# A Systematic Assessment of National, Regional, and Global Levels and Trends in the
## Sex Ratio at Birth
### and Scenario-based Projections

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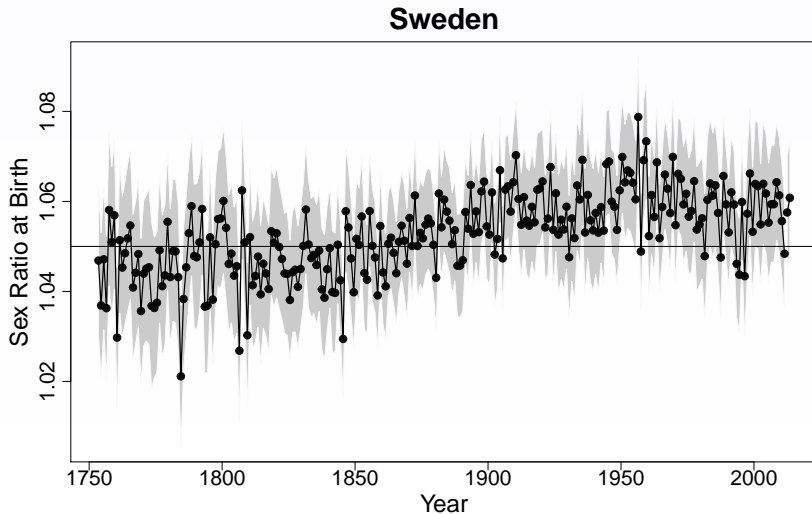[2]Mortality Section, **United Nations Population Division**
[3]Saw Swee Hock School of Public Health, **National University of Singapore**
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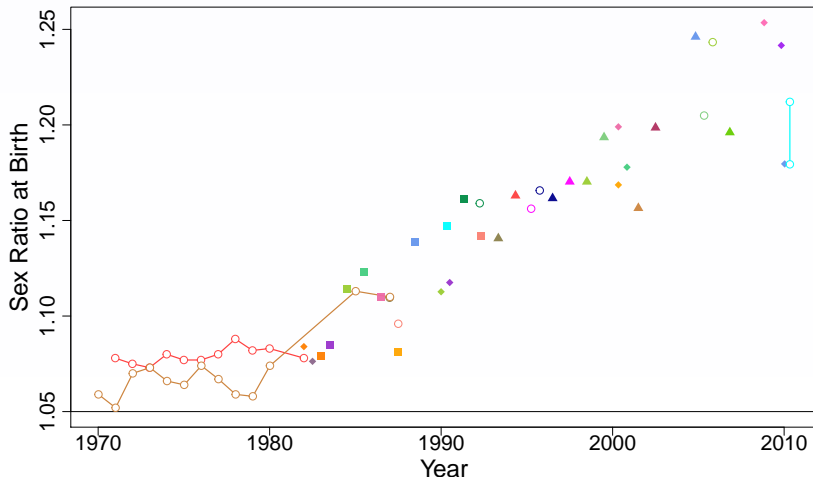
# Background

Sex Ratio at Birth (SRB): ratio of male to female live births.



**Sweden**

# Background

Observed SRB from many Asian countries have been well above the biological level (varies between 1.04 and 1.07 for decades.



**China**

## Objectives

No assessment of SRBs for all countries over time has been carried out using all available data and reproducible estimation methods.

- To estimate and project SRB on national, regional, and global level over time from 1950;
- To quantify the effect of SRB imbalance due to sex-selective abortion.

## Data

| Data source type | # obs. | (% of total) |
|:---:|:---:|:---:|
| Census | 61 | (1) |
| DHS | 2,005 | (20) |
| Other DHS | 886 | (9) |
| Others | 151 | (2) |
| VR | 6,826 | (69) |
| **total** | **9,929** | (100) |

Table 1: **Database for modeling**. DHS: Demographic and Health Surveys. VR: Vital Registration.

- 15,354 country-years of data;
- 72 country-years of data from each of the 212 countries/areas estimated.
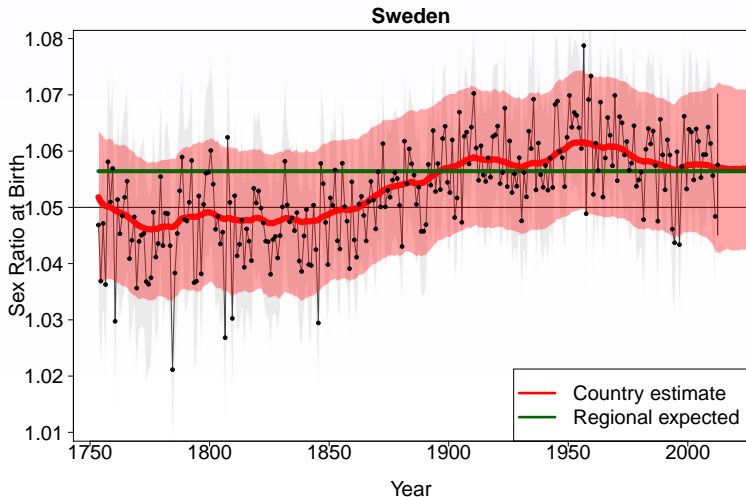
## Method – Main idea

