Inverse function of mortality as a measure of longevity extension

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Motivation

Three approaches to the operational definition of 'old' ages:

1. ages associated with a person's later stage of life, starting 65 or 70
2. ages corresponding to the old-age death heap in the age distribution of deaths
3. ages at high levels of adult mortality

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Three potential indicators:

1. life expectancy at some selected old ages such as e_x
2. the late modal age at death, M
3. age-of-mortality indicator, AoM

Aim

1. Investigate the use of *AoM* as possible measures of longevity extension
2. Conduct a methodological investigation by comparing AoM with e_x and M

Data & Methods

Human Mortality Database (HMD)

- data series: death counts and population exposure's by single year of age, calendar year, and sex
- countries: The Group of Seven (G7), i.e. Canada, France, Germany, Italy, Japan, UK, and US
- period: 1970-most recent available year

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For each country, calendar year, and sex:

- $e_{65} = \int_{65}^{\omega} exp\Big[- \int_{65}^{\omega} \mu(u)du\Big]$
- $M = \max_x \ f(x) = \max_x \mu(x) exp\Big[- \int_{10}^{\omega} \mu(u)du\Big]$
- the *AoM* indicator derived from the age-of-mortality function, $\nu(y)$

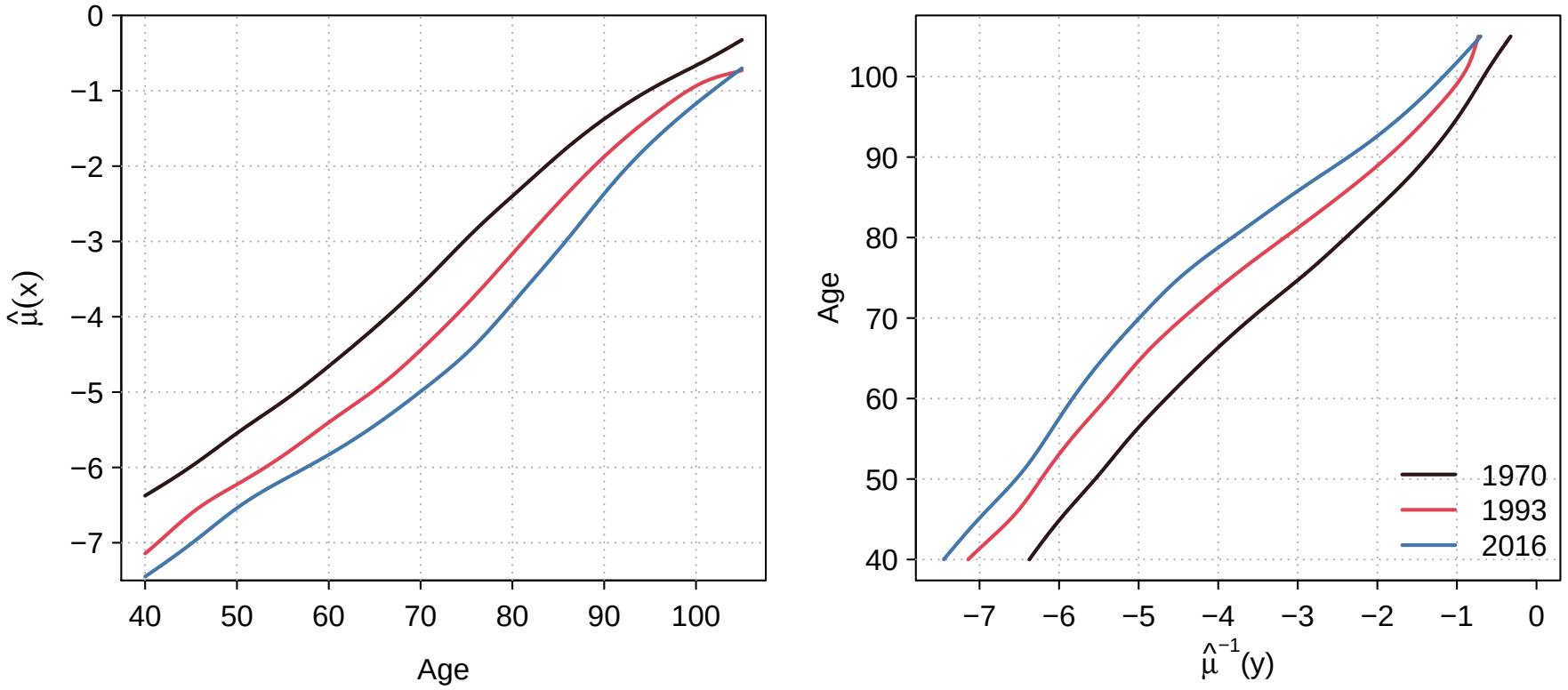
$$\nu(y) = \mu^{-1}(y)$$

$\mu(x)$ was estimated using Poisson P-splines smoothing.

