Session IX. Special topics

World Population Prospects: Current projection approach

10 March 2016

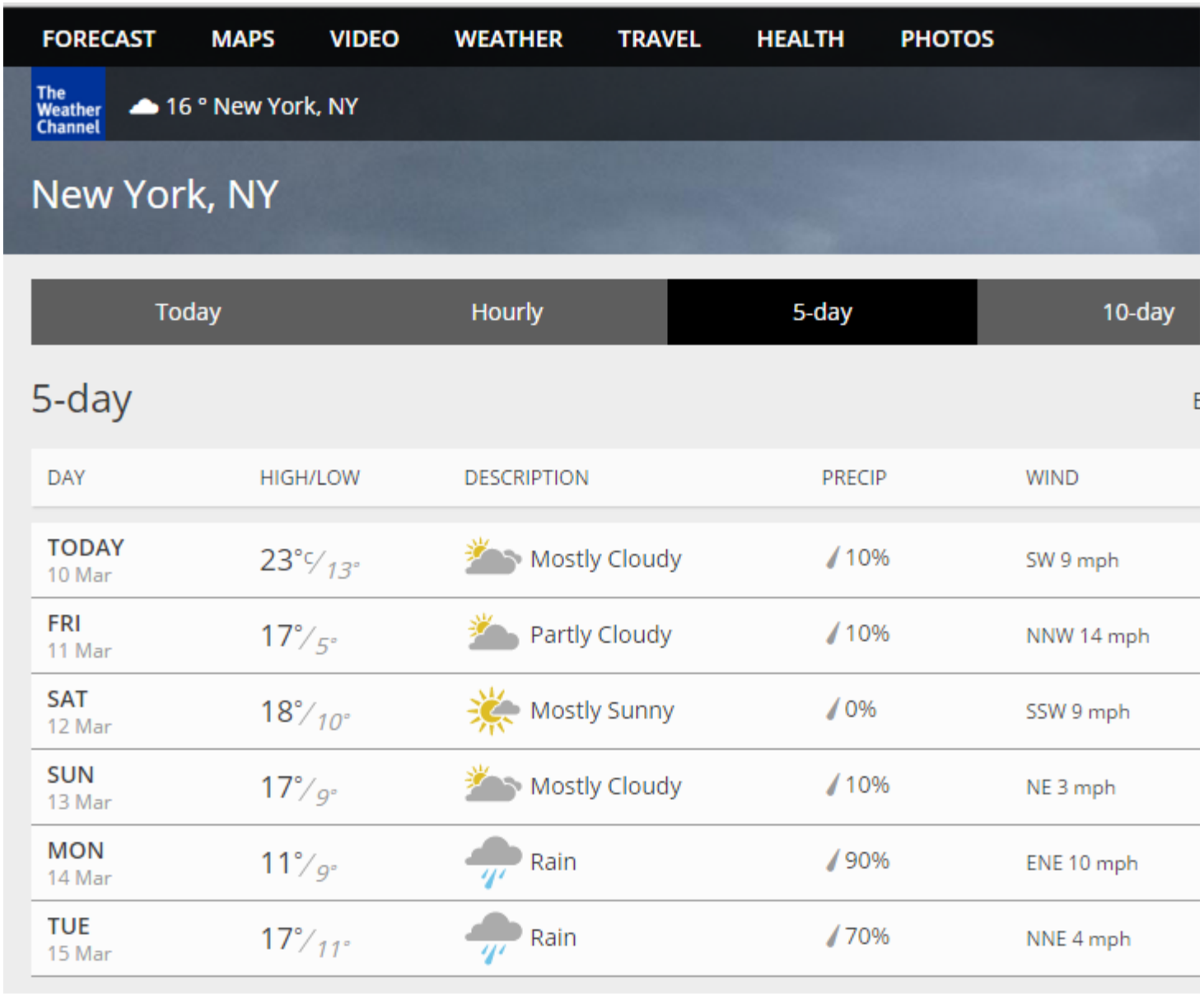
Cheryl Sawyer, Lina Bassarsky
Population Estimates and Projections Section

www.unpopulation.org

UN projection methods

- Calculations using a cohort-component approach
- Assumptions about future trends of fertility and mortality are:
  - Derived primarily from past trends for a given country
  - Also informed by theories of demographic change and the historical experience of other countries
- Alternative future trends have traditionally been described using variants and scenarios
- NEW: Alternative future trends are now also depicted using a probabilistic model

Probabilistic forecasting



FORECAST MAPS VIDEO WEATHER TRAVEL HEALTH PHOTOS

The Weather Channel 16 ° New York, NY

New York, NY

Today Hourly 5-day 10-day

5-day

DAY	HIGH/LOW	DESCRIPTION	PRECIP	WIND
TODAY 10 Mar	23°C/13°	Mostly Cloudy	10%	SW 9 mph
FRI 11 Mar	17°/5°	Partly Cloudy	10%	NNW 14 mph
SAT 12 Mar	18°/10°	Mostly Sunny	0%	SSW 9 mph
SUN 13 Mar	17°/9°	Mostly Cloudy	10%	NE 3 mph
MON 14 Mar	11°/9°	Rain	90%	ENE 10 mph
TUE 15 Mar	17°/11°	Rain	70%	NNE 4 mph

