

# **Session IV: Projecting the level and pattern of fertility**

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Population Estimates and Projections Section

[www.unpopulation.org](http://www.unpopulation.org)

Regional Workshop on the Production of Population Projections  
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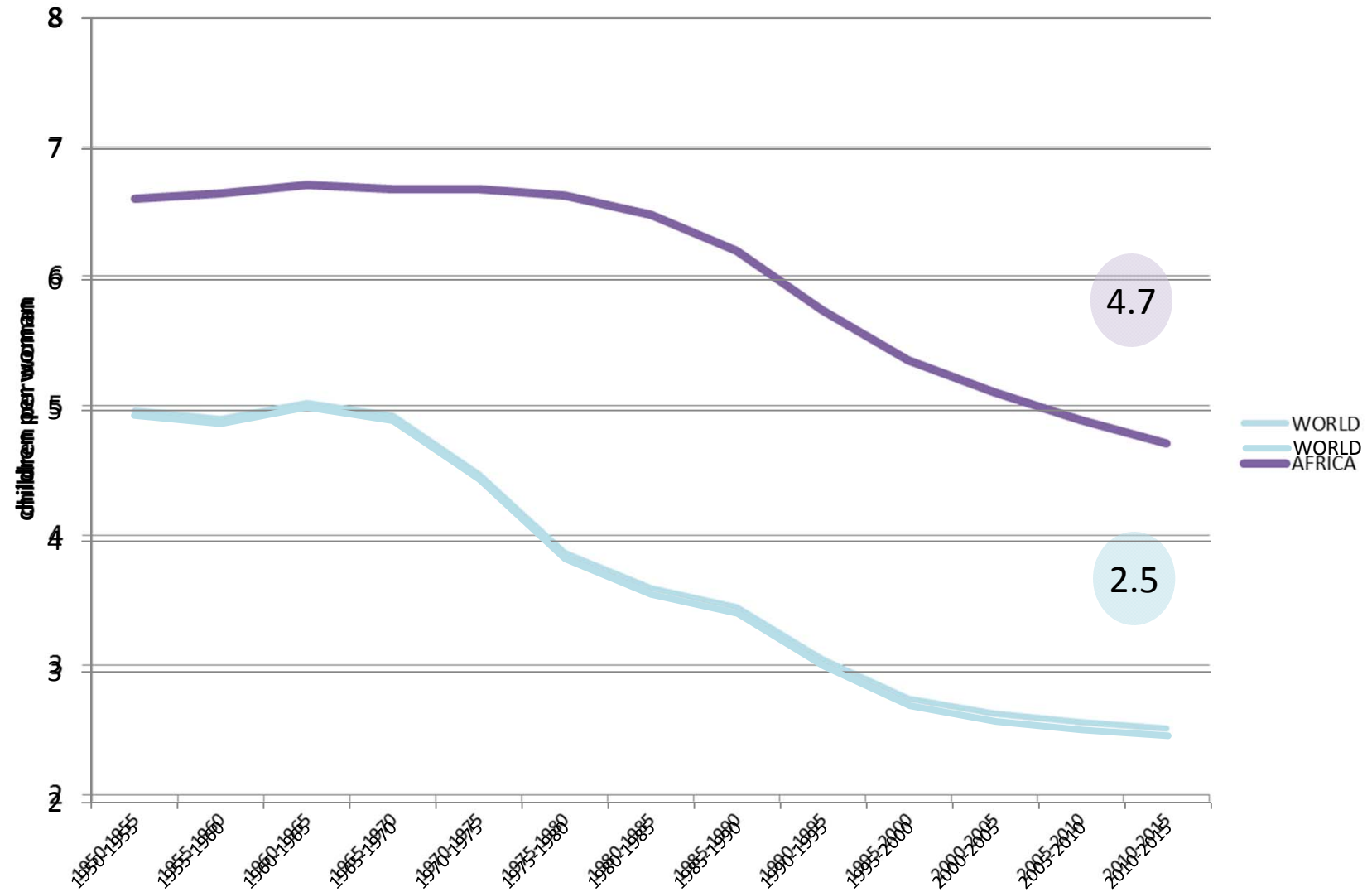
# Outline

- I. Projecting the level of fertility:
  - a. Overview
  - b. Establishing the baseline of fertility
  - c. The United Nations models
  - d. The US Bureau of Census model
  
- II. Projecting the age pattern of fertility:
  - a. Overview
  - b. Establishing the baseline of age patterns
  - c. Projection options

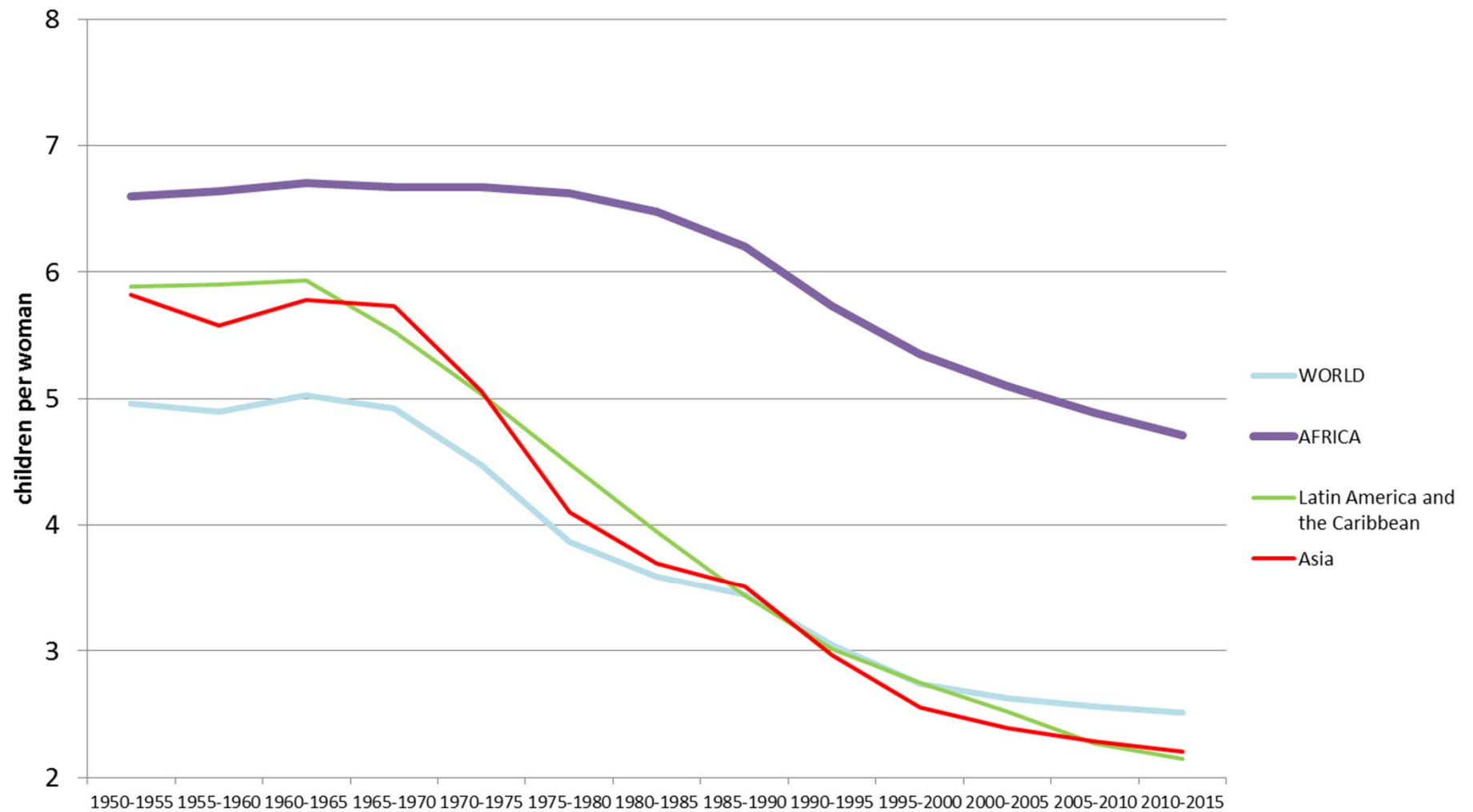
# Projecting the level of fertility:

## a. Overview

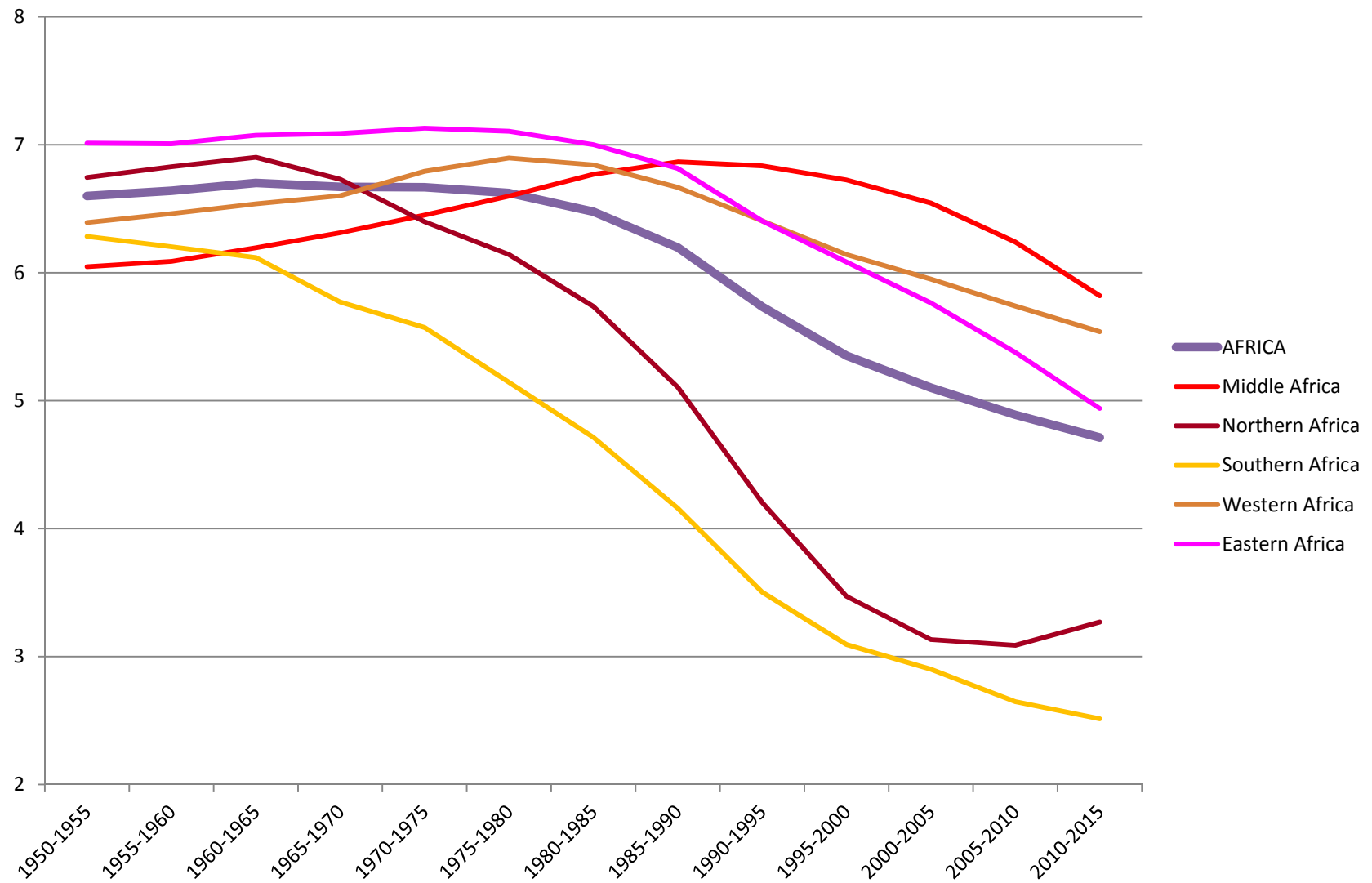
# Total Fertility 1950-2015 estimates



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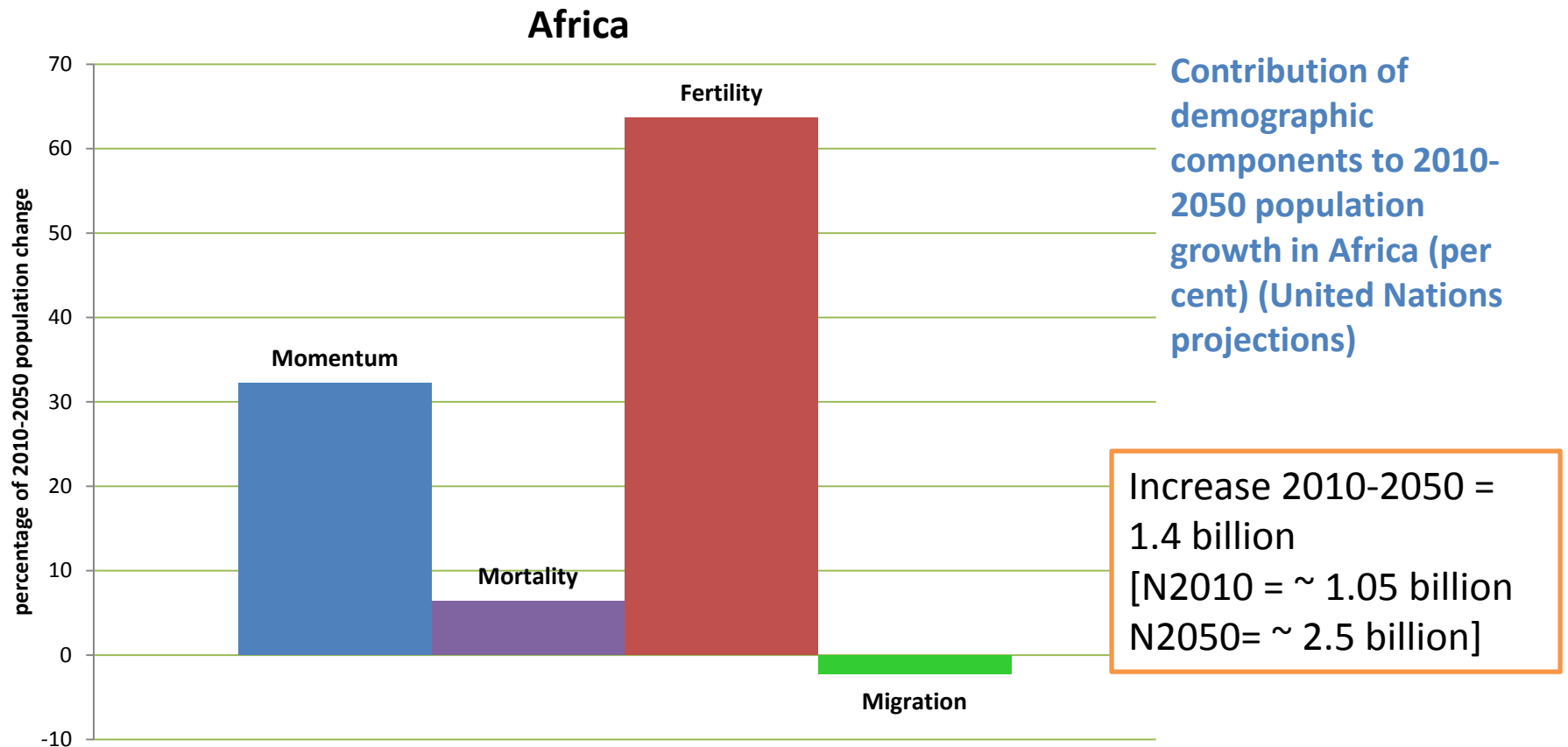