Age-of-mortality (AoM) function: Illustration

Force of mortality, $\mu(x)$, and the inverse of the force of mortality, $\mu^{-1}(y)$, resulting from nonparametric P-splines smoothing

Females, Japan



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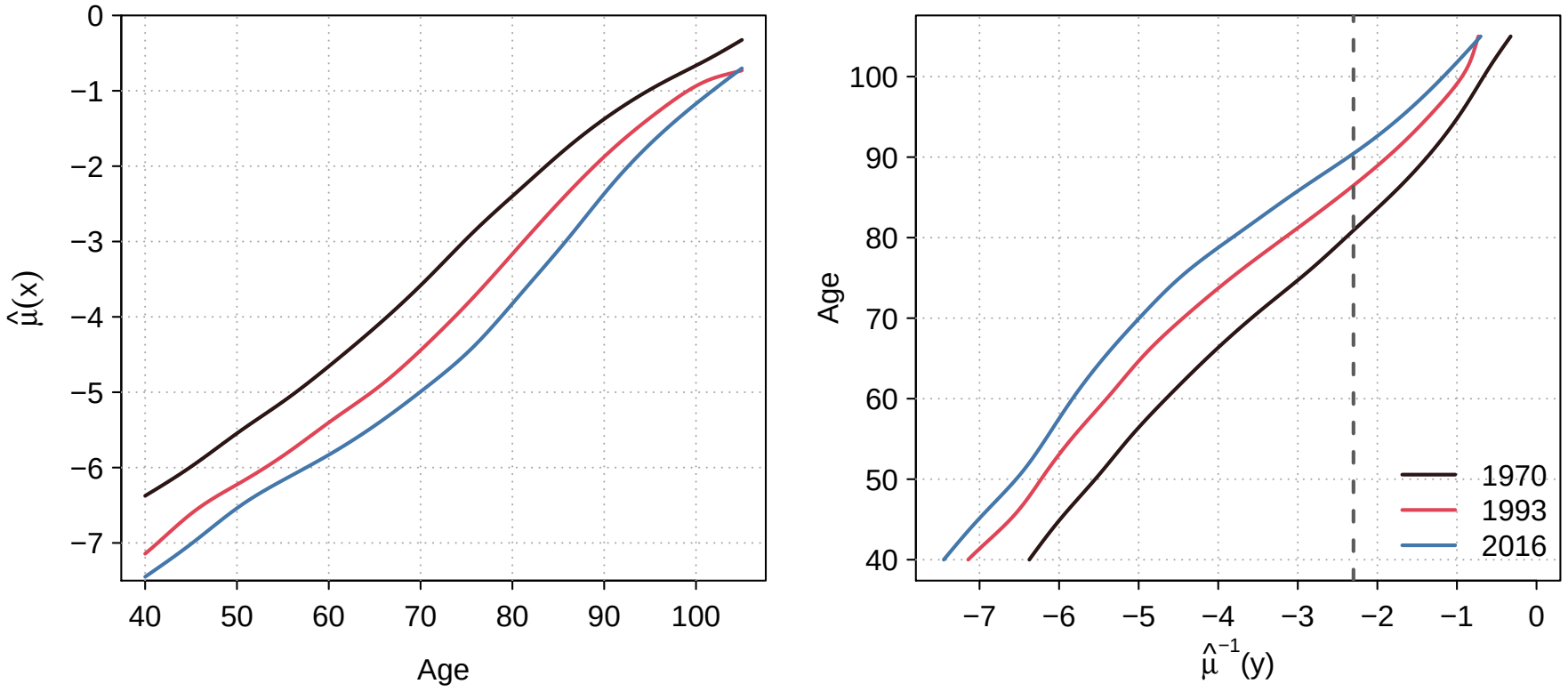
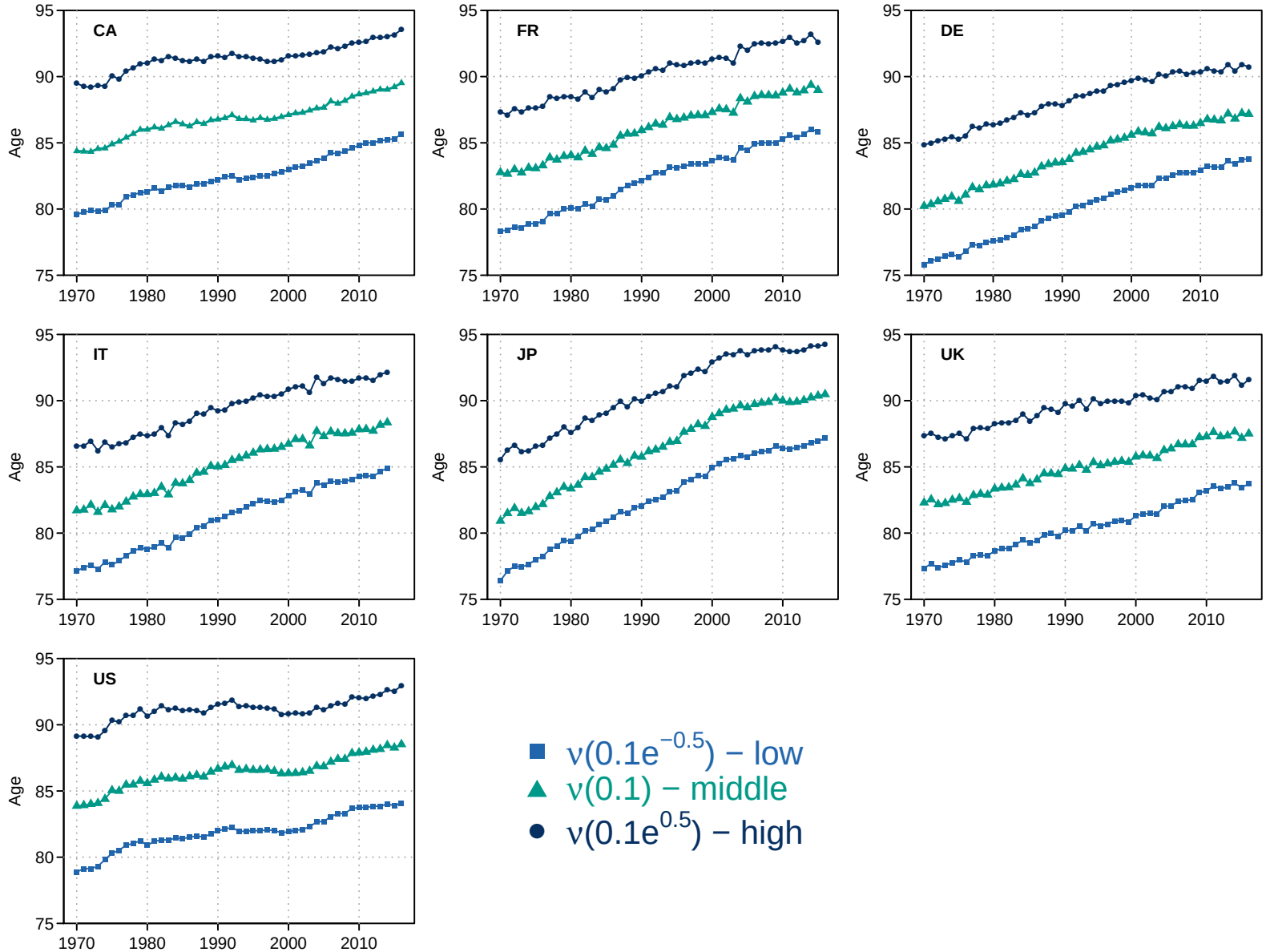
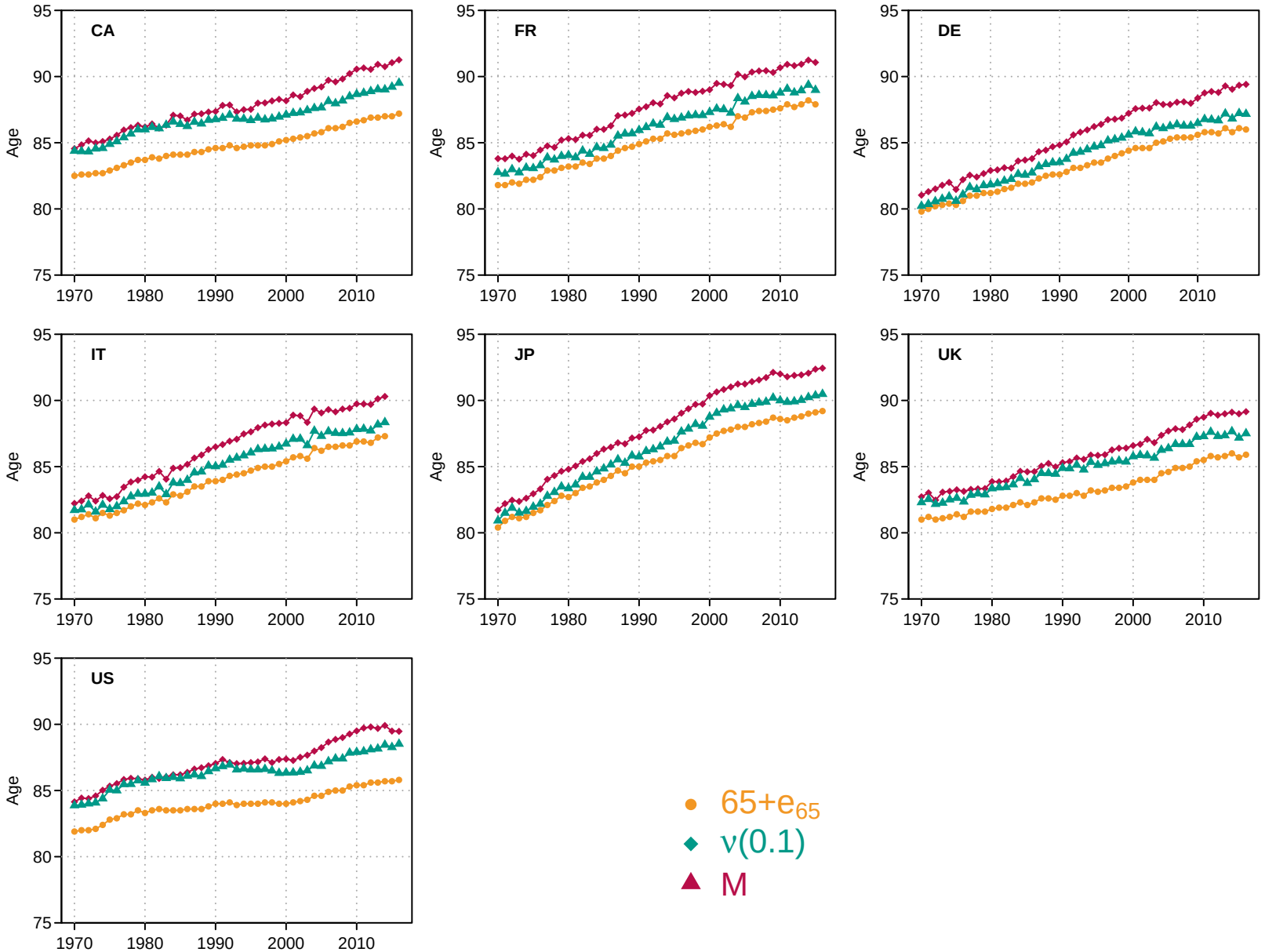


