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

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Introduction

- District level estimates of fertility desired for:
  - Improved population projections at subnational levels
  - Estimation of children living with HIV
    - Key epidemic indicator
    - Resource allocation for prevention of mother-to-child transmission
  - Evaluation of family planning programamtic scaleup

Objective Estimate annual age-specific fertility rates at district level for SSA countries from household survey data

Data sources | Malawi

- Household surveys with full birth histories
  - Demographic Health Surveys (2000, 2004, 2010, 2015)
  - Malaria Indicator Survey (2012, 2014, 2017)
  - Multiple Indicator Cluster Survey (2006, 2013)
- Full birth history data:
  - DHS, MICS: 15 years
  - MIS: 5 years

Challenges

- Non sampling biases
  - Displacing
  - Omitting
- Data available at di□erent spatial resolutions
  - DHS: geomasked coordinates –> district
  - MICS: coordinates unavailable –> province

Data and workflow | Non-sampling bias in household surveys

- DHS collects full birth histories for children in the 5 years preceding the survey, and an abbreviated question set thereafter
- Births are asked about “in the order in which they occured”

Model specification

$$_{a\,t} \square \quad (\ _{a\,t}, \ _{a\,t})$$

$$(\ _{a\,t}) = \quad + \ _{a} + \ _{t} + \quad + \ _{a,t} + \ _{a,} + \ _{,t}$$

Average log fertility rate: $\square$ (0 5)

Age pattern: $_{a} \square$ 1($^{2}_{\alpha}$) $\square$ {15 – 19 20 – 24 45 – 49}

Time trend: $_{t} \square$ 2($^{2}_{\gamma}$) $\square$ {1995 : 2020}

Spatial correlation: $\square$ 2($^{2}_{\delta}$) $\square$ {1 *n* }

Model specification

$$_{at} \square \quad (\ _{at} - \ _{at})$$

$$(\ _{at}) = \quad + \ _{a} + \ _{t} + \quad + \ _{a,t} + \ _{a,} + \ _{,t}$$

Observation model

$$(\tilde{}_{at}) = \quad (\ _{at} \times \ _{at}) + \beta_1 \quad _{d} + \quad IP$$

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

$$_{tps} \square \quad 1(\ _{\omega}^{2}) \qquad \square \{0 : 14\}$$

Model specification

$$_{at} \square \quad (\quad _{at} - \quad _{at})$$

$$(\quad _{at}) = \quad + \quad _{a} + \quad _{t} + \quad + \; _{a,t} + \; _{a,} + \; _{,t}$$

Aggregation model

$$(\tilde{\ }_{at}) = \sum$$

Model specification

- Model fit in Template Model Builder (TMB)
- Countries take < 2 minutes to fit and sample

Results

Discussion

- There exists district-level heterogeneity that is not captured by admin-1 estimates
- Non-sampling bias can lead to substantial distortion of fertility estimates in surveys
    - Role of bias adjustment depends on measure of fertility
- Can be adjusted for within automated analysis
- Consideration of further non-sampling bias
    - Displacement of first birth(s) at older ages

