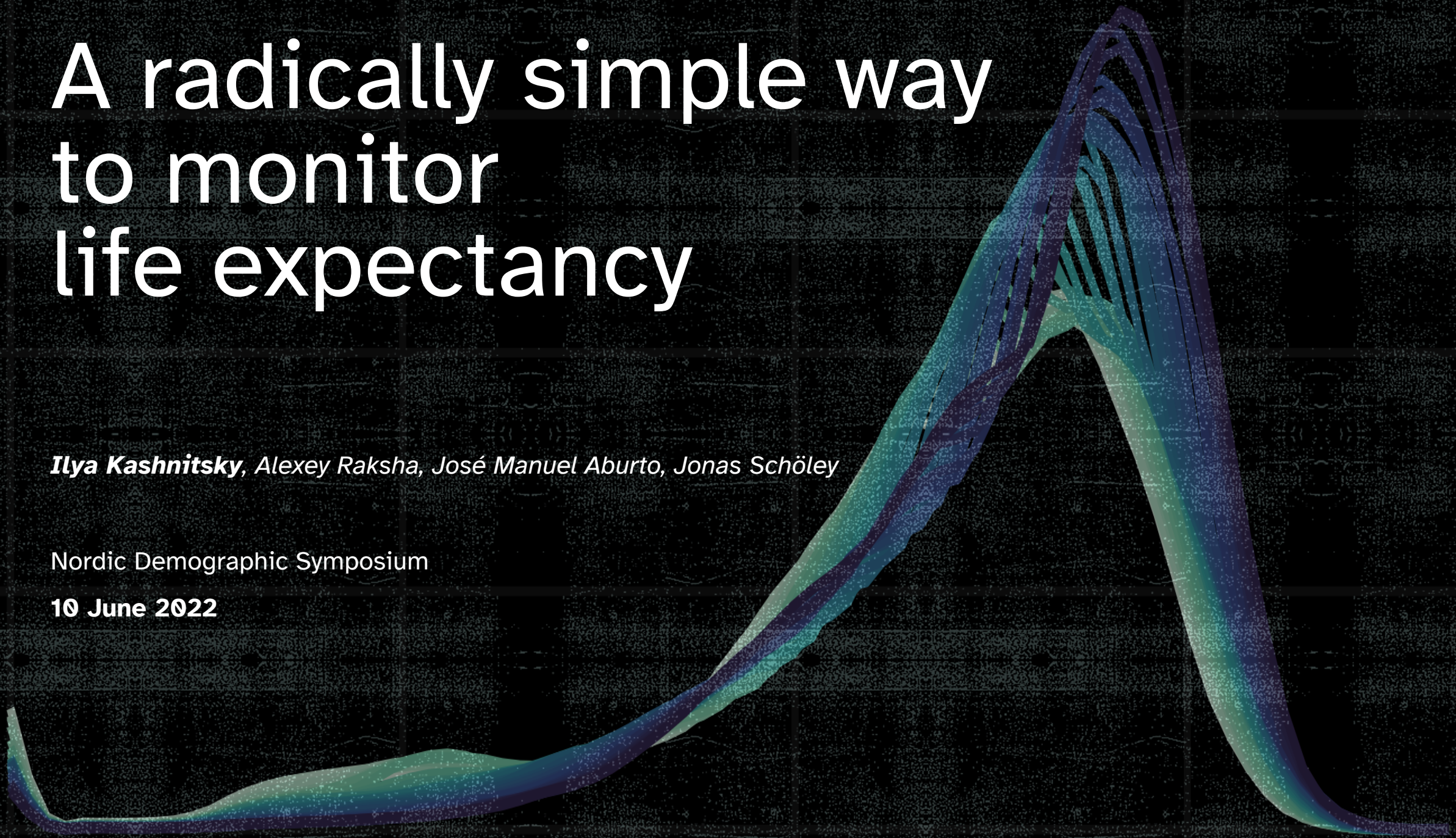
A radically simple way to monitor life expectancy

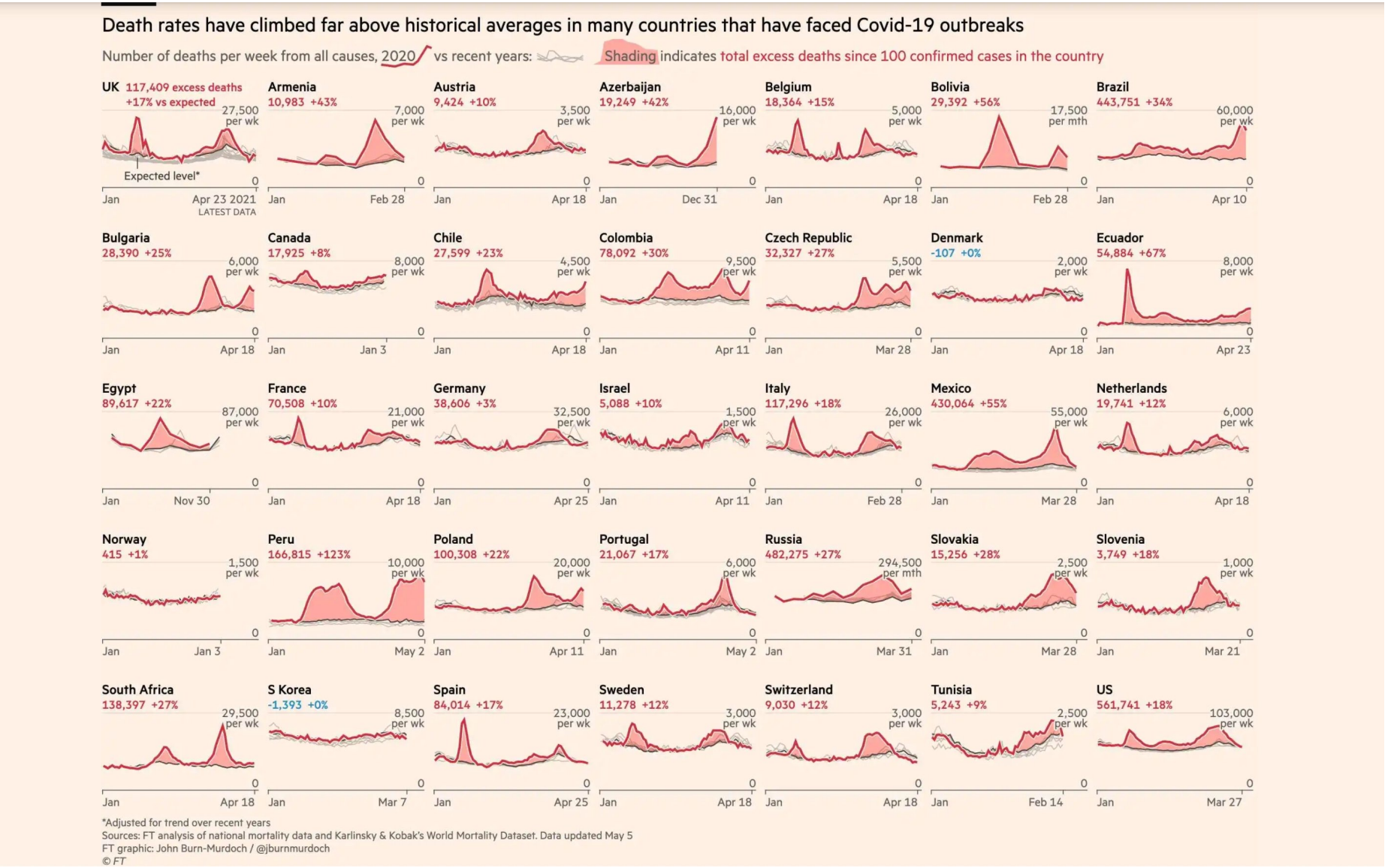


Ilya Kashnitsky, *Alexey Raksha, José Manuel Aburto, Jonas Schöley*

Nordic Demographic Symposium

10 June 2022

Measuring the impact of c19



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Life expectancy is the ultimate measure of current mortality

- Free from population age structure effect
- No need to choose standard
- Comparable across place and time

Gerontology

Of General Interest / Viewpoint

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DOI: 10.1159/000500955

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Accepted after revision: May 14, 2019
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Life Expectancy: Frequently Used, but Hardly Understood

Marc Luy[a, b] Paola Di Giulio[a, b] Vanessa Di Lego[a, b] Patrick Lazarevič[a, b] Markus Sauerberg[a, b]

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Keywords
Life expectancy · Cohort effects · Heterogeneity · Harvesting effect · Tempo effects

Abstract
Period life expectancy is one of the most used summary indicators for the overall health of a population. Its levels and trends direct health policies, and researchers try to identify the determining risk factors to assess and forecast future developments. The use of period life expectancy is often based on the assumption that it directly reflects the mortality conditions of a certain year. Accordingly, the explanation for changes in life expectancy are typically sought in factors that have an immediate impact on current mortality conditions. It is frequently overlooked, however, that this indicator can also be affected by at least three kinds of effects, in particular in the situation of short-term fluctuations: cohort effects, heterogeneity effects, and tempo effects. We demonstrate their possible impact with the example of the almost Europe-wide decrease in life expectancy in 2015, which caused a series of reports about an upsurge of a health crisis, and we show that the consideration of these effects can lead to different conclusions. Therefore, we want to raise an awareness concerning the sensitivity of life expectancy to sudden changes and the menaces a misled interpretation of this indicator can cause.

Introduction

Period life expectancy (PLE) is one of the most used summary indicators for the overall health of a population. It is based on the set of observed age-specific death rates, i.e., the number of deaths in a certain year and age group divided by the average number of people alive in this year and age group. These death rates are then transformed into probabilities of dying and connected to a survival function from birth to the highest age in which people are living. The mean age at death derived from this survival function is the PLE. It can be interpreted as the average number of years that newborns of a certain period would live under the hypothetical scenario that the prevailing age-specific death rates remain constant in the future [1].

The period perspective must be strictly distinguished from the cohort perspective. The latter is the more intuitive and more clearly interpretable analytic concept. It connects the age-specific death rates experienced by a cohort longitudinally over its entire life course. Thus, cohort life expectancy (CLE) reflects the actual mean age at death of real people who were born at the same time. Naturally, CLE can only summarize past mortality experiences, whereas PLE reflects the most current death rates cross-sectionally across all ages. This is why PLE is of higher relevance for most practical purposes and more frequently used than CLE.

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Article Navigation

Quantifying impacts of the COVID-19 pandemic through life-expectancy losses: a population-level study of 29 countries

José Manuel Aburto ✉, Jonas Schöley, Ilya Kashnitsky, Luyin Zhang, Charles Rahal, Trifon I Missov, Melinda C Mills, Jennifer B Dowd, Ridhi Kashyap Author Notes

International Journal of Epidemiology, dyab207, https://doi.org/10.1093/ije/dyab207

Published: 26 September 2021 **Article history** ▾

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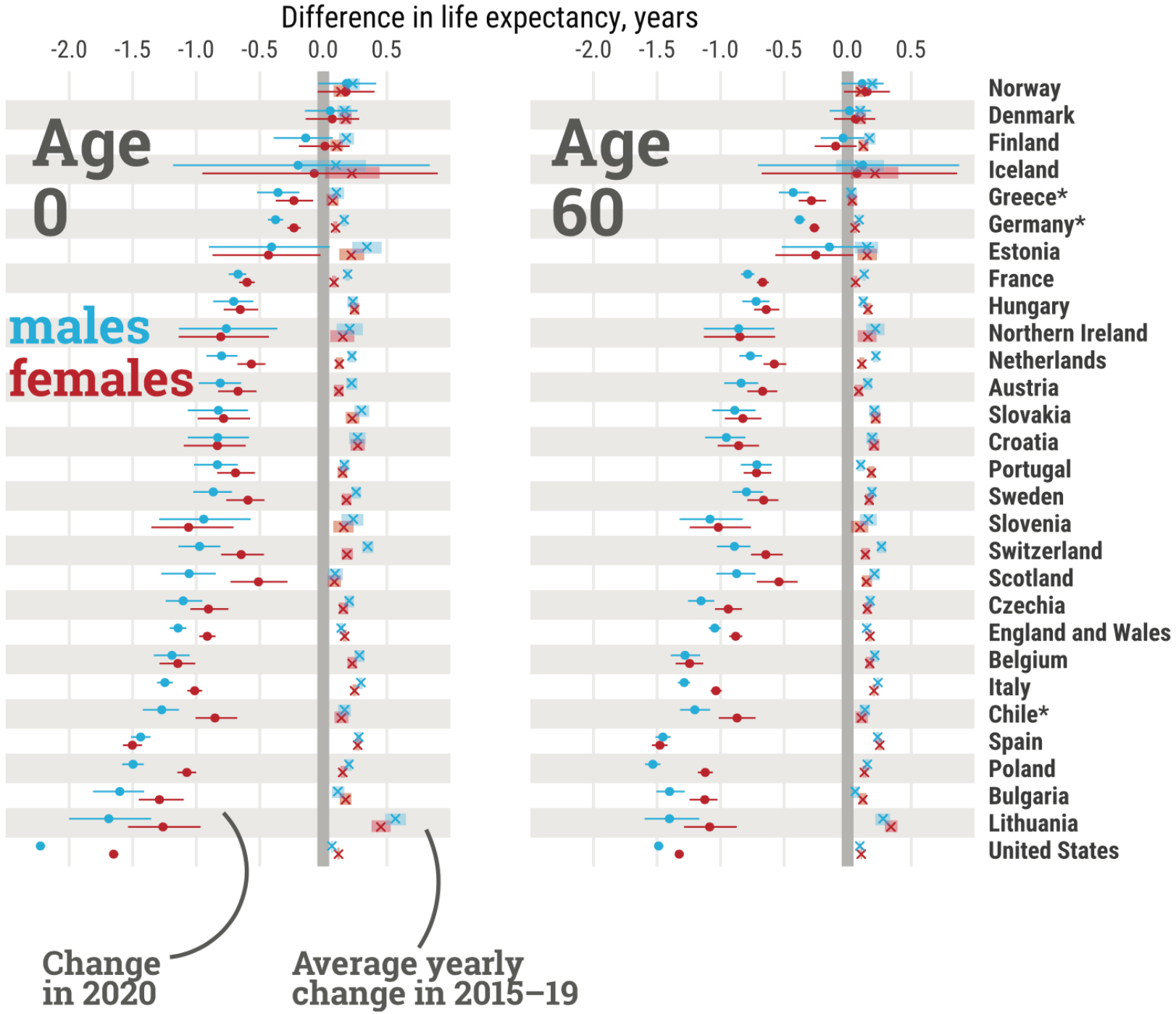

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International Journal of Epidemiology, 2022, 1–3
https://doi.org/10.1093/ije/dyac055
Letter to the Editor

OXFORD

Letter to the Editor

Life expectancy declines in Russia during the COVID-19 pandemic in 2020

José Manuel Aburto [1,2,3,4*†] Jonas Schöley,[3,4†] Ilya Kashnitsky [3†] and Ridhi Kashyap [1,2†]

[1]Leverhulme Centre for Demographic Science and Department of Sociology, University of Oxford, Oxford, UK, [2]Nuffield College, Oxford, UK, [3]Interdisciplinary Centre on Population Dynamics, University of Southern Denmark, Odense, Denmark and [4]Max Planck Institute for Demographic Research, Rostock, Germany

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†All authors contributed equally to this letter.

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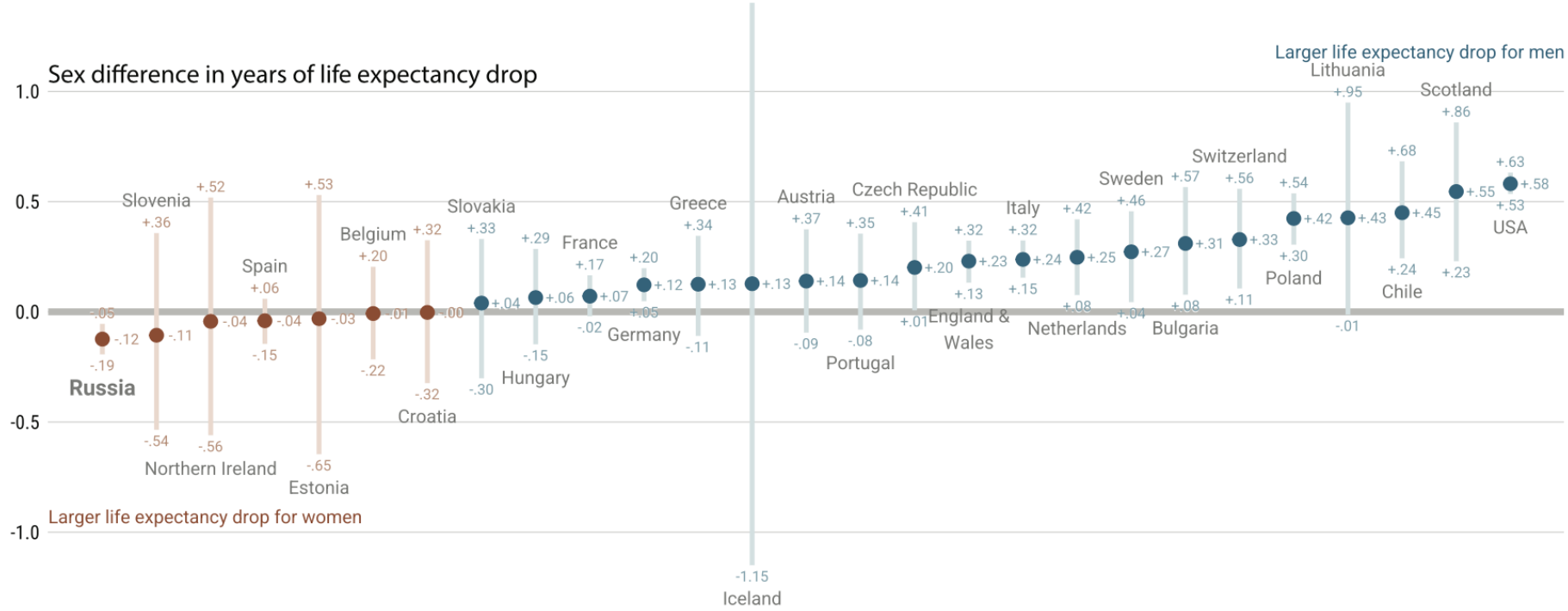

Figure 2 Sex differences in the life-expectancy change from 2019 to 2020 across countries experiencing life expectancy losses; 95% prediction intervals via Poisson sampling of age-specific death counts

José Manuel Aburto [1,2,3,4*†] **Jonas Schöley,** [3,4†] **Ilya Kashnitsky** [3†] **and Ridhi Kashyap** [1,2†]

[1]Leverhulme Centre for Demographic Science and Department of Sociology, University of Oxford, Oxford, UK, [2]Nuffield College, Oxford, UK, [3]Interdisciplinary Centre on Population Dynamics, University of Southern Denmark, Odense, Denmark and [4]Max Planck Institute for Demographic Research, Rostock, Germany

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†All authors contributed equally to this letter.

