Detecting omissions of recent births in birth histories in Sub-Saharan Africa

Bruno Schoumaker

Université catholique de Louvain, Belgium

bruno.schoumaker@uclouvain.be

March 20, 2012 – INED – journée Pôle Sud

Objectives & outline

1. Evidence of omissions of recent births in previous research
   - Various methods, mixed results
2. Comparisons of retrospective TFRs from successive DHS
   - Large discrepancies in many countries
3. Method to detect/measure omissions of recent births
   - Comparison of retrospective estimates from successive surveys
   - Modeling fertility trends by combining multiple surveys
4. Omissions of recent births in sub-Saharan Africa
   - 52 DHS in sub-Saharan Africa
5. Further evidence of omissions of recent births
   - Crisscross estimates of fertility

Context

- Major data source for fertility levels, trends & determinants in Africa
  - Full birth histories
  - Recent fertility (fertility rates and TFR, last 3 years)
- Previous work on data quality in birth histories
  - Omissions of births at young ages among older cohorts
    - Well studied with the WFS data
  - Birth displacements in DHS
    - Linked to the design of the questionnaire – lengthy health section
    - Serious issue in Sub-Saharan Africa (Pullum, 2006)
  - Less research on omissions of recent births
    - Potentially serious issue – with strong consequences on fertility levels and trends (and on child mortality)

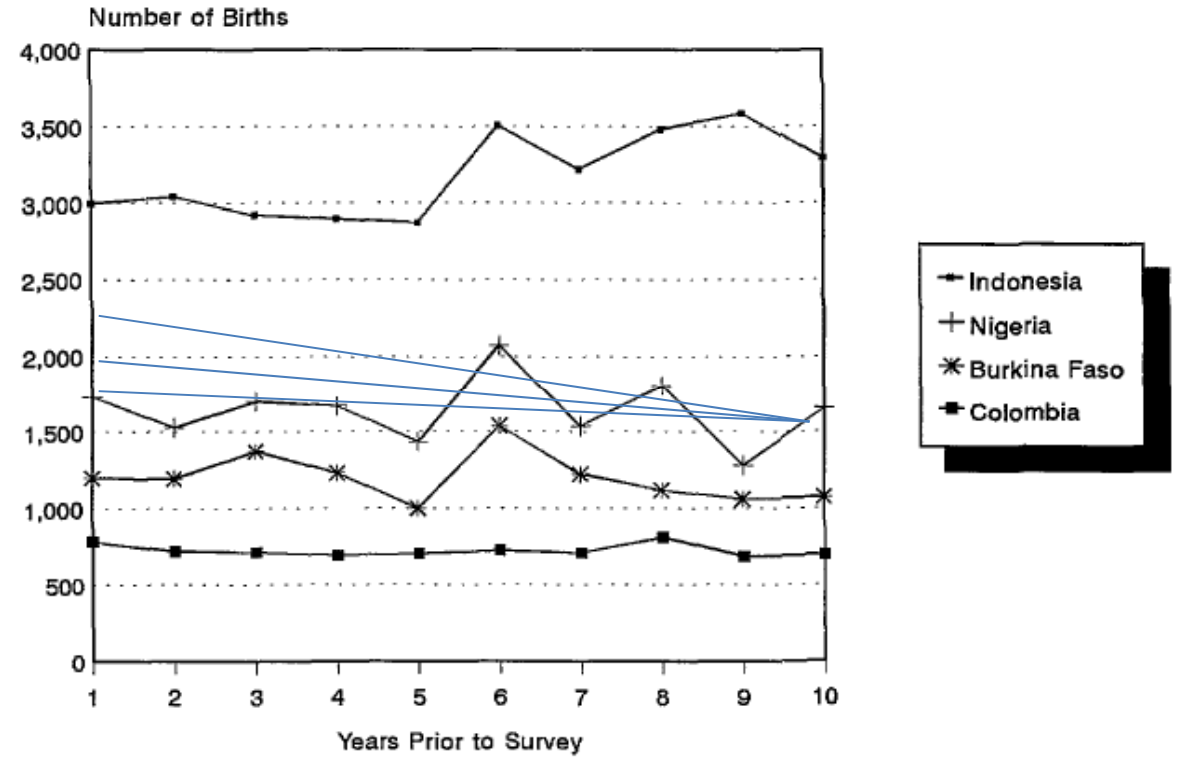
1. Evidence from previous research

Evidence on omissions of recent births (1)

- Arnold (1990)
  - Sex ratios at birth
  - Omissions of boys in 2 out of 9 DHS in Sub-Saharan Africa
- Sullivan et al. (1990)
  - Neonatal/infant mortality
  - No omissions of children deceased in early infancy (9 DHS)
- Cleland et al. (1994)
  - P/F method
  - No evidence of omissions in 13 DHS in SSA
- Marckwardt and Rutstein (1996)
  - Distribution of births by years (calendar or before survey)
  - No evidence of substantial omissions in 12 DHS in SSA

Distribution of births by years

Figure 1: Number of Births by Calendar Year Prior to Survey for Selected DHS-II Surveys

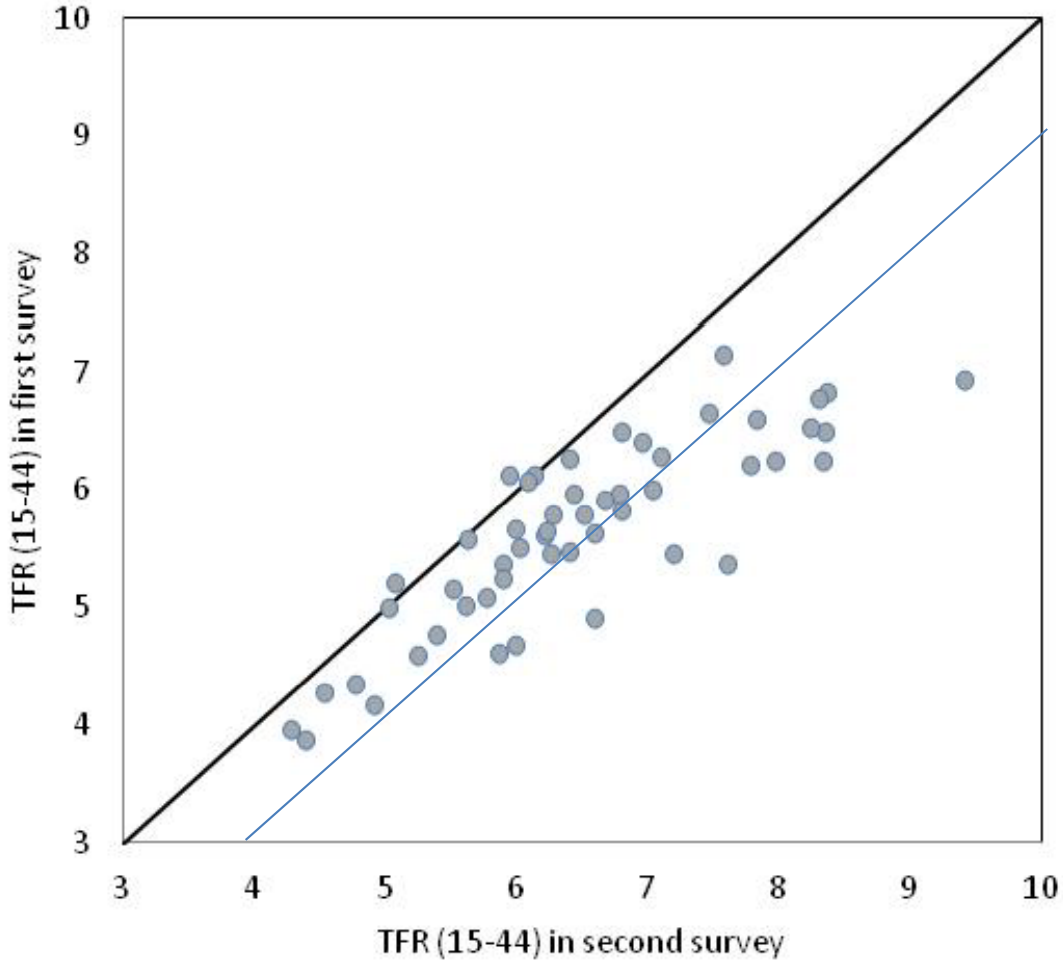


Source : Marckwardt & Rutstein (1996), Accuracy of DHS-II Demographic Data: Gains and Losses in Comparison with Earlier Surveys, *DHS Working Paper 19.*

Evidence on omissions of recent births (2)

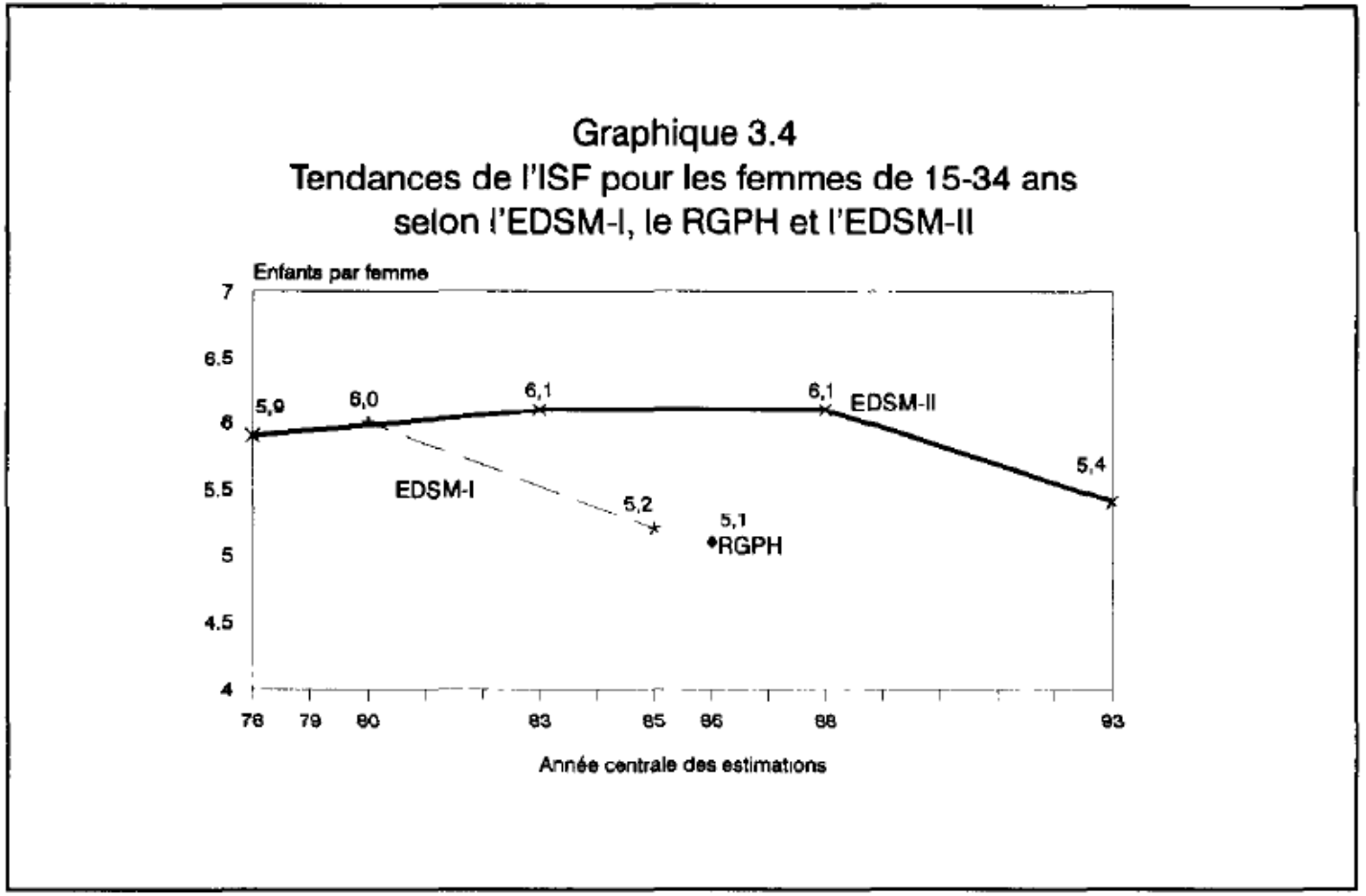
- DHS reports
  - Distribution of births by calendar years, comparisons of TFRs from successive surveys
  - Substantial omissions in a few surveys (Nigeria 1999, Liberia 2007, Mali 1987)
  - But common comment
    - « …les tests de cohérence ont montré que le sous-enregistrement des naissances et l'imprécision des déclarations de date de naissance et/ou d'âge ne sont pas suffisamment importants pour affecter de façon significative les niveaux de fécondité actuels. »
- Johnson, Rutstein and Govindasamy (2005)
  - Unusually low sex ratio at birth and NNM/IM
  - Omissions of births in Ghana 1998 DHS
- Pullum (2006)
  - comparisons of 3-year TFRs from successive surveys
  - Serious discrepancies (>1 child) in 7 countries in SSA

Comparison of TFRs from successive surveys



2. Comparison of annual fertility trends from successive DHS

Trends in TFR 15-34 - Mali

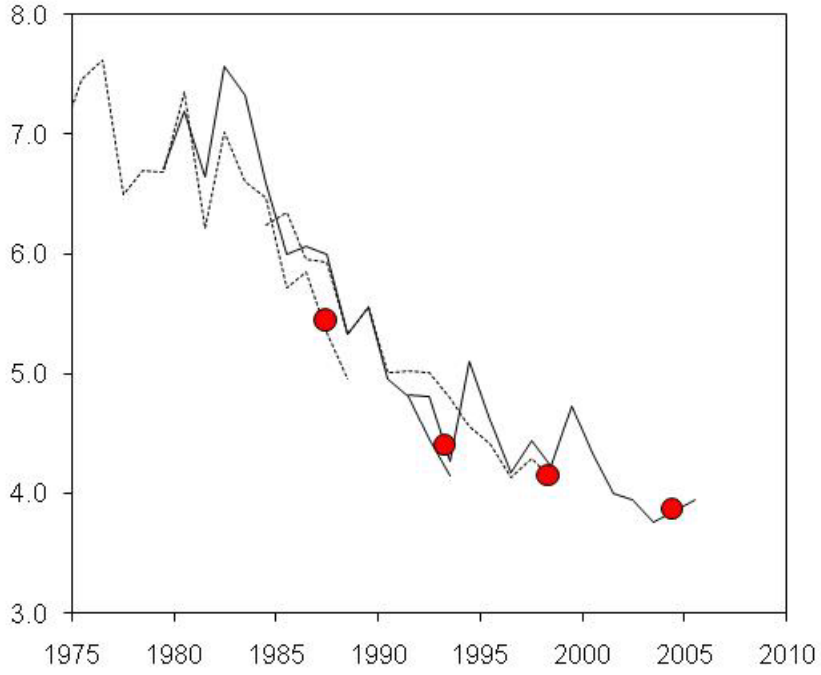


Source : 1995-95 Mali DHS Report

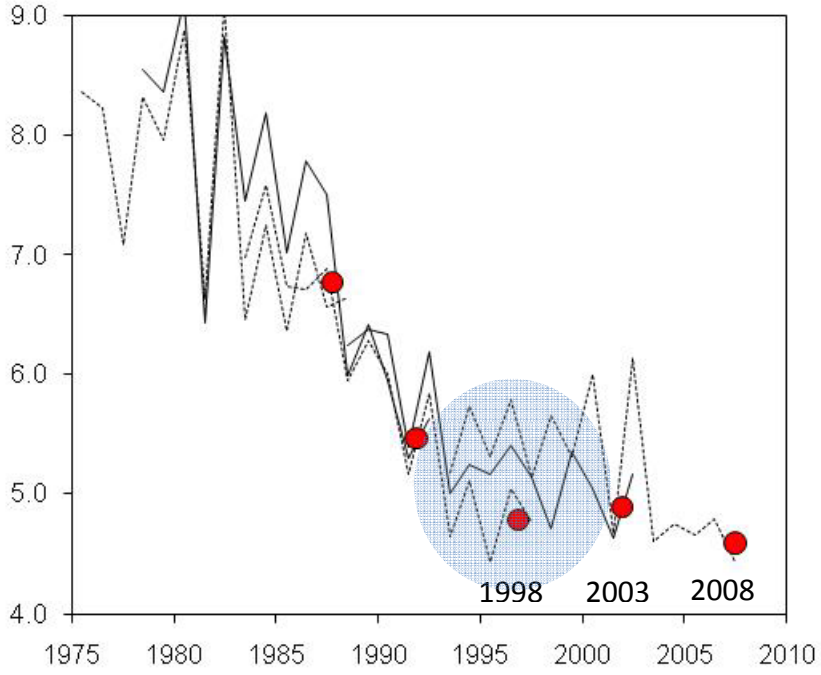
Method

- Reconstruction of TFR (15-49) over 15 years
  - Person-period data
    - Age and year constant on each line (period)
    - Aggregate into event/exposure table
  - Poisson regression
    - Dependant variable : births in period
    - Independant variables : age and year (dummy variables)
    - Exposure (duration of period)
  - TFR computed from regression coefficients
    - Assumption of constant age-schedule
    - Robust for 15 years

