Projecting NTAs

Tim Miller

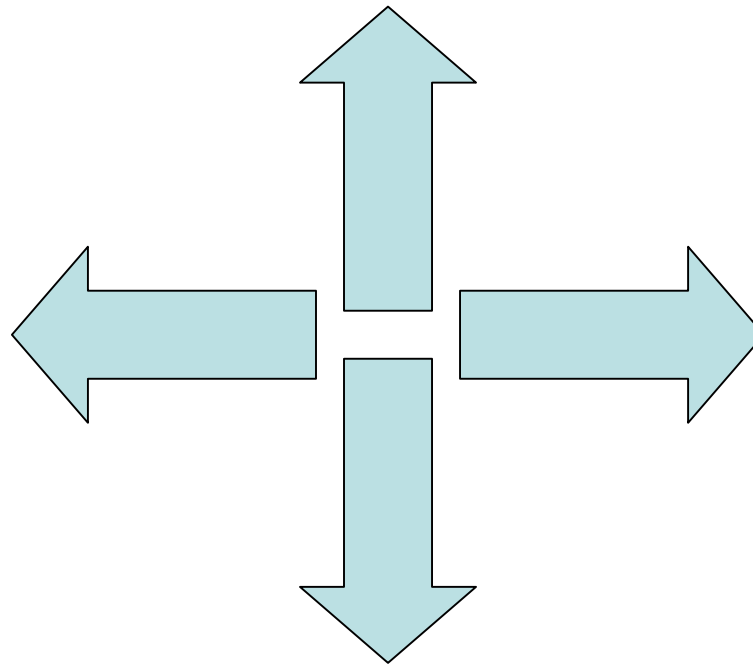## Center for the Economics and Demography of Aging, UC Berkeley

tmiller@demog.berkeley.edu

Beyond the Most Important Graph

Deepen accounts:
Develop Flow Accounts on Consumption (capital/current),
   Reallocations (capital/credit/land), and
   Transfers (education, health, other).
Develop Wealth Accounts.

Extend accounts:
Back to 1850?

Project accounts:
 Far into the future
(2100?)

Widen accounts: Beyond the mean. Education and Gender. Time Allocation
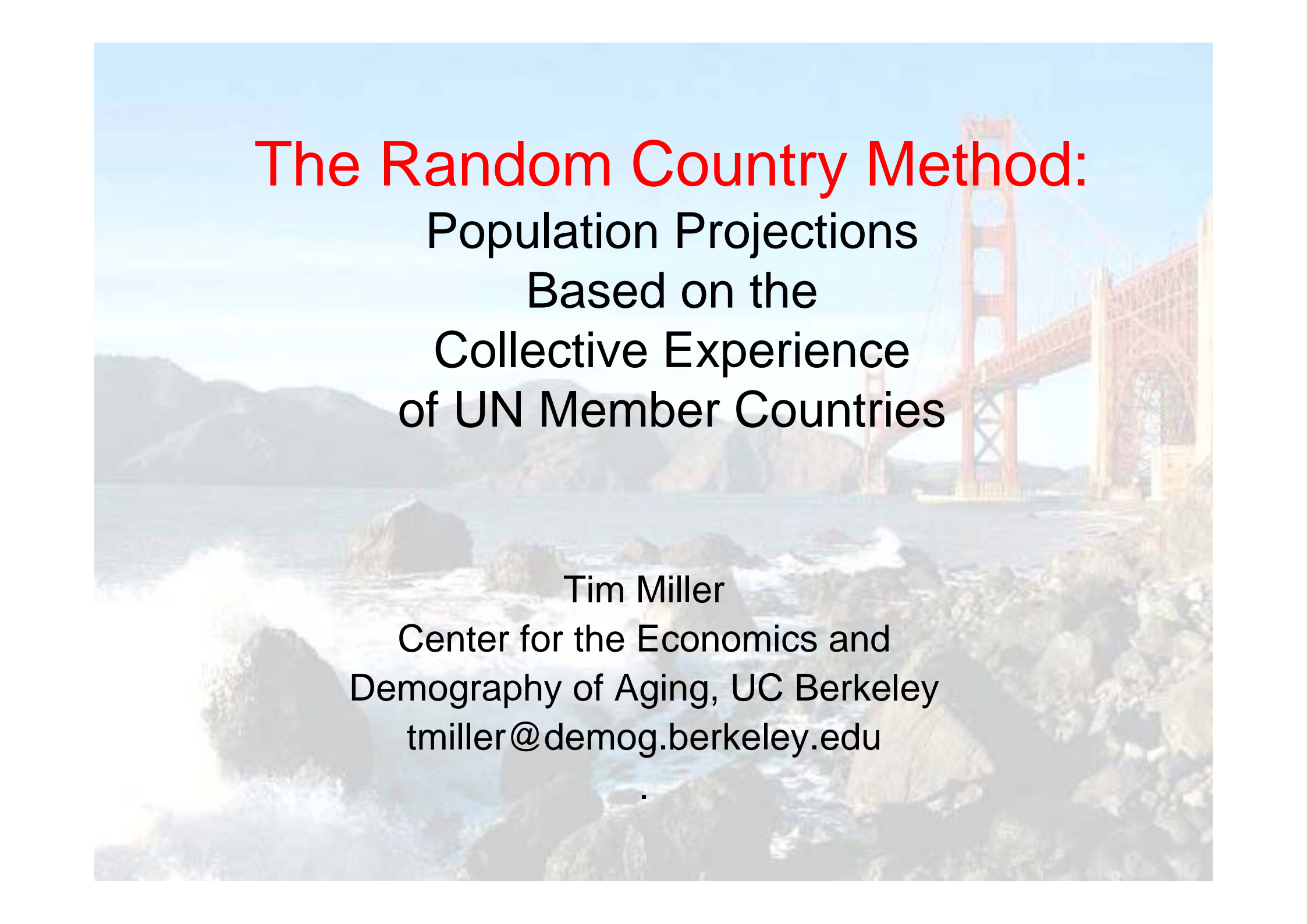
Three Models (Version 1.0)

1. Stochastic Population Forecasts

2. Forecasting Educational Distribution

3. Forecasting Government Budgets

United Nations
Economic Commission for Latin America and the Caribbean

Santiago, Chile

The Random Country Method:

Population Projections
Based on the
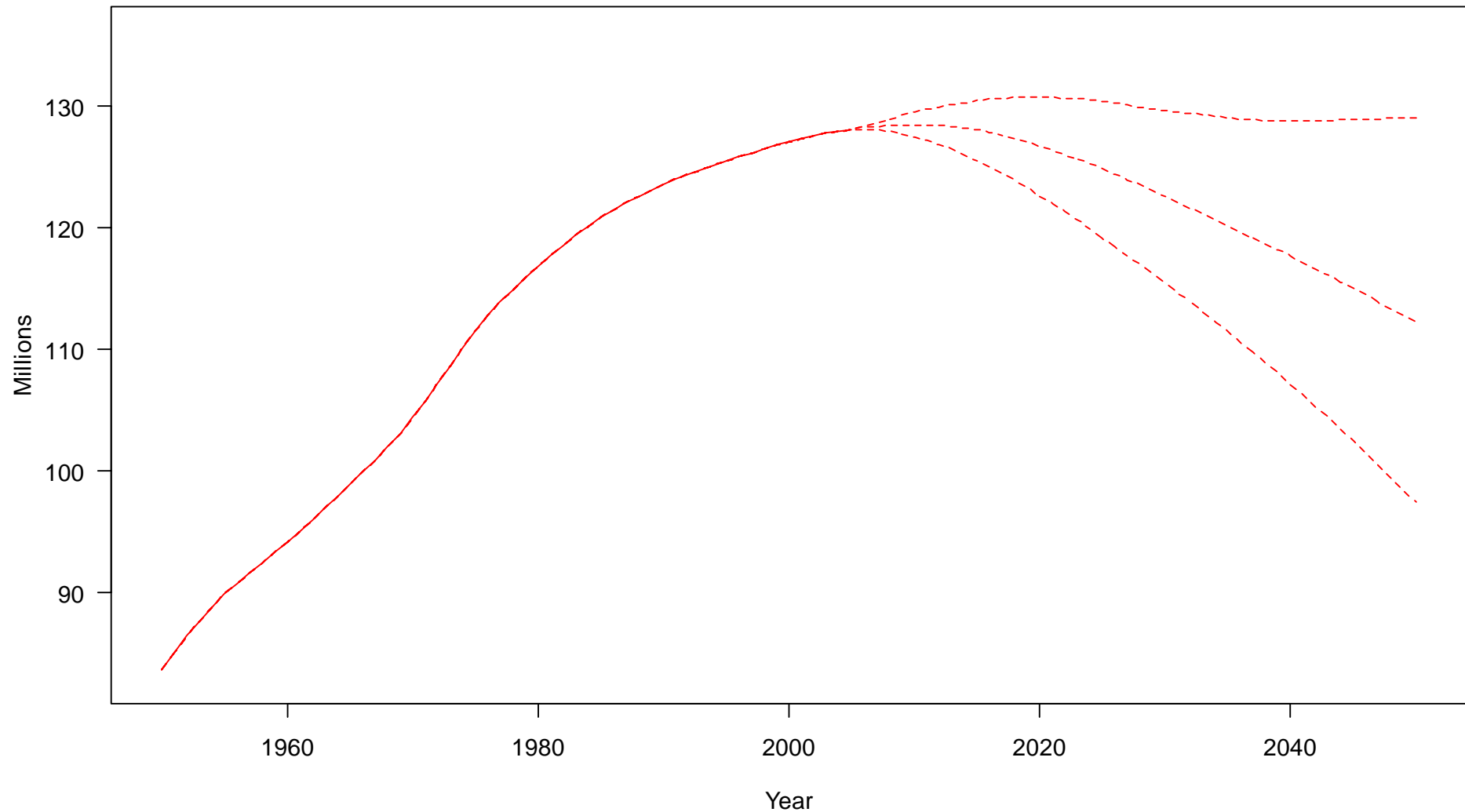## Collective Experience
of UN Member Countries

Tim Miller

Center for the Economics and

Demography of Aging, UC Berkeley

tmiller@demog.berkeley.edu

.

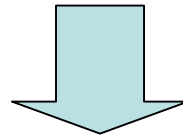# Scenario Forecasts
vs.
Stochastic Forecasts

Example of a Scenario Forecast

Population of Japan , 1950 to 2050
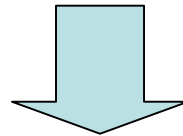with historical estimates and UN scenario forecasts.

3 Steps in a Scenario Forecast

Select future path of fertility, mortality, and migration **based on expert opinion.**
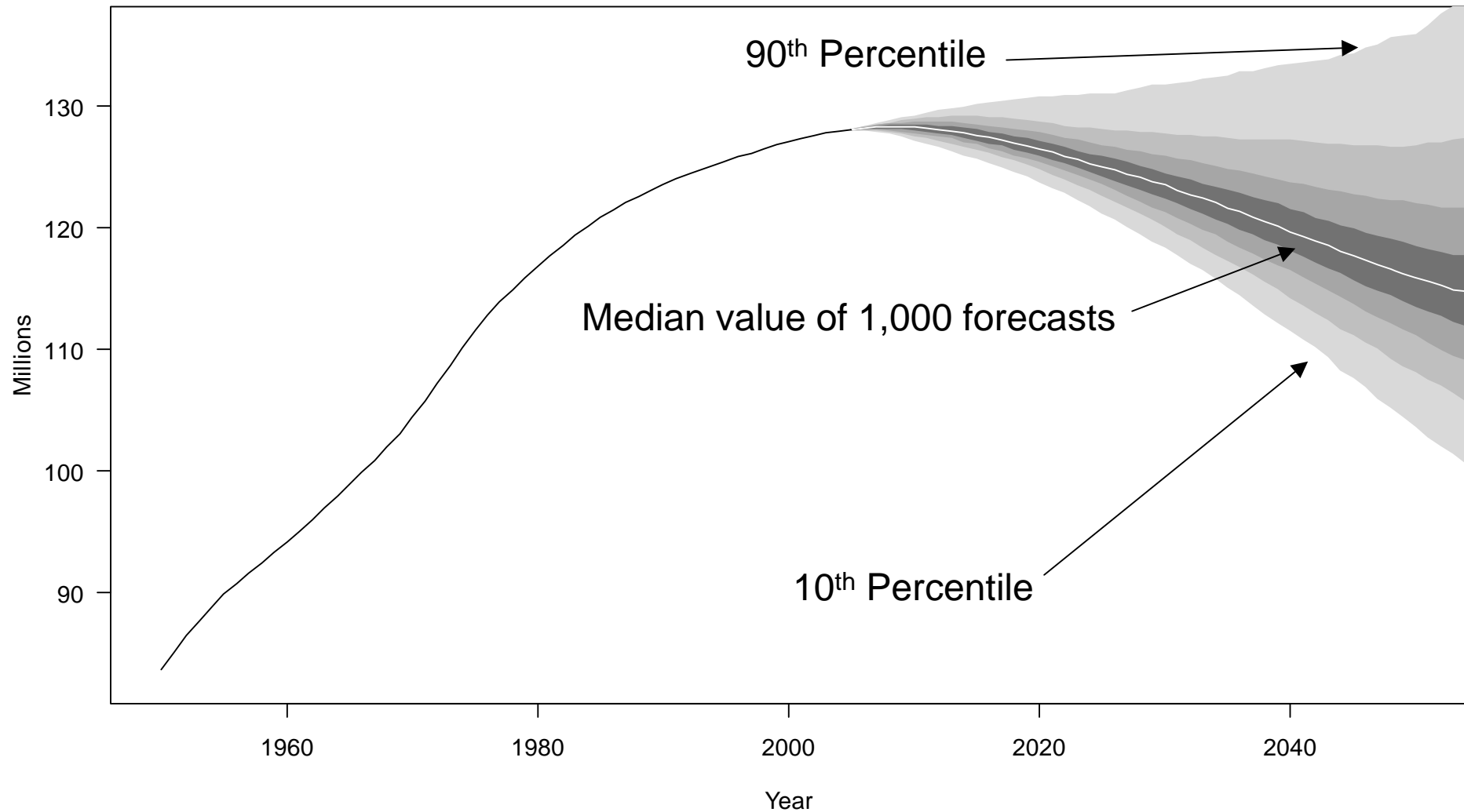
Forecast population using standard cohort-component method.