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Letter to the Editor

Life expectancy
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José Manuel Aburto
and Ridhi Kashyap [1]

[1]Leverhulme Centre for Demo
Oxford, UK, [2]Nuffield College, C
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*Corresponding author. Department of Sociology, University of Oxford, 42-43 Park End Street, Oxford OX1 1JD, UK. E-mail: jose-manuel.aburto@sociology.ox.ac.uk
[†]All authors contributed equally to this letter.

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CSH Cold Spring Harbor Laboratory BMJ Yale

Bounce backs amid continued losses: Life expectancy changes since COVID-19

Jonas Schöley, José Manuel Aburto, Ilya Kashnitsky, Maxi S. Kniffka, Luyin Zhang, Hannaliis Jaadla, Jennifer B. Dowd, Ridhi Kashyap

doi: https://doi.org/10.1101/2022.02.23.22271380

This article is a preprint and has not been peer-reviewed [what does this mean?]. It reports new medical research that has yet to be evaluated and so should *not* be used to guide clinical practice.

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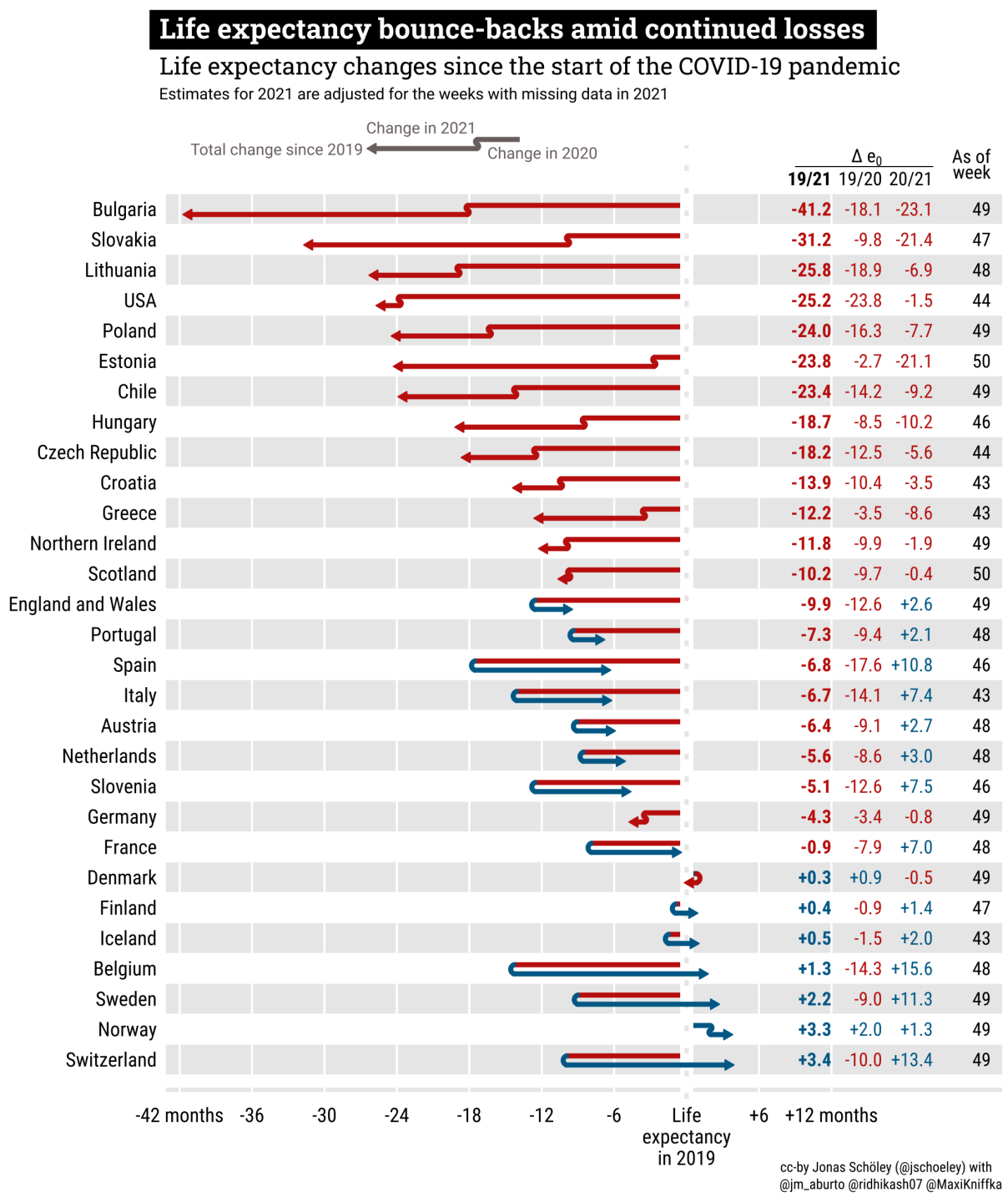
Abstract Full Text Info/History Metrics Preview PDF



Rest of the world

BMJ Global Health

Assessing the burden of COVID-19 in developing countries: systematic review, meta-analysis and public policy implications

Andrew T Levin ,[1,2] Nana Owusu-Boaitey,[3] Sierra Pugh,[4] Bailey K Fosdick,[5] Anthony B Zwi,[6] Anup Malani ,[7] Satej Soman ,[8] Lonni Besançon,[9] Ilya Kashnitsky,[10] Sachin Ganesh,[11] Aloysius McLaughlin,[11] Gayeong Song,[11] Rine Uhm,[11] Daniel Herrera-Esposito,[12] Gustavo de los Campos,[13] Ana Carolina Pecanha Peçanha Antonio ,[14] Enyew Birru Tadese,[15] Gideon Meyerowitz-Katz [16,17]

BMJ Global Health

Assessing the burden of COVID-19 in developing countries: systematic review,

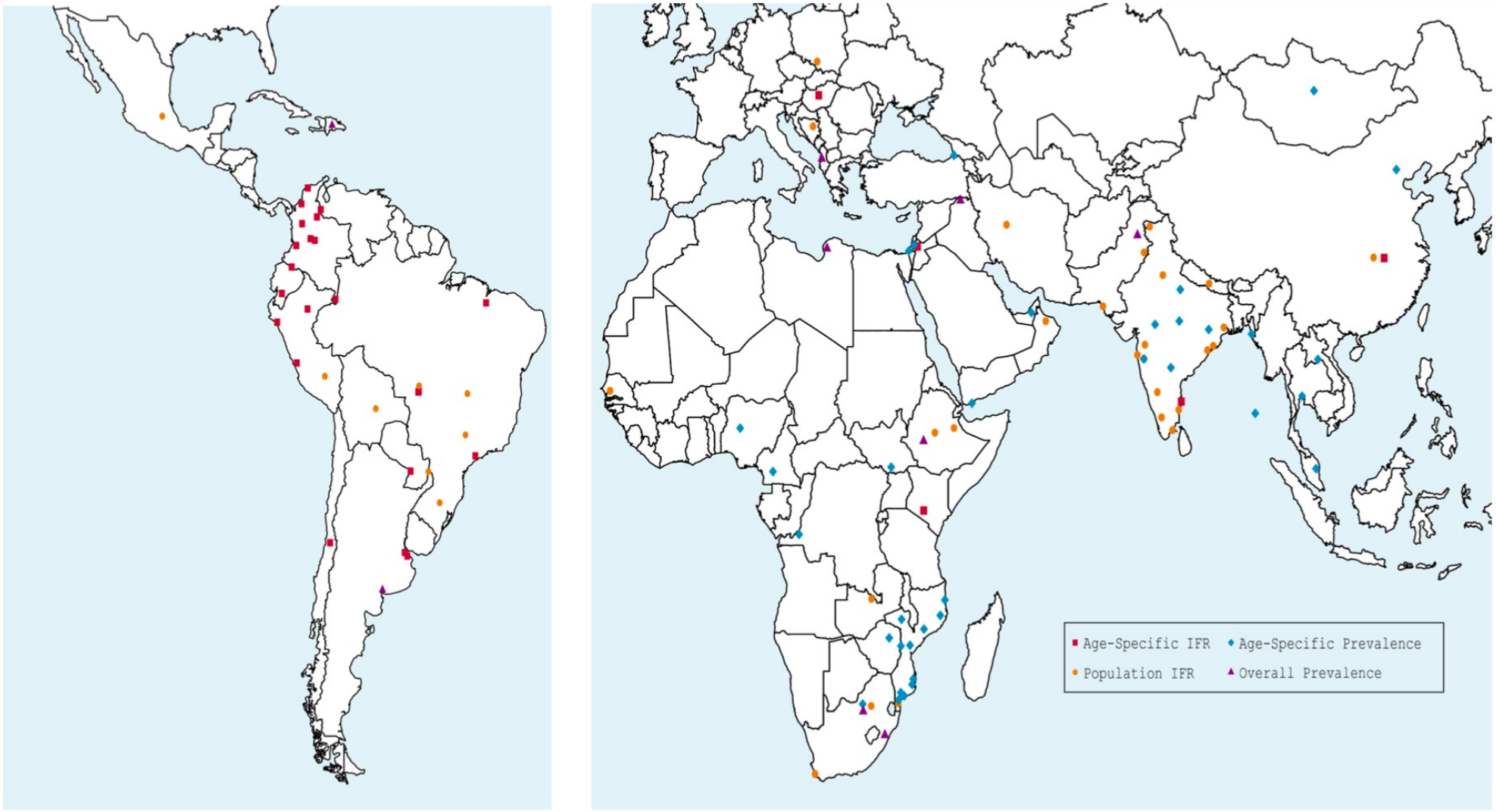


Figure 1 Map of study locations. IFR, infection fatality rate.

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Assessing the burden of COVID-19 in developing countries: systematic review,

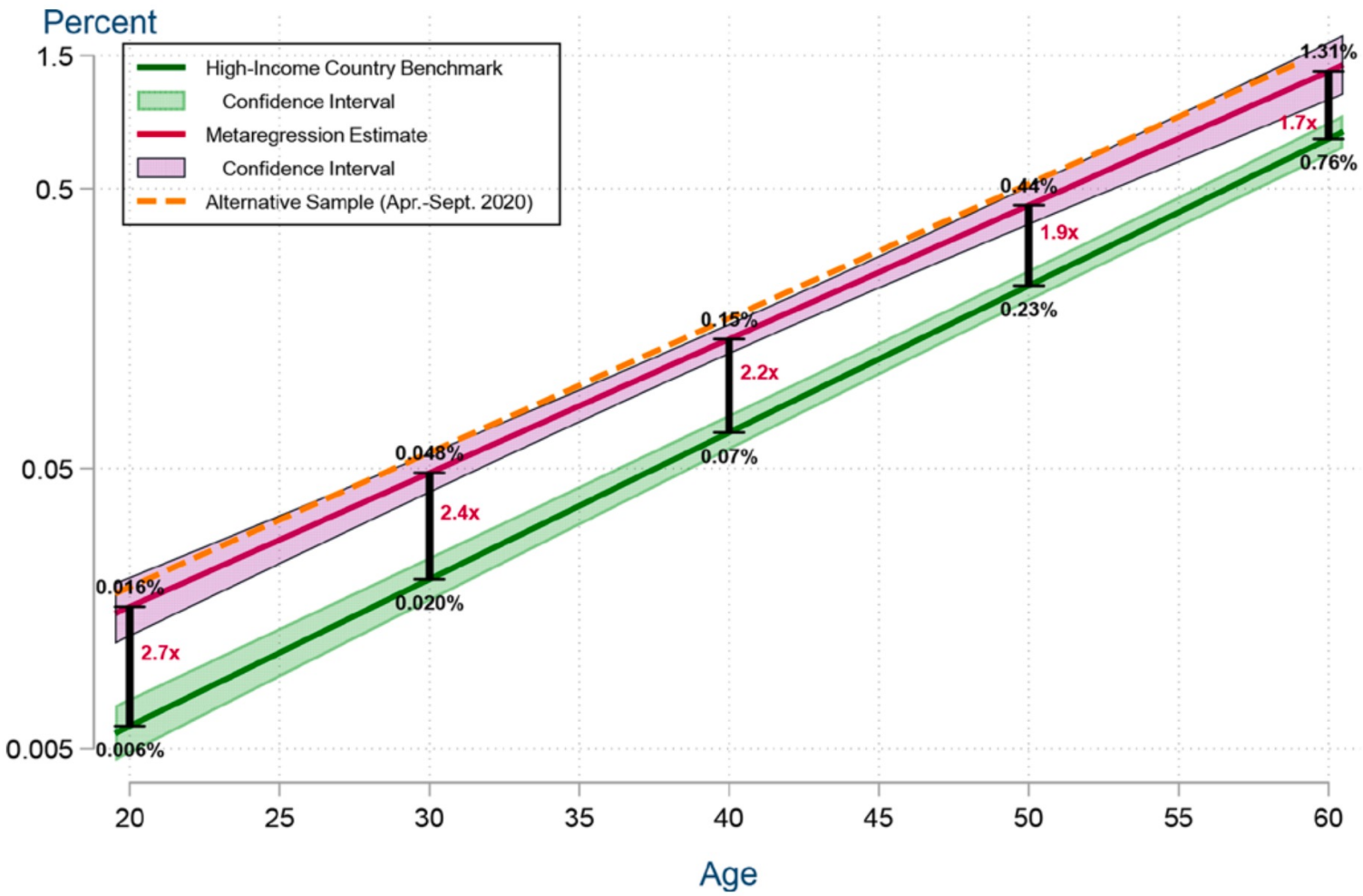

Figure 6 IFR in developing countries compared to high-income countries. IFR, infection fatality rate.

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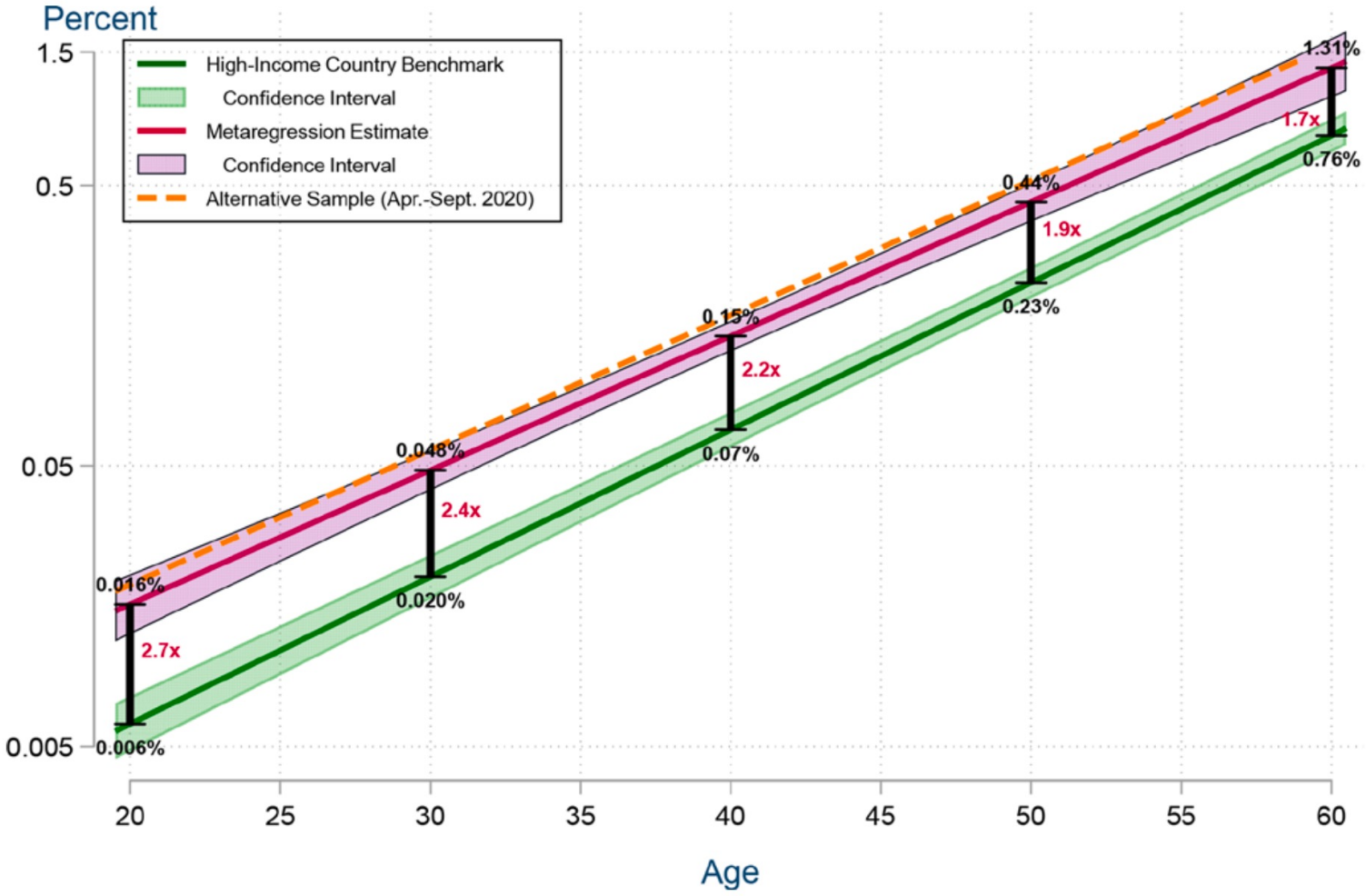


Figure 6 IFR in developing countries compared to high-income countries. IFR, infection fatality rate.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Prior meta-analyses of data from high-income countries have shown that the COVID-19 infection fatality rate (IFR) increases exponentially with age while seroprevalence (as measured by antibodies against SARS-CoV-2) has been markedly lower for older adults relative to younger adults.

WHAT THIS STUDY ADDS

⇒ We analyse serology and mortality data from 62 studies of 25 developing countries, and we find that age-stratified IFRs are about two times higher than the benchmark metaregression for high-income countries.

⇒ Indeed, population IFR in developing countries is similar to that of high-income countries, because differences in population age structure are roughly offset by disparities in healthcare access and elevated infection rates among older age cohorts.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Our findings underscore the urgency of disseminating vaccines and effective medications throughout the developing world.