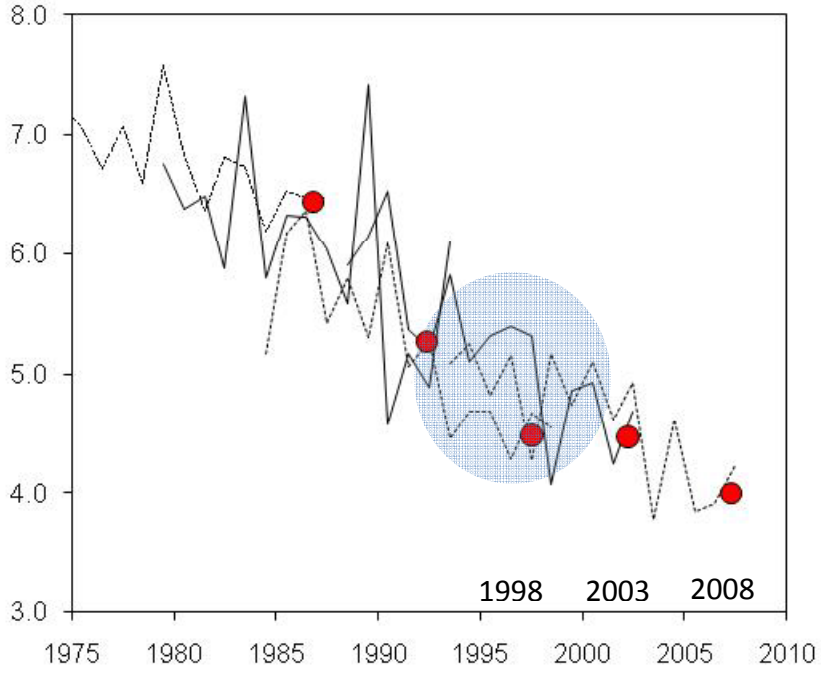
Zimbabwe



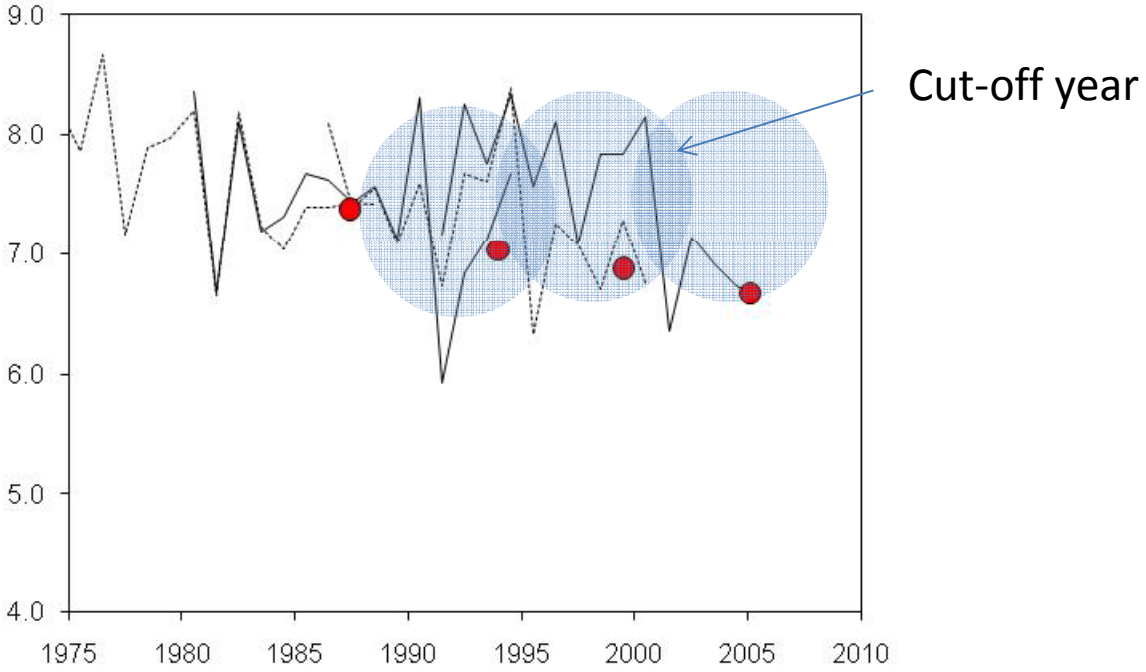
Kenya


9.0
8.0
7.0
6.0
5.0
4.0
1975
1980
1985
1990
1995
2000
2005
2010
1998
2003
2008

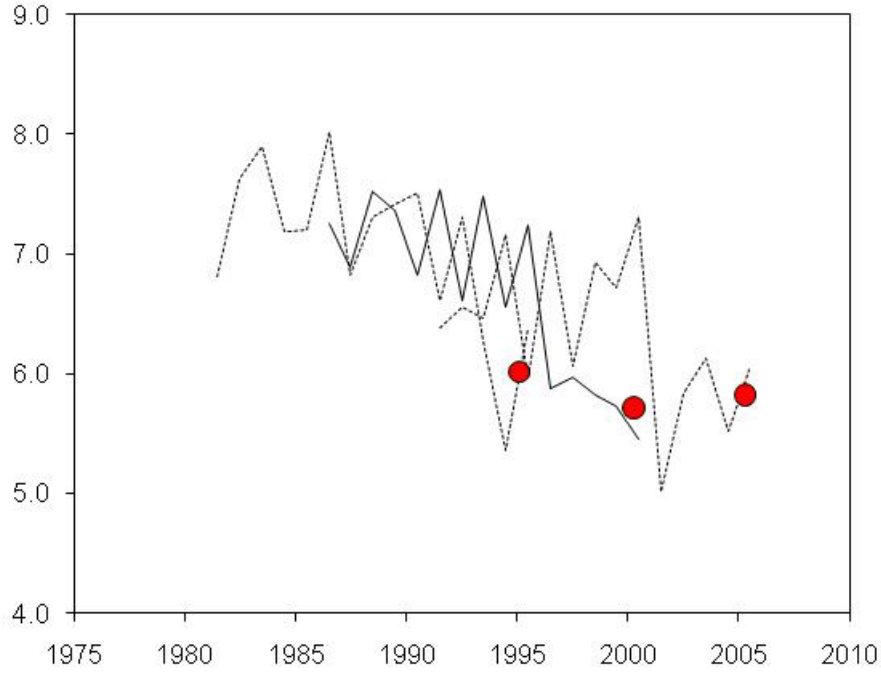
Ghana


8.0
7.0
6.0
5.0
4.0
3.0
1975
1980
1985
1990
1995
2000
2005
2010
1998
2003
2008

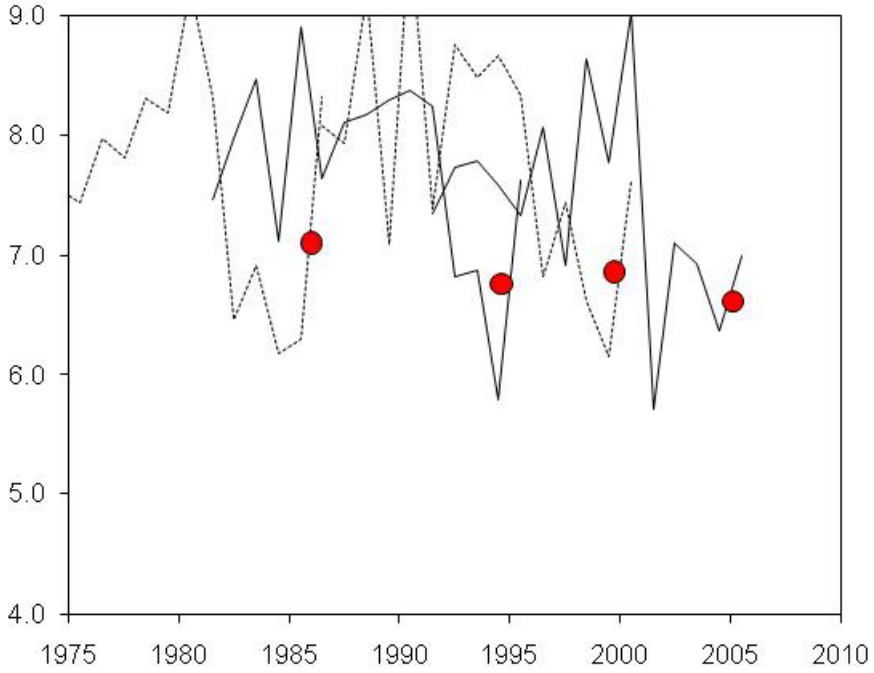
Uganda


9.0
8.0
7.0
6.0
5.0
4.0
1975
1980
1985
1990
1995
2000
2005
2010
Cut-off year

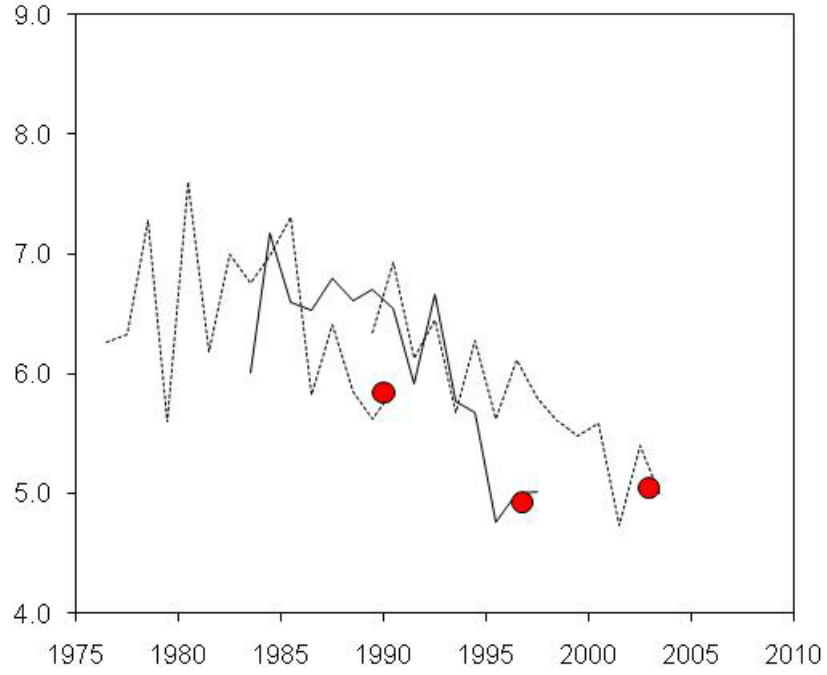
Benin



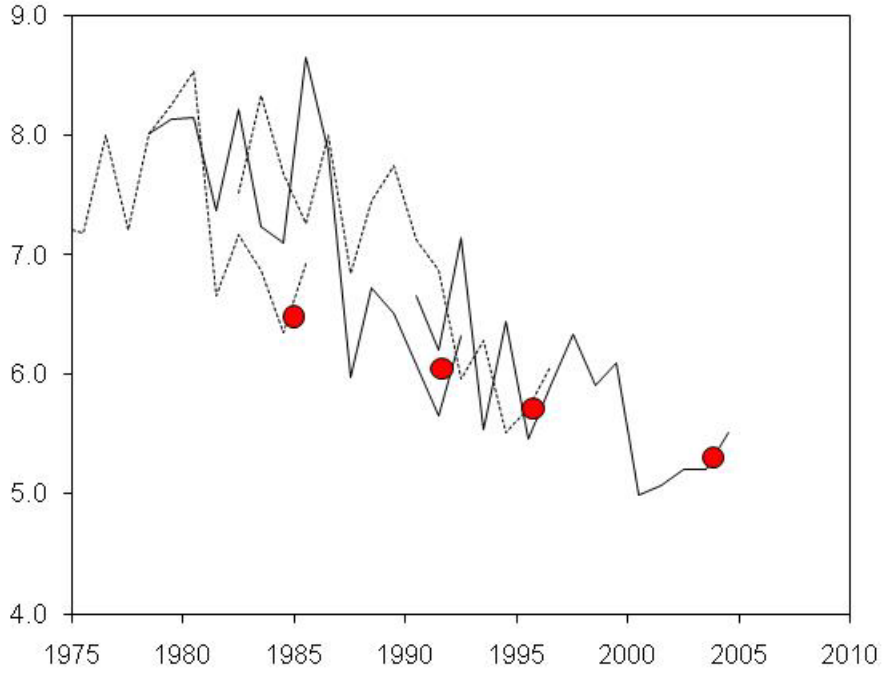
Mali



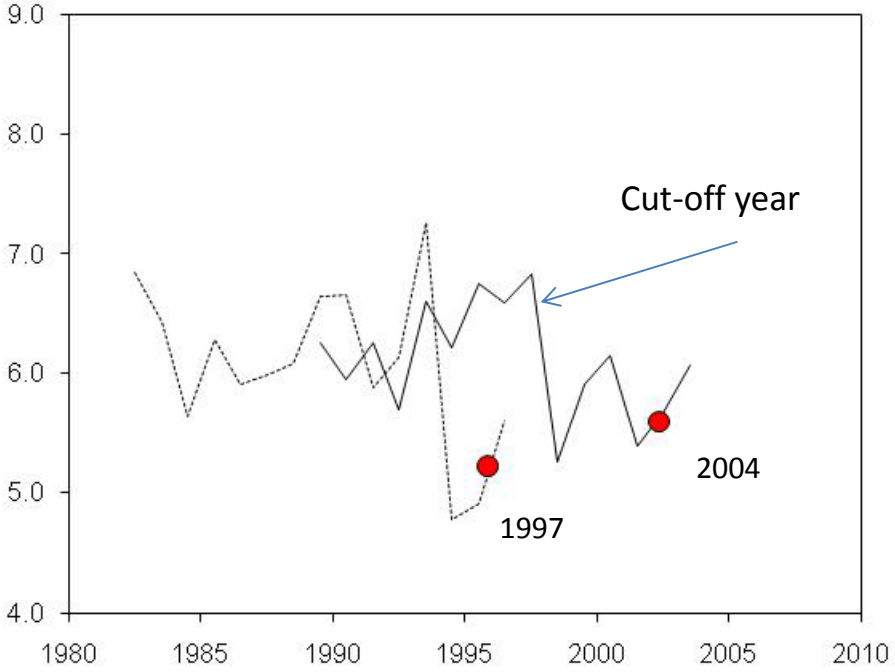
Cameroon



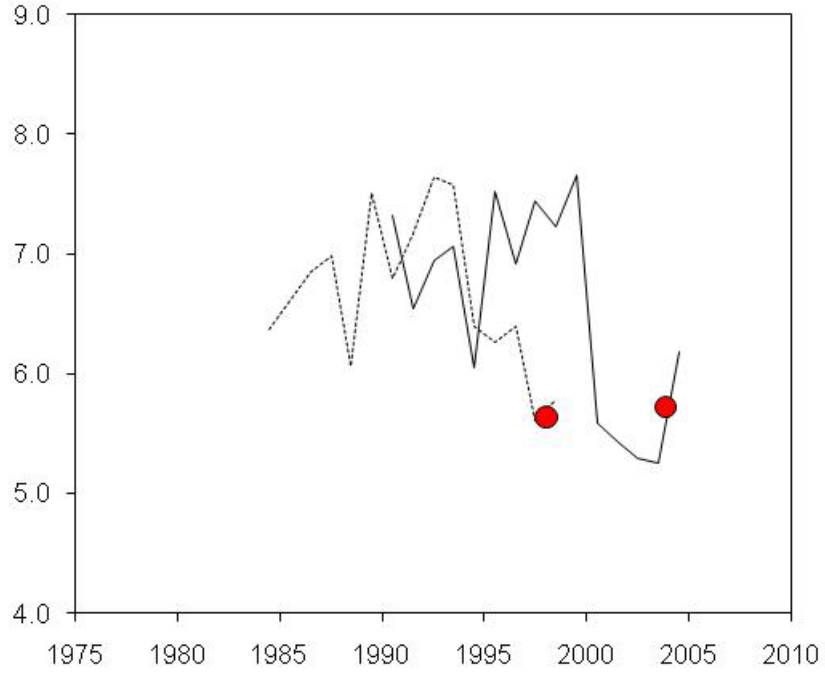
Senegal



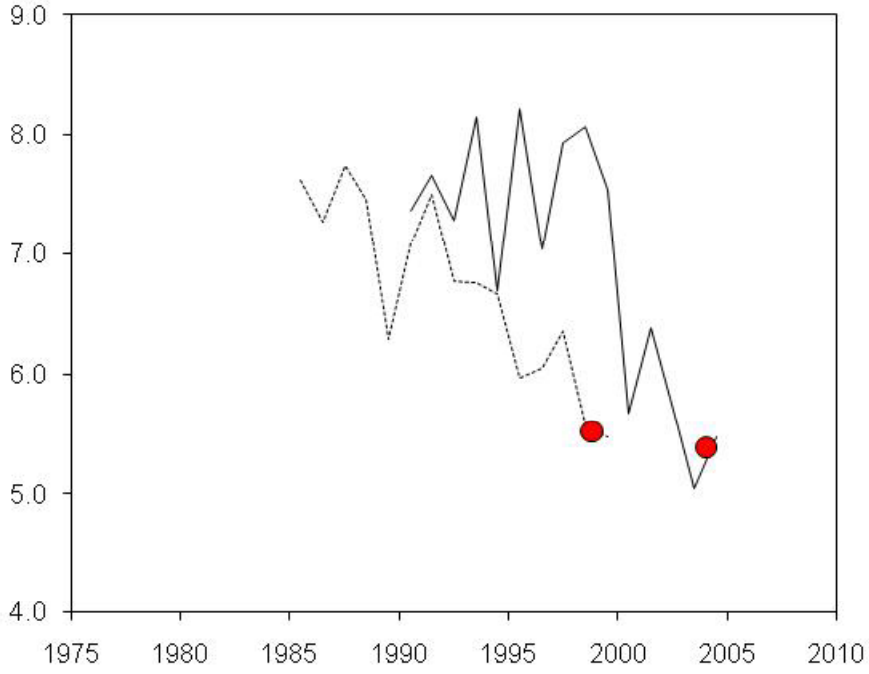
Mozambique


9.0
8.0
7.0
6.0
5.0
4.0
1980
1985
1990
1995
2000
2005
2010
Cut-off year
2004
1997