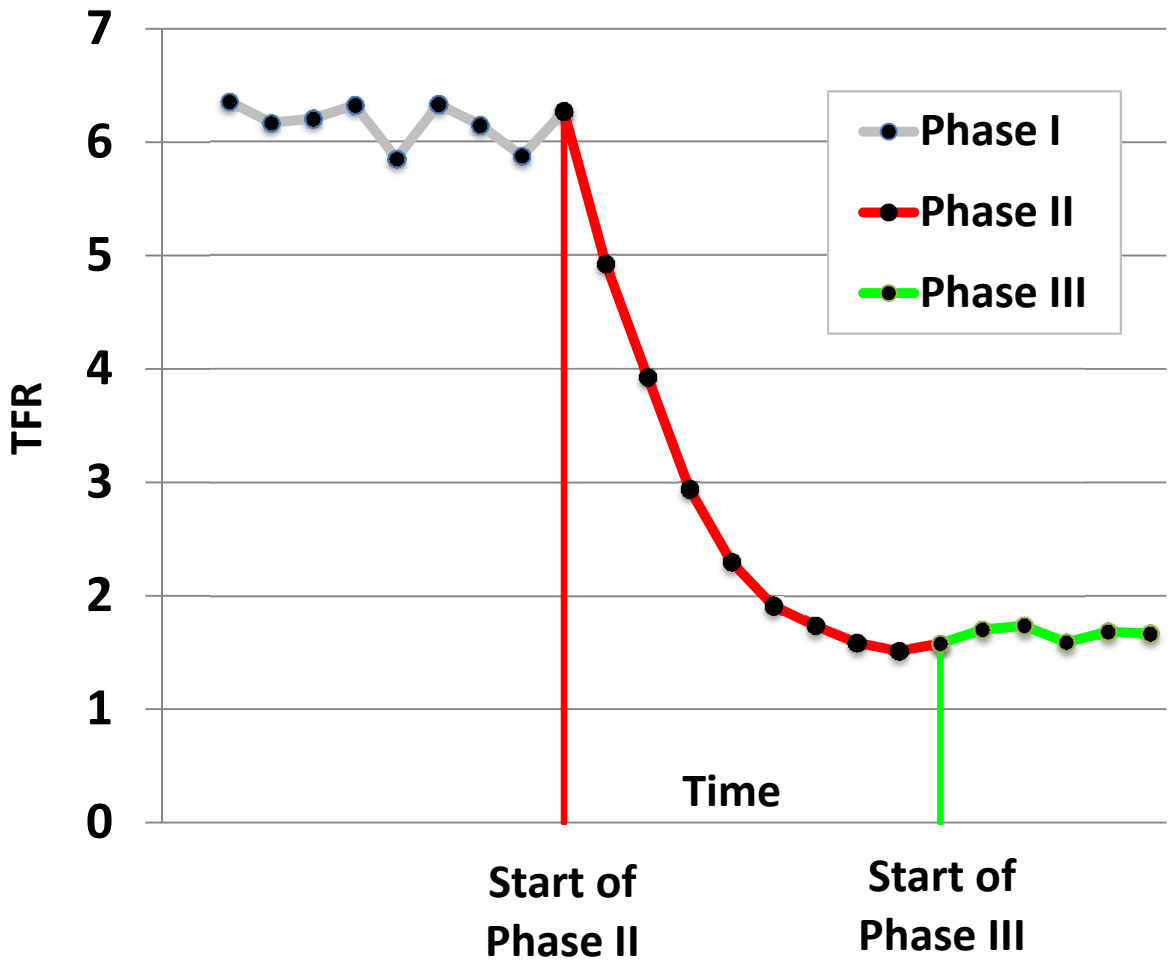
Using historical experience

- UN projections of fertility and mortality are guided by historical trends in those same variables
- Regularities in historical trends have led to theories of demographic change, which give structure to the projection model
- The model is calibrated for each country using an estimation procedure that combines the country's data with that of other countries:
  - Giving most weight to data from that country, if such data are plentiful
  - Giving more weight to data from other countries, if no or little data are available

Theory → Model structure

- Theories of the demographic transition share certain common points about the historical decline of fertility and mortality, which are reflected in the structure of the UN's projection model
- For fertility, there is a transition from high to low values of the TFR (below 2.0), typically followed by fluctuations and a modest recovery
- For mortality, the increase of life expectancy at birth follows an S-curve (slow-rapid-slow change), which remains positive and roughly linear in the final phase

Three phases of TFR trend: Pre-decline, decline, post-decline

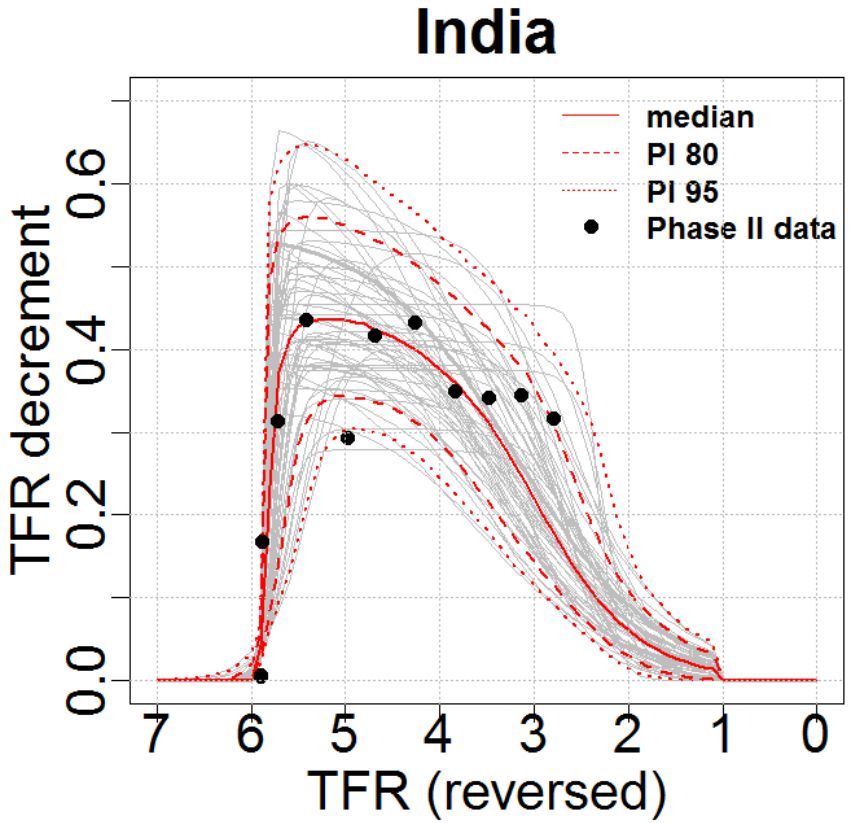


Fertility decline model: Phase II

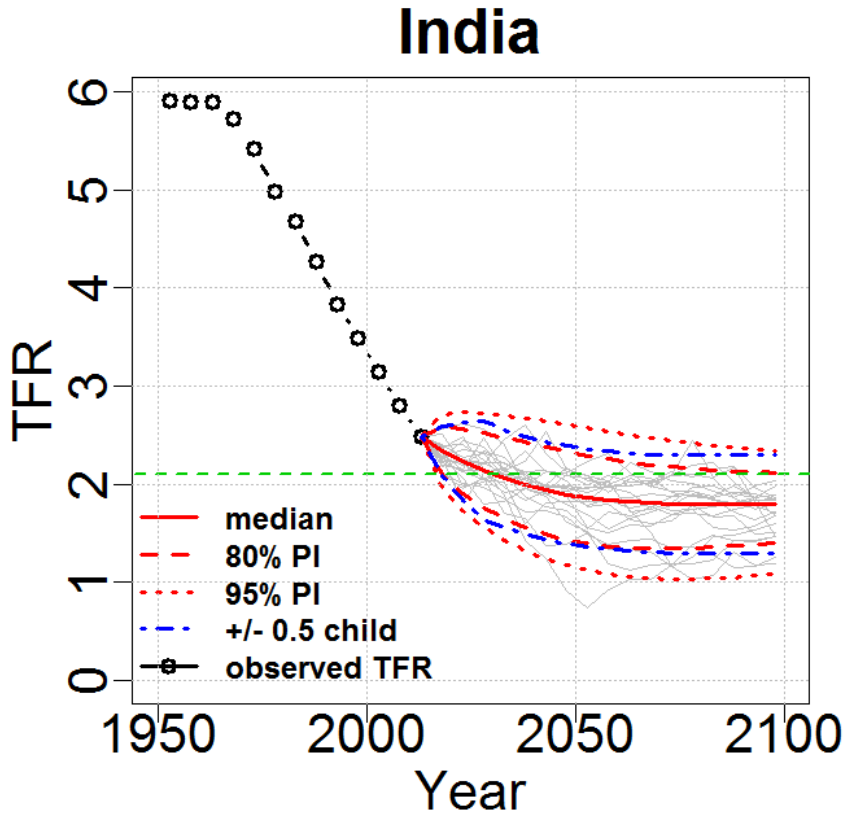
- Rate of TFR decline depends on level of TFR
  - Peak rate of decline around TFR=5
  - Slower decline for TFR > 5 or TFR < 5
- Rate of decline in the TFR, as a function of its current level, is modeled using a double-logistic function, which has an inverted U-shape
- Bayesian hierarchical model used to estimate model for the world and for each country
- In addition, standard time series methods are used to project future trends