Life expectancy can be

accurately

approximated with just

its own time series

and the

change in total death count

Life expectancy can be

accurately

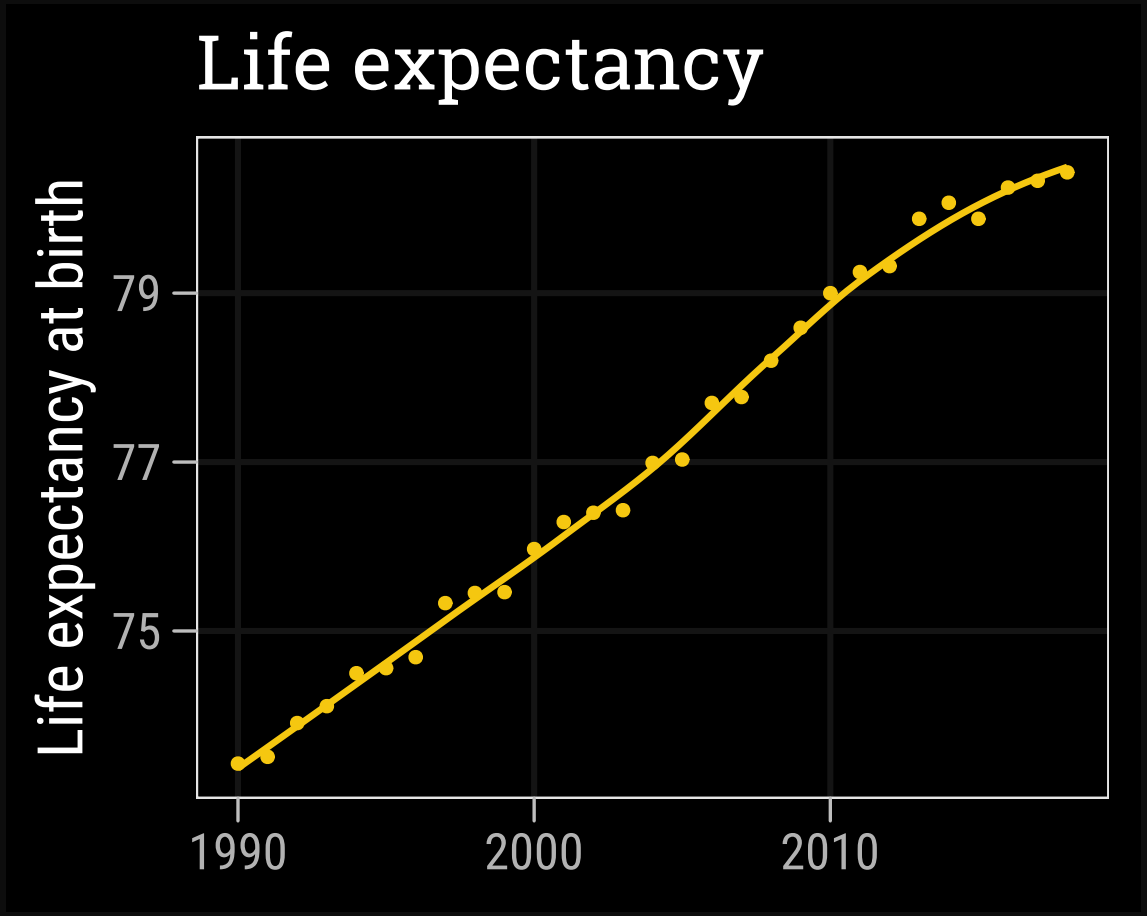
approximated with just

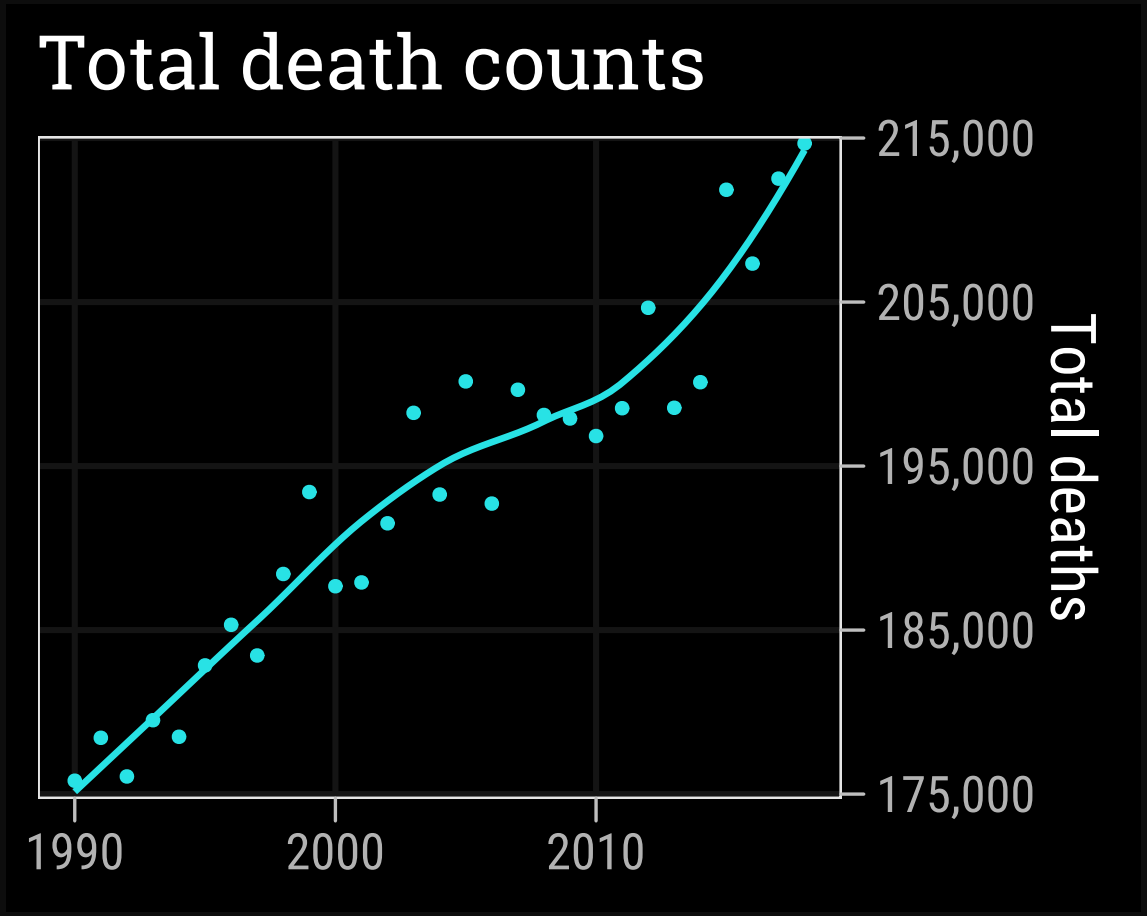
its own time series

and the

change in total death count

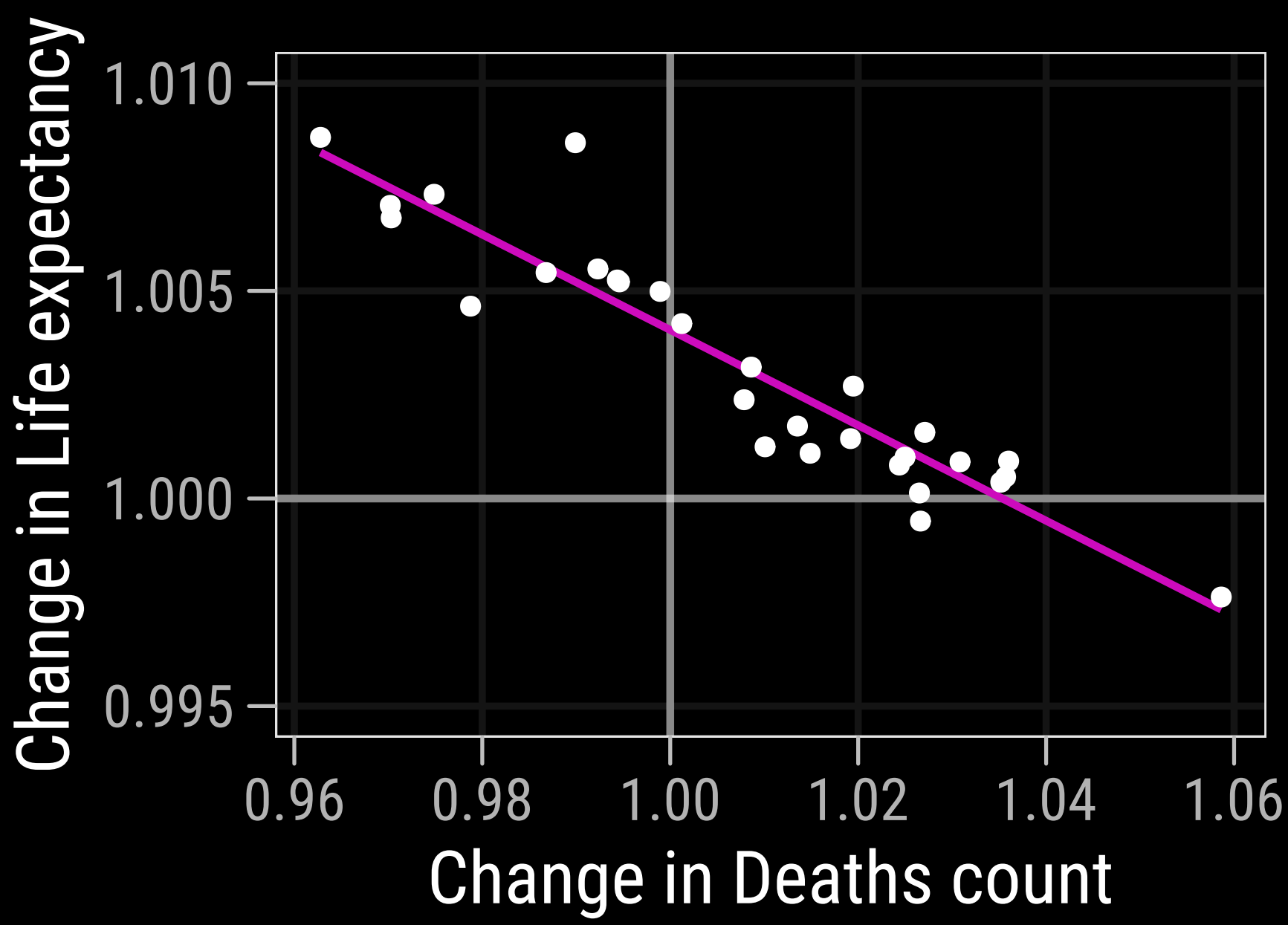
using a linear model





One country example: Spain, males

Linear fit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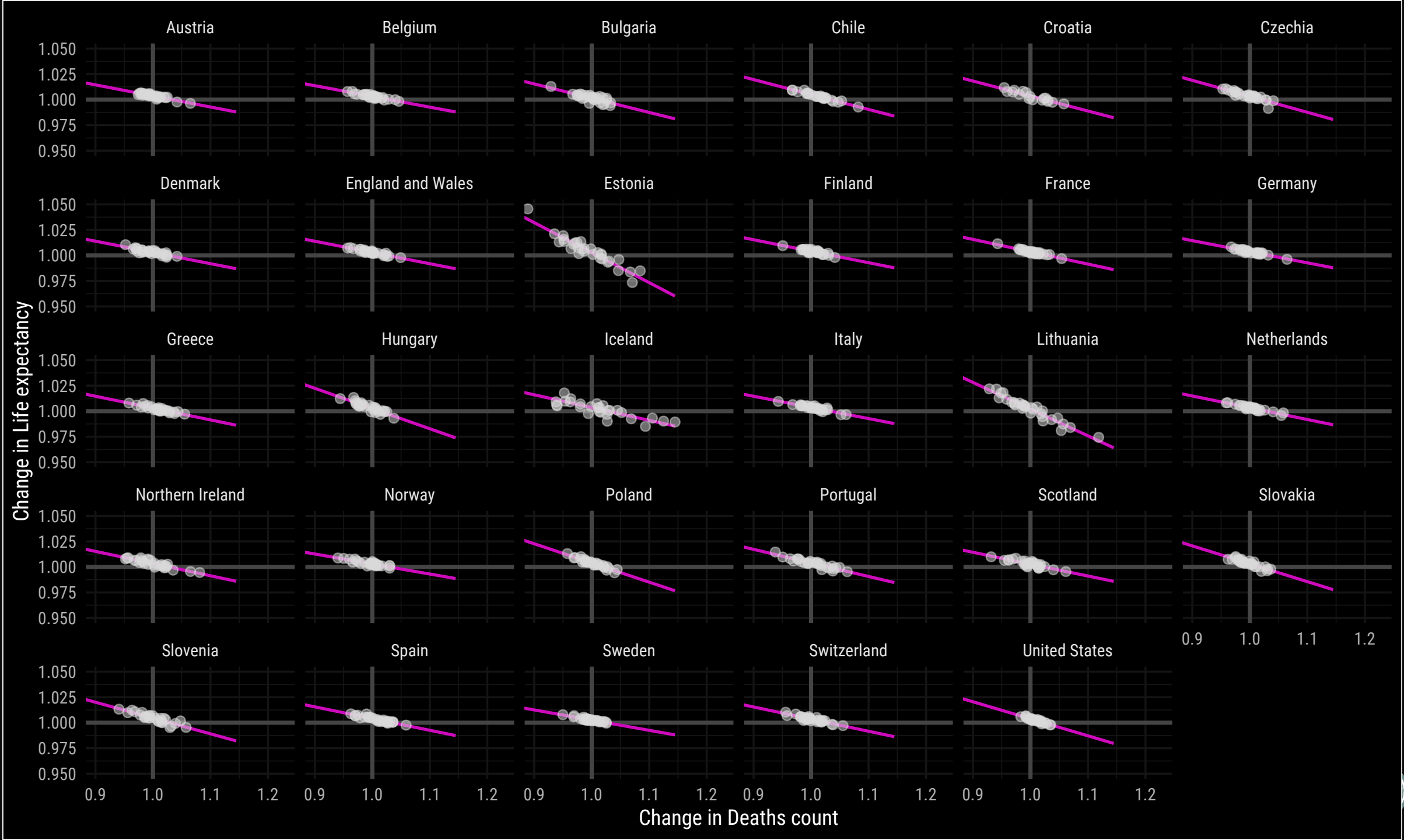
Change in Deaths count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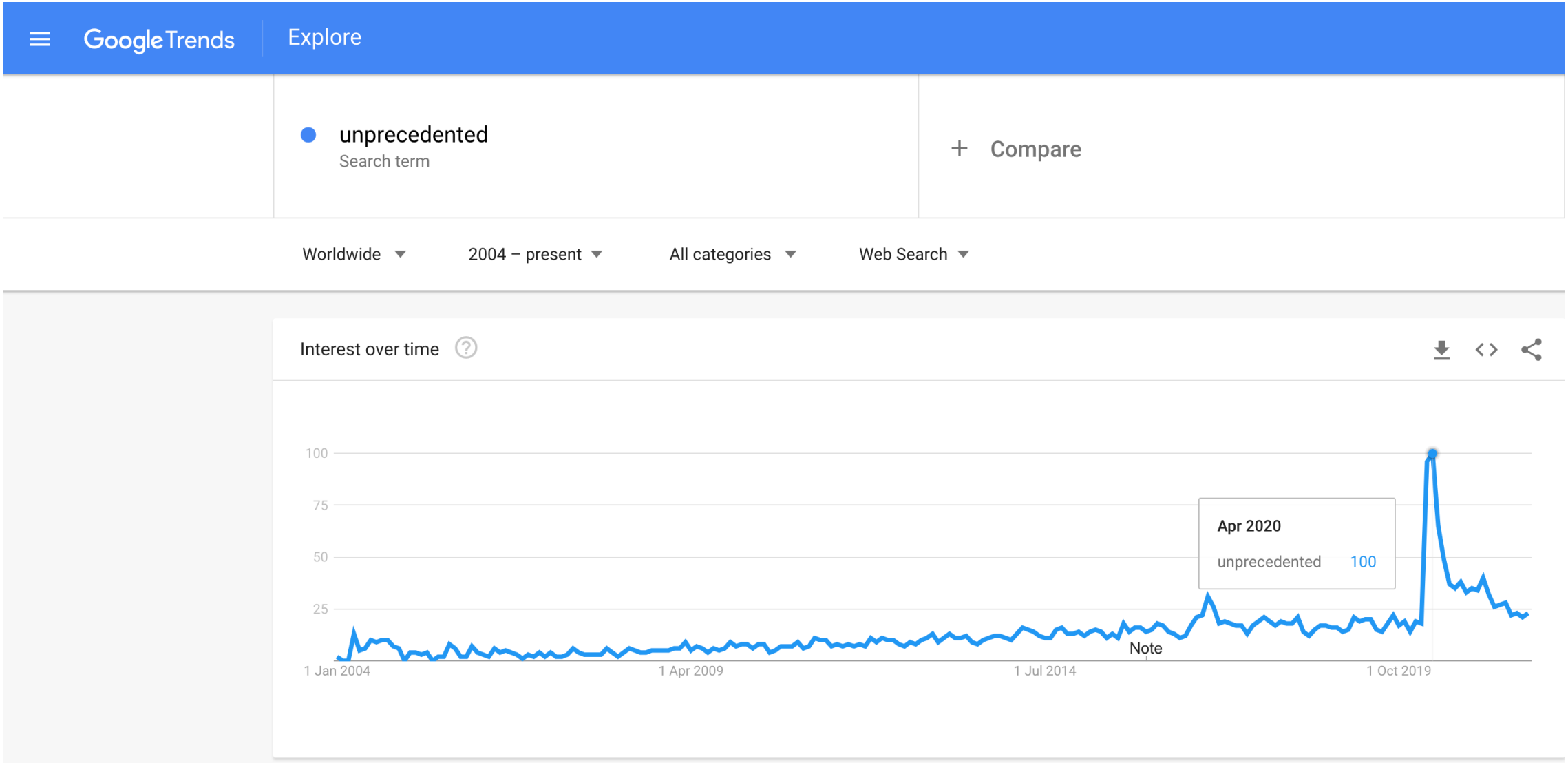
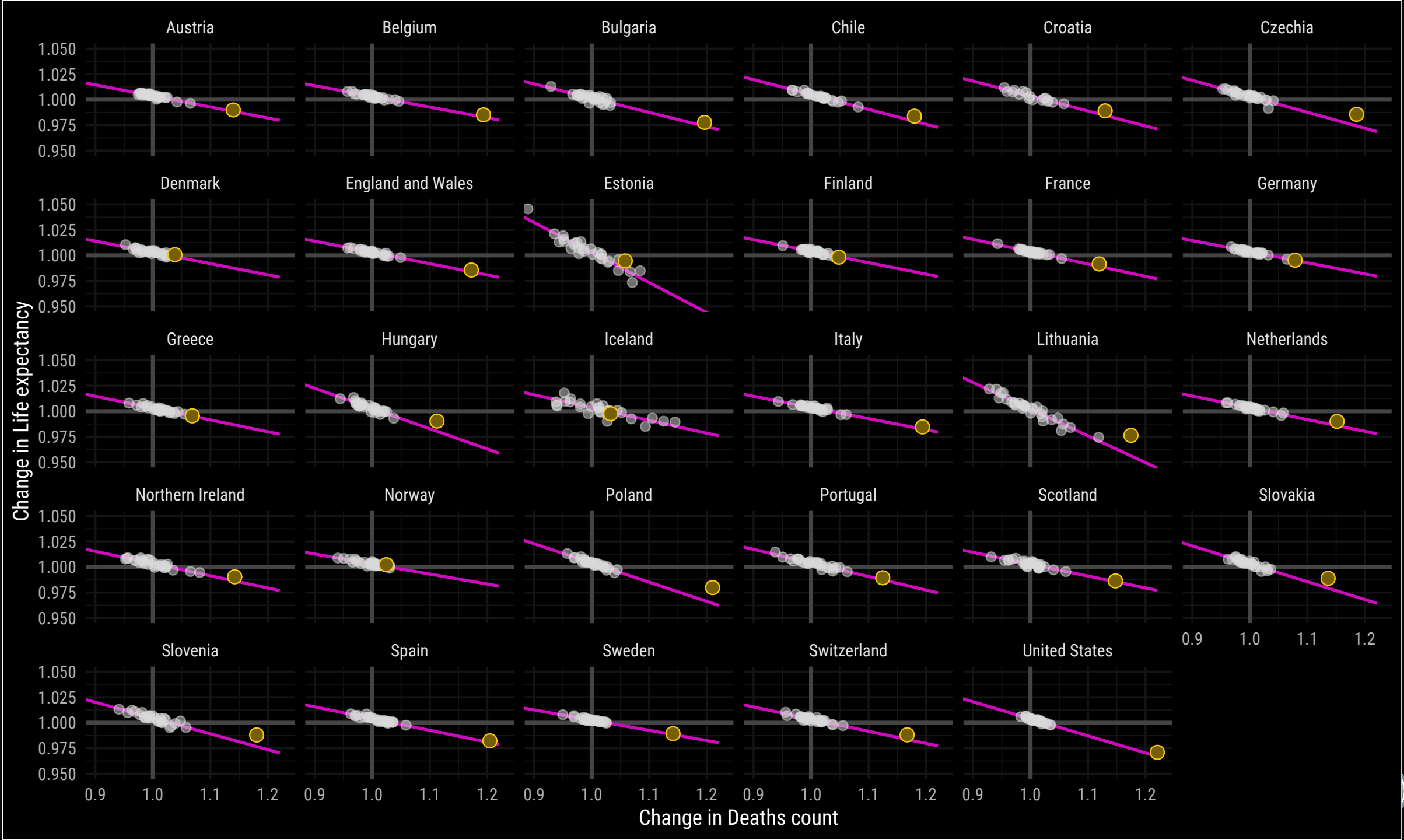
Change in Life expectancy
Change in Deaths count

What about 2020?