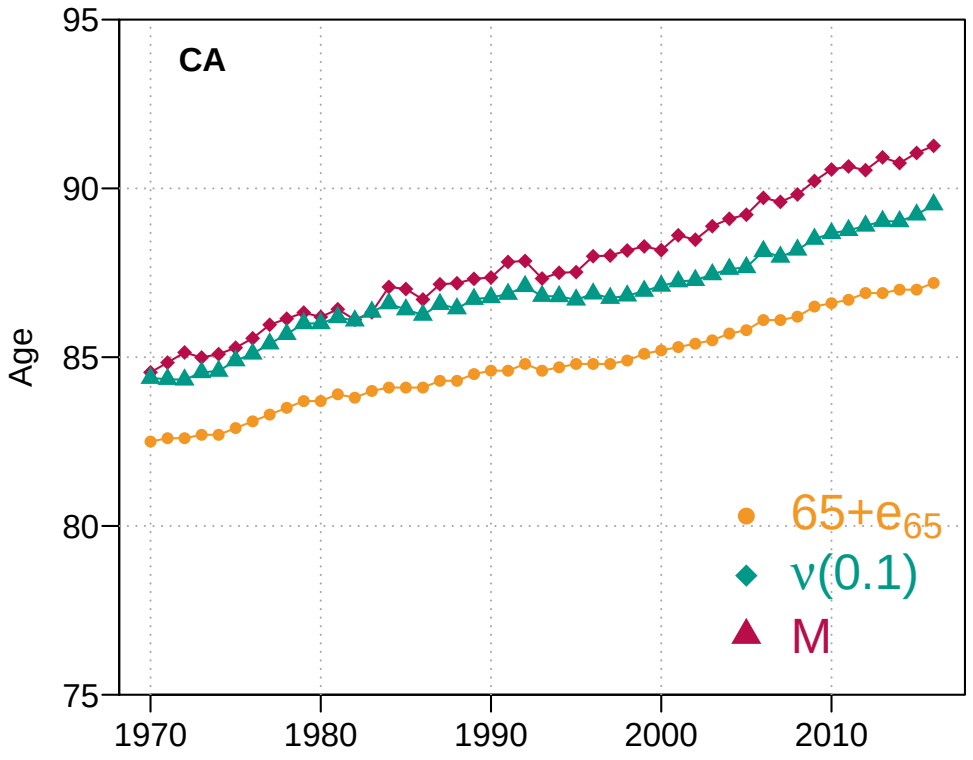
International trends and differentials in AoMs, females, G7 countries



