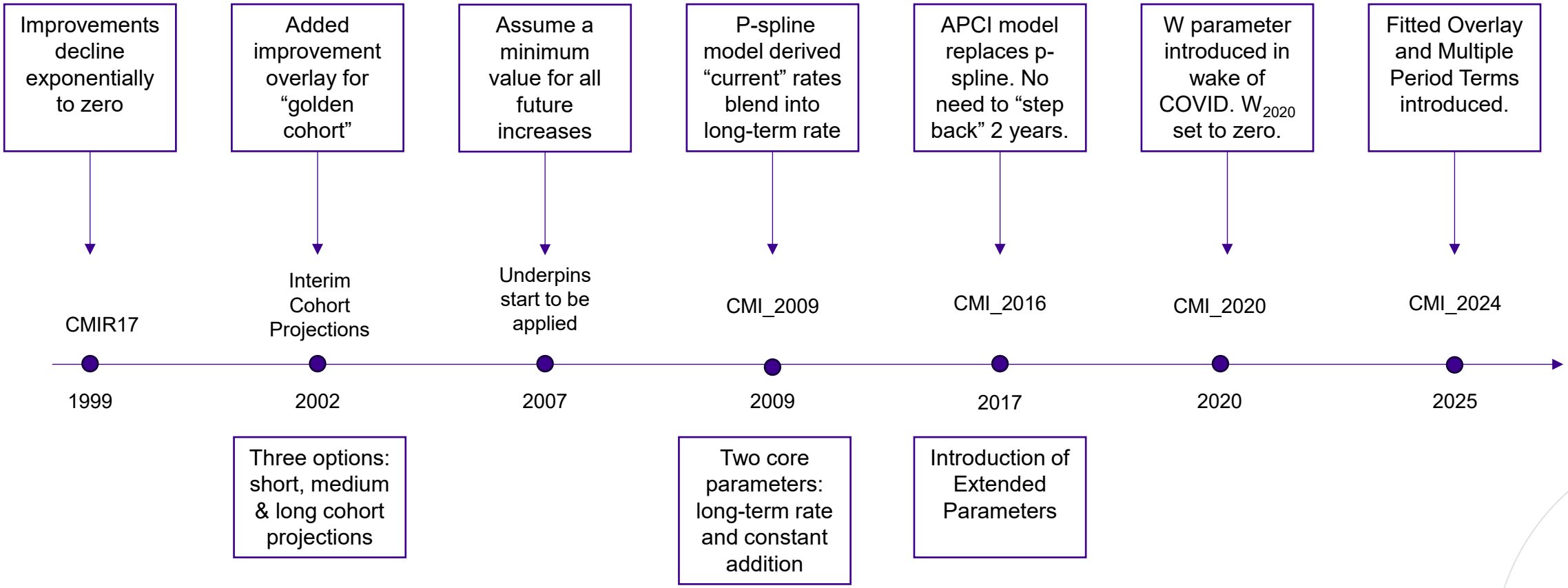
Client Delivery Lead, UK

Resident expert

Nick Chadwick FIA

Longevity risk specialist

Evolution of improvements over time



The CMI projections model overview

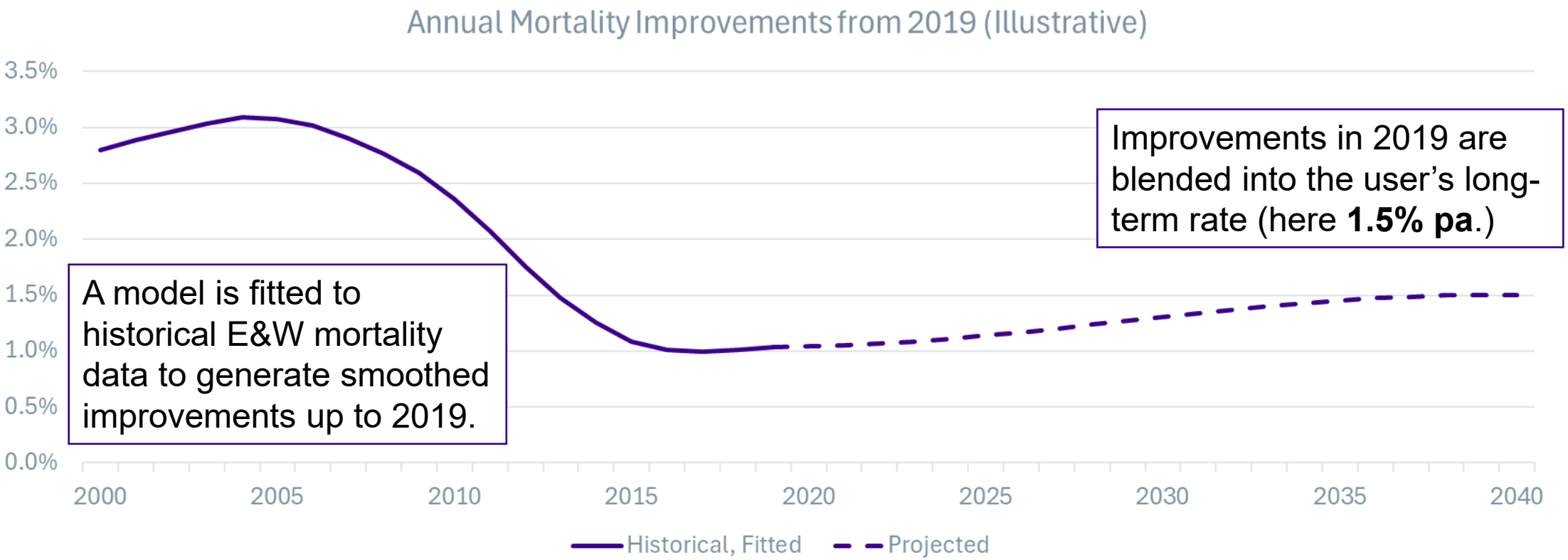


Chart shows age-period fitted and projected improvements for a 75-year-old man using CMI_2024 model with relevant core parameters but calibrated to 1979-2019 data.

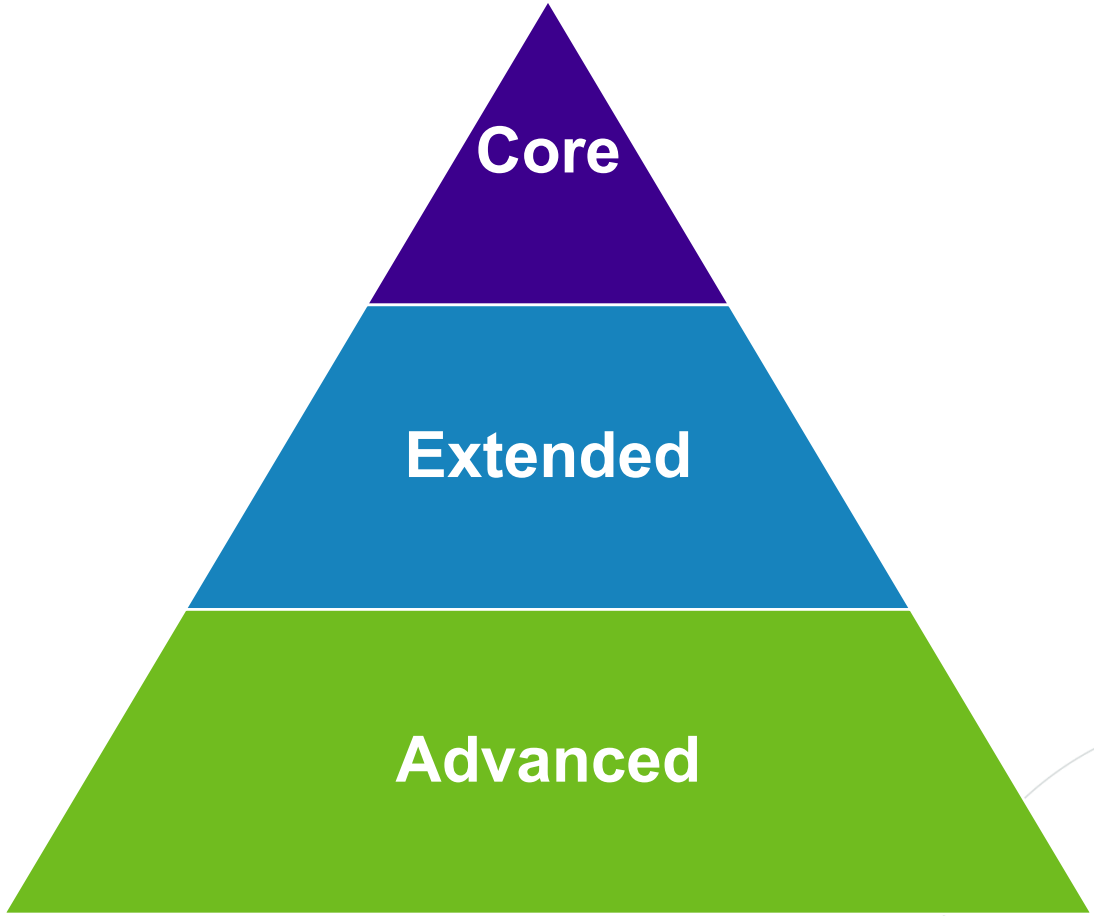
Core, Extended and Advanced Parameters

CMI Model User Guide

Must be determined by users of the Model, no default is provided.

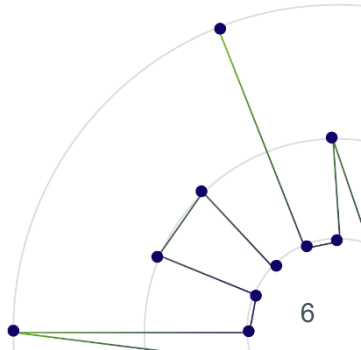
Defaults are provided, but users are encouraged to consider them carefully.

Parameters which are less likely to be amended by the user.



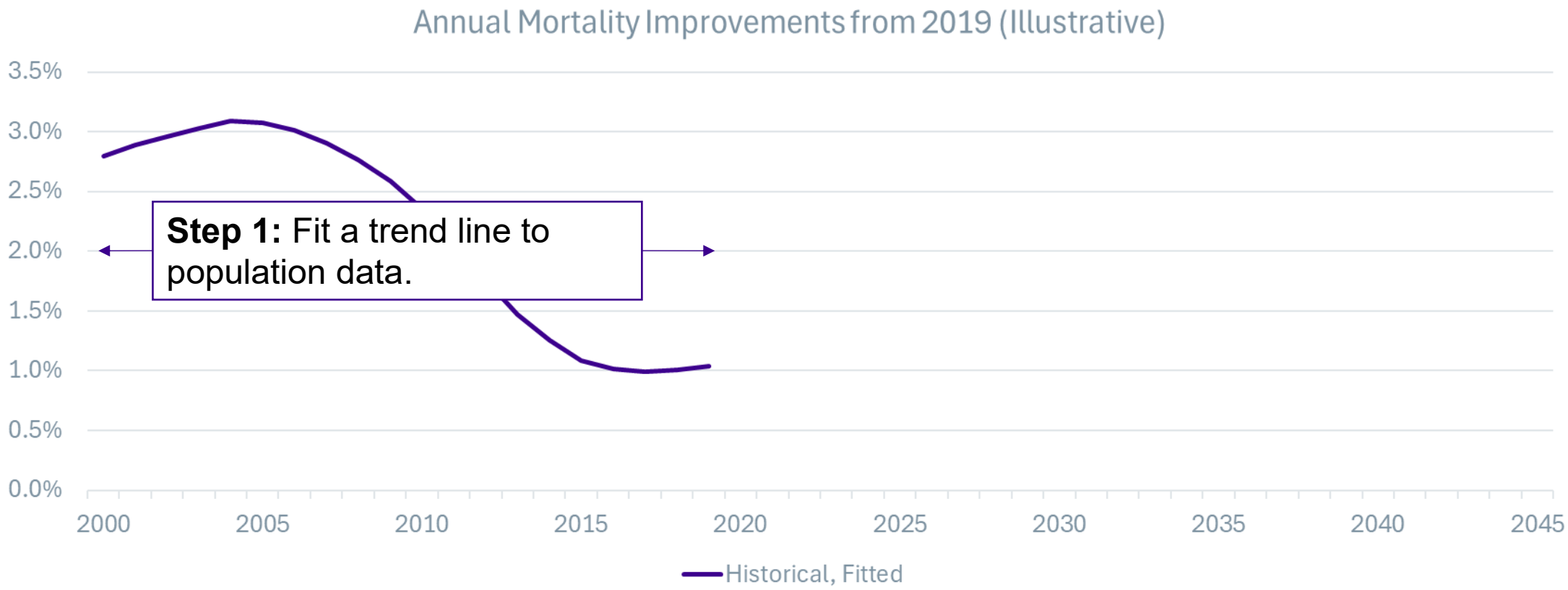
Aims for today's session

- Adopting the Core CMI model means inheriting a whole host of modelling decisions and implicit assumptions.
- We will outline a selection of **core**, **extended** and **advanced** parameters within the model which merit scrutiny by users.
- We will highlight some conceptual implications of adopting the core model and show the financial impact of taking an alternate view.
- We will also discuss considerations for certain parameters for modelling improvements in populations other than the England & Wales.

