

A Stochastic Version of the *World Population Prospects* - based on Bayesian Projections of Total Fertility and Life Expectancy

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Stochastic *World Population Prospects* (WPP)

- 1 WPP fertility estimates and projections:
Overview
- 2 Problems with WPP fertility projections
- 3 Stochastic population projections:
First test runs
- 4 Remarks about heterogeneity,
Conclusions



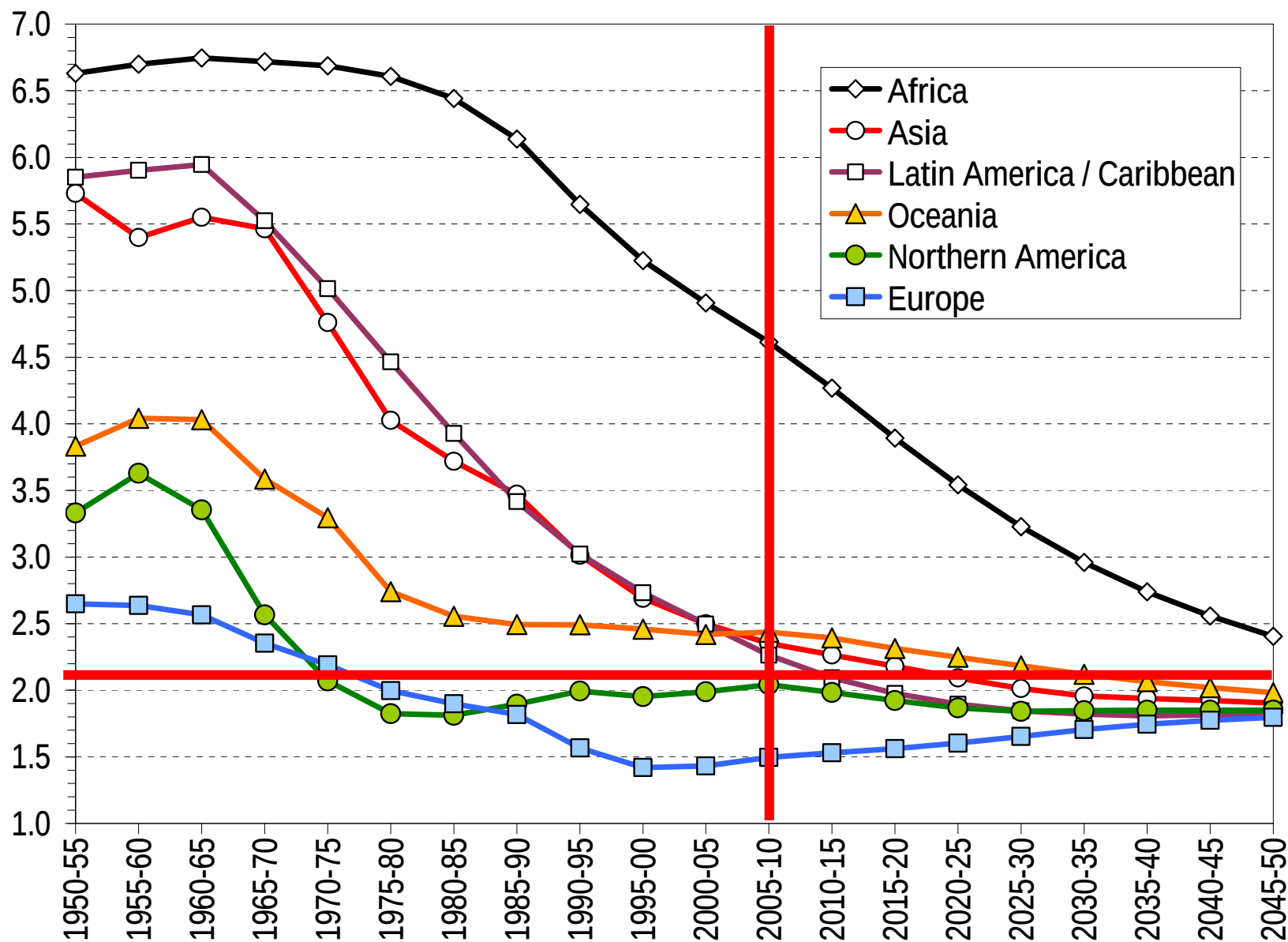