Repeat Steps 1 and 2. **Typically 3 times**: high, middle, and low forecasts.
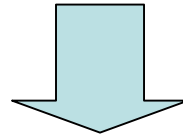
Example of a Stochastic Forecast

Population of Japan , 1950 to 2050
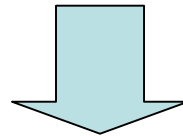with stochastic forecast.
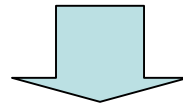
4 Steps for Stochastic Forecast

Select future path of fertility, mortality, and migration **based on random draws from a distribution (e.g., a set of similar countries).**

Forecast population using standard cohort-component method.

Repeat Steps 1 and 2. **Typically 1,000 or 10,000 times.**

Calculate predictive distributions for variables of interest (population size, OADR, e0, etc).
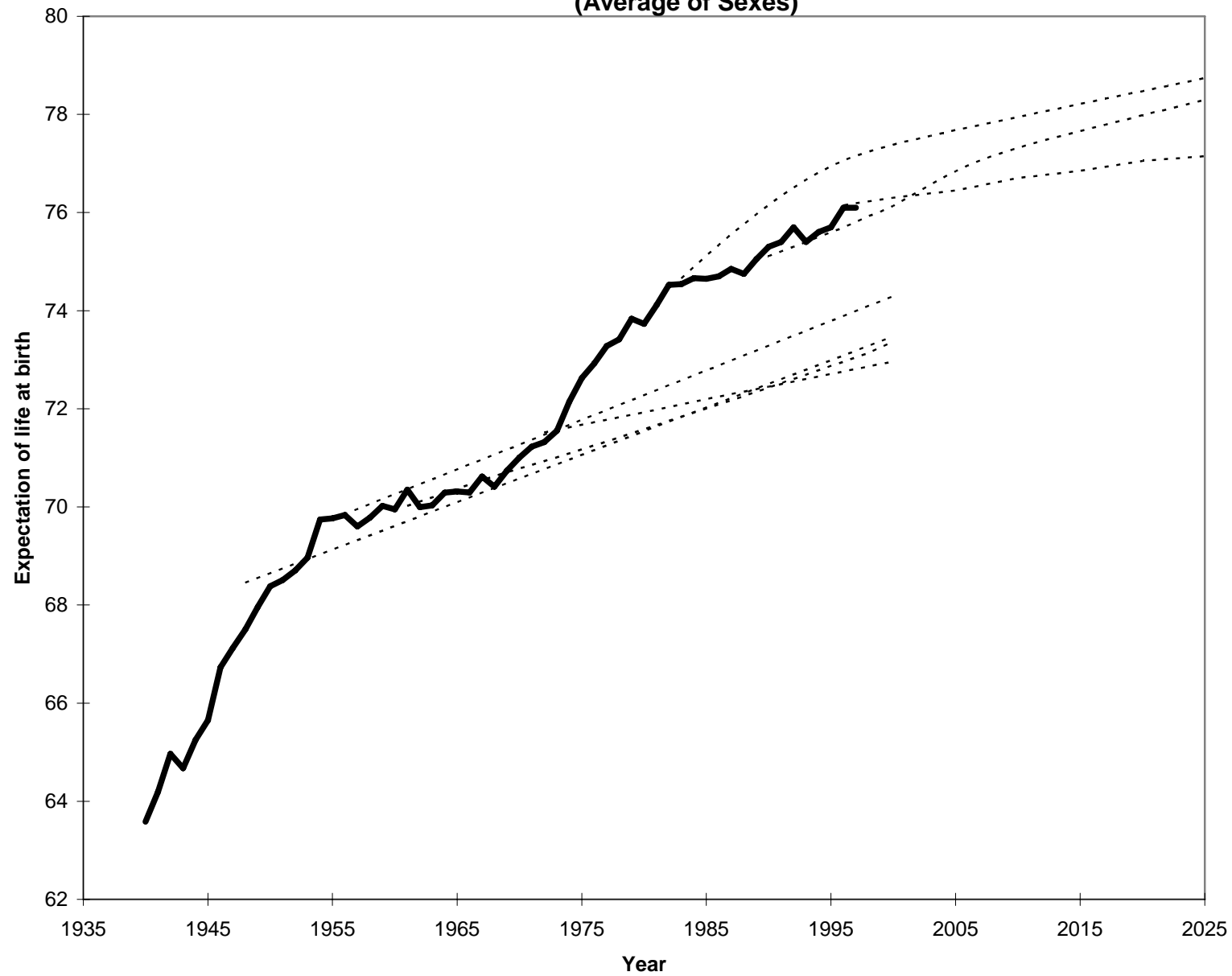
Strengths of Each Method

Scenario Forecast

– Relies on opinions of experts.

Stochastic Forecast

– Tries to avoid opinions of experts.

Figure 1. Actual U.S. Life Expectancy at Birth, 1940-1995, and Social Security Administration Forecasts (Average of Sexes)

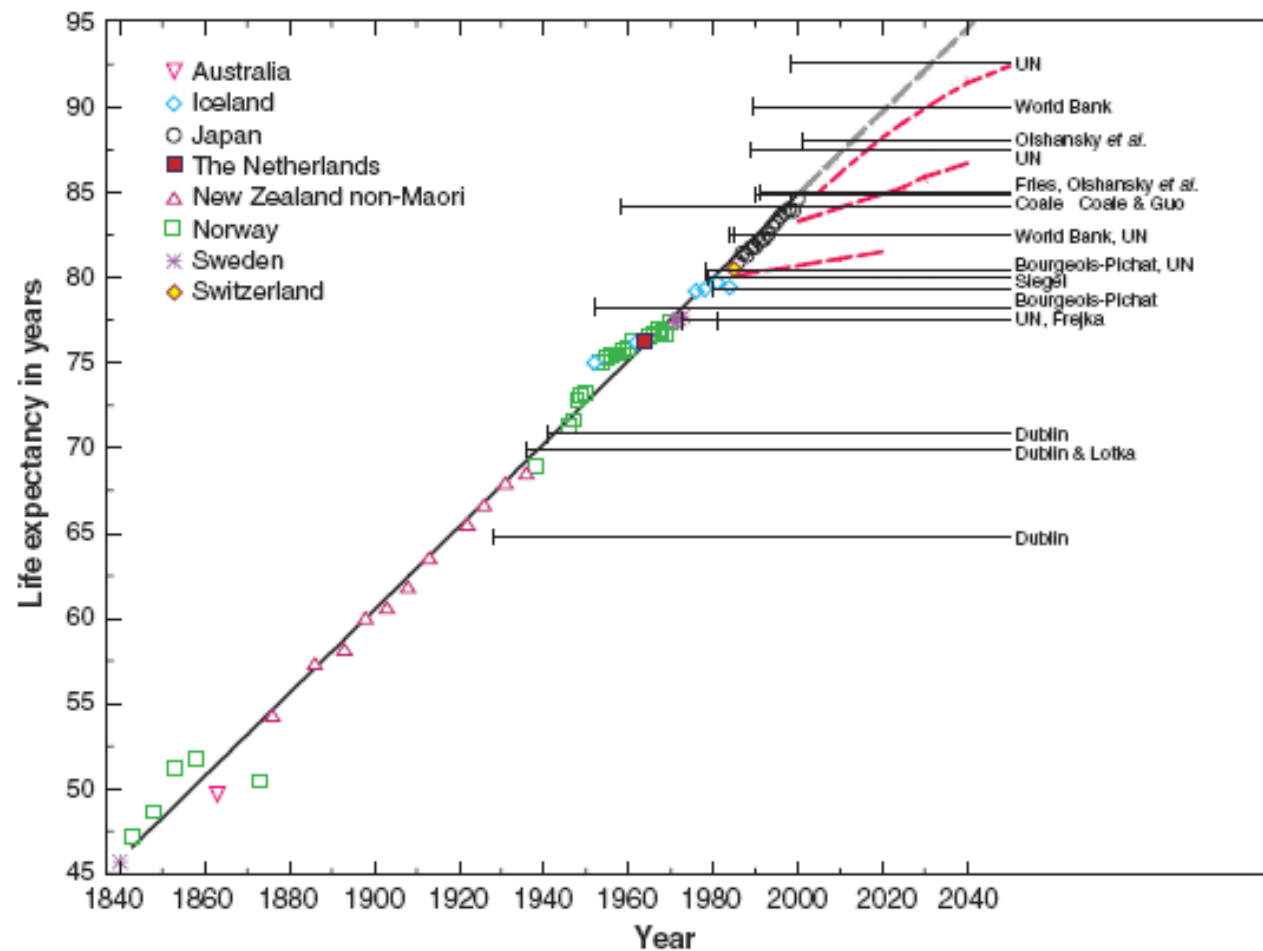# Oeppen and Vaupel (2002). Broken Limits to Life Expectancy

Fig. 1. Record female life expectancy from 1840 to the present [suppl. table 2 (1)]. The linear-regression trend is depicted by a bold black line (slope = 0.243) and the extrapolated trend by a dashed gray line. The horizontal black lines show asserted ceilings on life expectancy, with a short vertical line indicating the year of publication (suppl. table 1). The dashed red lines denote projections of female life expectancy in Japan published by the United Nations in 1986, 1999, and 2001 (1): It is encouraging that the U.N. altered its projection so radically between 1999 and 2001.

Strengths of Each Method

Scenario Forecast

- Relies on opinions of experts.

- "What-if…" scenarios.

Stochastic Forecast

- Tries to avoid opinions of experts.

Scenario Forecasts

Strengths of Each Method

Scenario Forecast

- Relies on opinions of experts.

- "What-if…" scenarios.

Stochastic Forecast

- Tries to avoid opinions of experts.

- Attempts to quantify our uncertainty about the future in a logical and consistent way.

Step 1of a Stochastic Forecast

Select future path of fertility, mortality, and migration
**based on random draws from a distribution
(e.g., a set of similar countries).**

Rather than rely on expert opinion,
stochastic forecasts try to use history as a guide.

But which history?

(1) Time-series model of long time series for a single country,
1900-1990 or 1950-1990, e.g. Lee-Tulja (1994).

(2) Data series for UN countries, 1950-2005, e.g. Miller (2006).

Two stochastic methods

Lee-Tulja (1994)

- Applied to United States.
- Based on time-series analysis of US historical series of TFR (1900-1994) and mortality (1950-1994).
- Stresses the uniqueness of each country.

Miller (2006)

- Chile, US, Brazil, Japan, China, India, the Philippines, and Thailand.
- Based on sampling from UN country experiences (TFR, e0, NMR for 1950-2005).
- Stresses the common collective experience of countries.

Random Country Method (RCM)

- Assumes countries with similar demographic parameters are being exposed to the same set of unknown social forces which will shape their future demographic trajectories.

- Tells us what the future would look like based on the collective experience of 192 UN member countries and territories from 1950 to 2005.

