

A Systematic Assessment of National, Regional, and Global Levels and Trends in **the Sex Ratio at Birth** and Identification of Countries with Outlying Levels

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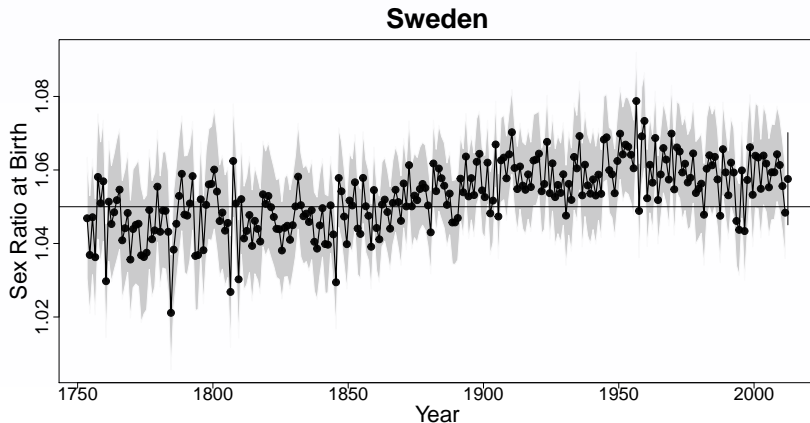
³Mortality Section, **United Nations Population Division**

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Background

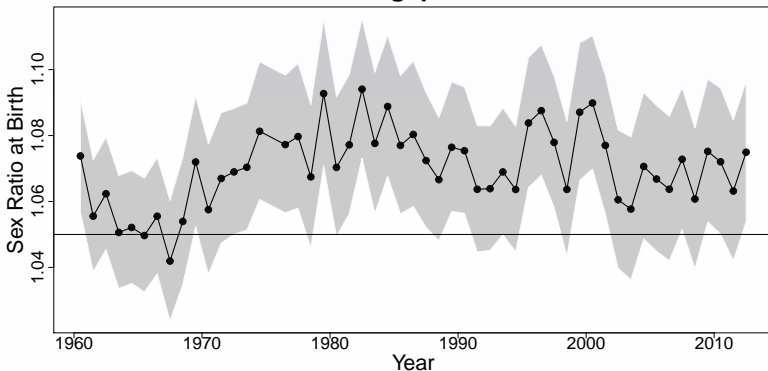
Sex Ratio at Birth (SRB): ratio of male to female live births.



Background

Observed SRB from many Asian countries have been well above the biological level (varies between 1.04 and 1.07²) for decades³⁴.

Singapore



²Anouch Chahnazarian. "Determinants of the sex ratio at birth: Review of recent literature". *Biodemography and Social Biology* 35.3-4 (1988). Available at <http://www.tandfonline.com/doi/abs/10.1080/19485565.1988.9988703#.U7ogvpSSx1Z>: 214-235. Print.

³Christophe Guilmoto. *Sex Imbalances at Birth: Current trends, consequences and policy implications*. Bangkok, Thailand: UNFPA Asia and Pacific Regional Office, 2012. 88. Web.

⁴Daniel Goodkind. "Child underreporting, fertility, and sex ratio imbalance in China". *Demography* 48.1 (2011): 291-316. Print.

Objectives

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

- To construct a database for SRB with national level data;
- To estimate and project SRB on national, regional, and global level over time from 1950;
- To identify countries/areas with outlying SRBs.

Data

Data source type	# obs.	% of total
Census	56	1
DHS	1,867	20
Other DHS	795	8
Others	148	2
VR	6,605	70
total	9,471	100

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

- 14,456 country-years of data;
- 68 country-years of data from each of the 212 countries/areas estimated.

Method – Main idea

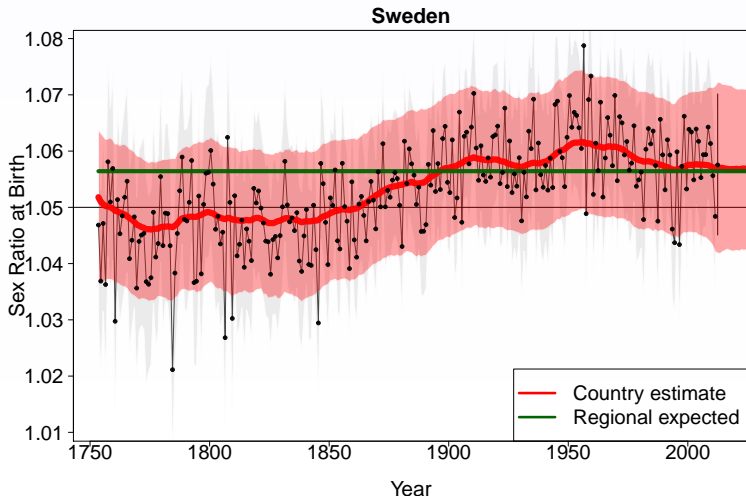
We use two models to estimate SRB for two groups of countries/areas:

- **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:

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



Method – Model setup

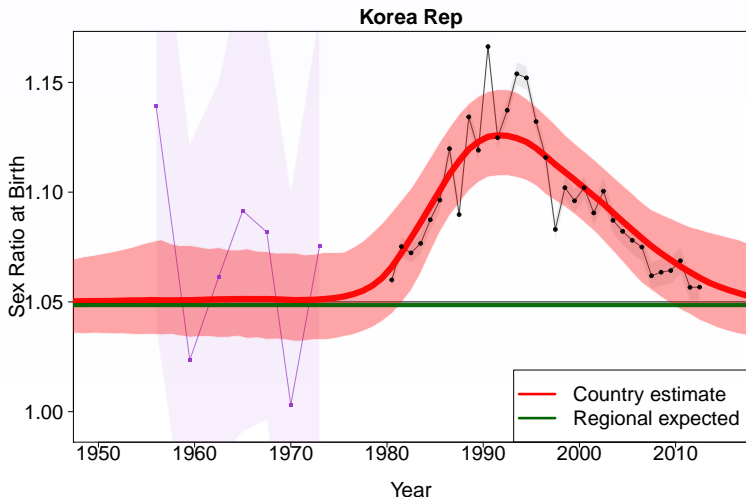
$$\text{true.SRB}_{\text{country,year}} = \text{exp.SRB}_{\text{region}} \times \text{P}_{\text{country,year}}$$

- **exp.SRB_{region}**: estimated using data from country-years without potential prenatal discrimination;
- **P_{country,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:

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



Method – Adjustment factor

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 - observed SRB is suspected to be beyond biological norm as supported by literature; OR
 - desired sex ratio at birth > 120 and/or sex ratio of last birth > 130 suggested in Bongaarts 2013⁵; OR

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- 27 selected countries/areas:

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 - **SSA (5)**: Chad, Mali, Mauritania, Niger, Senegal;
 - **Europe (2)**: Albania, Montenegro.

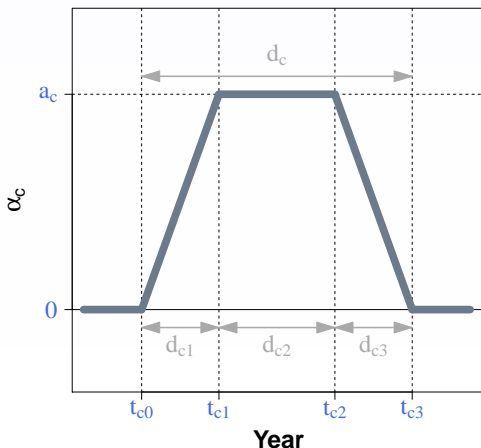
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Method – Adjustment factor

For selected country c , we use a Bayesian hierarchical model to estimate the adjustment factor.

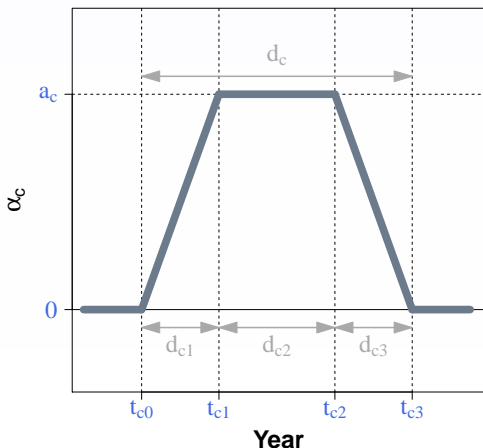
Adjustment Model Setting



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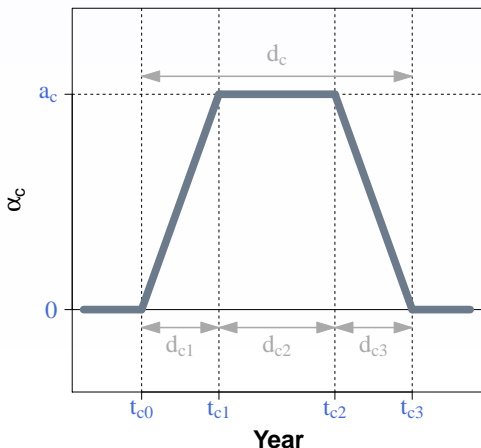