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Fertility estimates and projections in the *2008 Revision of the World Population Prospects* Overview



Total Fertility by major region, 1950-2050

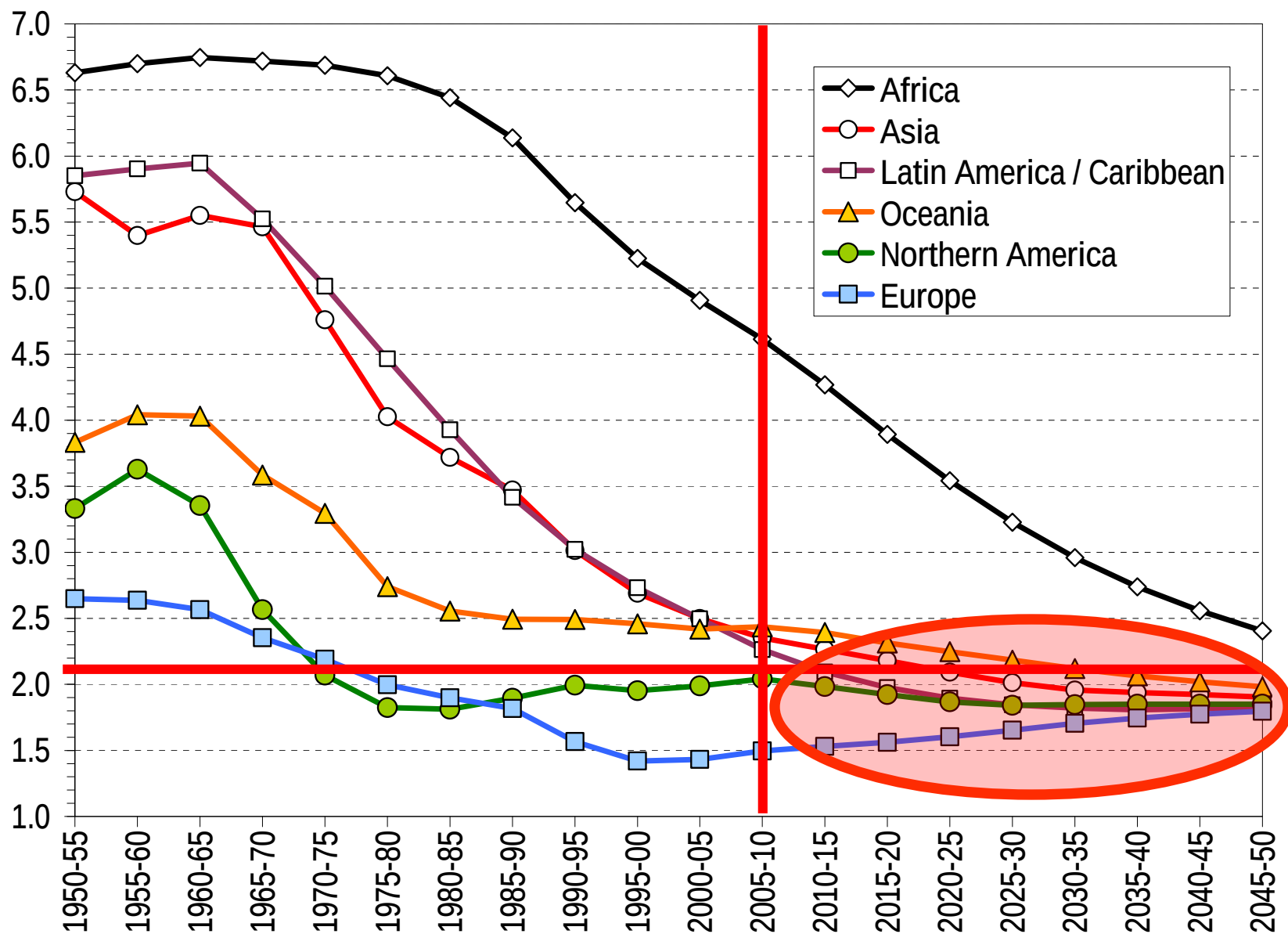