RCM **Fertility** Forecast

1. Define set of similar countries based on TFR of country of interest.

2. Randomly select one country from that set.

3. See what happened in that country. That's our prediction.

Total fertility rate by country: 1950 to 2050
Based on UN World Population Prospects, the 2004 revision.
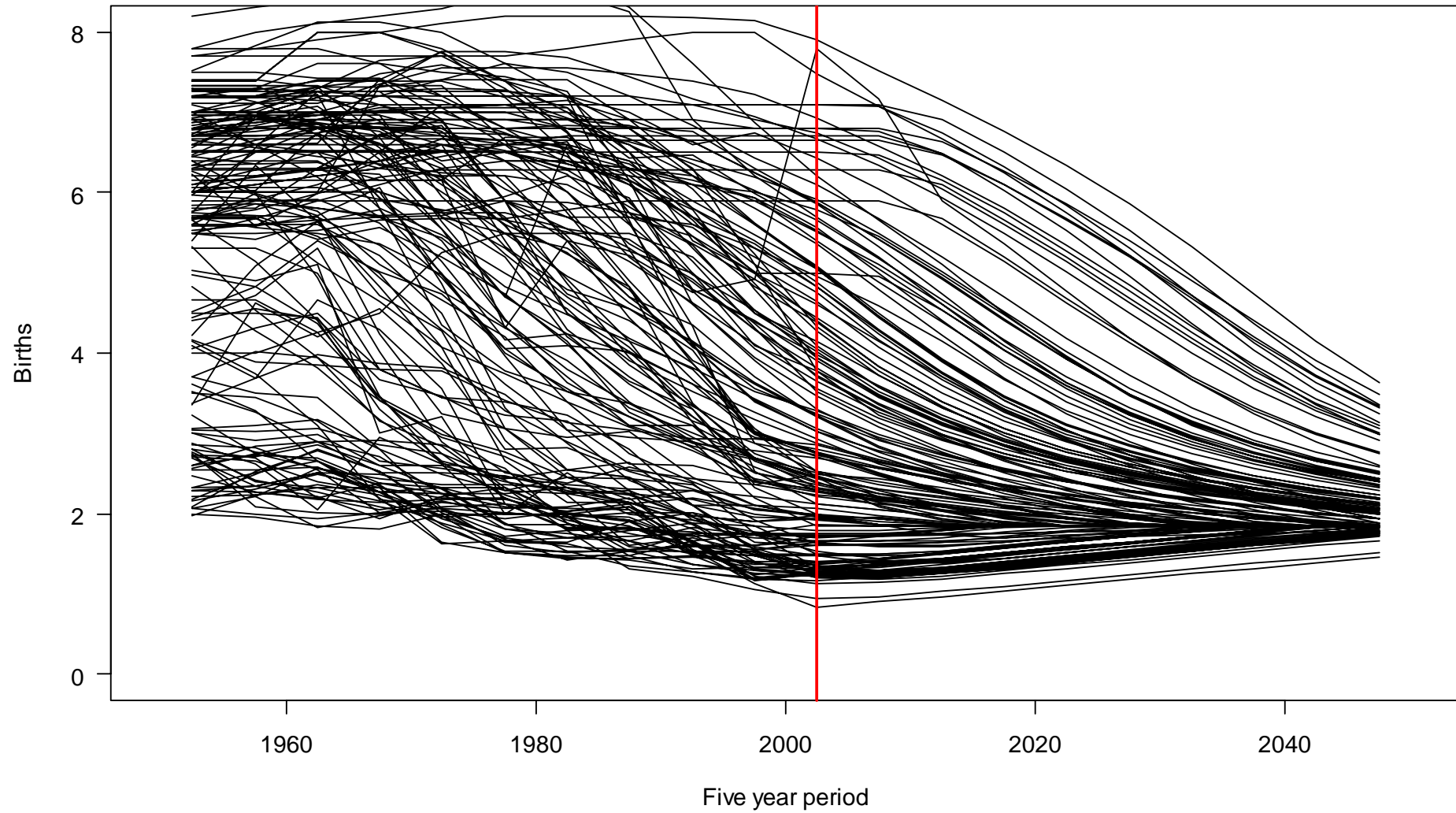
Example: Country with TFR=6
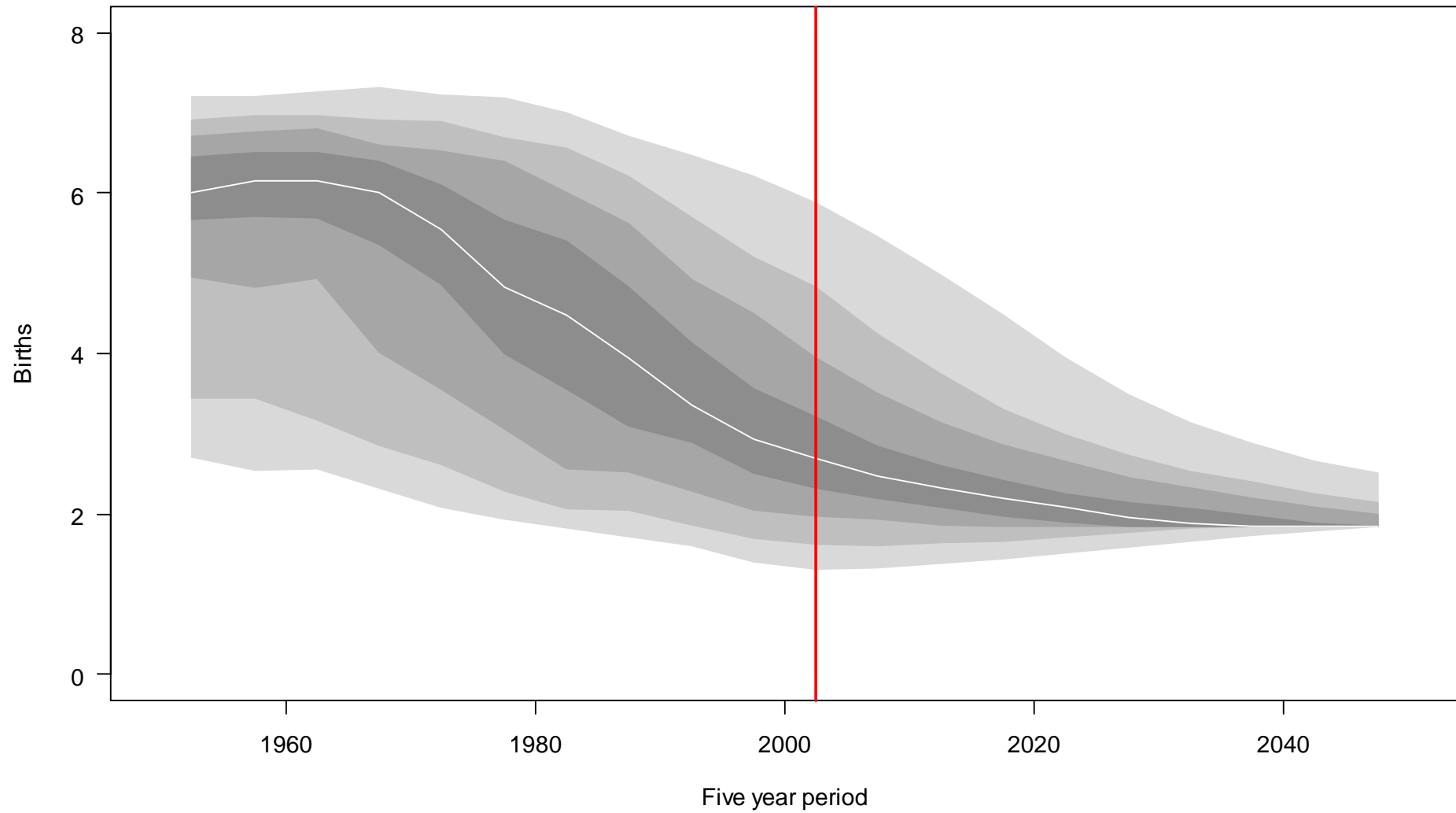
Sample of 100 countries in the hat:

Mongolia 1950-> 1955   6.0 -> 7.33

Myanmar 1965-> 1970   6.0 -> 5.75

Thailand 1965-> 1970   6.0 -> 4.97

Peru   1970-> 1975   6.0 -> 5.38

Honduras 1980-> 1985   6.0 -> 5.37

Mauritania 1995-> 2000 6.0 -> 5.79

# Total fertility rate by country: 1950 to 2050
Based on UN World Population Prospects, the 2004 revision.

Post-transition Fertility

- Eventually, all countries end up in the low, post-transition fertility region.

- Should I use expert judgment to correct for tempo effects?

- Assume low fertility countries are currently experiencing tempo effect of 0.25 births.

- Post-transition Fertility in stochastic model is 1.80 births per woman (with 95% annual predictive interval of 1.4 to 2.3 births). Very close to UN scenario forecasts!

Historical TFR and annual TFR in Japan , 1950 to 2100
with historical estimates, UN scenario forecasts, and RCM probability deciles.
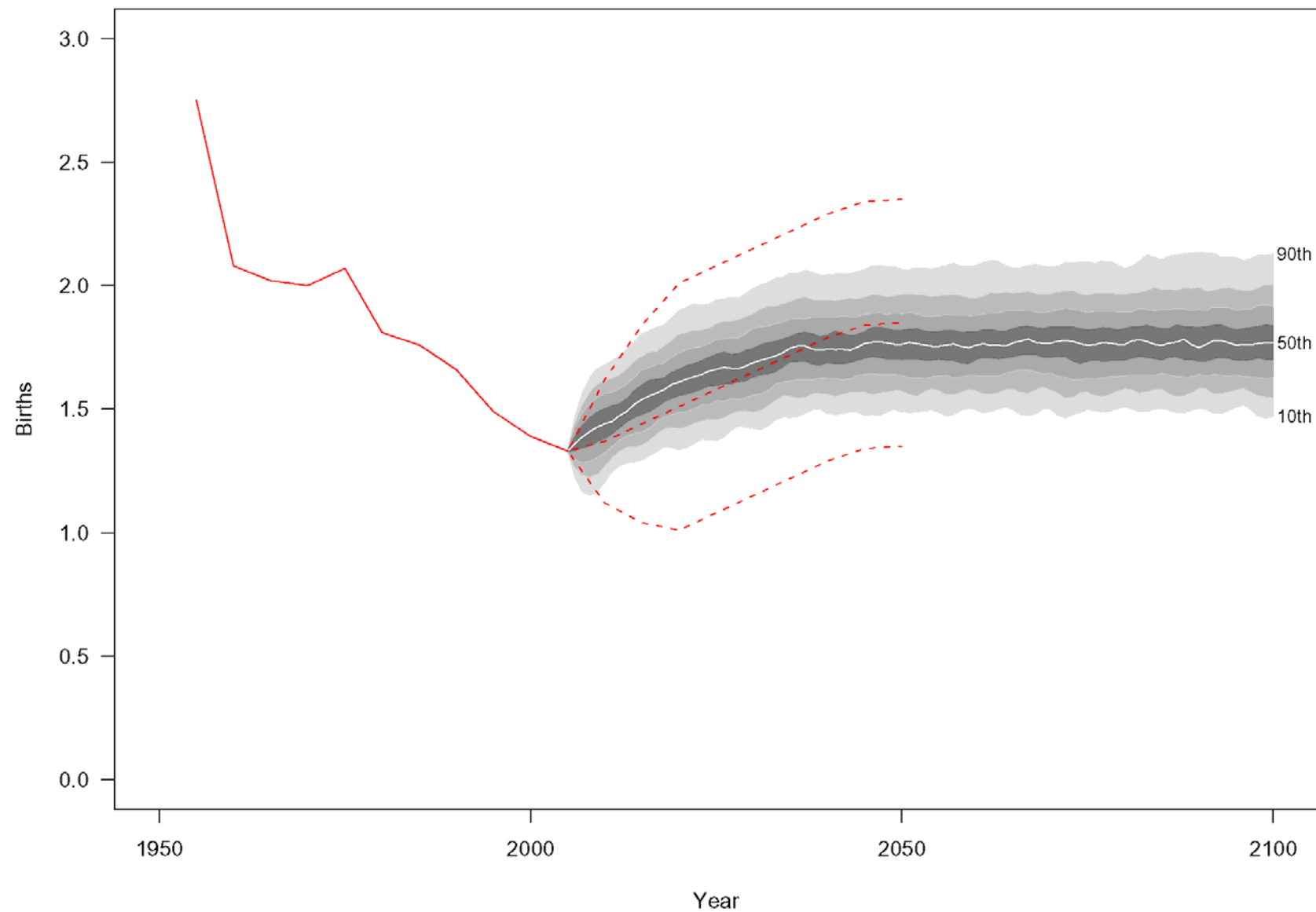
Population under age 20 in Japan , 1950 to 2100
with historical estimates, UN scenario forecasts, and RCM probability deciles.
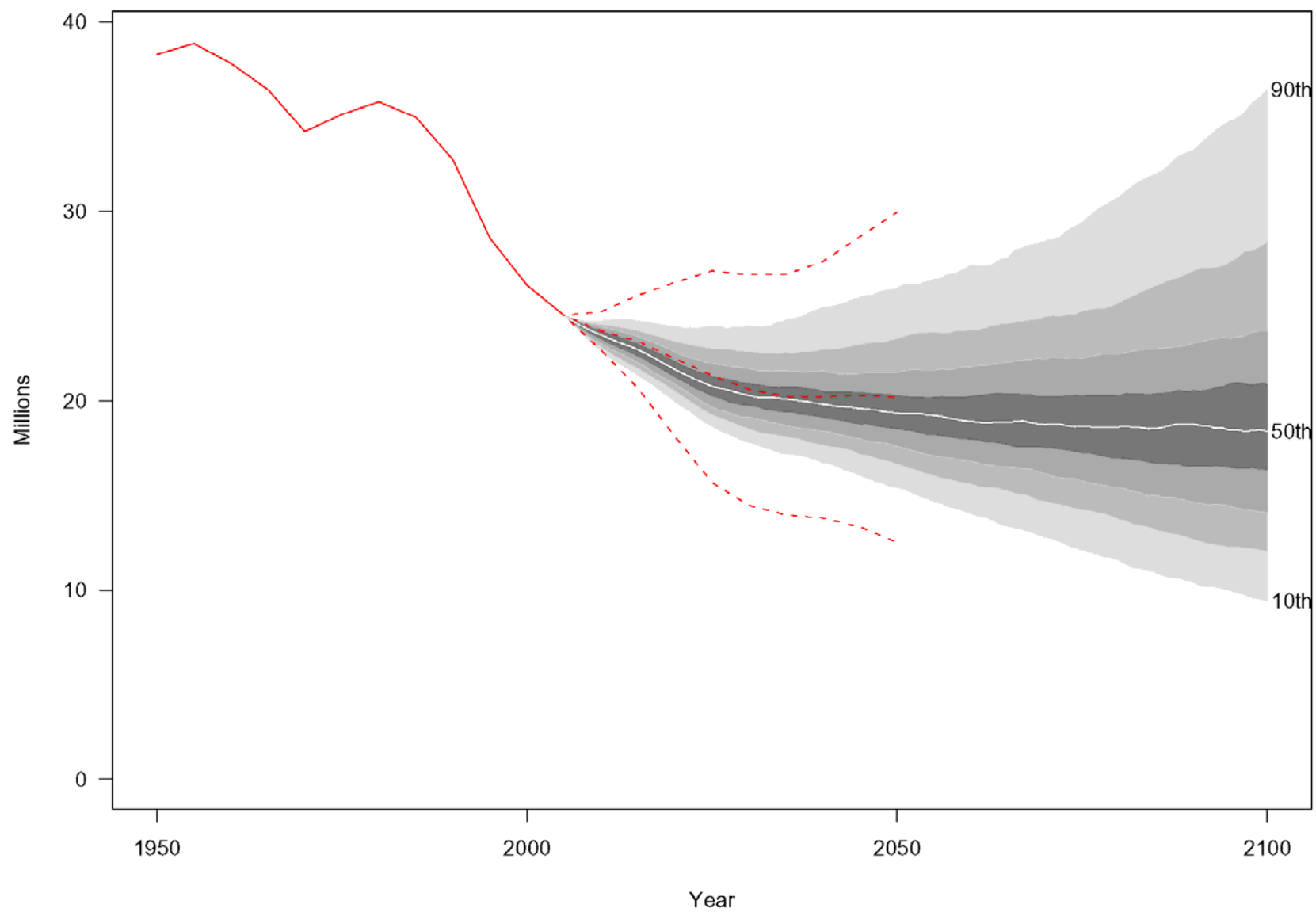
RCM **Mortality** Forecast