Trends and differentials in $\nu(0.1)$, e_{65}, and M, females, G7 countries

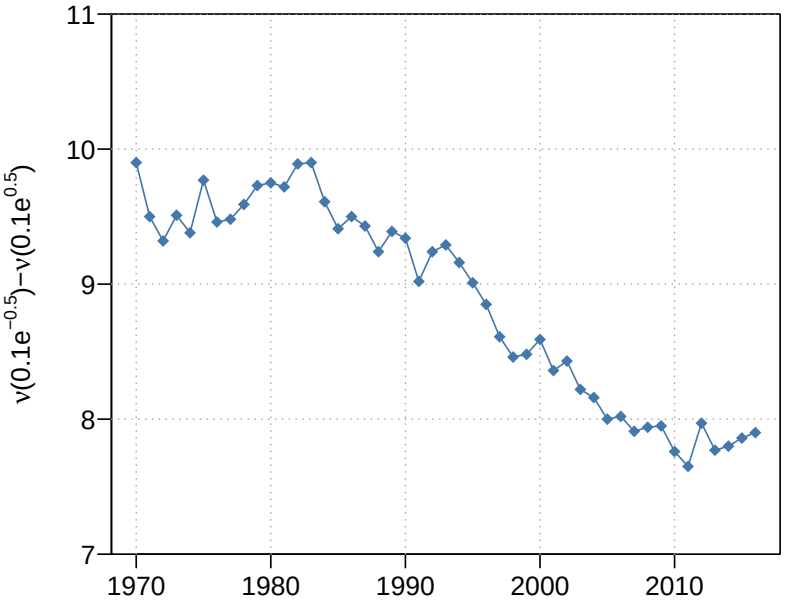


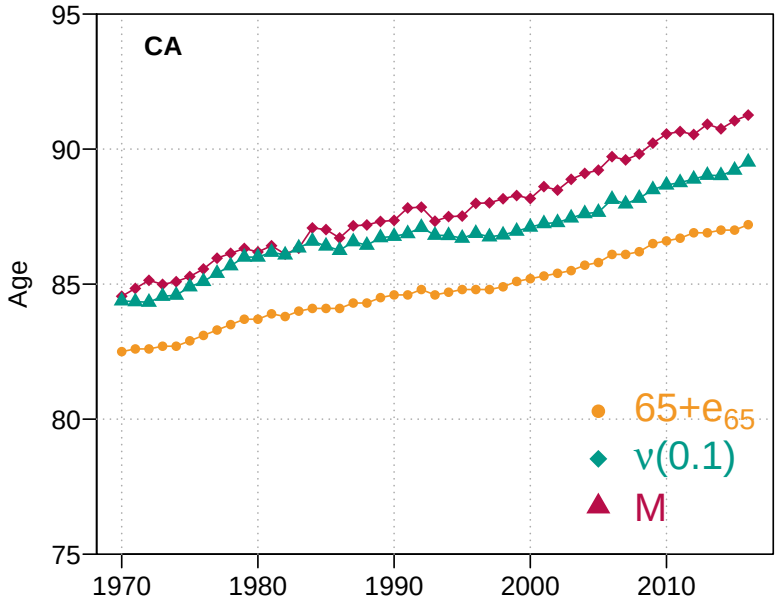
Trends and differentials in $\nu(0.1)$, e_{65}, and M, females, Canada



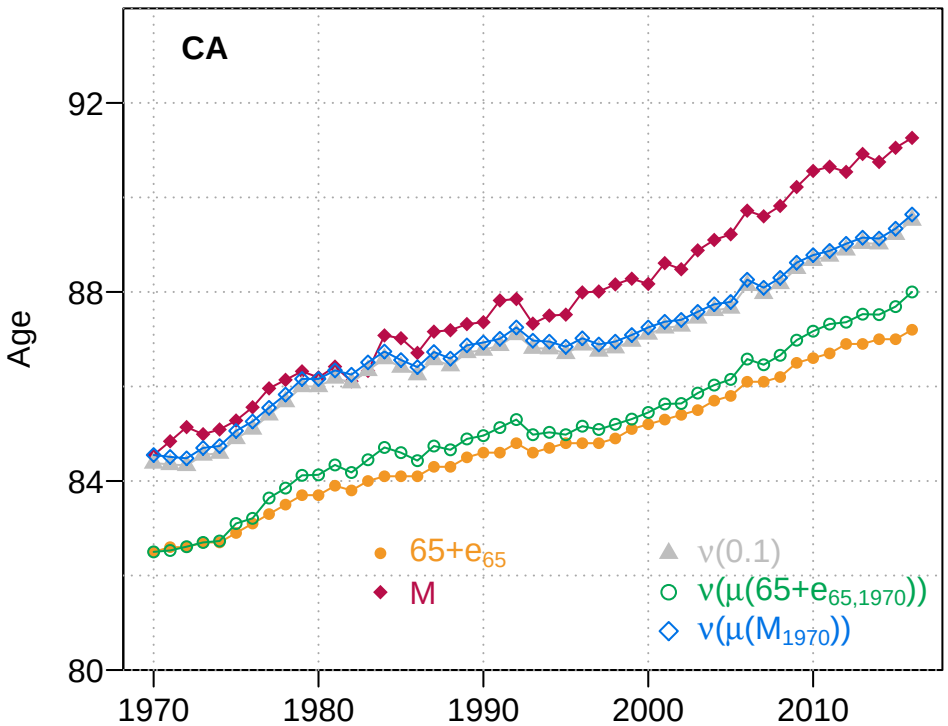
- $65 + e_{65,1970} = 82.5$
  $65 + e_{65,2016} = 87.2$
  $\Delta e_{65} = 4.7$
- $\nu(0.1)_{1970} = 84.4$
  $\nu(0.1)_{2016} = 89.5$
  $\Delta\nu(0.1) = 5.1$
- $M_{1970} = 84.5$
  $M_{2016} = 91.3$
  $\Delta M = 6.8$

Old-age compression of mortality, females, Canada





Trends in AoM at mortality level of total life expectancy at age 65 and of modal age at death in 1970, females, Canada



