Evaluation of Fertility Data Collected from Population Censuses

United Nations Statistics Division

Outline

1. Fertility data collected in censuses
    1. Children ever born
    2. Recent births
    3. Brass P/F method
    4. Other methods
2. Evaluation of fertility data
    1. Data collection errors, coverage and completeness
    2. Patterns of average parities and parity distributions
    3. Age-specific fertility rates from data on births
    4. Methods for deriving fertility estimates
    5. Comparing estimates from multiple independent sources

1. Children ever born (summary birth histories)

- Measure of **all live** births a woman has had in her lifetime
- Asked to all women age 15 and older
- For every woman the following information is collected:
  - Total number of female children she has borne in her lifetime
  - Total number of male children she has borne in her lifetime
  - Number of female children who are surviving
  - Number of male children who are surviving
    - CEB/CS

1. Children ever born

Recommended question sequence to improve completeness of data:

1. Total number of sons ever born alive during the lifetime of the woman
2. Total number of sons living (surviving) at the time of the census
3. Total number of sons born alive who died before the census data
4. Total number of daughters ever born alive during the lifetime of the woman
5. Total number of daughters living (surviving) at the time of the census
6. Total number of daughters born alive who died before the census date

Source: United Nations (2008), *Principles and Recommendations for Population and Housing Censuses*

1. Children ever born – When is it used?

- Widely used for over 50 years both for measures of fertility and for child mortality (next session)
- Very important for countries without or with incomplete birth registration
- Also important for countries with complete birth registration
  - > Allows for the study of fertility by detailed socio-economic characteristics

2. Recent births

- Measure of recent fertility
- Asked to all women age 15–49 at the time of the census who reported at least one live birth in their lifetime
- **Preferred question:** Date of birth of last child born alive (day, month and year)
- **Alternative question:** Births in the last twelve months to the woman or in the household
  - More error-prone than exact date of birth, although both are subject to under-reporting
  - Date of birth can be converted to births in last 12 months during data processing (will miss only small percentage of cases in which woman had multiple births in a year)

Fertility data – possible errors

Both methods: enumerator's error

1. **Enumerators' failure to reach individuals**
   a) The not-at-home error: information provided by neighbors
   b) Coverage error: omit an area or forgot to record the answer

2. **Recording error**
   a) Answer is recorded incorrectly by the enumerator
      e.g., childless women misclassified into parity not stated

Children ever born – possible errors

1. Errors because the respondent did not understand the question
   a) Mortality error: reported only children living rather than ever-born
   b) Non-resident error: did not report surviving children living elsewhere
   c) Marriage error: women not reporting her children born from previous marriage or children born out of wedlock

2. Errors because of respondents' lapse of memory or neglect
   a) Memory error: respondent forgot some children
      > Believed to be more common among older women

3. Age misreporting
   a) Teenage mothers may exaggerate their age
   b) Age misreporting if this results in a systematic over- or under-stating of age

Recent births – possible errors

1. Reference period errors
   a) Uncertain of the exact date of birth relative to the reference period
   b) Incorrectly moving birth into or out of the reference period
2. Births missed because mother not located
   a) Women had a birth recently but died or migrated before the census
   b) Household had a birth recently but the household dissolved before the census
   c) Not significant in most cases, however could become an issue when many deaths occurring in a short period (HIV/AIDS) or when there is significant migration

Standard fertility measures

Average Parity/Children Ever Born – average number of children had by women in an age group

Parity Distributions – distribution of women in each age group by number of children they have had

Age Specific Fertility Rates (ASFR) – indicates the age pattern of fertility in a society

$$ {}_nF_x = \frac{{}_nB_x}{{}_nW_x} $$

${}_nB_x$ =Births to women age x to $x+n$ during period

${}_nW_x$ =Mid-period population of women age x to $x+n$

Total Fertility Rate (TFR) – number of children a woman would have in her lifetime if she lived her whole life under today's fertility conditions (ASFRs)

$$ TFR = n \cdot \sum {}_nF_x $$

Census fertility data – what can we get?

	Parity Distribution	Average Parity	ASFR	TFR
Children Ever Born	**Y**	**Y**	**Y***	**Y***
Recent Fertility	**N**	**N**	**Y**	**Y**

*With one census under constant fertility, otherwise with two censuses

Evaluating fertility data using standard fertility measures

CEB – quality assessment (Step 1)

- Initial assessment of data quality and missing values
  - Any missing values in CEB data?
  - Missing value for any relevant variables? (age of mother, sex of child, survival status of the child)
  - Was imputation, hotdecking or any other method used to clean the data?
    - If so, should have a good understanding of the rules followed

Note: hot-deck imputation > a missing value imputed from a randomly selected similar record

CEB – quality assessment

Table 2.11 Proportion of women whose parity data was not subject to logical imputation or hotdecking, by age and population group, Census 2001

Age group	*African*	*Coloured*	*Indian/Asian*	*White*
12-14	65.2	53.5	61.4	46.2
15-19	73.5	63.7	68.8	55.9
20-24	82.5	78.5	79.1	73.9
25-29	88.2	87.6	88.0	85.4
30-34	90.9	91.2	92.2	90.2
35-39	91.9	92.6	93.5	91.3
40-44	91.4	92.5	93.3	91.5
45-49	89.9	91.3	91.9	90.4

Source: Moultrie & Dorrington (2004), *Estimation of fertility from the 2001 South Africa census data,* Centre for Actuarial Research, University of Cape Town.

CEB – quality assessment (Step 2)

Tabulation of children ever born

- Number of children should not be grouped, except for the last open category (usually no lower than 9+ or 10+ children)
- Children ever born *not stated* should be distinguished from *no children (parity "0")*
- Are parities reasonable?
  - Quick rule-of-thumb: maximum parity should be one child every 18 months from age of 12
  - E.g. by exact age 20 (end of 15 – 19 age group) maximum children should be 5

Source: Moultrie et al. (2013)

CEB – quality assessment

Morocco, 2004 Census (Source: UNSD, DYB Database)

Parity	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49
0	694	100876	168471	118301	87556	64500	59557	41704
1	324	58883	239418	199377	133071	82489	64040	42300
2	154	9846	128822	227261	196144	140834	102491	60317
3	101	21151	35855	130853	177173	153707	127640	78409
4	66	14231	10176	55591	119784	136350	132292	88127
5	49	7129	2563	18925	62481	95653	113917	86439
6	32	515	1392	7676	31723	63225	92044	80666
7	29	338	678	2882	13473	36229	66005	66574
8	12	328	911	2252	7476	21117	44559	51222
9	20	171	464	1195	3482	11048	27181	35099
10	9	164	331	605	1754	5874	16101	23450
11	9	94	259	352	812	2775	8180	12884
12+	8	73	213	493	1148	3309	9201	14933
Unknown								

Parities obviously wrong

Unknown not separated from parity '0'!

CEB – quality assessment

Morocco, 2004 Census (Source: UNSD DYB)

United Nations Statistics Division

Parity	15-19	20-24	25-29	30-34	35-39	40-44	45-49
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4	1181	10176	55591	119784	136350	132292	88127
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11	0	0	352	812	2775	8180	12884
12+	0	0	493	1148	3309	9201	14933
Unknown		472					
Total ever-married women	173652	589081	765763	836077	817110	863208	682124
Total children		6018	1474286	2264462	2879237	3727497	3413965
Proportion childless	0.581	0.286	0.154	0.105	0.079	0.069	0.061
Average parity	0.54	1.16	1.93	2.71	3.52	4.32	5.00

Proportion with unknown parity should stay constant

Total children by age group = Parity * women at that parity

Proportion childless should decrease with age

Average parity should increase with age

CEB – quality assessment

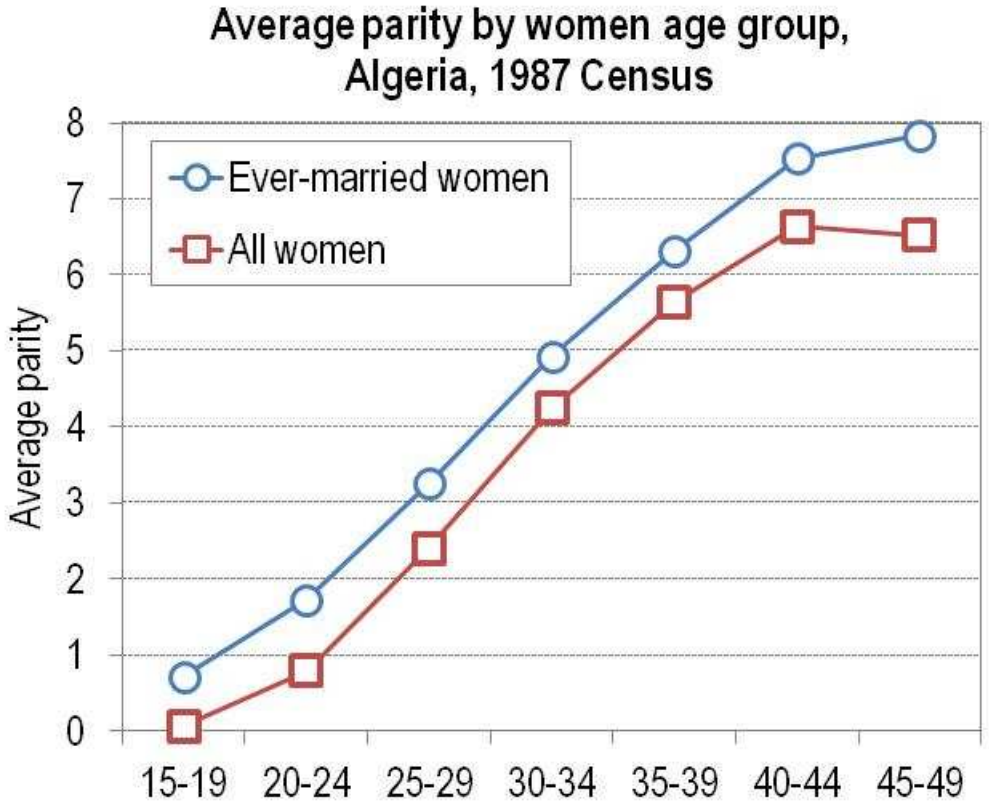
Average parity at age *x*:

$$P_x = \frac{B_x}{W_x} = \frac{\sum_j jW_{j,x}}{\sum_j W_{j,x}}$$

where

B_x = number of births by age x

$W_{j,x}$ = number of **all women** of age x at parity j



CEB – quality assessment

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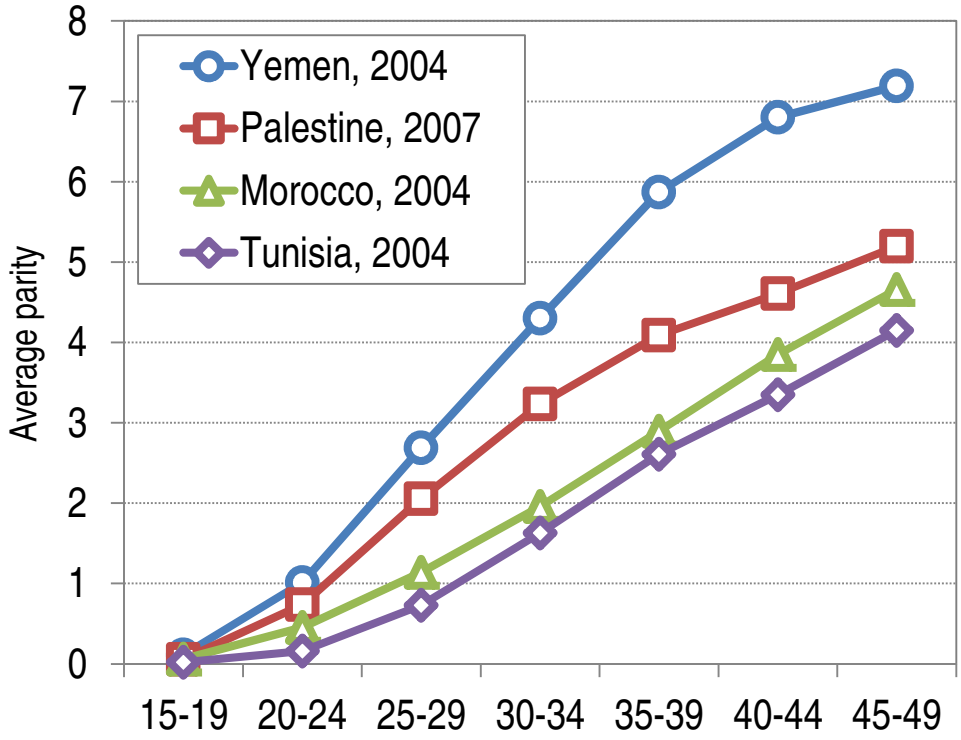
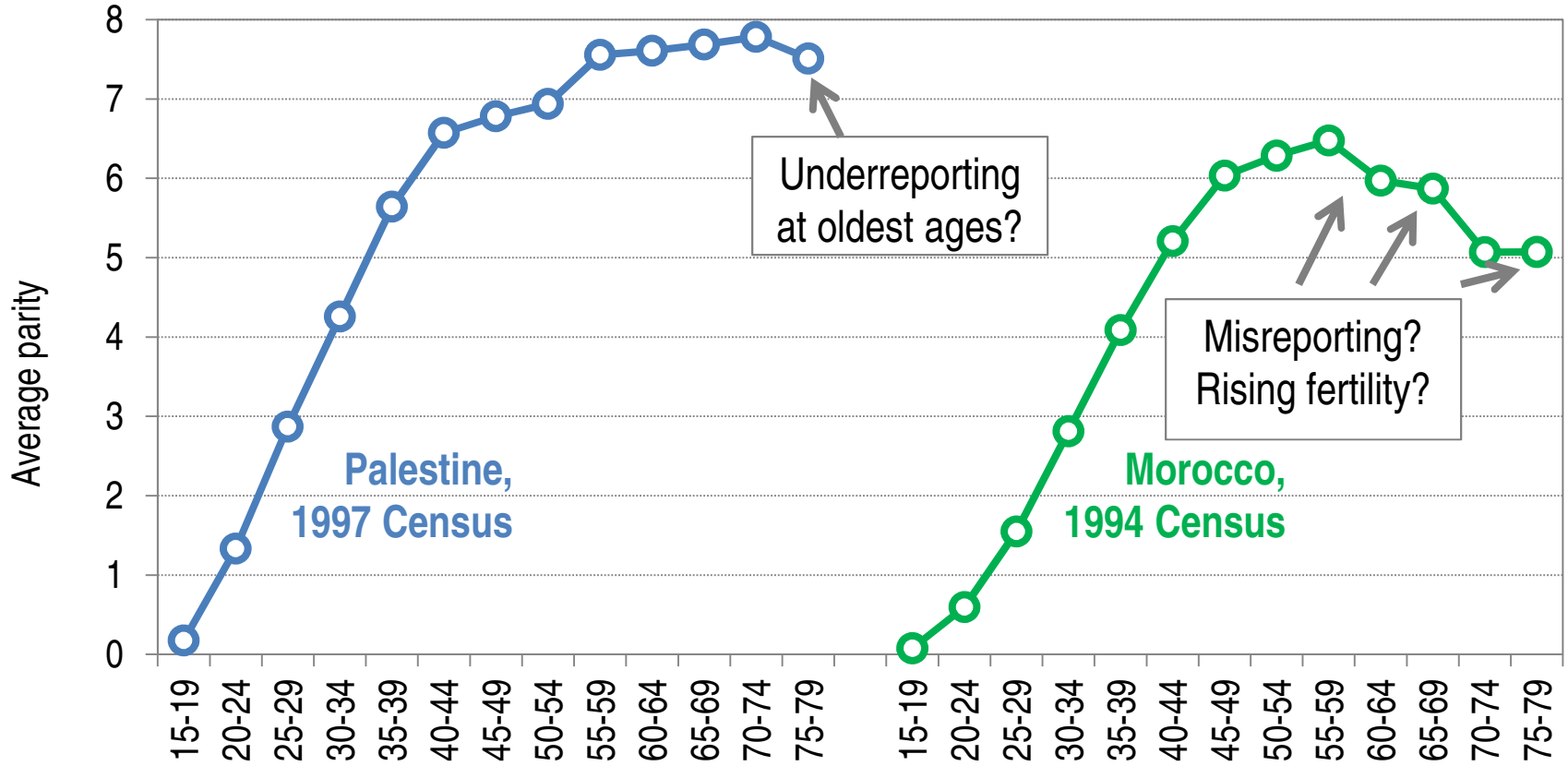


CEB – quality assessment

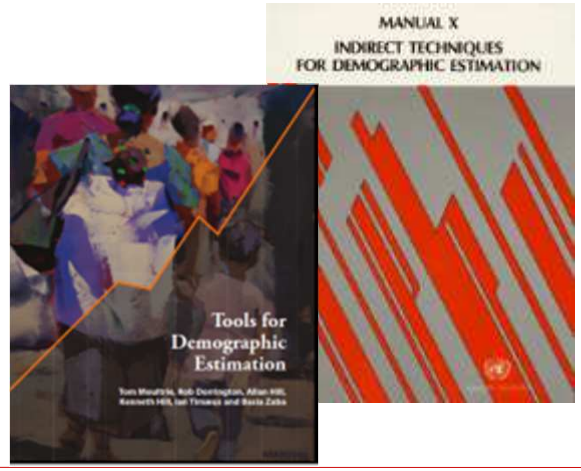


The el-Badry Correction

- to adjust reported data on children ever born
- A common problem with CEB data is that enumerators may incorrectly code women of zero parity as “parity unknown” or “parity not stated”
- The el-Badry method corrects for this
  - If parity unknown is less than 2% of each age group >> safe to assume that data are consistent and no correction needed. Women with unknown parity can be redistributed proportionally according to women with stated parities.
- Detailed examples in:

  - United Nations (1983, pp. 230-235).

  - Moultrie et al. (2013, pp. 35-41).



CEB checks, Parity distribution of women age 45-49

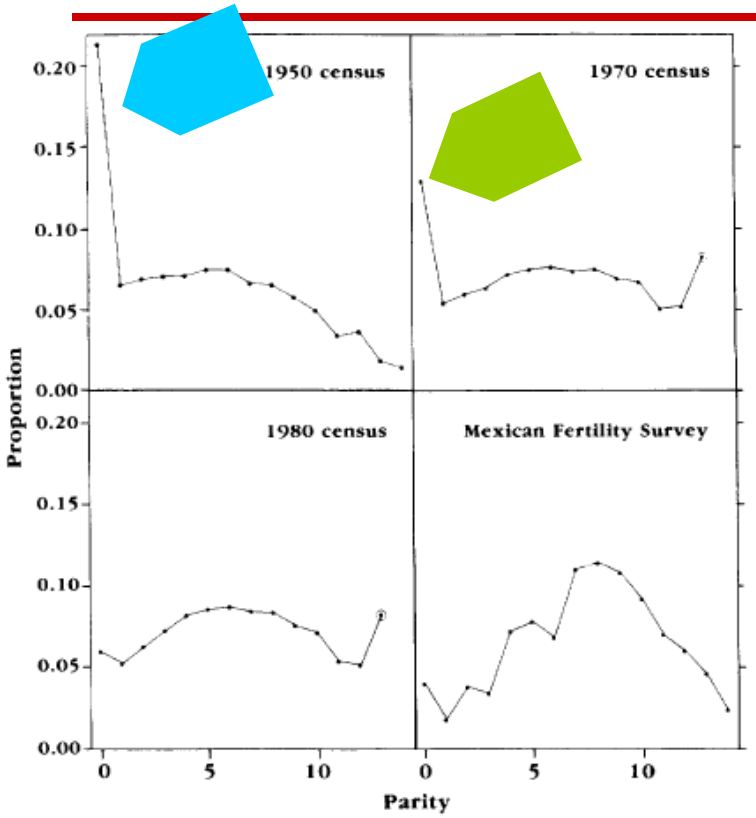
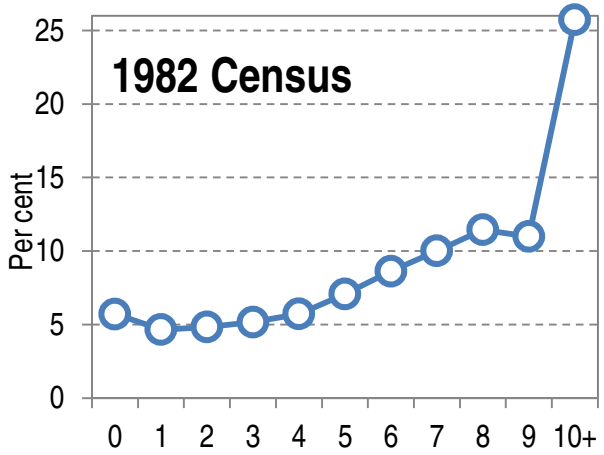


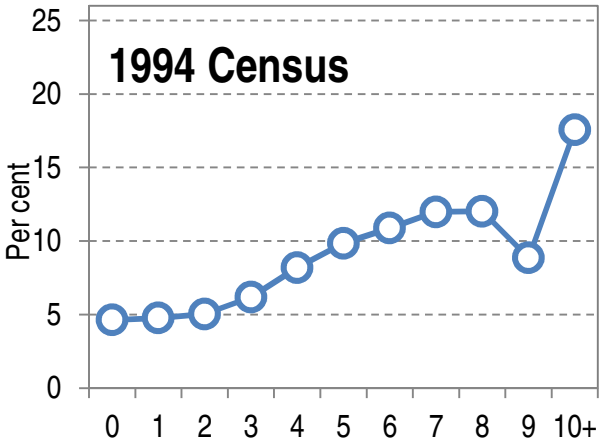
Figure 3. **Completed parity distributions for Mexico, from the censuses of 1950, 1970, and 1980 and from the Mexican Fertility Survey**