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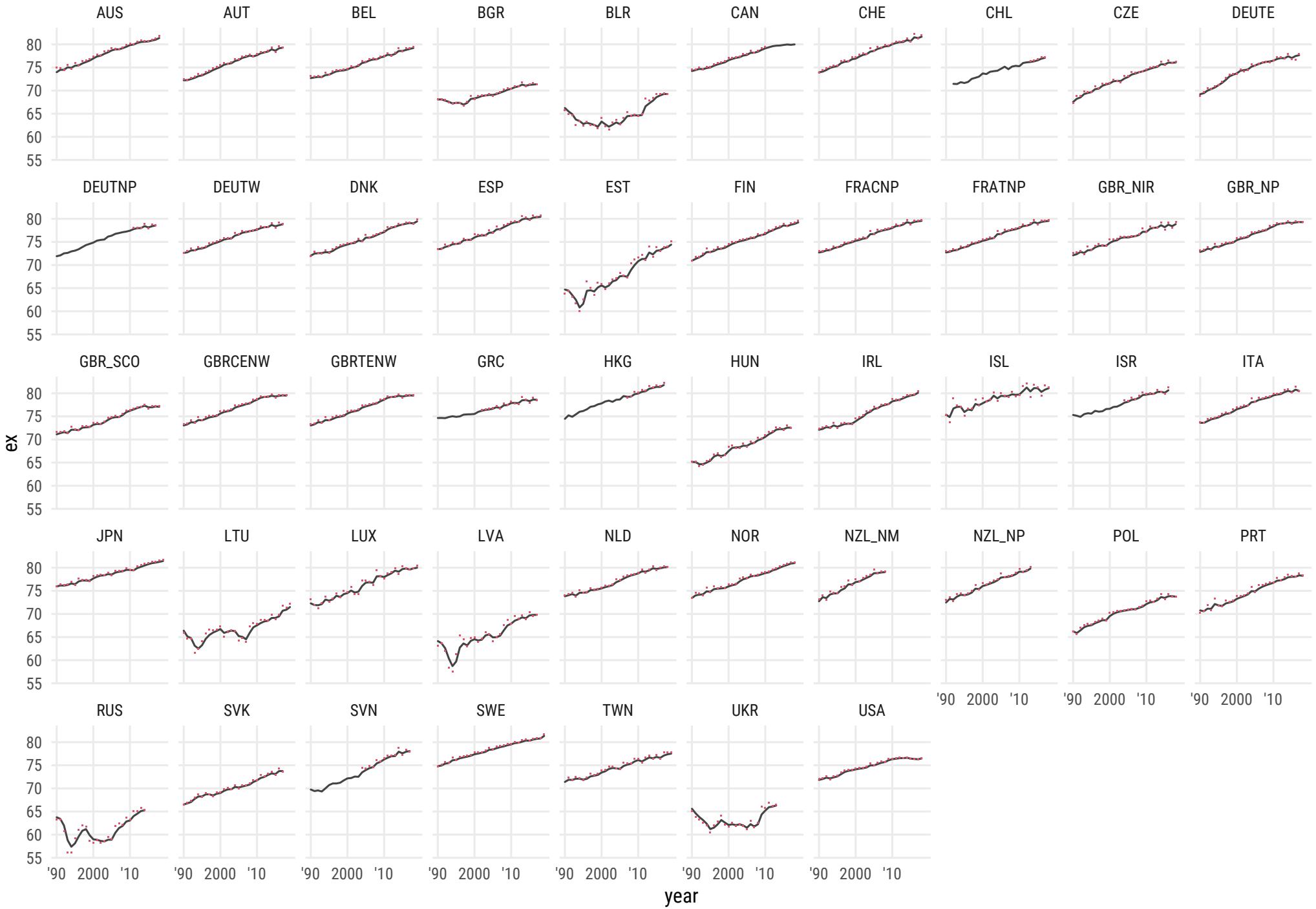
Change in Deaths count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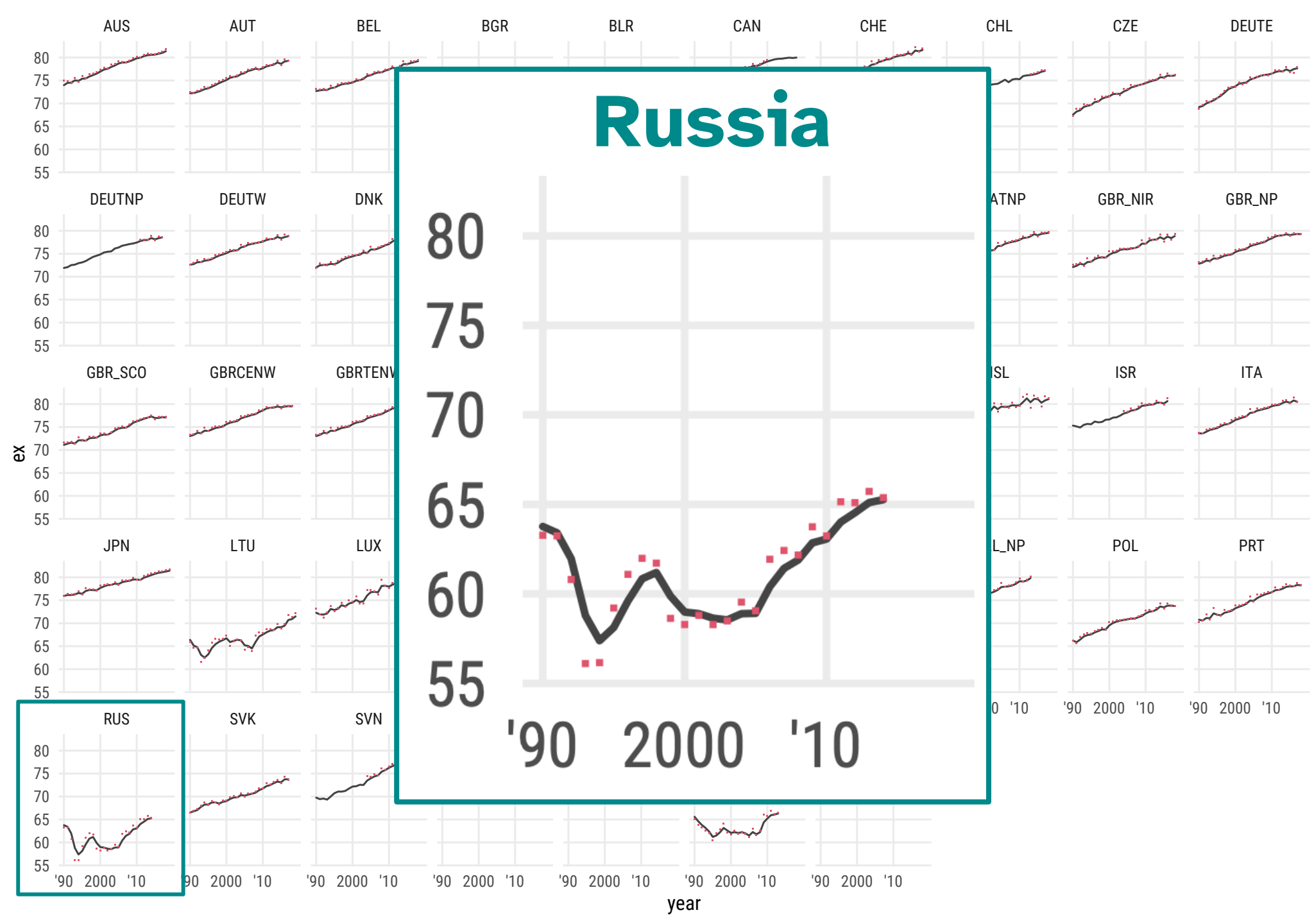
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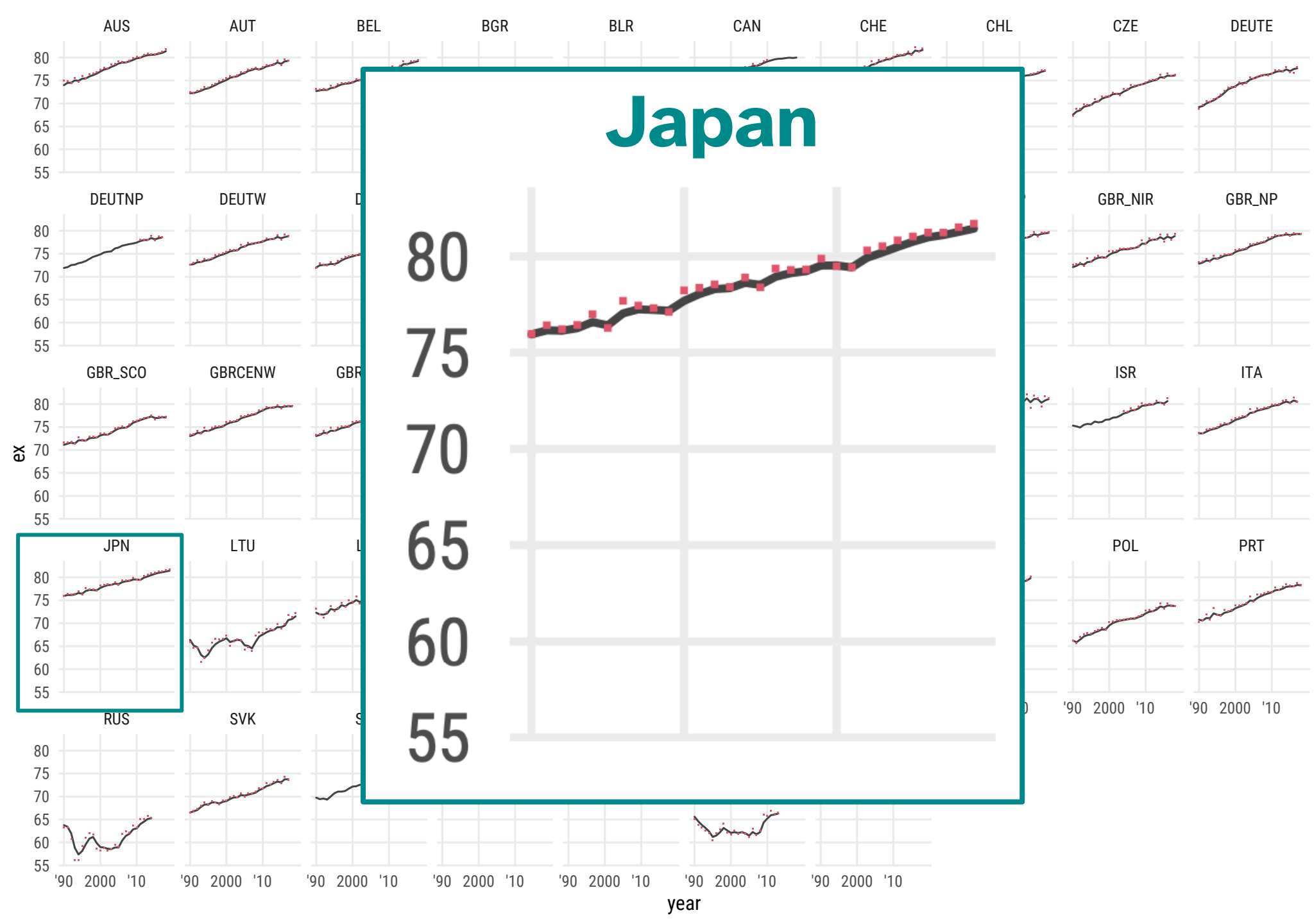
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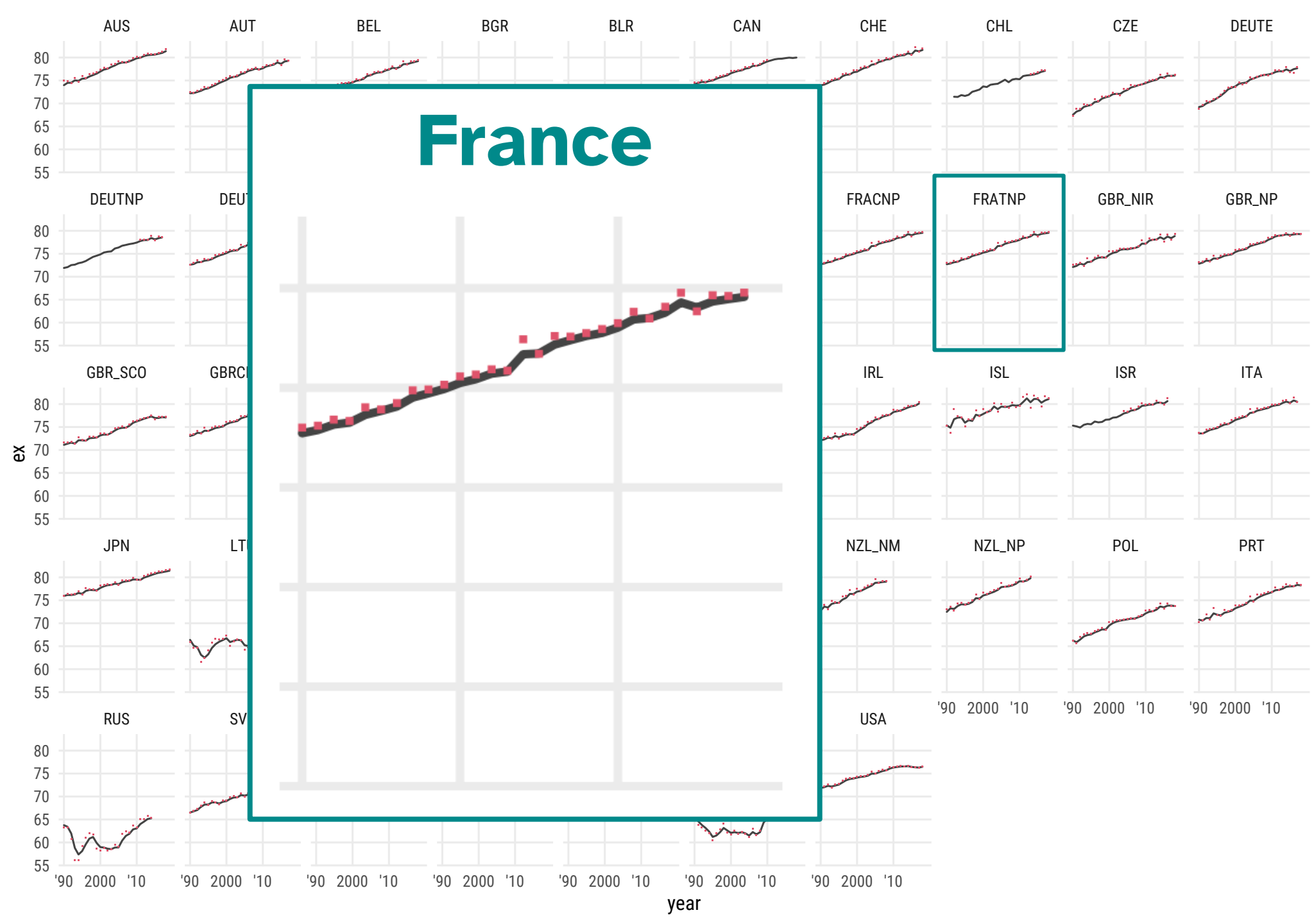