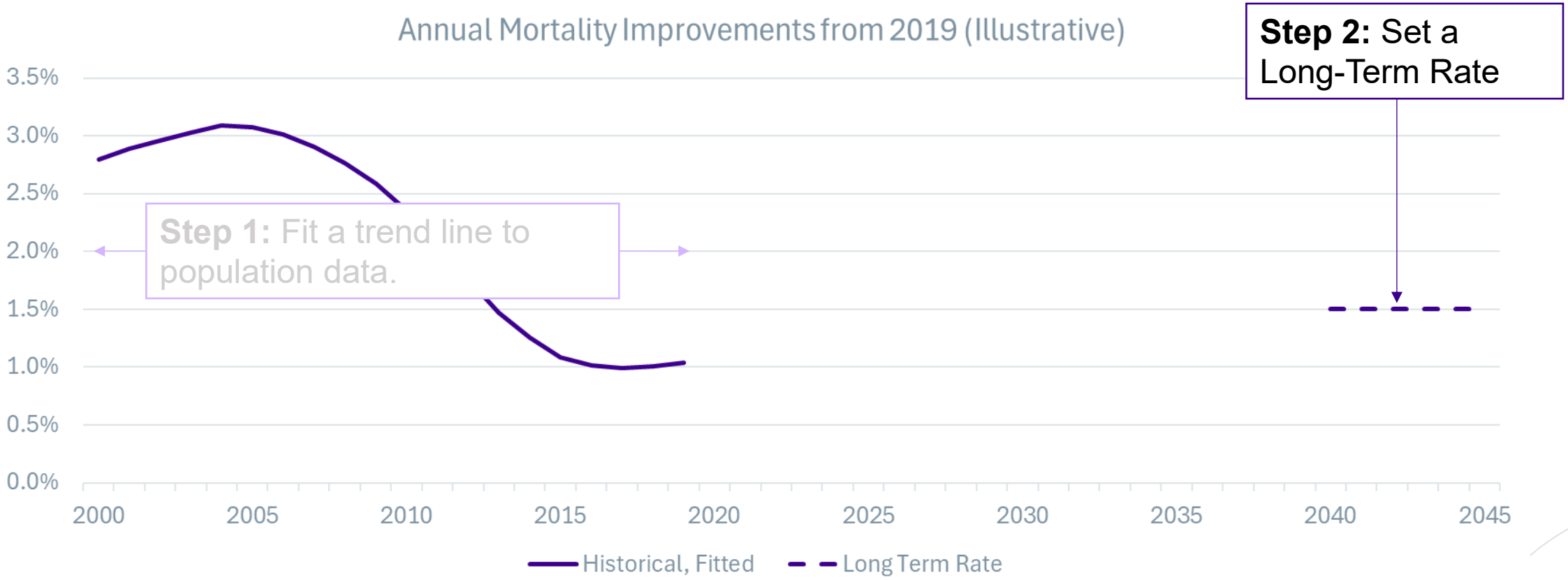


A 4-step approach to selecting an improvement assumption

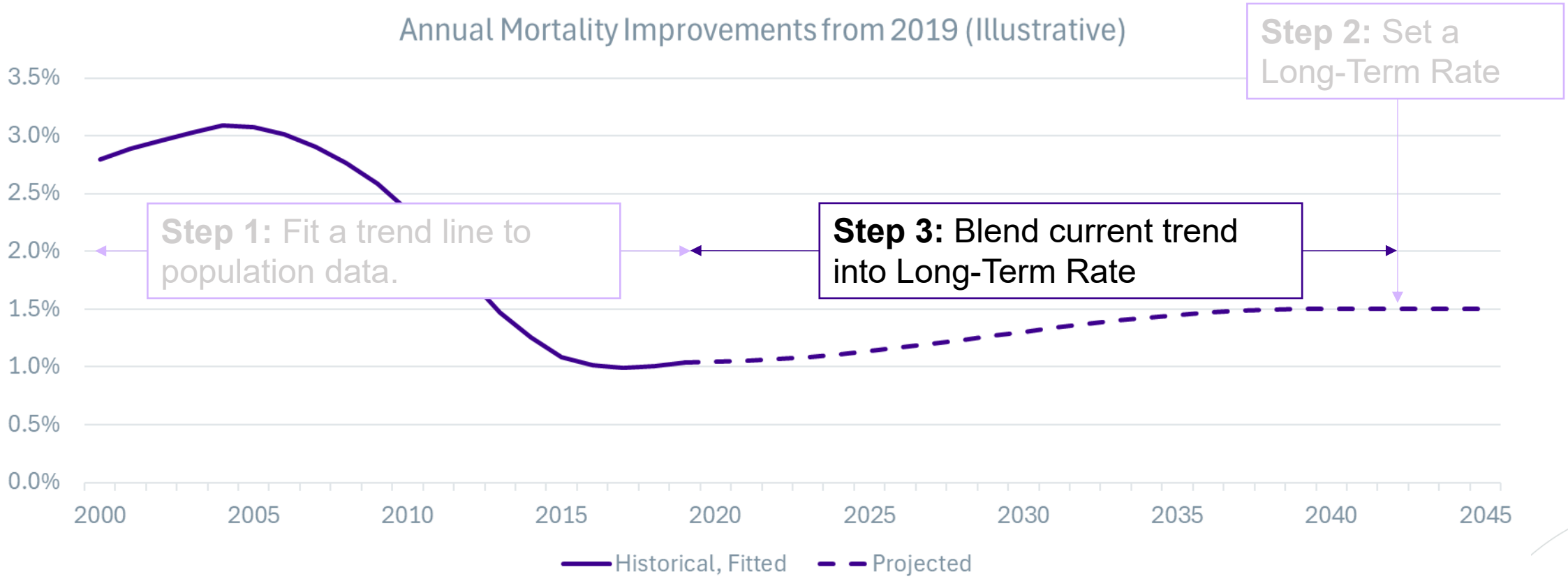
CMI Projection in practical use: Four Key Steps



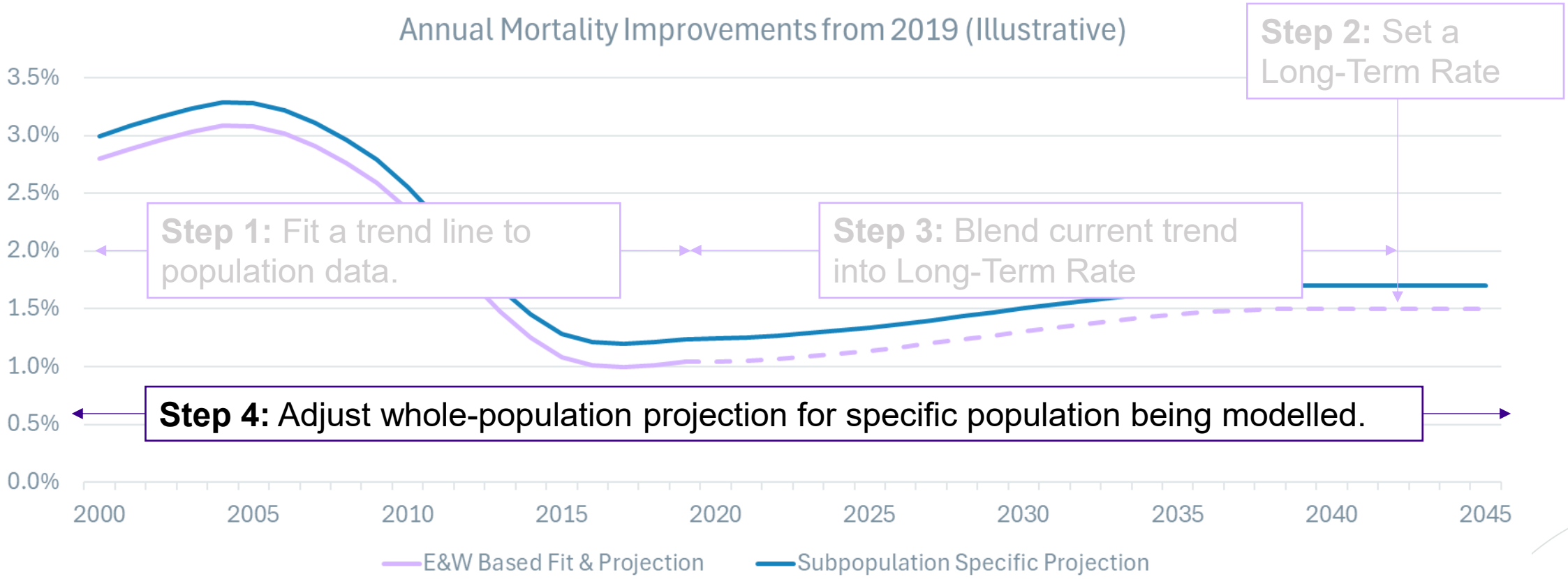
CMI Projection in practical use: Four Key Steps



CMI Projection in practical use: Four Key Steps



CMI Projection in practical use: Four Key Steps



CMI Model Health Warning

While the Core version of the Model is calibrated to data for the general population of England & Wales, it is typically applied to specific populations which have different characteristics. We encourage users to consider adjusting Model parameters to reflect the characteristics of the specific population that the Model is being used for, as well as their own views of future mortality.

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Step 1:
Fitting a trend line to population data

Levers of influence

S_K ("ess-kappa") Period Smoothing Parameter

- Tells the model how much year-on-year smoothing to apply when fitting a trend to historical data.
- Core value is 7.

COVID Fitted Overlay Half Life

- Tells the model how quickly COVID excess mortality should dissipate.
- Core shape is an exponential decline with a "half life" of one year.

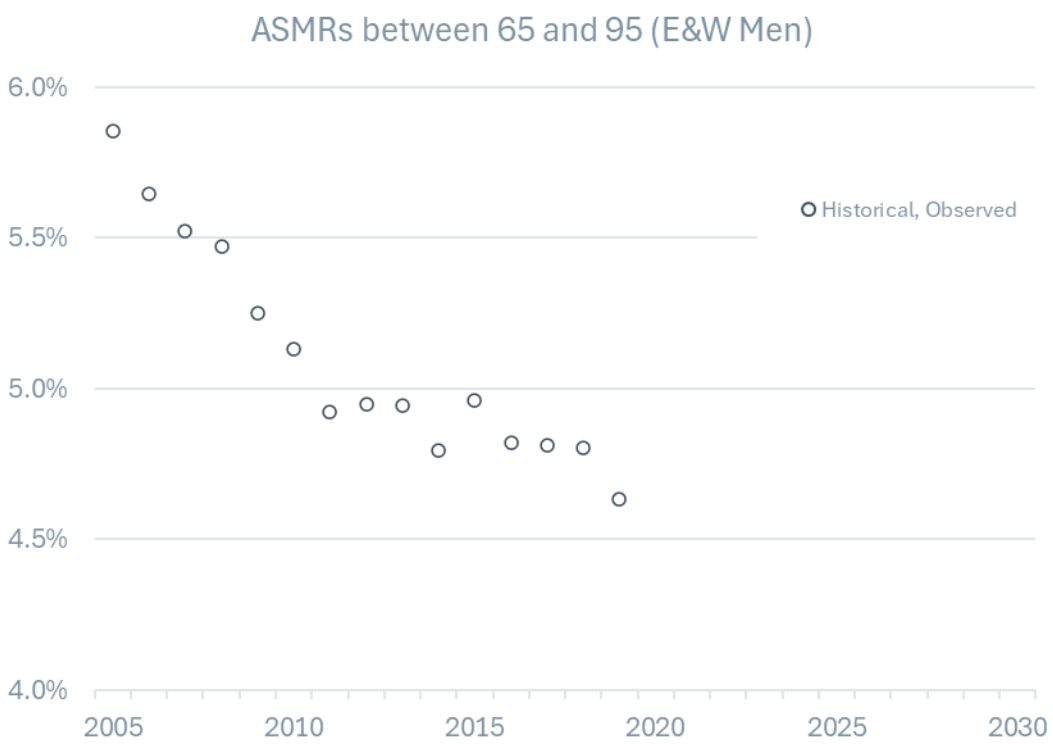
Multiple Period Terms

- Another new feature in CMI_2024, to better capture recent trends by age

These assumptions impact both the trend fitted to historical data and shorter-term projections.

S_K
Period Smoothing Parameter

What do we mean by period smoothing?
Male E&W data up to 2019

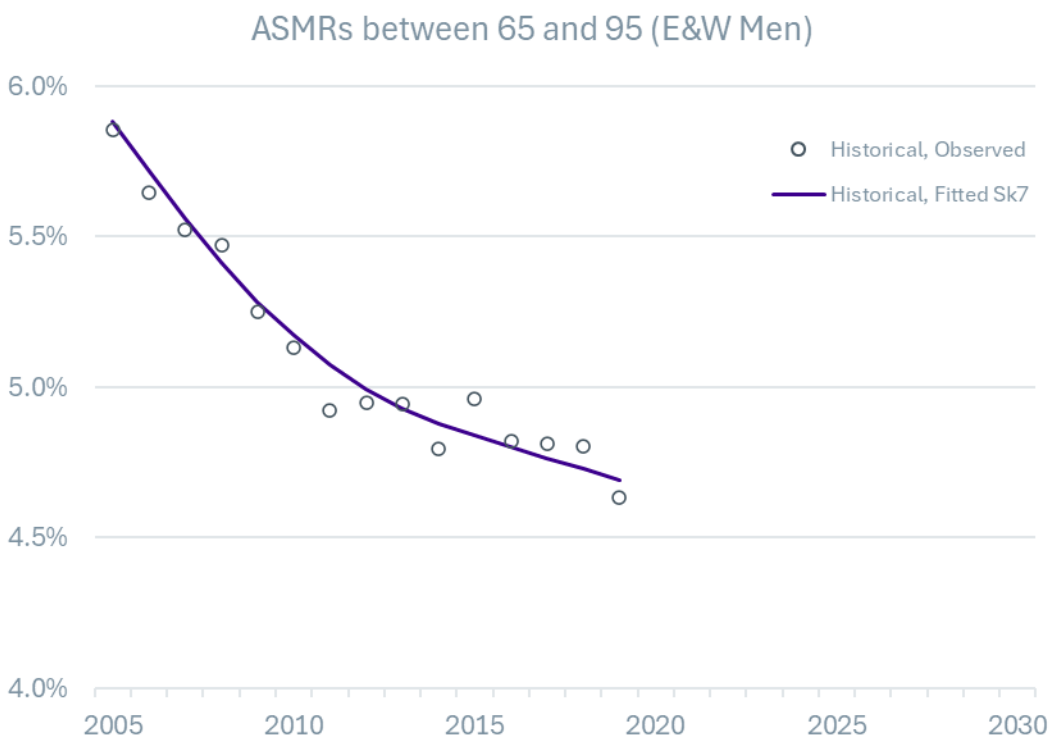


Separating the signal from the noise

- Here we show Age Standardised Mortality Rates (ASMRs) for E&W men, focussing on ages 65 to 95.
- The CMI model fits a trend line to this data.

ASMRs from CMI_2024 calibrated to 1979-2019 data.

Core value for S_κ
Male E&W data up to 2019

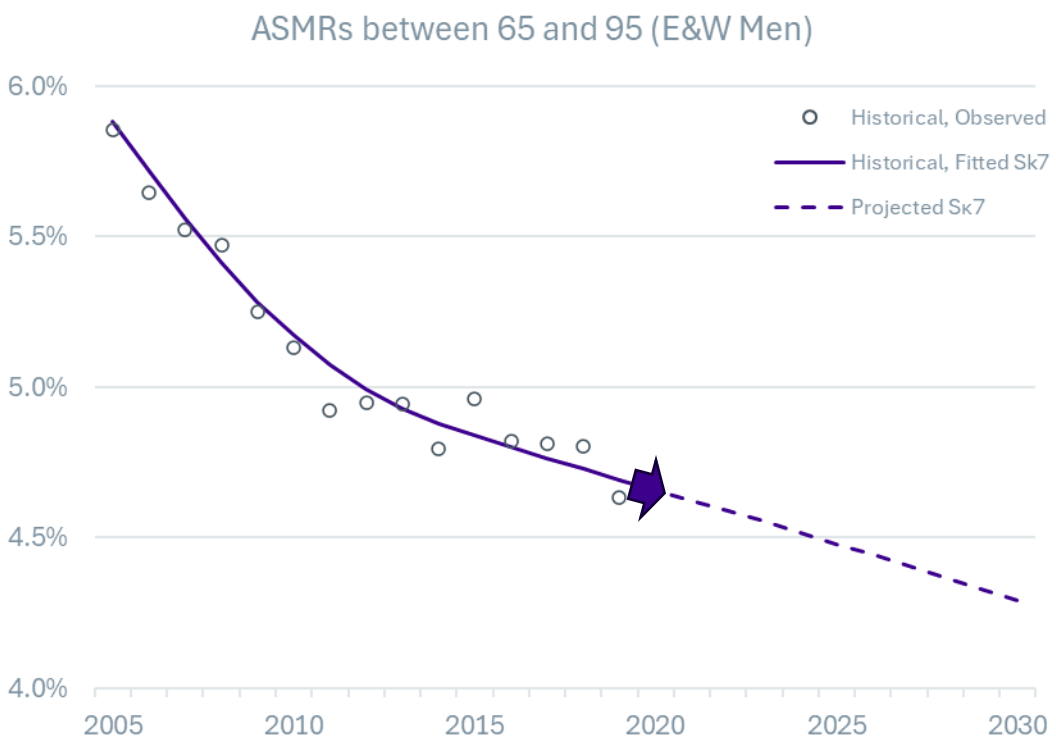


Fitted trend using core CMI model

- The core value for S_κ is set by the CMI Mortality Projections Committee.
- It was updated to 7 (from 7.5) in 2019.
- A value of 7 was found by the committee to strike a reasonable balance in its responsiveness to new data.
- Was previously an Extended parameter but since CMI_2024 it is Advanced.

CMI_2024 calibrated to 1979-2019 data, core parameters, long-term rate of 1.5% per annum, Fitted Overlay turned off to make model run.