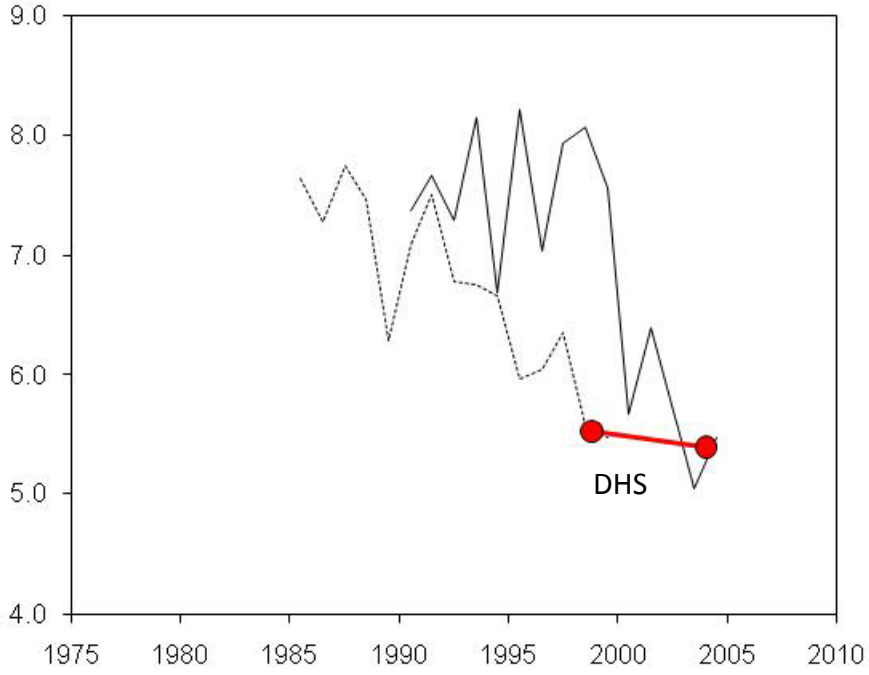
Guinea



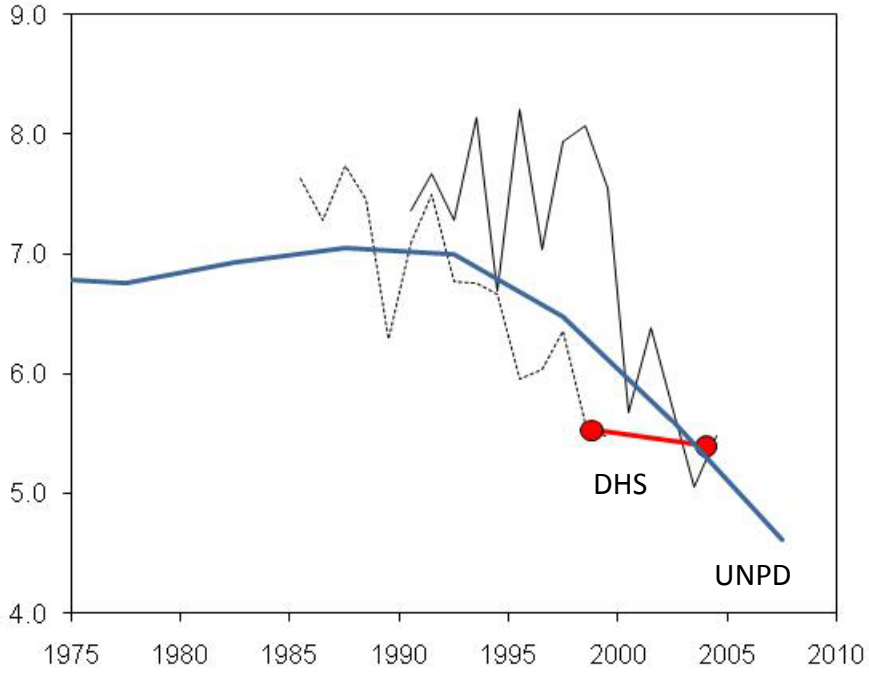
Ethiopia



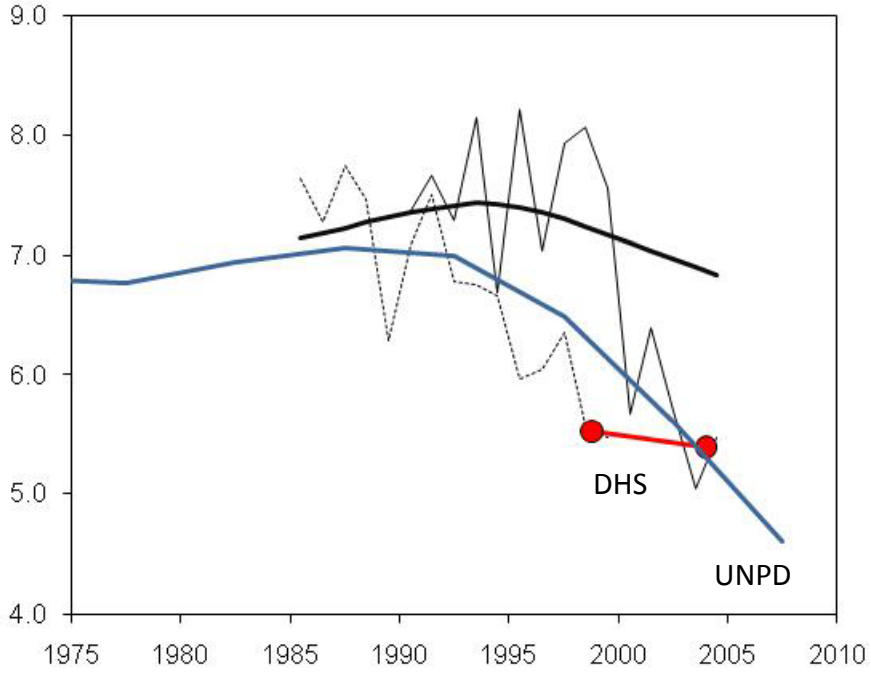
Ethiopia



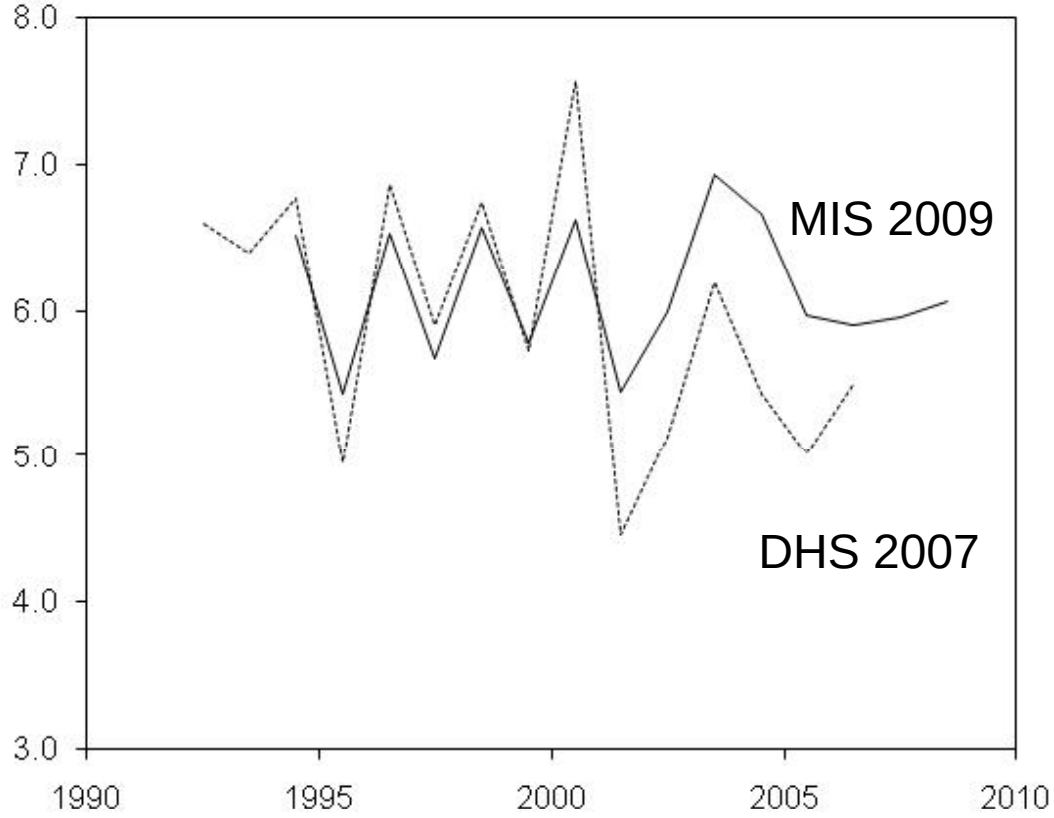
Ethiopia


9.0
8.0
7.0
6.0
5.0
4.0
1975
1980
1985
1990
1995
2000
2005
2010
DHS
UNPD

Ethiopia

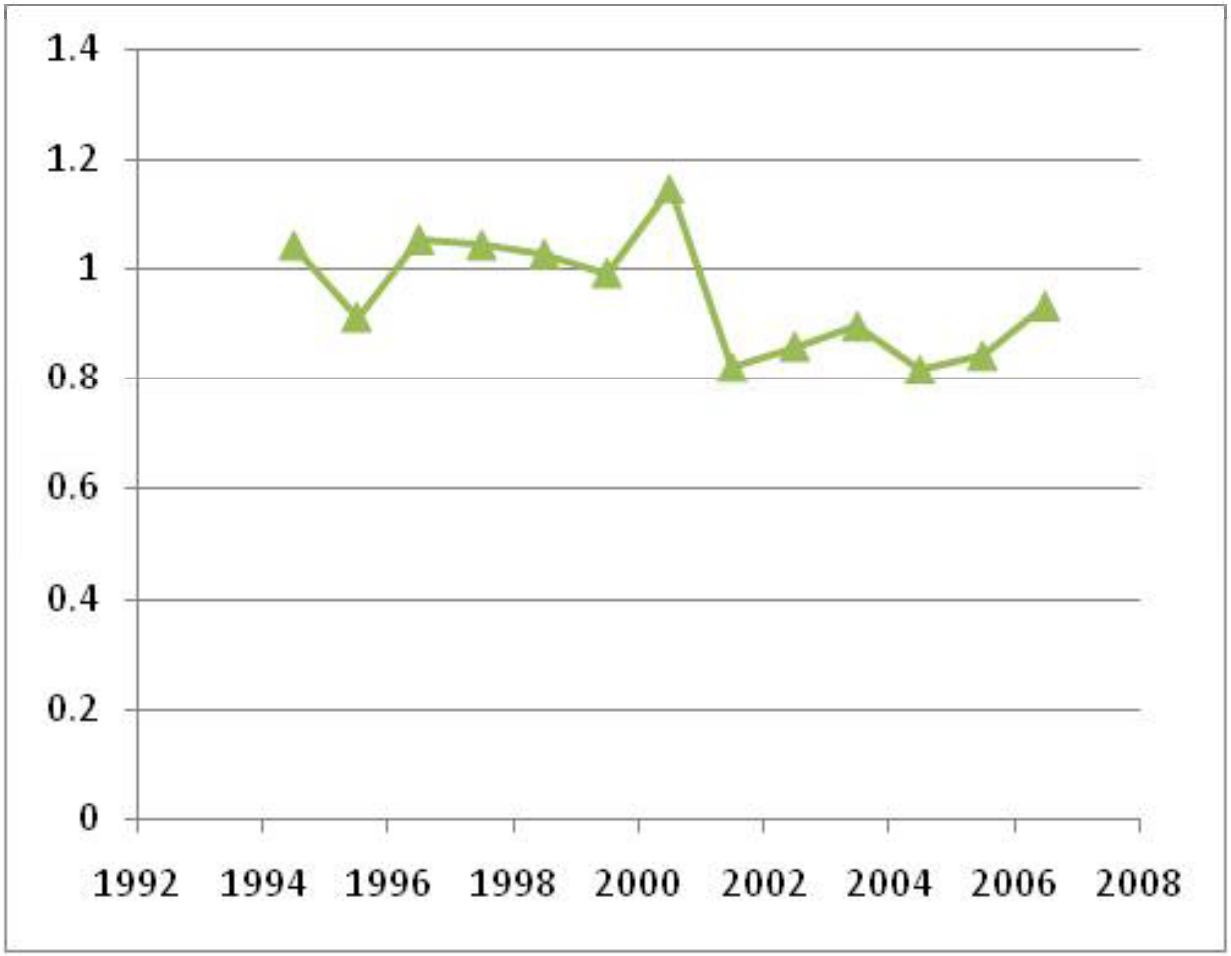

9.0
8.0
7.0
6.0
5.0
4.0
1975
1980
1985
1990
1995
2000
2005
2010
DHS
UNPD

Liberia



Ratios of TFR Liberia 2007-2009

TFR DHS/
TFR MIS

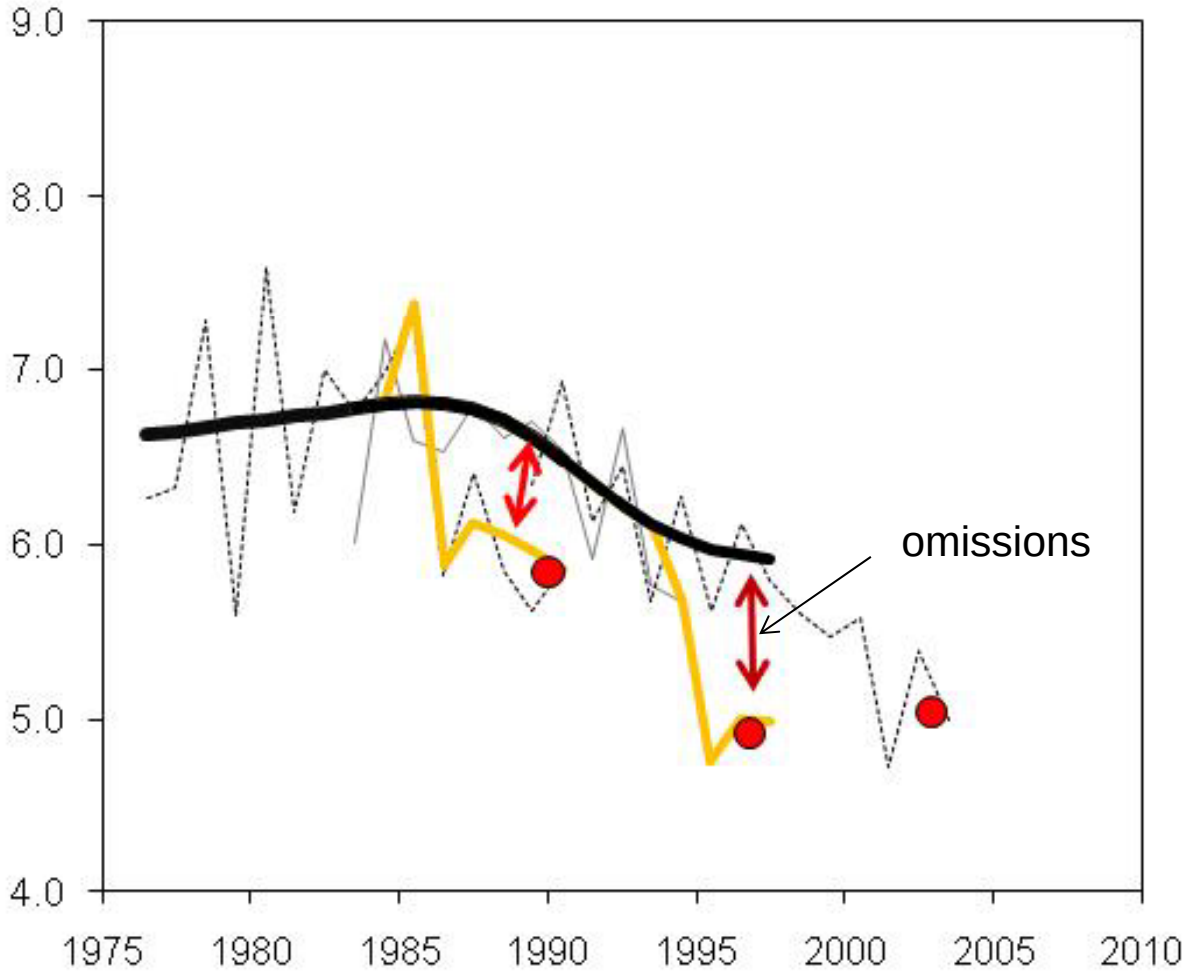


In summary

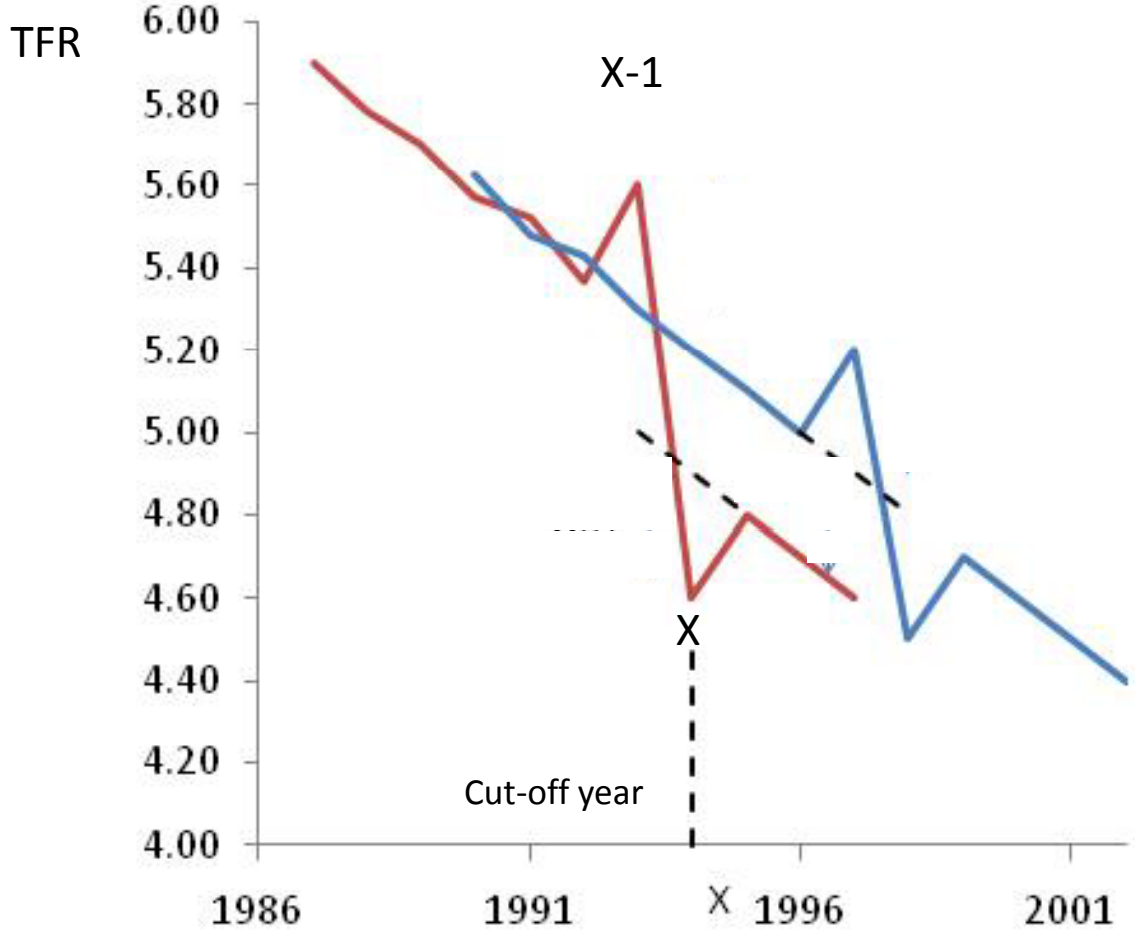
- Retrospective data suggest substantial omissions
  - Drop of TFRs at the cut-off year of health sections are very frequent
  - Recent fertility often much lower than in the next survey
- Possible implications on fertility levels and trends
  - Underestimation of fertility
  - Distortion of fertility trends in some countries

3a. Measuring omissions

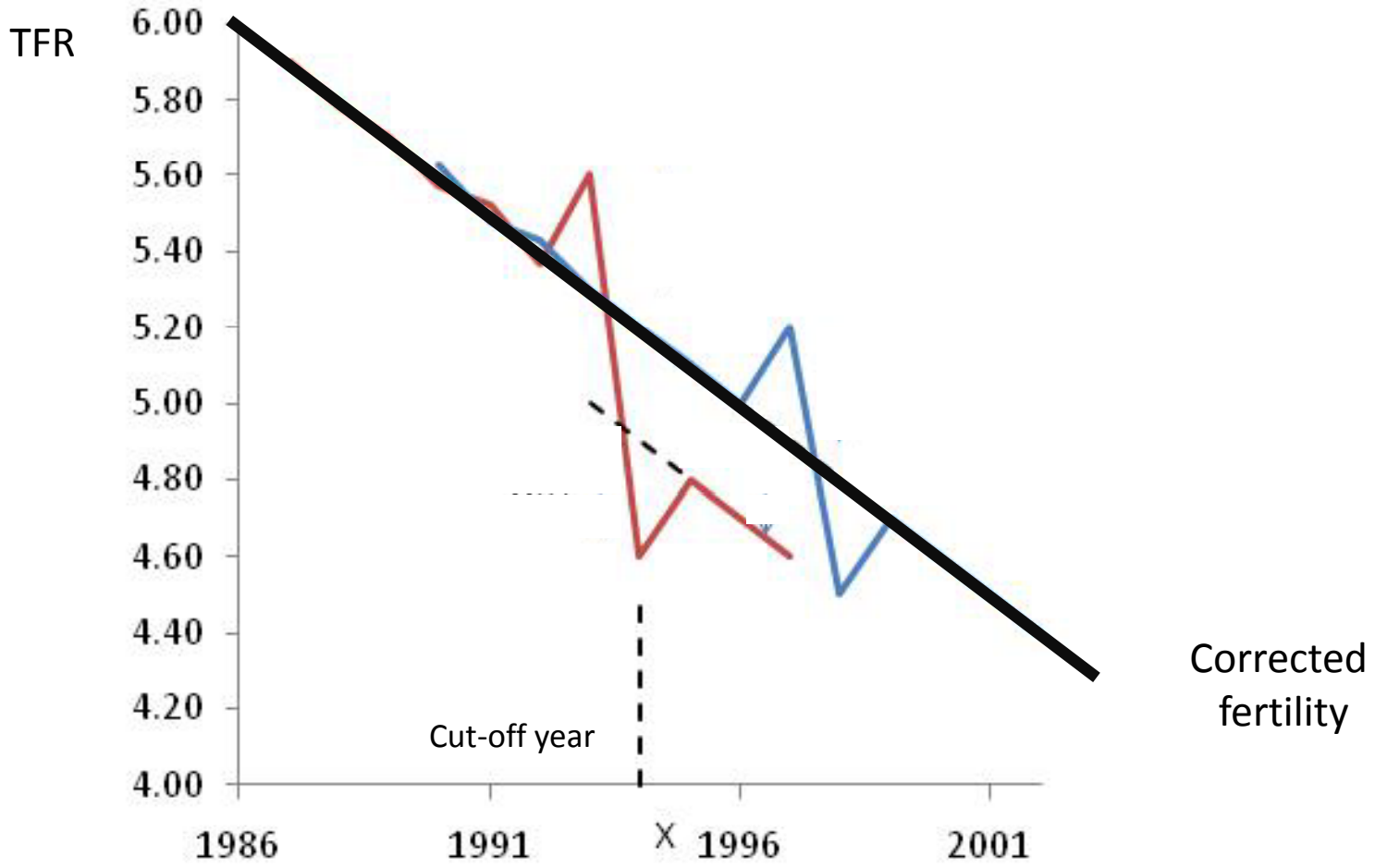
Cameroon – reconstructed fertility trends with and without omissions