Fertility projection for India

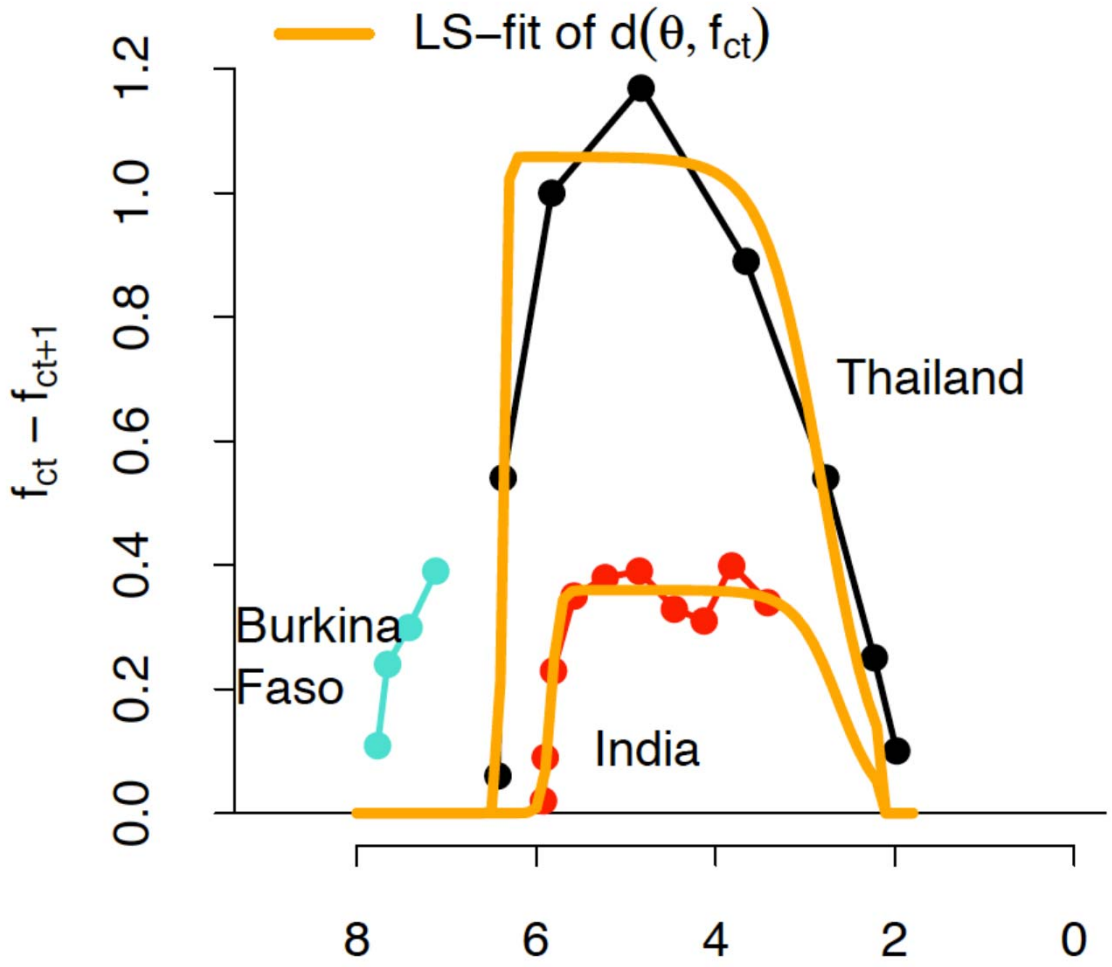
TFR decline function



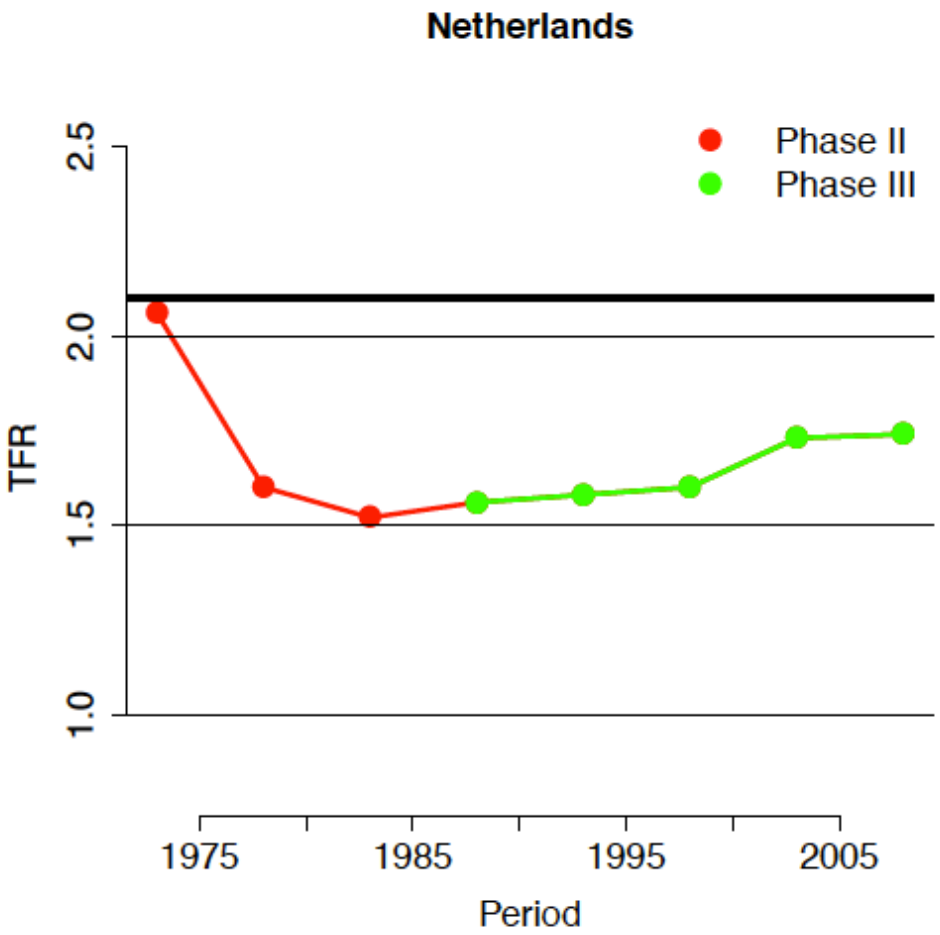
Probabilistic TFR projections



Country-specific estimates of double-logistic TFR decline function



Post-transition low-fertility rebound: Phase III



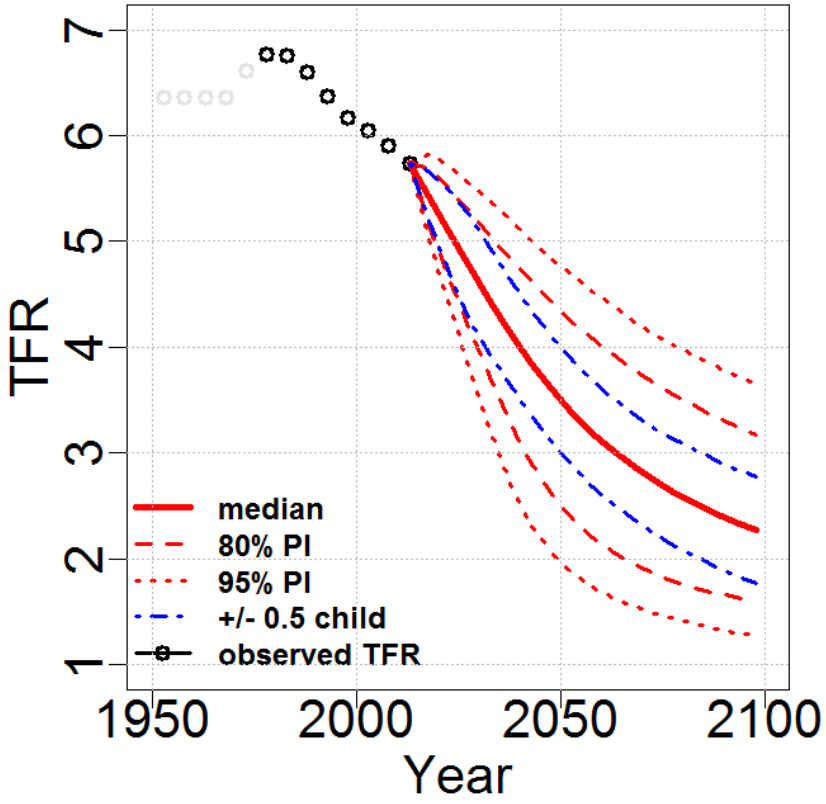
- Start of Phase III defined by two earliest consecutive 5-year increases when TFR < 2
- Has been observed in 38 countries or areas: 29 in Europe, 7 in Asia (China, Hong Kong, Macao, Japan, Republic of Korea, Singapore, Viet Nam) plus USA and Barbados