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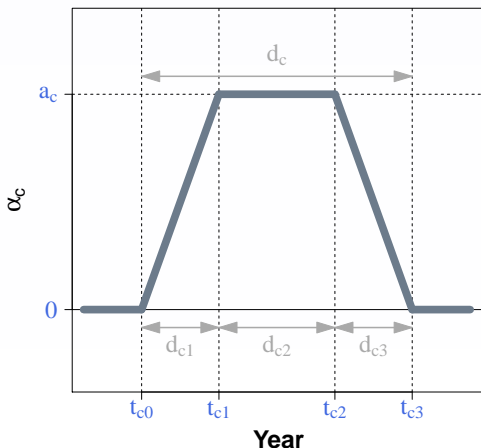


- $t_{c,0}$: starting year of inflation period (the year when TFR hits 2.1 is used);
- $d_c (= d_{c,1} + d_{c,2} + d_{c,3})$: total length of the inflation period;

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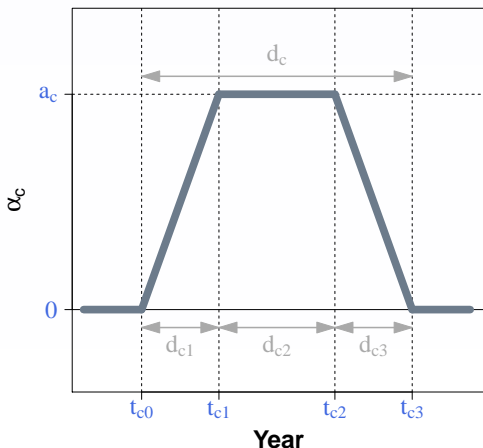


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- a_c : the maximum value that the adjustment factor could reach.

Results – Global and regional results

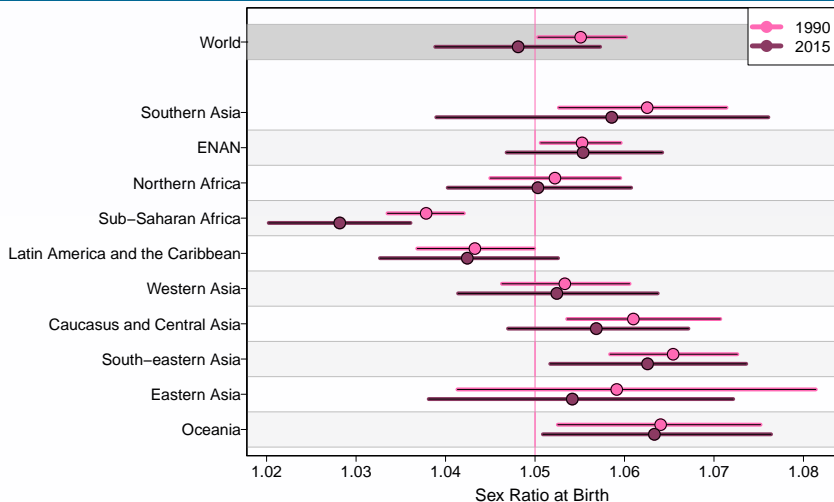


Figure: Sex ratio at birth for the world and regions in 1990 and 2015. Region “ENAN” refers to the combination of countries in Europe, North America, Australia, and New Zealand.

Results – National estimates & projections

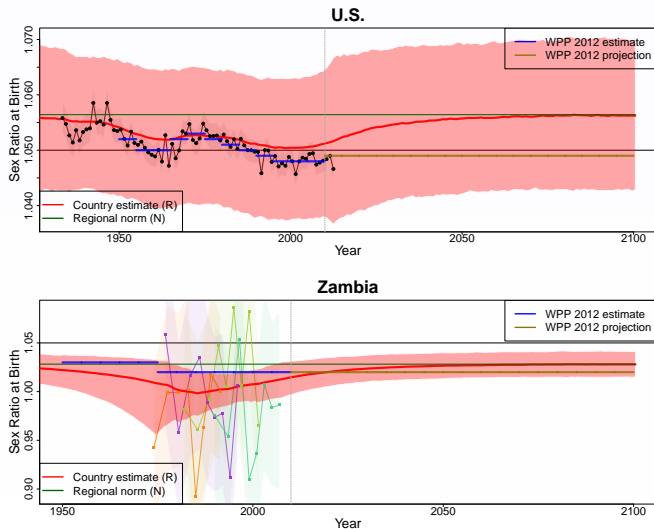


Figure: SRB over time for the United States and Zambia with WPP 2012 SRB estimates/projections.