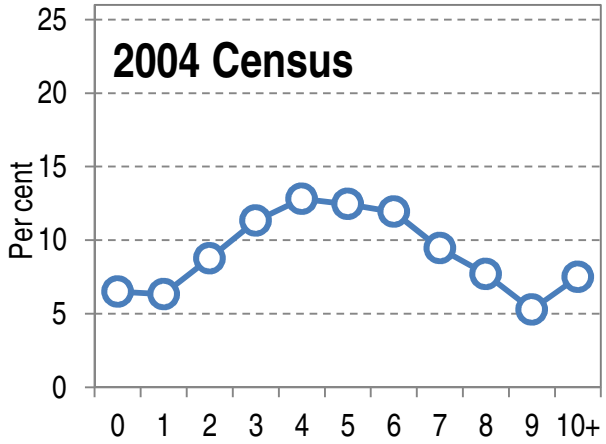
- High level of parity 0 in 1950 and 1970 censuses: possibly groups "not stated" and "0" parity combined. No separate groups unlike as in the 1980 census.
- Flat curve: probably some form of misreporting, seems to be improving over time
- Mexican fertility survey: shape of the curve more plausible (small sample size)

Source: Feeney (1991)

CEB Checks, Parity distribution of ever-married women age 45-49, Morocco, 1982-2004 censuses





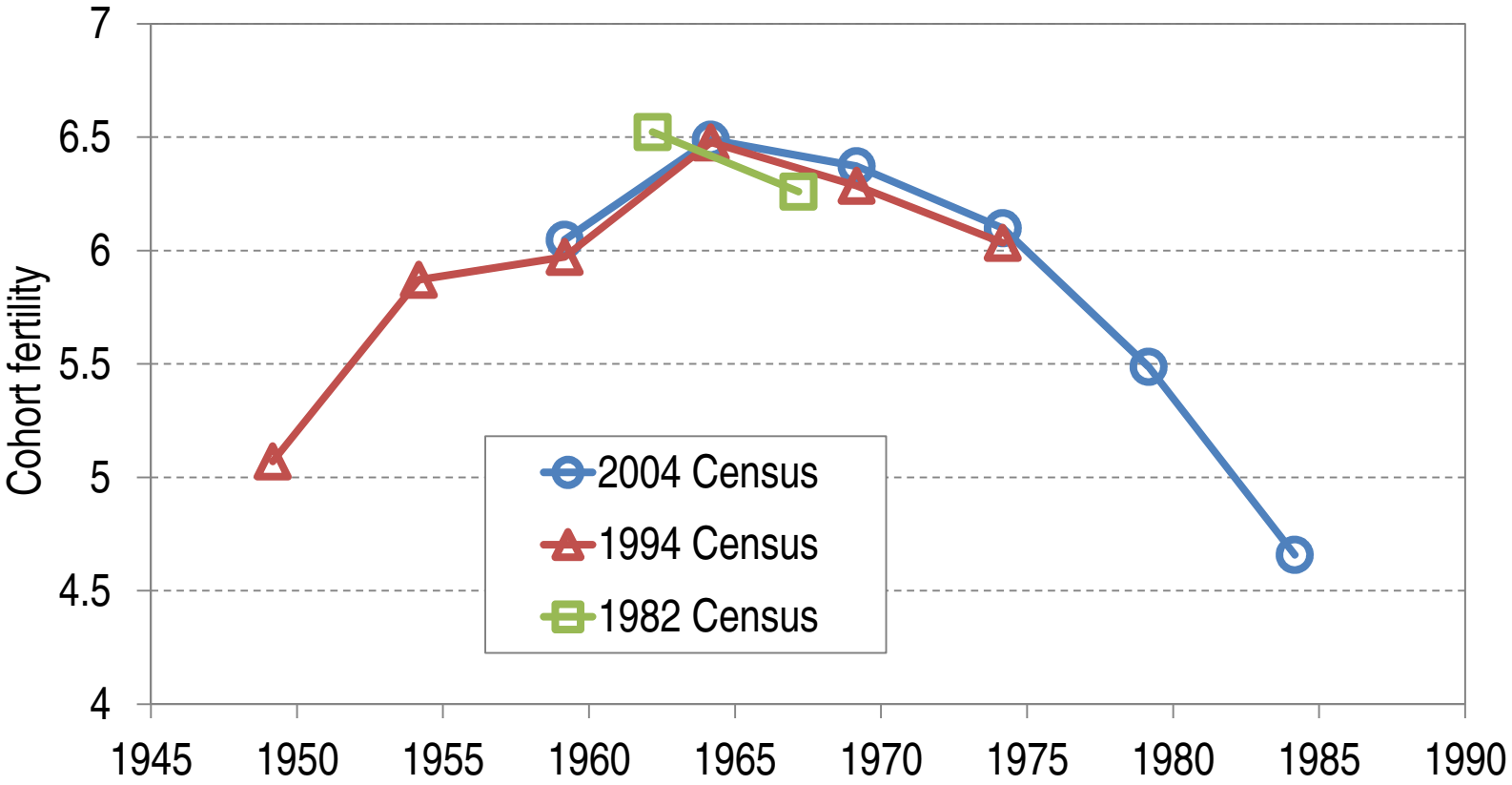


Data source:
Computed based on IPUMS-International

CEB Additional Checks
Cohort analysis of mean number of CEB

- Simple test for quality of reporting among older women
- Time-plotting of CEB (introduced by Feeney (1988))
- Assumes all childbearing at age 27 (or any other age)
- Year in time = Census year – (age – 27)
- Morocco example: 1982 to 2004 censuses
  >> past fertility increase?

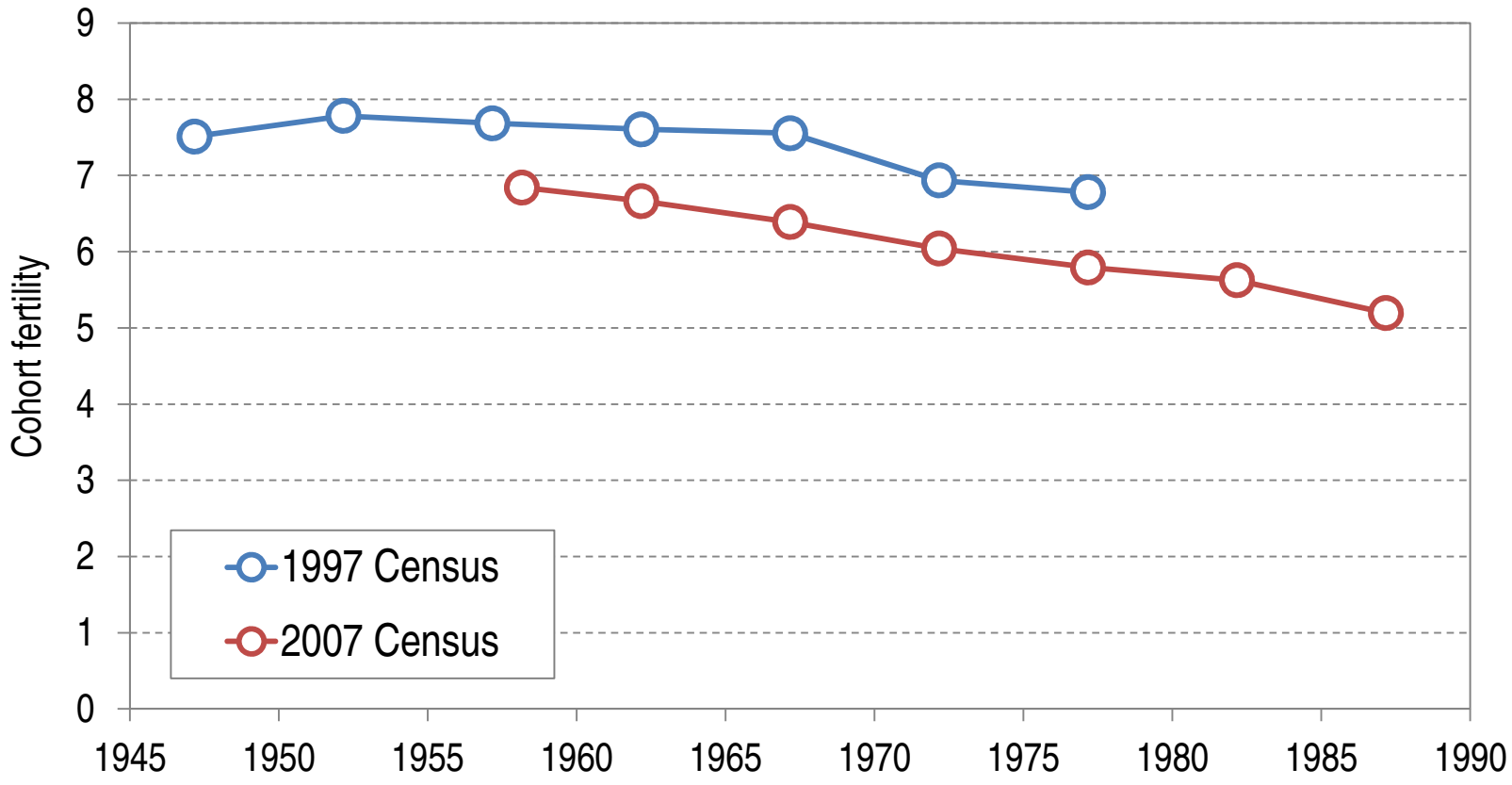
CEB - Additional Checks
Cohort analysis of mean CEB