Future trends are uncertain

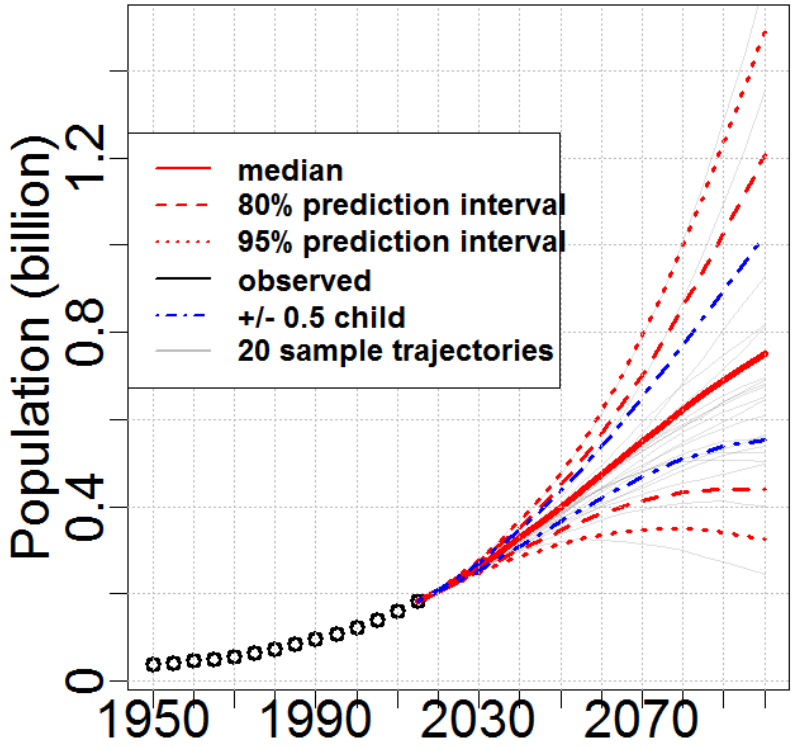
- Traditionally, UN projections have included several variants or scenarios:
  - Variants describe future trends produced by varying key assumptions (e.g. fertility), illustrating sensitivity of results
  - Scenarios describe hypothetical future trajectories, illustrating core concepts such as population momentum
- Bayesian hierarchical model of past trends, combined with time series model of future trends, yields probabilistic depiction of plausible future outcomes