Core value for S_{κ}
Male E&W data up to 2019

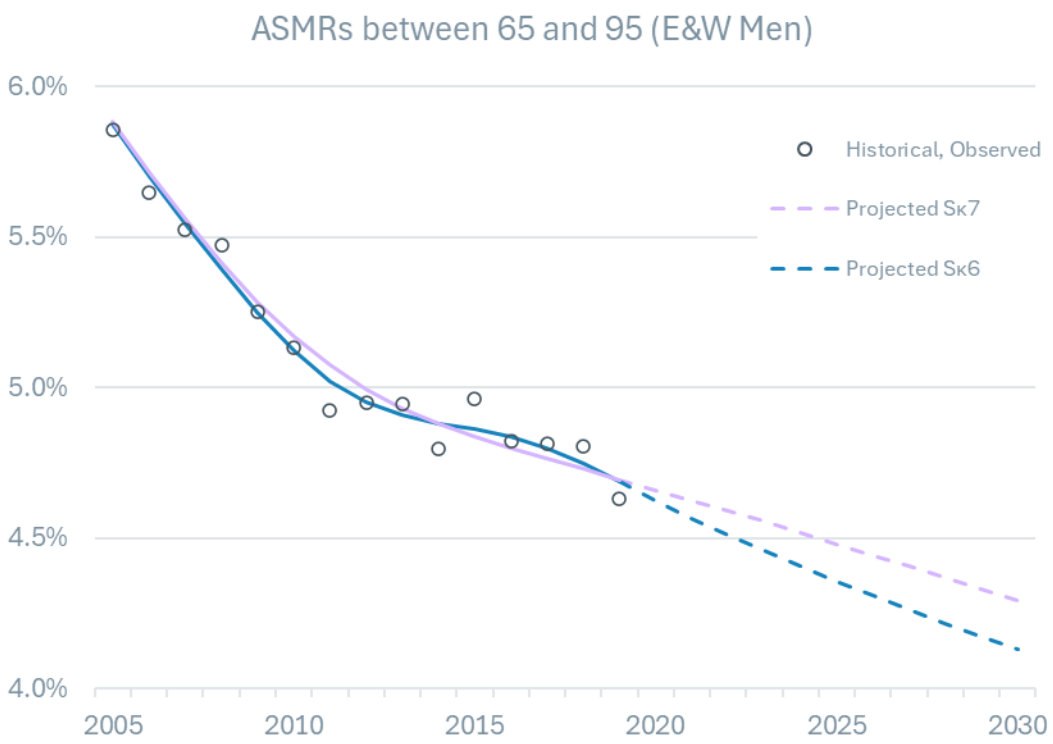


Starting point for projection

- The fitted rate of improvement in 2019 is the starting point of the projection.
- The fitted trend also impacts the roll-forward of base tables.
- In practice, the fitted trend and starting rates cover ages 20 to 100 with “cohort effects” also applying.

CMI_2024 calibrated to 1979-2019 data, core parameters, long-term rate of 1.5% per annum, Fitted Overlay turned off to make model run.

S_κ impact on projection
Less smoothing: moving to S_κ=6

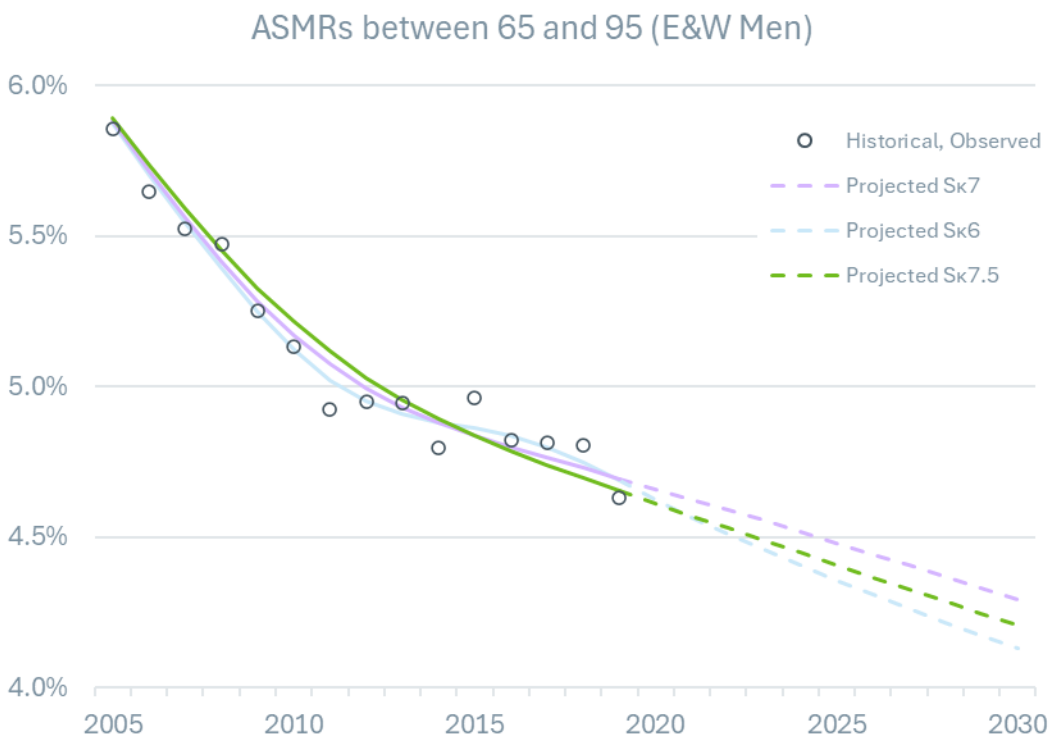


Impact of applying less smoothing

- More attention paid to each individual year, leading to a richer shape.
- In this example, more emphasis is put on 2019, leading to a higher starting rate.

CMI_2024 calibrated to 1979-2019 data, core parameters (other than S_κ), long-term rate of 1.5% per annum, Fitted Overlay turned off to make model run.

S_κ impact on projection
More smoothing: moving to S_κ=7.5



Applying both **more** and **less** smoothing than core model strengthens the projection!

Impact of applying more smoothing

- Less attention paid to each individual year.
- In this example, less emphasis is put on 2017 & 2018 data, again leading to a higher starting rate.
- The impact on projections of adjusting S_K is very **context specific**.

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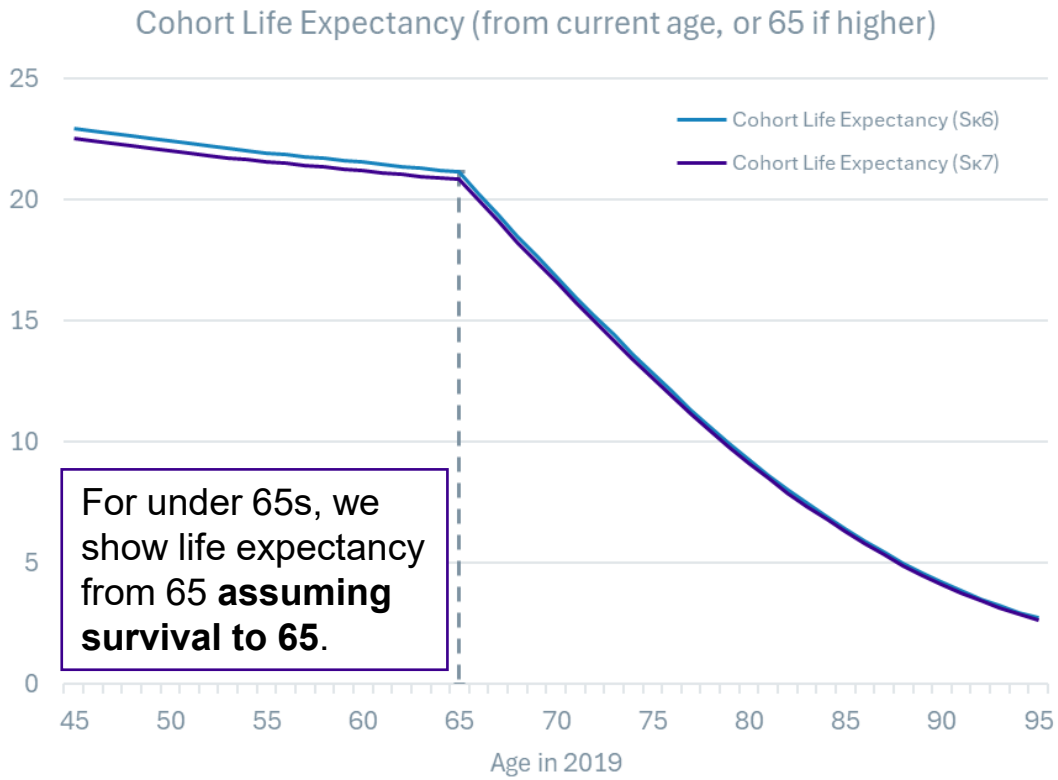
CMI_2024 calibrated to 1979-2019 data, core parameters (other than S_κ), long-term rate of 1.5% per annum, Fitted Overlay turned off to make model run.

S_κ impact on cohort life expectancy

Using S_κ =6 rather than S_κ =7, as applied to E&W data up to 2019



How to compare projections

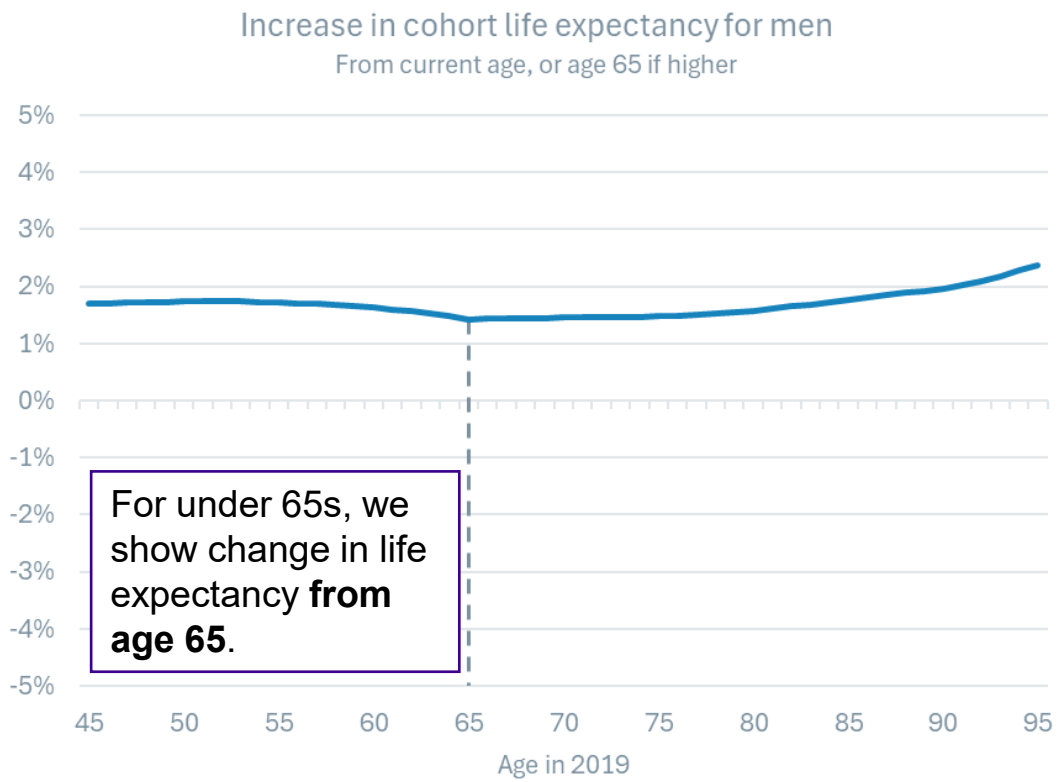
- Cohort life expectancy is a “real-world” measure which gives life expectancy at a given age **based on a specific combination of base table and projection**.

- By comparing cohort life expectancies under two projections, we can see the impact of changing projections for different age groups.

Impact will vary depending on base table strength and base year. Base table here is CV21v1_1719_MPNa (an average male normal health pensioner) which applies at 1 January 2018.

S_κ impact on cohort life expectancy

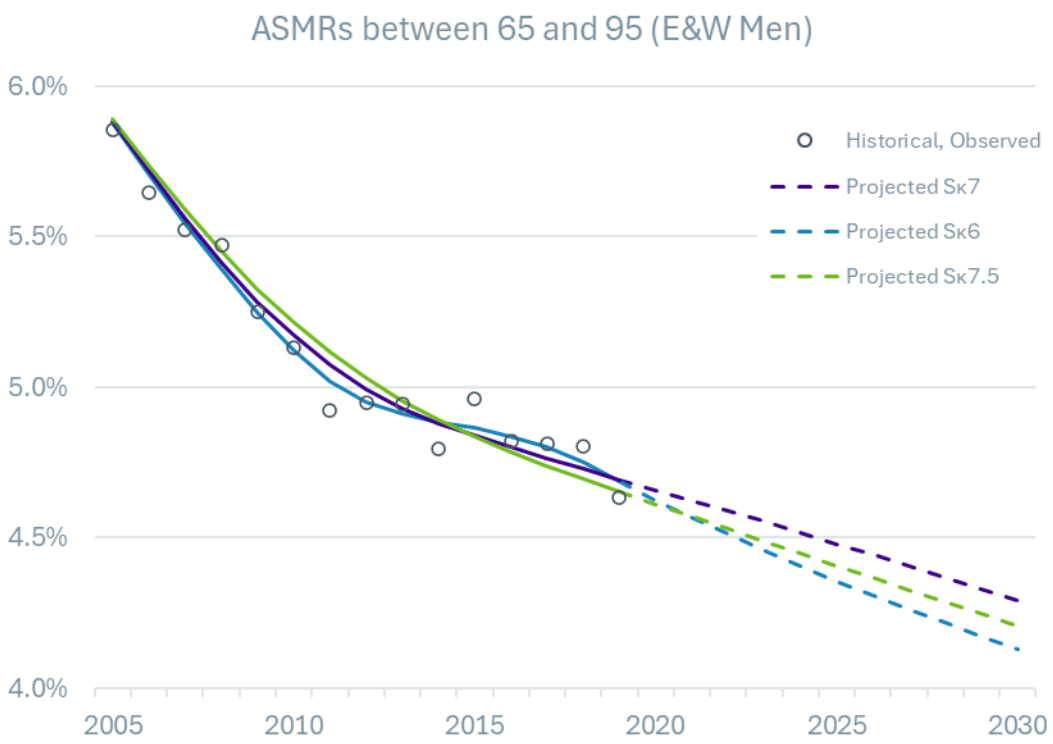
Using S_κ =6 rather than S_κ =7, as applied to E&W data up to 2019



- The choice of Sκ *can* make a material difference to projections.
- The size and direction of the impact will depend on the exact pattern of recent year-on-year data.
- Where users wish to sensitivity test the choice of Sκ, we encourage the use of **context specific** alternative values.

Impact will vary depending on base table strength and base year. Base table here is CV21v1_1719_MPNa (an average male normal health pensioner) which applies at 1 January 2018.