- $65 + e_{65,1970} = 82.5$
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- $M_{1970} = 84.5$
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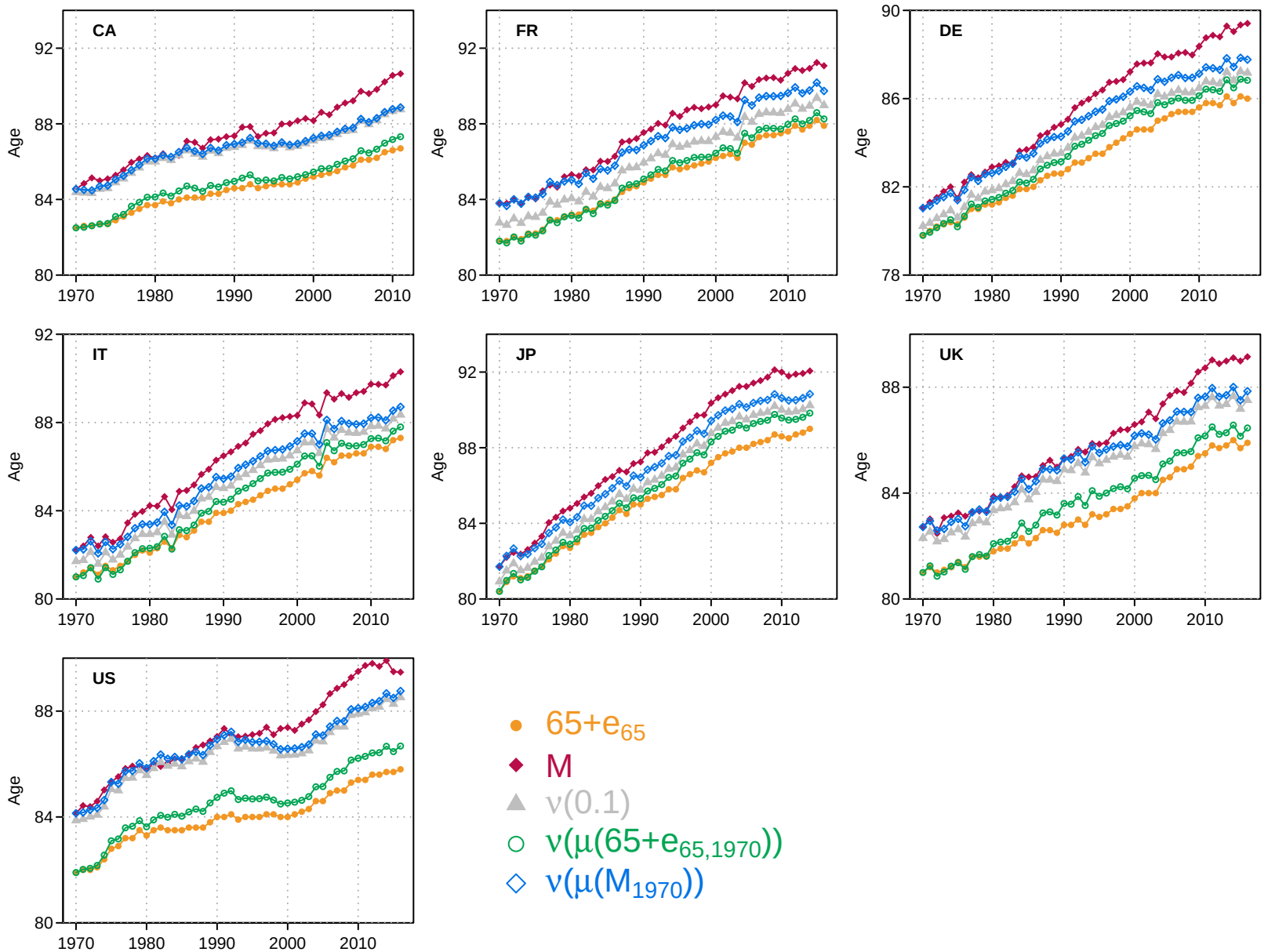
Trends in AoM at mortality level of total life expectancy at age 65 and of modal age at death in 1970, females, G7 countries



Conclusion and future work

Our study showed:

- the AoM indicator at the three selected levels of old-age mortality increased since 1970 in G7 countries,
- the shift in AoM to older ages occurred at faster pace at lower than higher mortality levels,
- $\nu(0.1)$ increased more rapidly than e_{65} and more slowly than M since 1970 in all G7 countries,
- use of AoM indicators in complementarity to e_x and M.

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Towards:

- an analysis and comparison of the pace of increase in e_{65}, $\nu(0.1)$, and M,
- construction of a composite AoM indicator.

Thank you for your attention

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