Nigeria

Total fertility rate

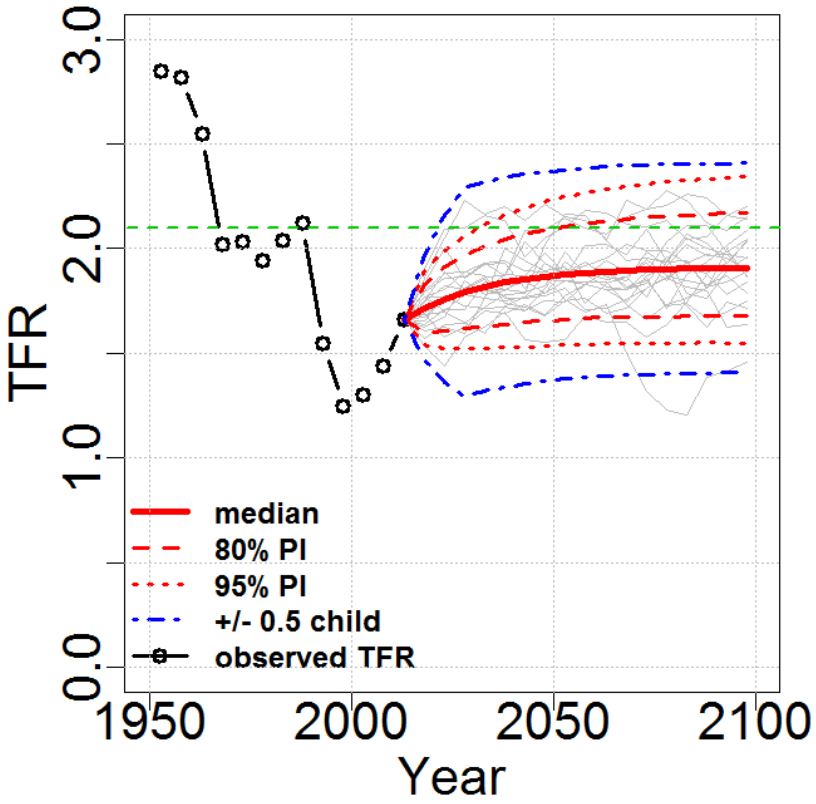


Total population

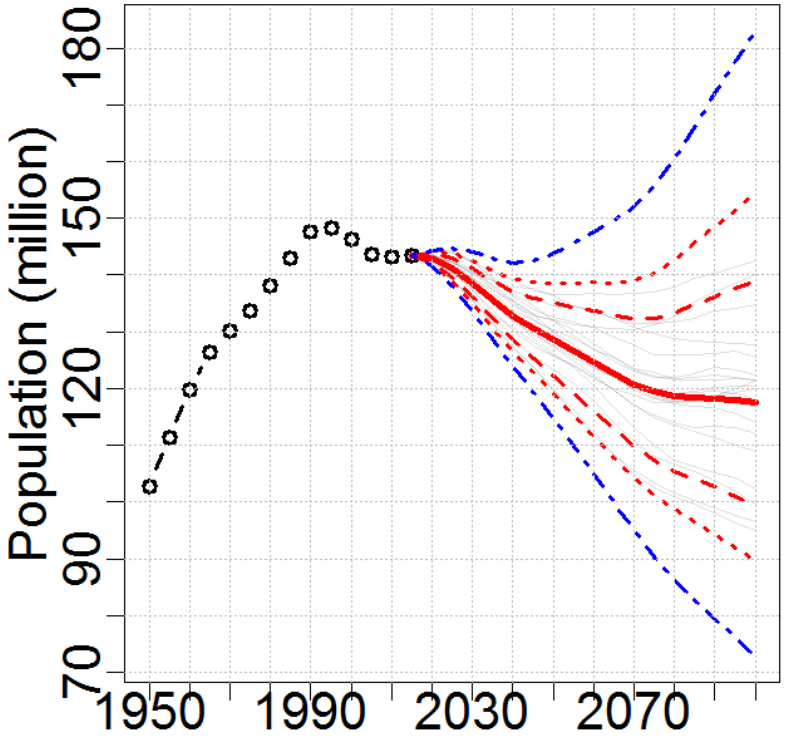


Russian Federation

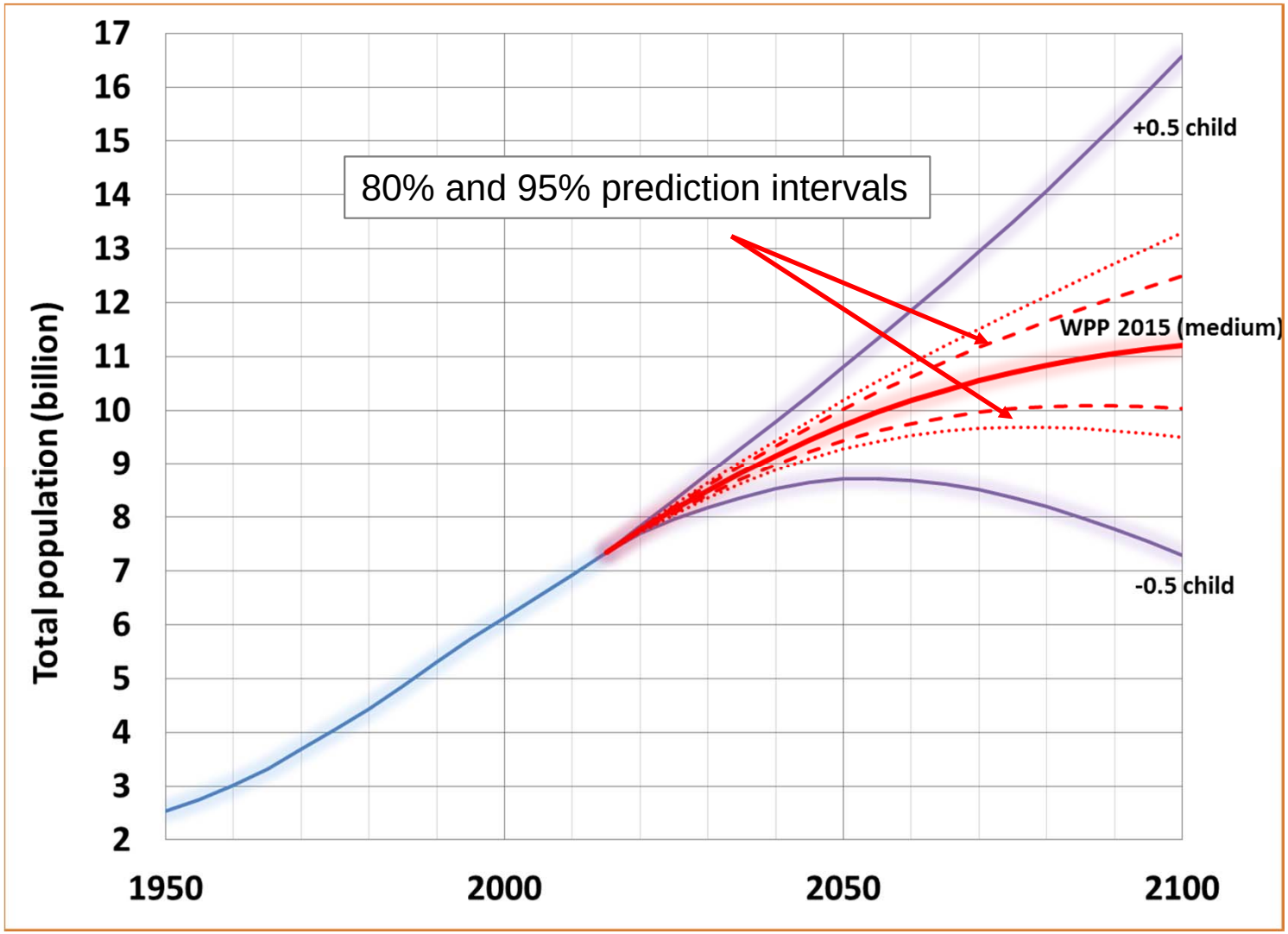
Total fertility rate



Total population



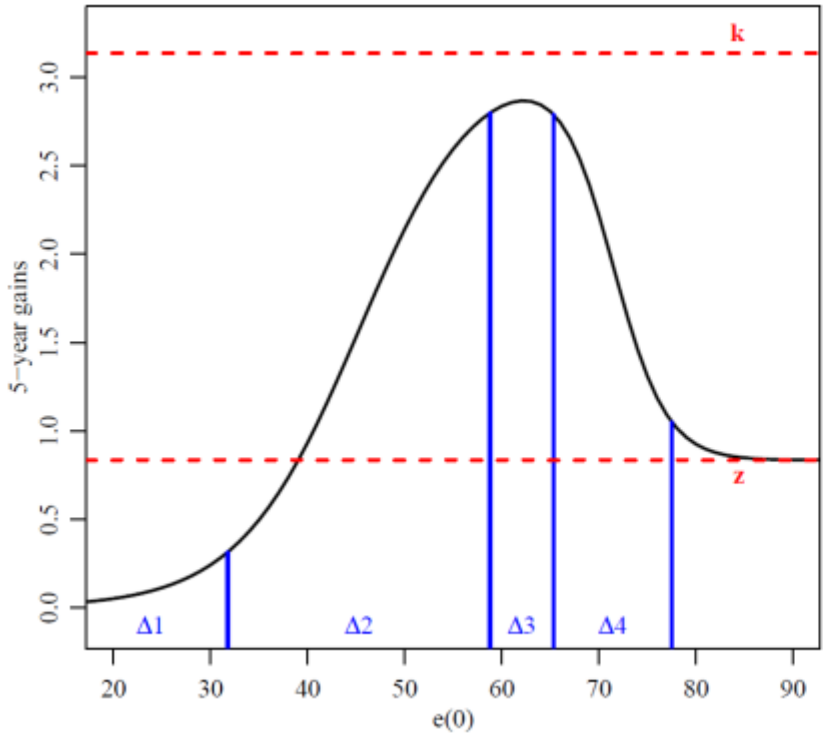
World population projections

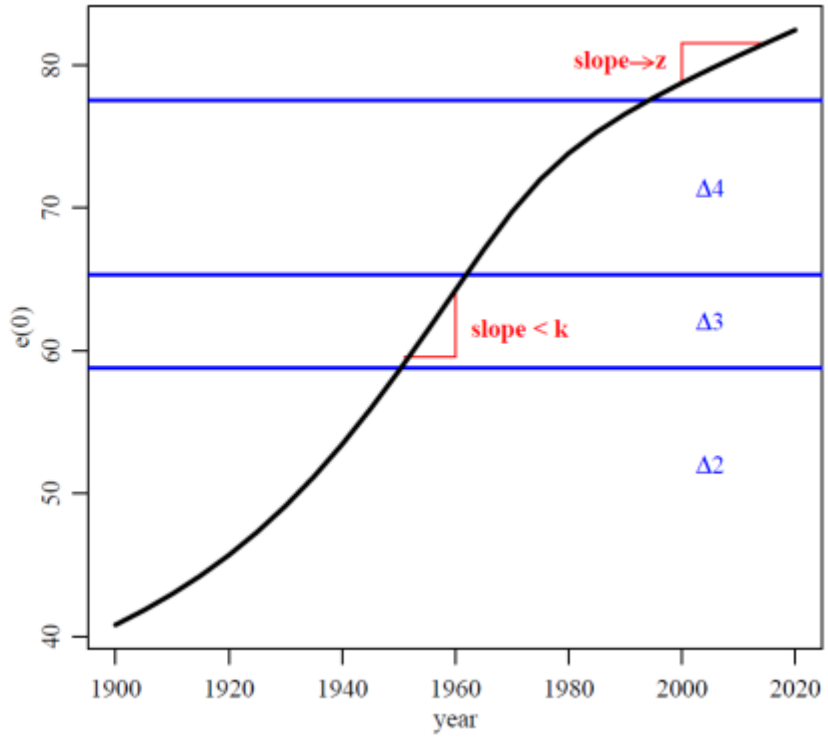