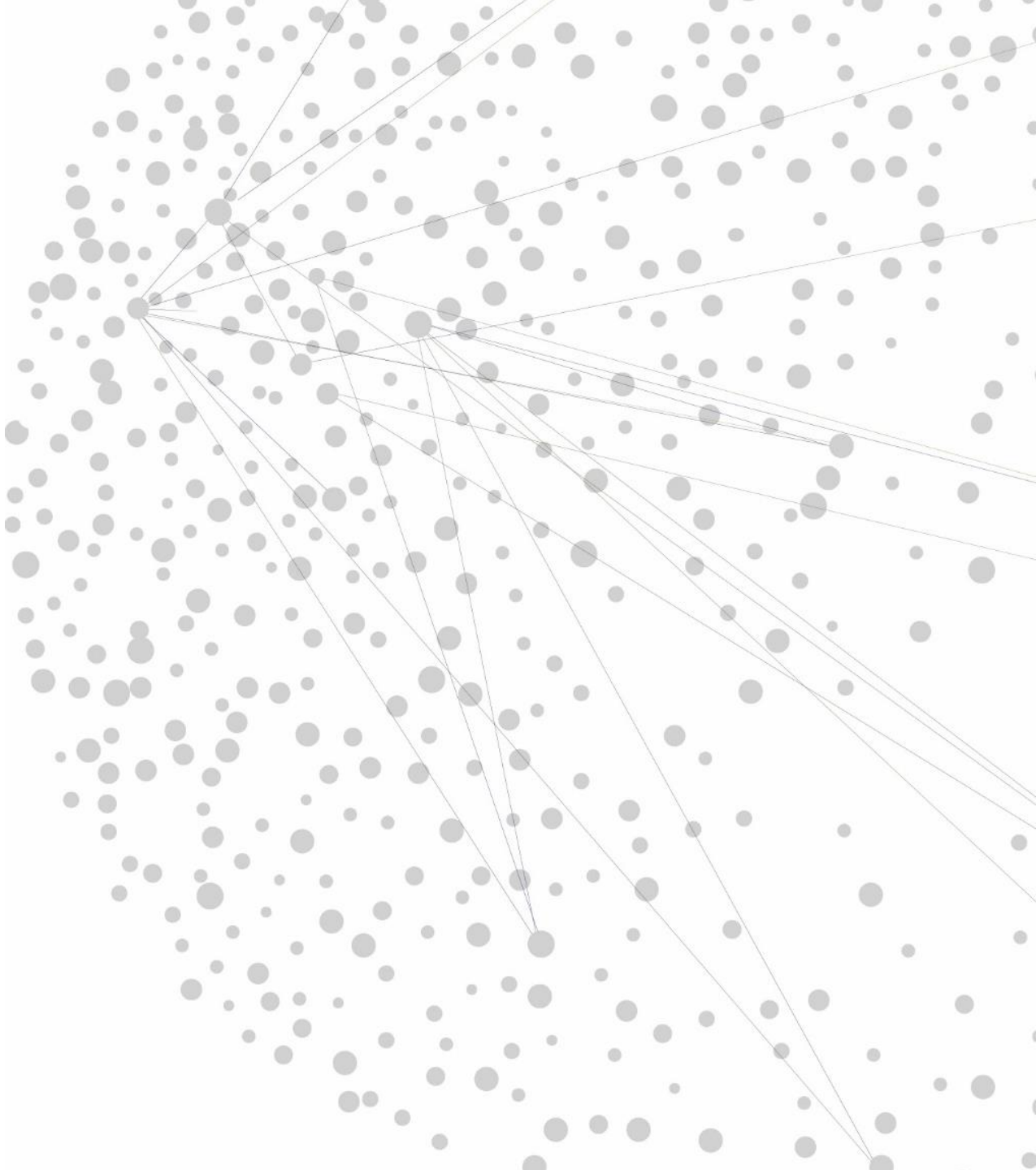
S_K: when to pull the lever?



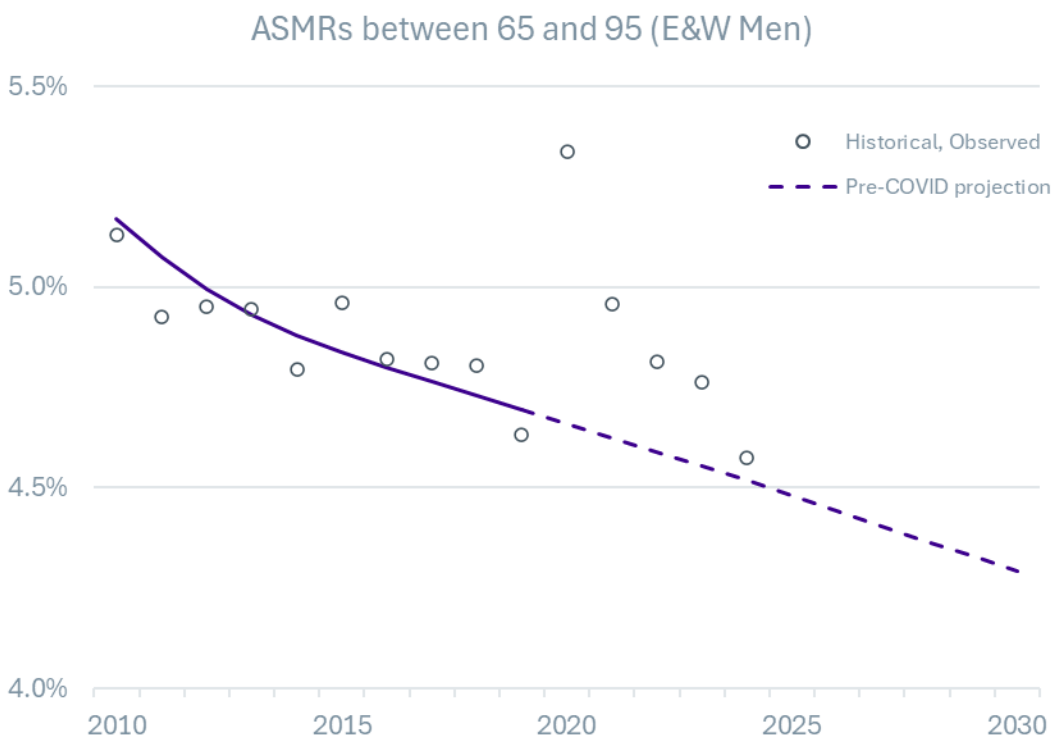
How useful is S_K as a lever?

- S_K has no intuitive meaning – we can't set an appropriate value from first principles.
- Its impact on projections depends upon context of recent year-on-year patterns.
- S_K = 7 selected based on England & Wales data – other populations should use the "Adjust Smoothing" option and may also have a different "Goldilocks" value.

Fitted overlay



Allowing for COVID in the CMI model
E&W data **up to 2024**



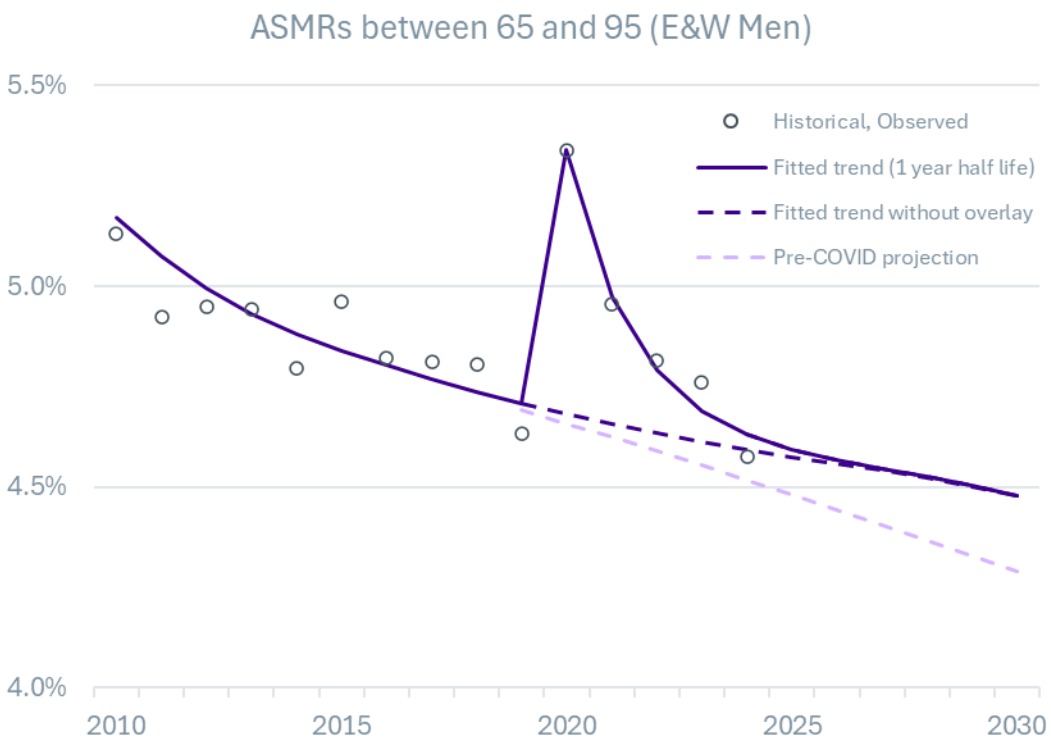
Separating the signal from the noise pt2

- The purple line shows a core projection based on data up to 2019.
- COVID-19 meant that mortality rates after 2019 were much heavier than predicted.
- For each year since 2019, how much of the higher-than-expected mortality should be considered “noise”?

ASMRs from CMI_2024 core model. Fitted trend is from previous section (core CMI_2024 but calibrated to 1979-2019 data).

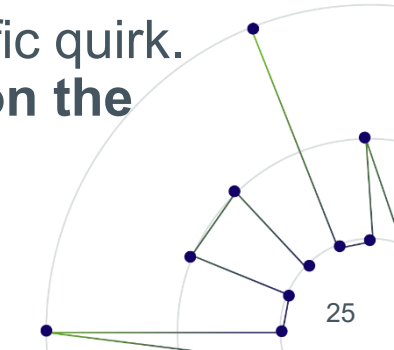
Core Fitted Overlay

E&W data up to 2024



Exponential decay with half life of 1 year

- Under the core model, the impact of COVID is assumed to halve each year from 2020.
- Users can alter the Fitted Overlay in any way they choose, but the most accessible lever is the "**Half Life**", which sets the rate of decay.
- Exponential decline is a UK specific quirk. **Overseas users shouldn't rely on the core / extended Fitted Overlay.**



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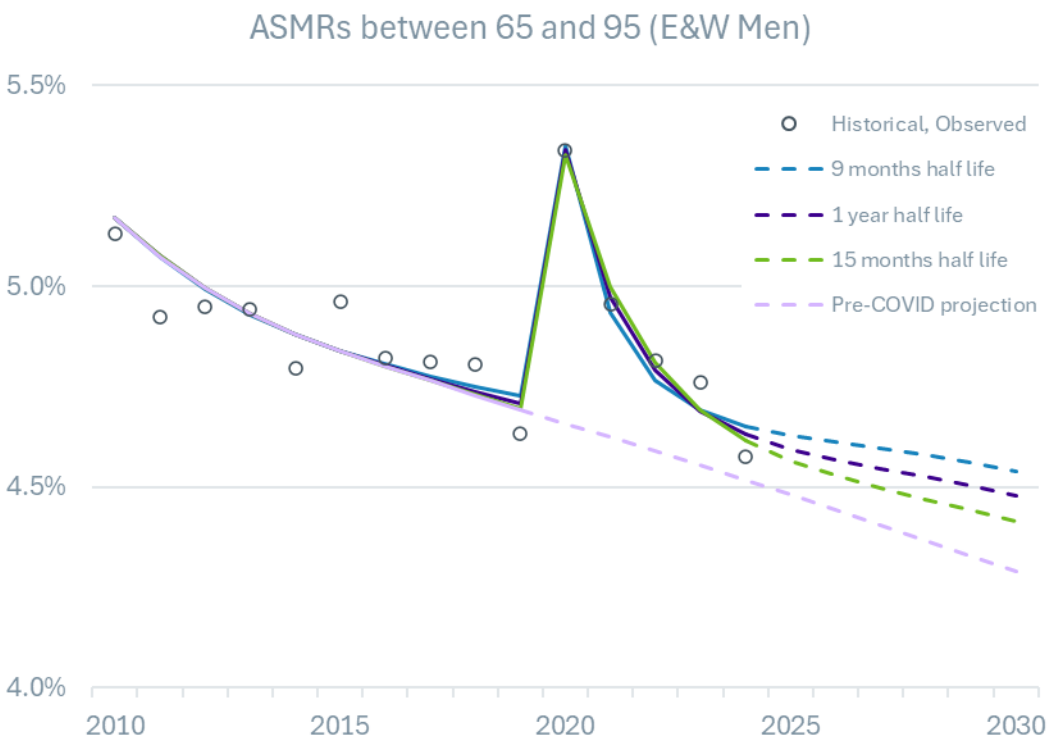
Dark purple line is core CMI_2024, long-term rate of 1.5% per annum.

Impact of changing the half-life
E&W data up to 2024



Quicker decay, weaker projection

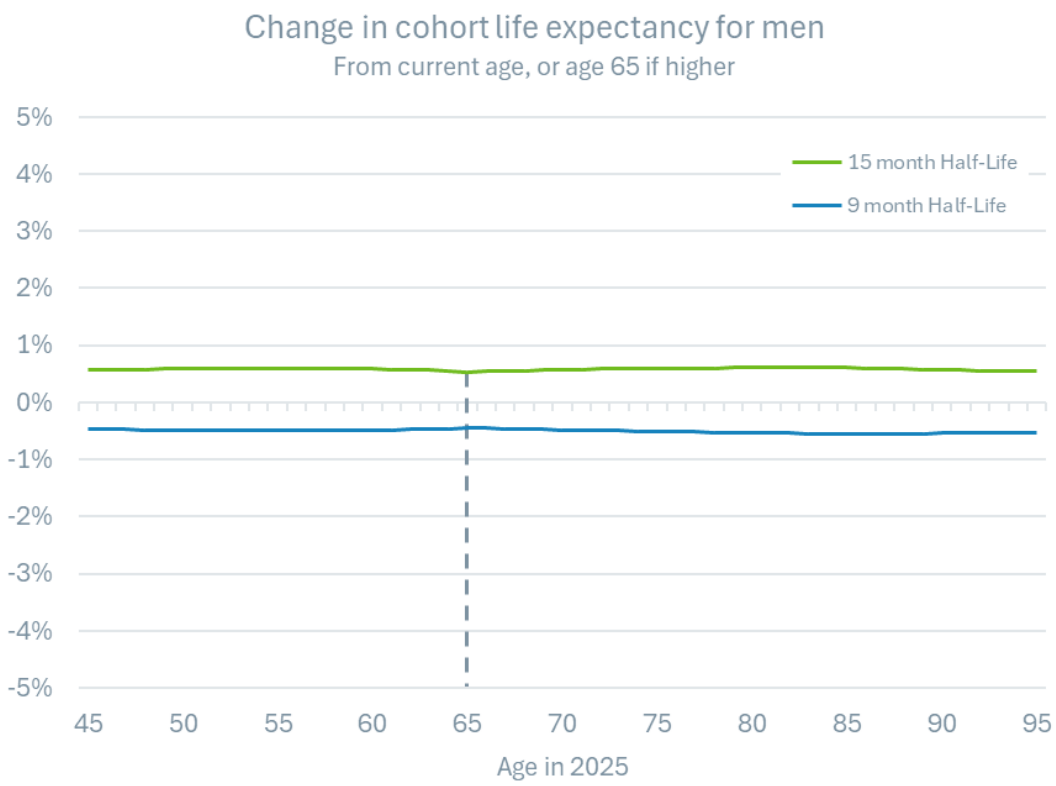
- Assuming COVID **runs off more quickly** means heavier underlying mortality and a **weaker underlying trend**.

- Assuming COVID **runs off more slowly** means lower underlying mortality and a **stronger underlying trend**.

Blue and green lines are extended calibrations of CMI_2024 with different values for the half life. The long-term rate remains at 1.5% pa.