1. Define set of similar countries based on e(0) of country of interest.

2. Randomly select one country from that set.

3. See what happened in that country. That's our prediction.

Historical Experience: 1950 to 2005

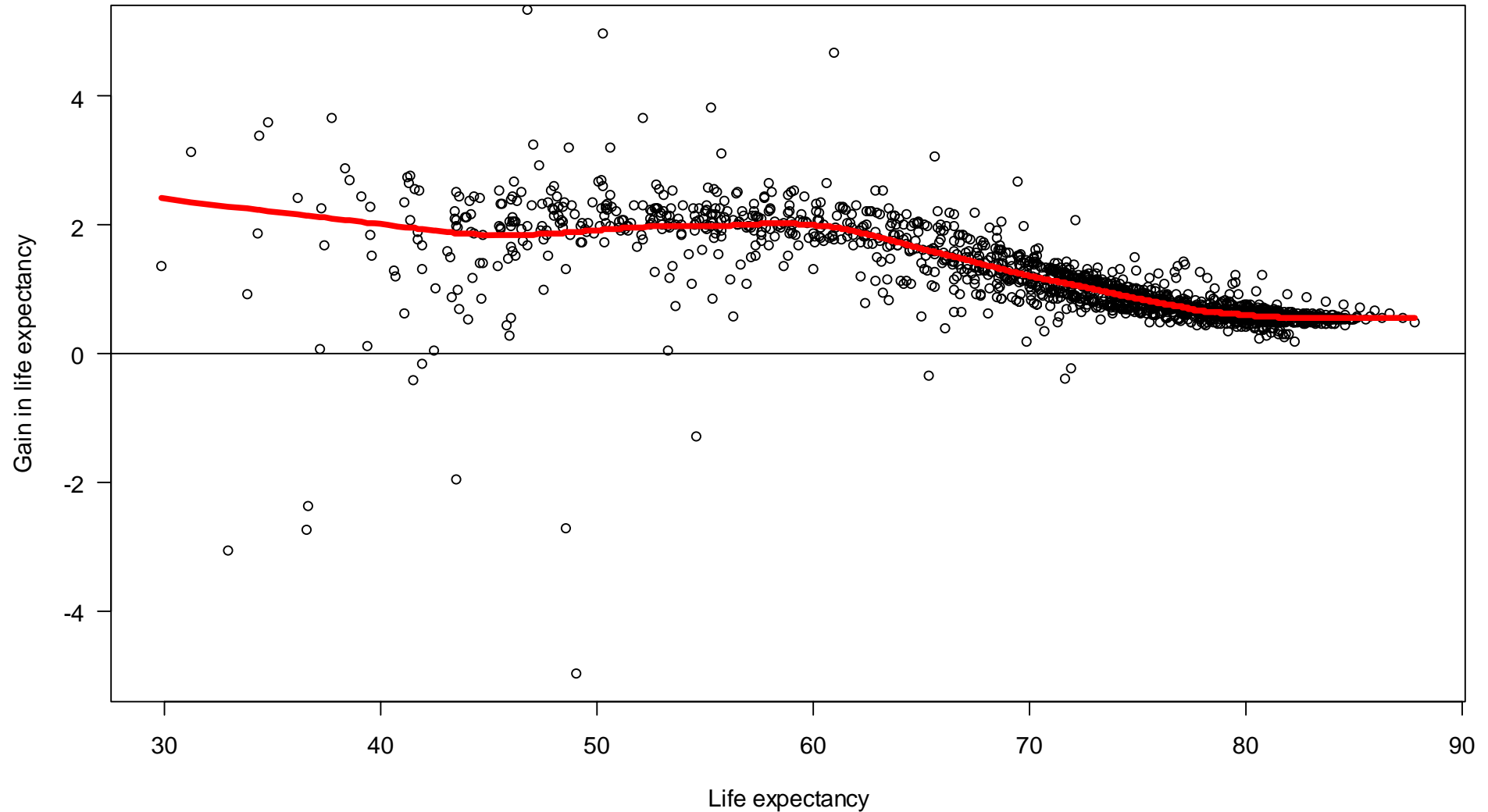**Gain in life expectancy during 5 year period as function of current life expectancy**

Based on historical data (1950-2005) from UN World Population Prospects, the 2004 revision.

Scatterplot smoother
(supsmu)
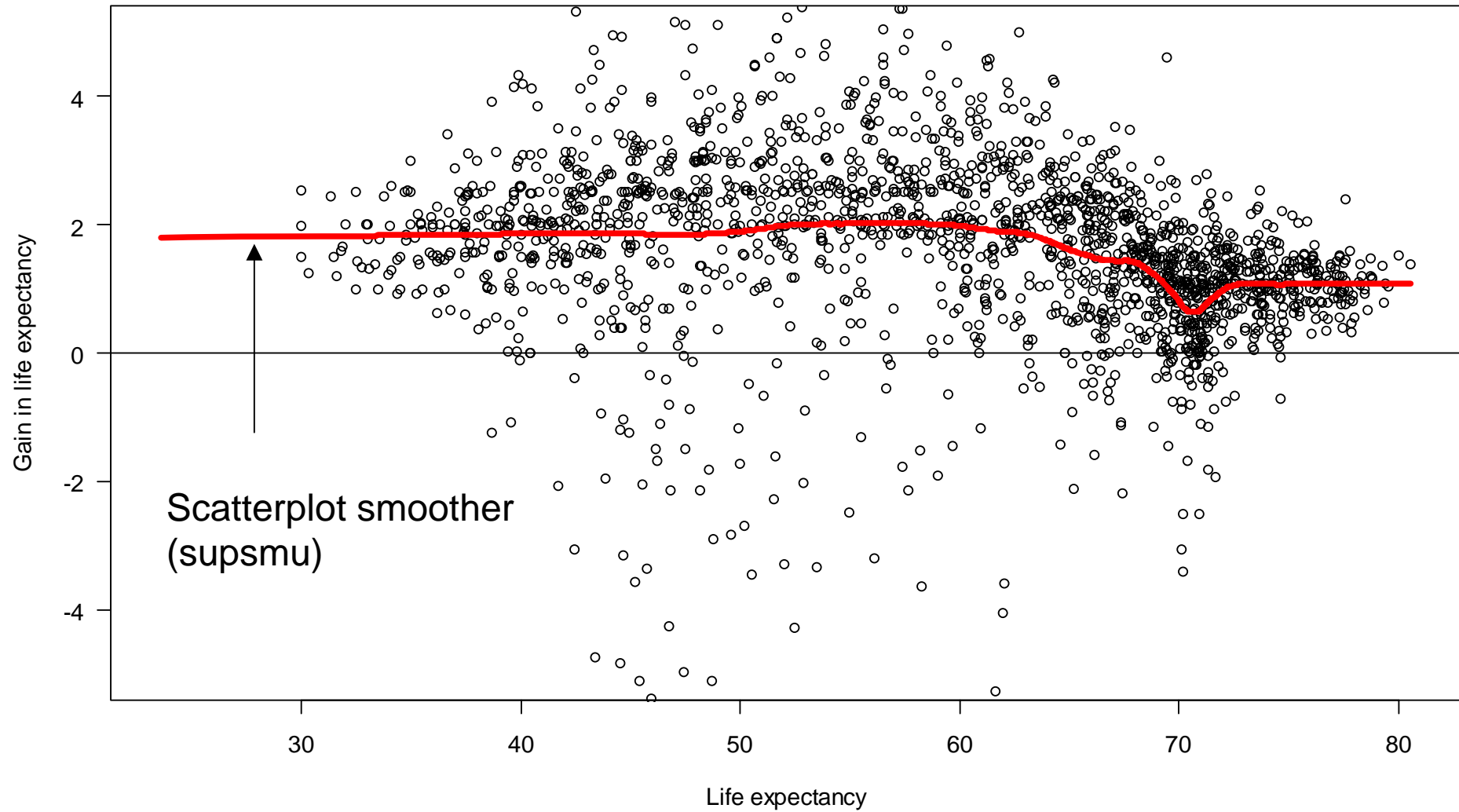
The Future According to UN Scenario Forecasts, 2004.

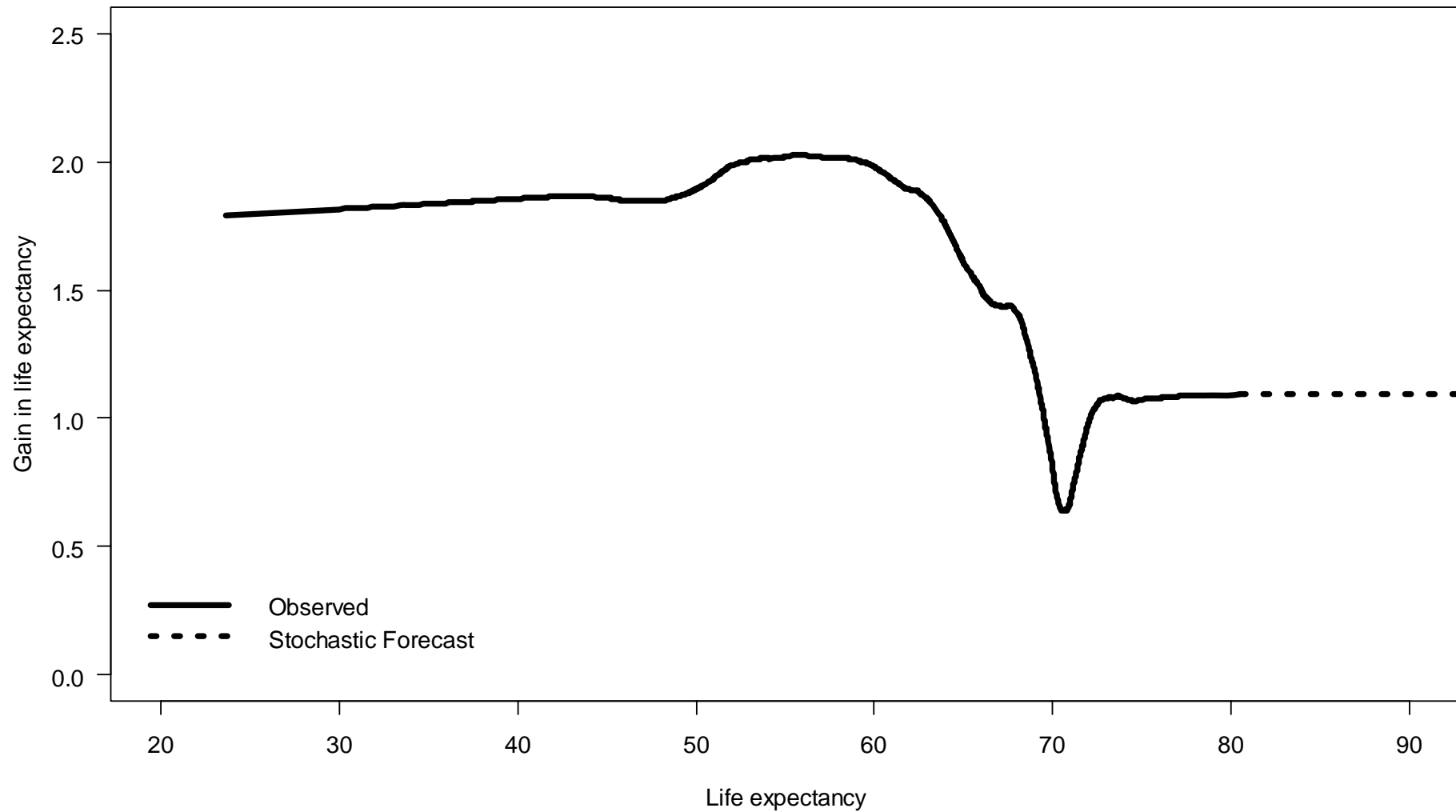**Forecast gain in life expectancy during 5 year period as function of current life expectancy**

Based on projections (2005-2050) from UN World Population Prospects, the 2004 revision.