What have we learned from the new approach?

- UN fertility variants (+/- half child):
  - Overstate the “uncertainty” of future trends at the global level, and also for some low-fertility countries (TFR < 2)
  - Understate the “uncertainty” of future trends for high-fertility countries (TFR > 3)

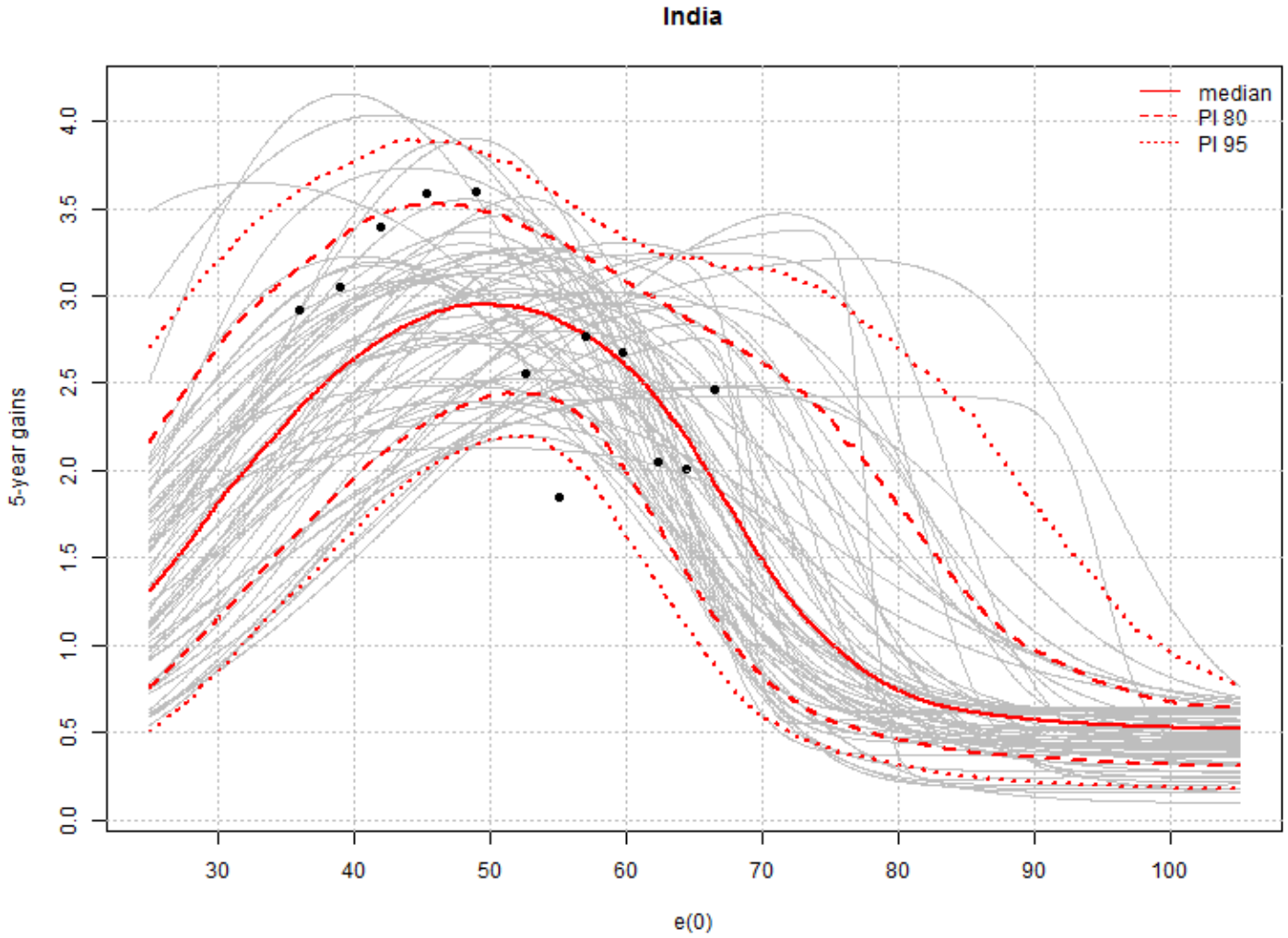
Model of historical trend in life expectancy at birth