# Total Fertility 1950-2015 estimates

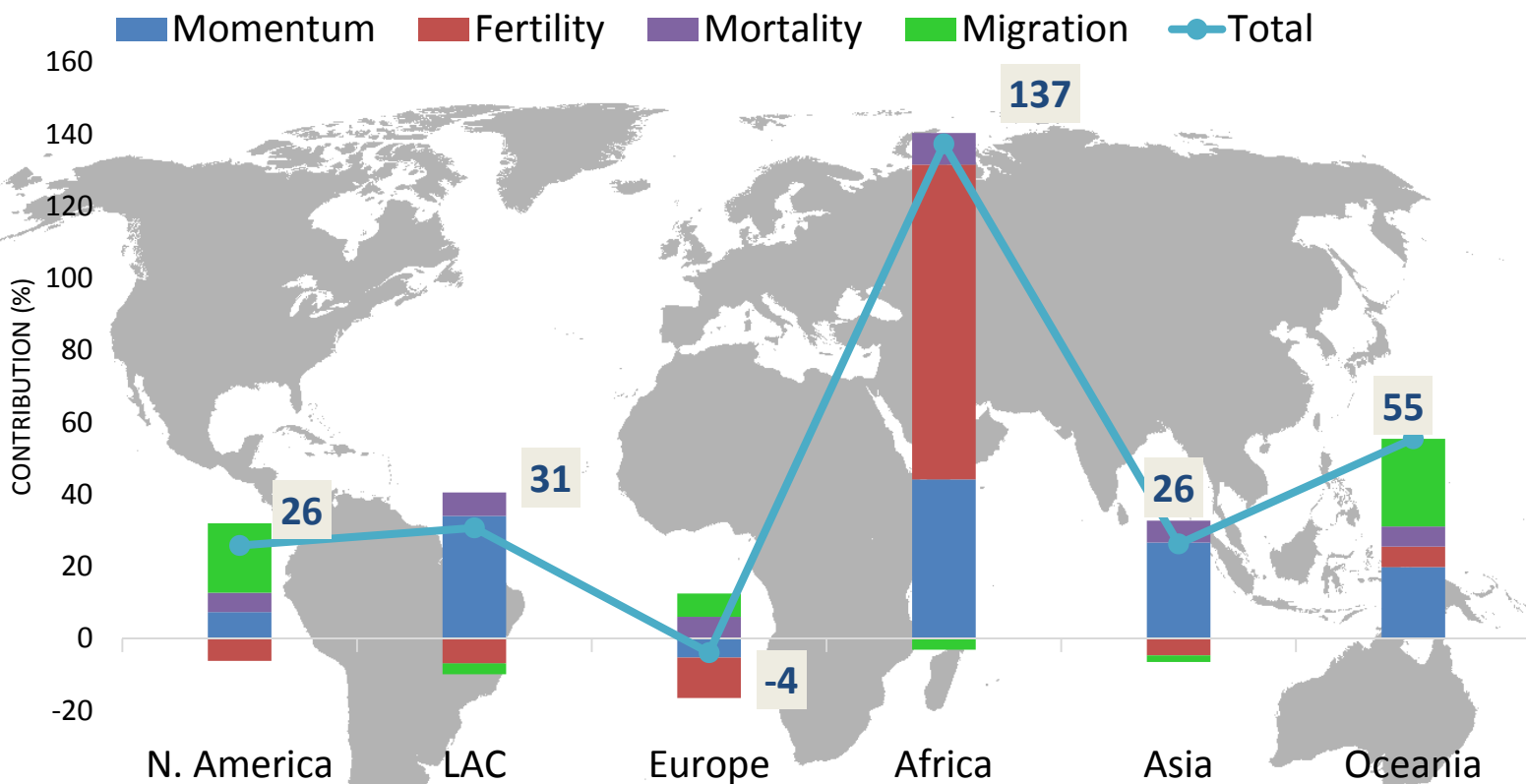


## Projecting the level of fertility: a. Overview

In many countries, fertility is the most important factor influencing future population growth. In Africa, for example, it has been estimated that fertility will be responsible for around 64 % of the population growth between 2010 and 2050



# Contribution of demographic components to 2010-2050 population growth as percentage of population in 2010





Fertility levels and trends depend largely on social and cultural factors, such as social norms on reproduction and contraception, individuals' desired family size, access to family planning, etc.

- 1. Observe and interpret past trends carefully ⇒ 2. make assumptions about future trends

Three steps:

1. Observe recent levels and trends
2. Compare recent trends with similar ones from the past (in the same or other populations)
3. Make inferences as to a plausible course of fertility development



Pay attention to recent irregularities:

- Check for data issues
- Fluctuations
- Exceptions (temporary postponement of marriage, wars, etc.)

### Assumptions about fertility projections

#### Examples:

“An increase in fertility is assumed [from 2013]. Greater increases are assumed during the first 5-year periods, until reaching very small increase at the end of the projection period. TFR increases from 1.71 to 1.96 over the span of the projection” [35 years]. Cuba (2015)

“The national estimated Total Fertility Rate (TFR) of 3.9 children per woman (...) was assumed to decline linearly to 2.4 to 2041”. Namibia (2014)

“Fertility has declined (...) though the levels and hence the magnitude of the decline may be debatable (...). Officially published and re-estimation figures suggest that the fertility decline between 2001 and 2011 appeared to be less steep than during the period 1980-2001. It was therefore assumed in all the scenarios that total fertility rate will continue to decline slowly during the period 2011 to 2016 at the same magnitude of the decline in 2001-2011 (...). ... it was assumed that total fertility will stabilise during the period 2016-2026 at the level in 2016.”. Botswana (2015)

Projecting the level of fertility:  
b. Establishing the baseline of fertility

## Projecting the level of fertility: b. Establishing the baseline of fertility

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To measure the level of fertility we compute the:

### Total Fertility Rate (*TFR*)



- *TFR* is independent of the effect of the age structure.
- *TFR* gives the number of births that women give birth to.
- *TFR* is the standard way to compare fertility levels across countries and time.

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

### Interpretation

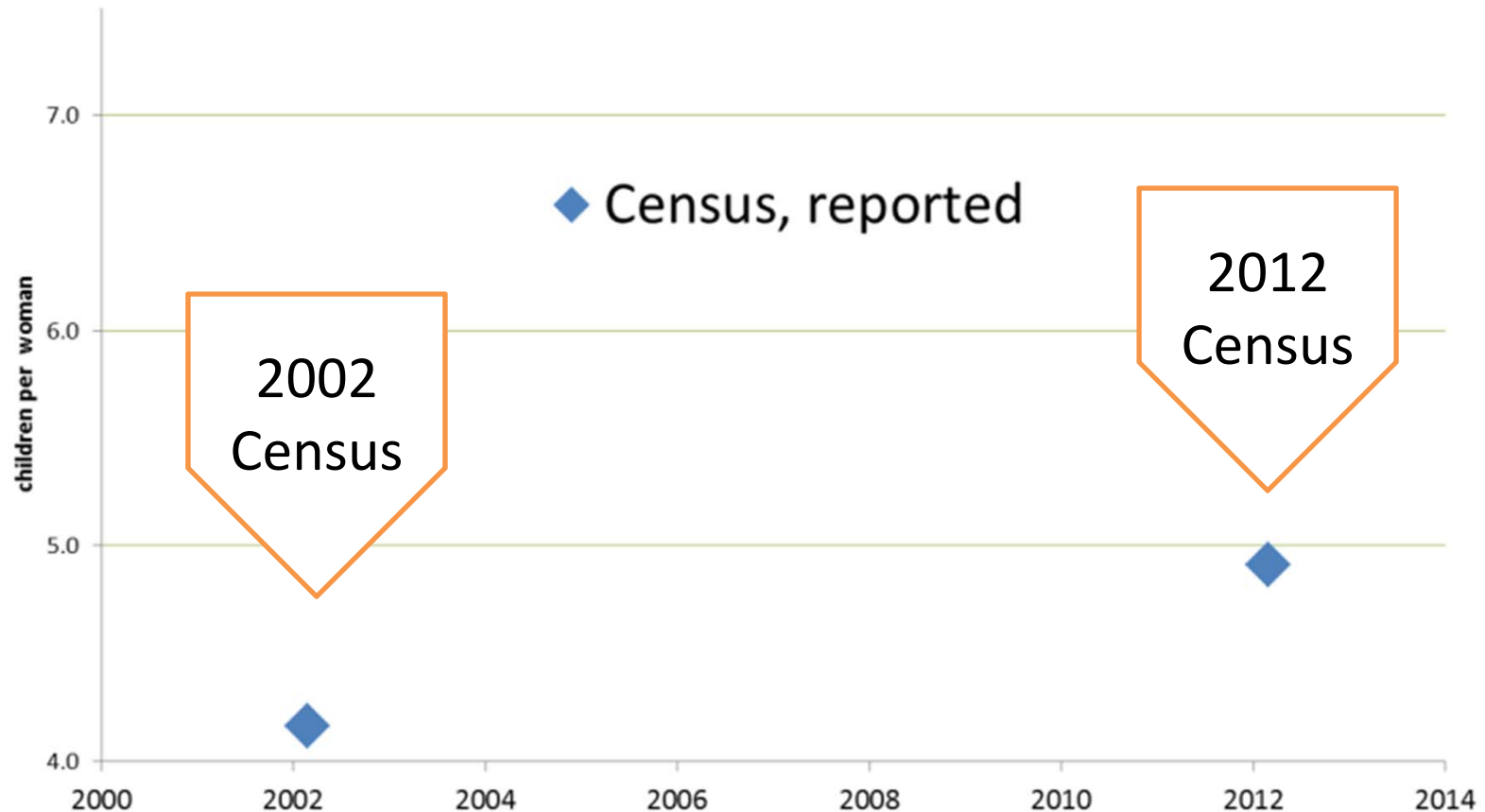
The number of children a woman **would have if** she lived from age 15 to age 50 and experienced the ASFRs of the period in question throughout her reproductive life.

> An example of a **synthetic cohort** > a measure of **period fertility**

May be subject to the *tempo* effect: a change in the timing of births produces an apparent and temporary change in fertility level

## Projecting the level of fertility: b. Establishing the baseline of fertility

Direct estimates of TFR (census reported), 2002 and 2012



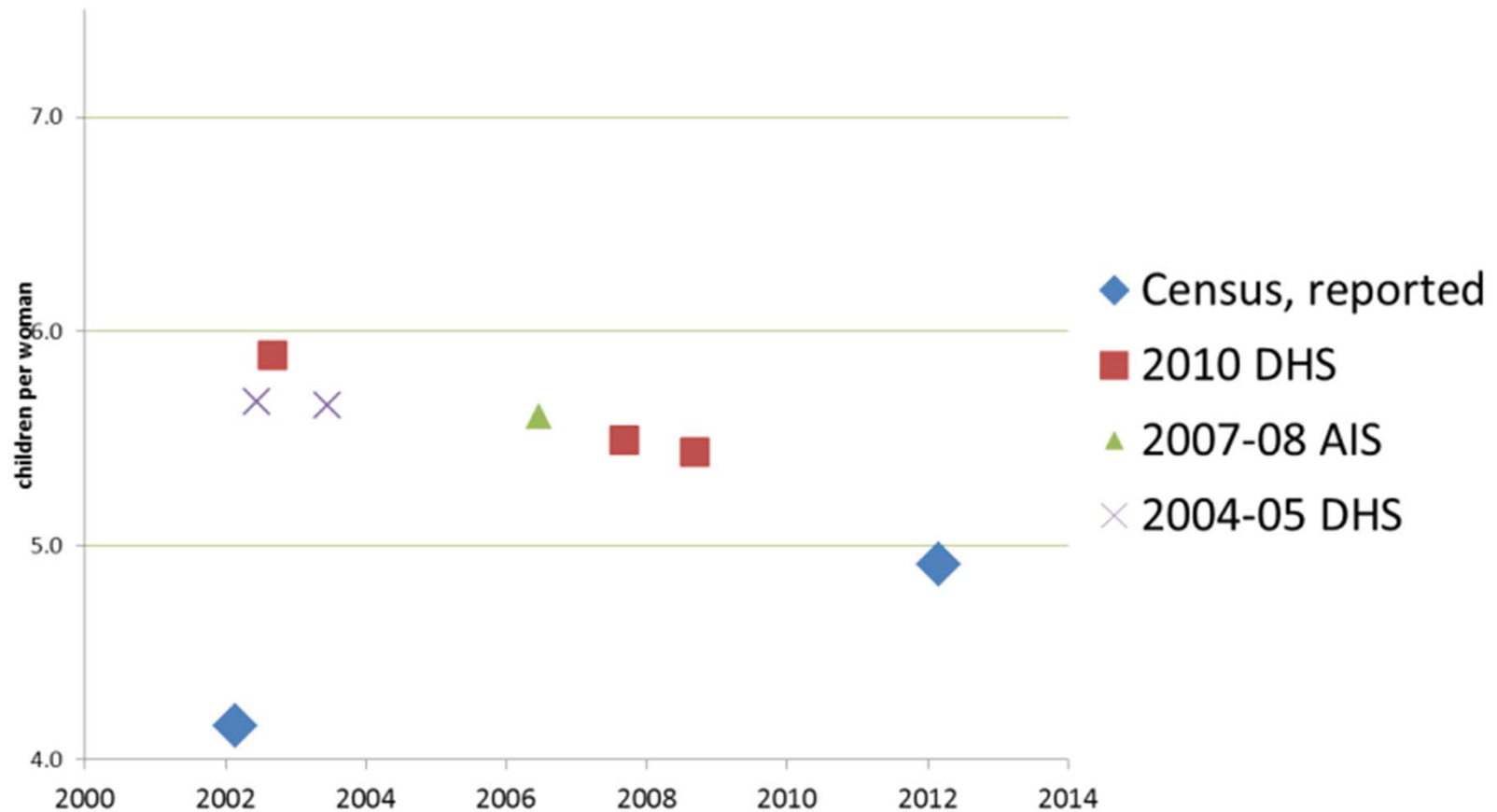
Establishing a 2012.5 baseline for fertility projection - example