Many thanks

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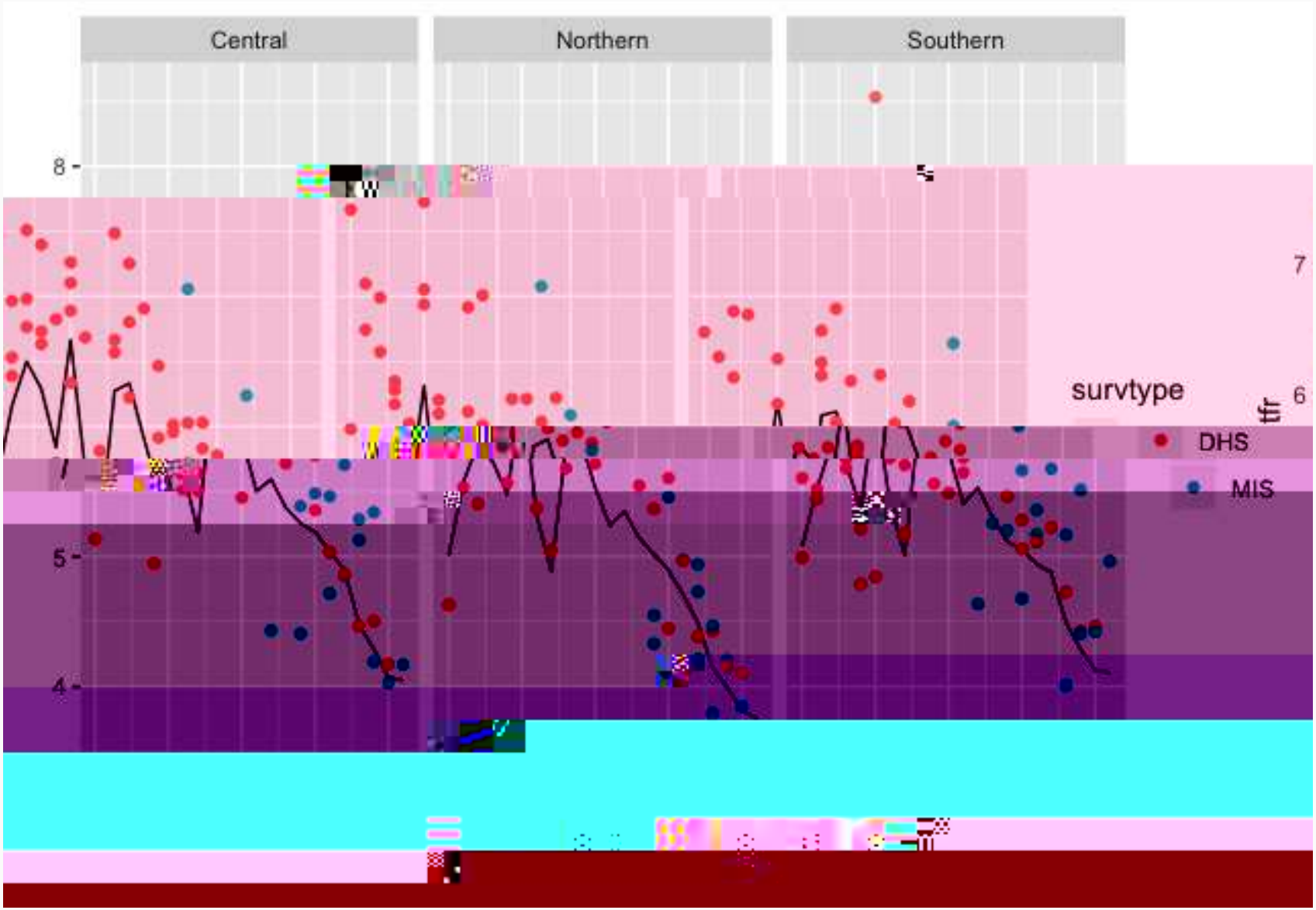
Extras