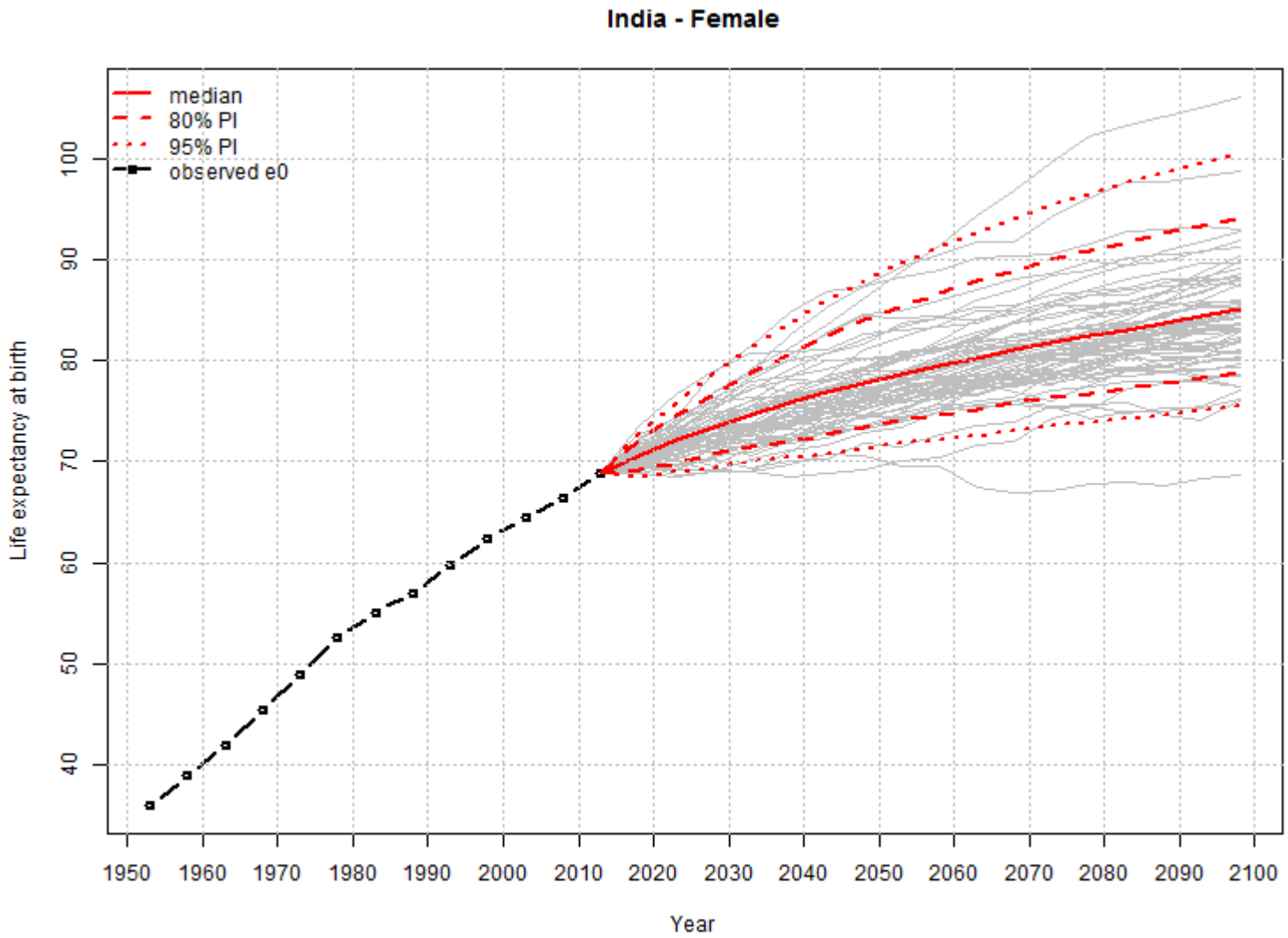
Fitting the model to female life expectancy