We use two models to estimate SRB for two groups of
countries/areas:

- **Basic model**: for countries/areas **without** SRB inflation;
- **Extended model**: for selected countries/areas **with**
  past/current/potential future SRB inflation.

# Method – Model setup

**Basic model**: for country-year **without** SRB inflation:

$$\text{true.SRB}_{\text{country,year}} = \text{exp.SRB}_{\text{region}} \times P_{\text{country,year}}$$
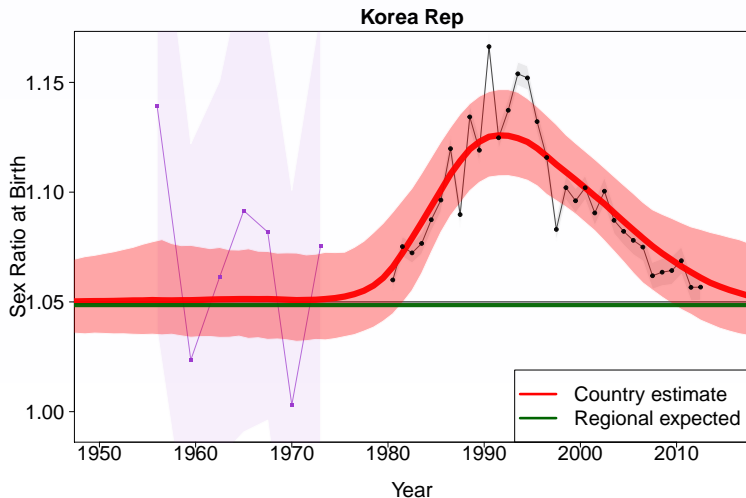


**Sweden**

Sex Ratio at Birth — (vertical axis, range 1.01 to 1.08)

Year — (horizontal axis, 1750 to 2000)

Legend:
— Country estimate (red)
— Regional expected (green)

## Method – Model setup

$$\text{true}.\text{SRB}_{\text{country},\text{year}} = \text{exp}.\text{SRB}_{\text{region}} \times \text{P}_{\text{country},\text{year}}$$

- **exp.SRB$_{\text{region}}$**: estimated using data from country-years without potential prenatal discrimination;
- **P$_{\text{country},\text{year}}$**: estimated by a time series model;
- Sampling and non-sampling errors are taken into account in the data model.

# Method – Model setup

**Extended model**: for country-year **with** SRB inflation:

$$\textcolor{red}{\textbf{true}.\textbf{SRB}_{\textbf{country,year}}} = \textcolor{green}{\textbf{exp}.\textbf{SRB}_{\textbf{region}}} \times \textbf{P}_{\textbf{country,year}} + \textcolor{blue}{\textbf{adj}_{\textbf{country,year}}}$$



Korea Rep

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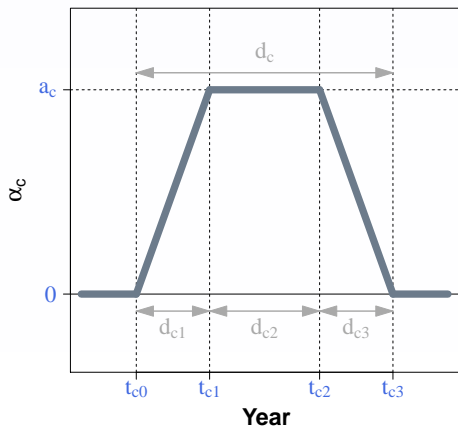
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  - **elsewhere (7)**: Albania, Algeria, Egypt, Montenegro, Morocco, Tonga.