Source: computed based on IPUMS-International

CEB - Additional Checks

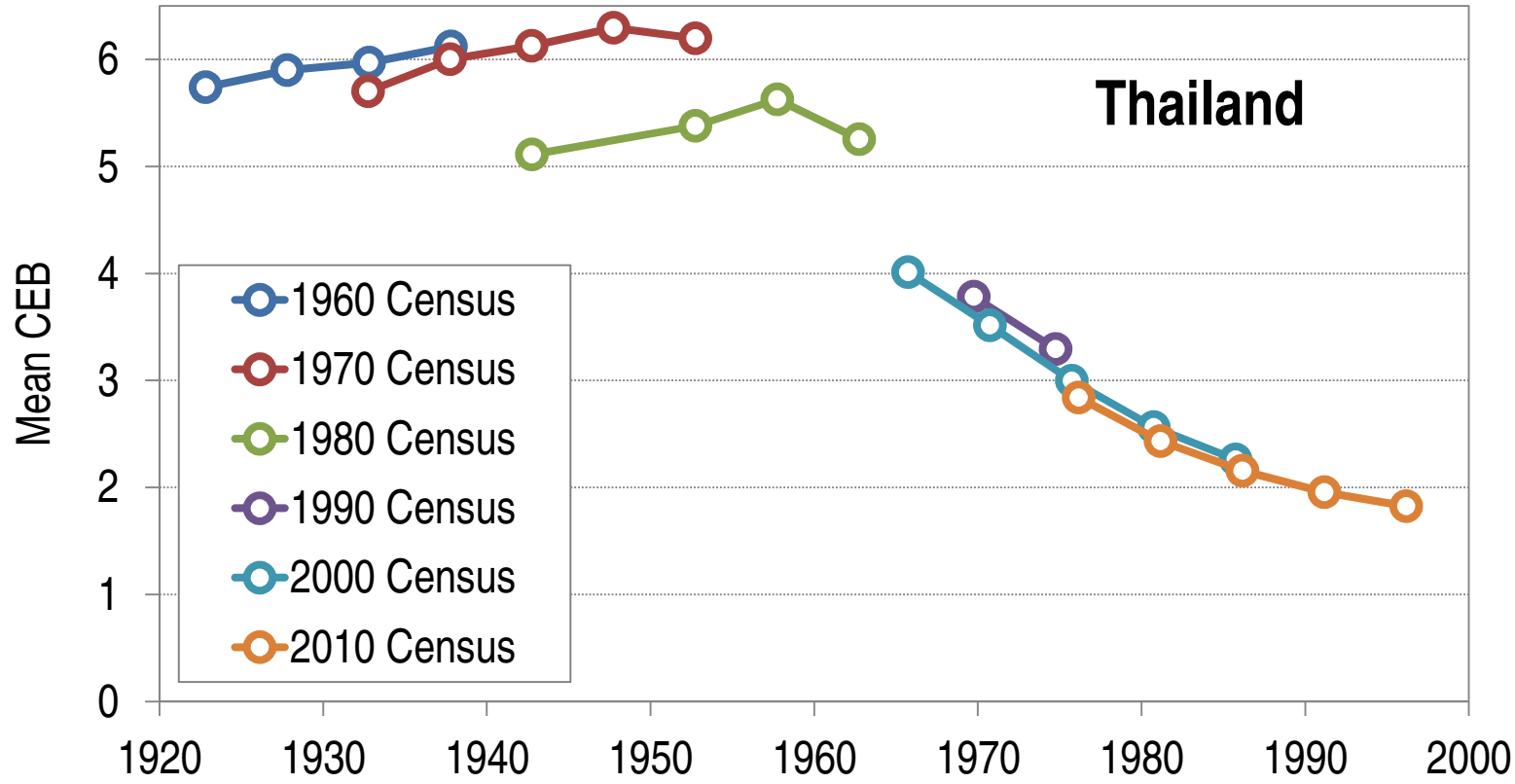
Cohort analysis of mean CEB, State of Palestine, 1997 & 2007 Census



Source: Computed based on IPUMS-International

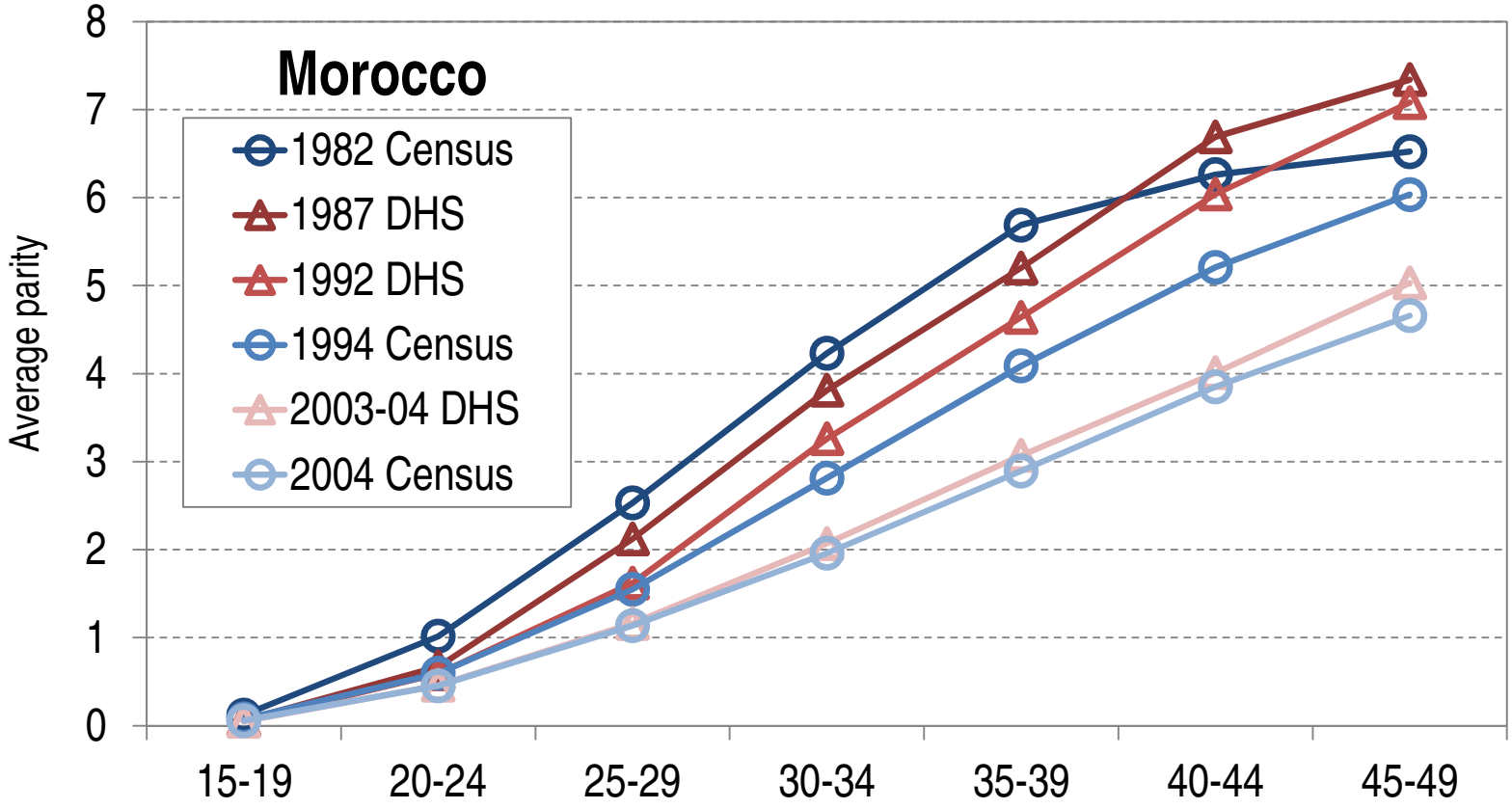
CEB - Additional Checks

Cohort analysis of mean CEB, Thailand, 1960-2010 Census



Source: based on Feeney (1991) using IPUMS-International

CEB – Additional checks
Multiple sources of data



Data source: IPUMS-International and DHS STATcompiler http://www.statcompiler.com/

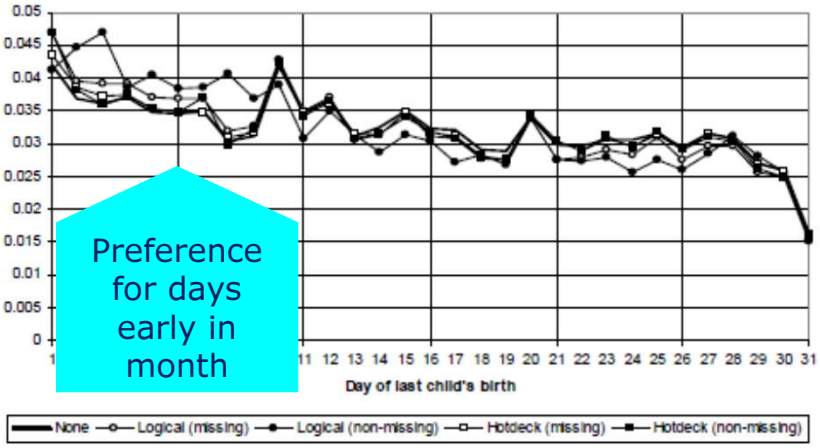
Recent births – quality assessment

Initial assessment

- Any missing values in data? (month/date/year of birth)
  - Missing data for any relevant variables? (age of mother, sex of child, survival status of the child)
- Is distribution of reported birth dates reasonable?
- If possible, compare with civil registration data on live births

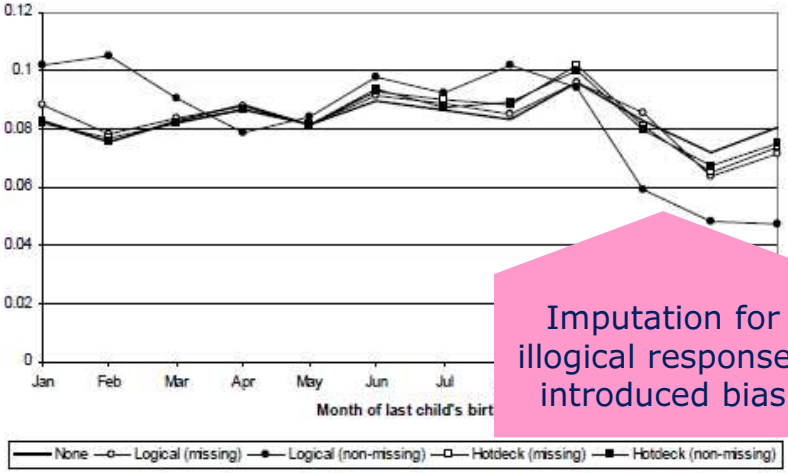
Recent births – quality assessment
Missing and inconsistent data

Figure 2.3 Distribution of last child born's day of birth by imputation and cleaning method, Census 2001



Preference for days early in month

Figure 2.4 Distribution of last child born's month of birth by imputation and cleaning method, Census 2001