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Total Fertility by major region, 1950-2050

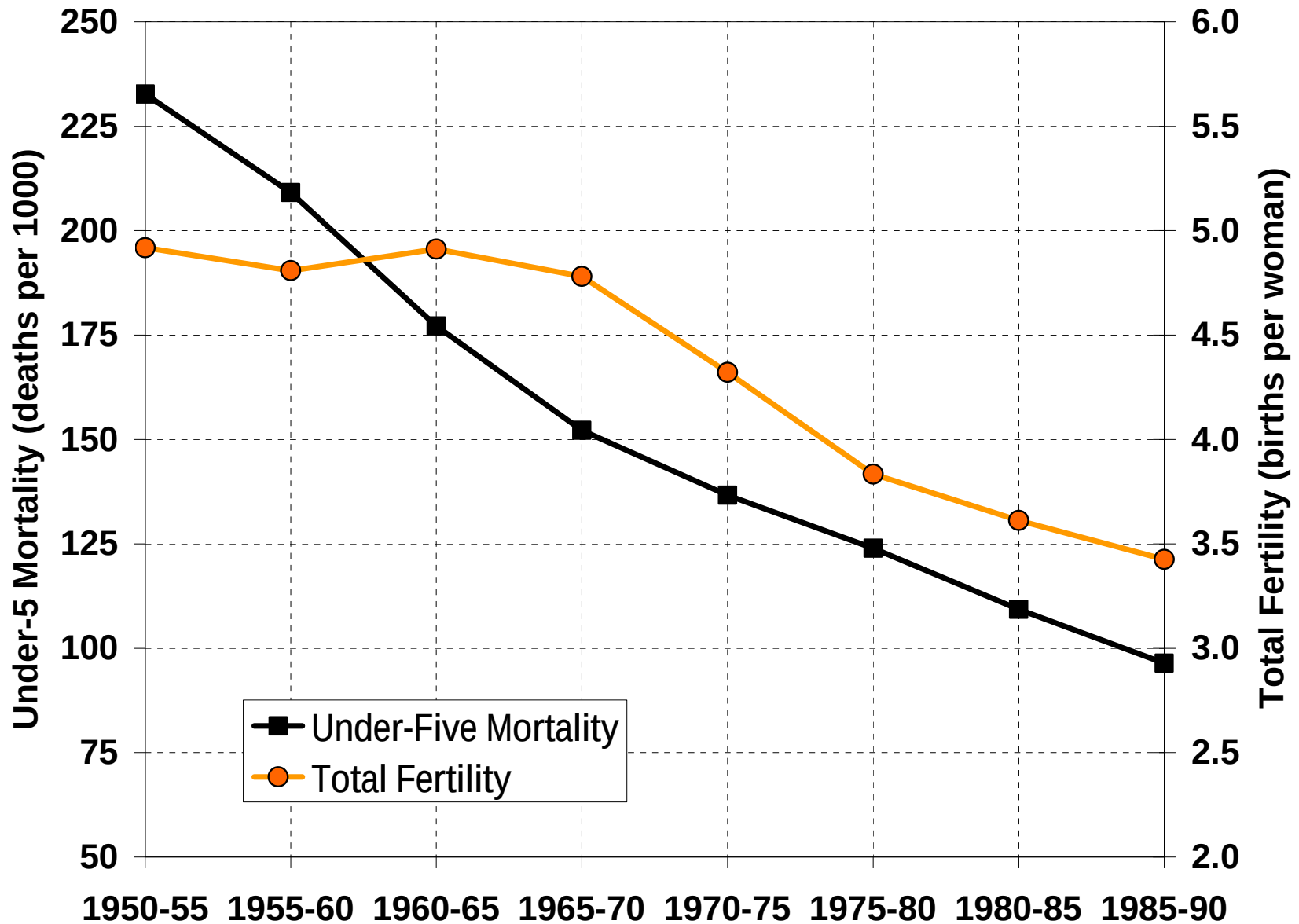
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Total Fertility and Under-5 Mortality, 1950-55 to 1985-90