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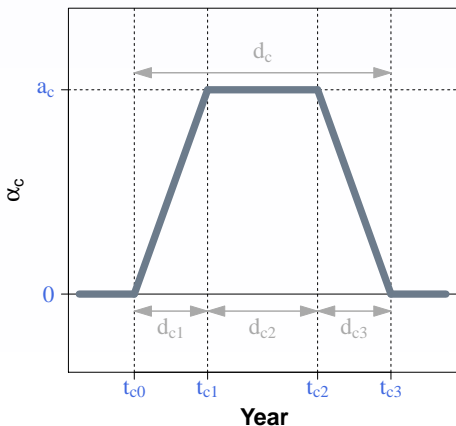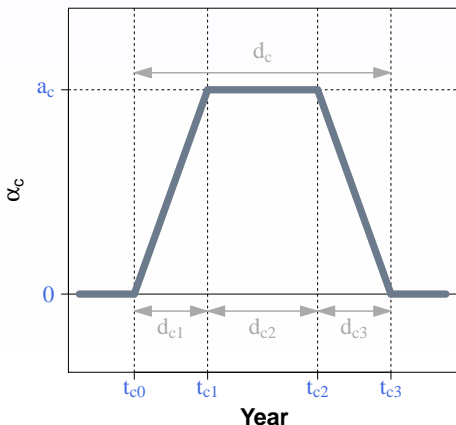


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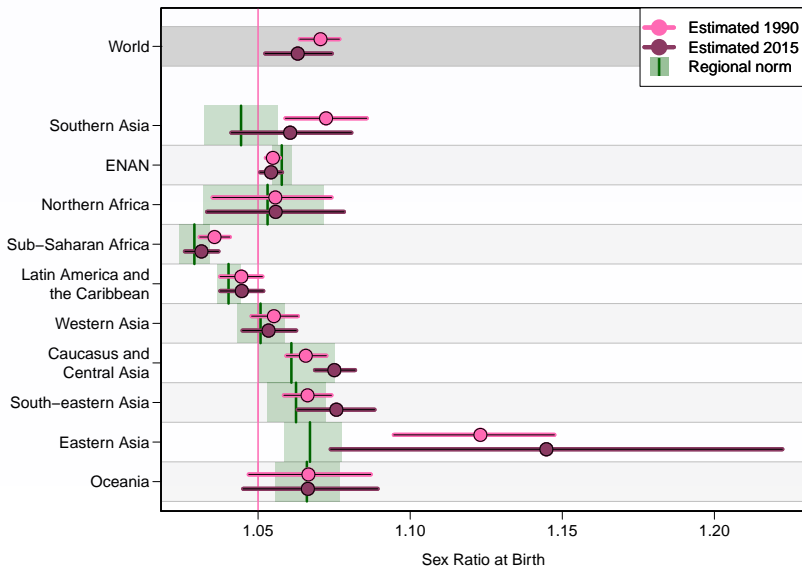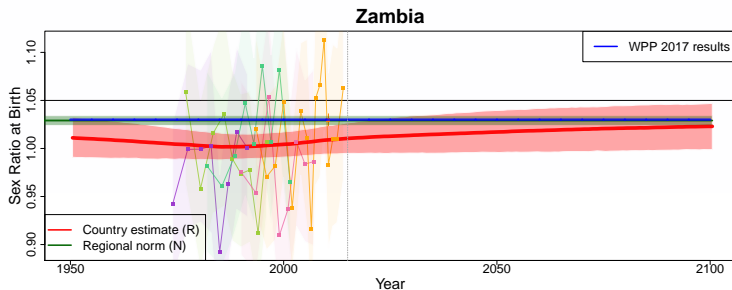
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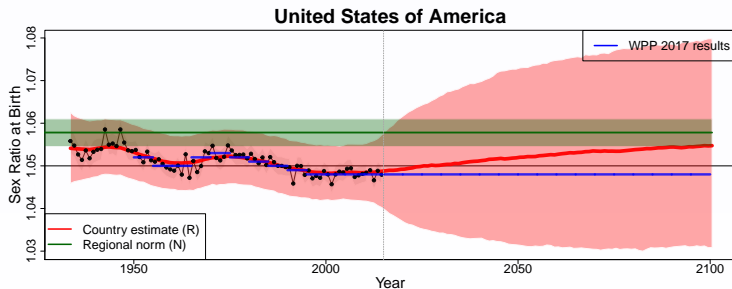
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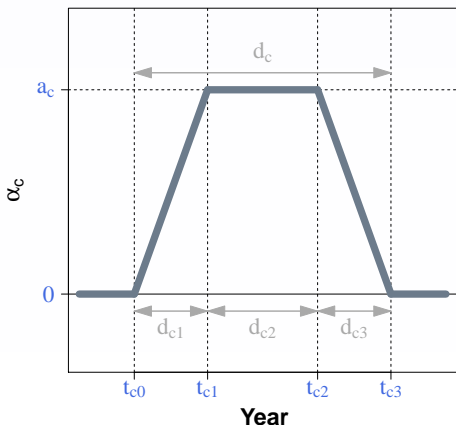


- $t_{c,0}$: starting year of inflation period (the year when TFR hits 2.8 is used);
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- $a_c$: the maximum value that the adjustment factor could reach.