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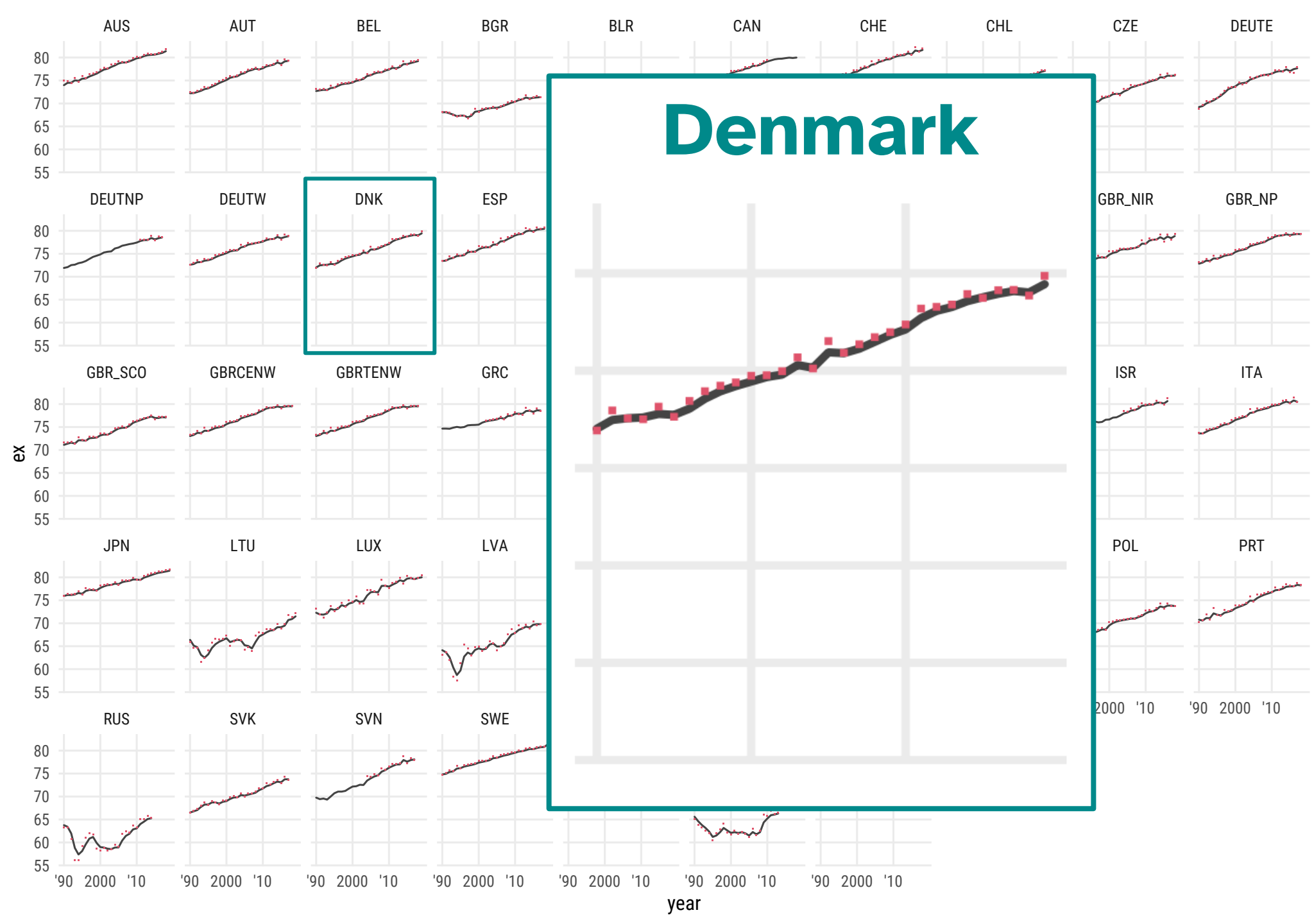
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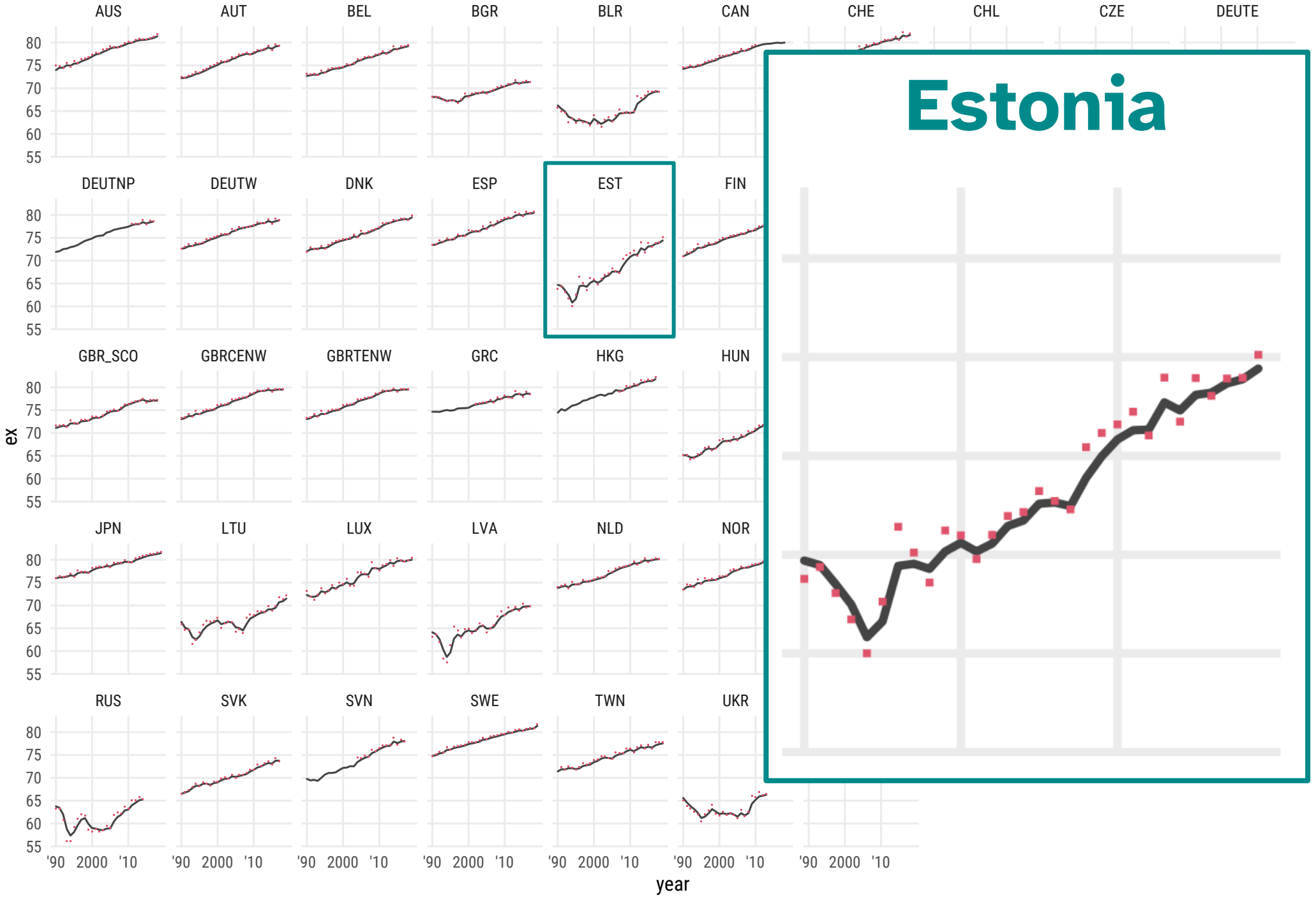
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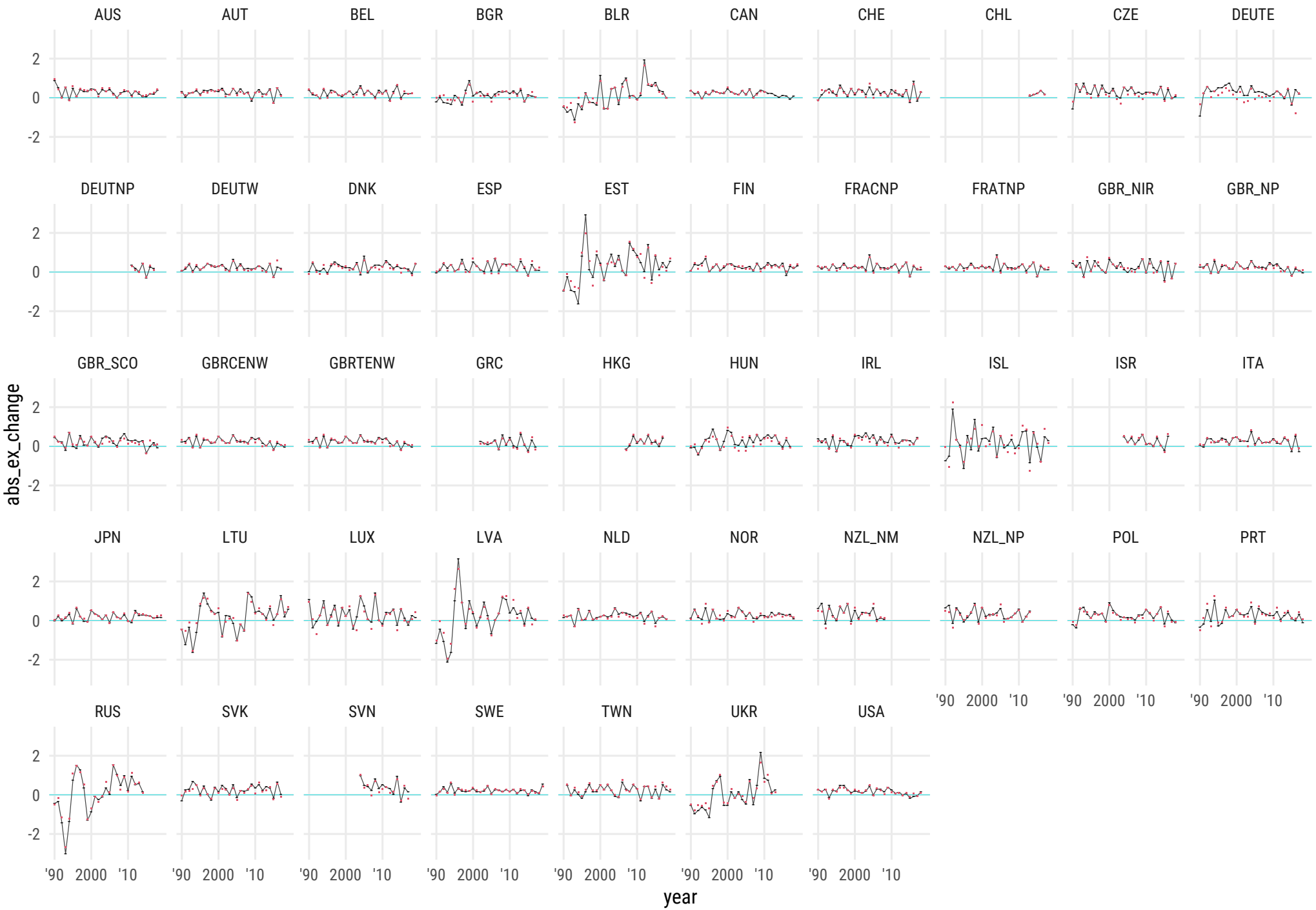
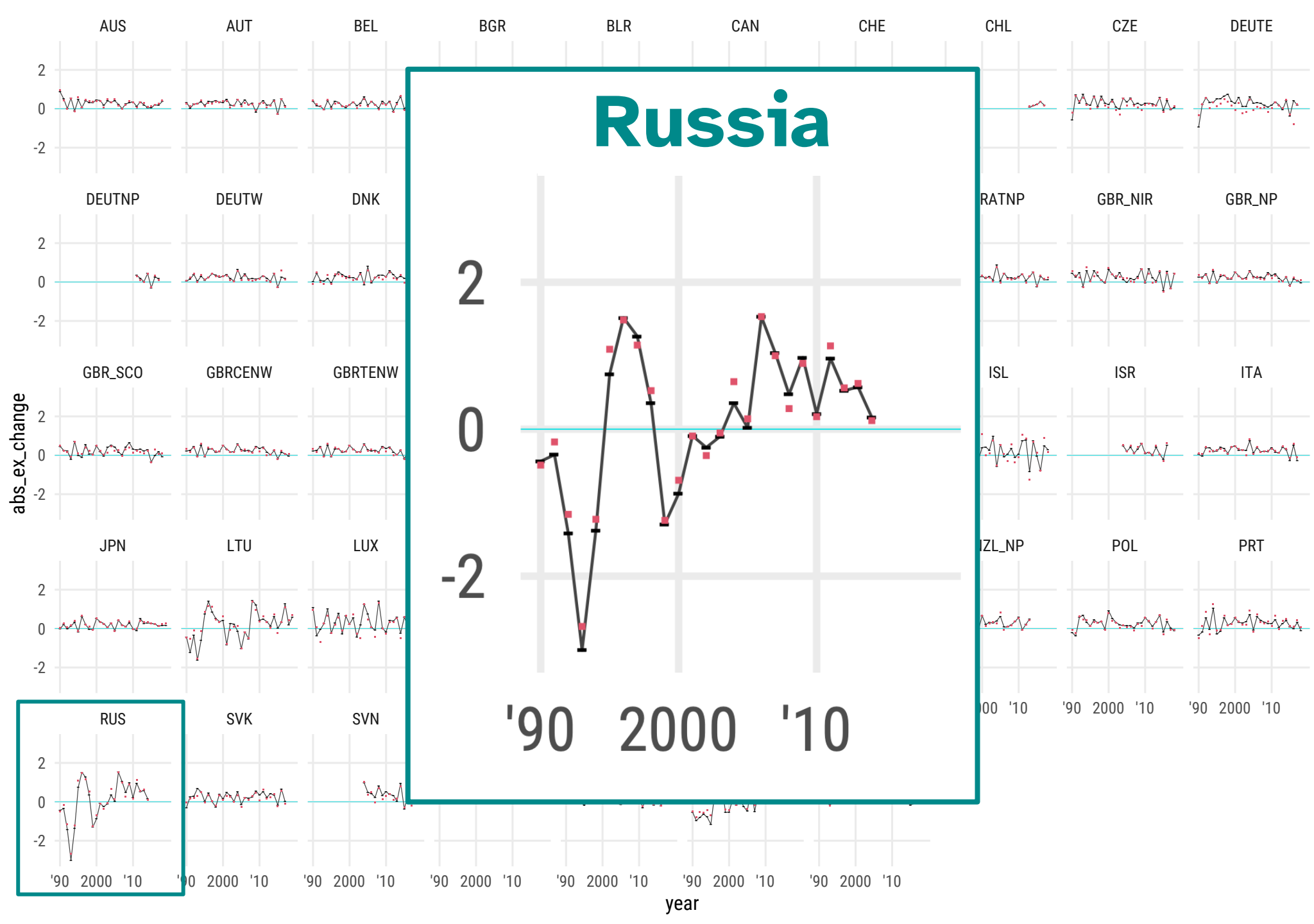
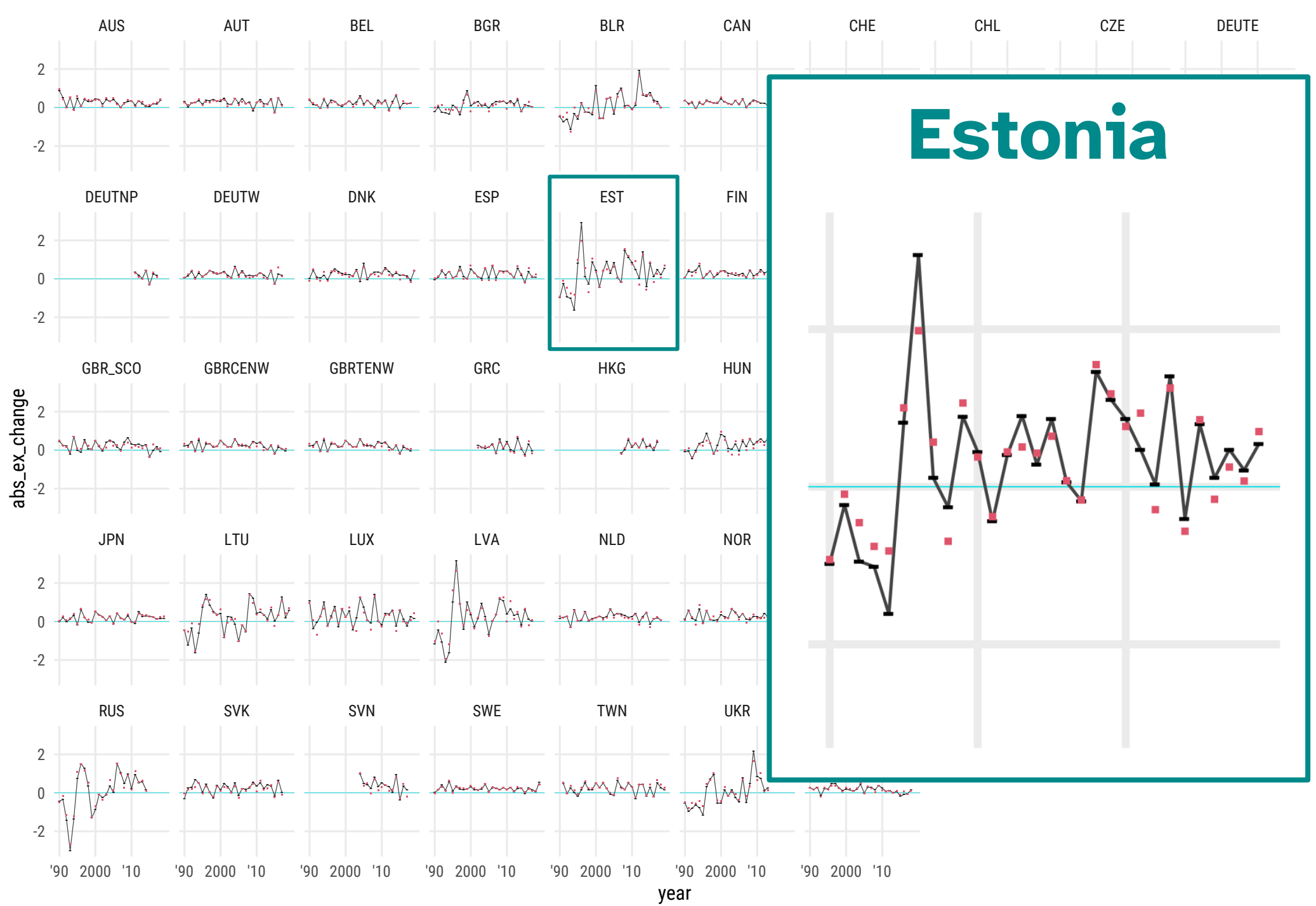