Historical Experience: 1950 to 2005

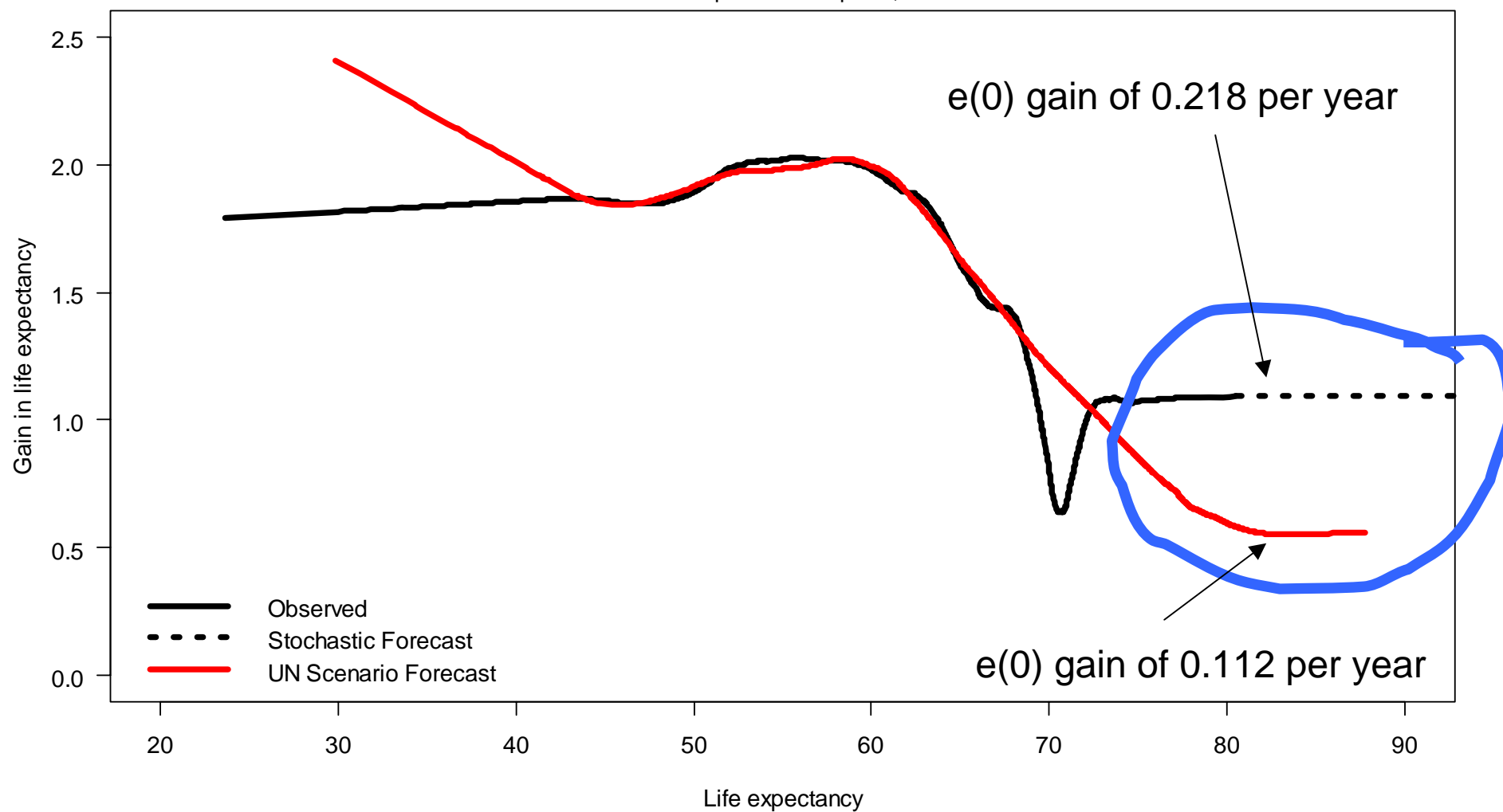**Gain in life expectancy during 5 year period as function of current life expectancy**

Based on UN World Population Prospects, the 2004 revision.

Historical Experience vs. UN Forecast

Gain in life expectancy during 5 year period as function of current life expectancy

Based on UN World Population Prospects, the 2004 revision.

e(0) gain of 0.218 per year

e(0) gain of 0.112 per year

Gain in life expectancy

Life expectancy

Observed
Stochastic Forecast
UN Scenario Forecast

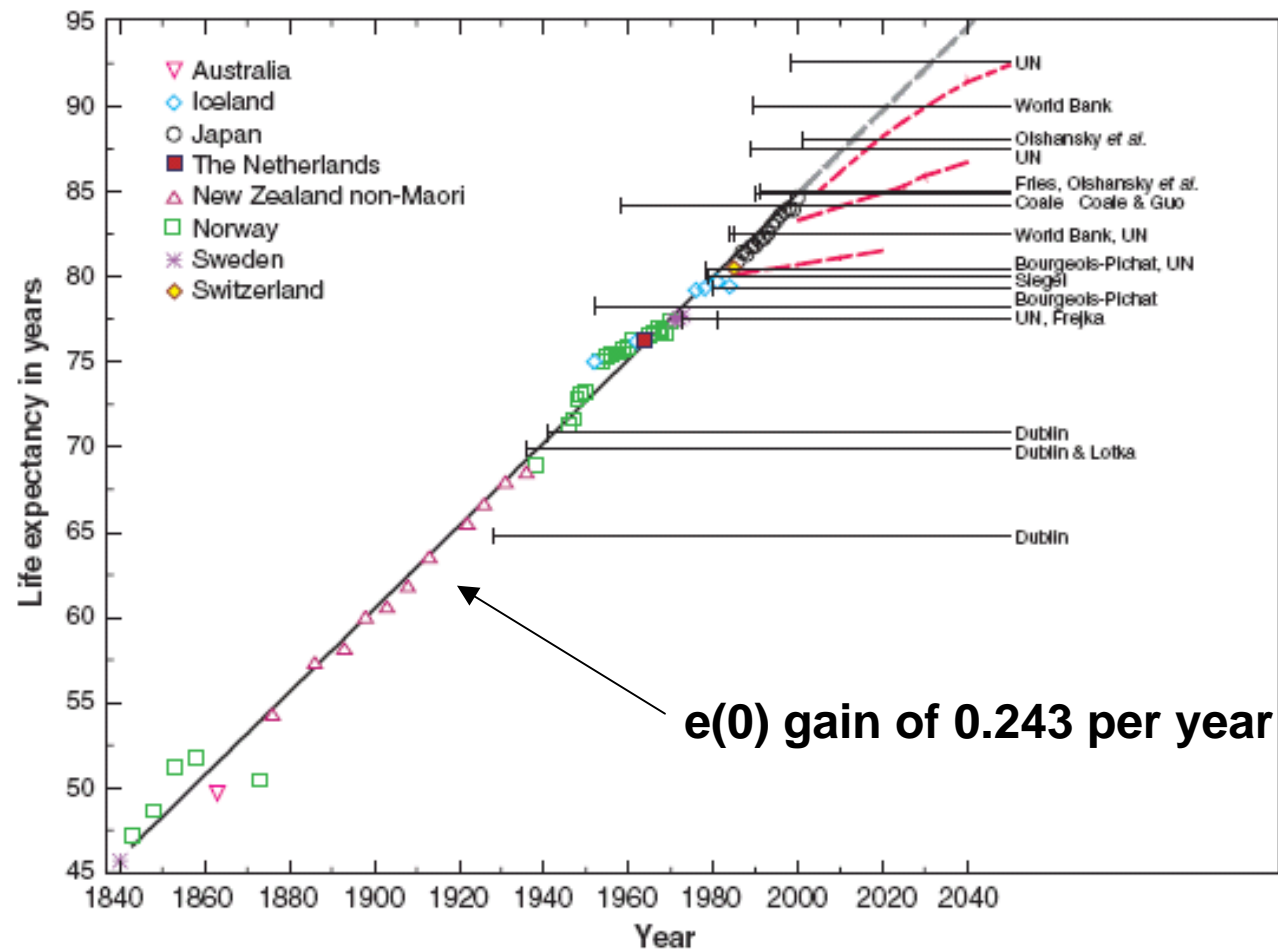# Oeppen and Vaupel (2002). Broken Limits to Life Expectancy

Fig. 1. Record female life expectancy from 1840 to the present [suppl. table 2 (1)]. The linear-re-gression trend is depicted by a bold black line (slope = 0.243) and the extrapolated trend by a dashed gray line. The horizontal black lines show asserted ceilings on life expectancy, with a short vertical line indicating the year of publication (suppl. table 1). The dashed red lines denote projections of female life expectancy in Japan published by the United Nations in 1986, 1999, and 2001 (1): It is encouraging that the U.N. altered its projection so radically between 1999 and 2001.