Caution! Quality assessment needed

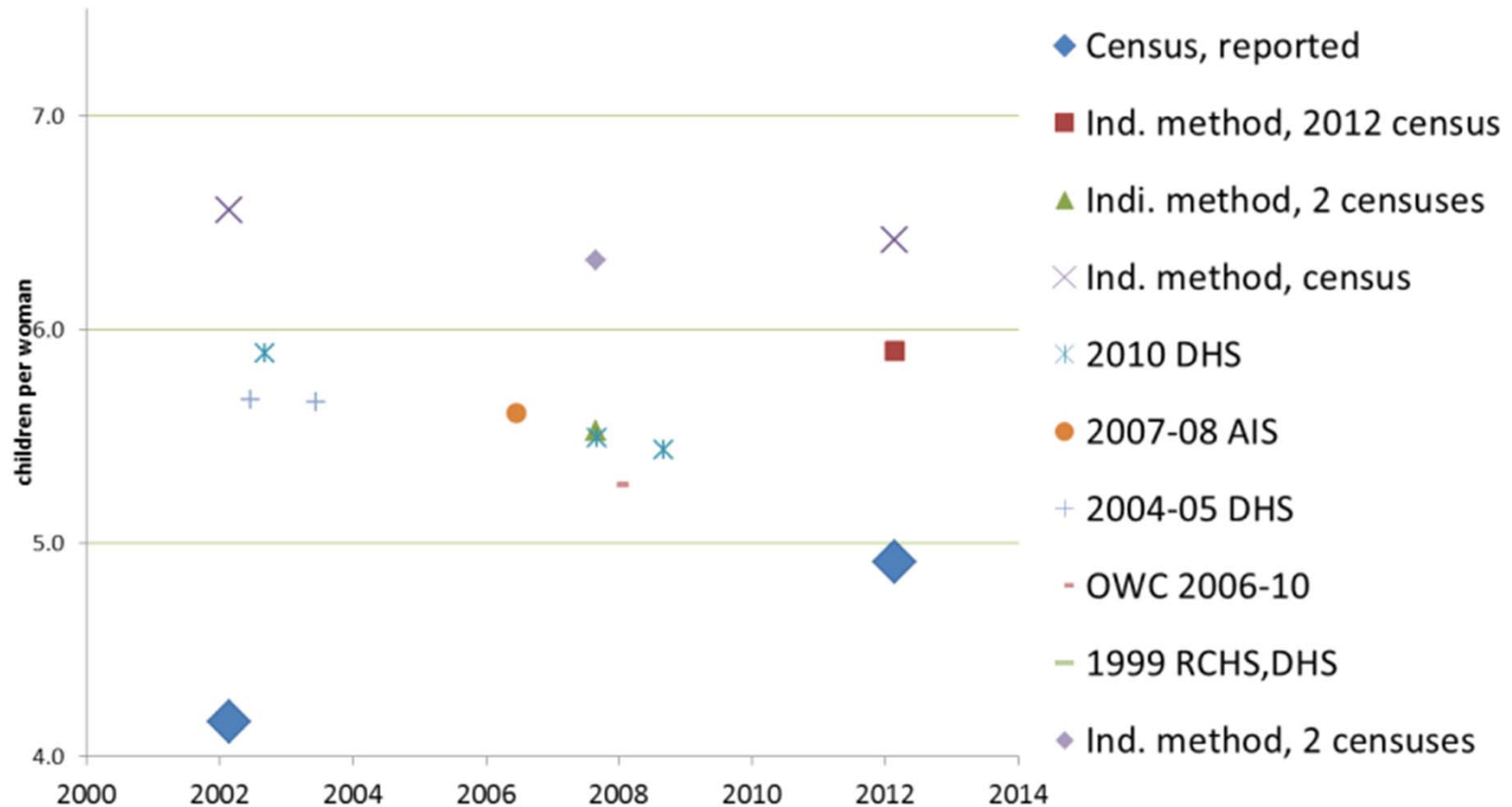
## Projecting the level of fertility: b. Establishing the baseline of fertility

### Direct estimates of TFR (census, surveys), 2002 to 2012



Caution! Quality assessment needed

## Direct & indirect estimates of TFR (census, surveys), 2000-2015



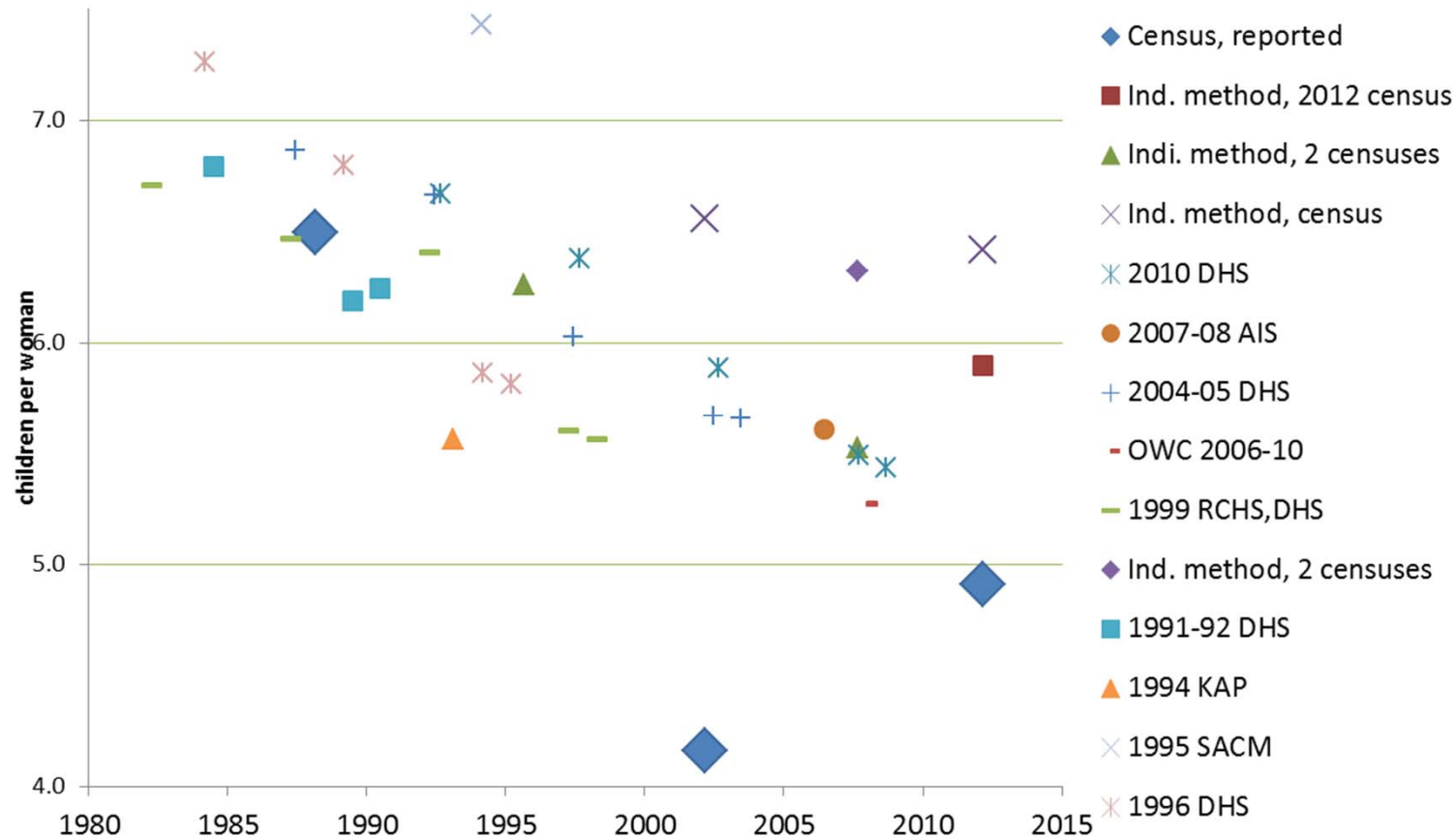
Based on national report



Caution! Quality assessment needed

## Projecting the level of fertility: b. Establishing the baseline of fertility

### Direct and indirect estimates of TFR, 1980-2012



Based on national report



Caution! Quality assessment needed



Projecting the level of fertility:  
c. The United Nations models

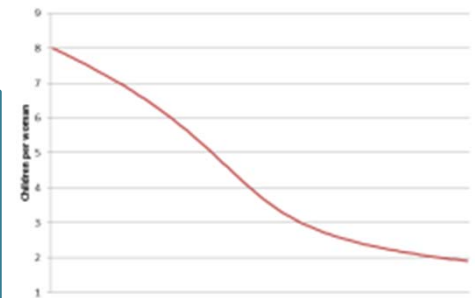
○ Two models of fertility projection:

- – **High and Medium-fertility countries**: until 2015 had had no or an incipient fertility decline (high) or fertility has been declining but were still above 2.1 children per woman in 2010-2015
- Low-fertility countries: total fertility is at or below 2.1 children per woman in 2010-2015.

## Projecting the level of fertility: c. The UN models

- Fertility projected through a transition from high to low levels
- Fertility modelling approach used in *World Population Prospects: the 2008 Revision* for high- and medium-fertility countries
- Uses a double-logistic function (similar model as for mortality).
- Not the level itself, but the **rates of change are modeled**.
- Incorporates the observation that during the demographic transition, fertility first changed slowly, then decline accelerated and finally decelerated.

2-phase process modeled by 2 logistic functions  
(one approaching an upper limit, and second one approaching a lower limit)



2-phase process modelled by 2 logistic functions  
(one approaching an upper limit, and second one approaching a lower limit)

- Sum of two 3-parameters logistic growth pulses for annual declines in TFR

General pattern:

$$\Delta TF = \frac{k_1}{1 + \exp\left[-\frac{\ln(81)}{\Delta t_1}(TF - t_{m1})\right]} + \frac{k_2}{1 + \exp\left[-\frac{\ln(81)}{\Delta t_2}(TF - t_{m2})\right]}$$

## Projecting the level of fertility: c. The UN models

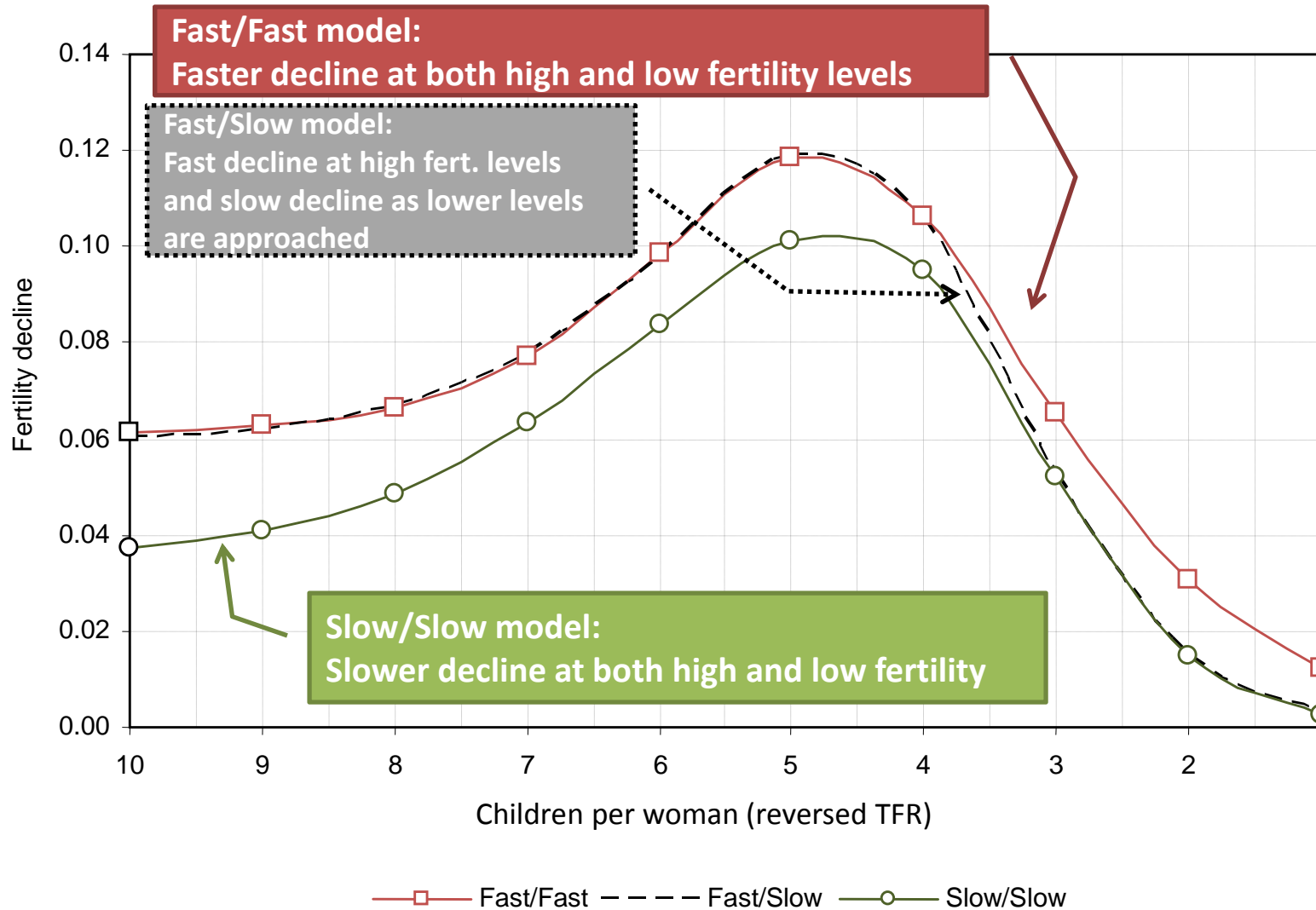
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- We model variations of the **general pattern**, associated with differences in pace of fertility decline at the beginning and at the end of the fertility transition.
- We create groups based on similar trends of pairs of level of fertility and fertility declines, which results in...
- **Three models of fertility decline: *Slow/Slow, Fast/Slow, Fast/Fast*.**
- The parameters of the two logistic functions vary across models:

<i>Parameter</i>	<i>Slow/Slow</i>	<i>Fast/Slow</i>	<i>Fast/Fast</i>
$k_1$	-0.112730	-0.160976	-0.252160
$\Delta t_1$	5.027900	4.341125	4.014580
$t_{m1}$	5.768830	5.064407	5.166560
$k_2$	0.147540	0.220137	0.312840
$\Delta t_2$	2.754150	3.022537	4.316520
$t_{m2}$	3.211780	3.523051	3.941380

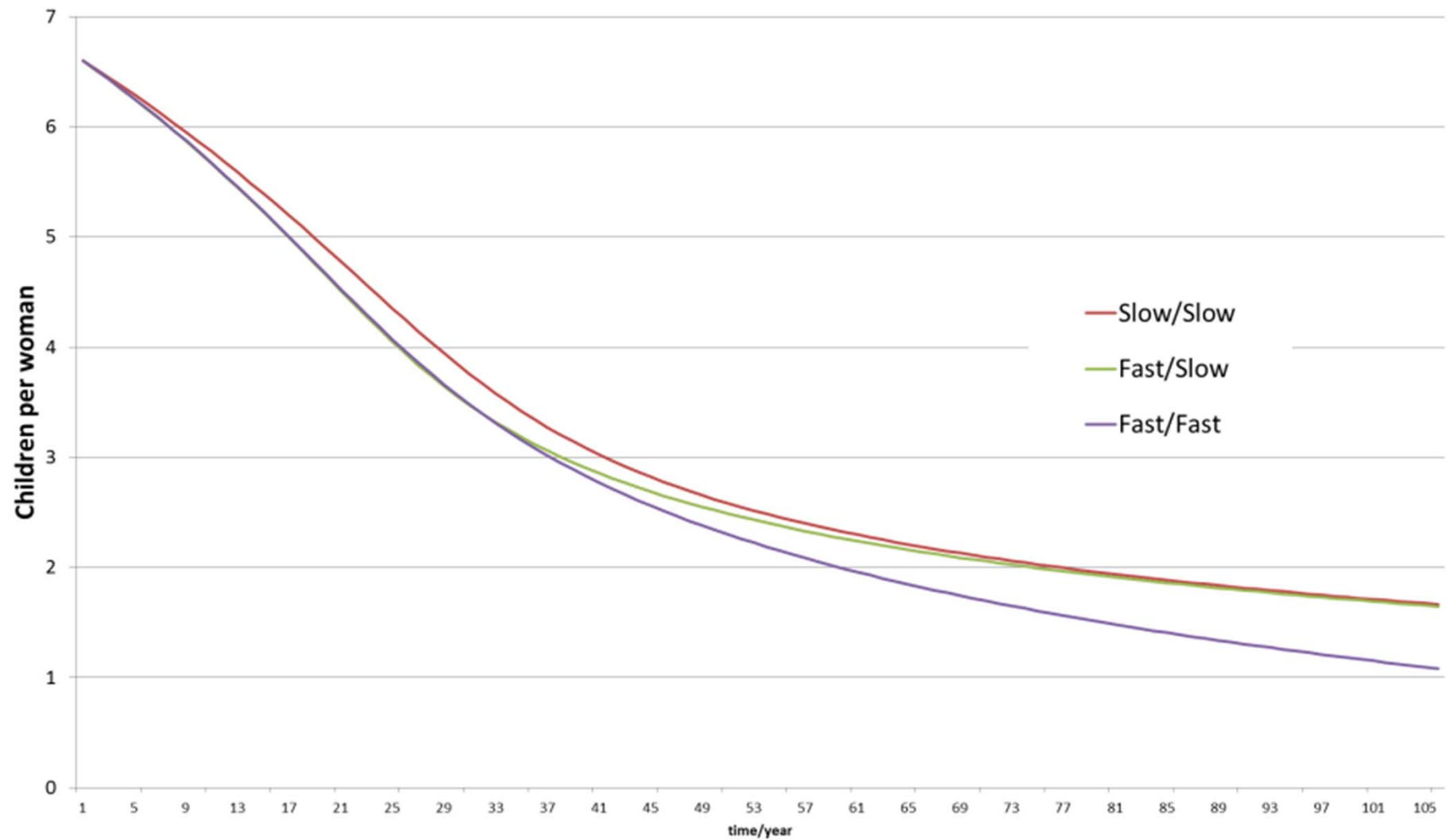
## Projecting the level of fertility: c. The UN models

### ■ 3 Models of fertility decline:



## Projecting the level of fertility: c. The UN models

### ■ 3 Models of fertility decline:



## Projecting the level of fertility: c. The UN models



Tool to use the three models of fertility decline:

**UNPD\_FerModel.xls**

3. Select a model

UNPD\_FerModel.xls - Microsoft Excel

Home Insert Page Layout Formulas Data Review View Developer Add-Ins Acrobat XY Chart Labels

G23

1	<b>United Nations Model of fertility decline</b>	
2	Source:	United Nations (2011). Methodology of the United Nations Population Estimates and Projections, Chapter VI in: World Population Prospects: The 2006 Revision, Vol. III, Analytical Report, New York, p. 121-160.
3	URL:	<a href="http://www.un.org/esa/population/publications/WPP2006RevVol_III/WPP2006RevVol_III_final.pdf">http://www.un.org/esa/population/publications/WPP2006RevVol_III/WPP2006RevVol_III_final.pdf</a>
4		
5	Title	<b>My projection of fertility decline</b>
6	Country	<b>Poplandia</b>
7	Date	<b>10.09.2012</b>
8		
9	Description	
10		
11		Select an appropriate fertility model
12	Base year	<b>2010</b>
13	Last year	<b>2100</b>
14	Base TFR	<b>6</b>
15		
16		
17		
18		
19	Year	TFR
20	2010	6.000
21	2011	5.902
22	2012	5.801
23	2013	5.698
24	2014	5.592
25	2015	5.484
26	2016	5.372

Slow/slow

Run model Clear data

UNFerModel Chart TFR UN model params

Ready 130%



## Projecting the level of fertility: d. The US Bureau of Census model

- Interpolates and extrapolates Total Fertility rates:  
**TFRLGST.xls**
- Fits a logistic function to 2 to 17 TFRs representing past trends, given an upper and a lower asymptotes. >>
  - Input data

## Projecting the level of fertility: d. The USBC model



Microsoft Excel - TFRLGST_AFG.xls [Compatibility Mode]								
	A	B	C	D	E	F	G	H
1	Table							
2	Afghanistan							
3	Interpolation and Extrapolation of the Total Fertility Rate							
4	Using a Logistic Function.							
5								
6	Item/							
7	year	Value	Year	TFR	Year	TFR		
8								
9	Asymptotes:		2004.50	7.21	2004.50	7.21		
10			2005.50	6.99	2009.50	5.71		
11	Lower	3.00	2006.50	6.72	2014.50	4.04		
12	Upper	8.00	2007.50	6.42	2019.50	3.27		
13			2008.50	6.08	2024.50	3.06		
14	Initial TFR's		2009.50	5.71	2029.50	3.01		
15			2010.50	5.33	2034.50	3.00		
16	1998.00	7.88	2011.50	4.96	2039.50	3.00		
17	2003.00	7.39	2012.50	4.62	2044.50	3.00		
18	2008.00	6.33	2013.50	4.31	2049.50	3.00		
19			2014.50	4.04	2054.50	3.00		
20			2015.50	3.81	2059.50	3.00		
21			2016.50	3.63	2064.50	3.00		
22			2017.50	3.48	2069.50	3.00		
23			2018.50	3.36	2074.50	3.00		
24			2019.50	3.27	2079.50	3.00		
25			2020.50	3.21	2084.50	3.00		
26			2021.50	3.15	2089.50	3.00		
27			2022.50	3.11	2094.50	3.00		
28			2023.50	3.09	2099.50	3.00		
29			2024.50	3.06	2104.50	3.00		
30			2025.50	3.05	2109.50	3.00		
31			2026.50	3.03	2114.50	3.00		
32			2027.50	3.03	2119.50	3.00		
33			2028.50	3.02	2124.50	3.00		
34			2029.50	3.01	2129.50	3.00		
35			2030.50	3.01	2134.50	3.00		
36			2031.50	3.01	2139.50	3.00		
37	Beginning date for		2032.50	3.01	2144.50	3.00		
38	results:		2004.50	3.00	2149.50	3.00		
39								
40	TFR - Total fertility rate.							
41	Source:							
42								

Tool to use the logistic curve given for fertility decline an upper and lower asymptotes :

**TFRLGST.xls**

3. Select a model

## Preparing the input for Spectrum

Demographic data - BeninMyTest

First year population   **Total fertility rate**   ASFR   Sex ratio at birth   Life expectancy   Model life table

Total fertility rate

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
TFR	6.73	6.76	6.80	6.86	6.89	6.92	6.95	6.98	7.00	7.00	7.00	7.01	7.01	7.00	6.97	6.95	6.92	6.89	6.85	6.78	6.72	6.66	6.59	6.52	6.44

Total fertility rate (TFR) is the average number of children that would be born alive to a woman (or a group of women) during her lifetime if she were to pass through all her childbearing years conforming to the age-specific fertility rates of a given year. TFR values are for the period from July 1st of the previous year to June 30th of the indicated year.

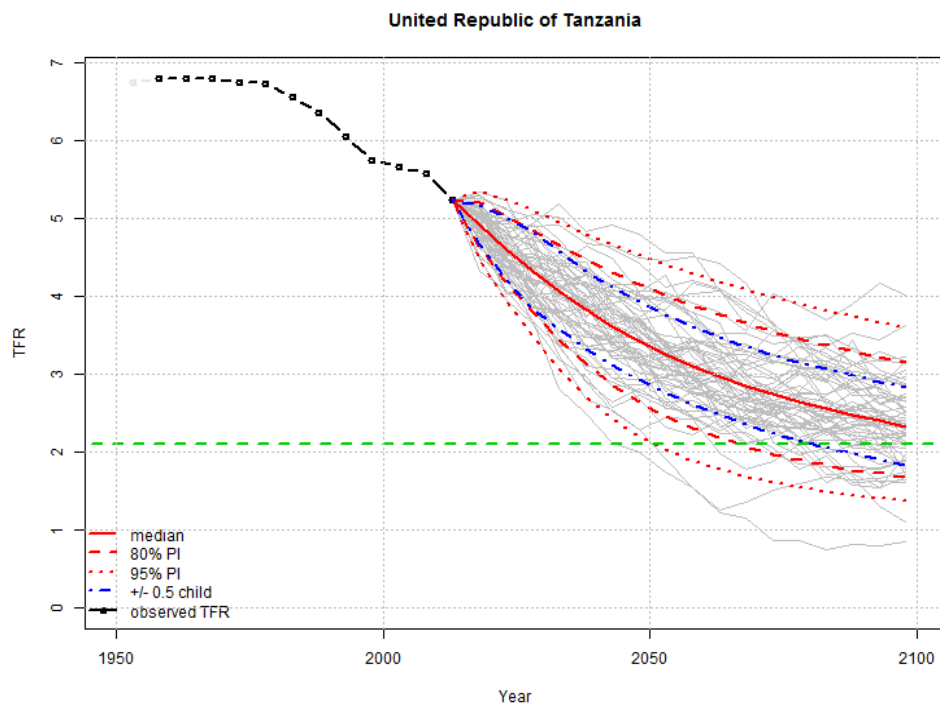
Ok   Cancel   Duplicate   Interpolate   Source   ? Help

The UNPD models and simple interpolation methods are easy “ready-to-go” projection tools. However, these tools may not reflect accurately some of the recently trends observed in the African region, or the expected future trends in the fertility transition of African countries.

Country-specific models and alternative approaches to global fertility projection have been developed, but their complexity (with regards to methodology, data requirement, etc.) make their implementation challenging.