Half-life impact on cohort life expectancy

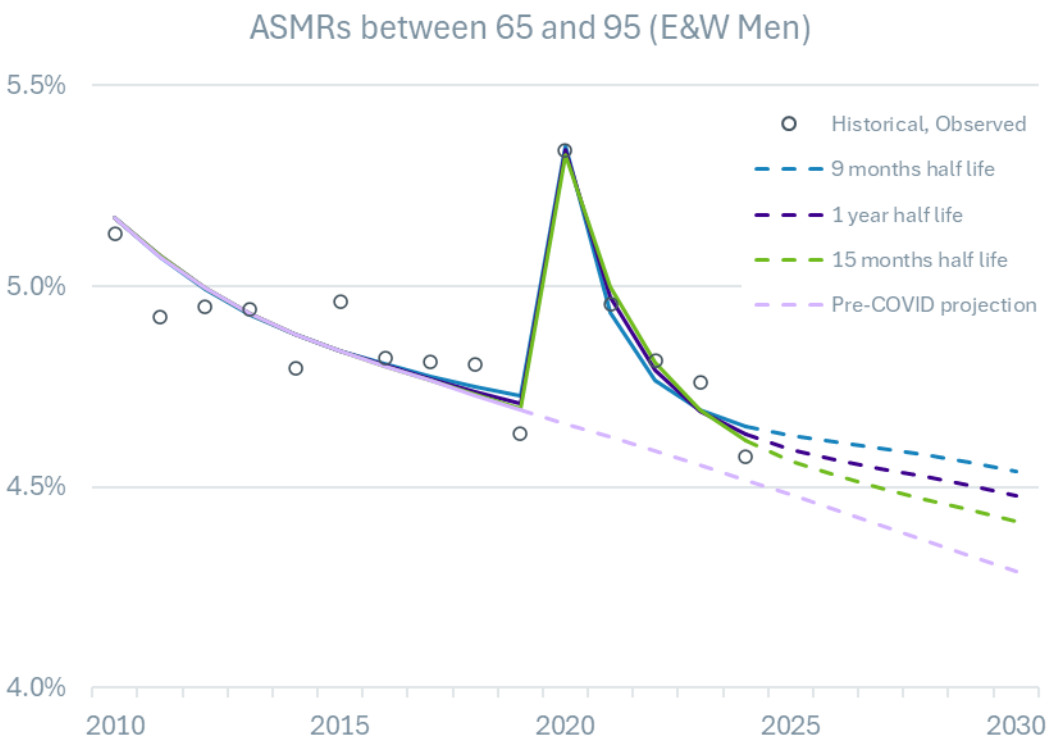
Using 15 months rather than 1 year half life



- In CMI_2024, the choice of half life has a limited impact under plausible alternative values.
- As post-COVID data builds up and the post-COVID signal becomes clearer, the half life parameter will become even less influential.

Impact will vary depending on base table strength and base year. Base table here is CV21v1_1719_MPNa (an average male normal health pensioner) which applies at 1 January 2018.

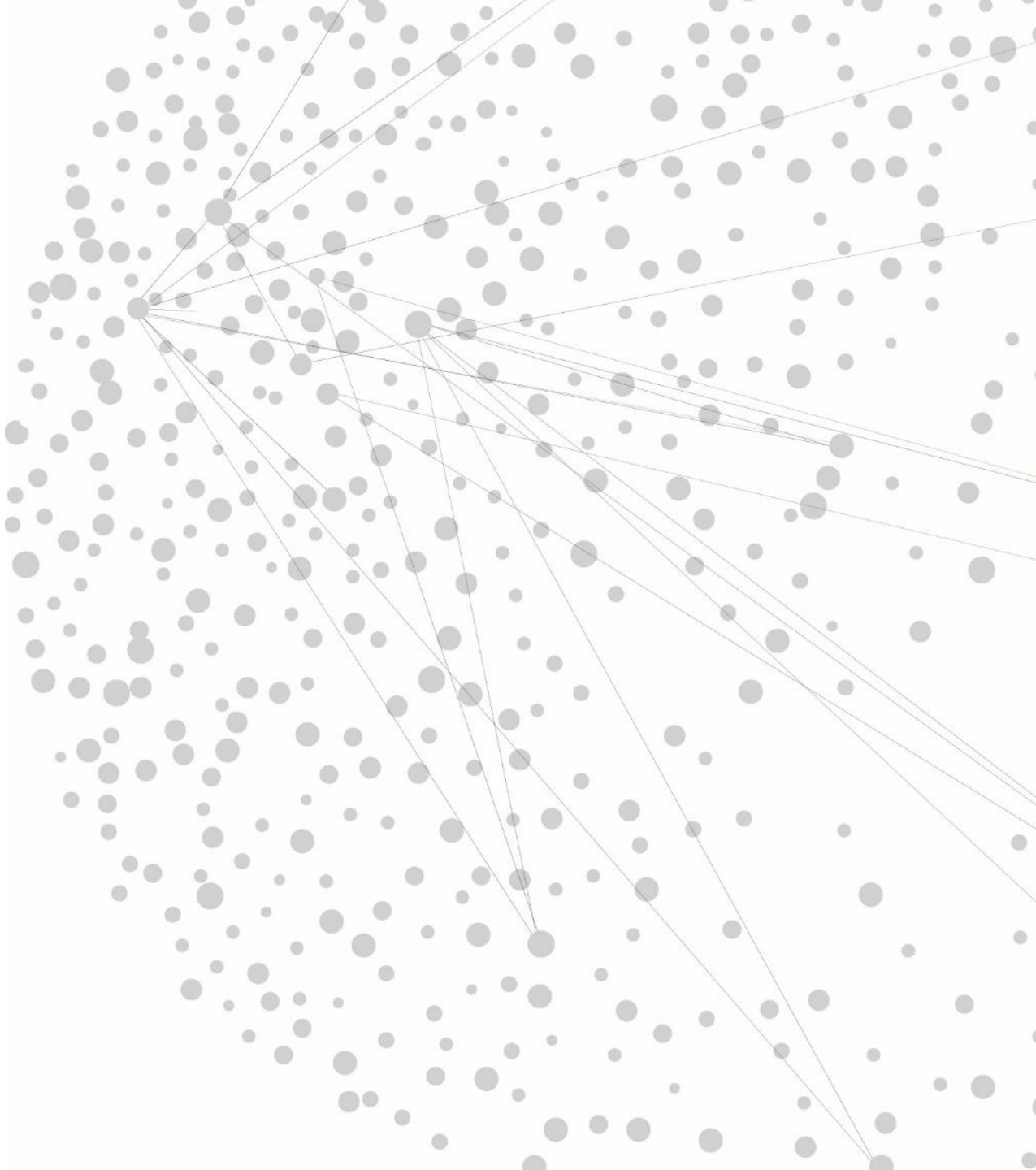
Half life: when to pull the lever?



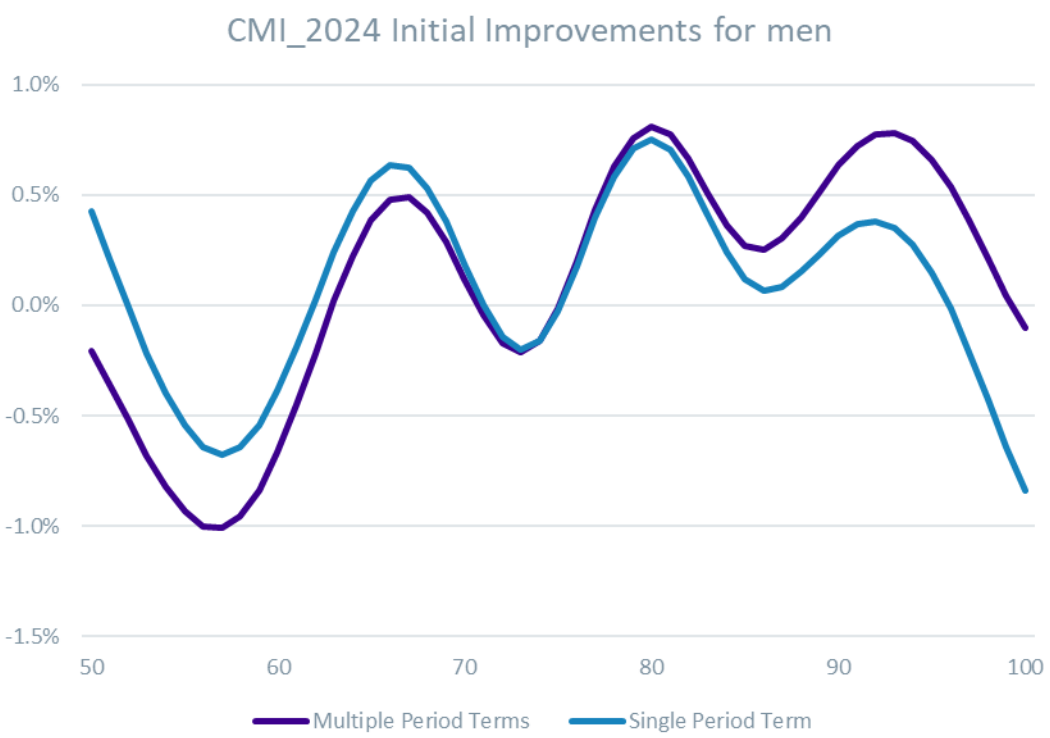
How useful is the half life as a lever?

- Just like Sκ, the half life parameter can be used as a lever to tweak short-term projections.
- The half-life parameter is **specific to how the pandemic progressed in the UK**.
- Users applying the CMI model to other populations can define their own Fitted Overlay, but this may require some outside-the-model work to define a suitable shape.

Multiple period terms

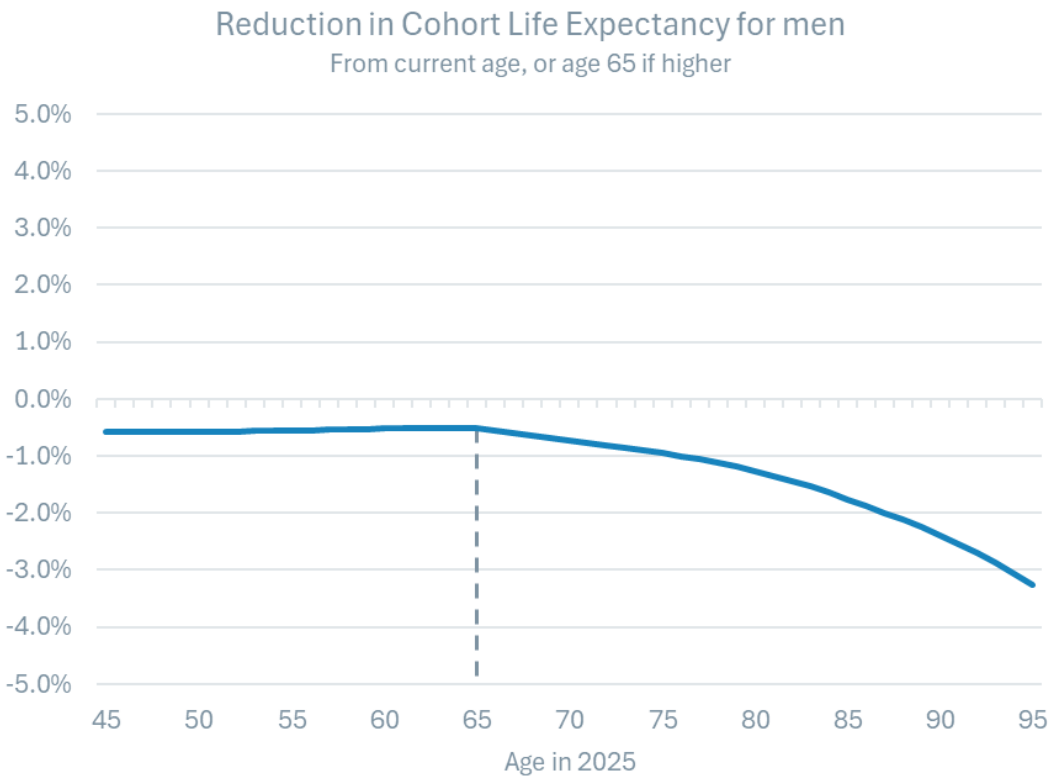


What about multiple period terms?



- Multiple Period Terms were introduced to better capture recent patterns of improvements by age.
- Using Multiple Period Terms leads to higher improvements at older ages and lower improvements at younger ages.
- This makes a material difference, particularly at older ages.

Impact of using Single Period Term



Use of Multiple Period Terms

- In the UK context, using Multiple Period Terms increases liabilities, particularly at older ages.

- For other populations, users will need to assess whether the additional complexity associated with using multiple period terms is supported by the data.

Step 2:
Setting a Long-Term Rate

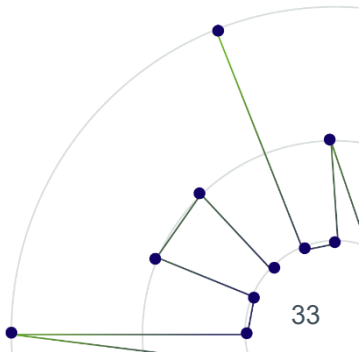
Levers of influence

Long-Term Rate (Core Parameter)

- "Headline" rate of improvement over the long-term.

Long-Term Rate shape by age

- Users can set their own shape by age based on their own views
- Under the core model, tapers to zero between ages 85 and 110.



International variations in Long-Term Rate

- Must be set by user in the CMI model.
- Most common value is 1.5% pa, can be set as high as 2%.
- Tapers to zero from ages 85 to 110.

CMI Model

- Fixed based on historical SSA improvements.
- Flat 1.35% rate to age 62, decreasing linearly to 1.1% at age 80, 0.4% at age 95, and 0% at age 115.

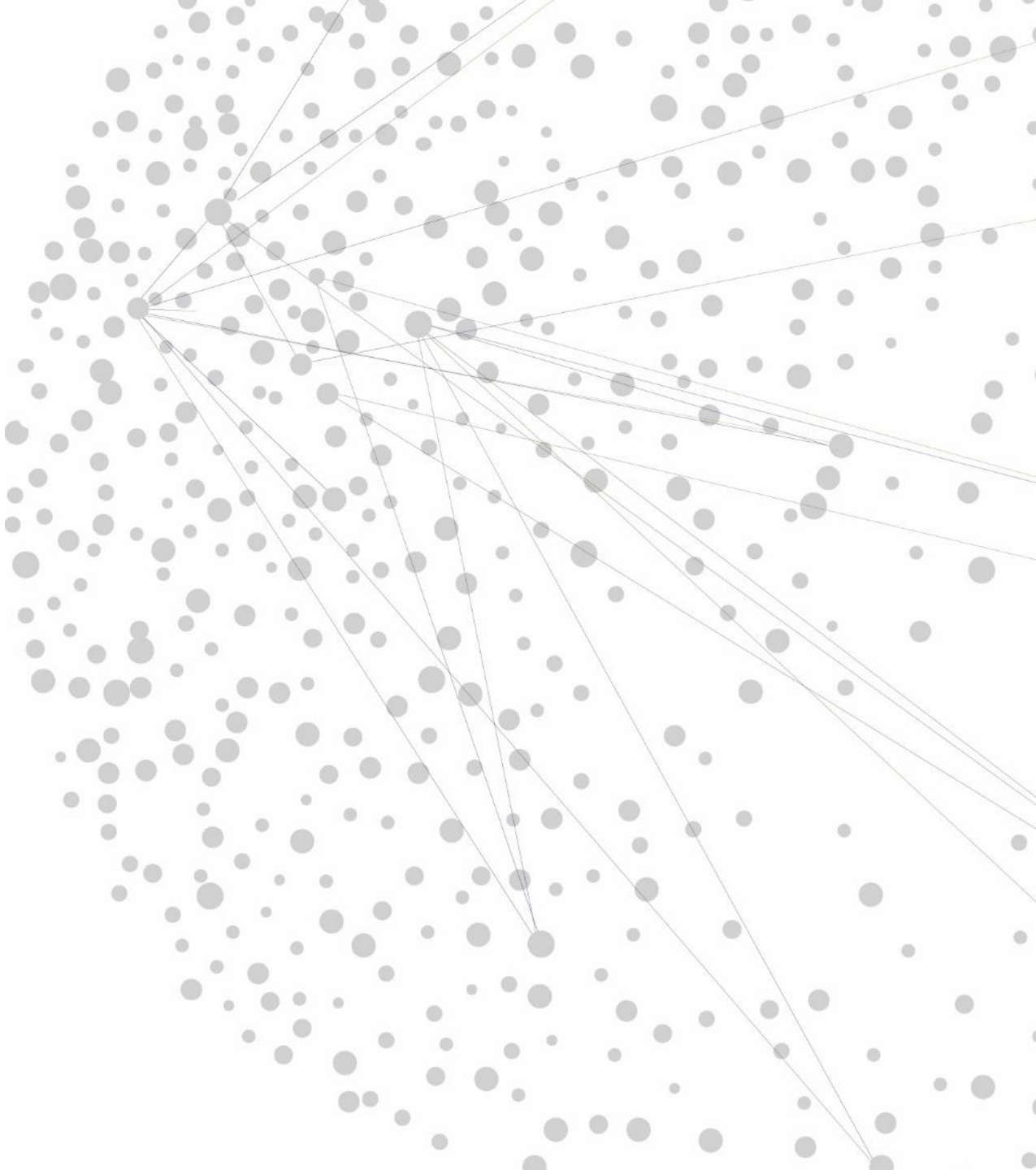
MP-2021

- Fixed based on historical population-level improvements
- ~flat 1.3% ages 40 to 90, tapers to 1.2% at 95, then to 0% at 115.