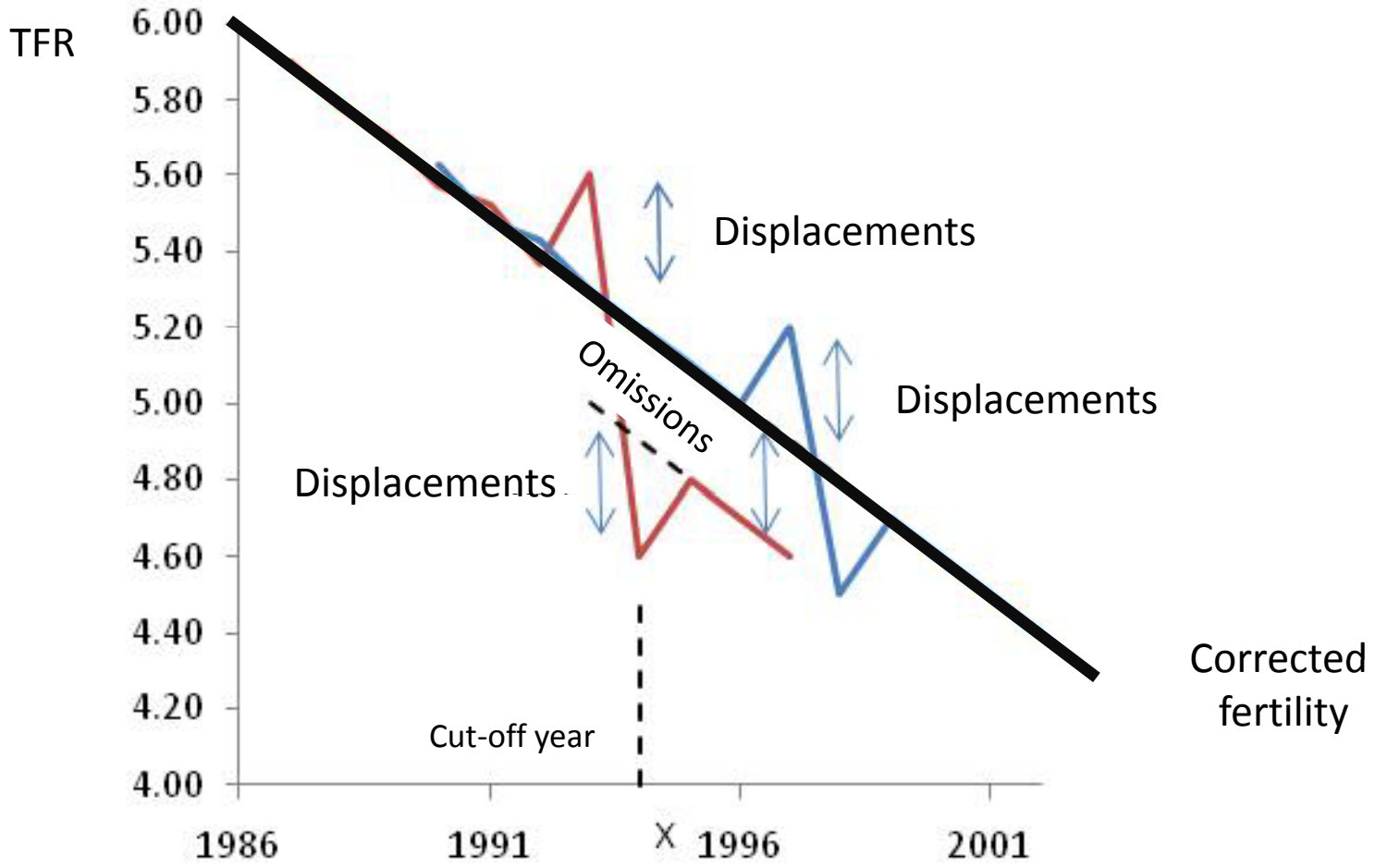
Effects of omissions and displacements



Effects of omissions and displacements



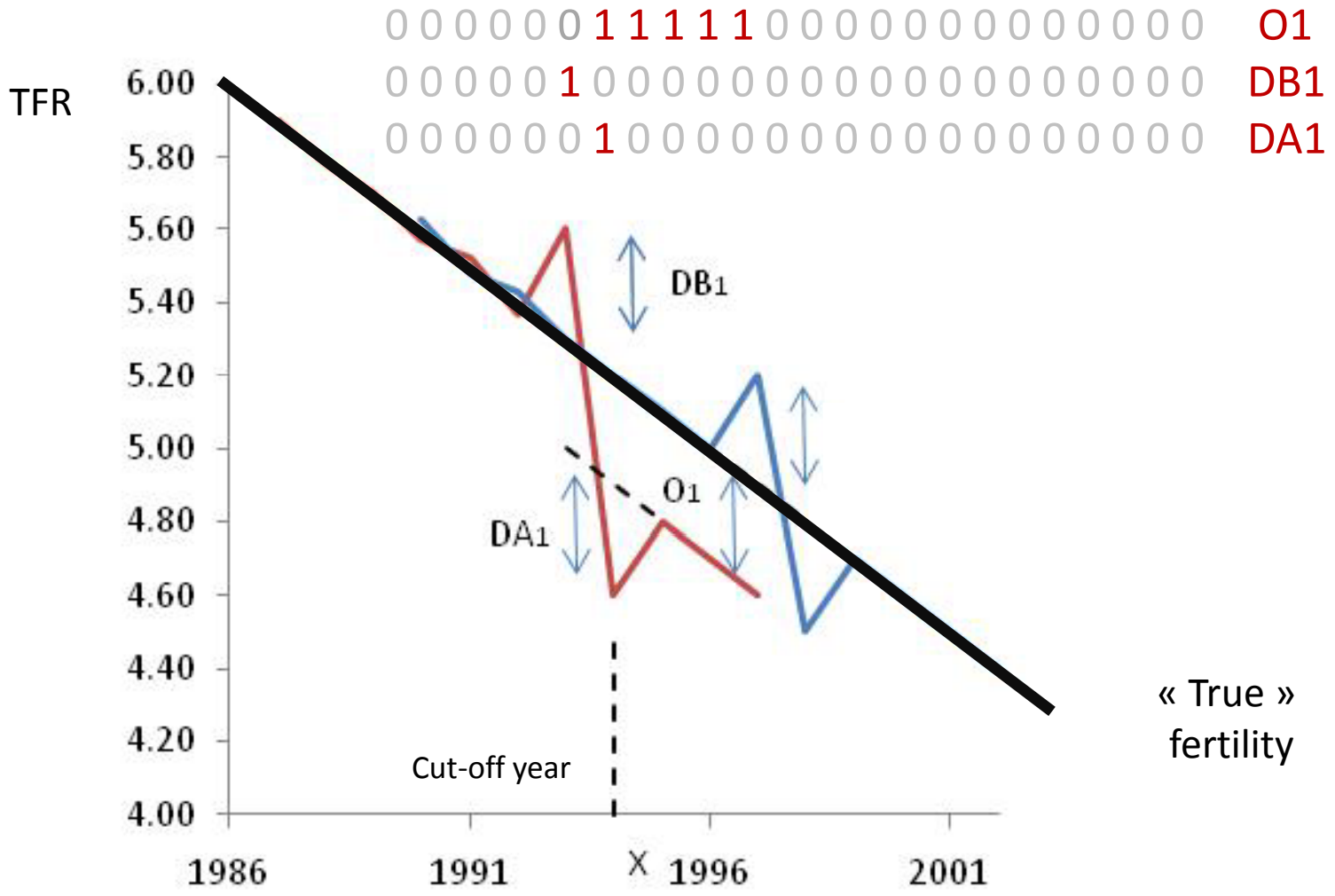
Effects of omissions and displacements



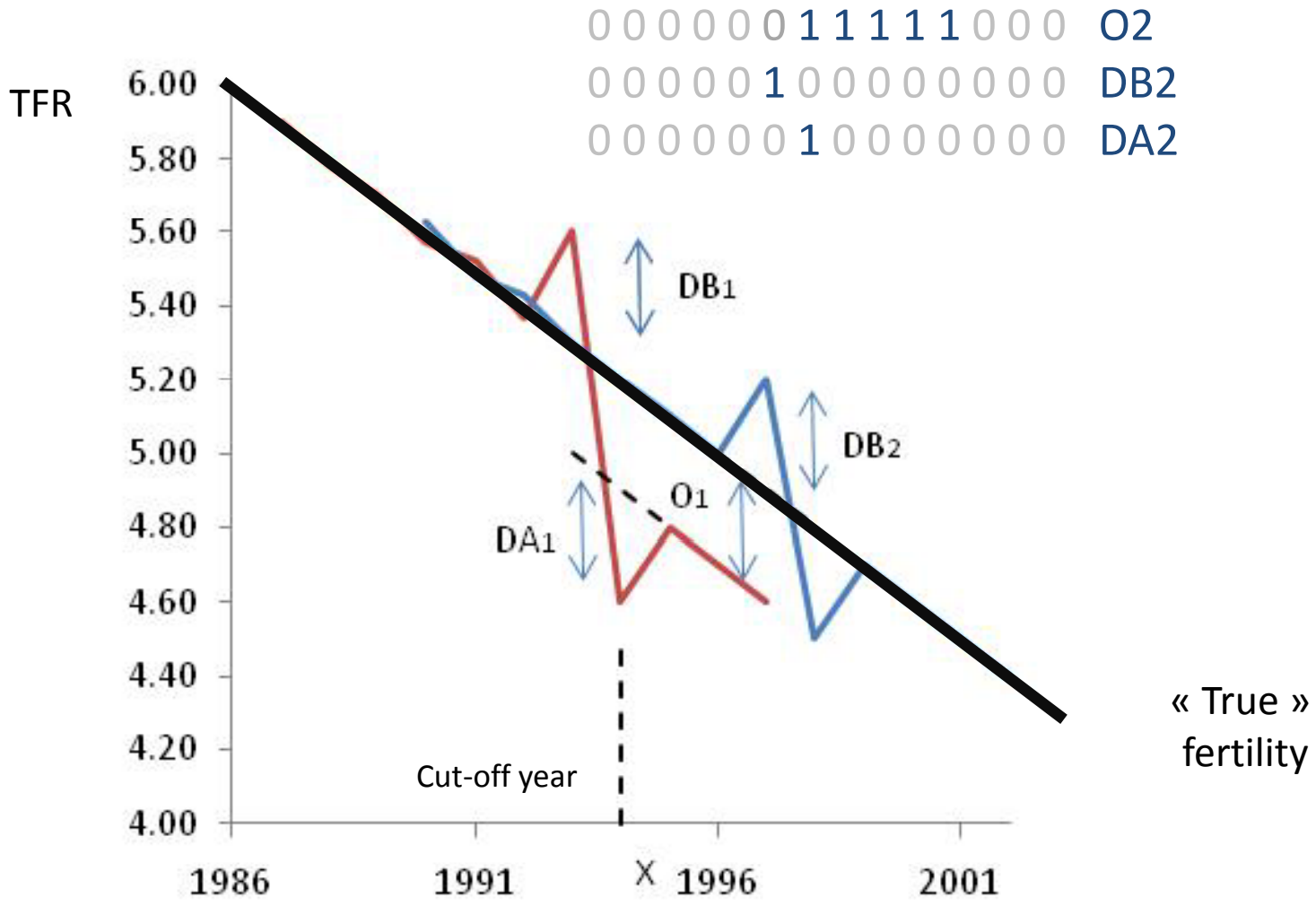
Method

- Several birth histories from the same country pooled together
- Fertility trends (TFR) reconstructed with Poisson regression
  - Trends smoothed with restricted cubic splines
- Dummy variables included to capture omissions and displacements

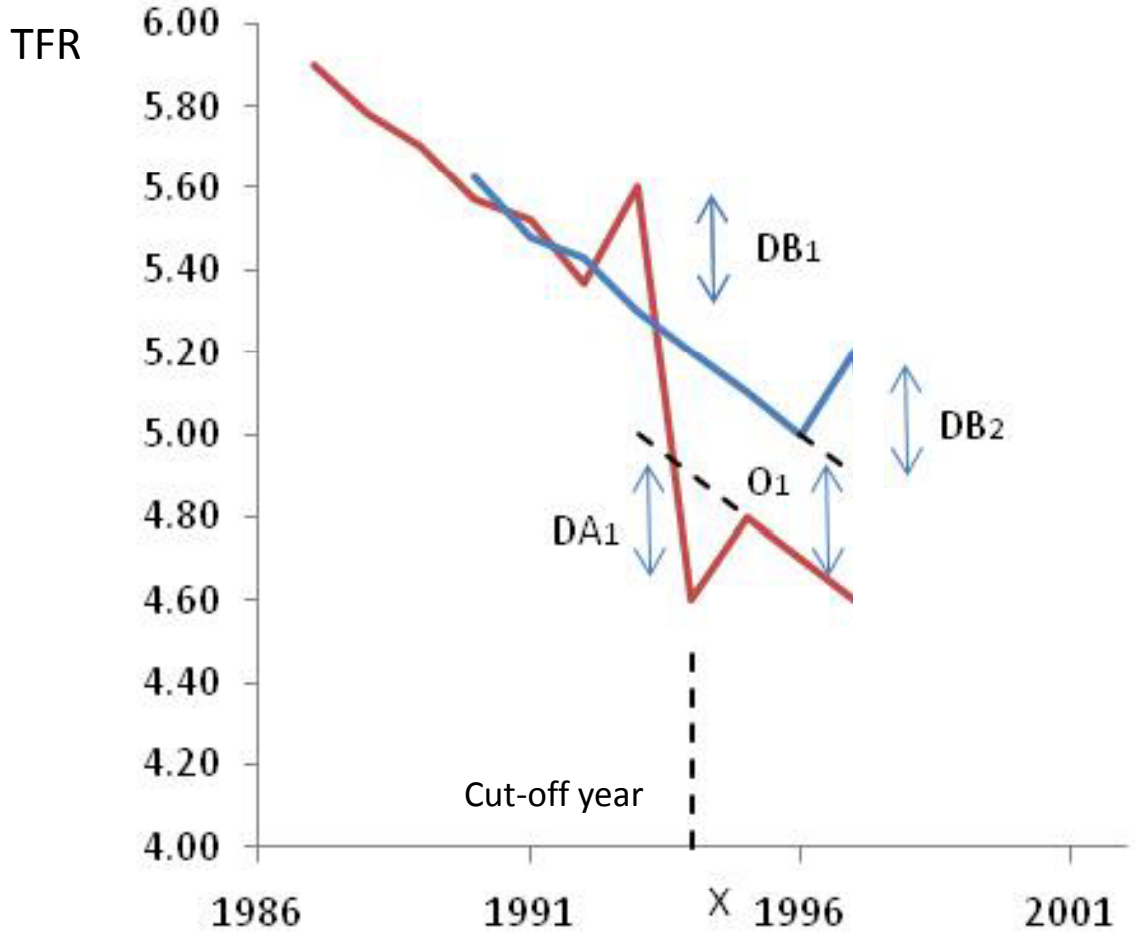
Effects of omissions and displacements



Effects of omissions and displacements



Effects of omissions and displacements



Year	ageg	births	exposure	cutoff	dumy85	bin85	bin84	dumy94	bin94	bin93	dumy98	bin98	bin97
76	15	95.7563	555.6355	86	0	0	0	0	0	0	0	0	0
77	15	112.497	557.0087	86	0	0	0	0	0	0	0	0	0
78	15	129.95	607.8437	86	0	0	0	0	0	0	0	0	0
79	15	106.856	626.3211	86	0	0	0	0	0	0	0	0	0
80	15	154.139	642.5535	86	0	0	0	0	0	0	0	0	0
81	15	111.193	626.1605	86	0	0	0	0	0	0	0	0	0
82	15	154.124	656.5363	86	0	0	0	0	0	0	0	0	0
83	15	141.06	660.6098	86	0	0	0	0	0	0	0	0	0
84	15	166.567	699.9847	86	0	0	0	0	0	0	0	0	0
85	15	161.608	729.0115	86	0	0	1	0	0	0	0	0	0
86	15	134.242	772.9039	86	1	1	0	0	0	0	0	0	0
87	15	166.543	828.2281	86	1	0	0	0	0	0	0	0	0
88	15	147.976	892.316	86	1	0	0	0	0	0	0	0	0
89	15	136.265	906.6396	86	1	0	0	0	0	0	0	0	0
90	15	156.911	924.898	86	1	0	0	0	0	0	0	0	0
76	20	138.668	423.8353	86	0	0	0	0	0	0	0	0	0
77	20	119.562	452.9352	86	0	0	0	0	0	0	0	0	0
78	20	151.336	456.8943	86	0	0	0	0	0	0	0	0	0
79	20	119.076	483.8677	86	0	0	0	0	0	0	0	0	0
80	20	173.363	511.5285	86	0	0	0	0	0	0	0	0	0
81	20	144.206	555.6355	86	0	0	0	0	0	0	0	0	0
82	20	185.237	557.0087	86	0	0	0	0	0	0	0	0	0
83	20	172.73	607.8437	86	0	0	0	0	0	0	0	0	0
84	20	199.481	626.3211	86	0	0	1	0	0	0	0	0	0