Life expectancy at birth in Japan , 1950 to 2100
with historical estimates, UN scenario forecast, and RCM probability deciles.
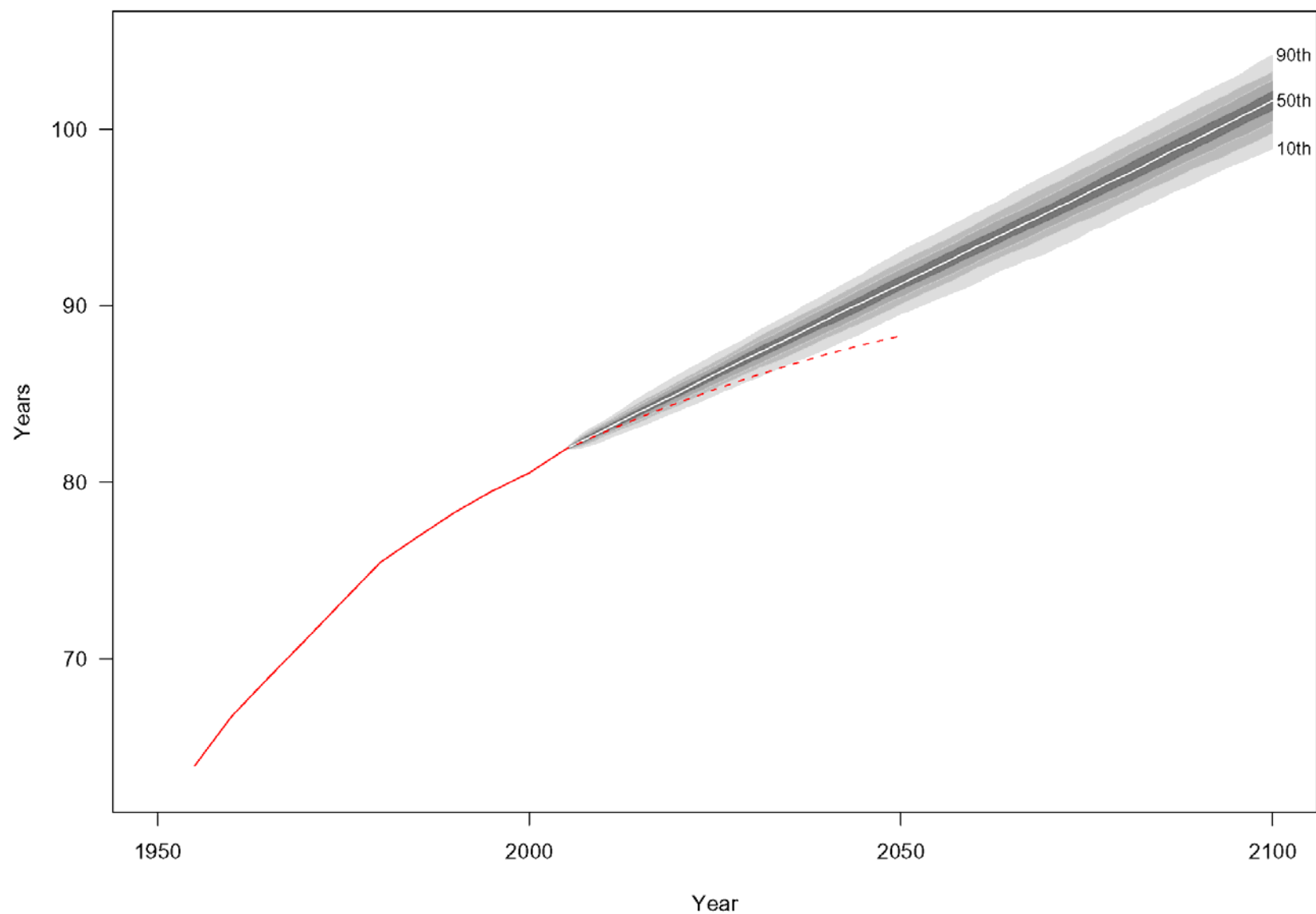
Population age 65 and older in Japan , 1950 to 2100
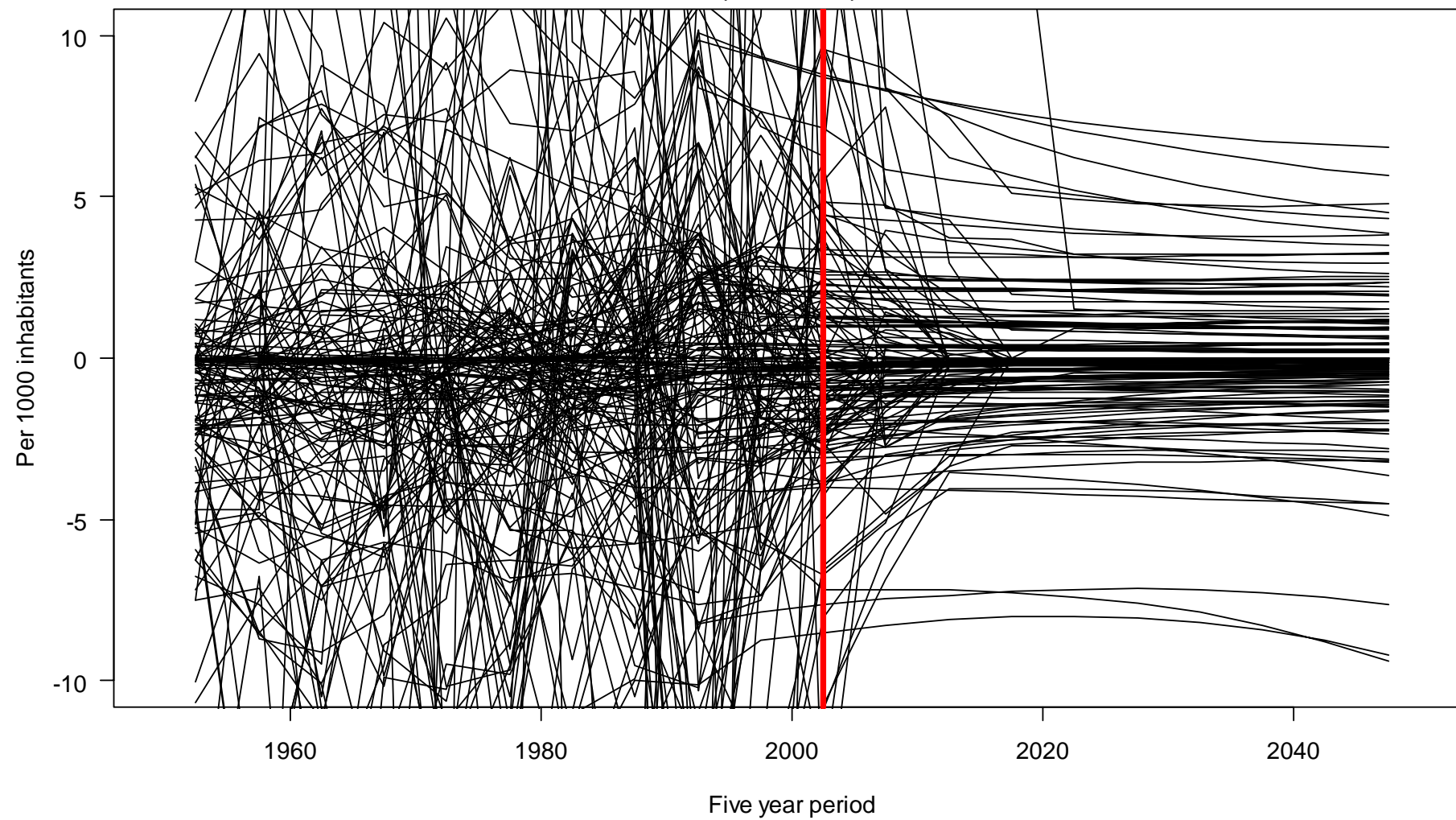with historical estimates, UN scenario forecasts, and RCM probability deciles.
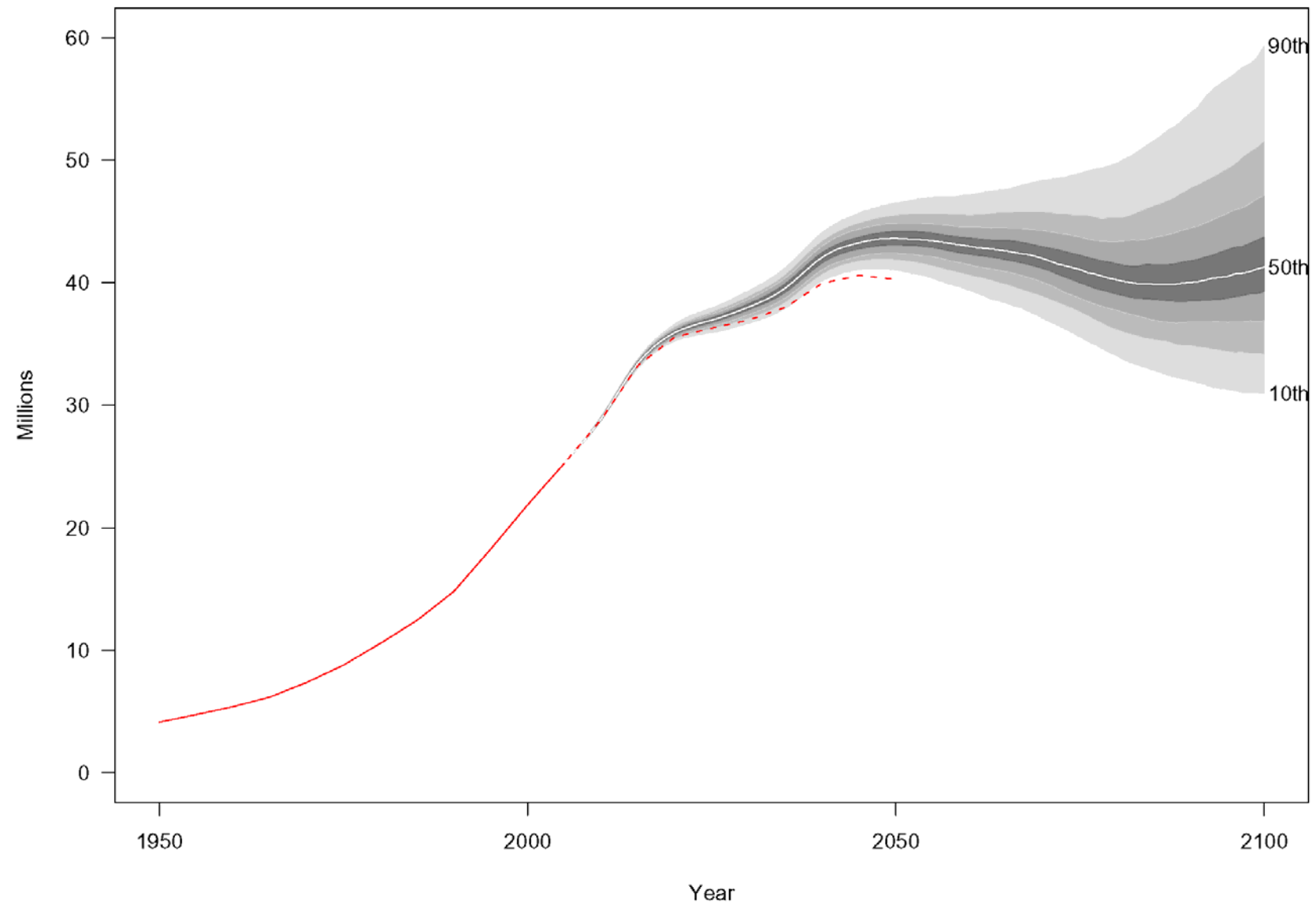
RCM **Migration** Forecast