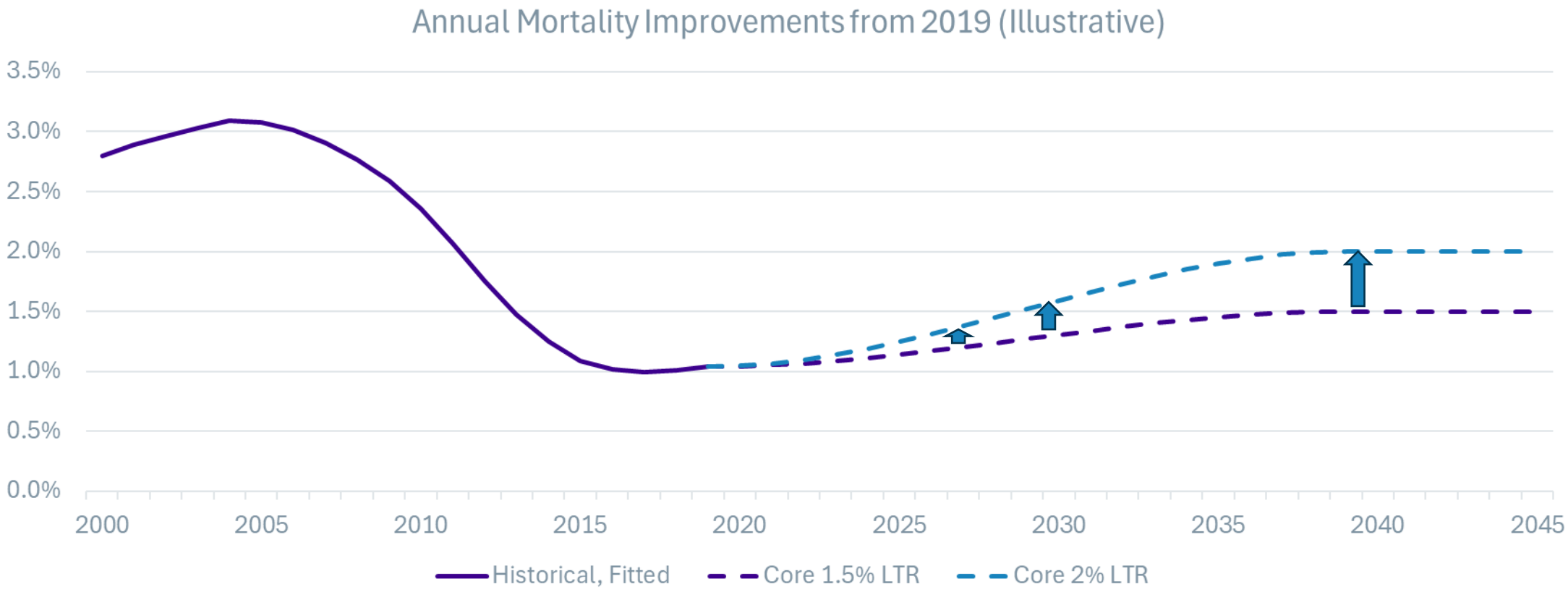
CanMI-2024

Club Vita webinar recording on how to set long term rates:
https://www.clubvita.net/uk/events/looking-to-the-horizon-how-should-we-set-long-term-longevity-improvement-rates

Long-term rate

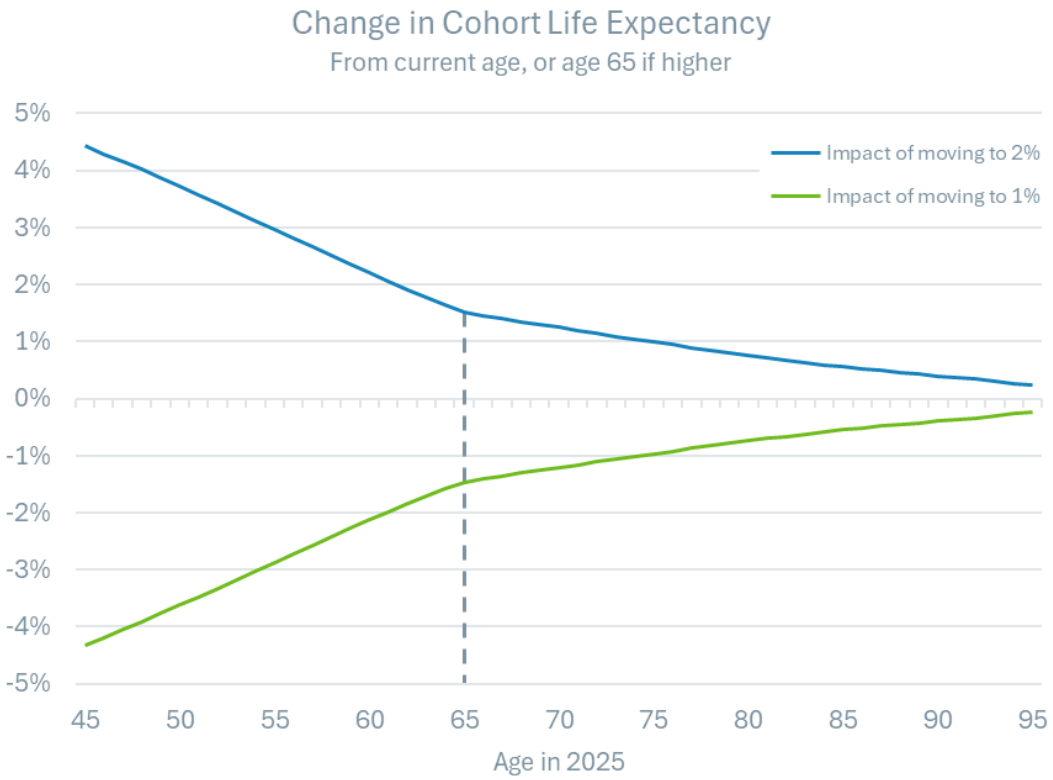


What does changing the long-term rate do?



Influences all future years, but biggest impact is on longer-term

Impact of changing the (core) Long Term Rate
Core CMI_2024 [1.5%]



How useful is the LTR as a lever?

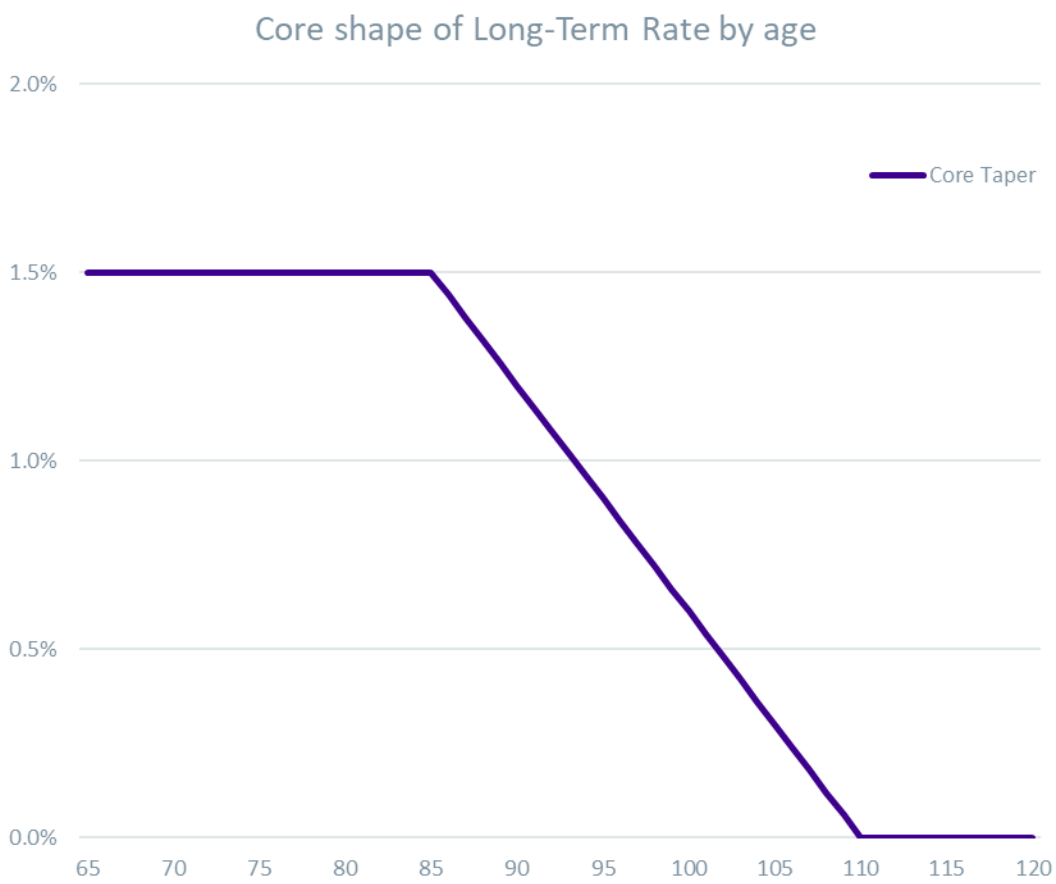
- A long-term rate is intuitive and has a real world meaning.
- The concept of changing the LTR is easy to envision, and the impact is intuitive.
- It is a blunt tool for sensitivity testing older lives.

Impact will vary depending on base table strength and base year. Base table here is CV21v1_1719_MPNa (an average male normal health pensioner) which applies at 1 January 2018.

Age shape of long-term rate

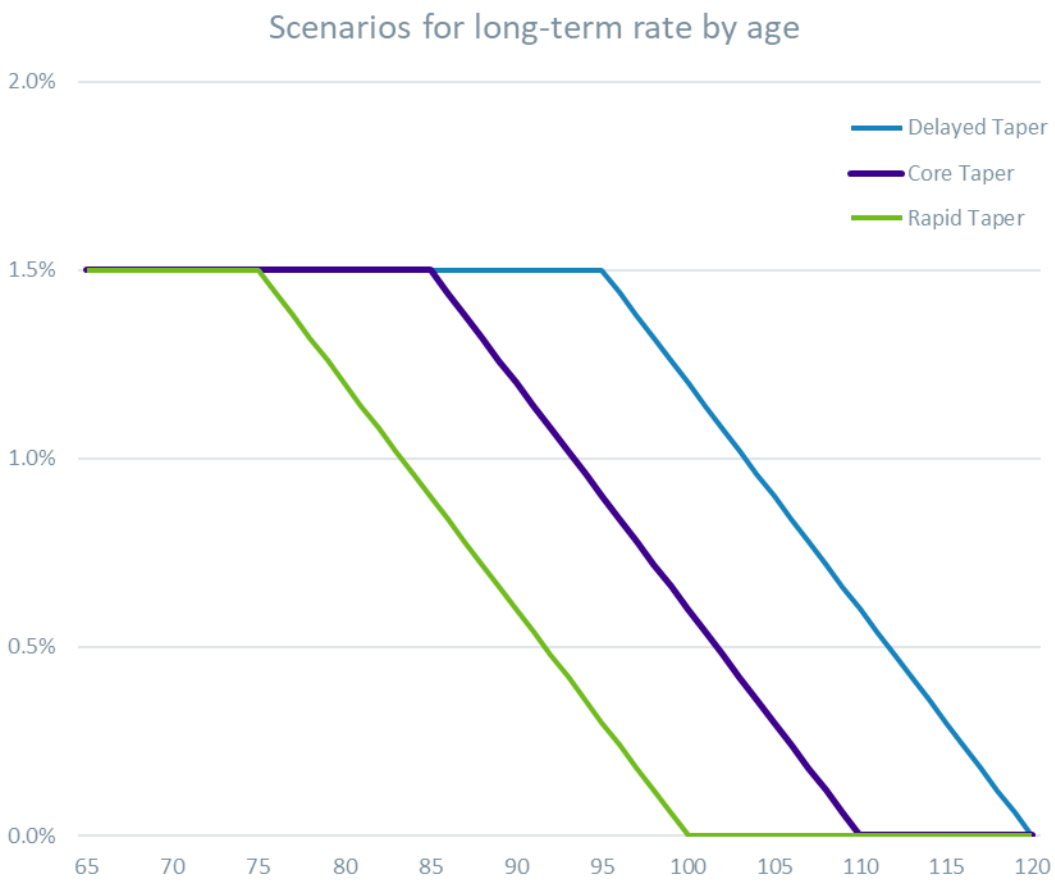
Age Shape of Long-Term Rate (Core Model)

- The long-term rate is assumed to taper from its headline rate to 0% between ages 85 and 110.
- This tapering reflects the fact that mortality rates at older ages have shown lower improvements.
- The taper ages were last reviewed in 2017.



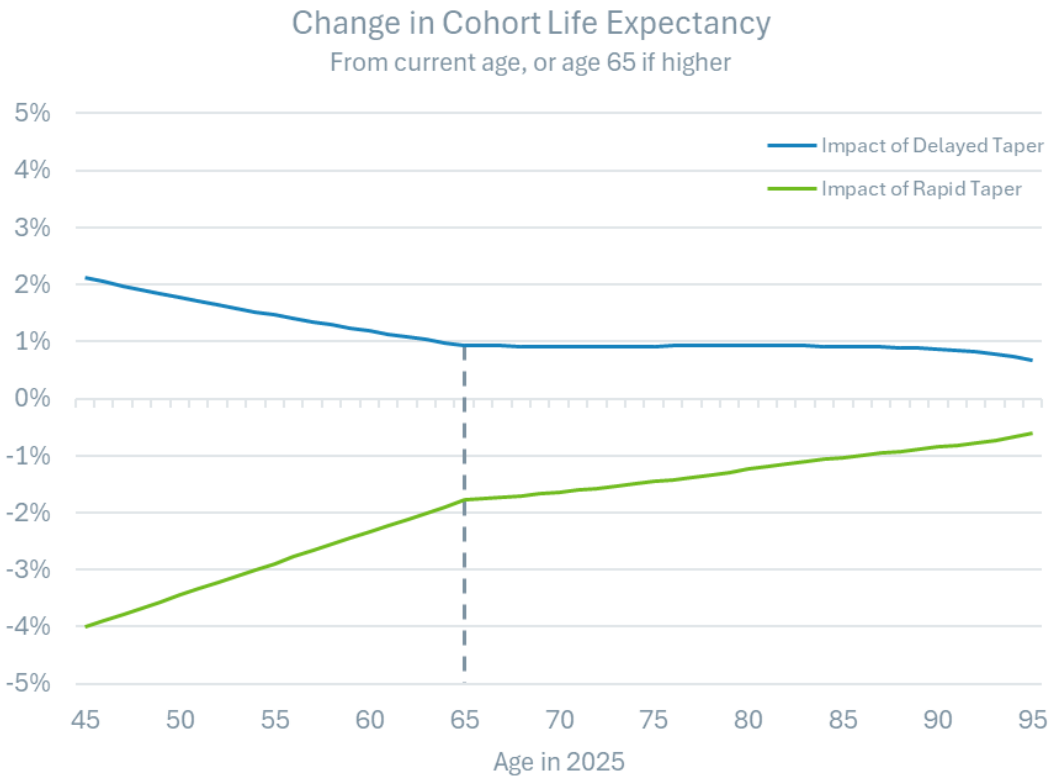
Age Shape of Long-Term Rate (alternative tapers)

- Here we show two alternative age-shapes for the long-term rate.
- Our **Rapid Taper** scenario broadly reflects the actual pattern of lower improvements at older ages during recent decades, starting to decline more rapidly from age **75**.
- Our **Delayed Taper** scenario assumes that in the longer term, the full long-term rate should apply up to age **95**.