Extras

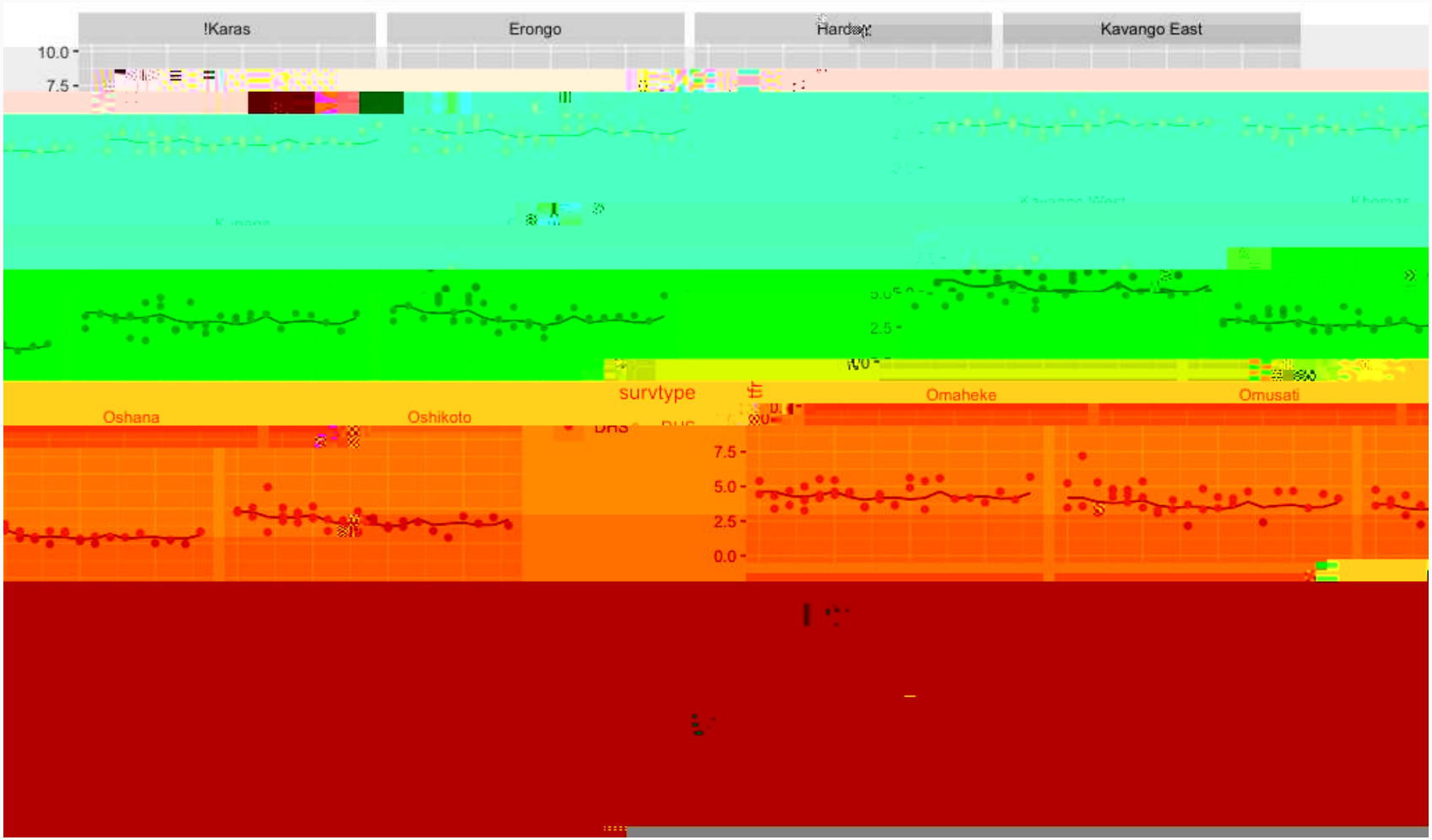


Figure 2: NAM admin-1

Extras

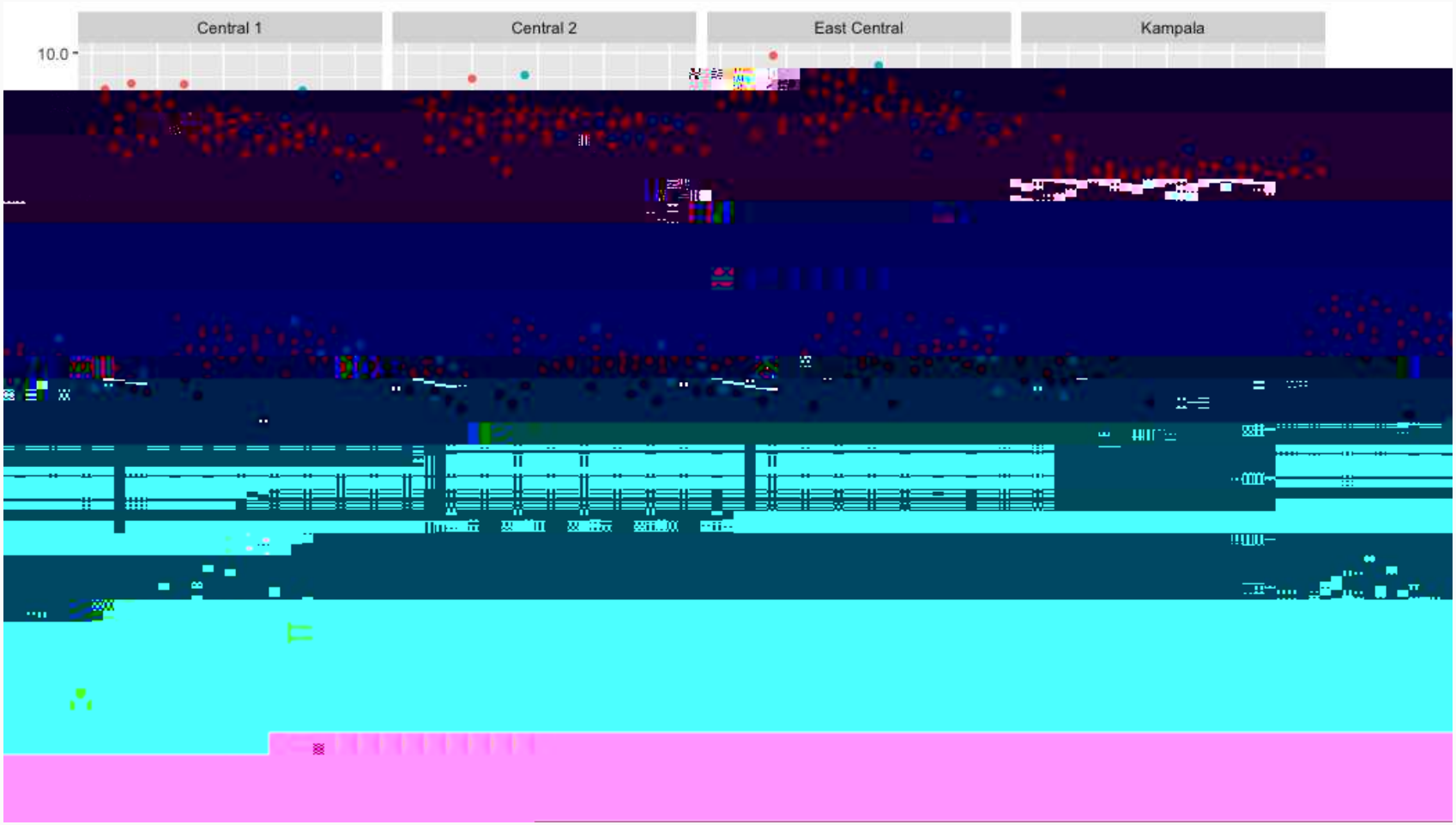
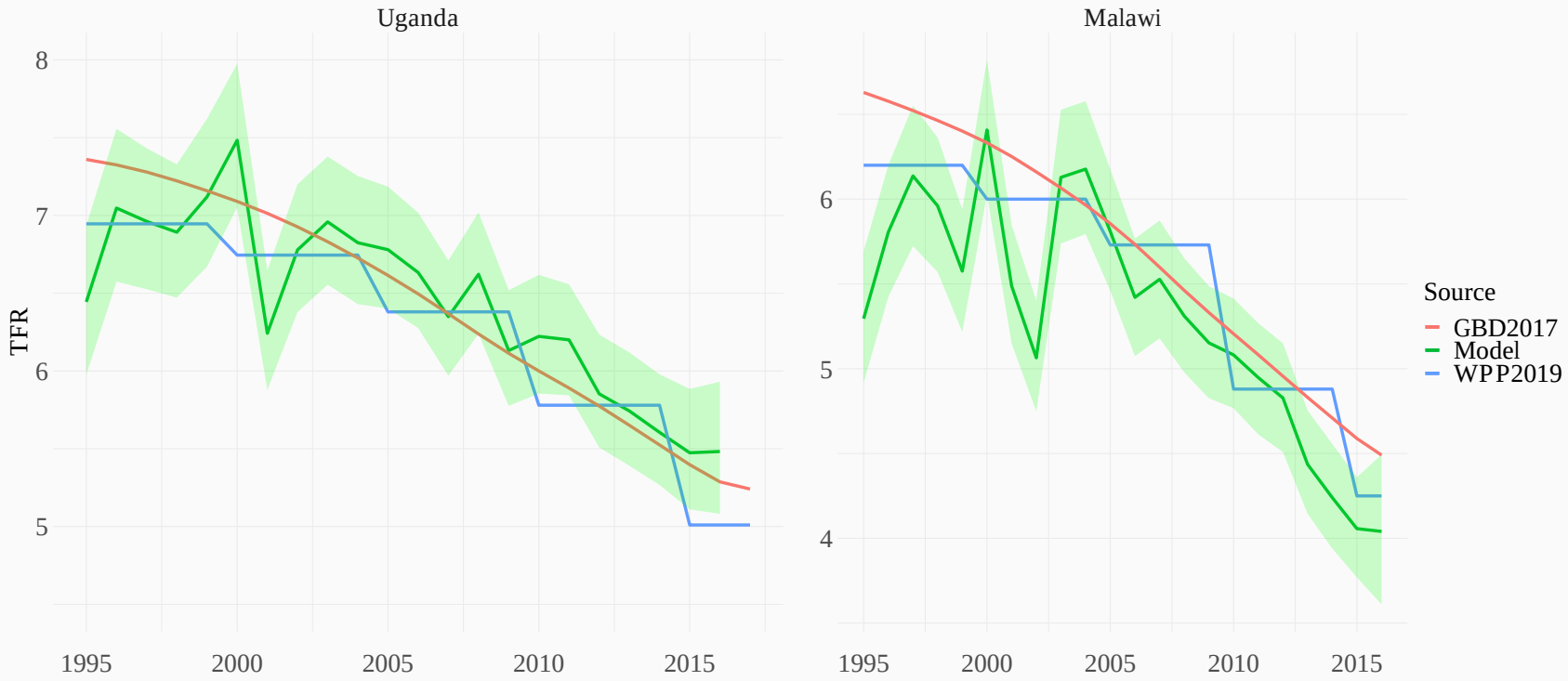


Figure 3: UGA admin-1

Extras

Figure 4: ZMB admin-1

Extras


Uganda
Malawi
TFR
8
7
6
5
4
1995
2000
2005
2010
2015
Source
GBD2017
Model
WPP2019