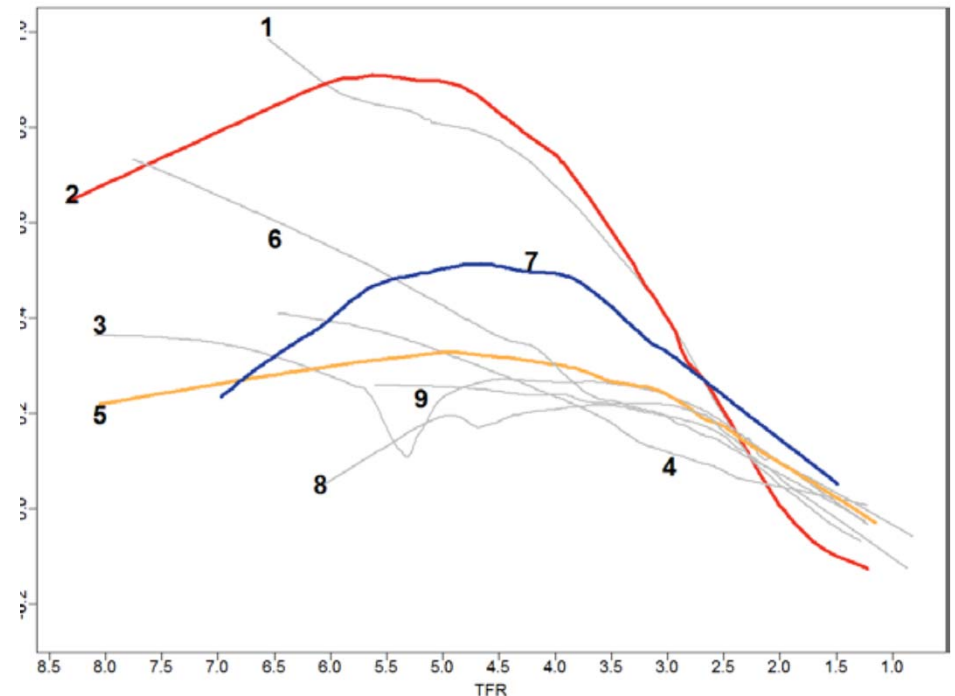
## Alternative approaches to fertility projections (work in progress):

**Illustration of probabilistic fertility projection based on Bayesian Hierarchical Modeling** (a small selection of the probabilistic trajectories are shown)



Based on World Population Prospects: the 2015 revision

**Illustration of nine clusters showing distinct patterns of pace of decline** (data from 130 counties, over 60 years)



Based on World Population Prospects: the 2012 revision

Source: Gerland, P. et al (2015) Demography is not destiny: Probabilistic scenarios of future fertility change in Sub-Saharan Africa

# Outline

- I. Projecting the level of fertility:
  - a. Overview
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  - c. The United Nations models
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- II. Projecting the age pattern of fertility:
  - a. Overview
  - b. Establishing the baseline of age patterns
  - c. Projection options

# Projecting the age pattern of fertility: a. Overview

To measure the age pattern (or schedules) of fertility we compute:



### Age-Specific Fertility Rates (ASFRs)

- ASFRs measure the annual number of births to women of a specified age or age group per 1,000 women in that age group

$$ASFR_{x,x+n} = {}_nF_x = \frac{{}_nB_x}{{}_nW_x}$$

- Where  ${}_nB_x$  refer to births to women age  $x$  to  $x+n$  (usually 5-year age groups covering the age range 15-49), during a given period, and  ${}_nW_x$  refers to the mid-period population of women age  $x$  to  $x+n$ .
- Dividing each ASFR by the sum of all across the childbearing ages, we obtain:

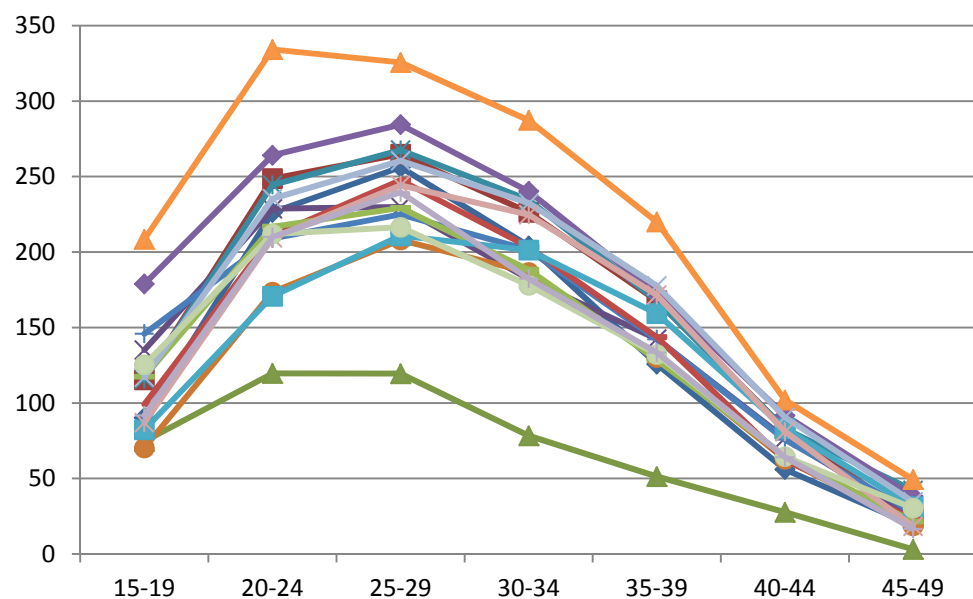
### Proportionate Age-Specific Fertility Rates (PASFRs)

- The sum of PASFRs = 1 (or 100)

An Excel template is available in the “**PASFRs MAC**” sheet of your exercise file

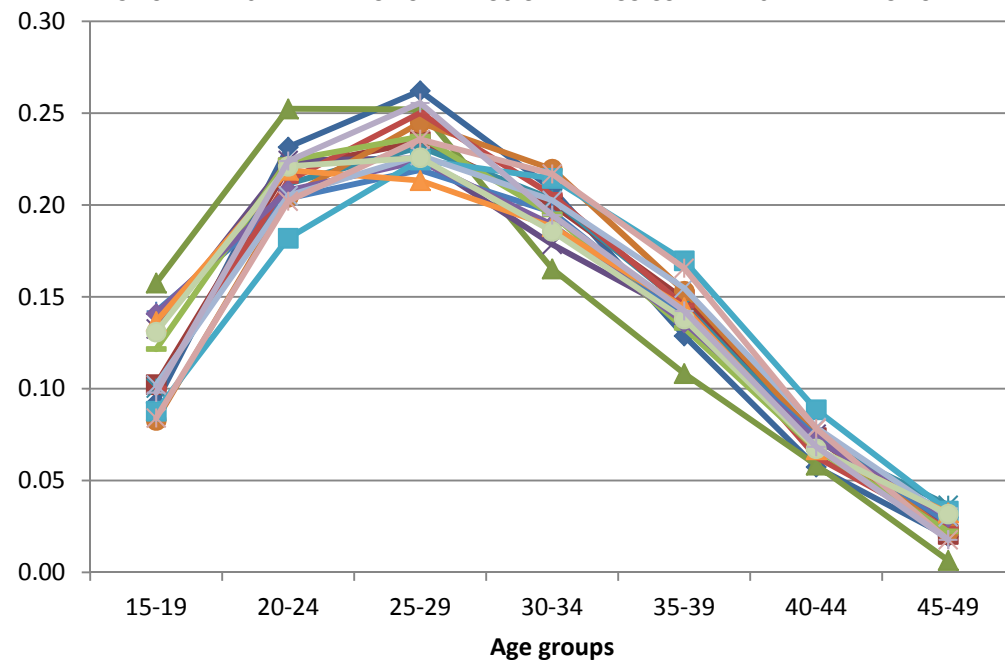
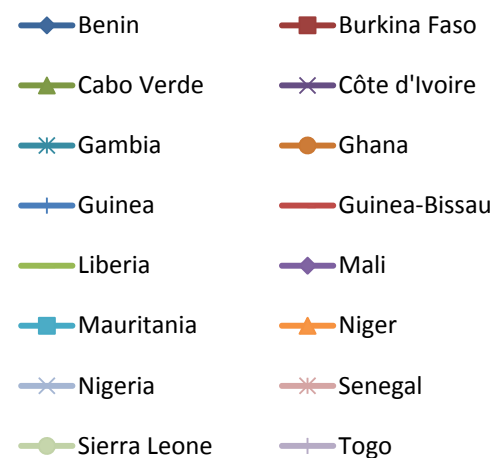


## Projecting the age pattern of fertility: a. Overview - ASFRs and PASFRs



### 2010-2015 ASFRs

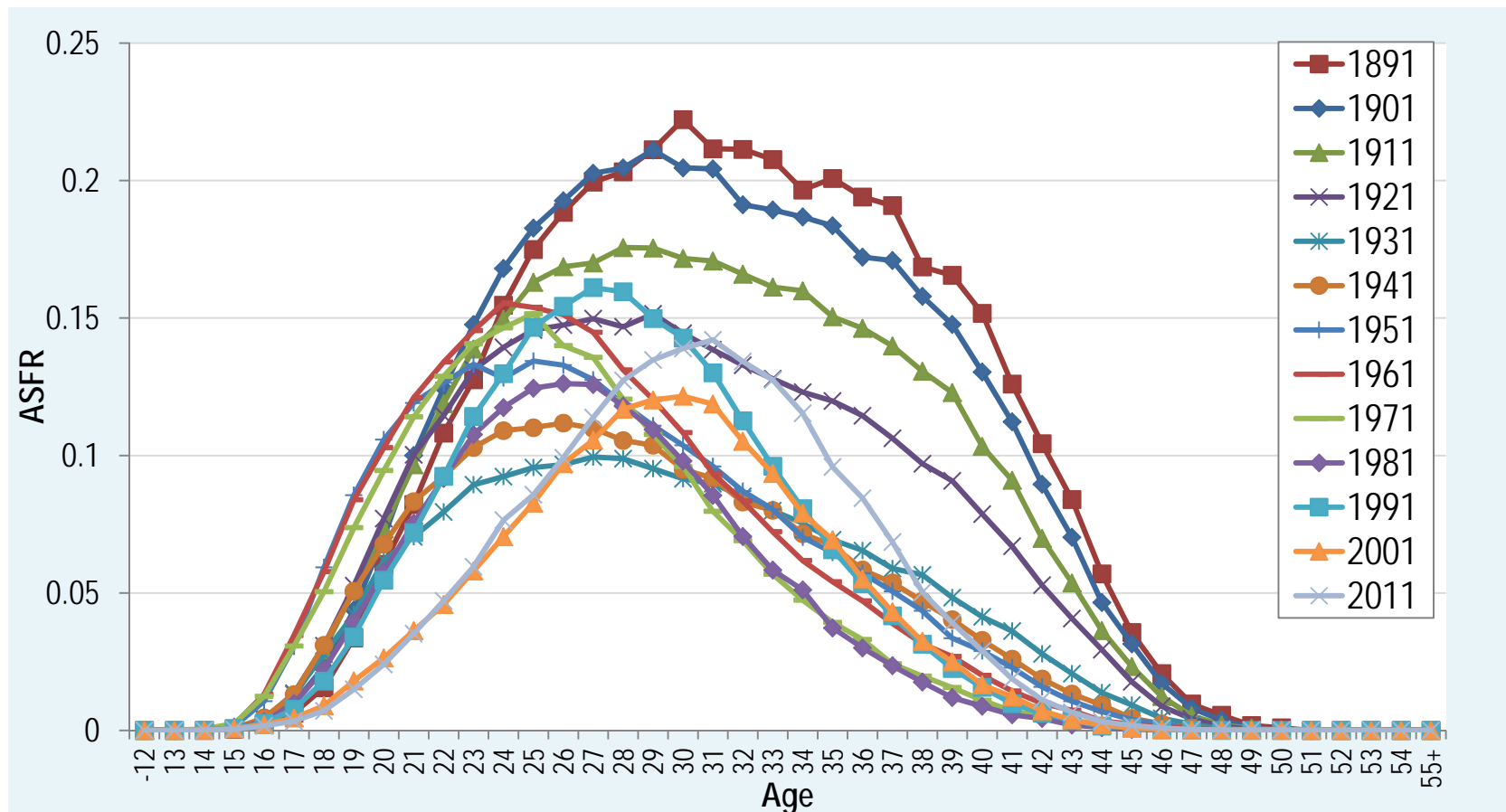
#### West African countries



### 2010-2015 PASFRs

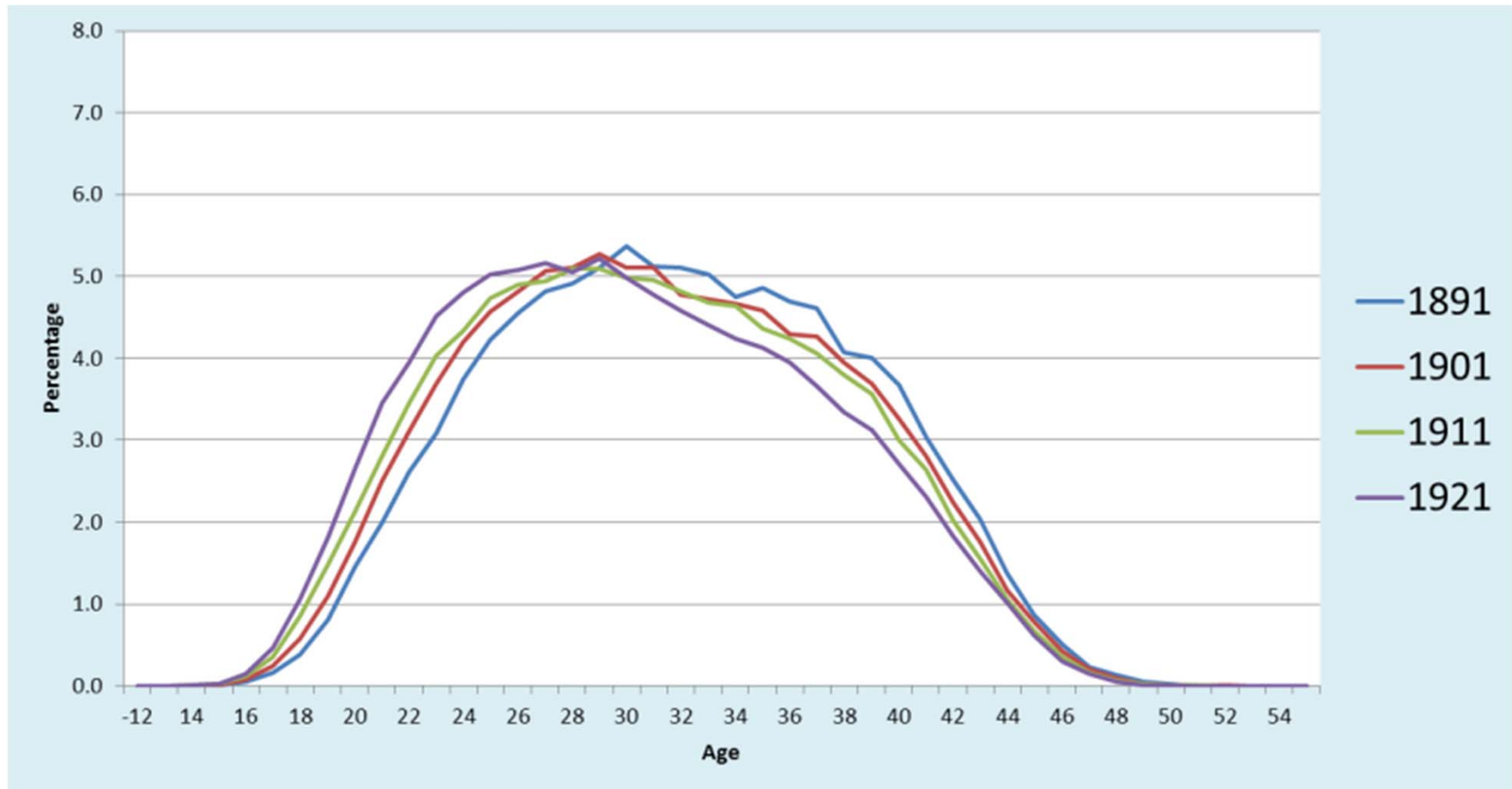
Source: World Population Prospects: the 2015 Revision