Statistical model – Poisson regression

« CORRECTED FERTILITY » + ERRORS

- Omissions
- Displacements

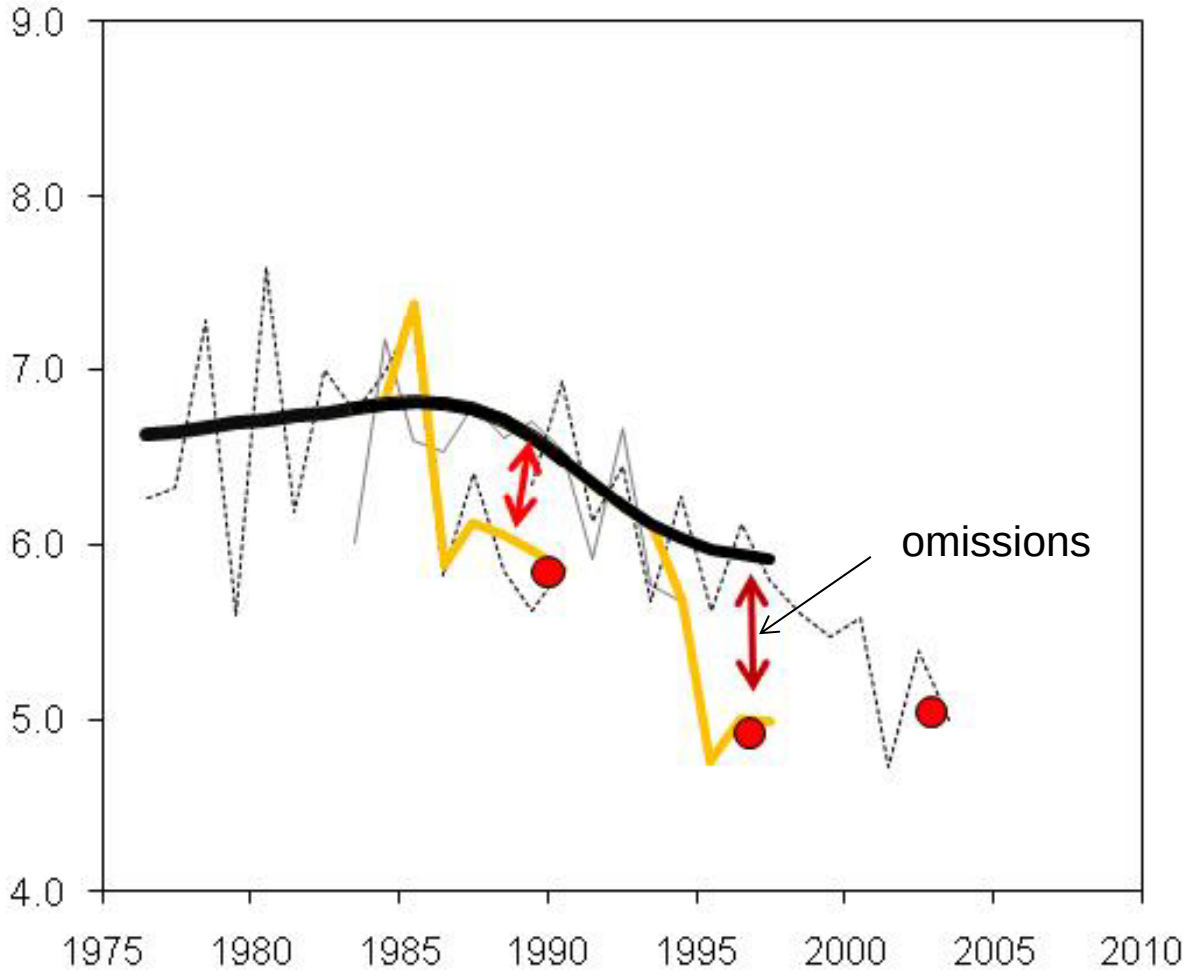
$$\log(\mu_i) = \log(t_i) + f(age) + f(time) + \beta_1.O_{1i} + \beta_1.DA_{1i} + \beta_3.DB_{1i} + \beta_4.DB_{2i}$$

- exposure
- Age
- Restricted cubic splines
- Omissions
- Displacements

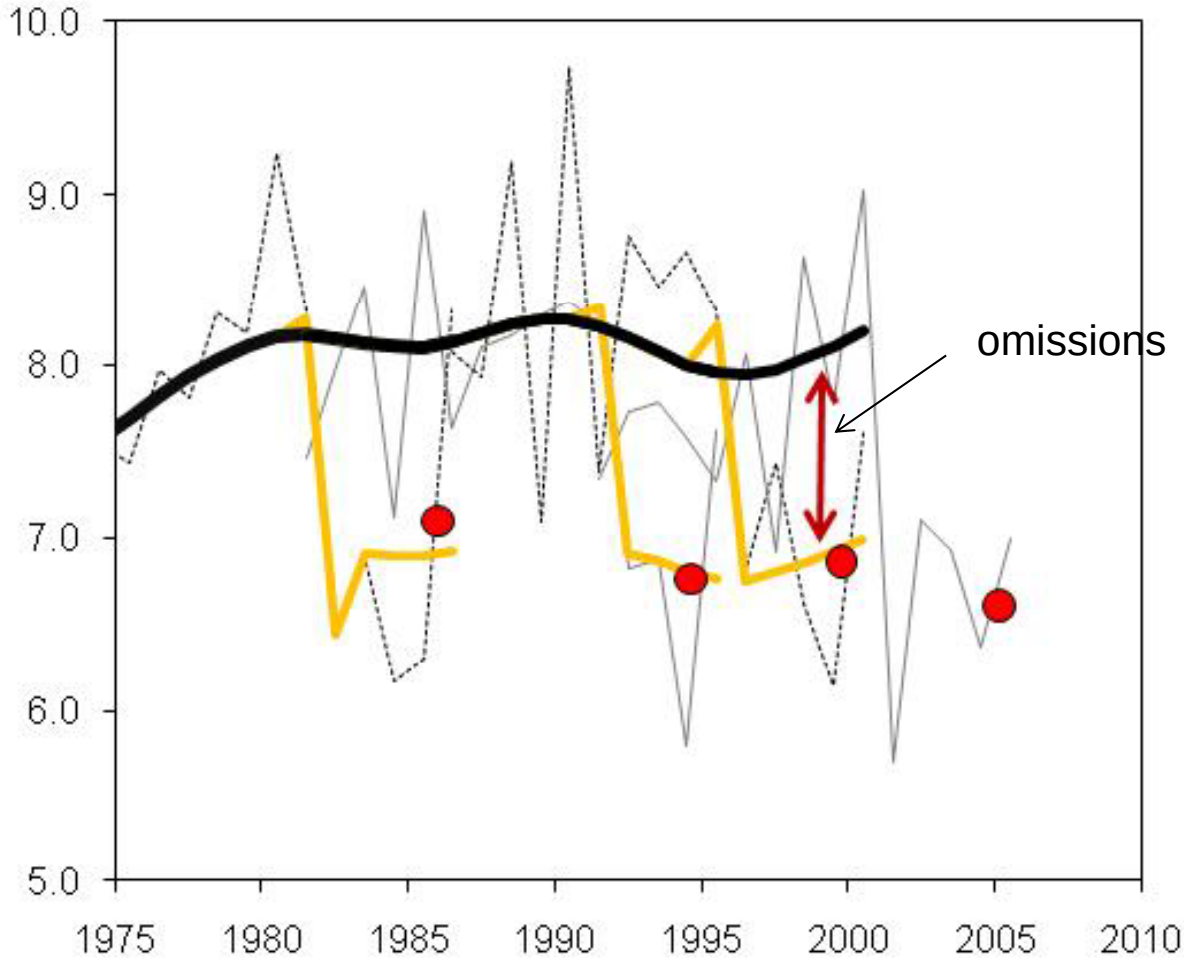
Assumptions

- Fertility is estimated fairly correctly before the health sections
- Displacements affect the cut-off year and the year just before
- Omissions are fairly constant between year X and survey year
- Differences in sample compositions between surveys have a negligible effect
- Age pattern of fertility stable

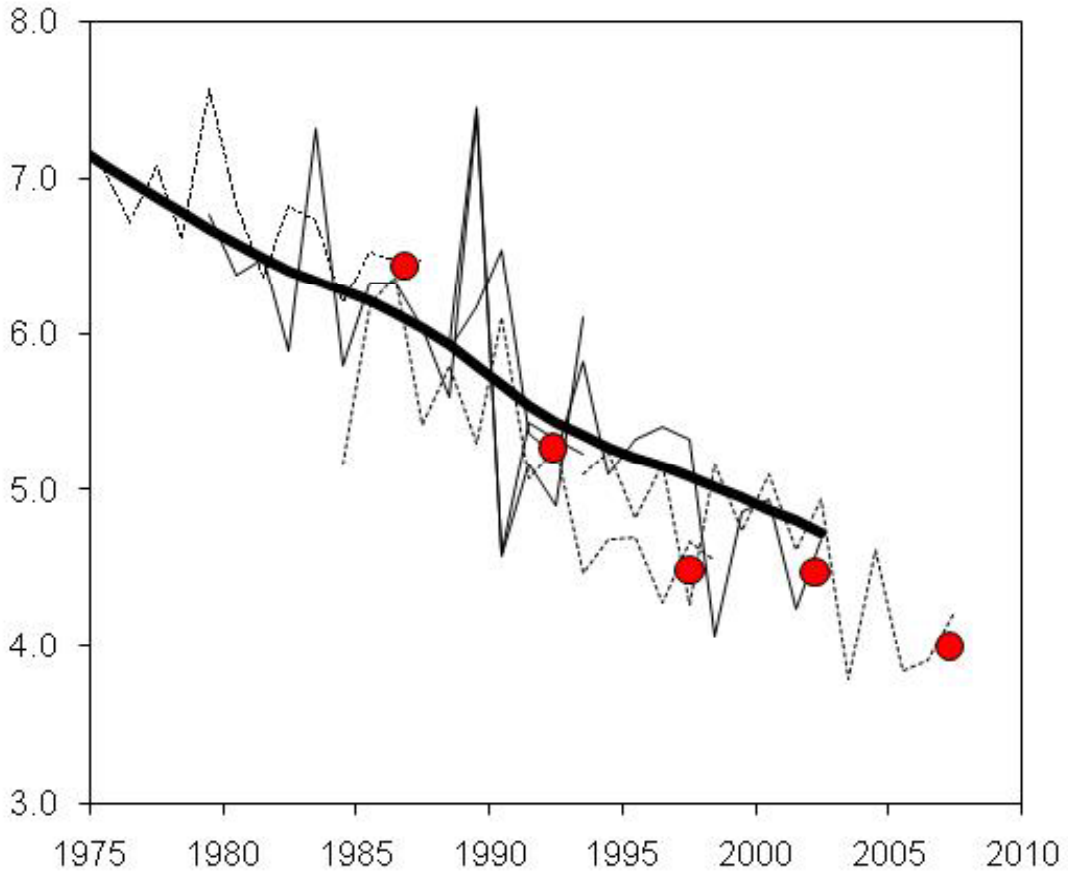
Cameroon – reconstructed fertility trends with and without omissions



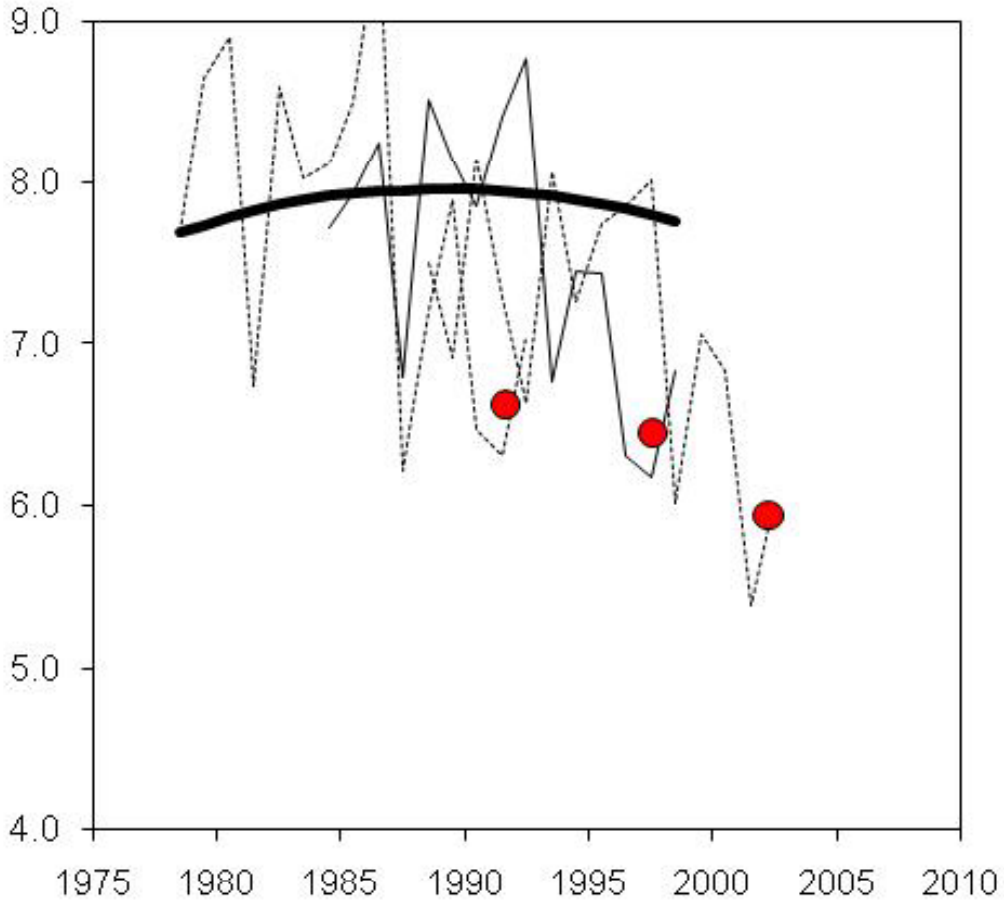
Mali – reconstructed fertility trends with and without omissions



Ghana



Burkina Faso



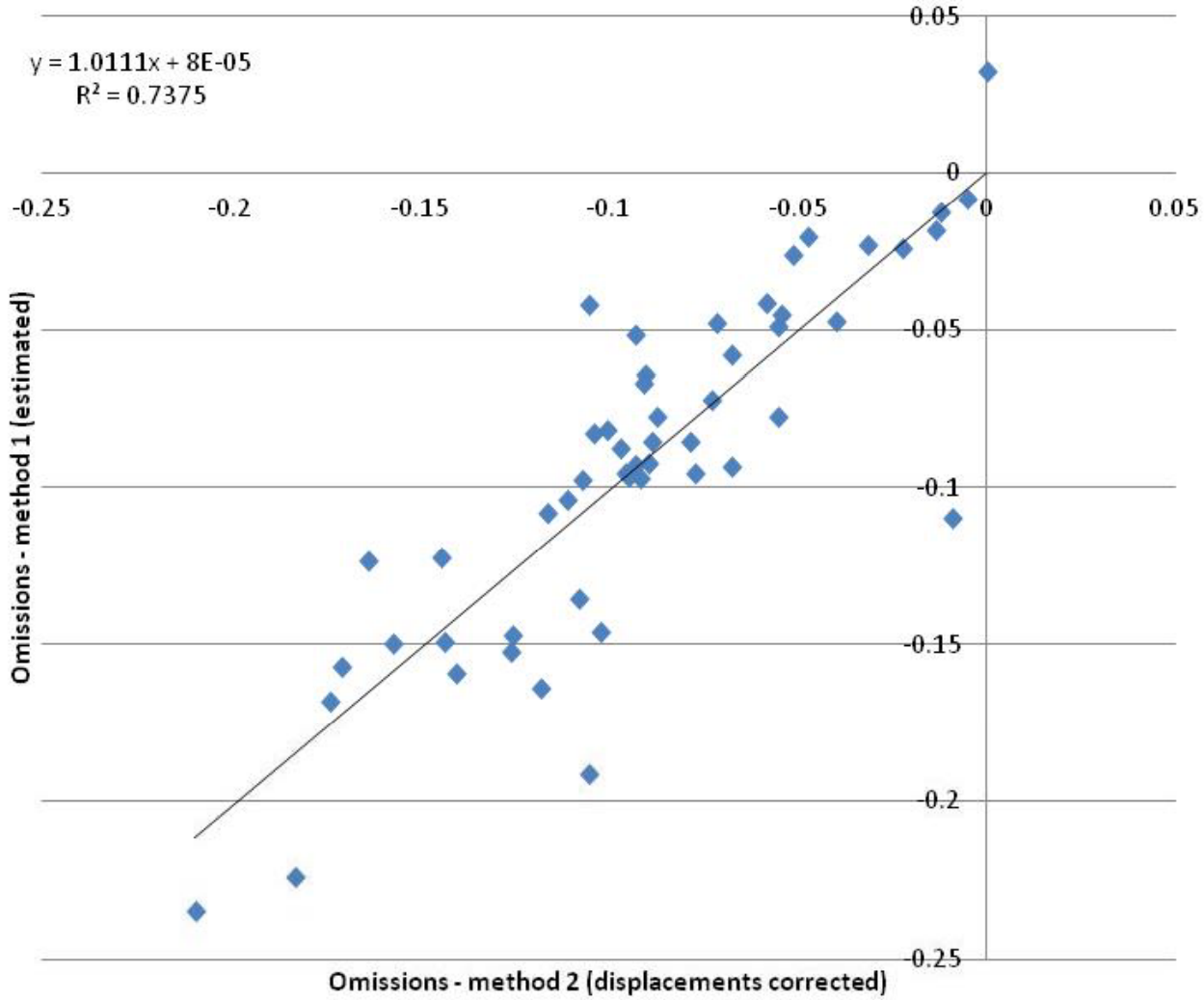
3b. Measuring omissions

Modified method

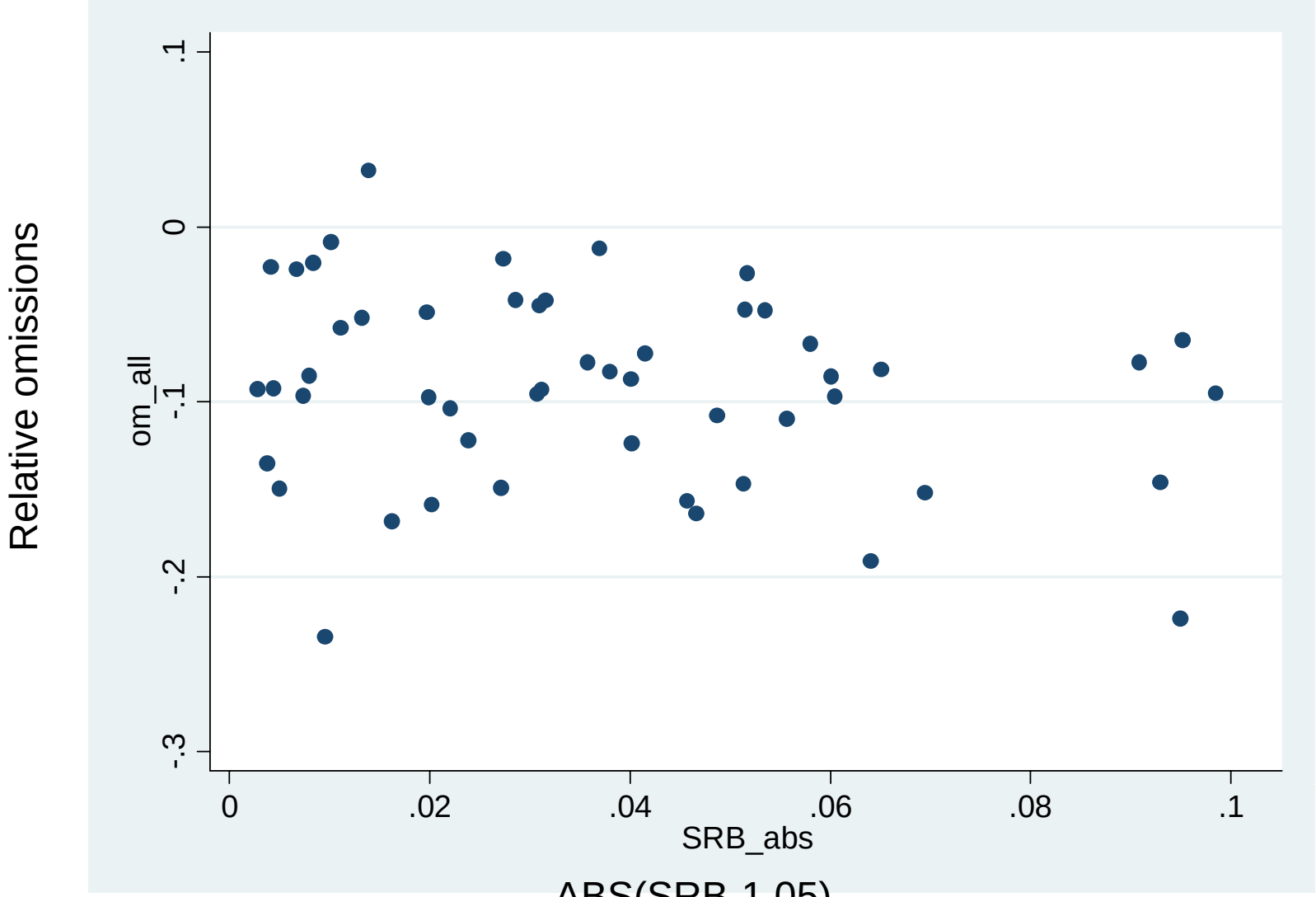
- Several birth histories from the same country pooled together
  - Correction for displacements of births
    - Number of births around cut-off year averaged
- Fertility trends (TFR) reconstructed with Poisson regression
  - Trends smoothed with restricted cubic splines
- Dummy variables included to capture omissions