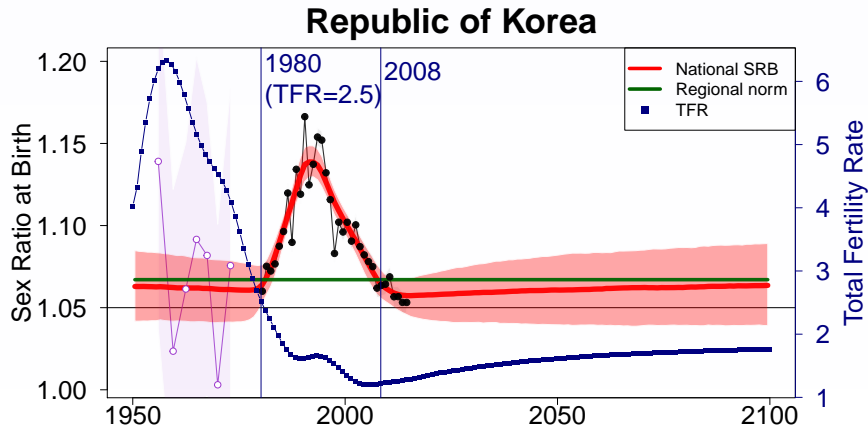# Results – Global and regional results



F Chao, P Gerland, A Cook, L Alkema

# Results – National estimates & projections



**United States of America**

WPP 2017 results

Country estimate (R)
Regional norm (N)

**Zambia**

WPP 2017 results

Country estimate (R)
Regional norm (N)

# Results – National estimates & projections

For a country with past SRB inflation:
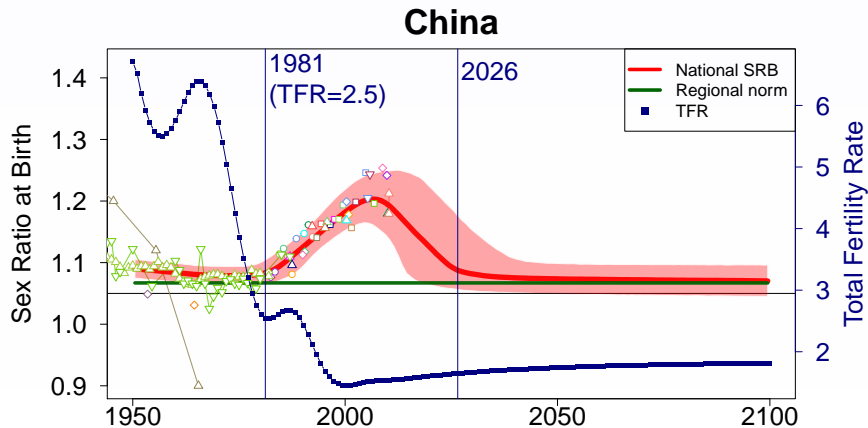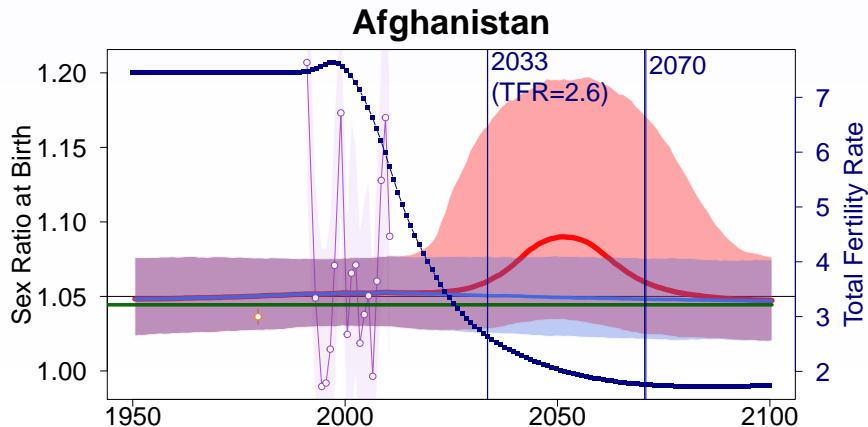


**Republic of Korea**

# Results – National estimates & projections

For a country with current SRB inflation:



China

# Results – National estimates & projections

For a country with potential future SRB inflation (based on model):



**Afghanistan**

## Summary

We constructed a country-level database for SRB, and implemented a Bayesian hierarchical time series model.

We constructed model-based national, regional, and global SRB estimations and projections up to 2100.

Ongoing research:

- How to select countries where SRBs may become distorted in the future?
- To estimate SRB, sex ratio of mortality, and under-5 sex ratios simultaneously.