Results – National estimates & projections

For a country with past SRB inflation:

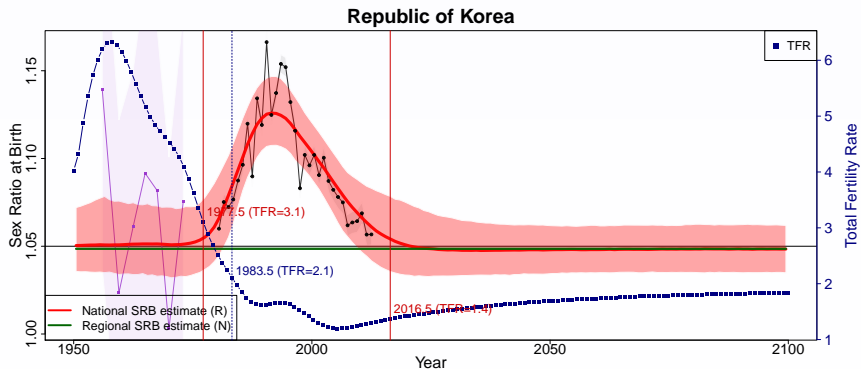


Figure: SRB over time for Republic of Korea with WPP 2012 TFR estimates/projections.

Results – National estimates & projections

For a country with current SRB inflation:

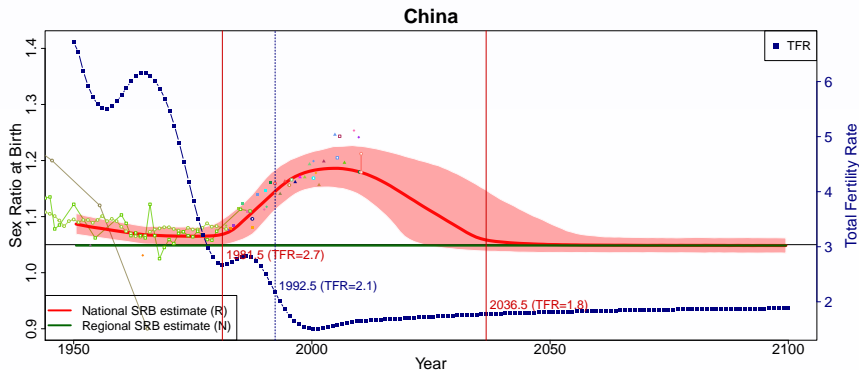


Figure: SRB over time for China with WPP 2012 TFR estimates/projections.

Results – National estimates & projections

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

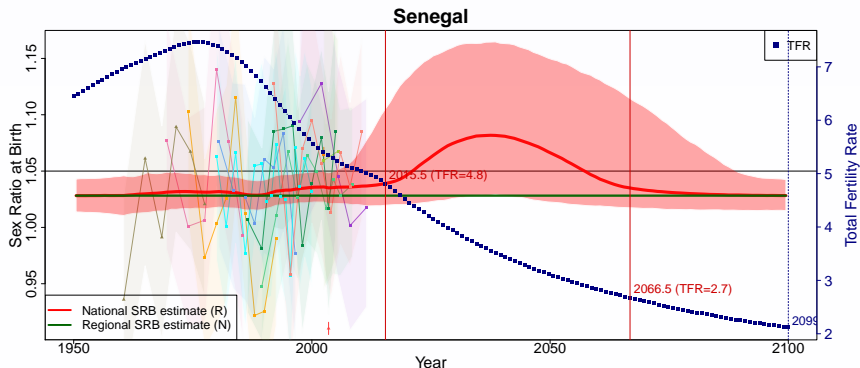


Figure: SRB over time for Senegal with WPP 2012 TFR estimates/projections.

Results – Countries/areas with outlying SRBs

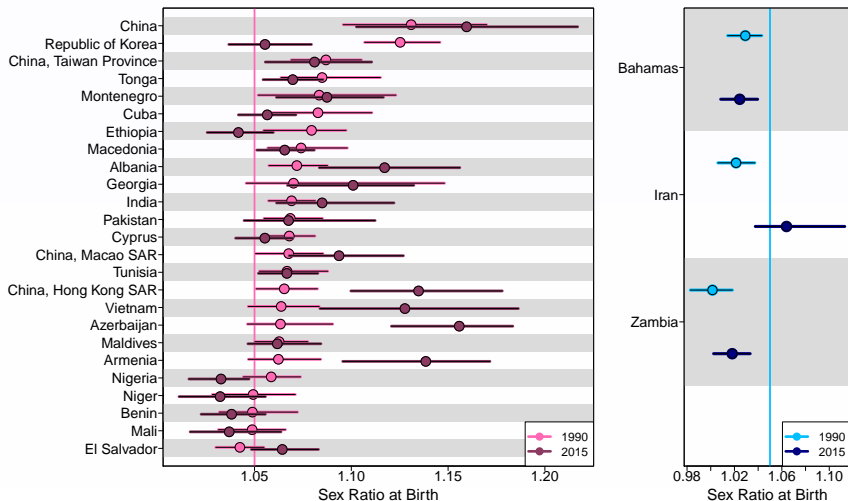


Figure: Countries/areas with outlying SRB in 1990 and/or 2015. “Outlying” means the 95% CI does not include their corresponding regional norms.

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.