Year	ageg	births	births_av	exposure	cutoff	dumy85	dumy94	dumy98	
	76	15	95.7563	95.75628	555.6355	86	0	0	0
	77	15	112.497	112.4975	557.0087	86	0	0	0
	78	15	129.95	129.9501	607.8437	86	0	0	0
	79	15	106.856	106.8562	626.3211	86	0	0	0
	80	15	154.139	154.1394	642.5535	86	0	0	0
	81	15	111.193	111.1934	626.1605	86	0	0	0
	82	15	154.124	154.1242	656.5363	86	0	0	0
	83	15	141.06	141.0596	660.6098	86	0	0	0
	84	15	166.567	157.2398	699.9847	86	0	0	0
	85	15	161.608	157.2398	729.0115	86	0	0	0
	86	15	134.242	157.2398	772.9039	86	1	0	0
	87	15	166.543	157.2398	828.2281	86	1	0	0
	88	15	147.976	147.9764	892.316	86	1	0	0
	89	15	136.265	136.2648	906.6396	86	1	0	0
	90	15	156.911	156.9111	924.898	86	1	0	0
	76	20	138.668	138.6684	423.8353	86	0	0	0
	77	20	119.562	119.5619	452.9352	86	0	0	0
	78	20	151.336	151.3362	456.8943	86	0	0	0
	79	20	119.076	119.0758	483.8677	86	0	0	0

Strong correlations of two methods



Low correlation with sex ratio at birth



4. Omissions of recent births in sub-Saharan Africa

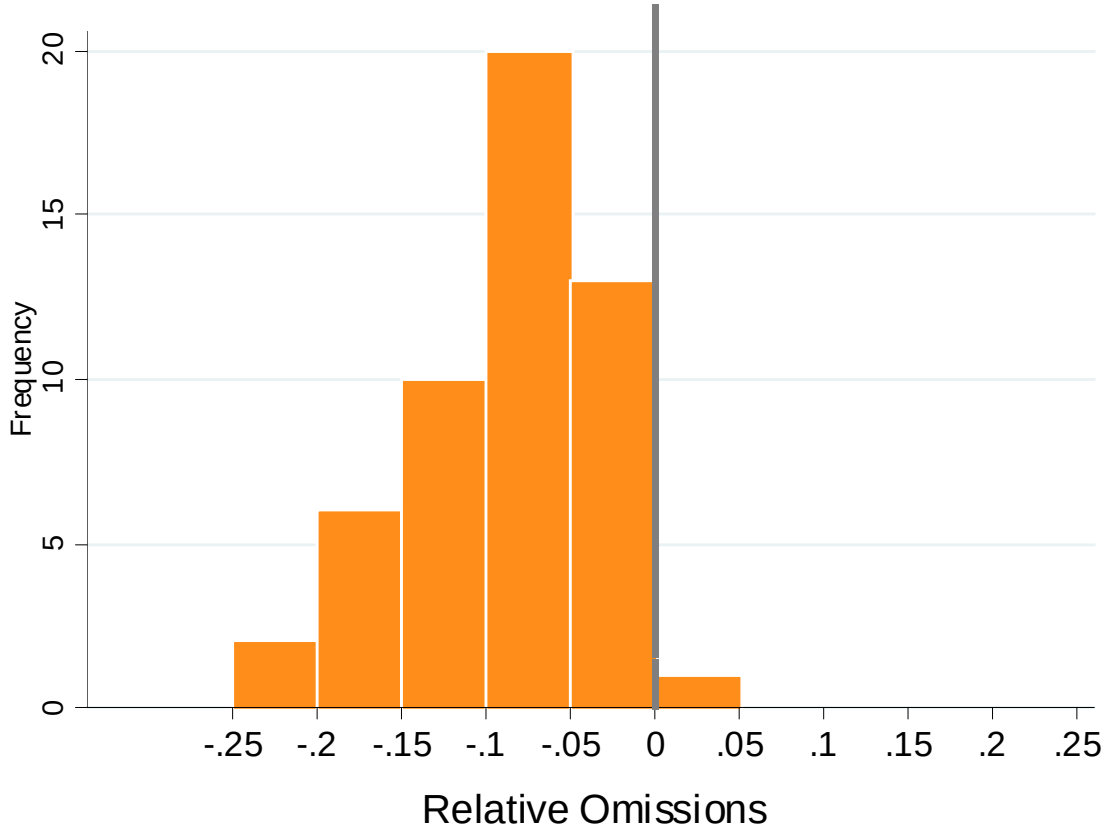
Data

- 75 Standard DHS surveys used
  - Interim DHS, AIS,… not included (but could be)
- 23 countries of sub-saharan Africa
  - Countries with at least two standard DHS

- Omissions measured in 52 surveys (75-23)

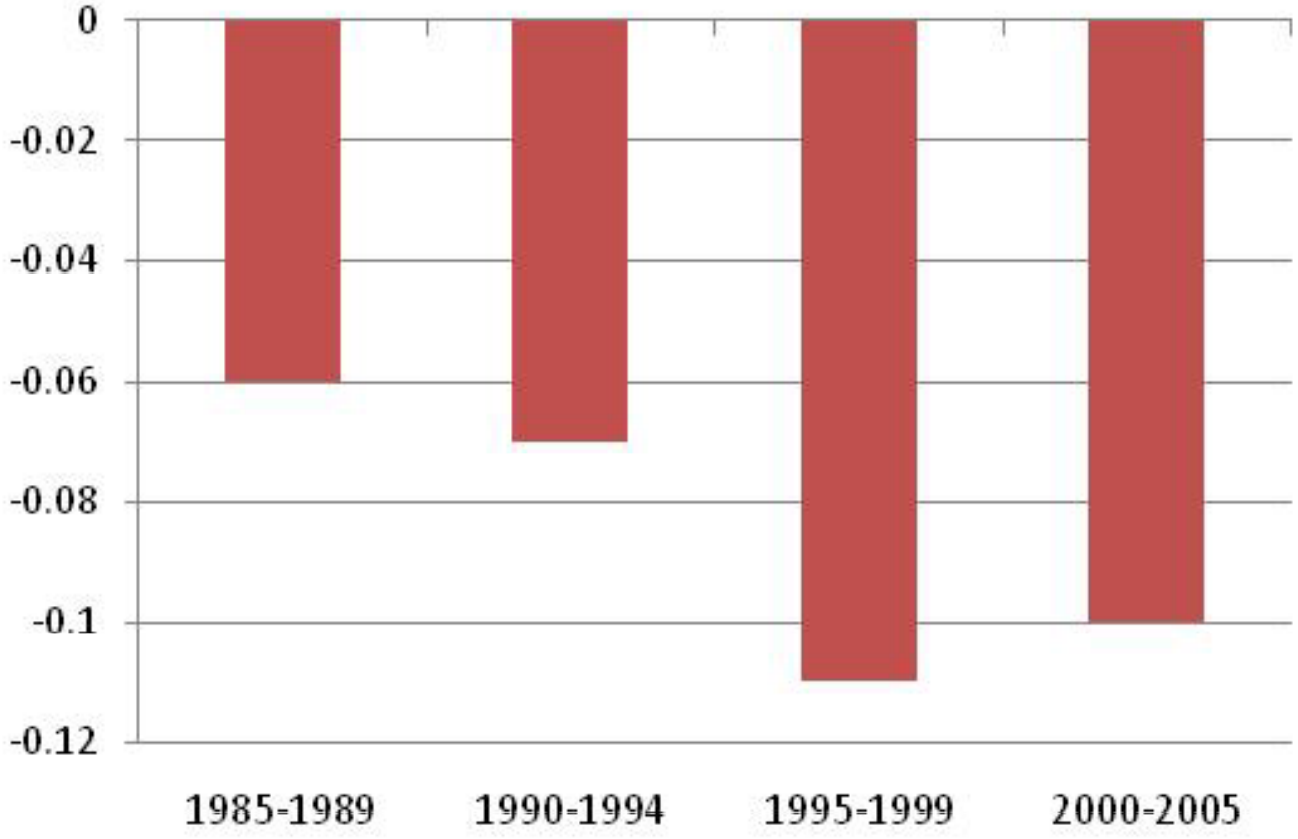
- Birth histories among women aged 15-49 at the survey

Omissions of recent births are common

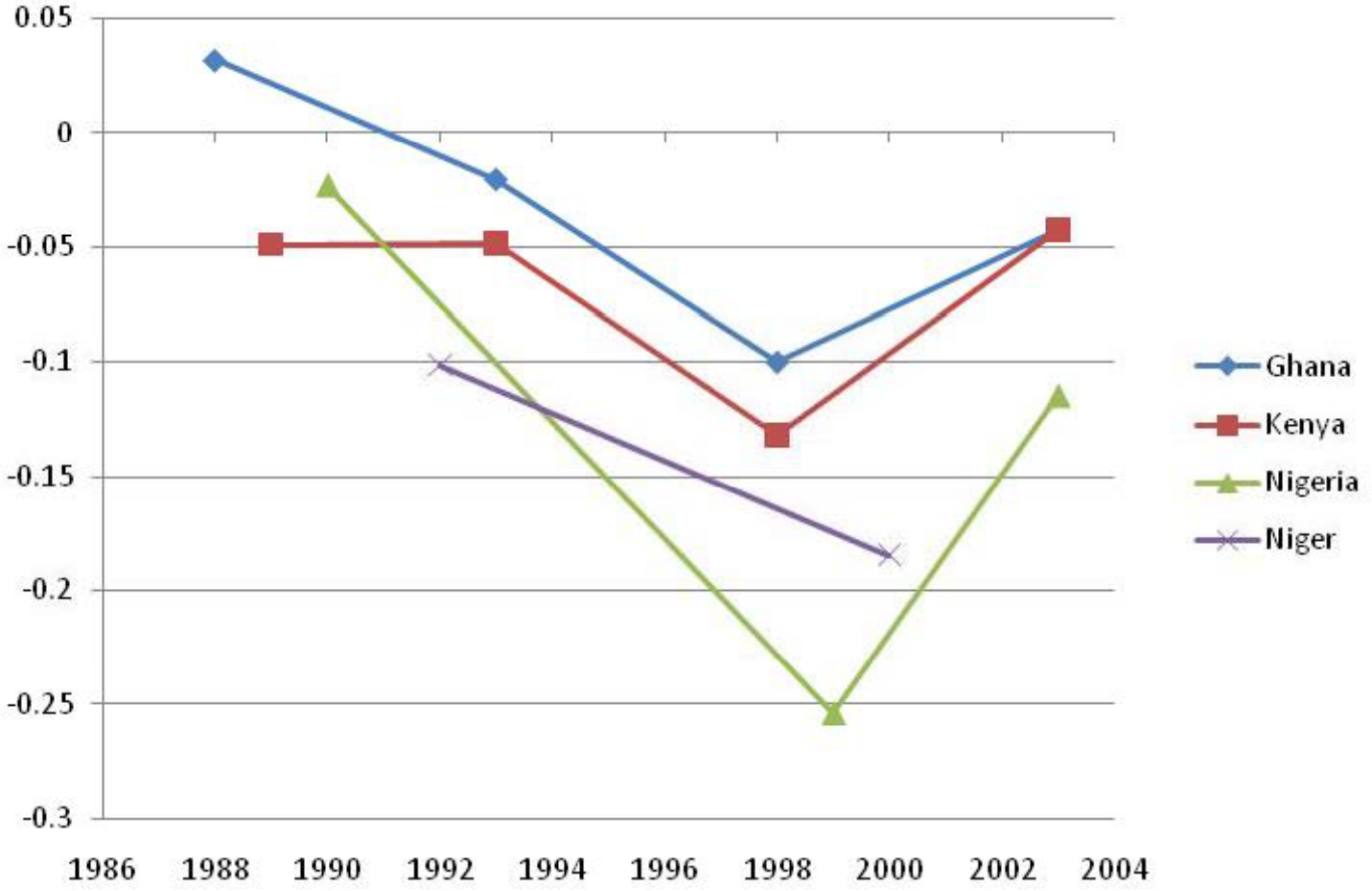


- Omissions in 51 out of 52 surveys
- Significant in 40 out of 52 surveys
- 9% on average
- 23% in Ethiopia 2000

The average level of omissions has ‘increased’



Omissions have varied over time in some countries



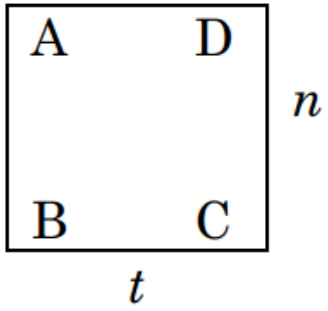
5. Further evidence from Criss-Cross Method

Criss-Cross Method

- Indirect method (Schmertmann , 2002)
  - Comparison of parity by age at two points in time
  - Infer period fertility rates from changes in parity
    - Any age group
    - Any duration between two points in time (not necessarily 5 or 10 years)

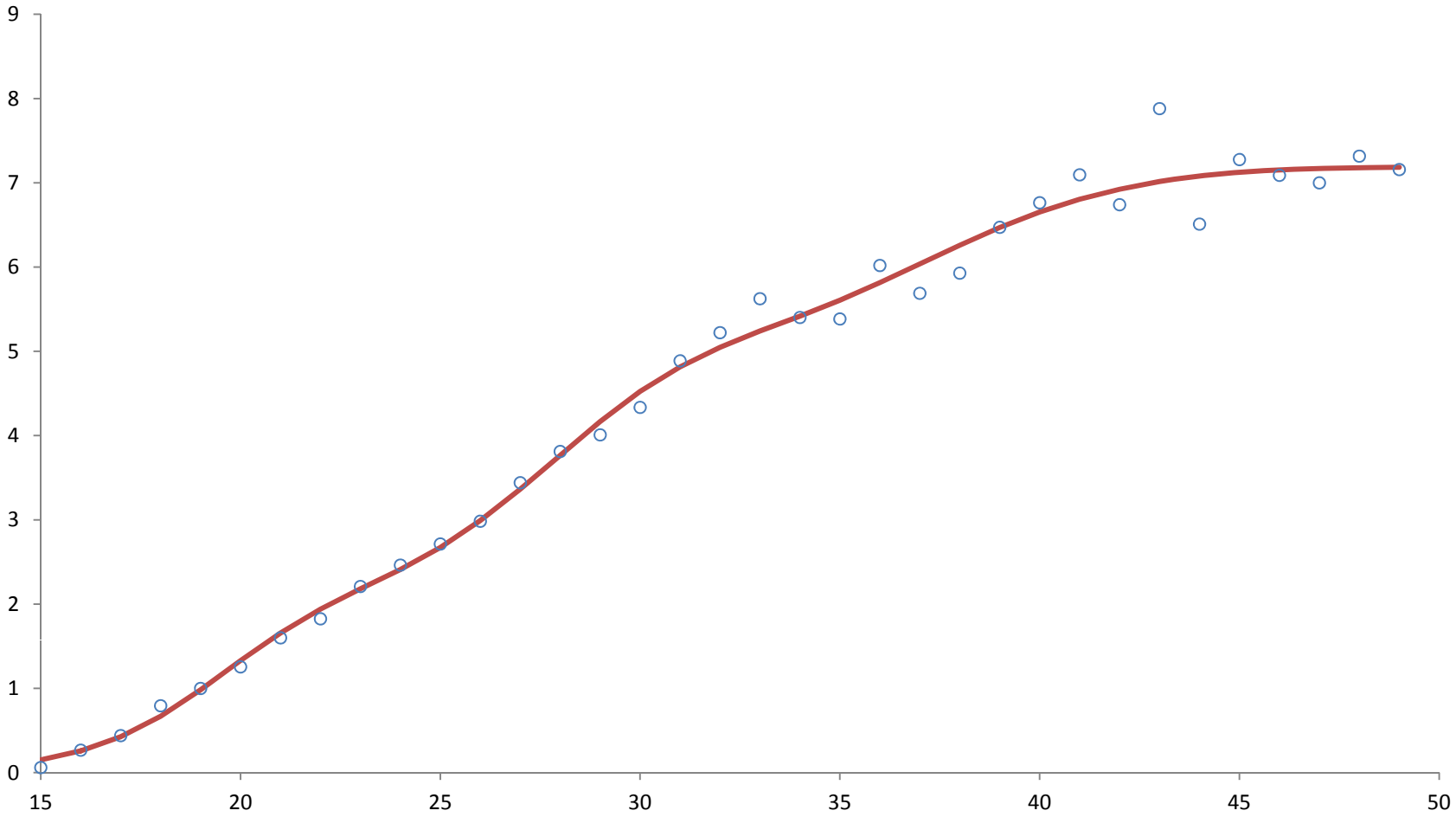
Criss-Cross Method

Illustration of Lexis diagram and formula for estimating fertility rates with the crisscross approach (adapted from Schmertmann, 2002).

