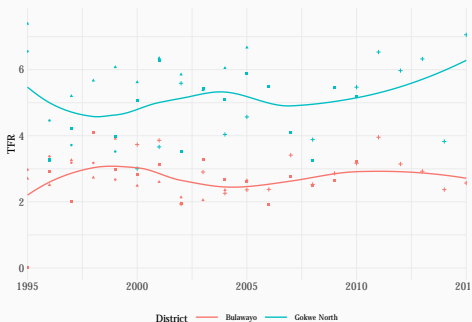


Small area estimation of district-level fertility in sub-Saharan Africa

Oli Stevens
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6th April 2020

- UNAIDS Reference Group for Estimates, Modelling and Projections provides technical recommendations to UNAIDS for the creation of annual HIV estimates
- Newly created subnational estimation model - Naomi
 - District-level estimates of prevalence, incidence, ART coverage by sex and 5 year age groups

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- Newly created subnational estimation model - Naomi
 - District-level estimates of prevalence, incidence, treatment coverage by sex and 5 year age groups
- District level estimates of fertility desired for:
 - Estimation of children living with HIV
 - Key epidemic indicator
 - Resource allocation for prevention of mother-to-child transmission
 - Improved projections at district level

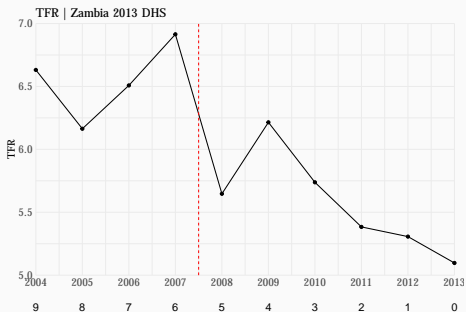
- Demographic Health Surveys
 - Geomasked coordinates assigned to district
 - 1999, 2005, 2010, 2015
- Multiple Indicator Cluster Survey
 - Survey region indicator
 - 2009, 2014, 2019
- Birth history data:
 - DHS, MICS: 15 years
 - (Malaria Indicator Survey/AIDS Indicator Surveys): 5 years

- R packages *rdhs* and *demogsurv*
- Reconstruct survey-weighted births and observed person years, by single year, 5 year age groups, and district
 - CMC respondent's birth
 - CMC respondent's births
 - CMC interview

- DHS collects full birth histories for children in the previous 5 years, and an abbreviated question set thereafter
- Interviewers can reduce workload by:
 - Displacing
 - Omitting

Data and workflow | Non-sampling bias in household surveys

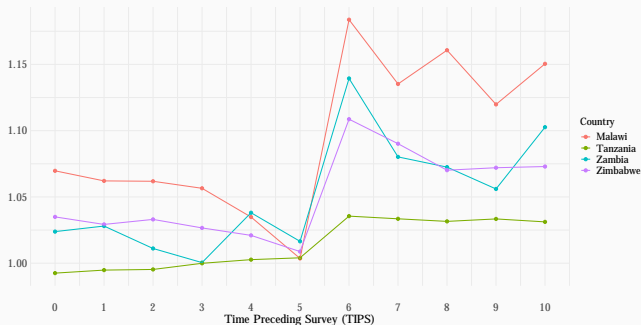
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- Intersurvey analysis can estimate magnitude of bias due to overlap in recall periods
 - Many countries within SSA have surveys of moderate or poor quality

Data and workflow | Non-sampling bias in household surveys

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Model specification

$$b_{ait} \sim Po(\lambda_{ait} \cdot E_{ait})$$

$$\log(\lambda_{ait}) = \mu + \alpha_a + \gamma_t + \delta_i + \eta_{a,t} + \eta_{a,i} + \eta_{i,t}$$

$$\mu \sim N(0, 5)$$

$$\alpha_a \sim RW1(\sigma_\alpha^2)$$

$$a \in \{15 - 19, 20 - 24 \dots 45 - 49\}$$

$$\delta_i \sim BYM2(\sigma_\delta^2)$$

$$i \in \{1 \dots n_i\}$$

$$\gamma_t \sim RW2(\sigma_\gamma^2)$$

$$t \in \{1995 : 2020\}$$

Model specification

$$b_{ait} \sim Po(\lambda_{ait} \cdot E_{ait})$$

$$\log(\lambda_{ait}) = \mu + \alpha_a + \gamma_t + \delta_i + \eta_{a,t} + \eta_{a,i} + \eta_{i,t}$$

$$\eta_{a,t} \sim N(0, \sigma_{\eta_{a,t}}^2) \quad AR1 \otimes AR1$$

$$\eta_{a,i} \sim N(0, \sigma_{\eta_{a,i}}^2) \quad AR1 \otimes ICAR$$

$$\eta_{i,t} \sim N(0, \sigma_{\eta_{i,t}}^2) \quad ICAR \otimes AR1$$

Model specification

$$b_{ait} \sim Po(\lambda_{ait} \cdot E_{ait})$$

$$\log(\lambda_{ait}) = \mu + \alpha_a + \gamma_t + \delta_i + \eta_{a,t} + \eta_{a,i} + \eta_{i,t}$$

Observation model

$$\log(\hat{b}_{ait}) = \log(\lambda_{ait} \times E_{ait}) + \beta_1 TIPS_d + \omega_{TIPS}$$

$$TIPS_d = \begin{cases} 0, & \text{if } TIPS < 5 \\ 1, & \text{otherwise} \end{cases}$$

$$\omega_{tips} \sim RW1(\sigma_\omega^2)$$

$$tips \in \{0 : 14\}$$

tfr maps at 3 admin levels

tfr trend at admin 1

asfr from all districts in overlay plot to see distribution

- Projections → leontine
- Survey effects - not necessarily surveyid iid, but survey type iid? probs not identifiable. TZA example where AIS and MIS far from DHS
- Census data, other surveys, summary birth histories