1. Define set of similar countries based on NMR and TFR of country of interest.

2. Randomly select one country from that set.

3. See what happened in that country. That's our prediction.

**Net migration rate by country: 1950 to 2050**
Based on UN World Population Prospects, the 2004 revision.

Historical NMR and average NMR over forecast horizon in Japan , 1950 to 2100
with historical estimates, UN scenario forecast, and RCM probability deciles.
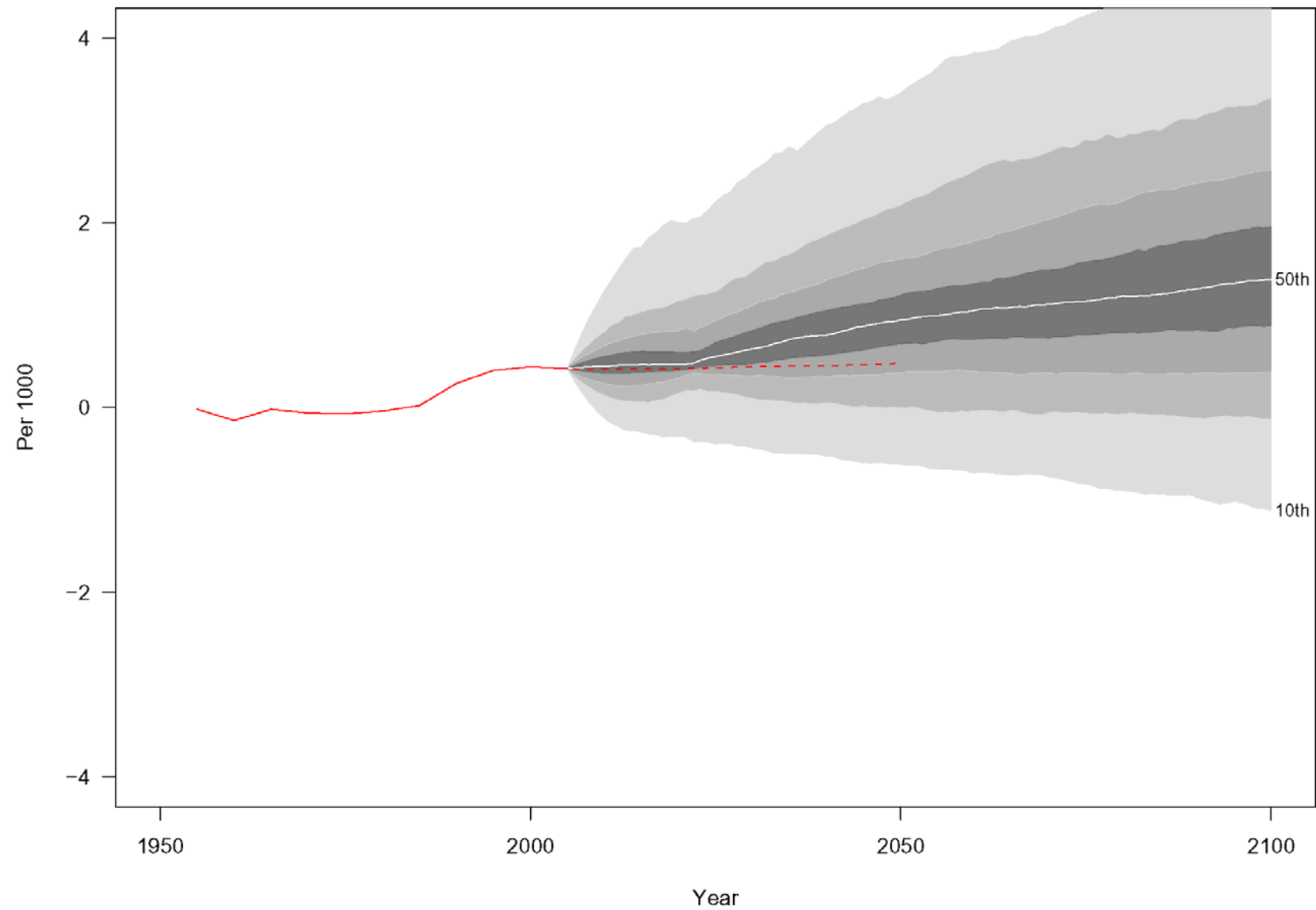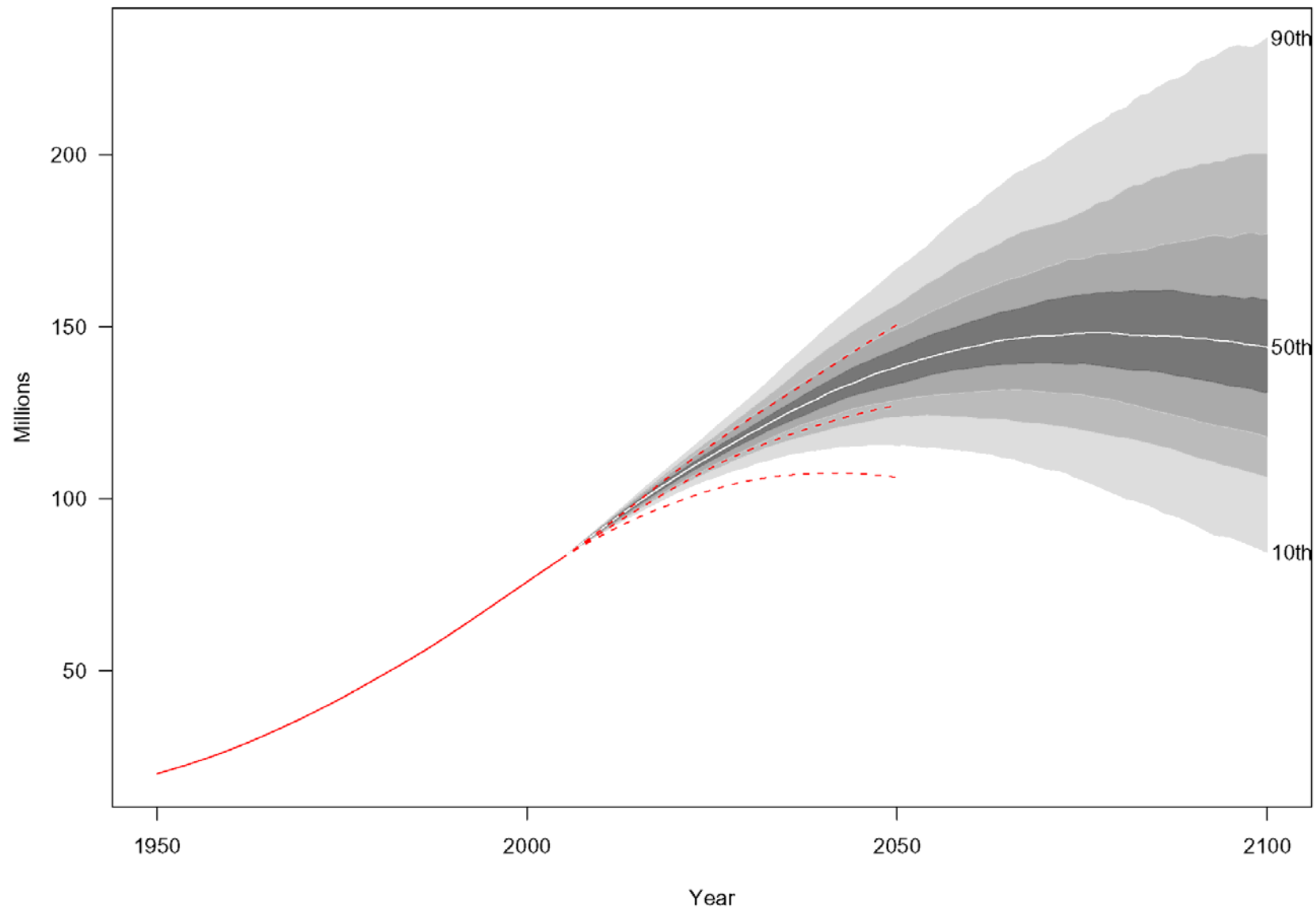
Population of Japan , 1950 to 2100
with historical estimates, UN scenario forecasts, and RCM probability deciles.
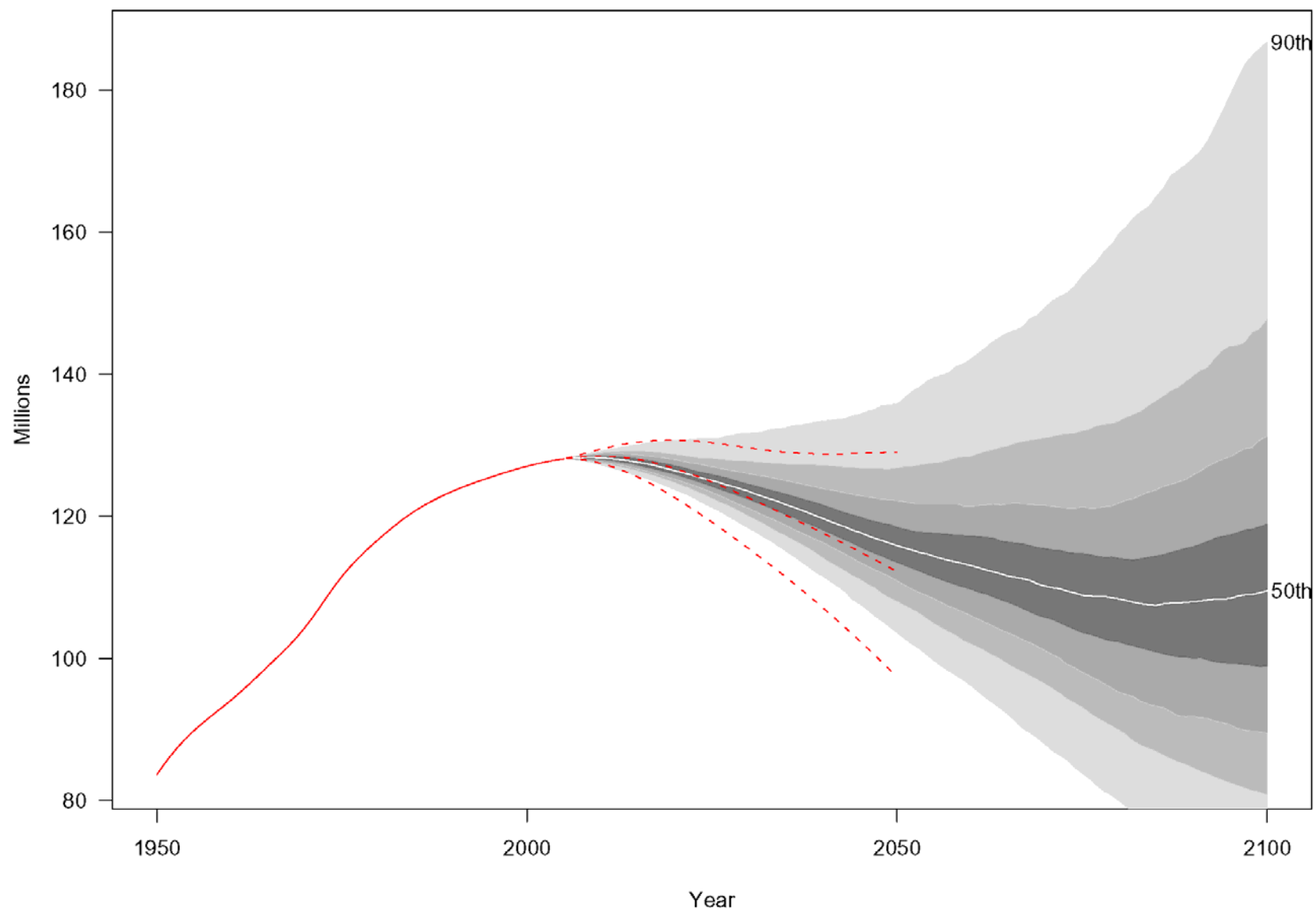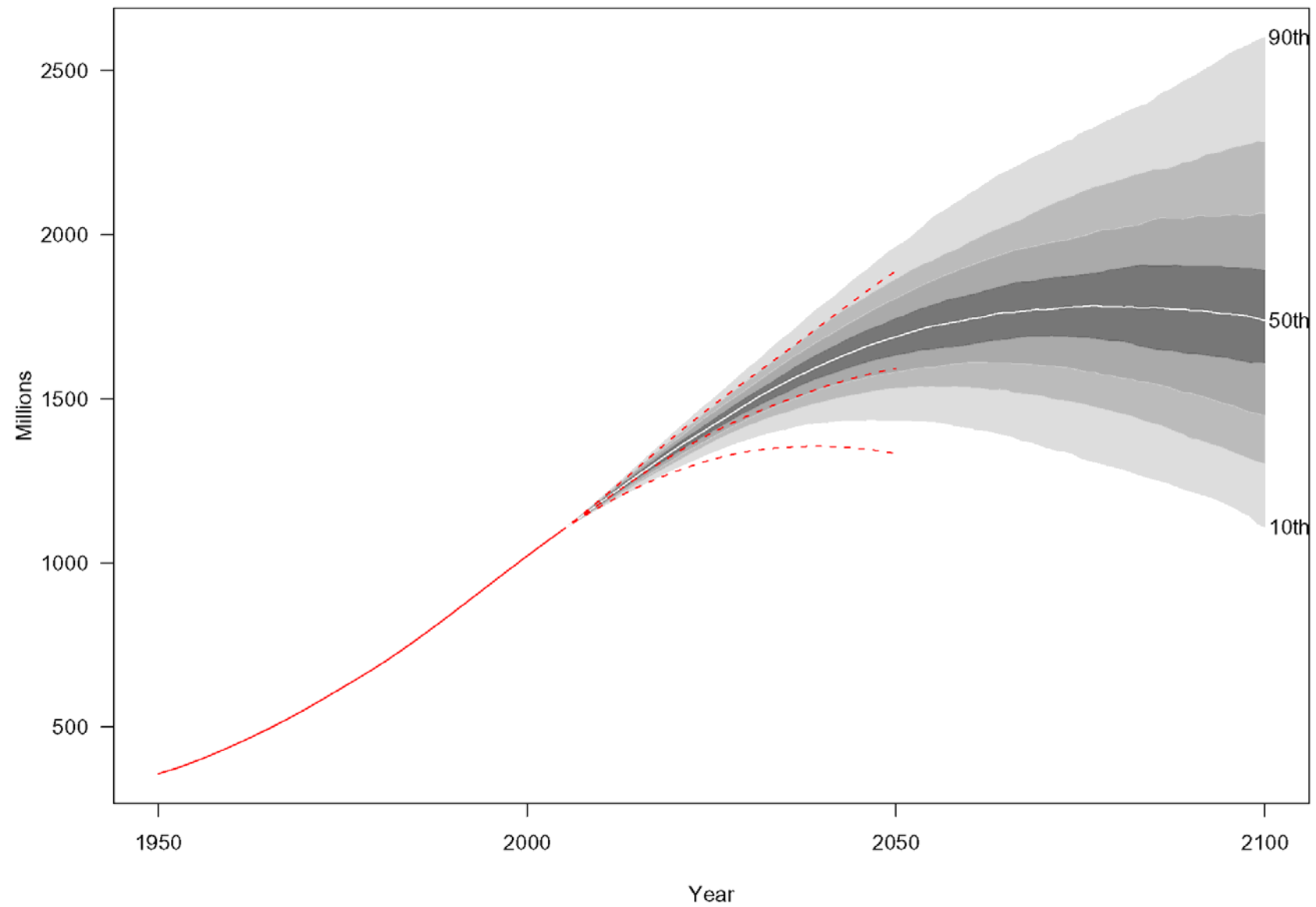
Population of Chile , 1950 to 2100
with historical estimates, UN scenario forecasts, and RCM probability deciles.
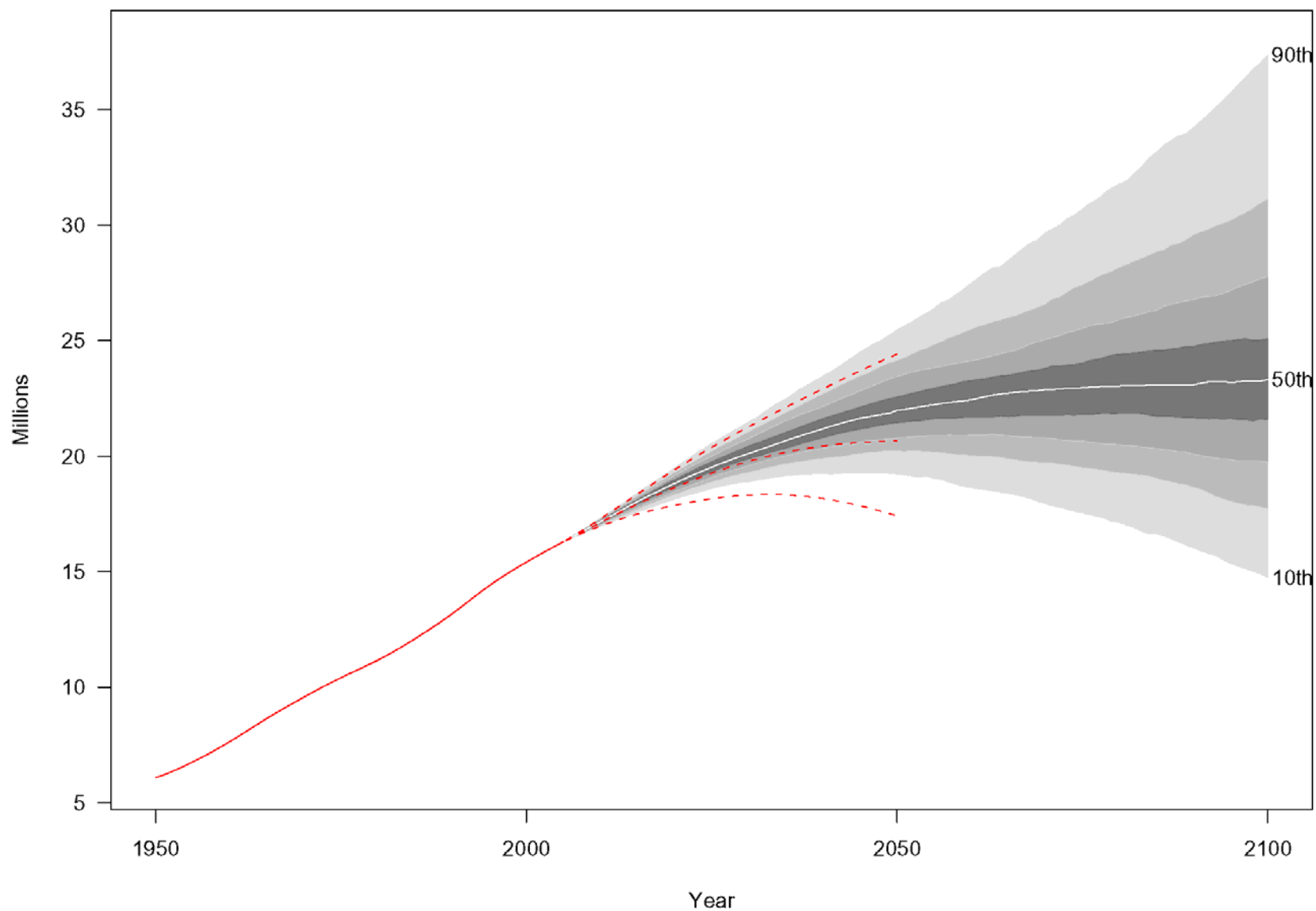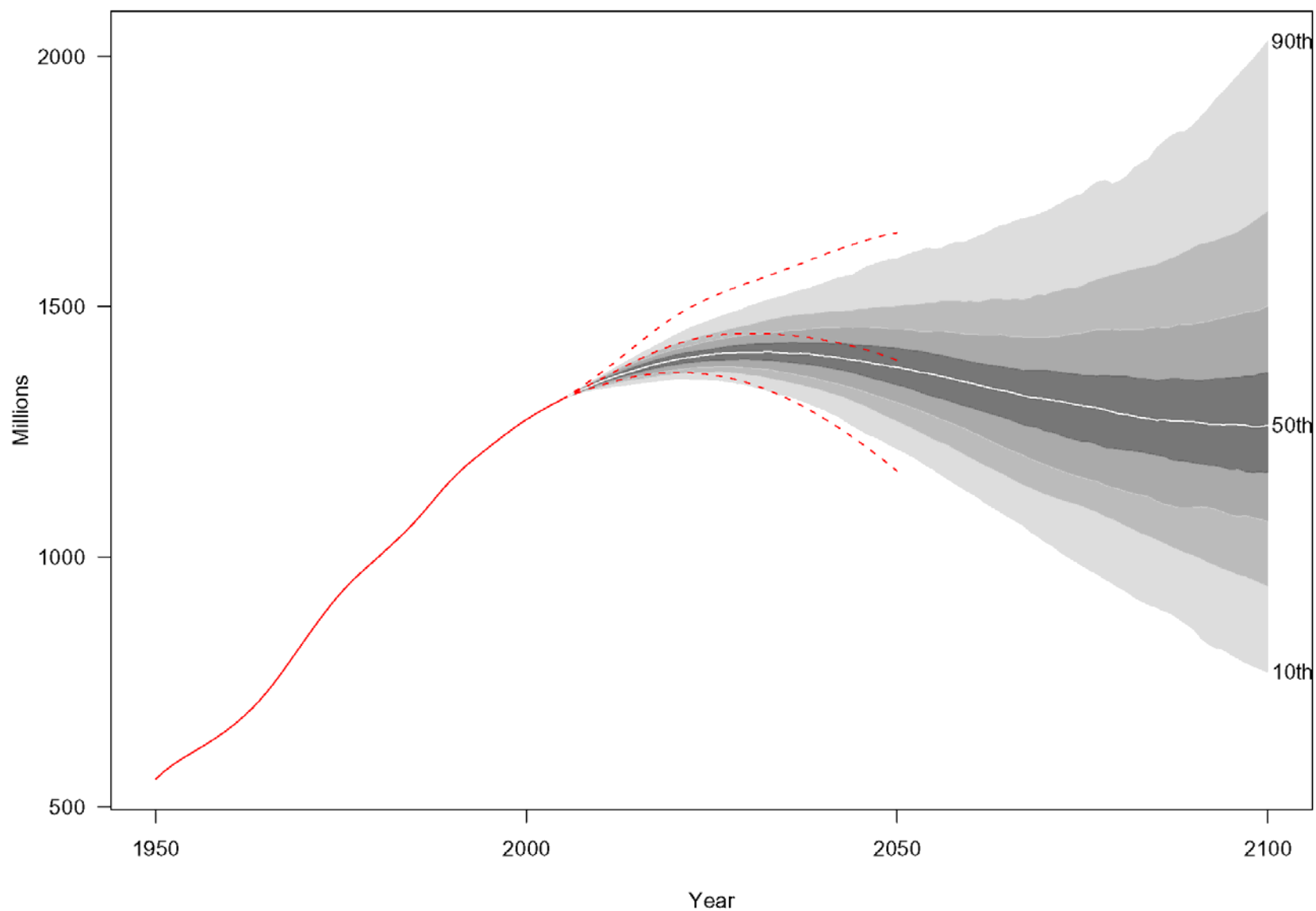
Population of Philippines , 1950 to 2100
with historical estimates, UN scenario forecasts, and RCM probability deciles.
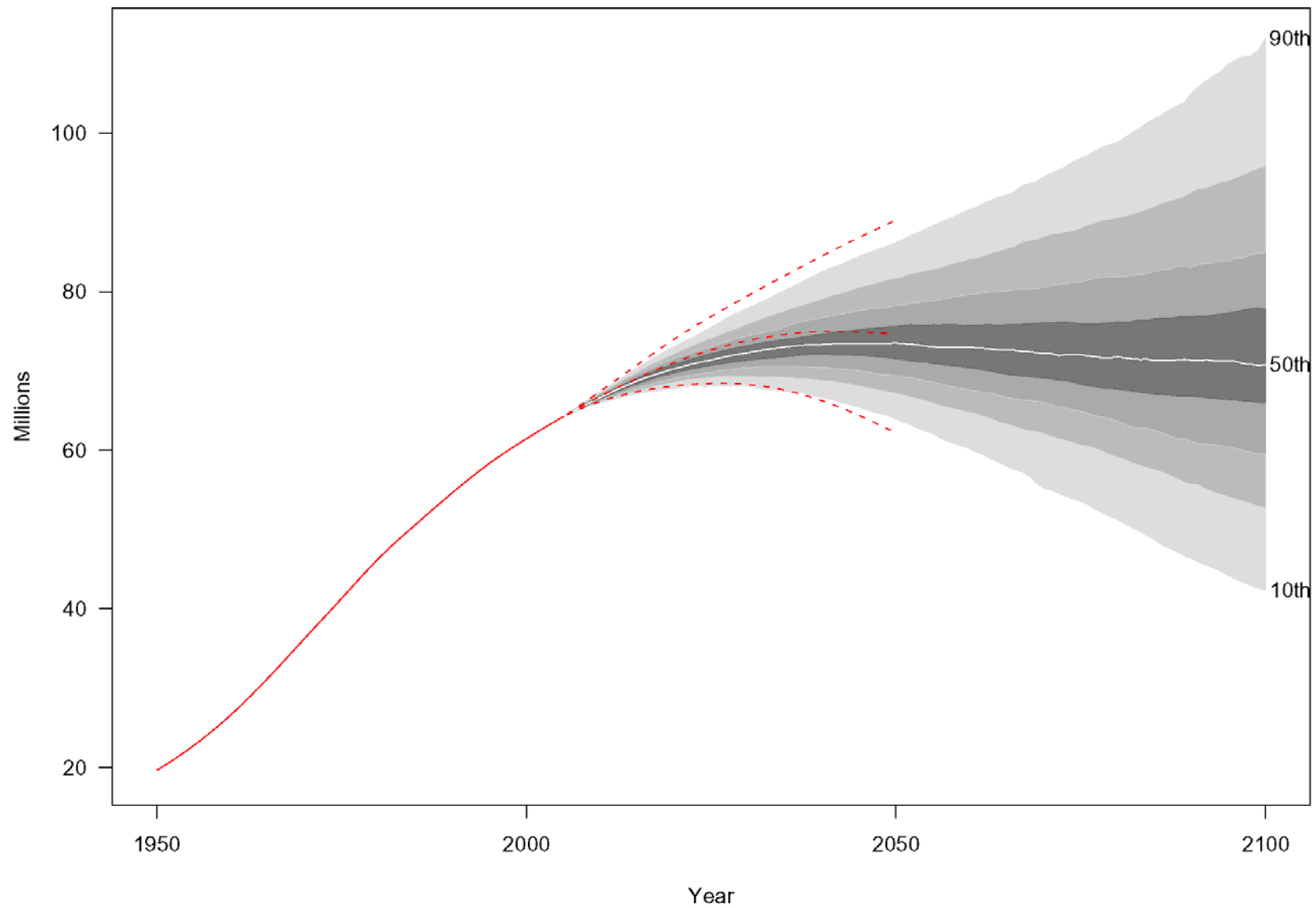
Population of India , 1950 to 2100
with historical estimates, UN scenario forecasts, and RCM probability deciles.