Absolute changes: observed and estimated



Absolute changes: observed and estimated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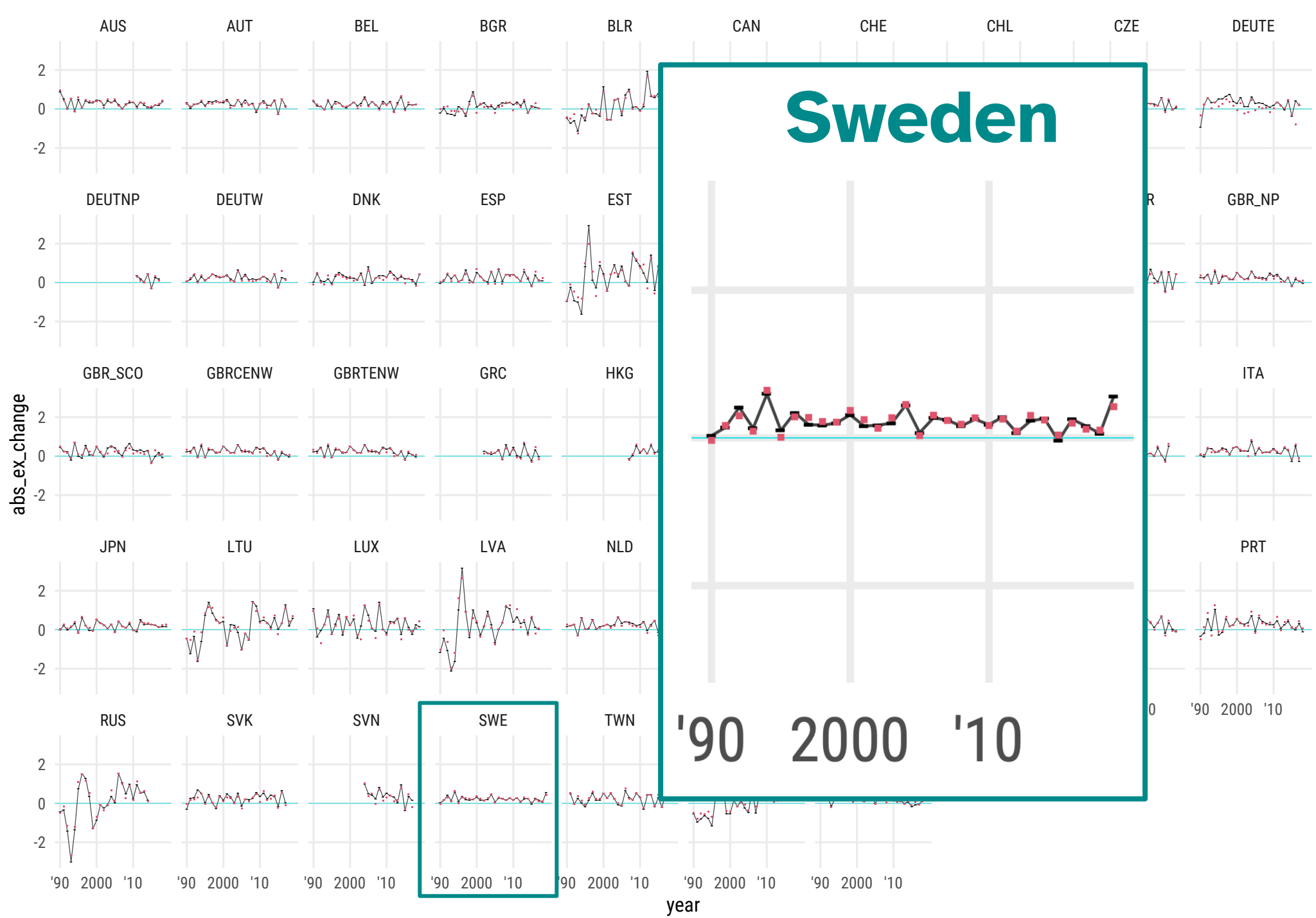
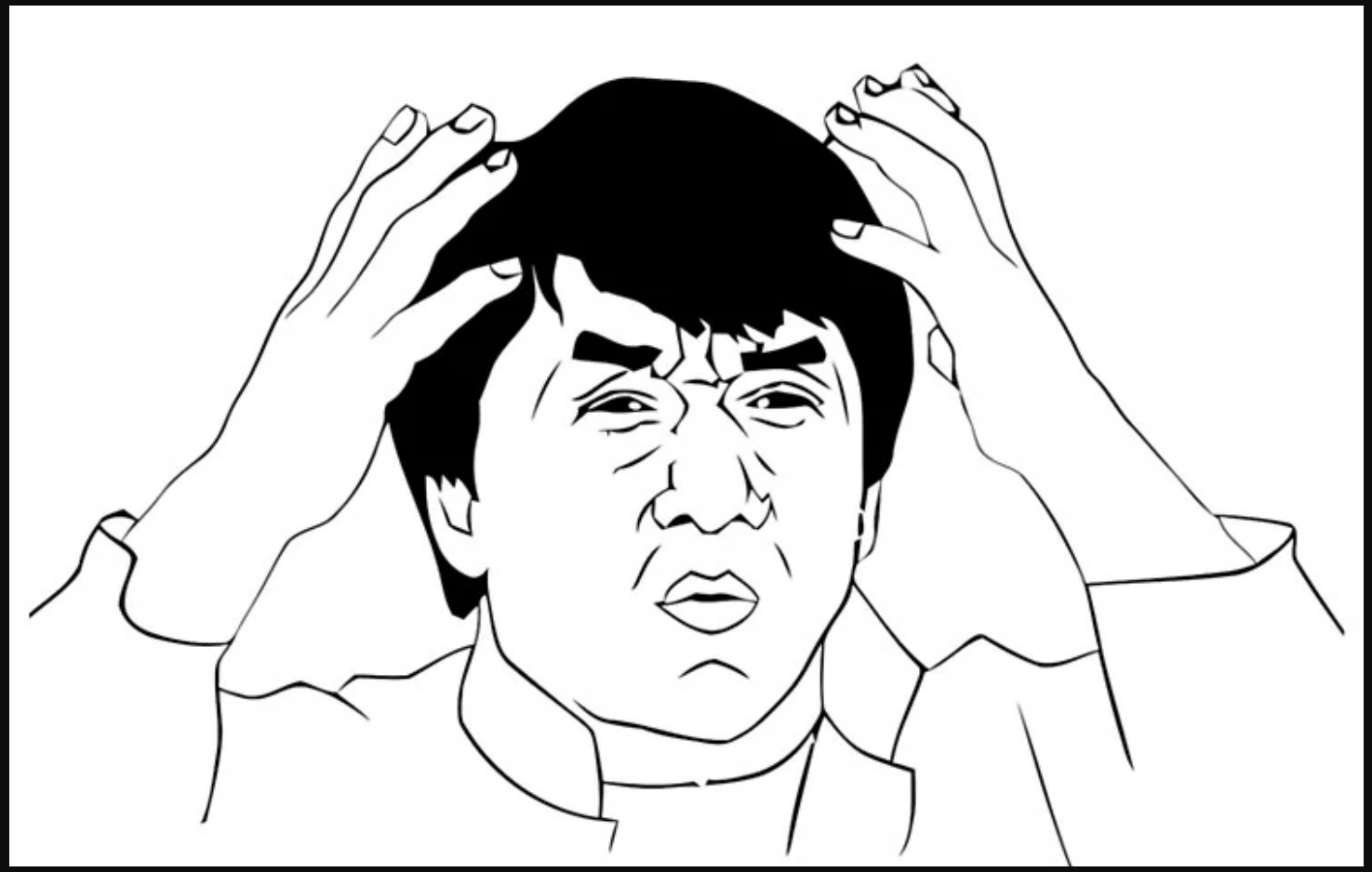
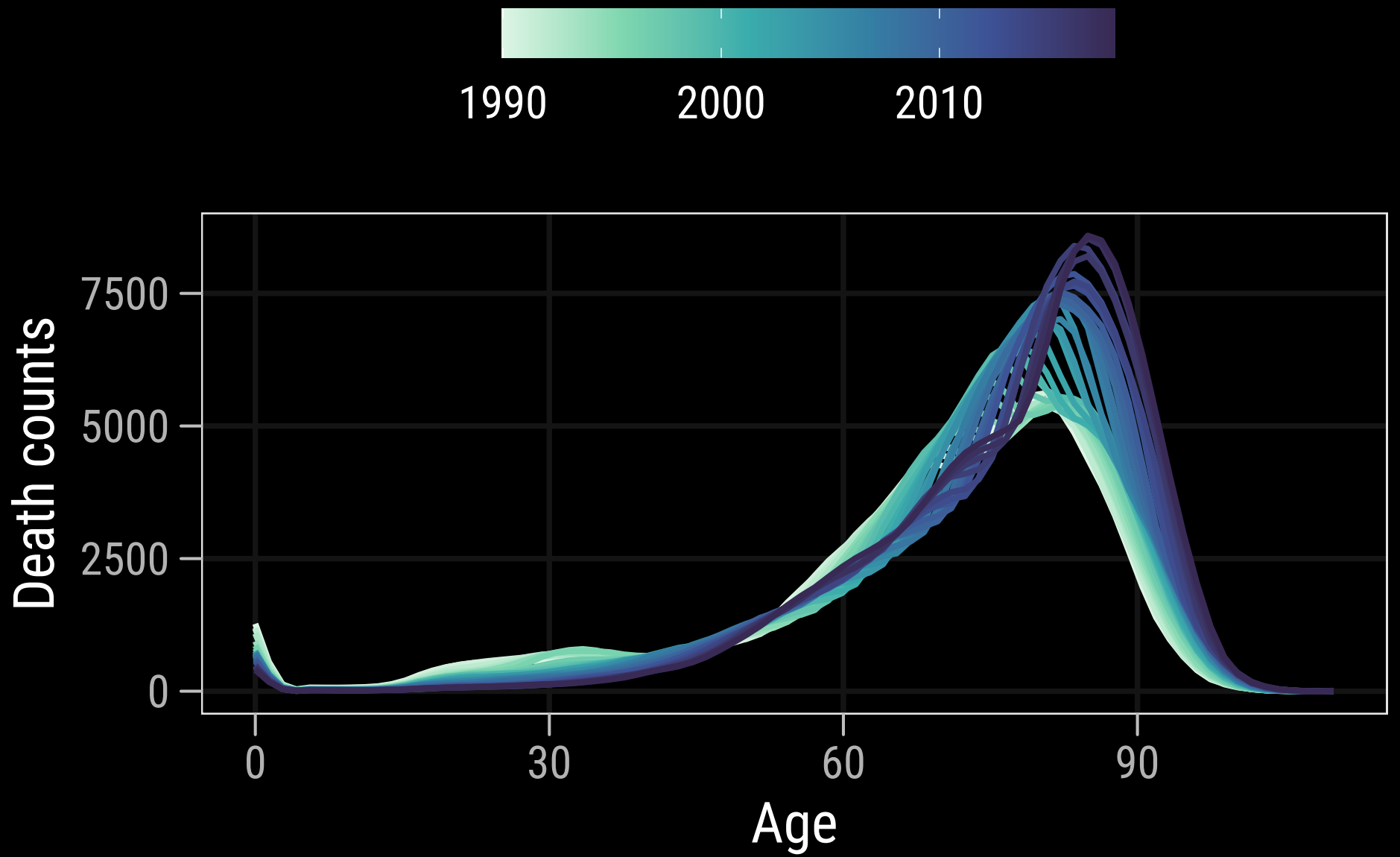


Absolute changes: observed and estimated

Why does it work?



Spain



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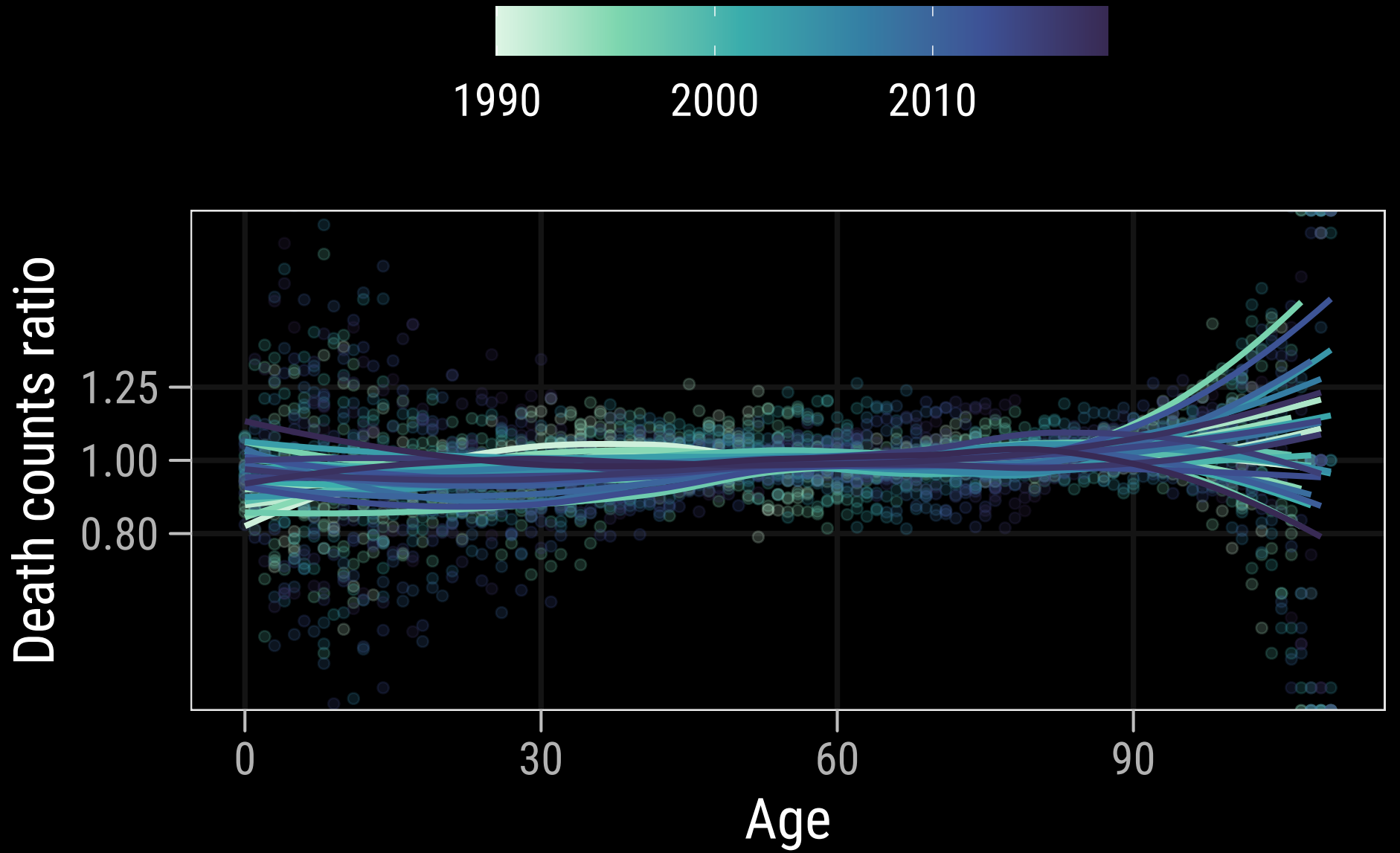

Keyfitz's H

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Demographic perspectives on the mortality of COVID-19 and other epidemics

Joshua R. Goldstein[a,1] and Ronald D. Lee[a,1,2]

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Edited by Douglas S. Massey, Princeton University, Princeton, NJ, and approved July 31, 2020 (received for review April 7, 2020)

To put estimates of COVID-19 mortality into perspective, we estimate age-specific mortality for an epidemic claiming for illustrative purposes 1 million US lives, with results approximately scalable over a broad range of deaths. We calculate the impact on period life expectancy (down 2.94 y) and remaining life years (11.7 y per death). Avoiding 1.75 million deaths or 20.5 trillion person years of life lost would be valued at $10.2 to $17.5 trillion. The age patterns of COVID-19 mortality in other countries are quite similar and increase at rates close to each country's rate for all-cause mortality. The scenario of 1 million COVID-19 deaths is similar in scale to that of the decades-long HIV/AIDS and opioid-overdose epidemics but considerably smaller than that of the Spanish flu of 1918. Unlike HIV/AIDS and opioid epidemics, the COVID-19 deaths are concentrated in a period of months rather than spread out over decades.

COVID-19 | epidemic | mortality | demography | life expectancy

August 29 (1). The prospect of subsequent waves in the fall and afterward is uncertain. Earlier projections of epidemic mortality suggested that deaths could total more than 2 million if nothing were done to slow the spread of the novel coronavirus (2). For illustrative purposes we use an intermediate scenario of 1 million deaths in 2020 due directly to COVID-19 across all waves, at times comparing it to a lower scenario of 250,000 and a higher one of 2 million. The metrics we produce scale approximately proportionately with the number of deaths, so readers can translate our results under different mortality scenarios.

The age pattern we use in this paper does not include the indirect increase in deaths as healthcare systems are overwhelmed or the long-term effect of infection on the mortality of survivors. It also does not take into account any potential lowering of mortality, for example, from decreased air pollution, traffic accidents, and consumption of alcohol resulting from the economic slowdown. These effects may be important, but the age pattern of these changes might be quite different

doi.org/10.1073/pnas.2006392117

Materials and Methods

Mathematical Models.

Keyfitz's result for life table entropy. Life expectancy at age 0 y is computed as the sum of expected person years of survival of a newborn:

$$e(0) = \int_0^\omega \ell(x)\, dx.$$

Survival $\ell(x)$ is given in terms of the hazard of death $m(a)$ as

$$\ell(x) = e^{-\int_0^x m(a)\, da}. \quad [1]$$

A population subject to a new cause of mortality that increases death rates at all ages by Δ, such that $m(x|\Delta) = m(x)(1+\Delta)$, will have life expectancy given by

$$e(0|\Delta) = \int \ell(x)^{1+\Delta}\, dx.$$

Differentiating the logarithm of life expectancy with respect to Δ,

$$\frac{d \log e(0|\Delta)}{d\Delta} = \frac{\int \log \ell(x) \ell(x)^{1+\Delta}\, dx}{\int \log \ell(x)^{1+\Delta}\, dx}.$$

At $\Delta = 0$, this simplifies to

$$\left.\frac{d \log e(0|\Delta)}{d\Delta}\right|_{\Delta=0} = \frac{\int \log \ell(x) \ell(x)\, dx}{e(0)}.$$

Keyfitz defines H as $-\int \log \ell(x)\ell(x)\, dx / e(0)$. Some further manipulation gives us the form for H in terms of remaining life expectancy:

$$H = \frac{\int d(x) e(x)\, dx}{e(0)}. \quad [2]$$

Vaupel, J. W. (1986). How Change in Age-specific Mortality Affects Life Expectancy. *Population Studies*, *40*(1), 147–157. https://doi.org/10.1080/0032472031000141896

McCann 1976

doi.org/10.2307/2060805

DEMOGRAPHY© Volume 13, Number 2 May 1976

A TECHNIQUE FOR ESTIMATING LIFE EXPECTANCY WITH CRUDE VITAL RATES

James C. McCann
Center for Studies in Demography and Ecology, University of Washington, Seattle, Washington 98195

Abstract—This paper describes a method of estimating life expectancy at birth on the basis of crude vital rates. The method is derived from stable population theory and it furnishes good estimates insofar as the current crude vital rates of a population are close to its intrinsic rates. This condition is generally met in closed populations which have not experienced sharp movements in fertility. The method is useful for estimating life expectancy in developing nations with good sample registration systems but for which information on age is of poor quality. It is also useful for estimating the movement of life expectancy in certain European nations in the period prior to regular census taking. There are a number of nations and regions in Europe for which long series of birth and death rates are available but for which census age counts are widely spaced.

THE RELATIONSHIP BETWEEN CRUDE RATES AND LIFE EXPECTANCY IN STABLE POPULATIONS

In this section it is shown that in stable populations, life expectancy at birth, e_0, is closely approximated by the relation,

$$e_0 \cong e'_0 + rR, \qquad (1)$$

where

$$e'_0 = \frac{1}{r}(\ln b - \ln d) \qquad (2)$$

and where b, d, and r are, respectively, the crude rates of birth, death, and natural increase. The term e'_0 is a first order approximation to e_0 and it approaches e_0 as r approaches zero; R is a correction factor which depends strongly on e'_0, which, in turn, depends only on b and d.

Thank you!