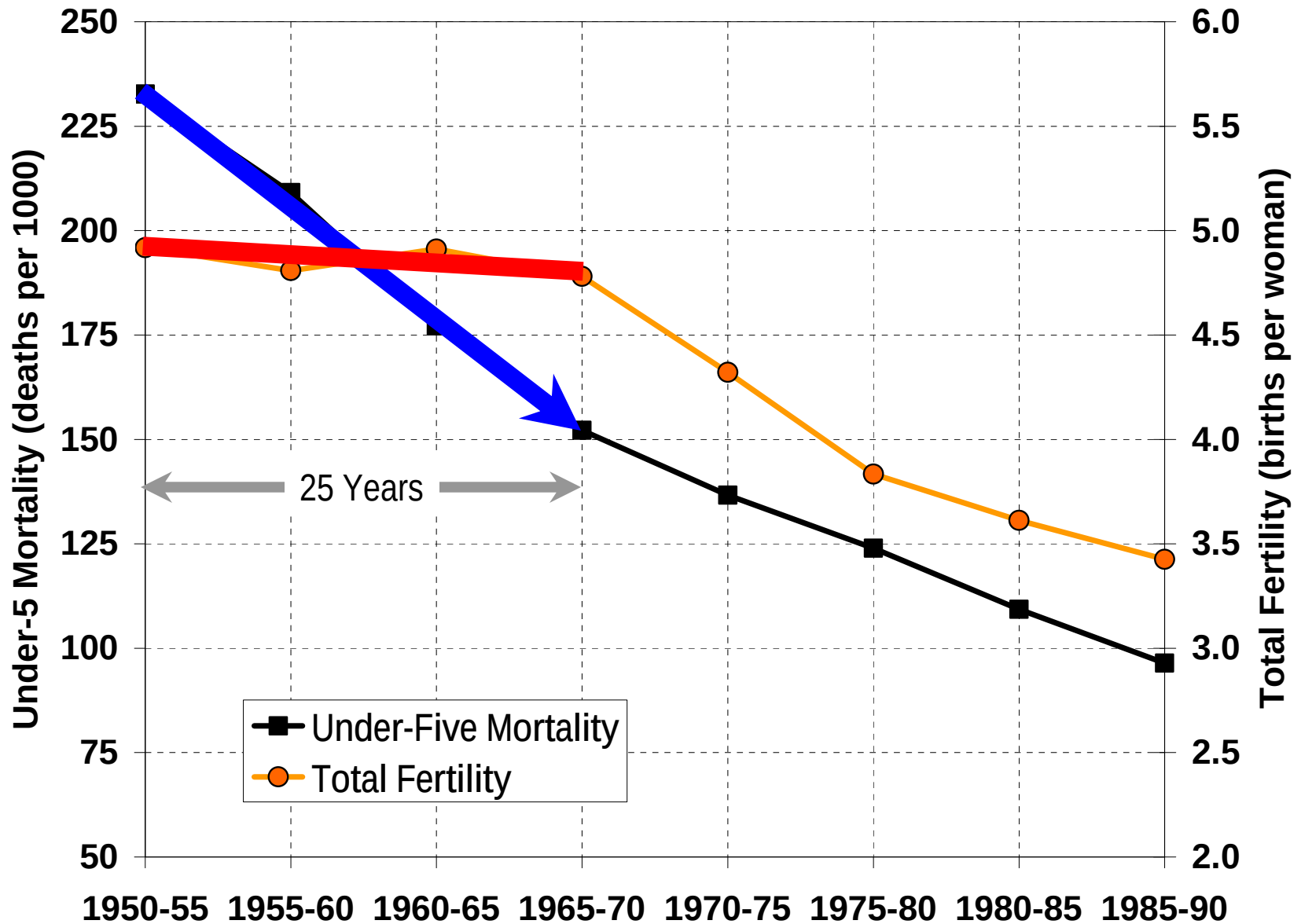
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Total Fertility and Under-5 Mortality, 1950-55 to 1985-90

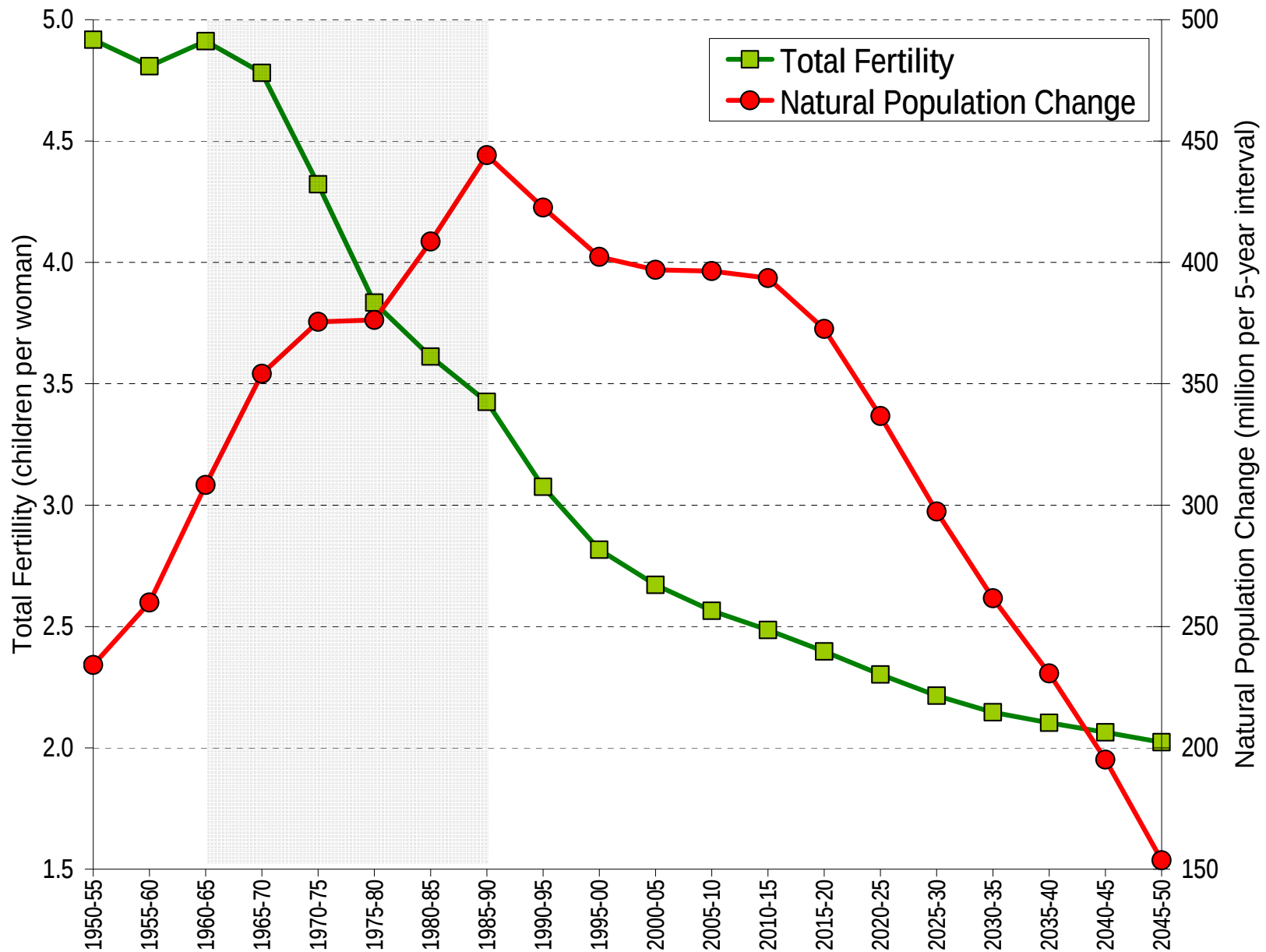