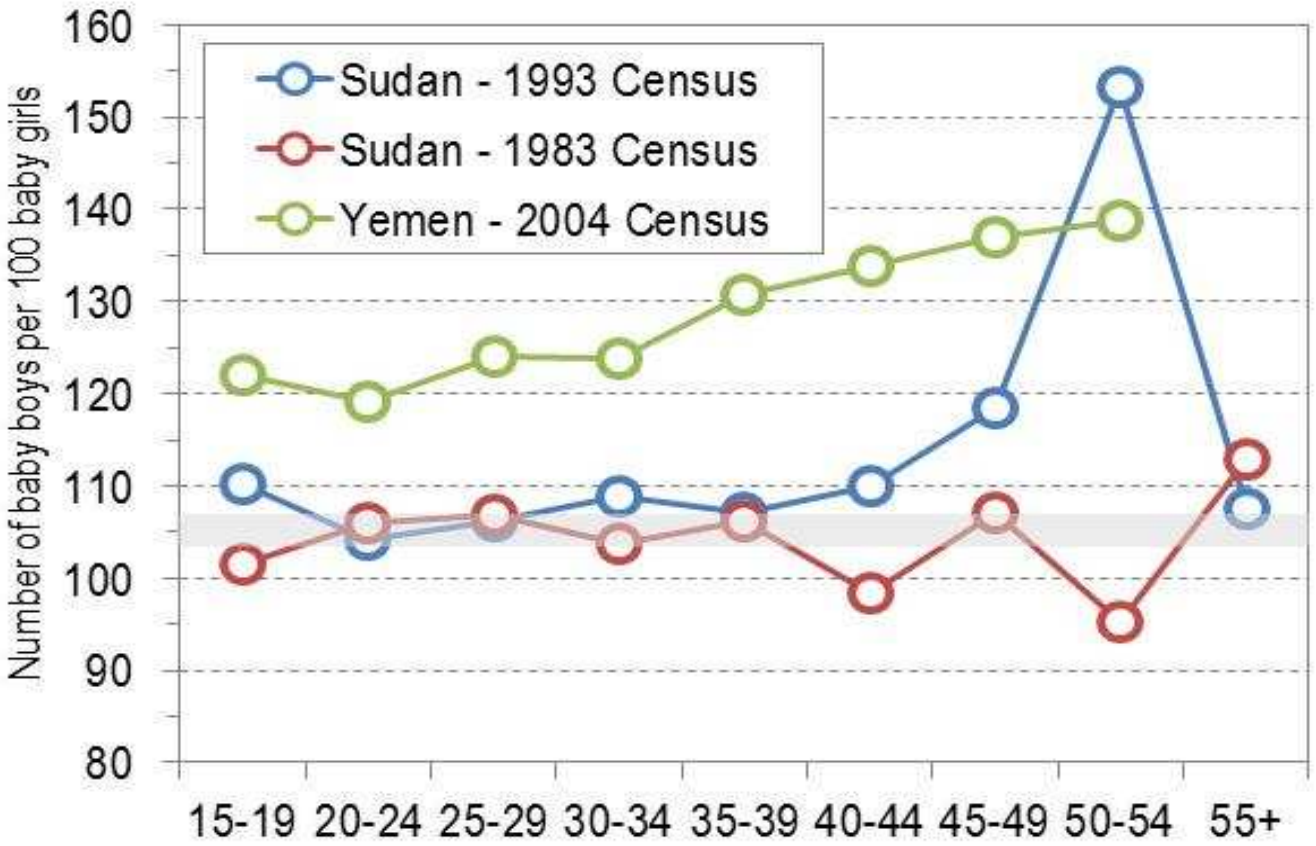
Imputation for illogical responses introduced bias

Table 2.9 Distribution of women aged 12 to 49 by imputation flag for response to question on year of last child's birth

	No imputation	*Logical imputation from*		*Hotdeck applied to*		*TOTAL*
		missing response	*non-missing response*	*missing response*	*non-missing response*	
Women	6560661	604260	391548	734257	165002	8455728
(per cent)	77.6	7.1	4.6	8.7	2.0	77.6

Source: Moutrie & Dorrington (2004)

Recent births, quality assessment – sex ratio at birth



Data sources: Sudan: 1983 and 1993 National Census Reports; Yemen: 2004 Census Final Report (table 48-1)

Recent births quality assessment age specific fertility rates (ASFR)

Age Specific Fertility Rate (ASFR)

$$nFx = \frac{nBx}{nWx}$$

nBx =Births to women age x to x+n during period

nWx =Mid-period population of women age x to x+n

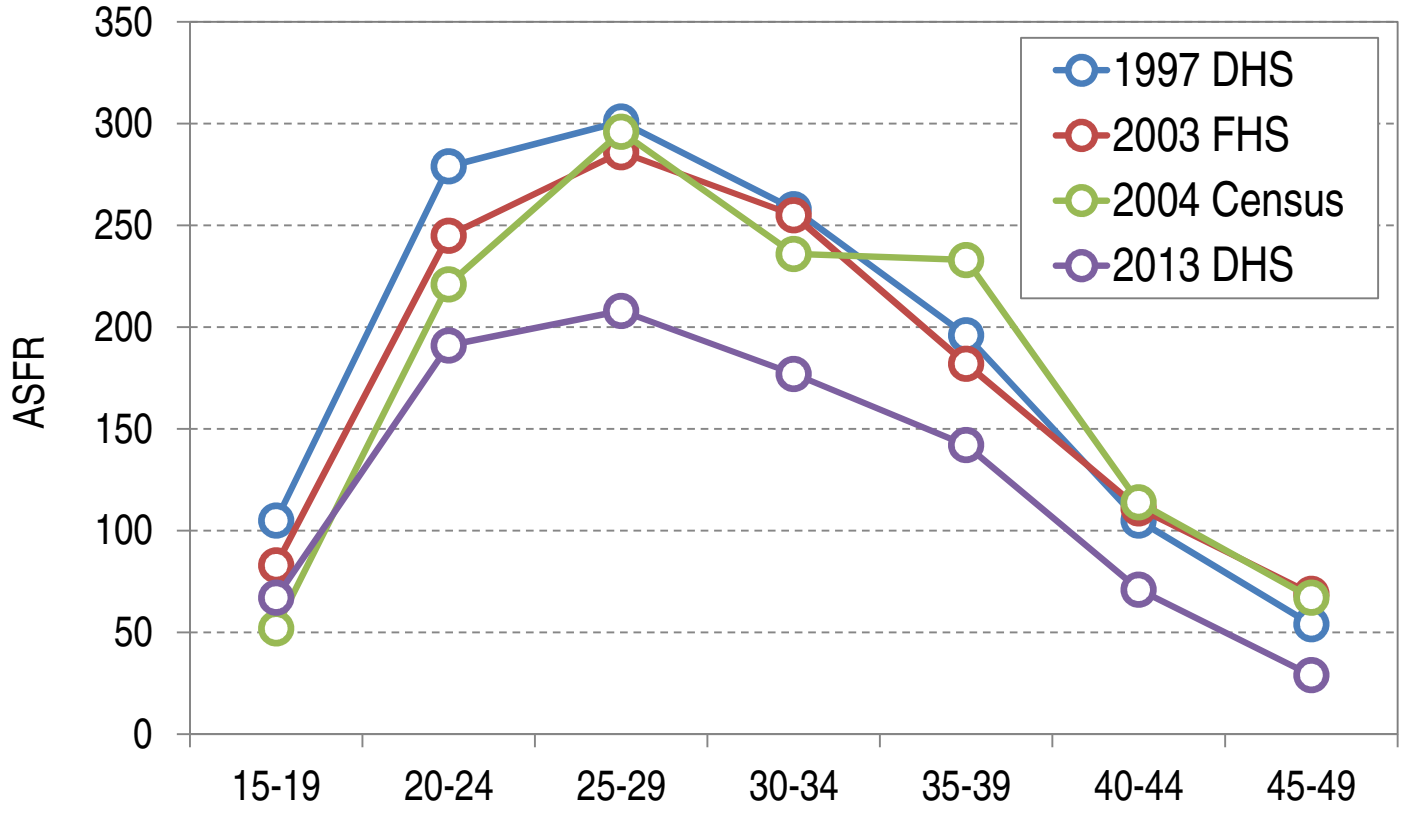
Are births classified by age of mother at birth of her child or by age of mother at the survey/census date?

If not known, assume the latter, almost universally, in censuses, data are classified by age of mother at time of census. In this case, ASFRs are shifted by ½ year as mothers were ½ year younger at the time of birth.

SUDAN, 1993 Census

Age group	Births in 12 months preceding census	Total women in age group	ASFR
14.5 – 19.5	46,349	1,135,111	0.0408
19.5 – 24.5	138,105	932,340	0.1481
24.5 – 29.5	193,451	917,711	0.2108
29.5 – 34.5	117,374	594,113	0.1976
34.5 – 39.5	96,165	625,048	0.1539
39.5 – 44.5	27,497	409,462	0.0672
44.5 – 49.5	10,004	364,021	0.0275

Recent births, quality assessment
Comparing ASFRs, Yemen

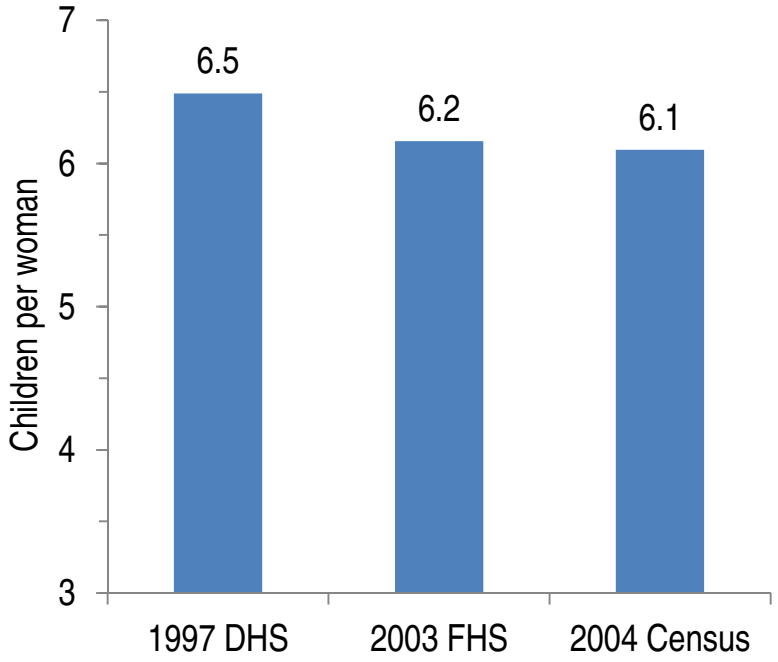


Data sources: Census Analytical Report, p.28; YFHS, p. 66; DHS STATcompiler

Recent births, quality assessment
Comparing Total fertility rates (TFR)

Yemen, TFRs comparison

Age group	1997 DHS	2003 FHS	2004 Census
15 - 19	0.105	0.083	0.052
20 - 24	0.279	0.245	0.221
25 - 29	0.301	0.286	0.296
30 - 34	0.258	0.255	0.236
35 - 39	0.196	0.182	0.233
40 - 44	0.105	0.111	0.114
45 - 49	0.054	0.069	0.067
TFR	**6.5**	**6.2**	**6.1**