Impact of changing the age shape of LTR

Core CMI_2024 [1.5%] otherwise core



- **How useful is the LTR taper as a lever?**
- The core CMI model makes some implicit assumptions about older age mortality.
- Although it is an advanced parameter, the age-shape of the long-term rate provides a simple and impactful mechanism for exploring different scenarios for “ageing of improvements”.

Impact will vary depending on base table strength and base year. Base table here is CV21v1_1719_MPNa (an average male normal health pensioner) which applies at 1 January 2018.

Step 3:
Blending current trend into Long-Term Rate

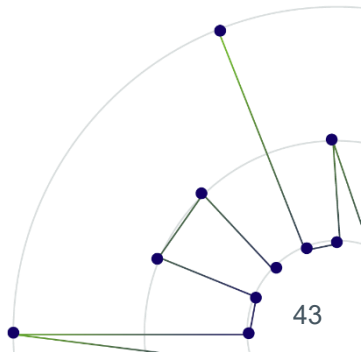
Levers of influence

Convergence Period

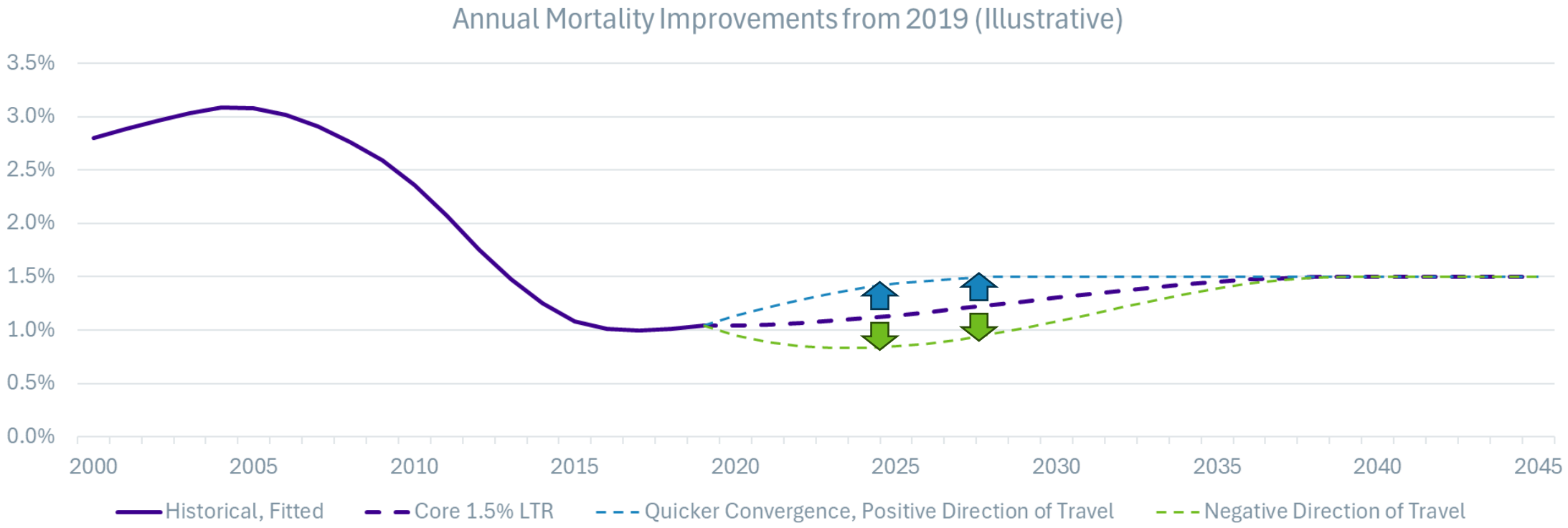
- Dictates how quickly the initial rates blend into the long-term rate.
- Varies by age in the core model

Convergence Shape (using Direction of Travel parameter)

- Users can set their own shape by age based on their own views.



Different convergence patterns are possible



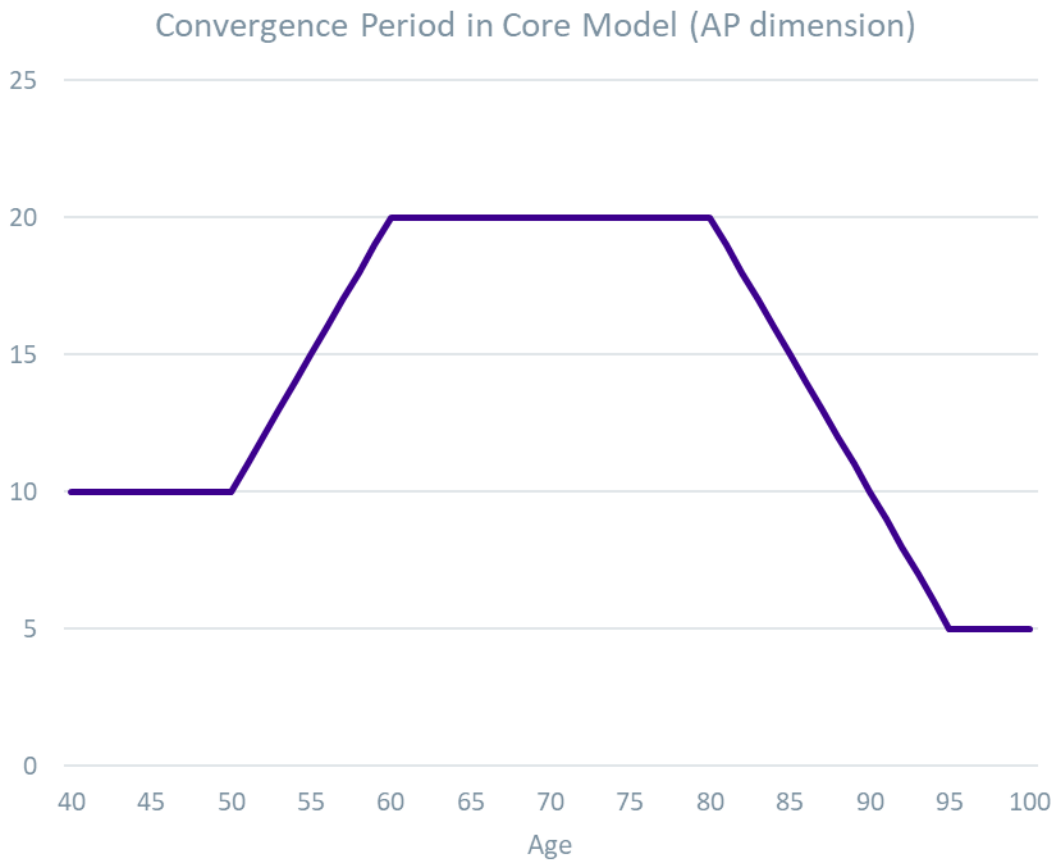
Influences short- to medium-term improvements

Convergence period

Convergence Period (Core Model)
Age-Period Component

- The convergence period dictates how quickly the initial rates blend into the long-term rate.
- This varies by age in the core model.
- Why is this? See CMI WP39…

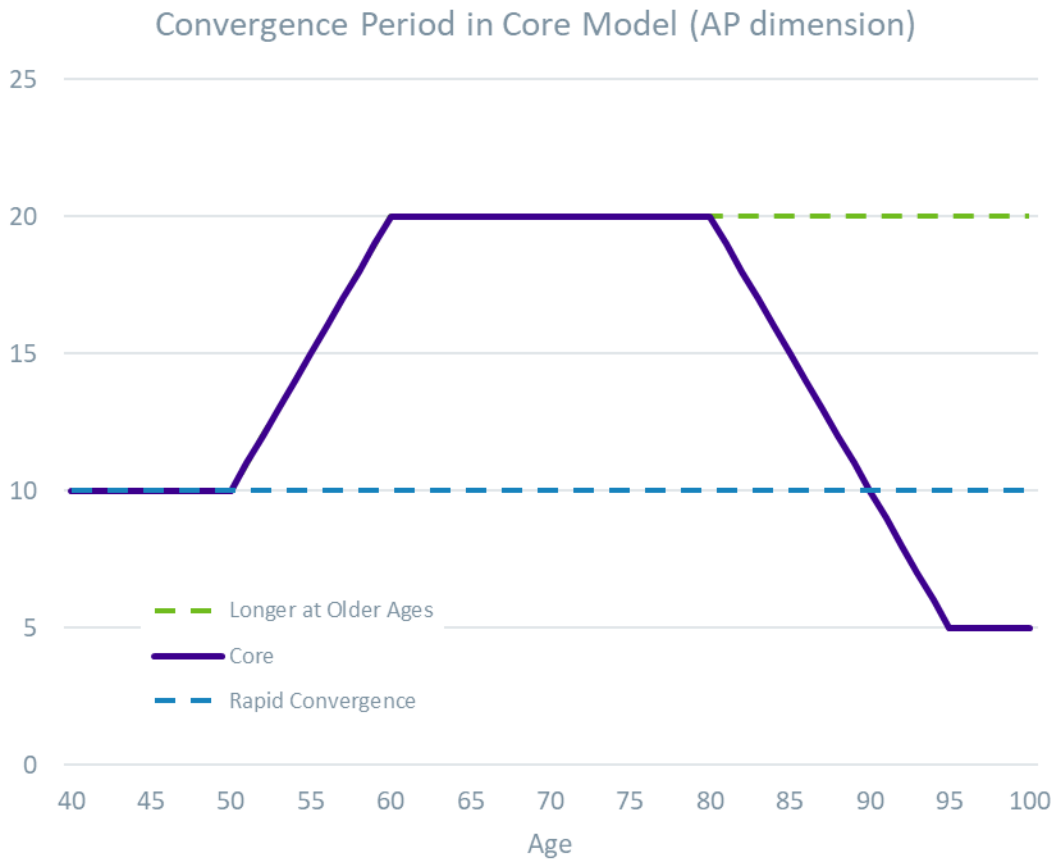
For the oldest ages it seems appropriate to use a short Period of Convergence, in keeping with the general concept of mortality improvement rates running to zero relatively quickly after age 100.



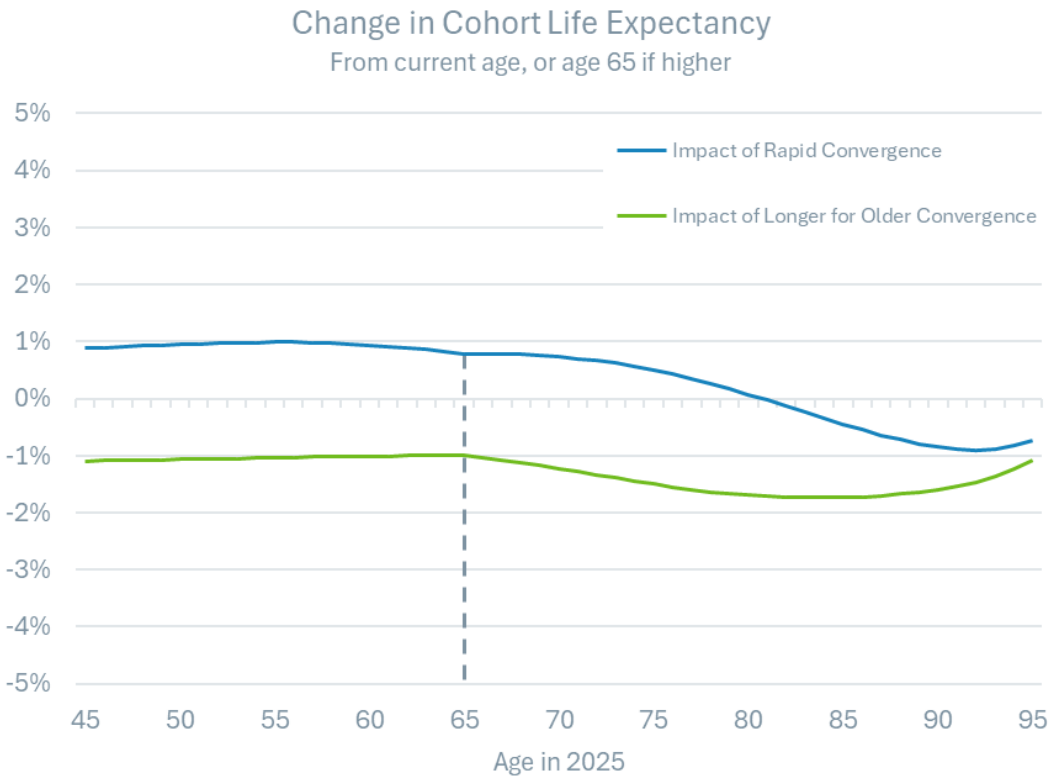
Convergence Period (Alternate Scenarios)
Age-Period Component

Here we set out two alternative scenarios:

- **Longer Convergence at Older Ages:** the convergence period is **20 years for all older ages**.
- **Rapid Convergence:** the convergence period is **10 years at all ages** (including over 90s).



Impact of changing the convergence period
CMI_2024 [1.5%] otherwise core



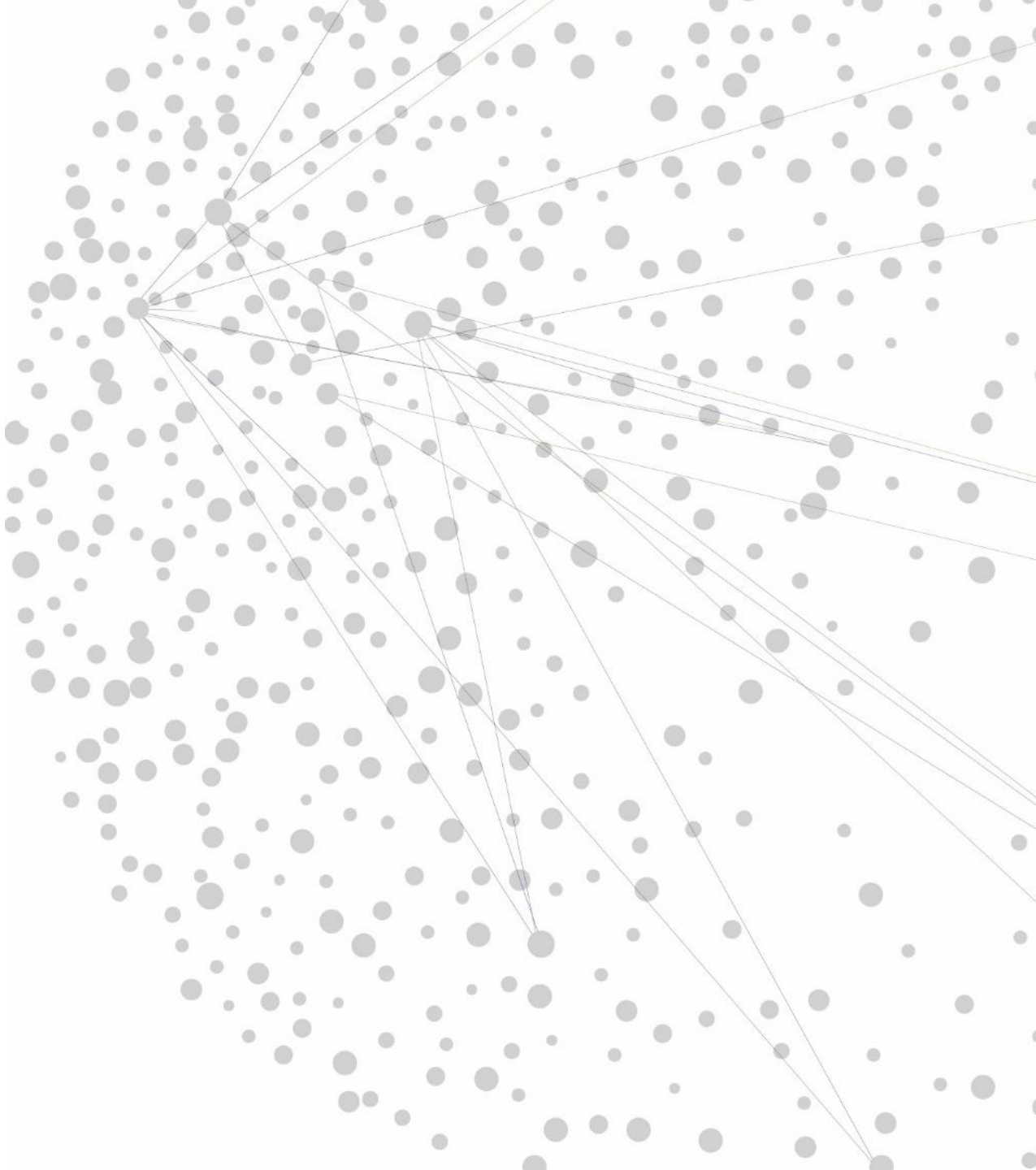
How useful is the convergence period as a lever?