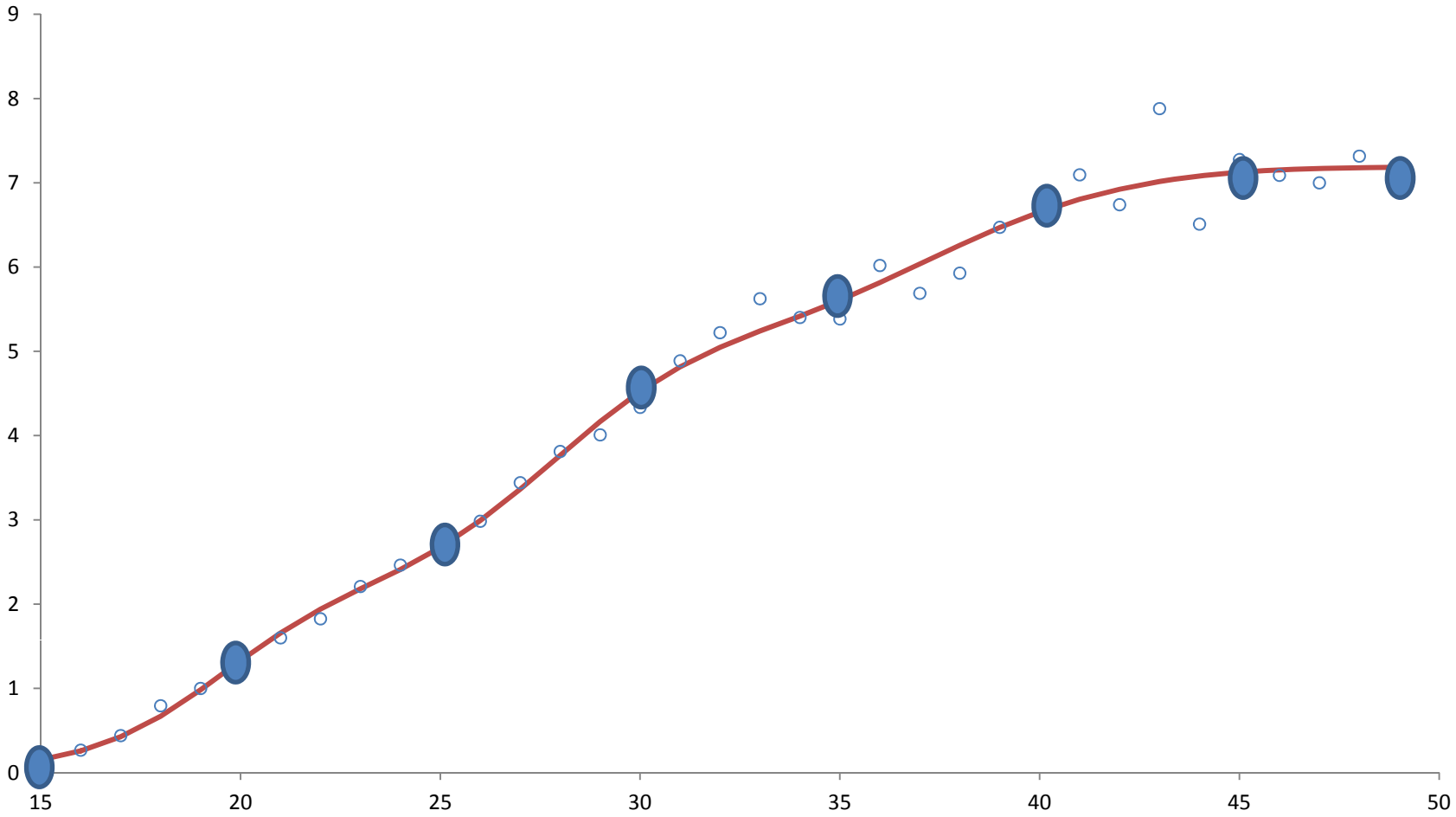


$$\left(\frac{1}{2n}+\frac{1}{2t}\right).(D-B)+\left(\frac{1}{2n}-\frac{1}{2t}\right).(A-C)$$

Smoothing parity by age



Smoothing parity by age

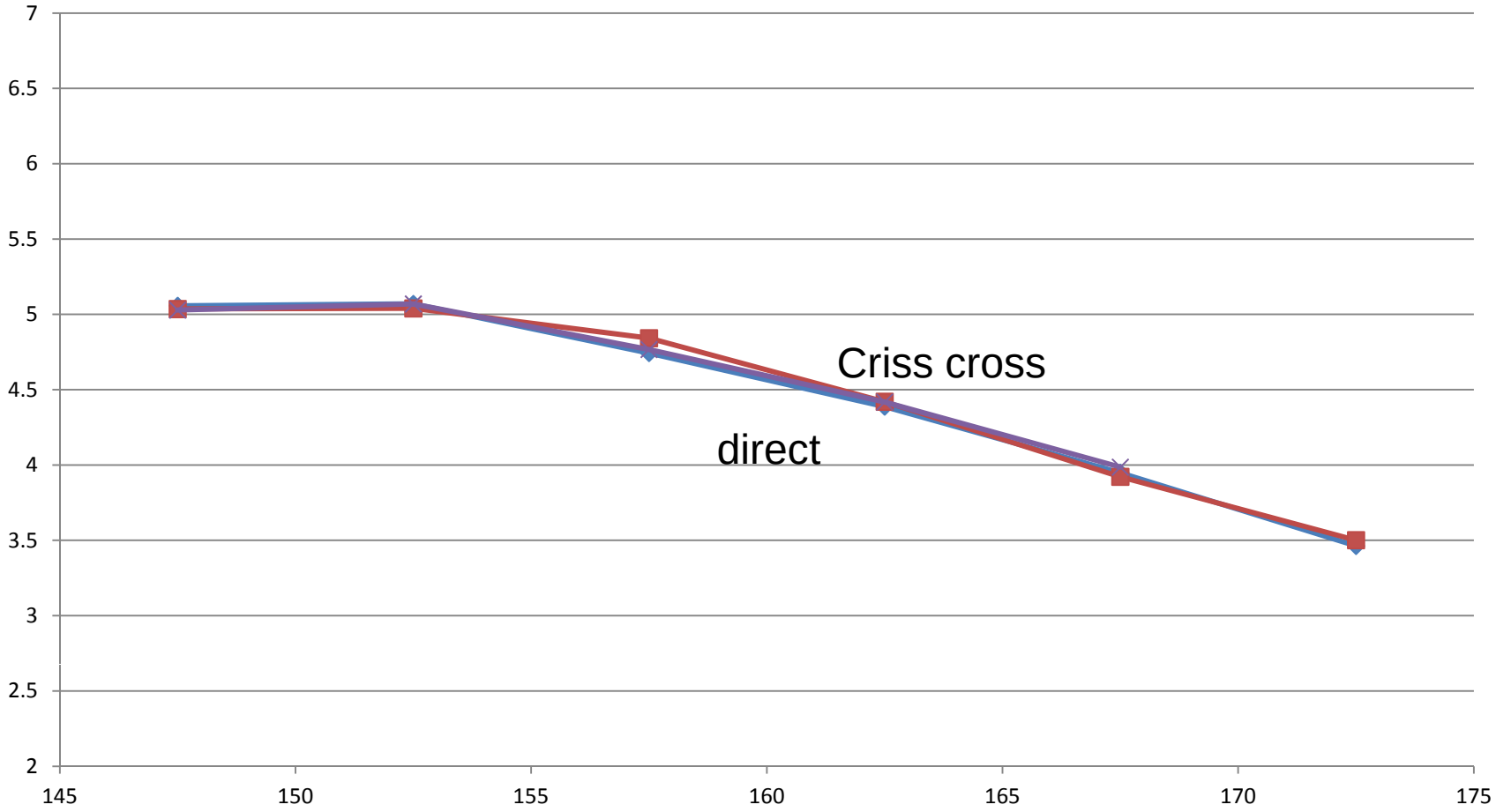


What can criss-cross show ?

- That there are data quality problems
  - If no data quality problems, criss-cross and direct methods should match
  - > Difference between CC and DM indicate data quality issues
- that there are omissions of recent births
  - If CC > DM : suggests omissions of recent births
    - Working among young women (limit the impact of omissions of births in the past)
    - Effects of displacements on DM neutralized
      - Births around the cut-off year averaged
      - Or DM computed over a long period (impact of displacements limited)
  - But,…
    - difficult to know in which survey… and to quantify omissions
    - May also be influenced by differences in sample composition

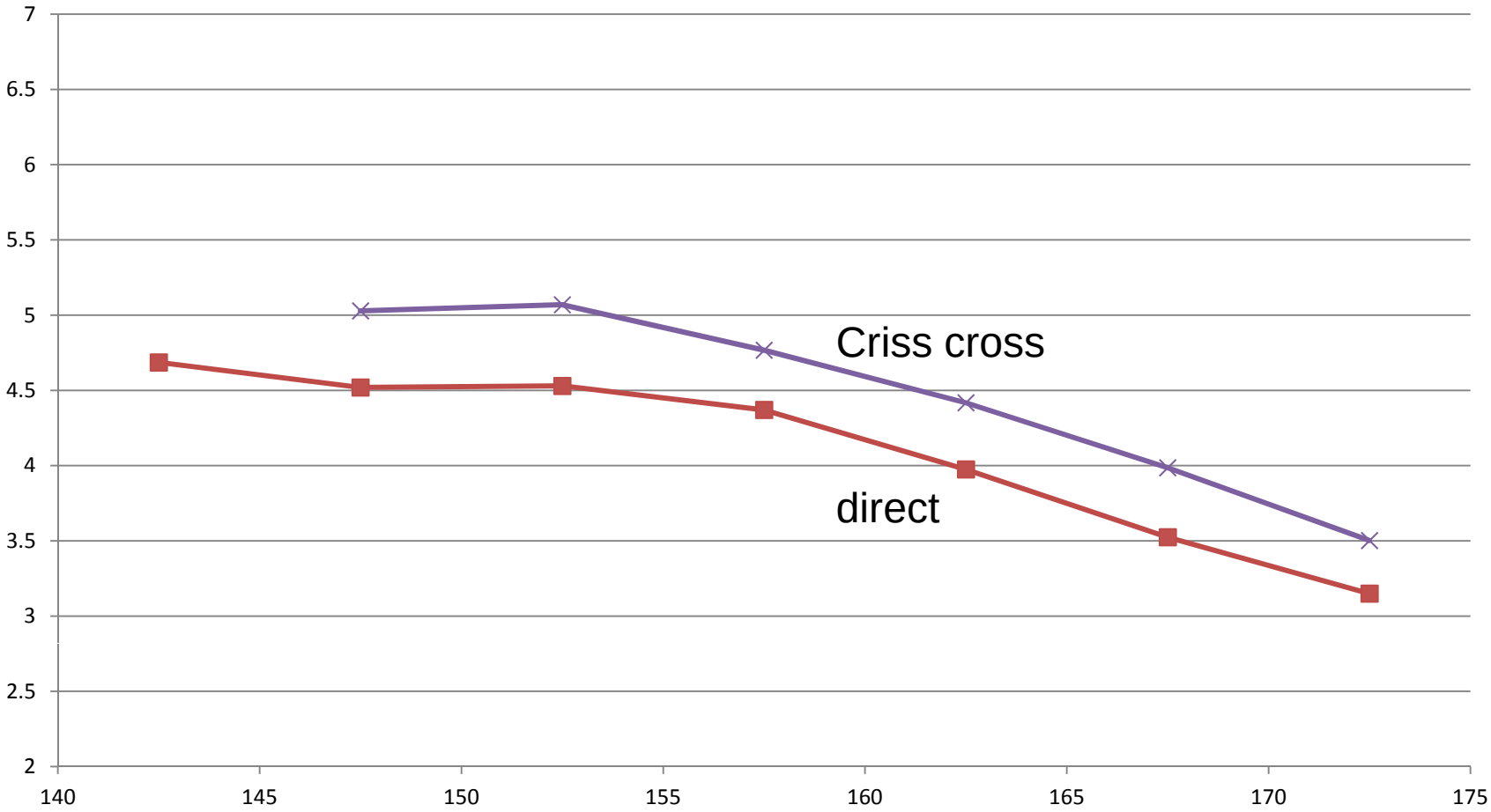
No data quality problems

simulated birth histories

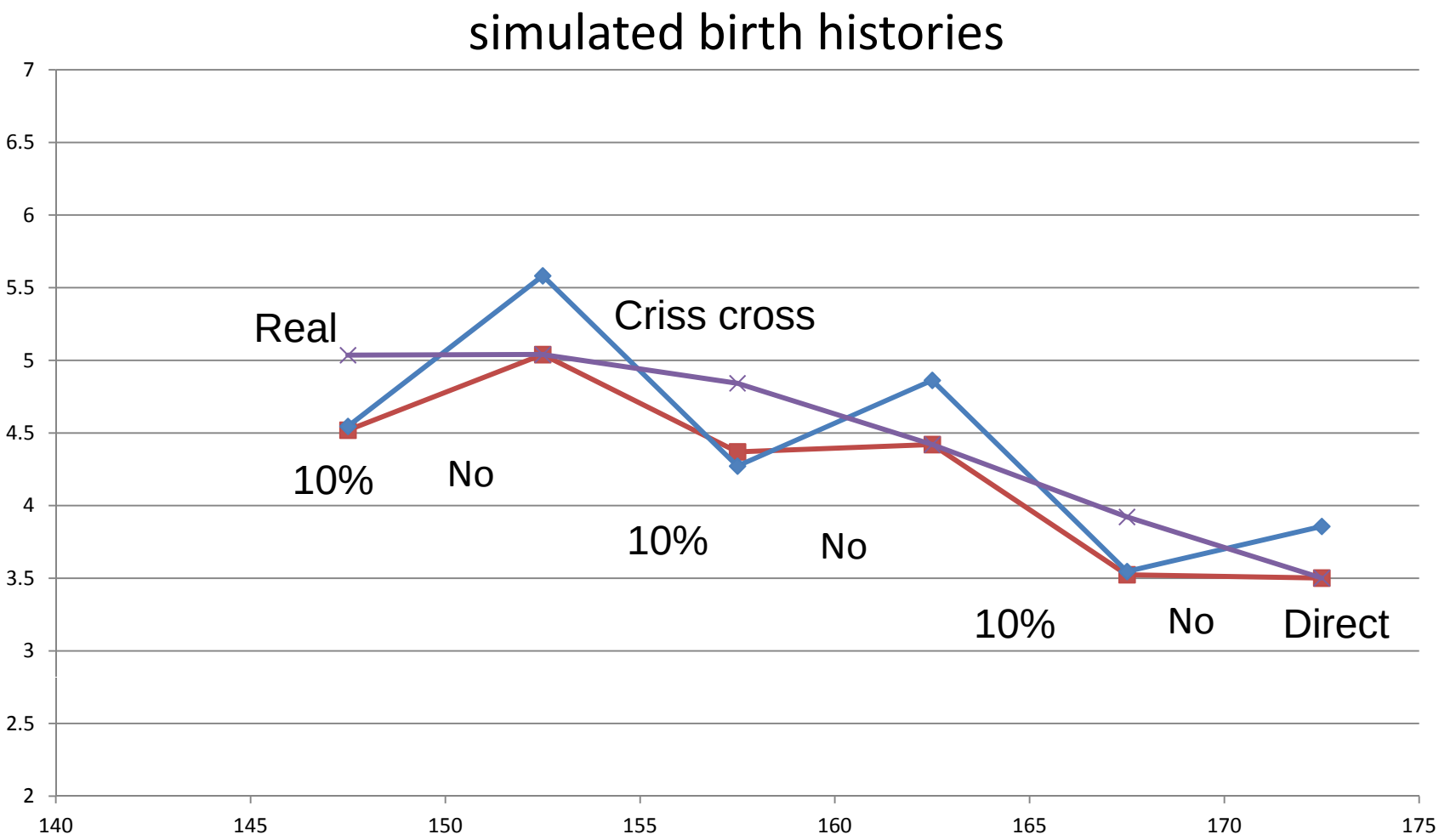


Omissions of 10% of recent births in all surveys

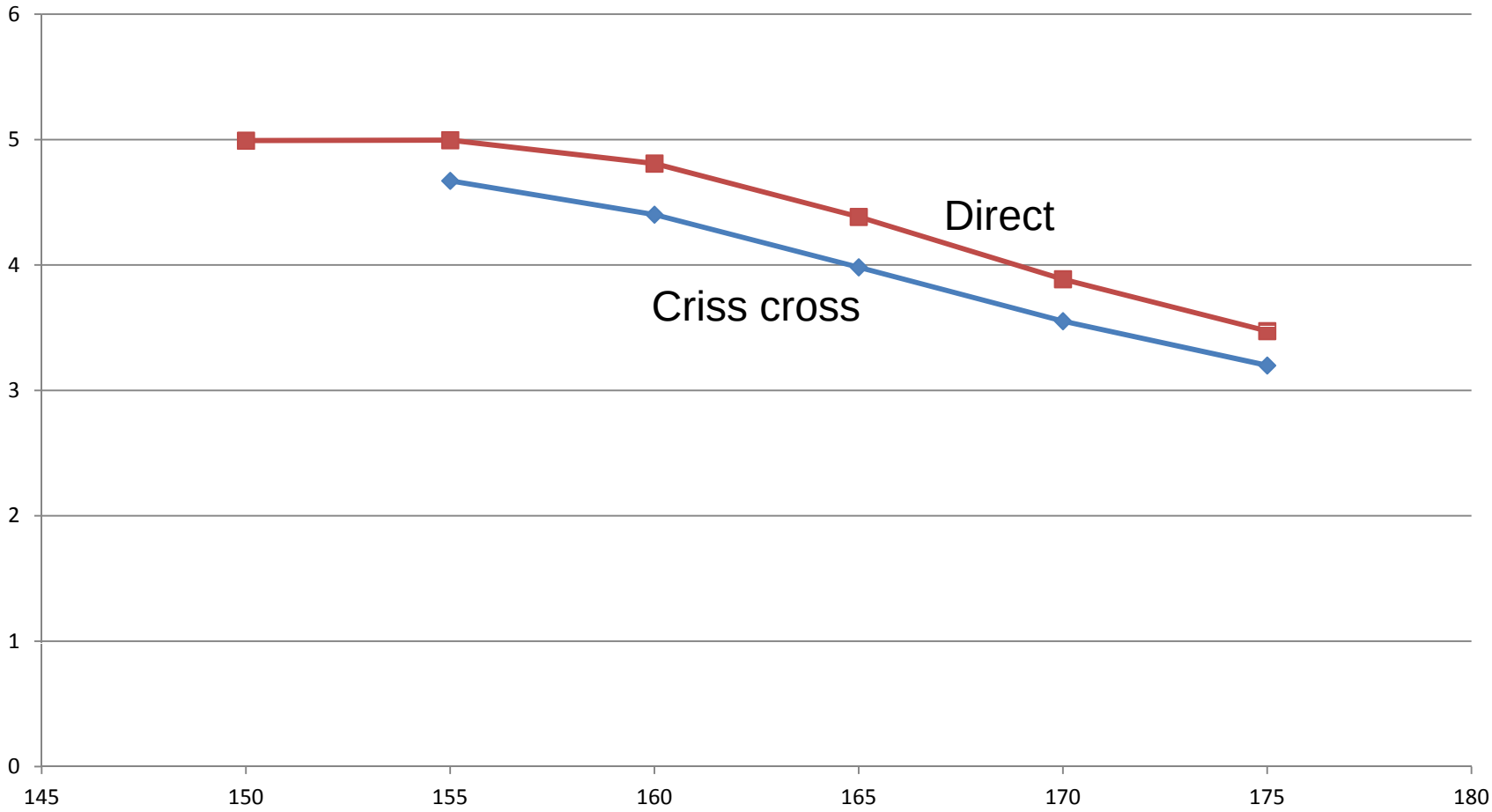
simulated birth histories



10 % omissions of recent births in every other survey

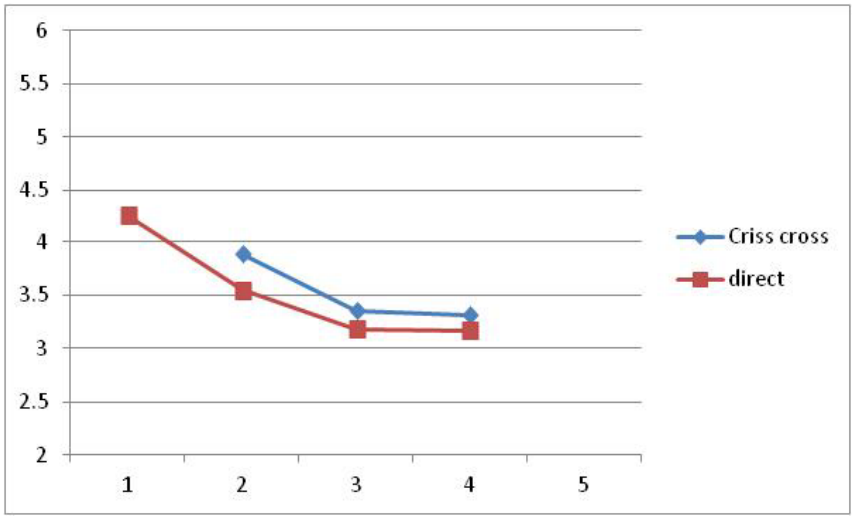


Omissions of past births (omissions increase linearly with time since survey)