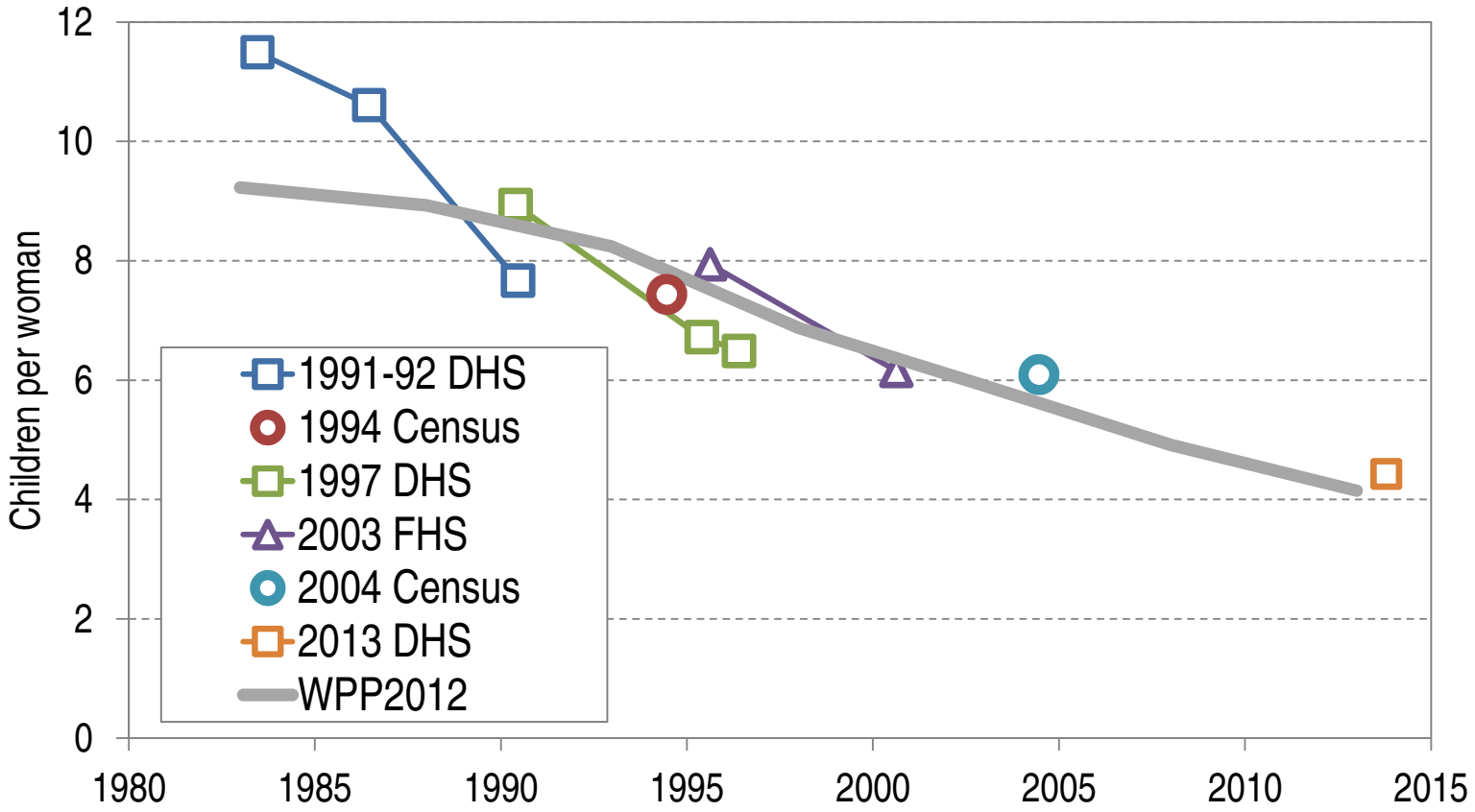


$$TFR = 5 \cdot \sum_{x=15-19}^{45-49} {}_5F_x$$

Estimating fertility from data collected in censuses

- To obtain new estimates of fertility
- To compare estimates from the current census with estimates available from other sources (e.g. surveys)

Yemen, TF estimates from different sources



Methods for estimating fertility

- Interpolation of average parities (Mortara, 1949)
- Brass P/F method and its variations and extensions, e.g. Arriaga (1983), Relational Gompertz model
- Methods based on population structure: Reverse Survival and Own Children Method
- Methods based on data from two or several censuses: Arriaga (1983), synthetic relational Gompertz model, parity increments

Interpolation and backdating average parities

Average parity at ages x, $x+n$ by definition:

$$ {}_nP_x = \int_x^{x+n} F(a)da $$

where *F* is cohort cumulative fertility function.

- By using interpolation one can compute age-specific fertility rates from average parities, P, assuming that fertility was more or less constant before the census
- For ages with completed fertility, e.g. age > 45, we can assume that P ≈ TFR, total fertility for a given cohort
- By plotting P ≈ TFR at years defined by the census date and mean age at childbearing, one can produce estimates of historical TFR trends (Feeney, 1991, see slide presented before)
- Software: **FERTCB** application in MORTPAK

The P/F ratio method: Rationale

- The P/F method aims to balance out the strengths and weaknesses of CEB and recent fertility data by comparing:
  - Cumulative fertility equivalent derived from recent fertility data "F" (trusting the age pattern of fertility but not level)
  - Life-time average parities "P" (trusting the overall level but not the age distribution)
- The method is typically used to adjust estimates of current fertility level (computed from data on recent births or from incomplete civil registration)
- The method is also used to assess the quality of CEB data and, sometimes, the age reporting of the mother
- Works well if:
  - fertility was constant before the census (improbable now);
  - no severe problems with the data

Source: United Nations (1983)

P/F Method: Data requirements

1. Total number of children ever born by 5-year age group of mother
2. Recent fertility by 5-year age group of mother, measured either by:
   - Births in past year question on census
   - Births registered in year of census from vital registration
3. Total number of women in each 5-year age group

P/F Method: Assumptions

- Misreporting of current fertility is constant across all age groups
- Increasing under-reporting of parity (children ever born) by age of women
- Constant fertility (most important for youngest age groups up to 35 or so)
  - > Can be relaxed through a modification of the original P/F ratio method that uses two consecutive censuses or fertility rates derived from vital registration or another data source

P/F Method: Computational procedure

Procedure described here follows Arriaga (1983) implemented in MortPak

0	1	2	3	4	5		6
Age Group	p(i)	f(i)	p*(i)	f*(i)	P(i)	F(i)	P/F
	Average CEB as shown	ASFRs as shown	CEB transformed into age-specific rates	ASFR adjusted for time of census	Cumulated P(i) and F(i)		Adjustment factor for fertility rates, usually ages groups 20-24, 25-29 or 30-34 as the most reliable

P/F method: Interpretation

Typical "look" of P/F ratios:

- With perfect data, ratio should be the same for all age groups and close to 1
- In practice, ok if ratios for 20-24, 25-29 and (less important) 30-34 are close

- Typically, P/F ratio will decrease with women's age
- Deviation from the above typical pattern: indicates either violations of the assumptions or different patterns of under-reporting

Example in MortPak: Yemen, 1994 Census

TITLE: Yemen, 1994 Census

Arraiga's approach for estimation of ASFR for one point in time and the age pattern of fertility (Brass)

	First Enumeration
Month	December
Year	1994
Fertility pattern is tabulated by age of woman at:	enumeration

p*(i) f*(i) P(i) F(i)

In the present case the adjustment factors are declining over the age groups:
Increasing fertility or increasing mis-reporting with women's age?

Age Group of Woman	Children Ever Born	Age Specific Fertility Pattern (A.S.F.P.)	Fertility Consistent with C.E.B. (A.S.F.R.)	Fertility Pattern by Age at Survey Date	Fertility Pattern by Age at Birth of Child	Cumulation of A.S.F.R.	Cumulation of Fertility Pattern by Age at Birth	Adjustment Factors	Age Specific Fertility Rates Based on Adjustment Factor for the Age Group 20 - 25	25 - 30	30 - 35
December 2004											
				Recorded	Calculated						
15 - 20	0.15	0.0660	0.1055	0.0660	0.0817	0.1055	0.0817	1.2912	0.0938	0.0913	0.0925
20 - 25	1.28	0.2830	0.3329	0.2830	0.3004	0.4384	0.3822	1.1472	0.3447	0.3356	0.3401
25 - 30	3.15	0.3490	0.3798	0.3490	0.3504	0.8183	0.7326	1.1169	0.4020	0.3914	0.3967
30 - 35	4.97	0.3150	0.3270	0.3150	0.3101	1.1453	1.0427	1.0984	0.3558	0.3464	0.3511
35 - 40	6.29	0.2580	0.1779	0.2580	0.2502	1.3232	1.2929	1.0234	0.2870	0.2795	0.2833
40 - 45	6.73	0.1430	0.0727	0.1430	0.1302	1.3959	1.4232	0.9808	0.1494	0.1455	0.1474
45 - 50	6.82	0.0730	0.0267	0.0730	0.0638	1.4226	1.4870	0.9567	0.0732	0.0713	0.0723
Mean Age of Childbearing:			27.6019		28.9295						
Total Fertility Rate:			7.1128		7.4350				8.5295	8.3044	8.4169

Example in MortPak: Timor-Leste 2004 Census

Estimation of age-specific fertility rates from data on children ever born

TITLE: Timor-Leste, 2004 Census

Arraiga's approach for estimation of ASFR for one point in time and the age pattern of fertility (Brass)

	First Enumeration
Month	July
Year	2004
Fertility pattern is tabulated by age of woman at:	enumeration

p*(i) f*(i) P(i) F(i)

Age Group of Woman	Children Ever Born	Age Specific Fertility Pattern (A.S.F.P.)	Fertility Consistent with C.E.B. (A.S.F.R.)	Fertility Pattern by Age at Survey Date	Fertility Pattern by Age at Birth of Child	Cumulation of A.S.F.R.	Cumulation of Fertility Pattern by Age at Birth	Adjustment Factors	Age Specific Fertility Rates Based on Adjustment Factor for the Age Group 20 - 25	25 - 30	30 - 35
July 2004				Recorded	Calculated						
15 - 20	0.113	0.0427	0.0828	0.0427	0.0552	0.0828	0.0552	1.5007	0.0621	0.0550	0.0586
20 - 25	1.049	0.2485	0.2795	0.2485	0.2667	0.3624	0.3219	1.1257	0.3002	0.2659	0.2831
25 - 30	2.564	0.3263	0.2866	0.3263	0.3290	0.6490	0.6509	0.9971	0.3703	0.3280	0.3492
30 - 35	3.859	0.3066	0.2353	0.3066	0.3005	0.8843	0.9513	0.9295	0.3382	0.2996	0.3189
35 - 40	4.912	0.2269	0.1692	0.2269	0.2184	1.0535	1.1698	0.9006	0.2459	0.2178	0.2319
40 - 45	5.426	0.1204	0.0867	0.1204	0.1100	1.1402	1.2798	0.8909	0.1238	0.1097	0.1168
45 - 50	5.327	0.0453	0.0316	0.0453	0.0369	1.1718	1.3167	0.8900	0.0416	0.0368	0.0392
Mean Age of Childbearing:			27.9248		28.9905						
Total Fertility Rate:			5.8592		6.5836				7.4113	6.5647	6.9880

In the present case the adjustment factors are declining over the age groups:
Increasing fertility or increasing mis-reporting with women's age?