Ilya Kashnitsky

ikashnitsky@sdu.dk

@ikashnitsky

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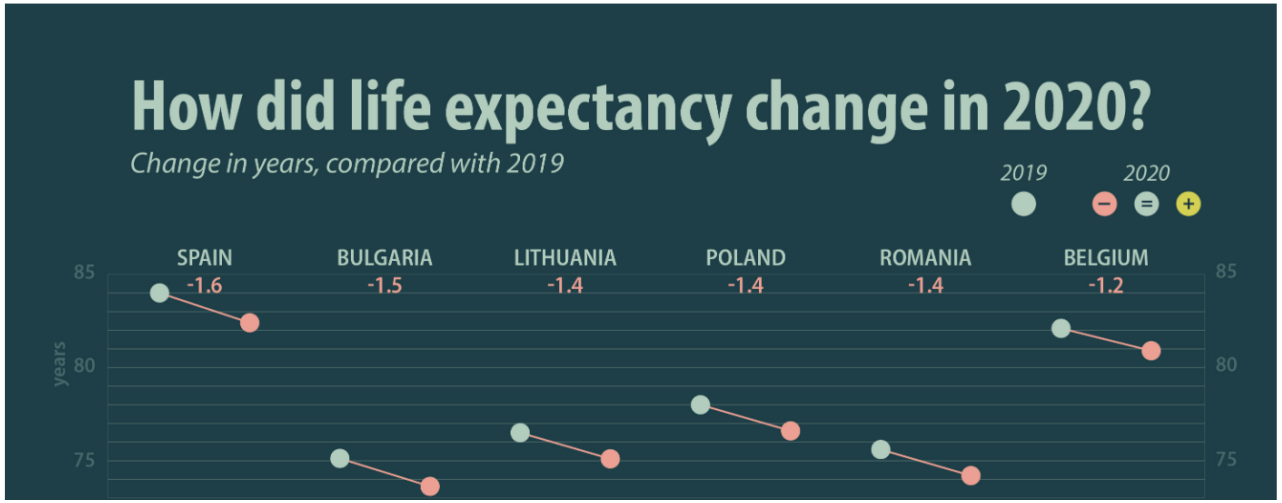
Life expectancy decreased in 2020 across the EU

07/04/2021

Life expectancy at birth has been increasing over the past decade in the EU: official statistics reveal that life expectancy has risen, on average, by more than two years per decade since the 1960s. However, the latest available data suggest that life expectancy stagnated or even declined in recent years in several EU Member States.

Moreover, following the outbreak of the COVID-19 pandemic last year, life expectancy at birth fell in the vast majority of the EU Member States with available 2020 data. The largest decreases were recorded in Spain (-1.6 years compared with 2019) and Bulgaria (-1.5), followed by Lithuania, Poland and Romania (all -1.4).

This information comes from recently published provisional estimates on life expectancy in 2020.



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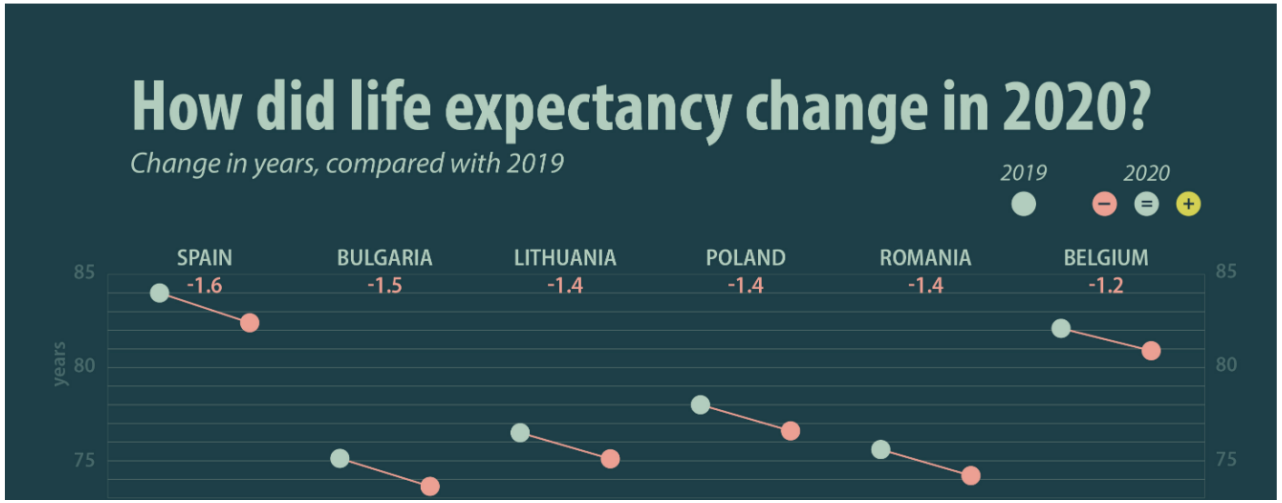

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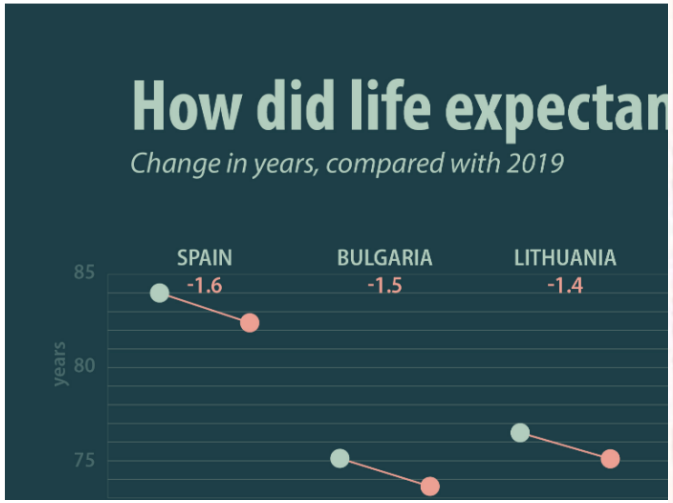

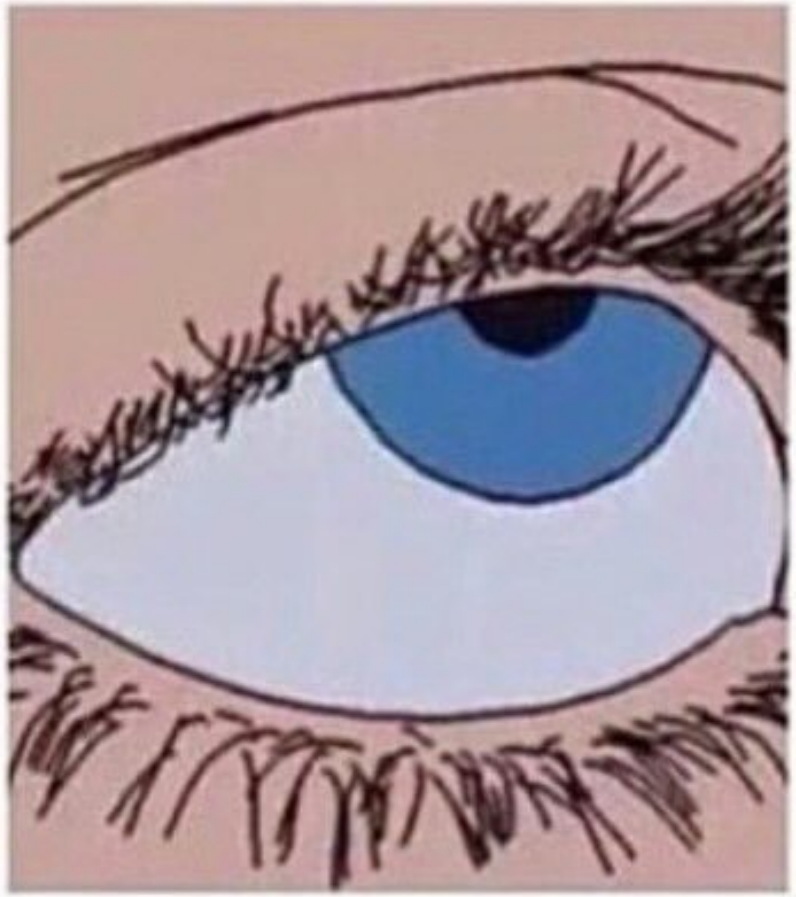

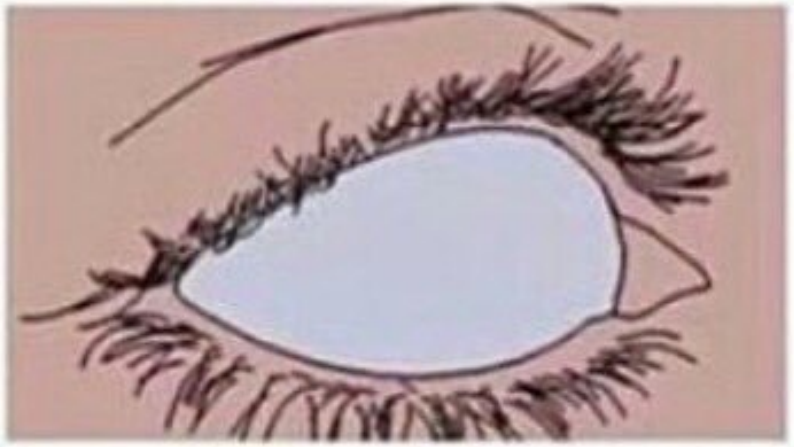

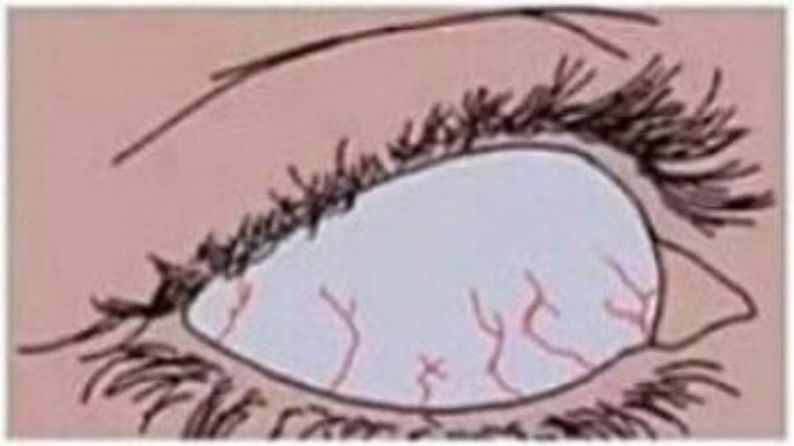

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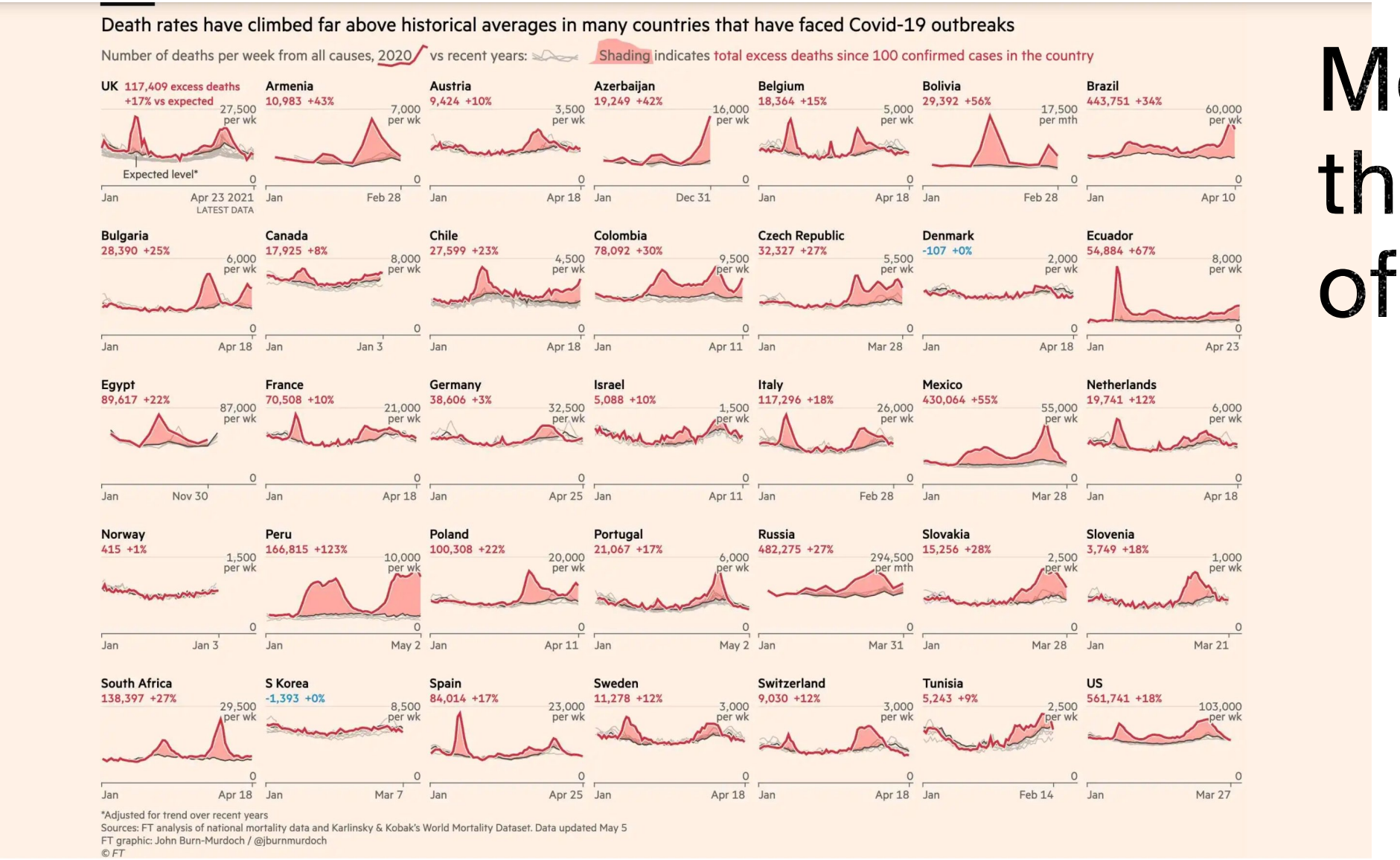
Measuring the impact of c19



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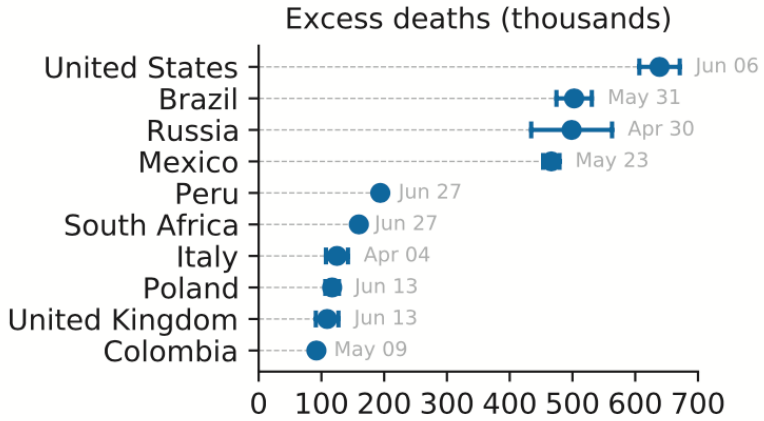
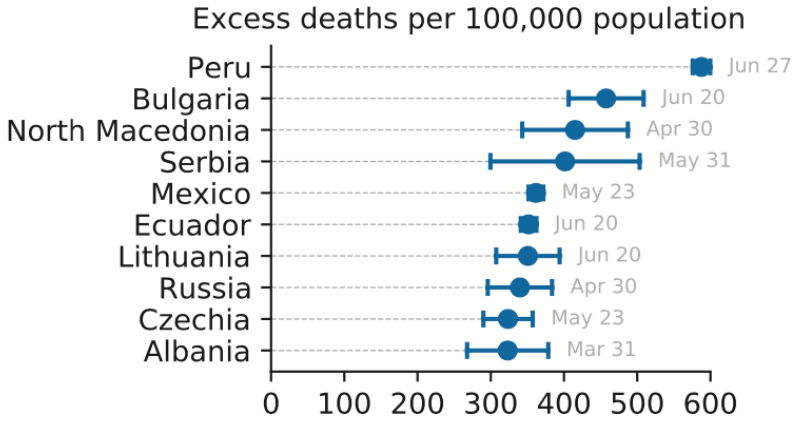
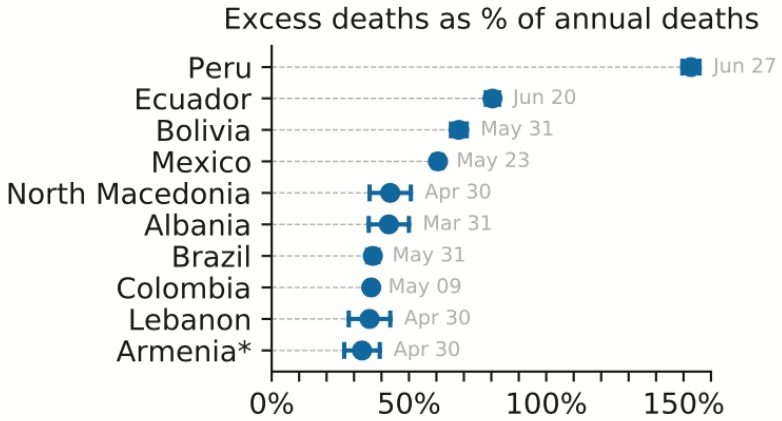
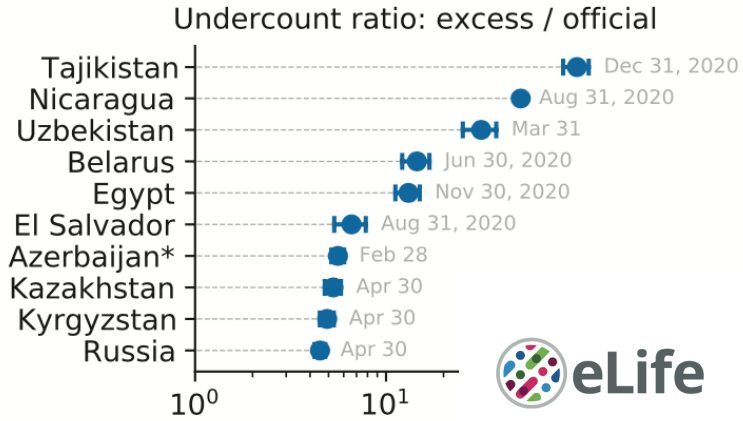








Measuring the impact of c19

eLife

TOOLS AND RESOURCES

Tracking excess mortality across countries during the COVID-19 pandemic with the World Mortality Dataset