## Age-Specific Fertility Rates (ASFRs) – Sweden, 1891-2011



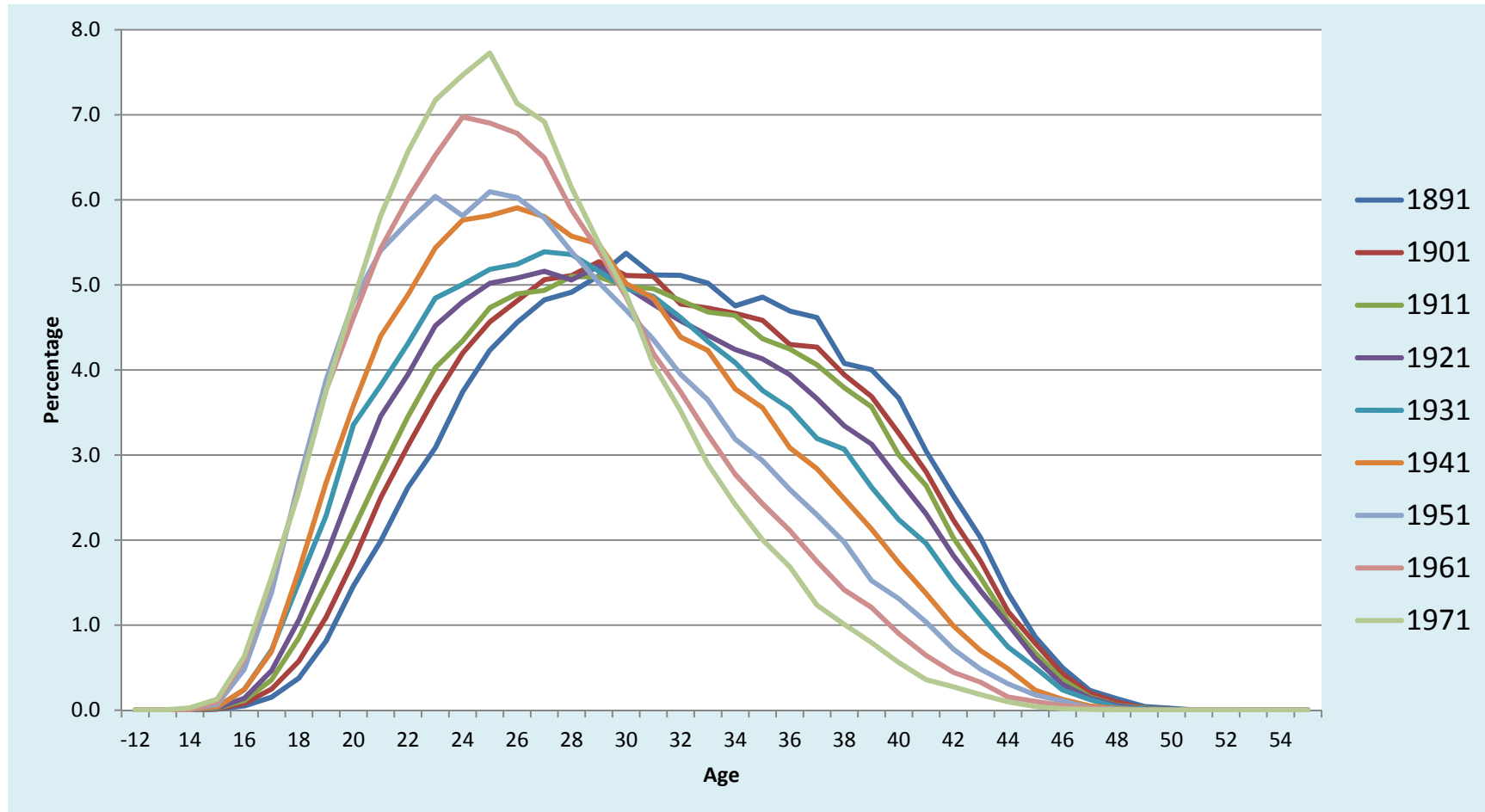
Source: Human Fertility Database

## Proportionate Age-Specific Fertility Rates (*PASFRs*) – Sweden



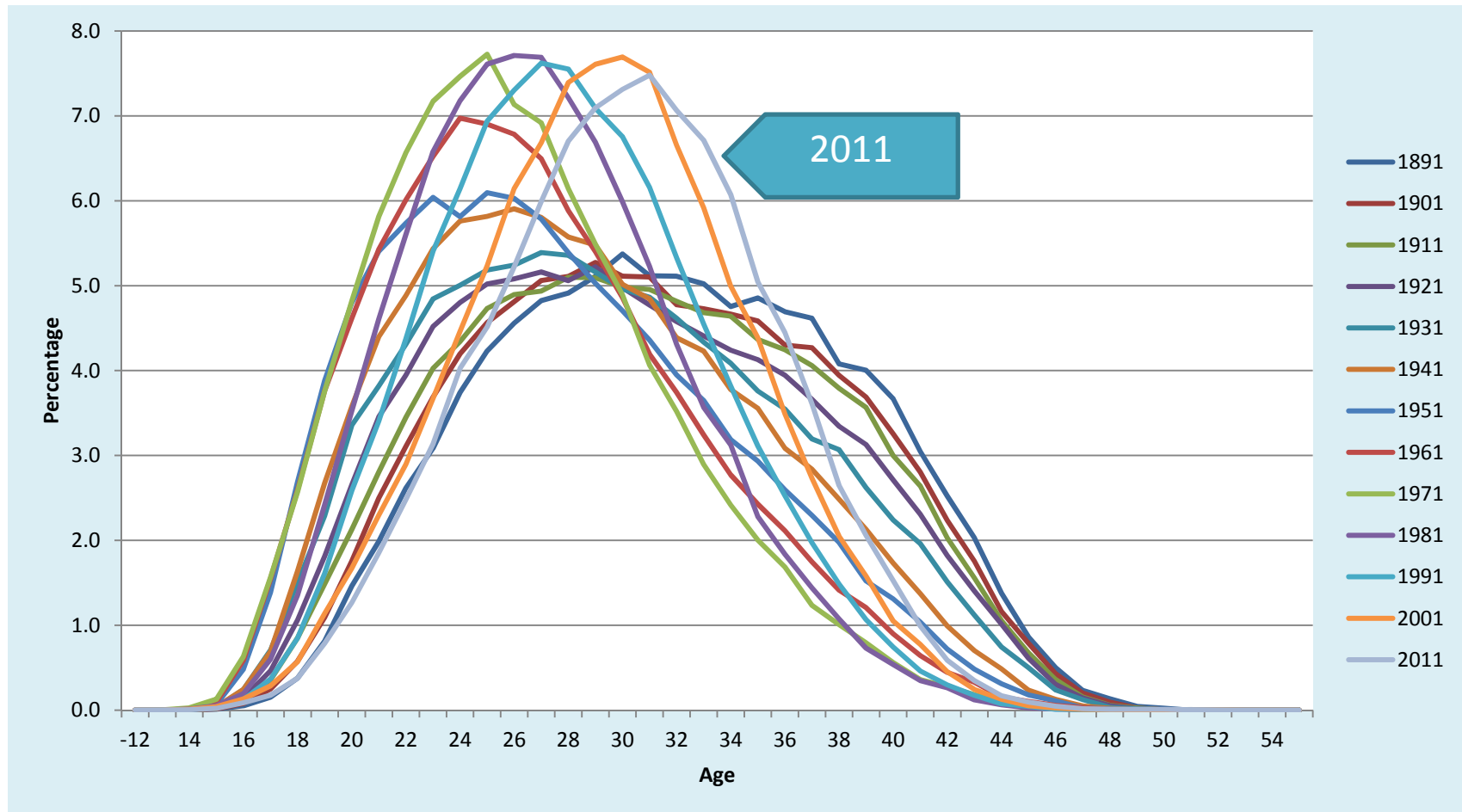
Source: Human Fertility Database

## Proportionate Age-Specific Fertility Rates (*PASFRs*) – Sweden



Source: Human Fertility Database

## Proportionate Age-Specific Fertility Rates (*PASFRs*) – Sweden

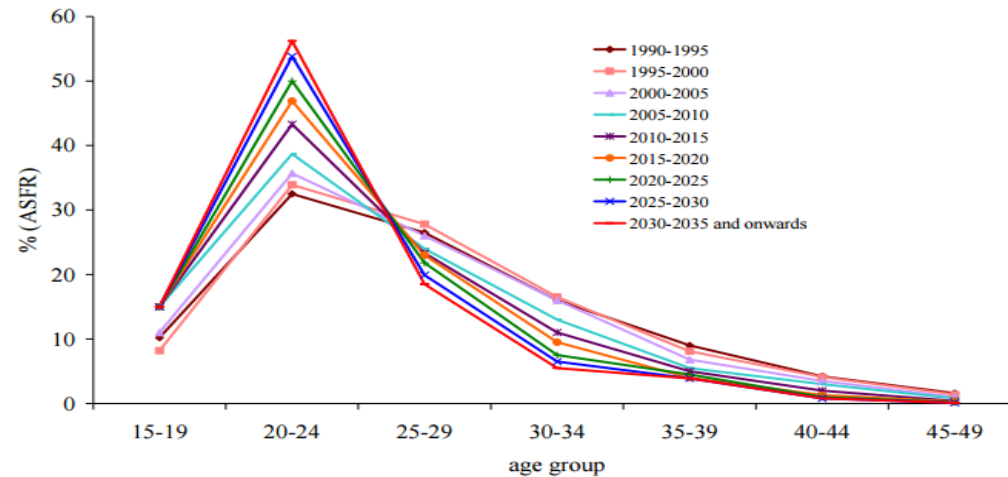


Source: Human Fertility Database

## Projecting the age pattern of fertility: a. Overview - ASFRs and PASFRs

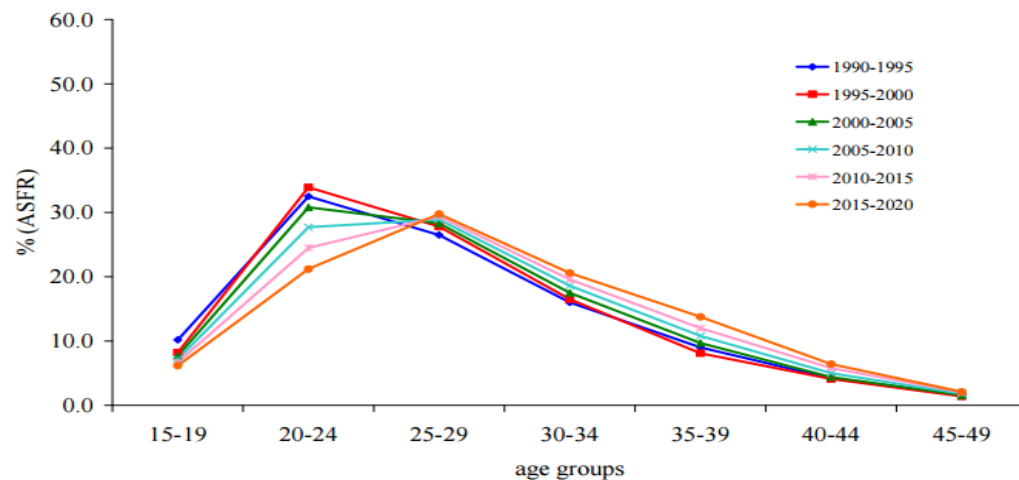
Source: Matthews et al. (2009), "Does early childbearing and a sterilization-focused family planning programme in India fuel population growth", Demographic Research, vol. 20 art. 28, pp. 693-720.