Life expectancy increase function



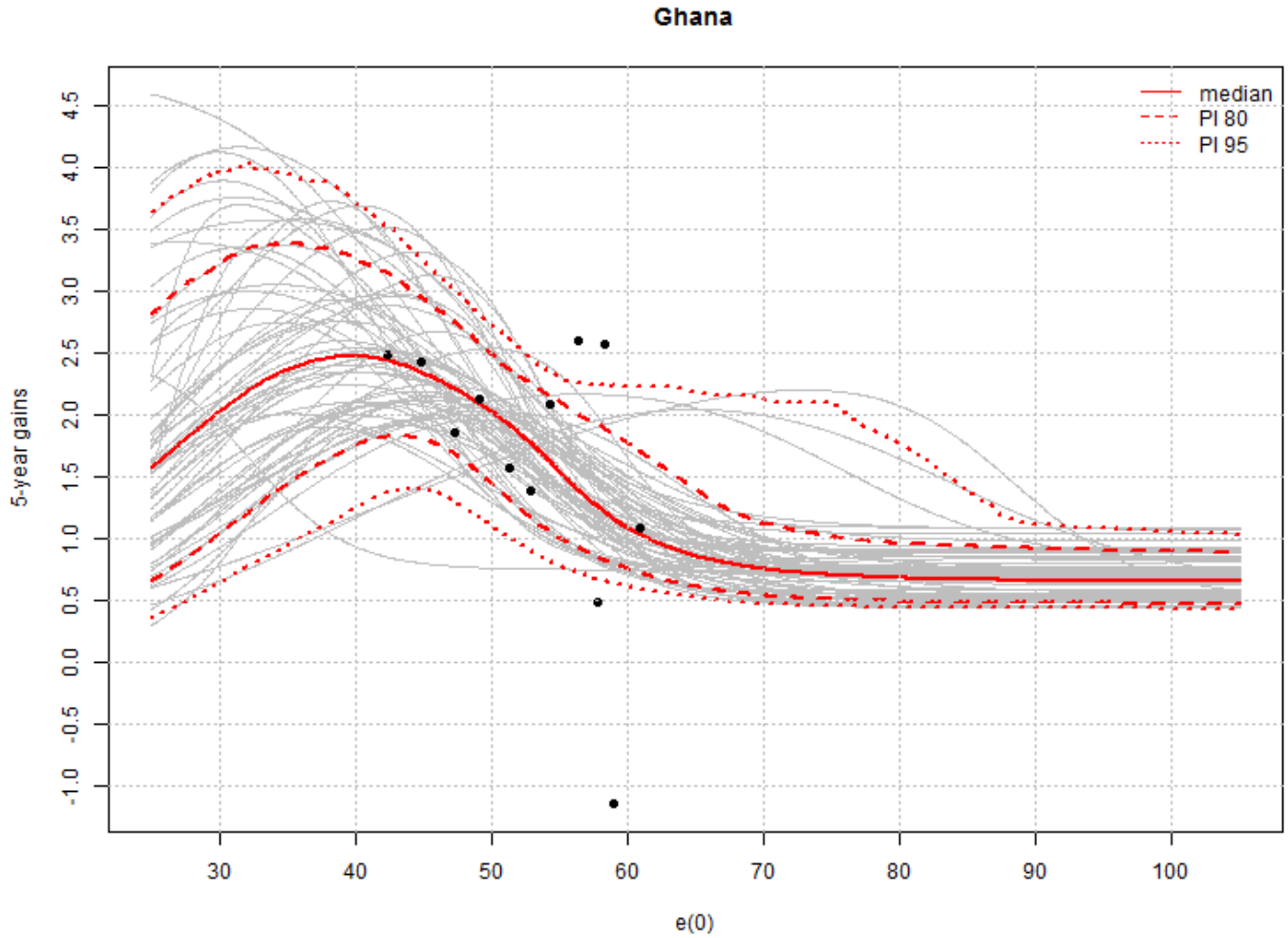
Fitting the model to female life expectancy

Probabilistic projection of life expectancy



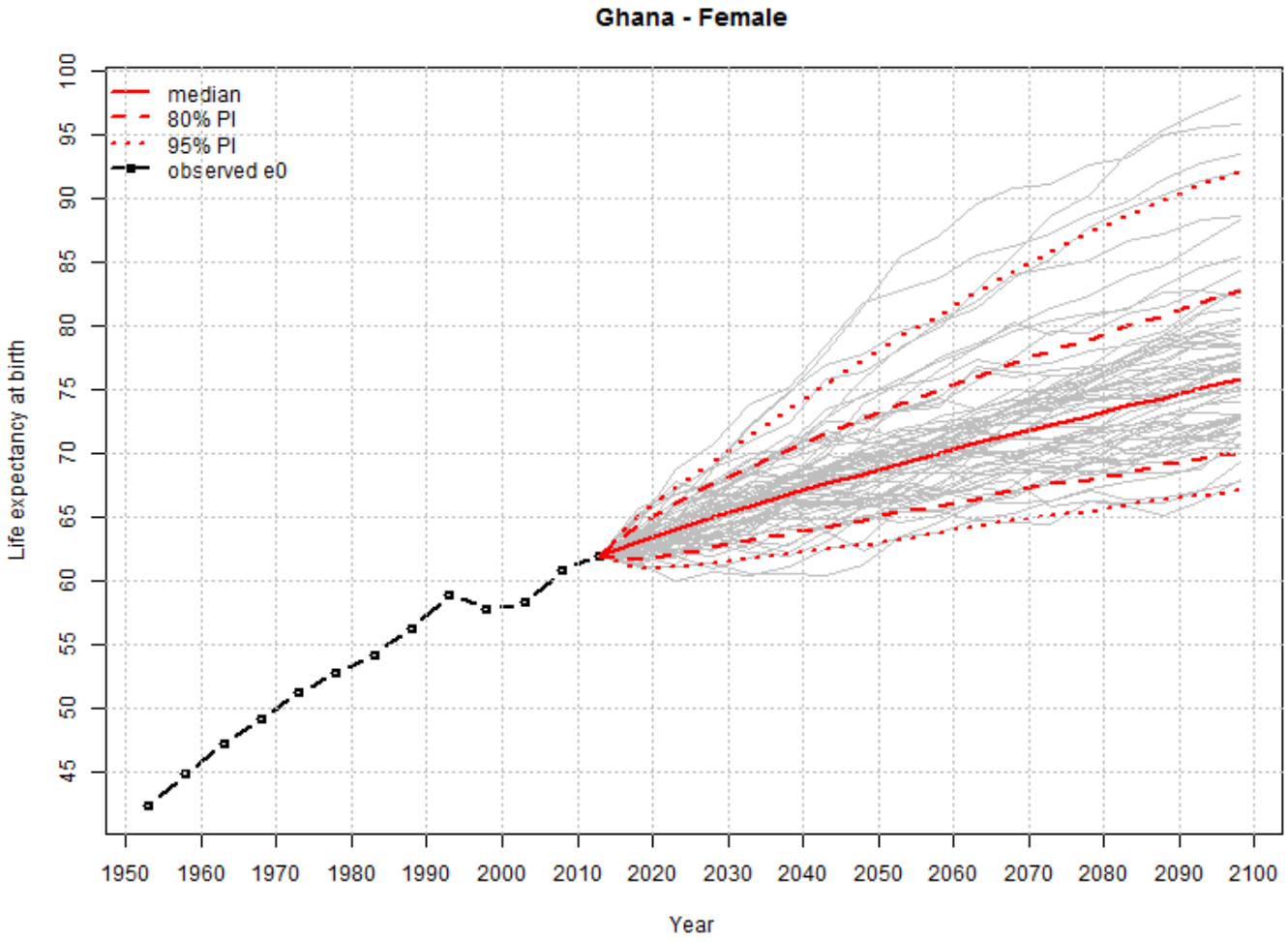
Fitting the model to female life expectancy

Life expectancy increase function



Fitting the model to female life expectancy

Probabilistic projection of life expectancy



Some caveats on the life expectancy model

- Not used for median projection of e0 in countries where HIV is modelled explicitly
- Projected increase too fast or slow in certain countries.

Thank you

Questions?

>> until 11 March:

>> After 11 March: sawyerc@un.org
bassarsky@un.org