Ariel Karlinsky[1]*, Dmitry Kobak[2]*

[1]Hebrew University, Jerusalem, Israel; [2]Institute for Ophthalmic Research, University of Tübingen, Tübingen, Germany

doi.org/10.7554/eLife.69336

Graphic detail

Covid-19 data

The pandemic's true death toll

excess deaths around the world

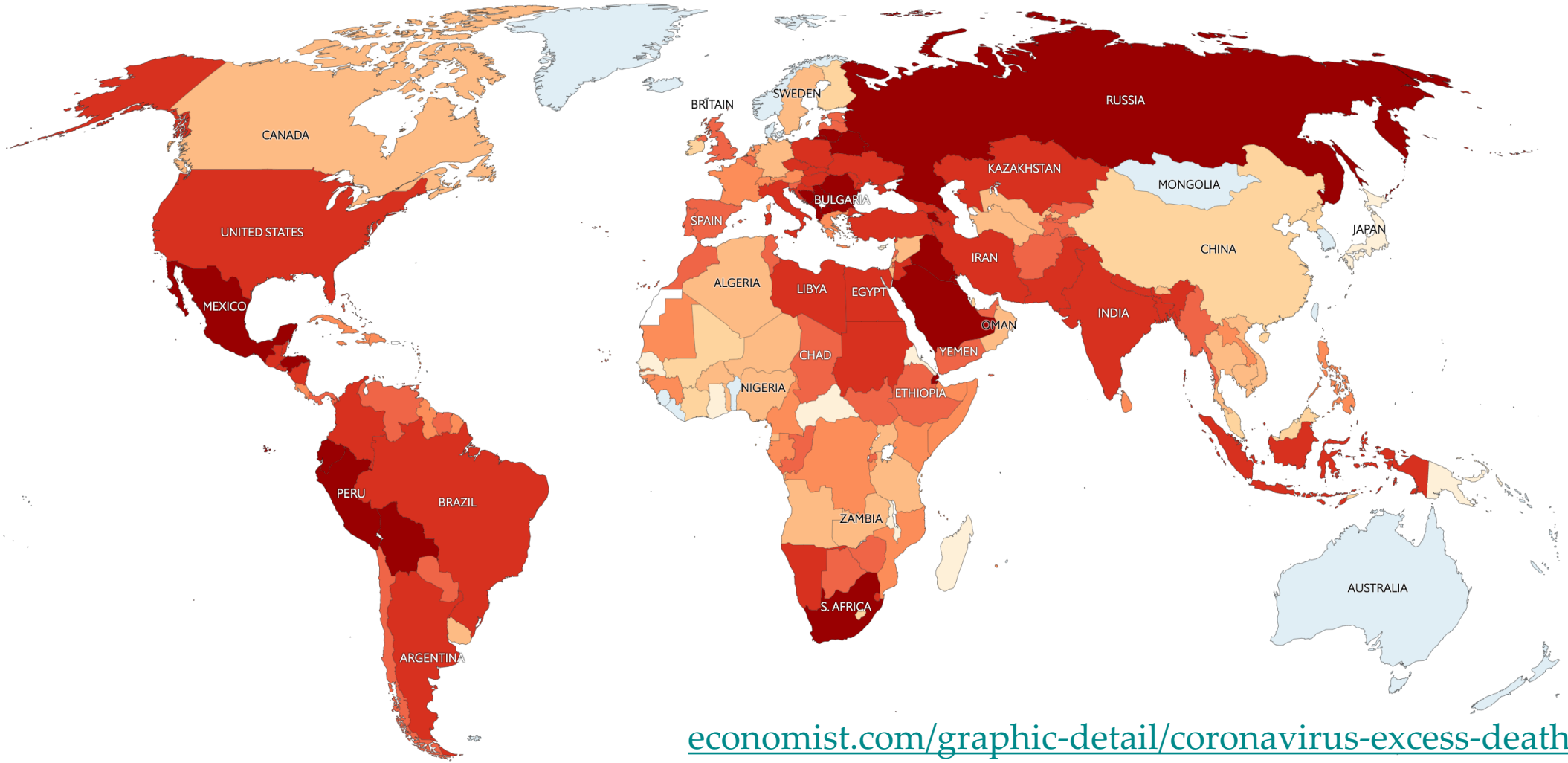
Estimated global excess deaths
With 95% confidence interval

9.6m | 15.5m | 18.2m
2.1x | 3.3x official deaths | 3.9x

Official global covid-19 deaths 4.7m

Excess deaths per 100,000 people
Central estimate, Jan 2020-present

0 25 50 100 150 250 350 No data



economist.com/graphic-detail/coronavirus-excess-deaths-estimates

Demographers:

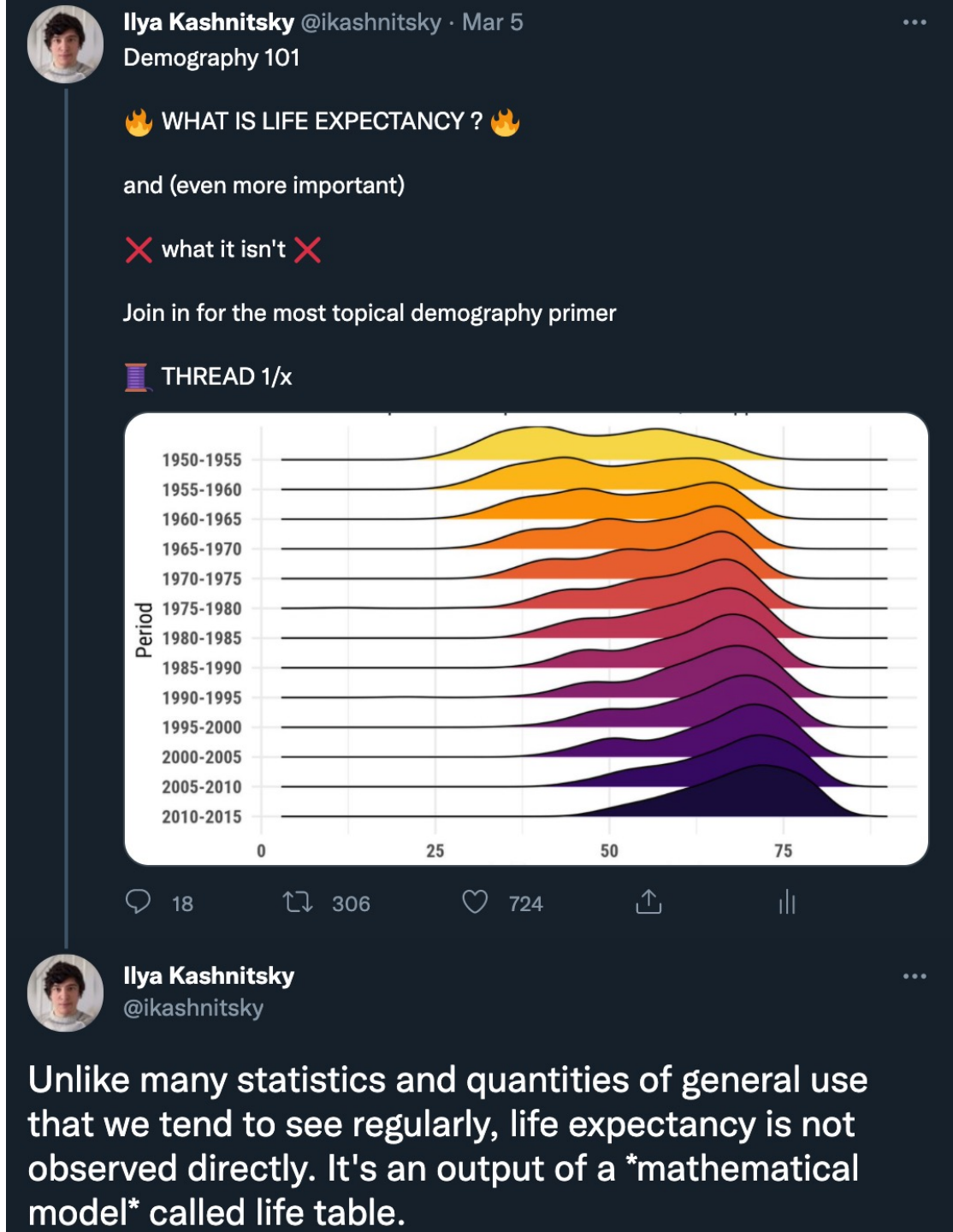
Life expectancy is the **ultimate** measure of **current** mortality

World:

Life expectancy is the ultimate measure of current mortality

- Free from population age structure effect
- No need to choose standard
- Widely used

https://twitter.com/ikashnitsky/status/1367856010476613632



Life expectancy is the ultimate measure of current mortality

- Free from population age structure effect
- No need to choose standard
- Widely used and misunderstood

Gerontology

Of General Interest / Viewpoint

Gerontology 2020;66:95–104
DOI: 10.1159/000500955

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Accepted after revision: May 14, 2019
Published online: August 7, 2019

Life Expectancy: Frequently Used, but Hardly Understood

Marc Luy[a, b] Paola Di Giulio[a, b] Vanessa Di Lego[a, b] Patrick Lazarevič[a, b] Markus Sauerberg[a, b]

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Keywords
Life expectancy · Cohort effects · Heterogeneity · Harvesting effect · Tempo effects

Abstract
Period life expectancy is one of the most used summary indicators for the overall health of a population. Its levels and trends direct health policies, and researchers try to identify the determining risk factors to assess and forecast future developments. The use of period life expectancy is often based on the assumption that it directly reflects the mortality conditions of a certain year. Accordingly, the explanation for changes in life expectancy are typically sought in factors that have an immediate impact on current mortality conditions. It is frequently overlooked, however, that this indicator can also be affected by at least three kinds of effects, in particular in the situation of short-term fluctuations: cohort effects, heterogeneity effects, and tempo effects. We demonstrate their possible impact with the example of the almost Europe-wide decrease in life expectancy in 2015, which caused a series of reports about an upsurge of a health crisis, and we show that the consideration of these effects can lead to different conclusions. Therefore, we want to raise an awareness concerning the sensitivity of life expectancy to sudden changes and the menaces a misled interpretation of this indicator can cause.

Introduction

Period life expectancy (PLE) is one of the most used summary indicators for the overall health of a population. It is based on the set of observed age-specific death rates, i.e., the number of deaths in a certain year and age group divided by the average number of people alive in this year and age group. These death rates are then transformed into probabilities of dying and connected to a survival function from birth to the highest age in which people are living. The mean age at death derived from this survival function is the PLE. It can be interpreted as the average number of years that newborns of a certain period would live under the hypothetical scenario that the prevailing age-specific death rates remain constant in the future [1].

The period perspective must be strictly distinguished from the cohort perspective. The latter is the more intuitive and more clearly interpretable analytic concept. It connects the age-specific death rates experienced by a cohort longitudinally over its entire life course. Thus, cohort life expectancy (CLE) reflects the actual mean age at death of real people who were born at the same time. Naturally, CLE can only summarize past mortality experiences, whereas PLE reflects the most current death rates cross-sectionally across all ages. This is why PLE is of higher relevance for most practical purposes and more frequently used than CLE.

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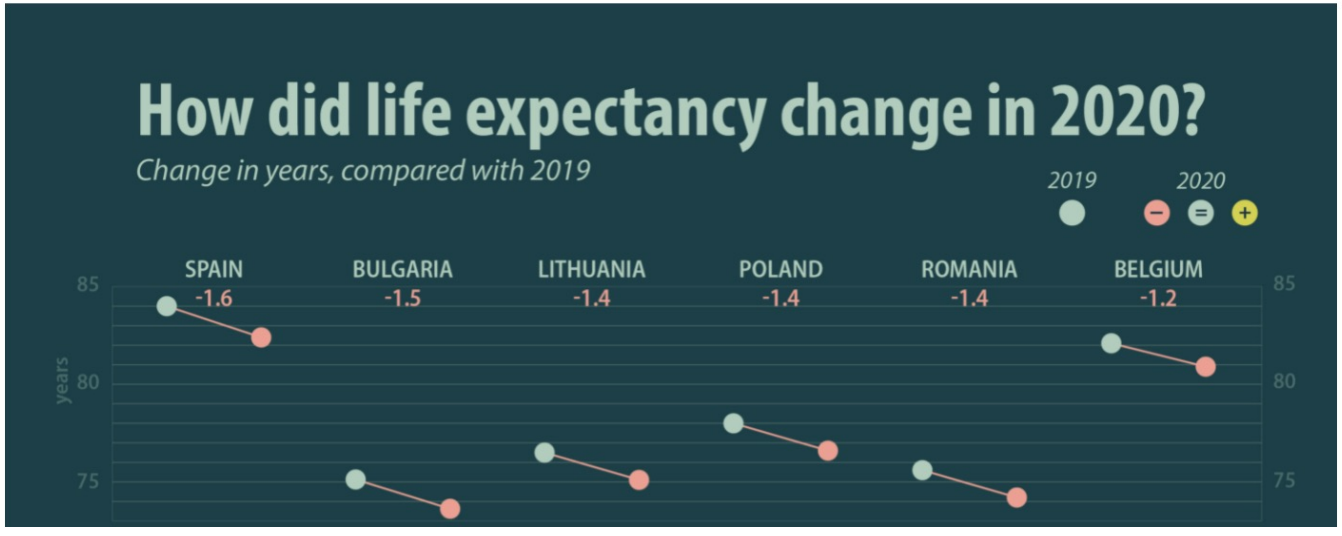

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Tracking excess mortality across countries during the COVID-19 pandemic with the World Mortality Dataset

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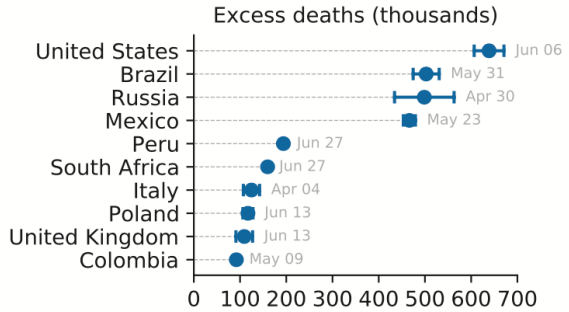

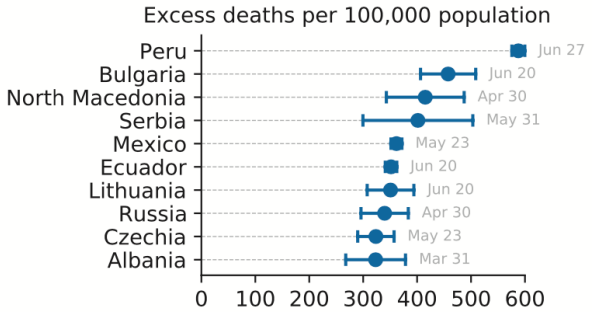

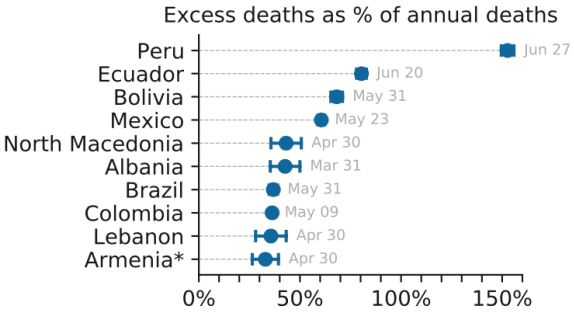

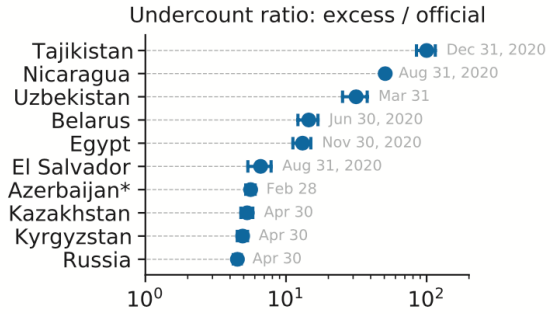

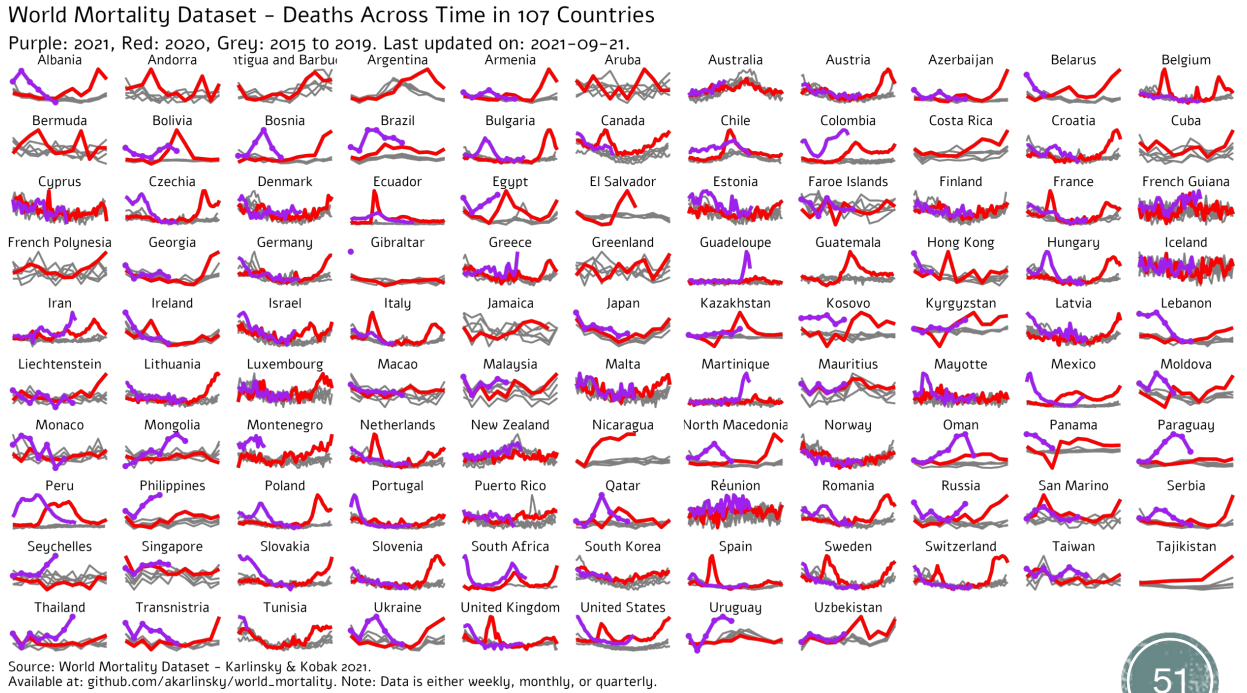

Source: World Mortality Dataset - Karlinsky & Kobak 2021.
Available at: github.com/akarlinsky/world_mortality. Note: Data is either weekly, monthly, or quarterly.

RadioFreeEurope RadioLiberty

A Russian Demographer Questioned Government COVID-19 Numbers. He Was Fired Earlier This Month.

July 13, 2020 16:24 GMT

By Mark Krutov Timur Olevsky

Rusian demographer Aleksei Raksha (file photo)

Initial idea

Alexey Raksha