- The convergence period becomes more material when starting rates are very different to long-term rates.

- Users should ensure they are comfortable assuming it will take a full 20 years to revert to the long-term rate and that the more rapid convergence at older ages is appropriate.

Impact will vary depending on base table strength and base year. Base table here is CV21v1_1719_MPNa (an average male normal health pensioner) which applies at 1 January 2018.

Direction of travel

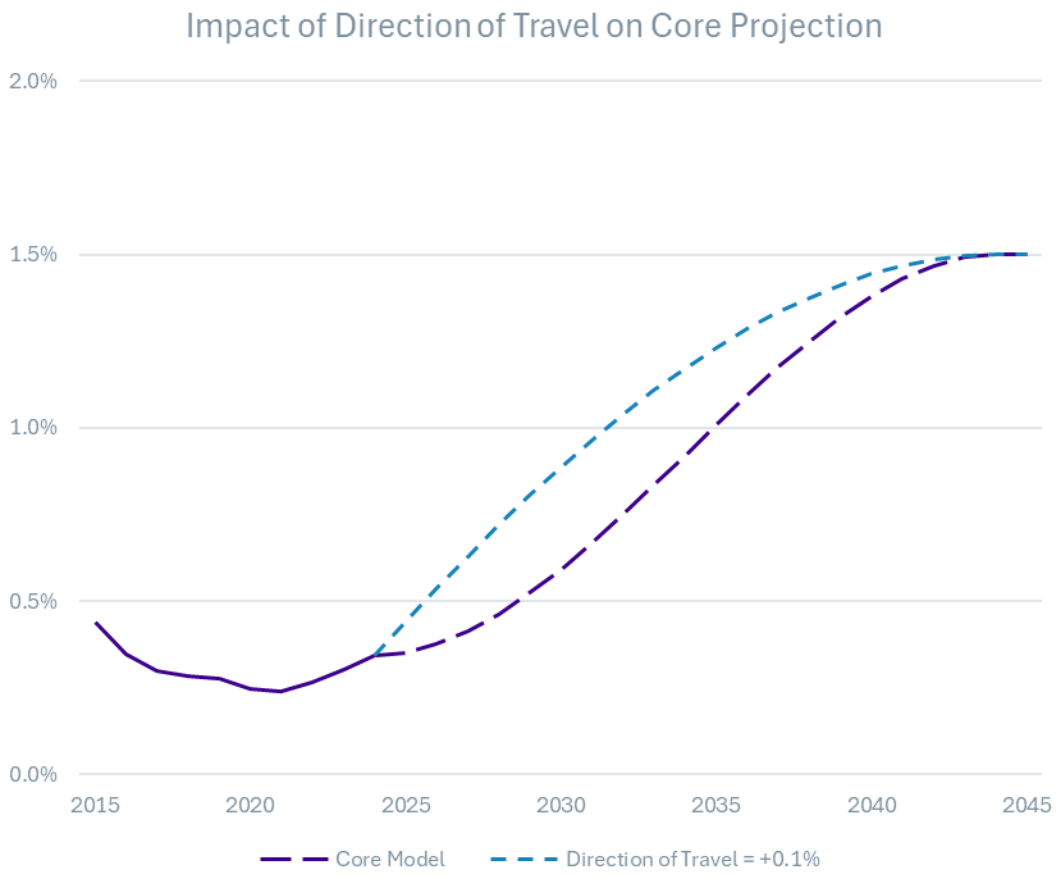


Direction of Travel

What does it do?

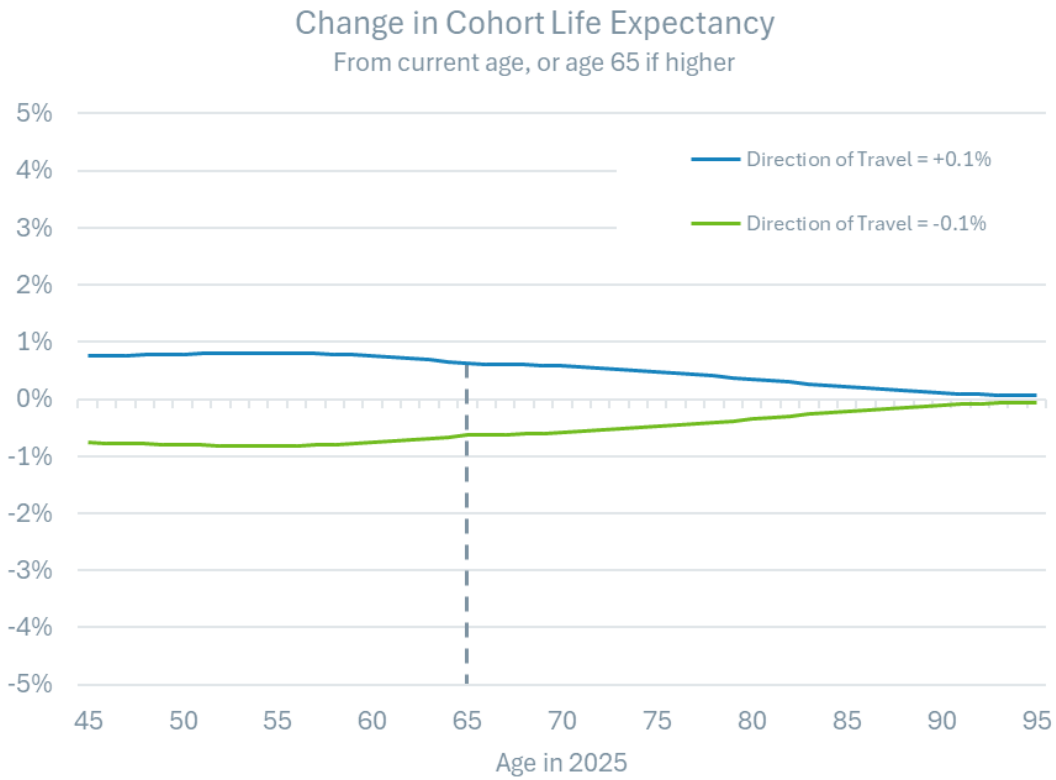
- Under the core model, the direction of travel is set to zero. This means that improvements in the first year of projection will be very close to those in the last fitted year.

- If we set a non-zero value, we can instead force the model to adopt a different convergence shape in the short-term.



Annual age period improvements for an 80-year-old male, excluding Fitted Overlay. Purple line is CMI_2024 [1.5%], blue is the same projection with a Direction of Travel of 0.1%.

Impact of changing the Direction of Travel
CMI_2024 [1.5%] otherwise core



How useful is the convergence period as a lever?

- This is another **context specific** parameter. In certain circumstances the core convergence pattern may not look like the most natural fit to the data / wider evidence.

- The CMI model has a further option: "APCI/initial direction of travel" – this derives the short-term rate of change of improvements.

DoT assumed to taper to zero between 85 and 110. Impact will vary depending on base table strength and base year.
Base table here is CV21v1_1719_MPNa (an average male normal health pensioner) which applies at 1 January 2018.

Step 4:
Adjusting E&W based projection for specific population being modelled

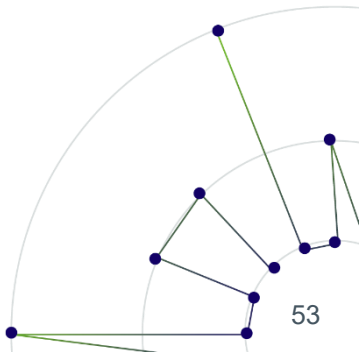
Levers of influence

Initial addition to mortality improvements ("The A Parameter")

- Applies an adjustment to the fitted starting rate under the model.
- Under the extended model, tapers to zero between ages 85 and 110.
- Alternative shapes by age are possible in Advanced Model.

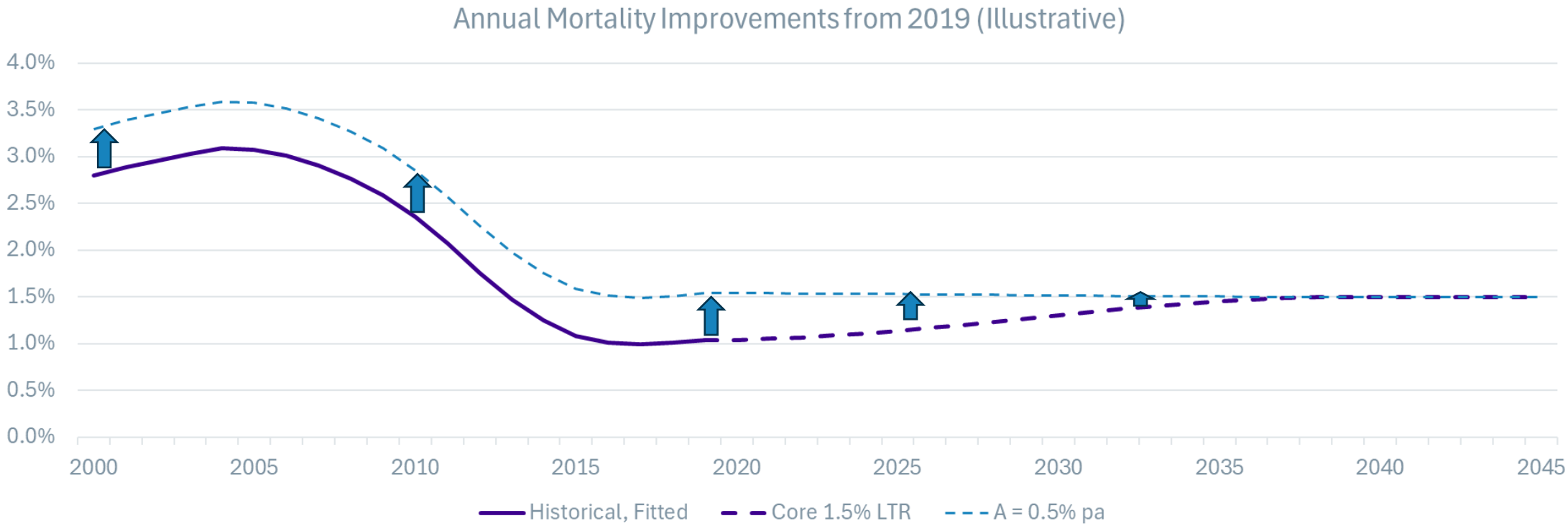
Everything else!

- Users could reasonably take a view on how different populations might expect different long-term rates of improvement, different convergence patterns etc.



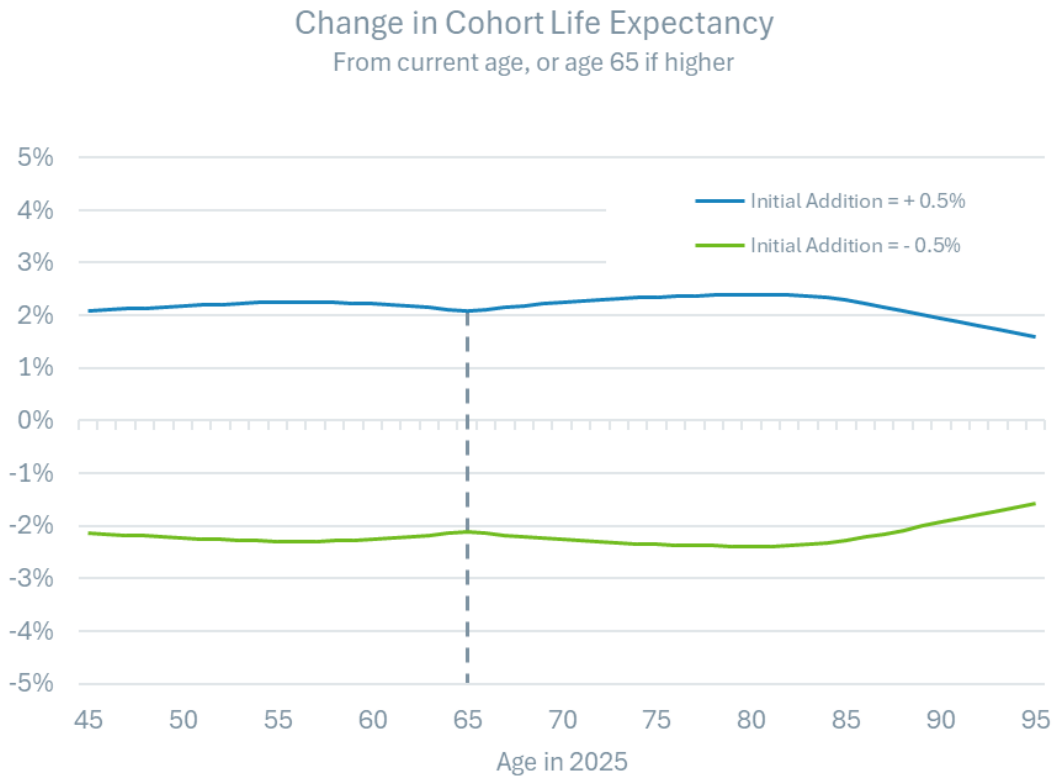
Initial addition to mortality improvements ‘A’ parameter

What does the A parameter do?



Influences the past and short-to-medium term future

Impact of the A parameter
CMI_2024 [1.5%]



How useful is the convergence period as a lever?

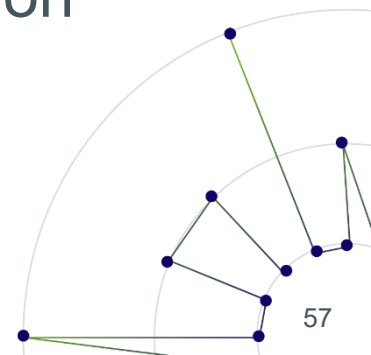
- Like the Long-Term Rate, the A parameter is intuitive and has a real world meaning.

- The concept of changing the A parameter for different subpopulations is easy to communicate, and the impact is predictable, with an intuitive response across the age range.

Impact will vary depending on base table strength and base year. Base table here is CV21v1_1719_MPNa (an average male normal health pensioner) which applies at 1 January 2018.

Summing Up

- The CMI projections model provides the industry with a useful and valuable tool for setting future mortality projections
- The flexibility in the model is very welcome, allowing users to reflect different views of the future and tailor improvements to different populations
- Recent emerging data has become difficult to model – resulting in a lot of extra complexity being built into the model
- Are users aware of the implicit assumptions in the model?
- Would a simpler model lead to increased engagement with key projection assumptions?



Questions?

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Thank you