P/F Method: Interpretation

- Example 1: a **declining trend in the P/F ratios** by age of women could indicate that
  a) Fertility has been increasing or
  b) that reported data on children ever born suffer from progressively increasing omissions of children as age of women increases
- Example 2: **large fluctuations in the P/F ratios** may reflect either differential coverage by age or selective age misreporting by women
- Example 3: a **rising trend in the P/F ratios** by age of women indicates that fertility could have been decreasing in the past

Variants on the P/F method

- P/F method for first births – not affected by fertility decline through higher-parity control
- Two-census methods, deriving age schedule of fertility from the two censuses or an additional source (such as vital registration)
  - Can be implemented in MortPak FERTPF by adding optional data for second census
- The Relational Gompertz model uses the same data as the P/F model, but
  - Does not require an assumption of constant fertility
  - Compares/replaces recent fertility data with model fertility schedules to check accuracy
  - Relies on parity data for all age groups (not just younger ones)

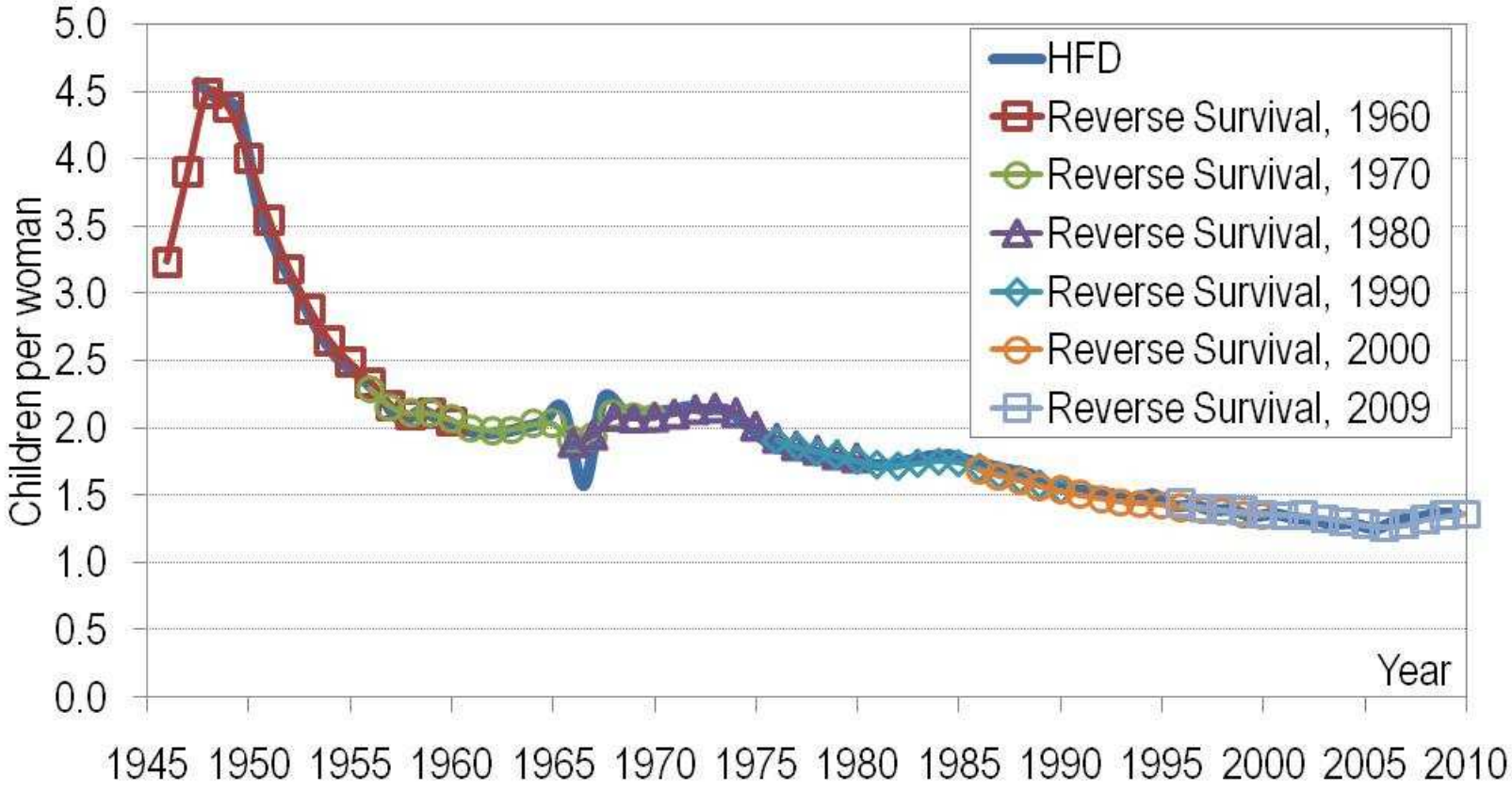
Relational Gompertz model

- An improved and more versatile version of the Brass P/F method with the same input data
- Shape of fertility distribution adheres to Gompertz relational model
- Level is estimated from average parities
- Robust
- Can be used for smoothing and extrapolation of fertility schedule
- Can be used with different standard patterns
- Software:
  - Excel Sheet "**FE_RelationalGompertz.xlsx**" in Moultrie (2013), available online at: http://demographicestimation.iussp.org/content/relational-gompertz-model
  - Excel Sheet "**REL-GMPZ.xls**" in PASEX, available online at: http://www.census.gov/population/international/software/uscbtoolsdownload.html

Reverse Survival method of fertility estimation

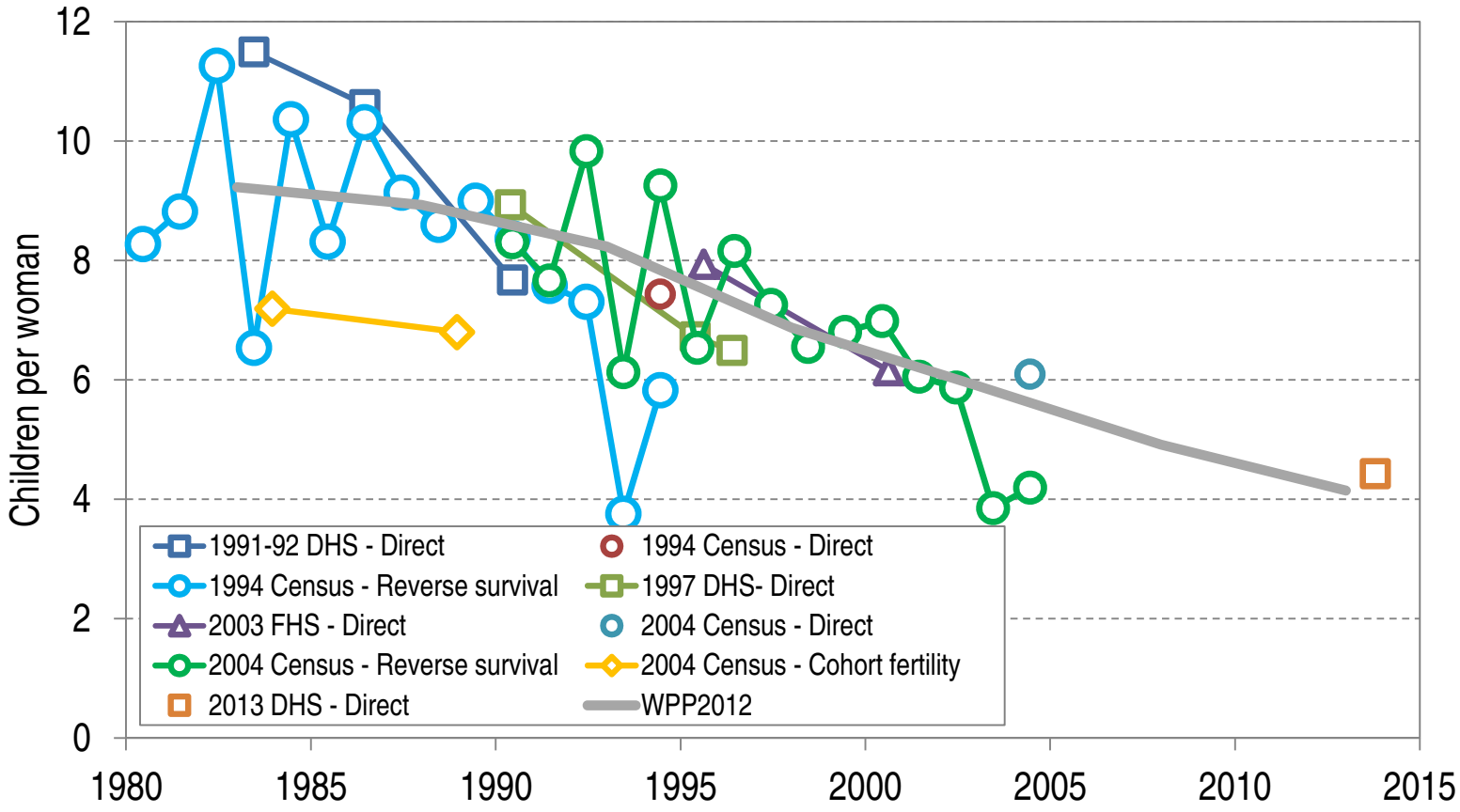
- Population by single age and sex is 15-year back projected (reverse survived)
- TFR for years y0, y-1, y-2, … y-14 computed to match births obtained by reverse survival
- Assumptions:
  - Population by single age and sex is free of errors
  - Estimates of mortality are available for the period before census
  - Reasonably good assumptions can be made about age patterns of recent fertility and mortality
- Software: Excel Sheet "**FE_reverse.xlsx**" in Timæus & Moultrie (2013), available online at: http://demographicestimation.iussp.org/content/reverse-survival-methods

Reverse survival fertility estimates, Japan, 1945-2010



Sources:Human Fertility Database (HFD) and computed from Human Mortality Database (Spoorenberg (2014))

Reverse survival fertility estimates, Yemen, 1980-2013



Sources: computed based on UNSD DYB Database; DHS reports, 2004 Census Report

Own-children method of fertility estimation

- Based on the same idea as the reverse survival method
- Produces estimates of both TFR and fertility age pattern
- Data requirements
  - Distribution of own children by age and by age of mother
  - Estimates of mortality for the period before census
- Sotfware: **FERT** developed by East-West Center, available online: http://www.eastwestcenter.org/research/research-program-overview/population-and-health/demographic-software-available-from-the-east-west-center
- Reference: United Nations (1983, pp. 182-195).