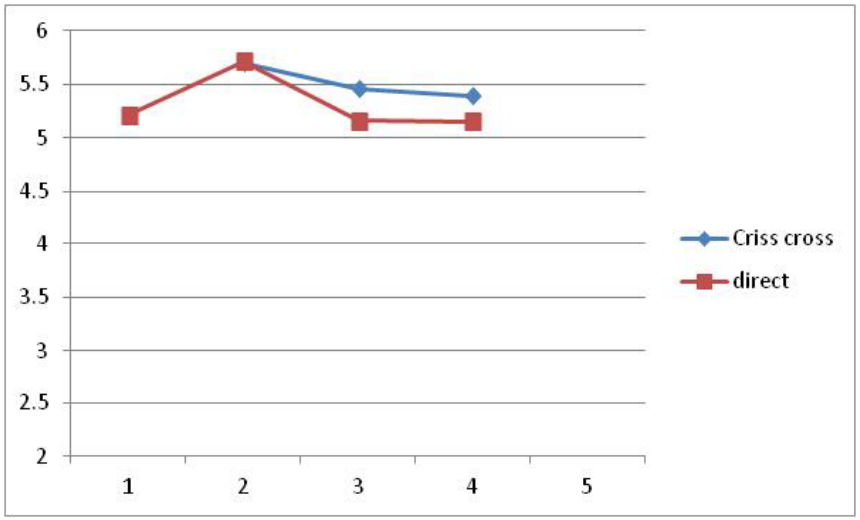


Criss-cross vs. direct method

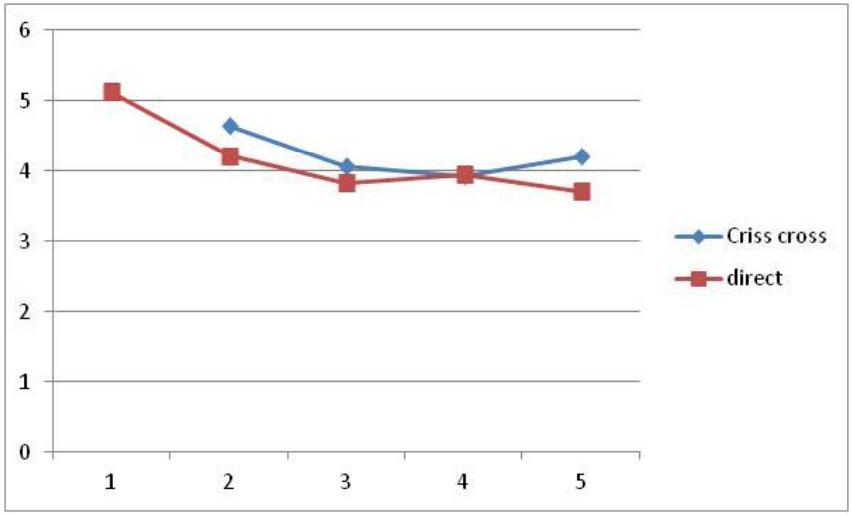
Zimbabwe



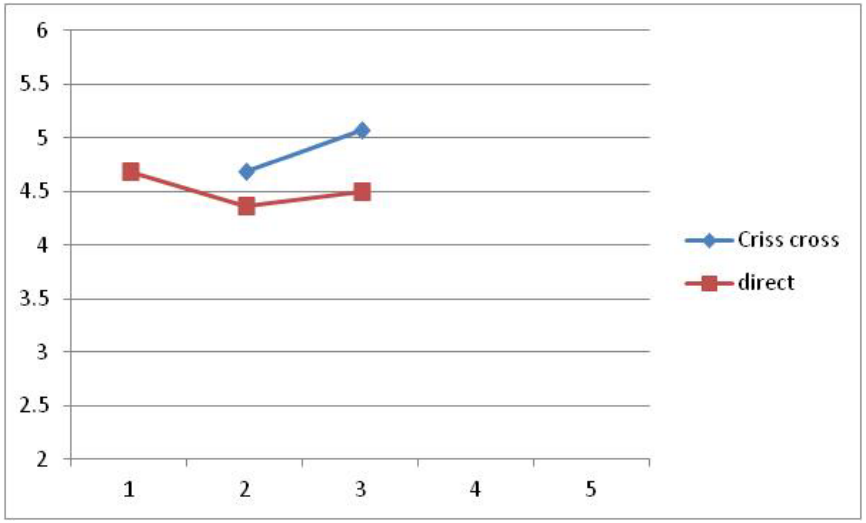
Mali



Kenya

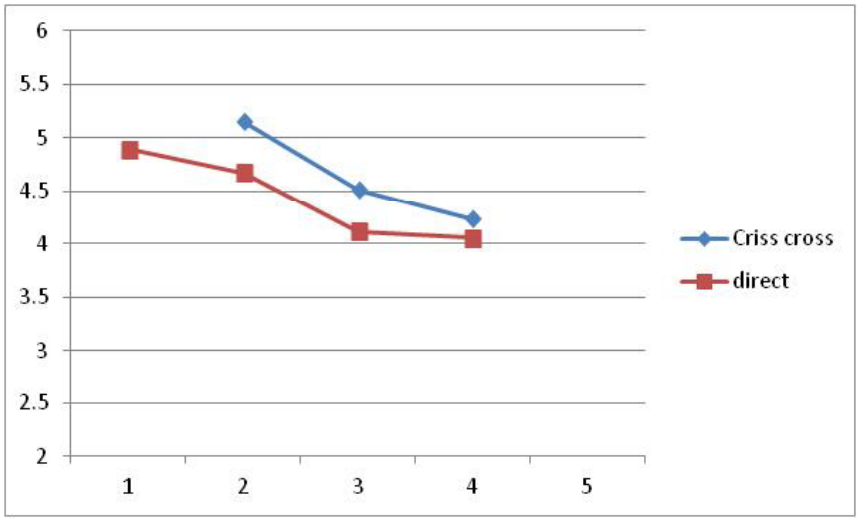


Benin

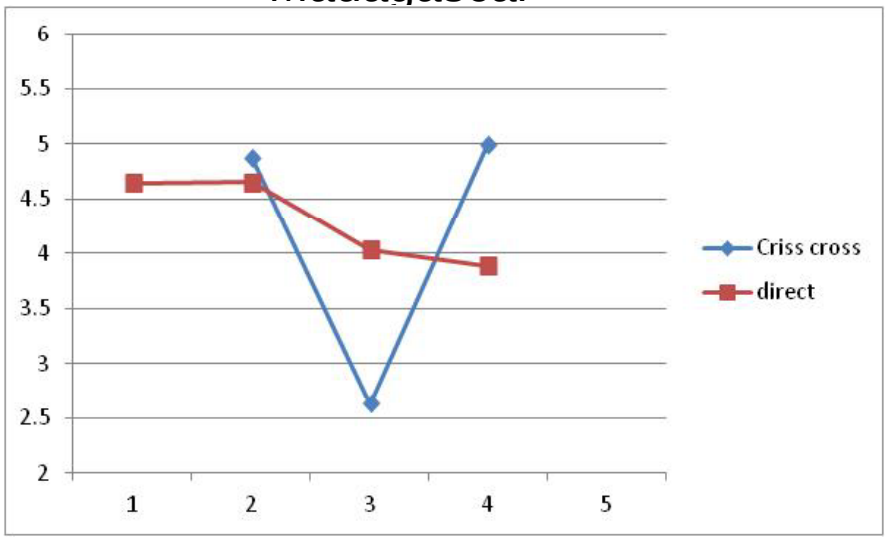


Criss-cross vs. direct method

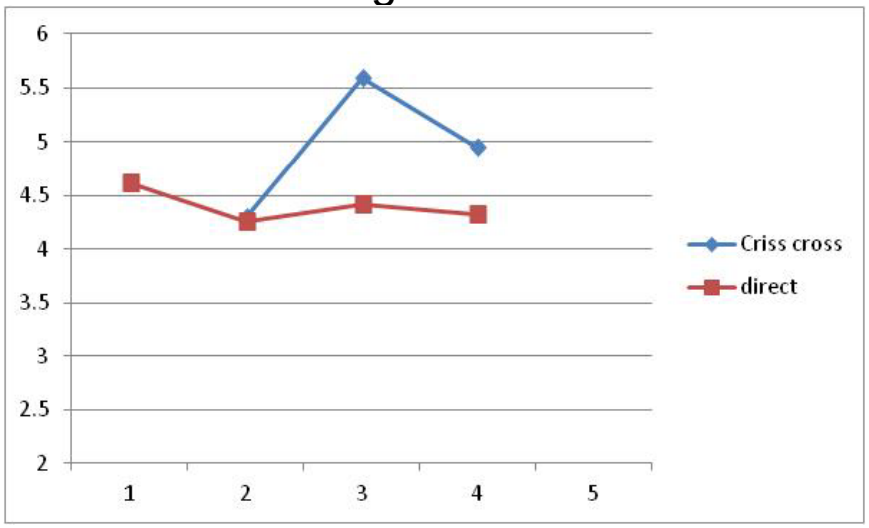
Senegal



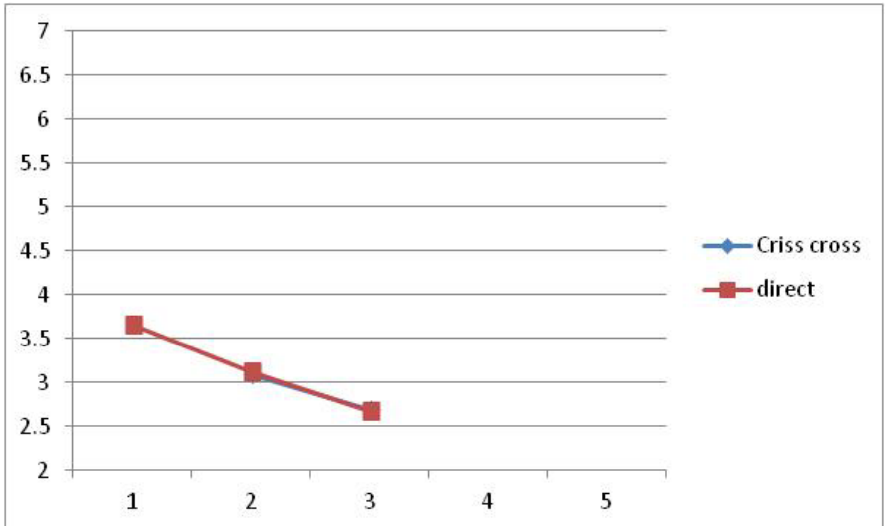
Madagascar



Nigeria

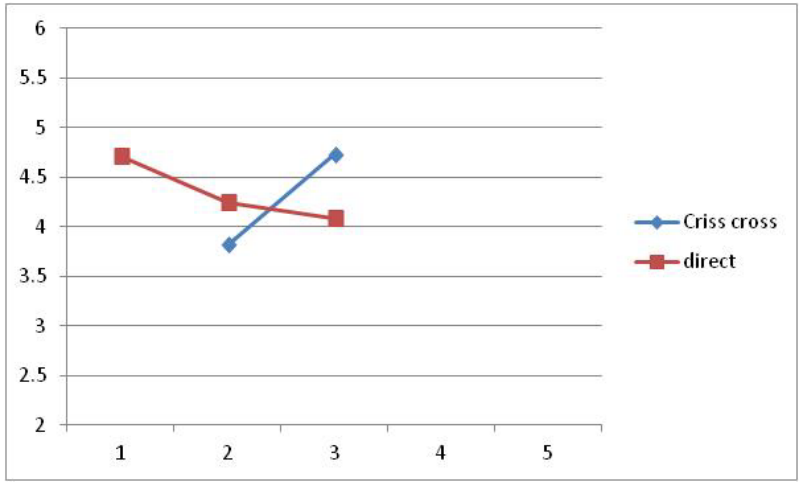


Namibia

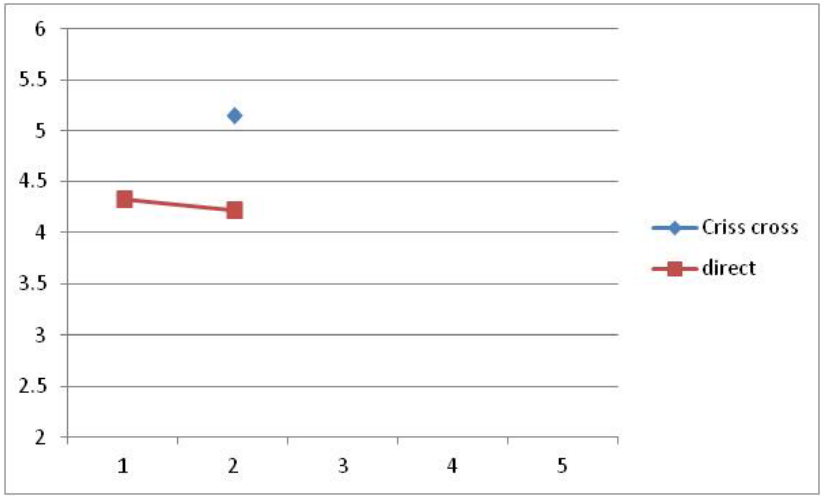


Criss-cross vs. direct method

Cameroon



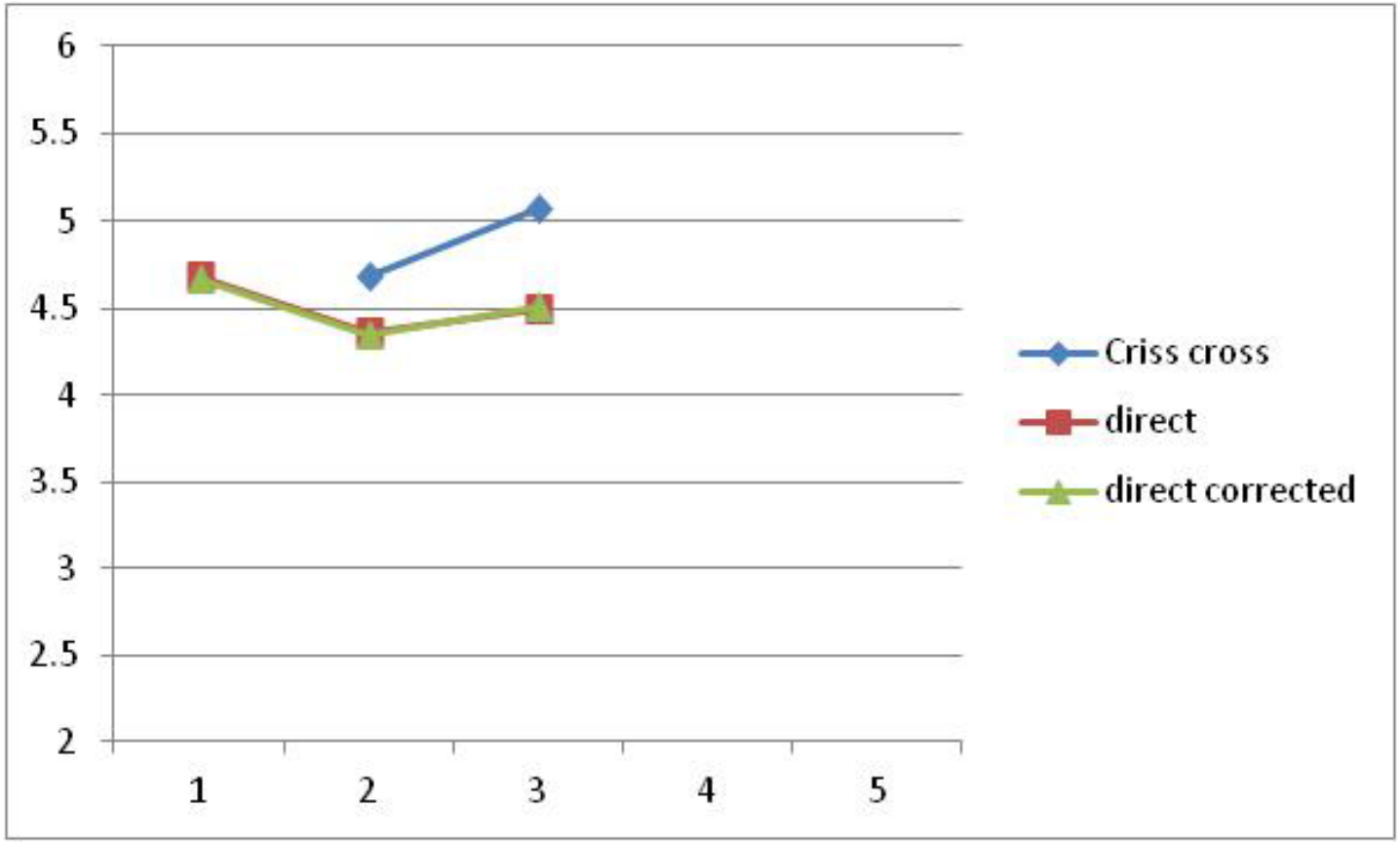
Ethiopia



Crisscross - summary

- Very often : CC > DM
  - Suggest omissions of recent births
  - Relative difference between CC and DM
    - often between 5 % and 15%
    - But interpretation not straightforward
- Correcting DM for displacements
  - Preliminary results lead to similar conclusions

Example of Benin



Conclusion

- Omissions of recent births seem to be a serious issue in the measurement of fertility levels and trends in Africa
  - Suggested by several approaches
    - But not by traditional approaches
- Fertility levels and trends need to be interpreted with caution
- Further research
  - Interpretation of crisscross
  - Comparison of crisscross and other methods