**Figure 4a: Assumptions for early childbearing pattern**



Early age  
patterns of  
fertility

**Figure 4b: Assumptions for late childbearing pattern**

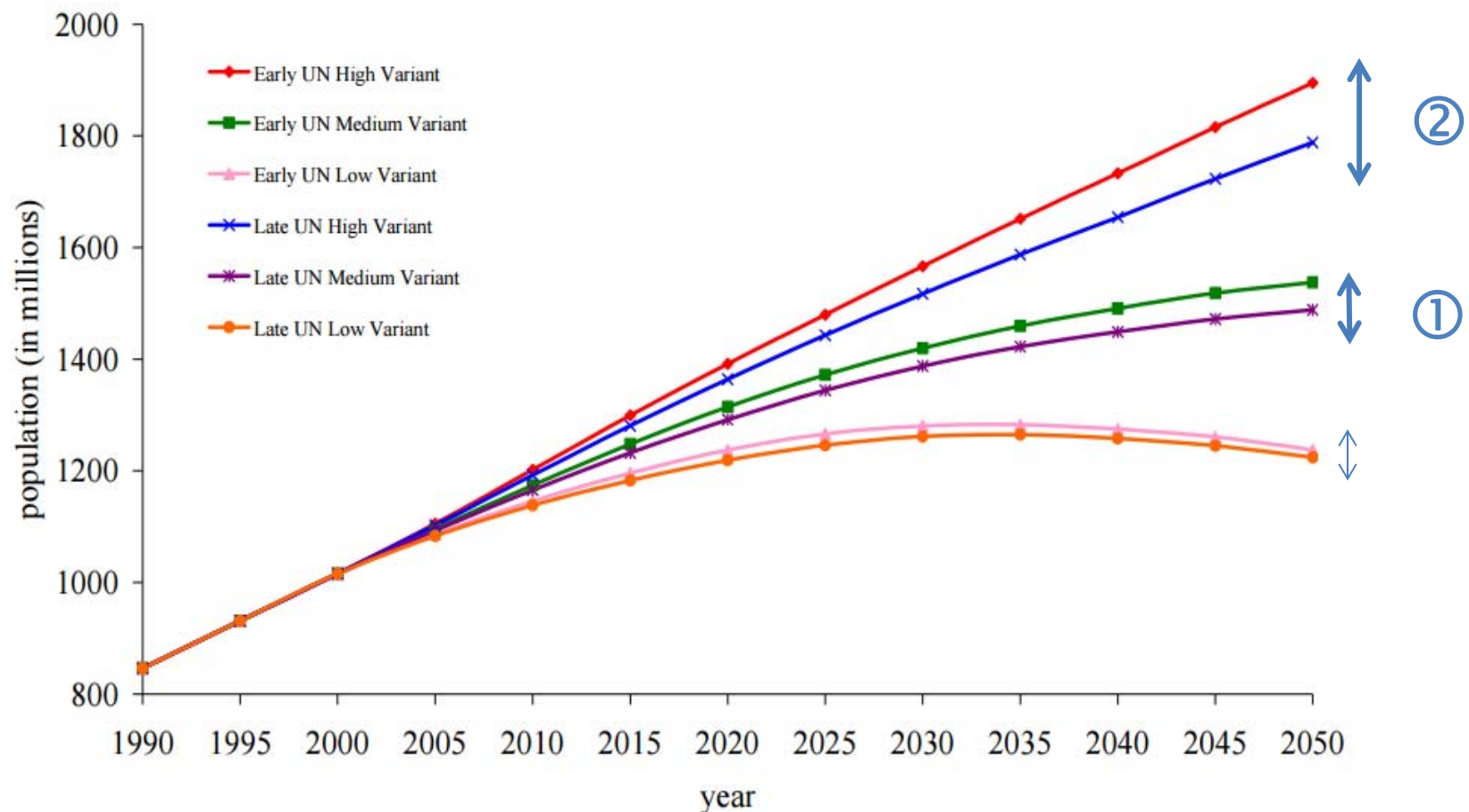


Late age  
patterns of  
fertility

## Projecting the age pattern of fertility: a. Overview - ASFRs and PASFRs

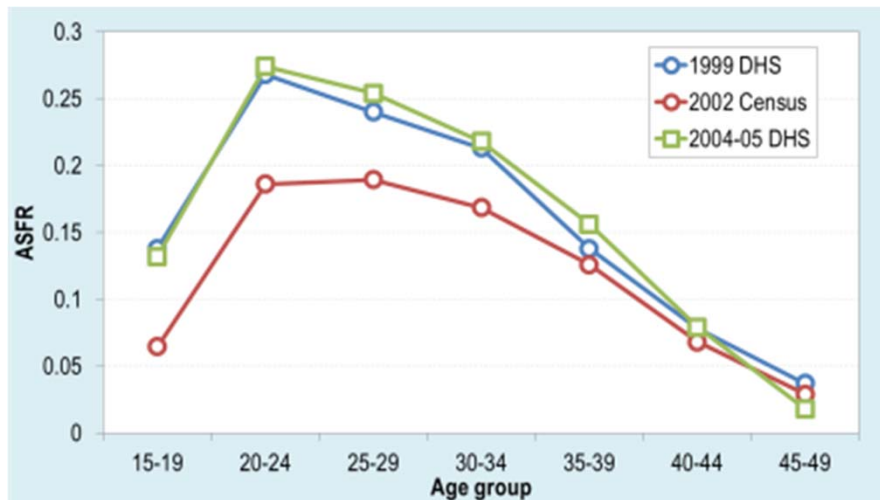
Matthews et al. (2009), "Does early childbearing and a sterilization-focused family planning programme in India fuel population growth", Demographic Research, vol. 20 art. 28, pp. 693-720.

**Figure 5: Projected population of India based on early and late childbearing patterns, 1990–2050**



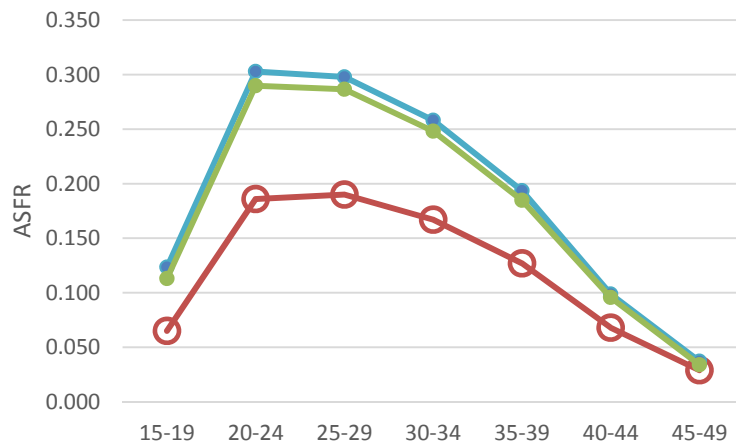
## Projecting the age pattern of fertility: b) Baseline

### Direct and indirect estimates of ASFRs – different sources



Age group	1999 DHS	2002 Census	2004-04 DHS
15 - 19	0.138	0.064	0.132
20 - 24	0.268	0.186	0.274
25 - 29	0.240	0.189	0.254
30 - 34	0.213	0.168	0.218
35 - 39	0.138	0.126	0.156
40 - 44	0.078	0.068	0.079
45 - 49	0.037	0.029	0.018
<b>TFR</b>	<b>5.6</b>	<b>4.2</b>	<b>5.7</b>

2002 ASFRs estimates



2002 census			
	Reported	Brass P/F Ratio	Arriaga
15-19	0.065	0.123	0.113
20-24	0.186	0.303	0.290
25-29	0.190	0.298	0.287
30-34	0.167	0.258	0.248
35-39	0.127	0.194	0.185
40-44	0.068	0.099	0.096
45-49	0.029	0.037	0.034
<b>TFR</b>	<b>4.16</b>	<b>6.56</b>	<b>6.26</b>



Caution! Quality assessment needed



## Projecting the age pattern of fertility: b) Baseline

### Example of quality assessment of ASFRs based on recent births data from Malawi

#### Age Specific Fertility Rate (ASFR)

$$nF_x = \frac{nB_x}{nW_x}$$

$nB_x$  = Births to women age  $x$  to  $x+n$  during period

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

Are births be 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  $\frac{1}{2}$  year as mothers were  $\frac{1}{2}$  year younger at the time of birth.

#### Malawi, census June 2008

Age group	Births in 12 months preceding census	Total women in age group	ASFR
14.5 - 19.5	70,737	699,155	0.10117
19.5 - 24.5	169,406	596,363	0.28407
24.5 - 29.5	130,331	539,482	0.24159
29.5 - 34.5	79,232	517,345	0.15315
34.5 - 39.5	43,747	374,526	0.11681
39.5 - 44.5	15,956	276,264	0.05776
44.5 - 49.5	5,599	224,100	0.02498



Caution! Quality assessment needed

# Projecting the age pattern of fertility:

## c. Projection options

- Since we have projected levels of fertility, we will use PASFRs (not ASFRs) to project age patterns.
- In Spectrum, PASFRs are expressed in percentages (the sum of PASFRs = 100)
- Two options are available:
  - 1) “Use model table”
  - 2) “Enter from keyboard”: User-defined projections

First year population   Total fertility rate   **ASFR**   Sex ratio at birth   Life expectancy   Model life table   International migration

☐ Use model table  
☒ Enter from keyboard

Age Distribution of Fertility (%)

Age	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
15-19	8.27	8.26	8.22	8.16	8.10	8.04	8.00	7.96	7.93	7.91	7.88	7.84	7.81	7.77	7.74	7.70	7.66	7.63	7.59
20-24	20.42	20.41	20.40	20.39	20.37	20.34	20.32	20.31	20.29	20.27	20.26	20.24	20.22	20.19	20.17	20.15	20.12	20.10	20.07
25-29	24.46	24.51	24.64	24.81	25.00	25.15	25.26	25.33	25.40	25.46	25.52	25.59	25.66	25.73	25.80	25.86	25.93	25.99	26.06
30-34	21.92	22.00	22.18	22.42	22.68	22.89	23.04	23.15	23.25	23.34	23.43	23.53	23.64	23.74	23.84	23.94	24.04	24.14	24.25
35-39	15.31	15.31	15.29	15.27	15.24	15.21	15.20	15.19	15.18	15.17	15.17	15.16	15.15	15.14	15.13	15.12	15.12	15.11	15.10
40-44	7.41	7.33	7.17	6.94	6.71	6.52	6.40	6.31	6.24	6.16	6.09	6.02	5.94	5.87	5.80	5.73	5.66	5.59	5.53
45-49	2.21	2.17	2.10	2.00	1.91	1.83	1.78	1.74	1.71	1.68	1.65	1.62	1.59	1.56	1.52	1.49	1.47	1.44	1.41
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

This table requires the percentage of lifetime births that occur at each age group. The values should sum to 100% in each year.

Comparison   Normalize

Ok   Cancel   Source   ? Help

## Projecting the age pattern of fertility: c. Projection options

---

- **Option 1:** User-defined projection using Spectrum interpolation function.

We need a base year pattern and a target pattern.

- **Option 2:** User-defined patterns using models from the Excel template **ASFRPATT.xls**

Finds age patterns of fertility for a given level of fertility, based on typical age-specific fertility patterns.

- **Option 3:** User-defined patterns using models from the Excel template **UNPD\_ASFR.xlsm**

Characteristic empirical age patterns of fertility are used as a basis for projections.

- **Option 4 (caution is recommended):** “Use model table” from Spectrum software

## Projecting the age pattern of fertility: c. Projection options

- **Option 1:** User defined projection using Spectrum interpolation function.

We need a base year pattern and a target pattern.

test1LB - Spectrum

Home Modules Tools

Demographic data - test1LB

First year population Total fertility rate **ASFR** Sex ratio at birth Life expectancy Model life table International migration

☐ Use model table  
☒ Enter from keyboard

Age Distribution of Fertility (%)

Age	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
15-19	7.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.60
20-24	20.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.63
25-29	22.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.08
30-34	20.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.69
35-39	15.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.93
40-44	9.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
45-49	4.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

This table requires the percentage of lifetime births that occur at each age group. The values should sum to 100% in each year.

Comparison Normalize

Ok Cancel Source

Open menu with mouse right click

Linear Ctrl+I  
S-Shaped  
Exponential  
Front Loaded  
Interpolate  
Normalize Ctrl+N  
Multiply Ctrl+M  
Data Source  
Show Thousands Separator

## Projecting the age pattern of fertility: c. Projection options

### ○ Option 1: How do we define a **target pattern**?

test1LB - Spectrum

Home Modules Tools

Demographic data - test1LB

First year population Total fertility rate **ASFR** Sex ratio at birth Life expectancy Model life table International migration

☐ Use model table  
☒ Enter from keyboard

Age Distribution of Fertility (%)

Age	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
15-19	7.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.60
20-24	20.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.63
25-29	22.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.08
30-34	20.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.69
35-39	15.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.93
40-44	9.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
45-49	4.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

This table requires the percentage of lifetime births that occur at each age group. The values should sum to 100% in each year.