Step 1

Obtain distribution of own children by age and by age of mother:

TABLE 161. OWN-CHILDREN DATA, WITH CHILDREN CLASSIFIED BY SINGLE YEAR OF AGE AND SINGLE YEAR AGE OF MOTHER, COLOMBIA, 1978

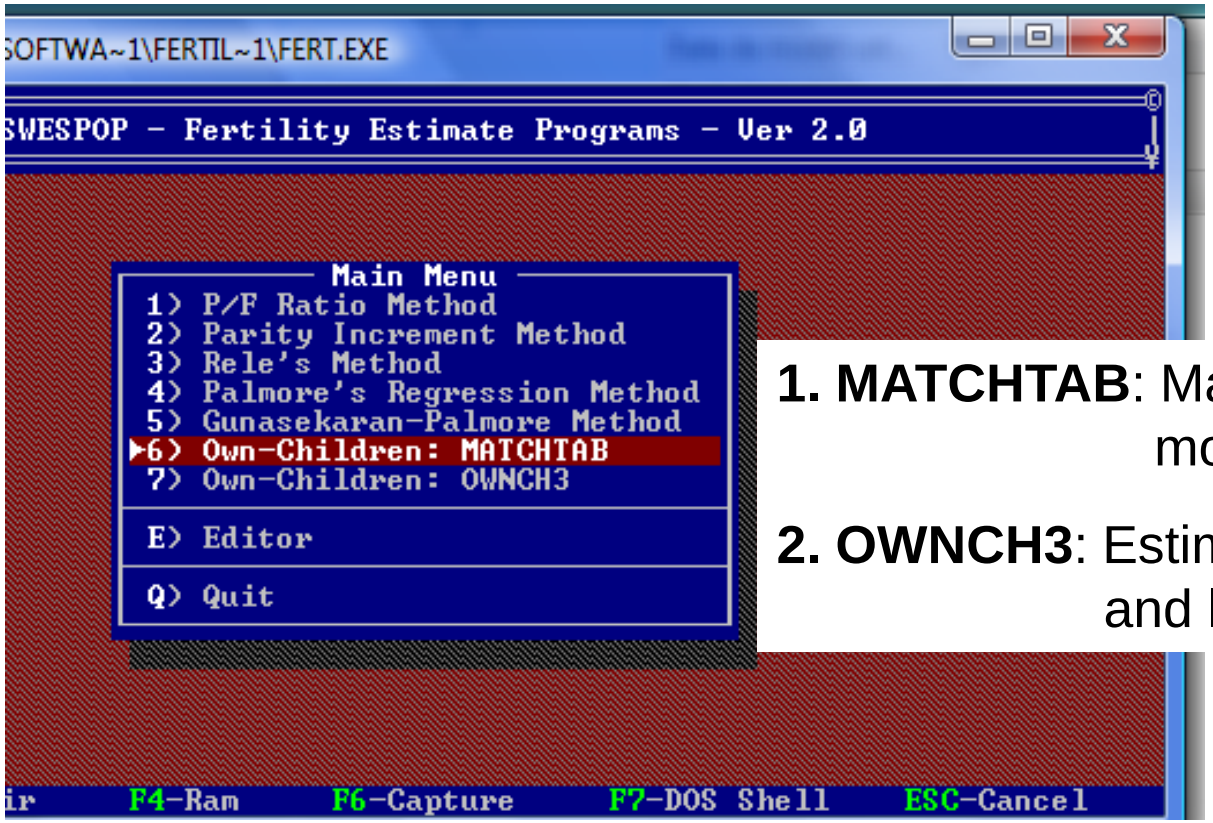
Age of mother	Number of children, by age of child																Number women
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
15	13	7	0	2	2	2	1	4	3	4	2	1	3	1	3	3	755
16	12	3	0	2	0	2	1	1	1	0	0	0	2	0	0	1	696
17	23	16	6	1	0	0	0	0	0	0	1	0	0	0	0	0	686
18	58	36	17	3	0	3	1	2	0	0	0	0	0	0	0	0	706
19	66	46	24	13	11	1	3	1	0	0	0	0	1	0	0	1	538
20	77	55	45	33	19	12	2	1	0	2	2	1	1	1	0	0	602
21	78	71	56	47	48	17	7	5	3	0	1	2	1	1	0	0	488
22	84	80	76	73	46	26	18	15	3	0	0	0	0	0	1	0	534
23	84	85	80	84	61	53	29	24	7	9	1	2	0	2	1	0	488
24	93	63	78	72	56	48	45	34	17	9	8	3	0	1	1	1	411
25	91	84	87	83	69	71	55	52	31	21	5	5	2	1	0	0	464
26	73	67	65	70	66	70	61	55	41	24	17	11	1	1	2	0	393
27	58	61	70	58	63	79	64	64	47	28	27	16	11	5	2	1	339
28	83	71	77	81	94	80	87	91	80	60	42	34	16	8	3	2	442
29	48	58	52	59	68	64	77	75	61	66	48	50	23	23	6	4	330
30	46	60	70	62	82	86	86	86	82	74	69	50	45	31	20	8	403
31	42	39	42	36	44	44	55	66	63	56	57	46	43	24	12	8	243
32	45	50	67	54	66	65	73	82	79	91	78	64	63	66	38	30	343

Usually requires tabulations of **microdata**. Algorithms for matching mothers and own children can be fairly complicated.

Step 2

Apply reverse survival techniques to the distribution obtained at the previous step to estimate age pattern and level of fertility in the last 15 years

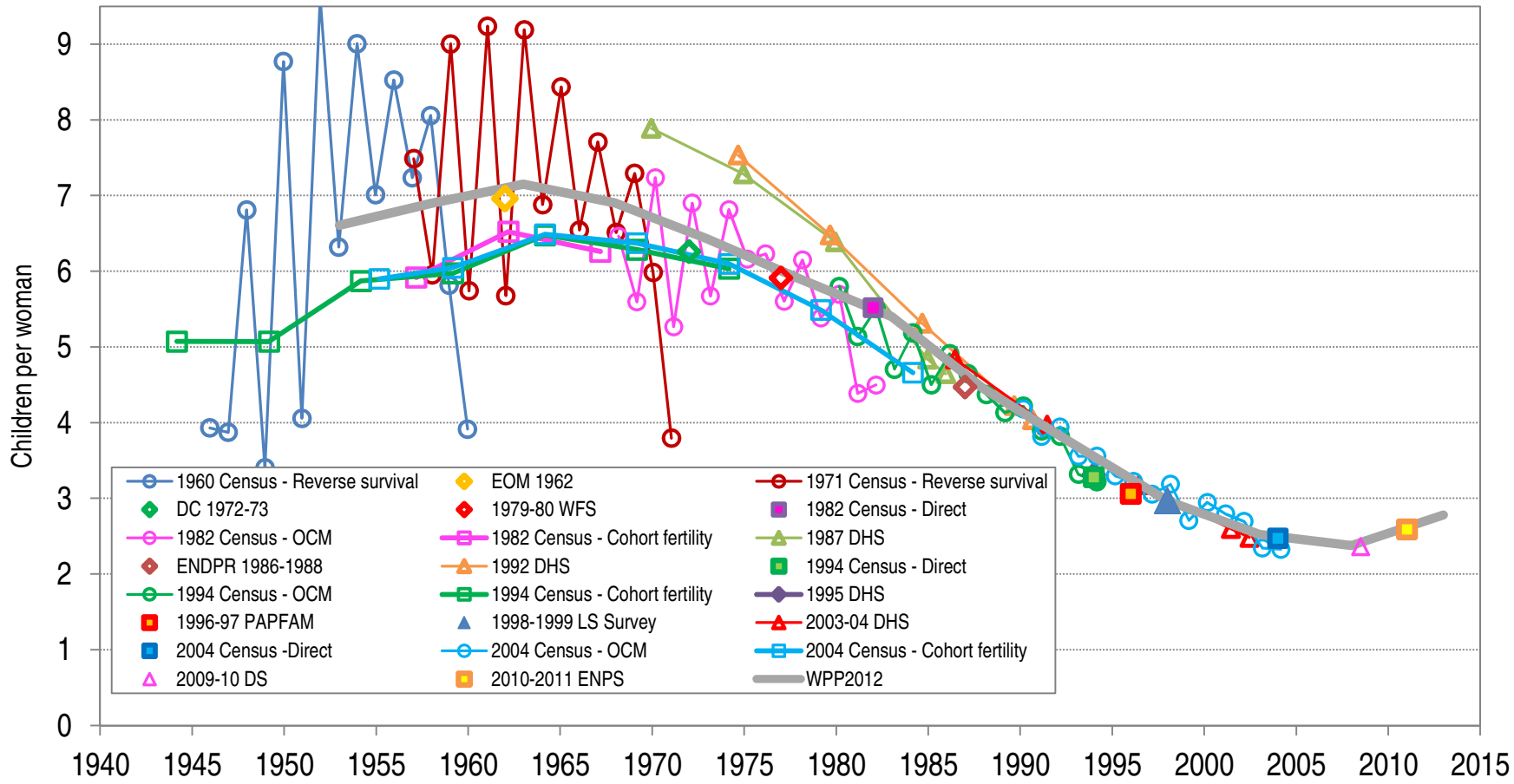
Own-children method: FERT software



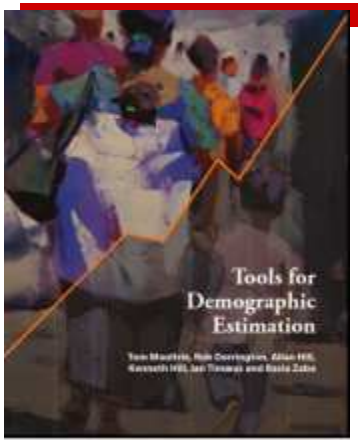
1. MATCHTAB: Matching children with mother

2. OWNCH3: Estimation of age patterns and level of fertility

Fertility estimates, Morocco, 1945-2011



Main references



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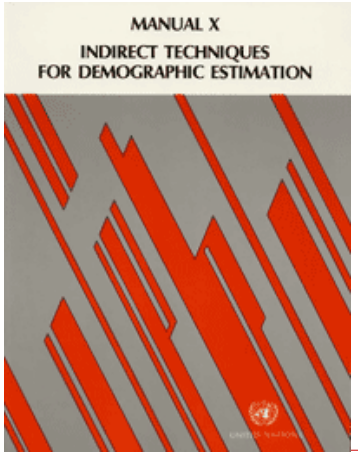

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Softwares

MORTPAK – The United Nations software package for demographic measurement, available online: http://www.un.org/en/development/desa/population/publications/mortality/mortpak.shtml

Excel templates provided with each chapter of Moultrie et al. (2013), available online: http://demographicestimation.iussp.org/

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