Population of China , 1950 to 2100
with historical estimates, UN scenario forecasts, and RCM probability deciles.
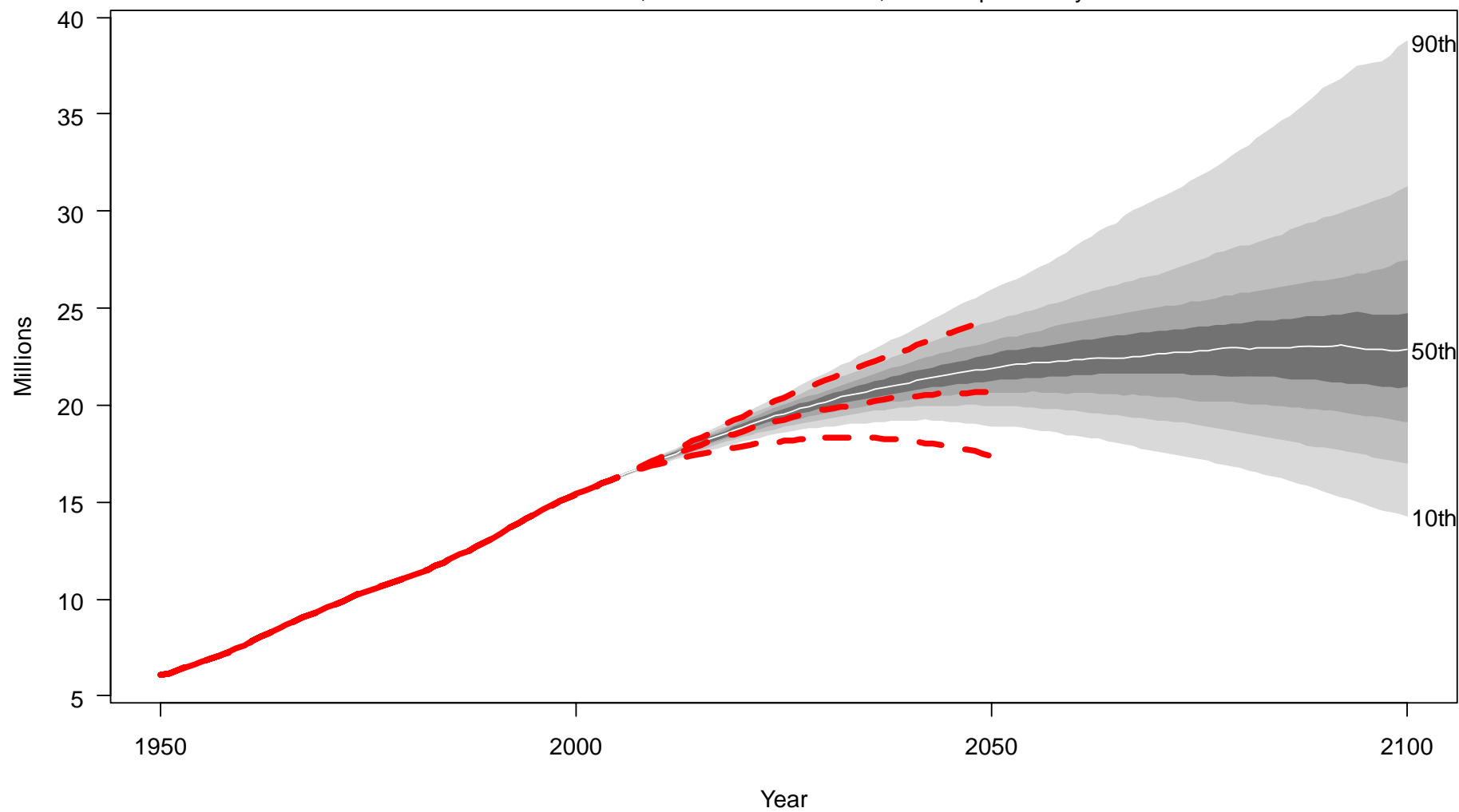
Population of Thailand , 1950 to 2100
with historical estimates, UN scenario forecasts, and RCM probability deciles.

Population of Chile, 1950 to 2100
with historical estimates, UN scenario forecasts, and VOI probability deciles.

Conclusions

➢ Likely demographic surprises that countries will face:

    ➢ Larger elderly populations than anticipated.

    ➢ Unanticipated shifts in immigration levels (e.g., from net labor exporter to net labor importer).

➢ These Random Country Model Forecasts could be used as a background against which particular scenarios could be evaluated. It leads the scenario forecaster to ask:

    ➢ Why is this country unique?

    ➢ Why would the future represent a distinct break with the past?

Three Models (Version 1.0)

1. ~~Stochastic Population Forecasts~~

2. Forecasting Educational Distribution

3. Forecasting Government Budgets