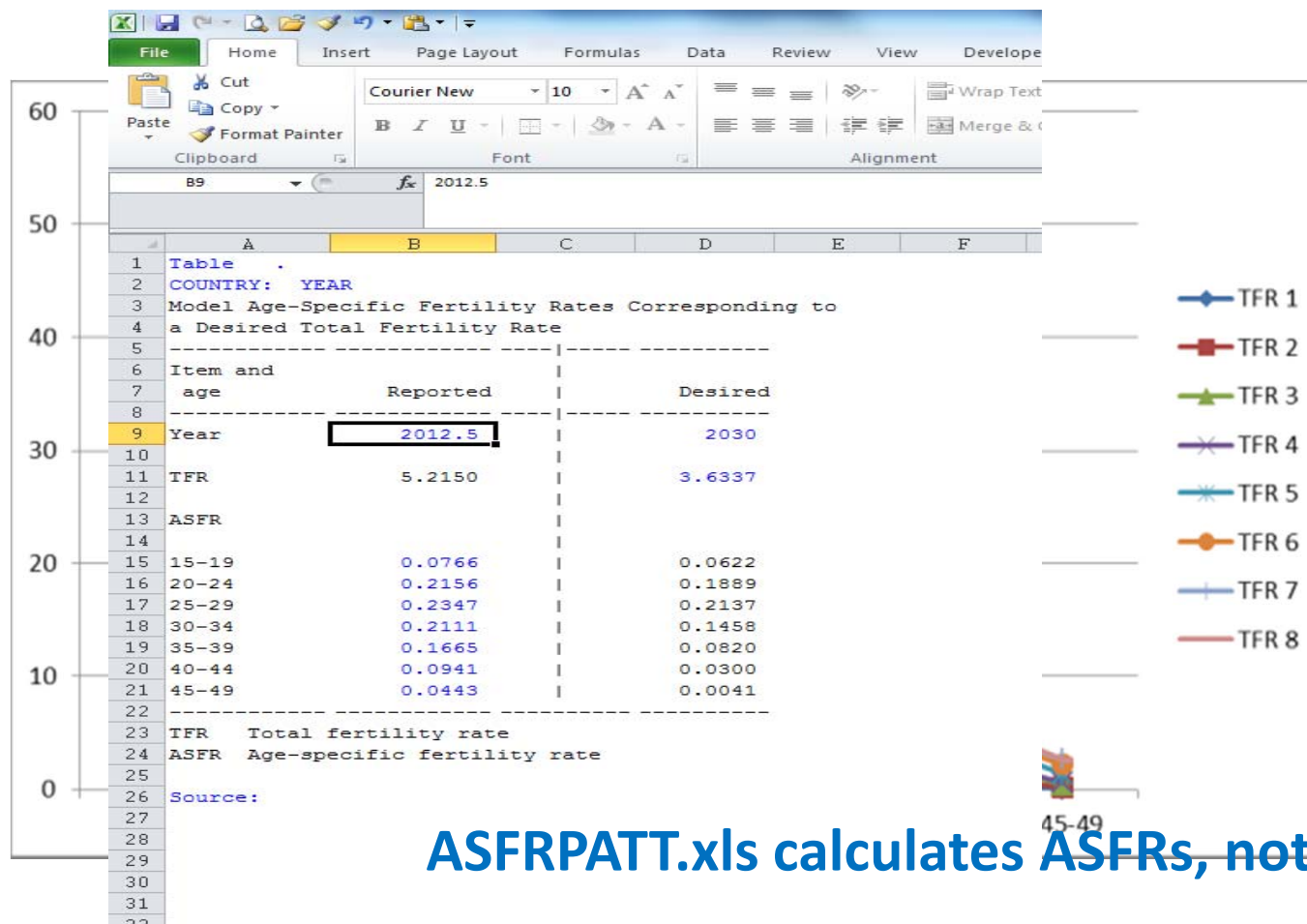
Comparison Normalize

Ok Cancel Source

Linear Ctrl+I  
S-Shaped  
Exponential  
Front Loaded  
Interpolate  
Normalize Ctrl+N  
Multiply Ctrl+M  
Data Source  
Show Thousands Separator

## Projecting the age pattern of fertility: c. Projection options

- **Option 2:** Use Excel template **ASFRPATT.xls**
- Finds age patterns of fertility for a given level of fertility, based on typical age-specific fertility patterns.





## Projecting the age pattern of fertility: c. Projection options

- **Option 3:** Use Excel template **UNPD\_ASFR.xls**
- Uses characteristic age-patterns of fertility associated with select levels of fertility
- The model generates a series of age patterns by interpolating between a base pattern and a target pattern.
- The template allows for extending the target pattern beyond the last year (target year) by keeping it constant.
- Model age patterns of fertility are presented as PASFRs, indexed by the *mean age at childbirth (MAC)*

The screenshot shows the UNPD\_ASFR.xls Excel template. The input section includes fields for Base year (2012), Last year (2031), and Ultimate year (2100). A dropdown menu for 'Select fertility model for Last Year' is set to 'Model 7, MAC: 26.48 years'. Below this, a table shows the base year fertility pattern (Births per 1000 women) for age groups 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49. The resulting table, 'Proportionate age-specific fertility rates', shows the projected rates for each year from 2012 to 2035, indexed by the mean age at childbirth (MAC).

Year	15-19	20-24	25-29	30-34	35-39	40-44	45-49
2012	0.07342	0.20672	0.22505	0.20244	0.15967	0.09022	0.04246
2013	0.07579	0.21059	0.23037	0.20158	0.15521	0.08624	0.04023
2014	0.07815	0.21445	0.23569	0.20071	0.15075	0.08225	0.03799
2015	0.08052	0.21832	0.24100	0.19985	0.14629	0.07827	0.03576
2016	0.08288	0.22219	0.24632	0.19898	0.14182	0.07428	0.03352
2017	0.08525	0.22606	0.25164	0.19811	0.13736	0.07029	0.03129
2018	0.08761	0.22992	0.25696	0.19725	0.13290	0.06631	0.02905
2019	0.08998	0.23379	0.26227	0.19638	0.12843	0.06232	0.02682
2020	0.09234	0.23766	0.26759	0.19552	0.12397	0.05834	0.02458
2021	0.09471	0.24152	0.27291	0.19465	0.11951	0.05435	0.02235
2022	0.09707	0.24539	0.27823	0.19378	0.11505	0.05037	0.02011
2023	0.09944	0.24926	0.28355	0.19292	0.11058	0.04638	0.01788
2024	0.10180	0.25312	0.28886	0.19205	0.10612	0.04239	0.01564
2025	0.10417	0.25699	0.29418	0.19119	0.10166	0.03841	0.01341
2026	0.10653	0.26086	0.29950	0.19032	0.09719	0.03442	0.01117
2027	0.10890	0.26473	0.30482	0.18945	0.09273	0.03044	0.00894
2028	0.11126	0.26859	0.31013	0.18859	0.08827	0.02645	0.00670
2029	0.11363	0.27246	0.31545	0.18772	0.08381	0.02246	0.00447
2030	0.11599	0.27633	0.32077	0.18686	0.07934	0.01848	0.00223
2031	0.11836	0.28019	0.32609	0.18599	0.07488	0.01449	0.00000
2032	0.11836	0.28019	0.32609	0.18599	0.07488	0.01449	0.00000
2033	0.11836	0.28019	0.32609	0.18599	0.07488	0.01449	0.00000
2034	0.11836	0.28019	0.32609	0.18599	0.07488	0.01449	0.00000
2035	0.11836	0.28019	0.32609	0.18599	0.07488	0.01449	0.00000



## Mean age at childbirth (MAC):

The sum of ASFRs weighted by the mid-point of each group, divided by the sum of ASFRs

$$MAC = \sum_a x_a f_a / \sum_a f_a$$

where  $x_a$  is the mid-point of each age interval (17.5, 22.5, ... 47.5) and  $f_a$  is the ASFR for women in age group  $a$

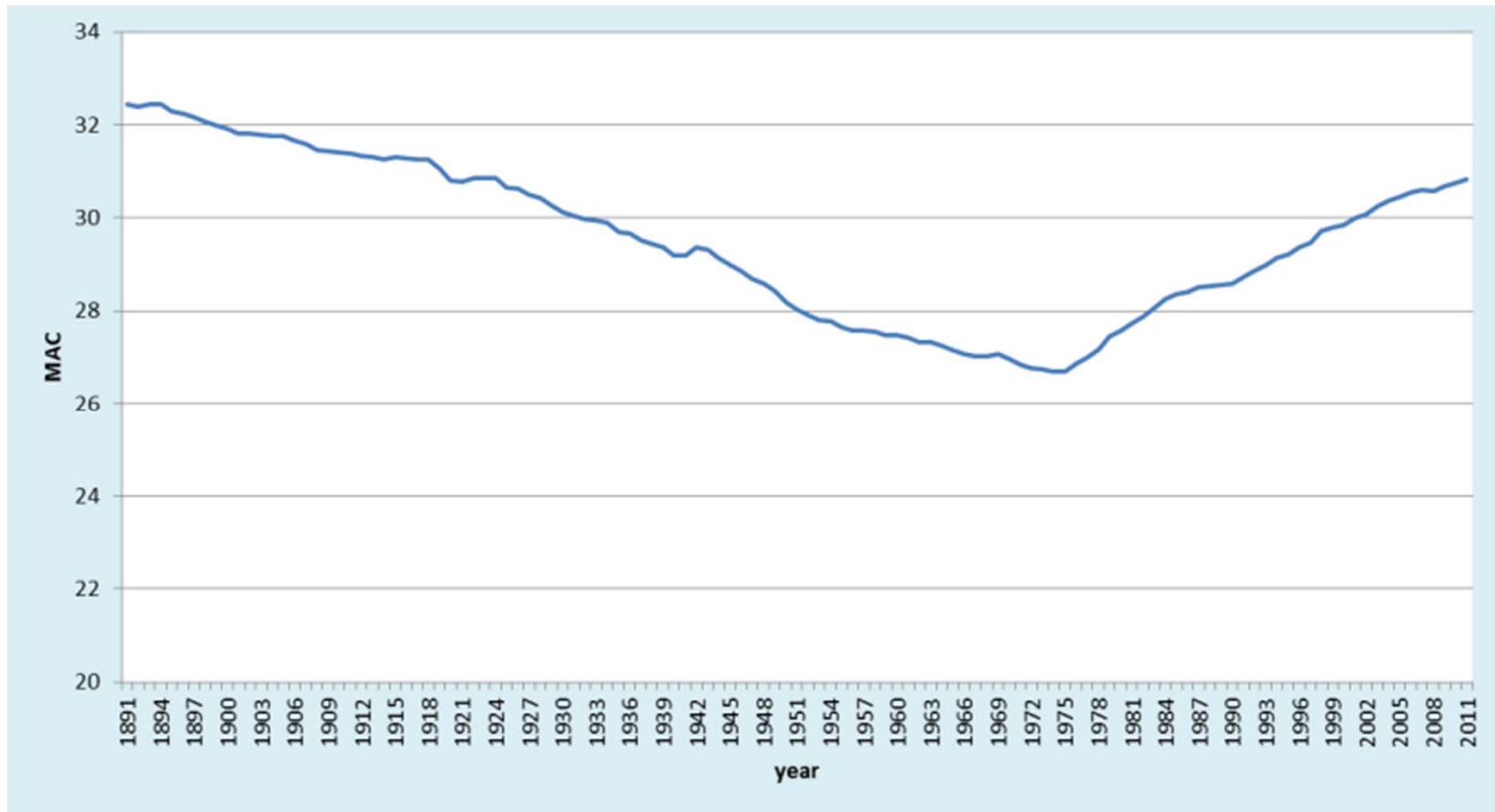
### Interpretation

The mean age of mothers at the birth of their children, under the assumption that women are subject through age 50 to the ASFRs observed in a given year.

An Excel template is available in the **"PASFRs MAC"** sheet of your exercise file



## Mean age at childbirth (MAC): – Sweden, 1891-2011

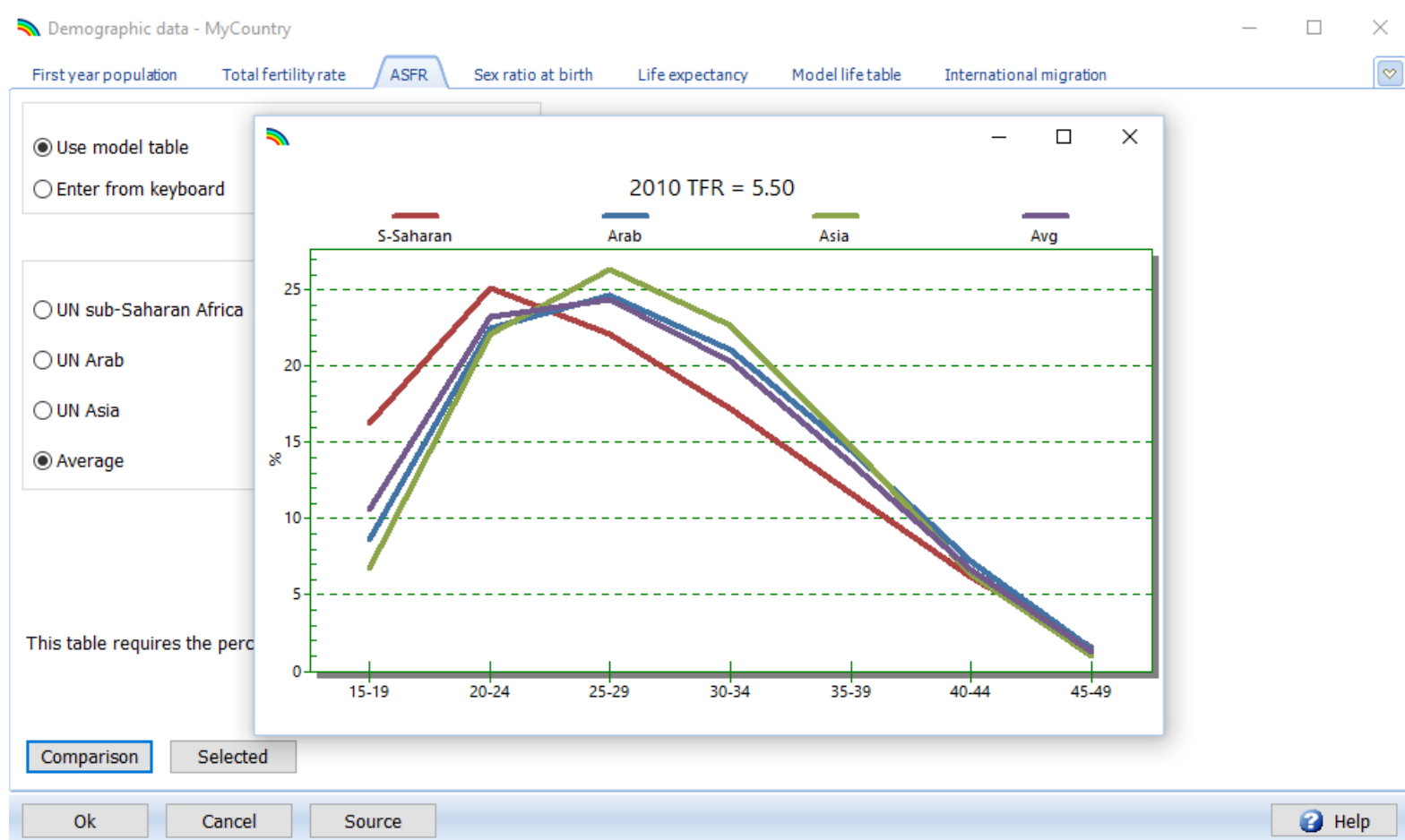


Source: Human Fertility Database

## Projecting the age pattern of fertility: c. Projection options

- **Option 4: (caution is recommended):** “Use model table” from Spectrum software

3 regional models and one average model are provided.



*Thank you*

Questions?

>> until 11 March:



>> After 11 March: [sawyerc@un.org](mailto:sawyerc@un.org)  
[bassarsky@un.org](mailto:bassarsky@un.org)