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World: Total Fertility and Natural Population Change

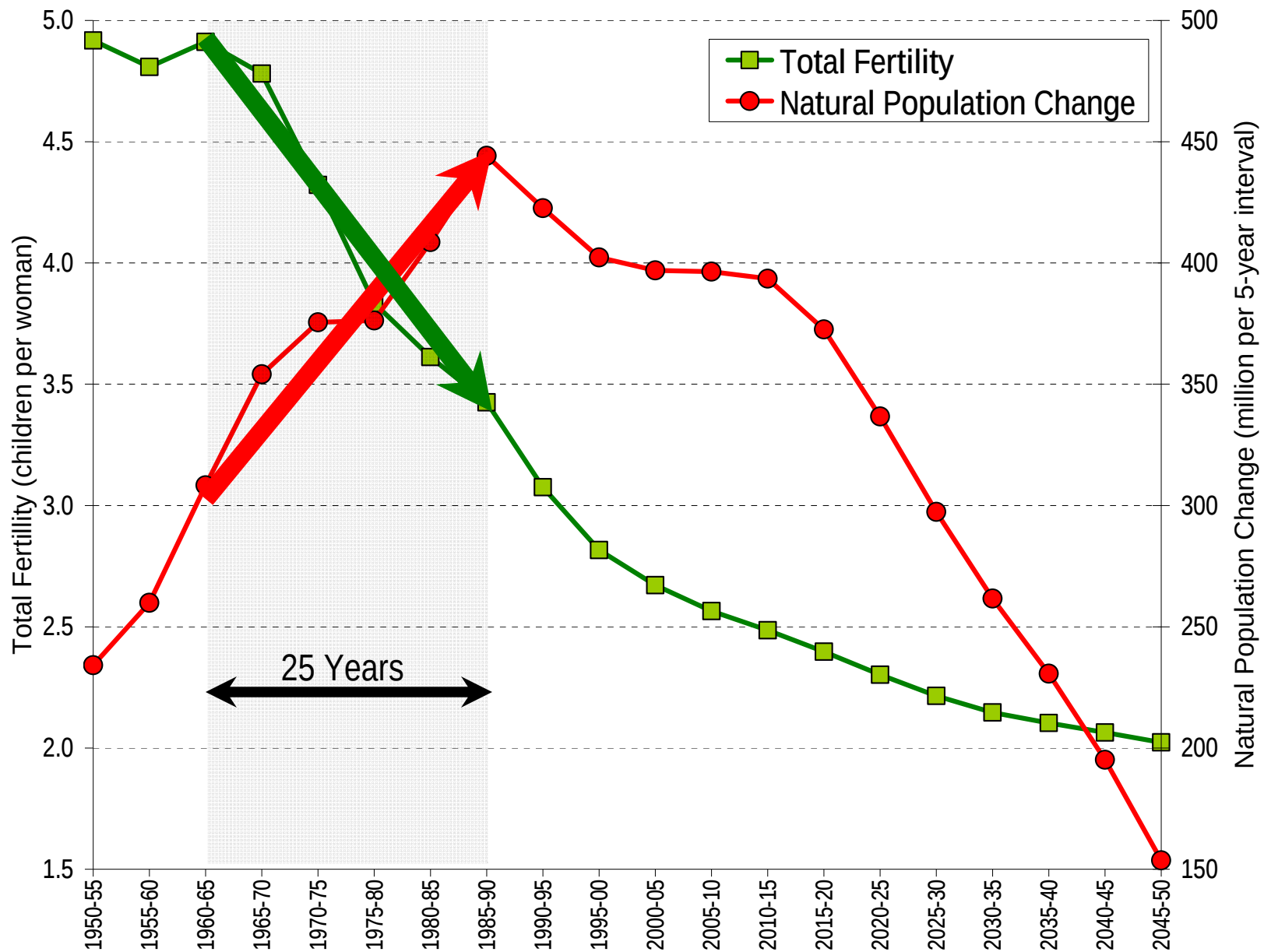
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World: Total Fertility and Natural Population Change

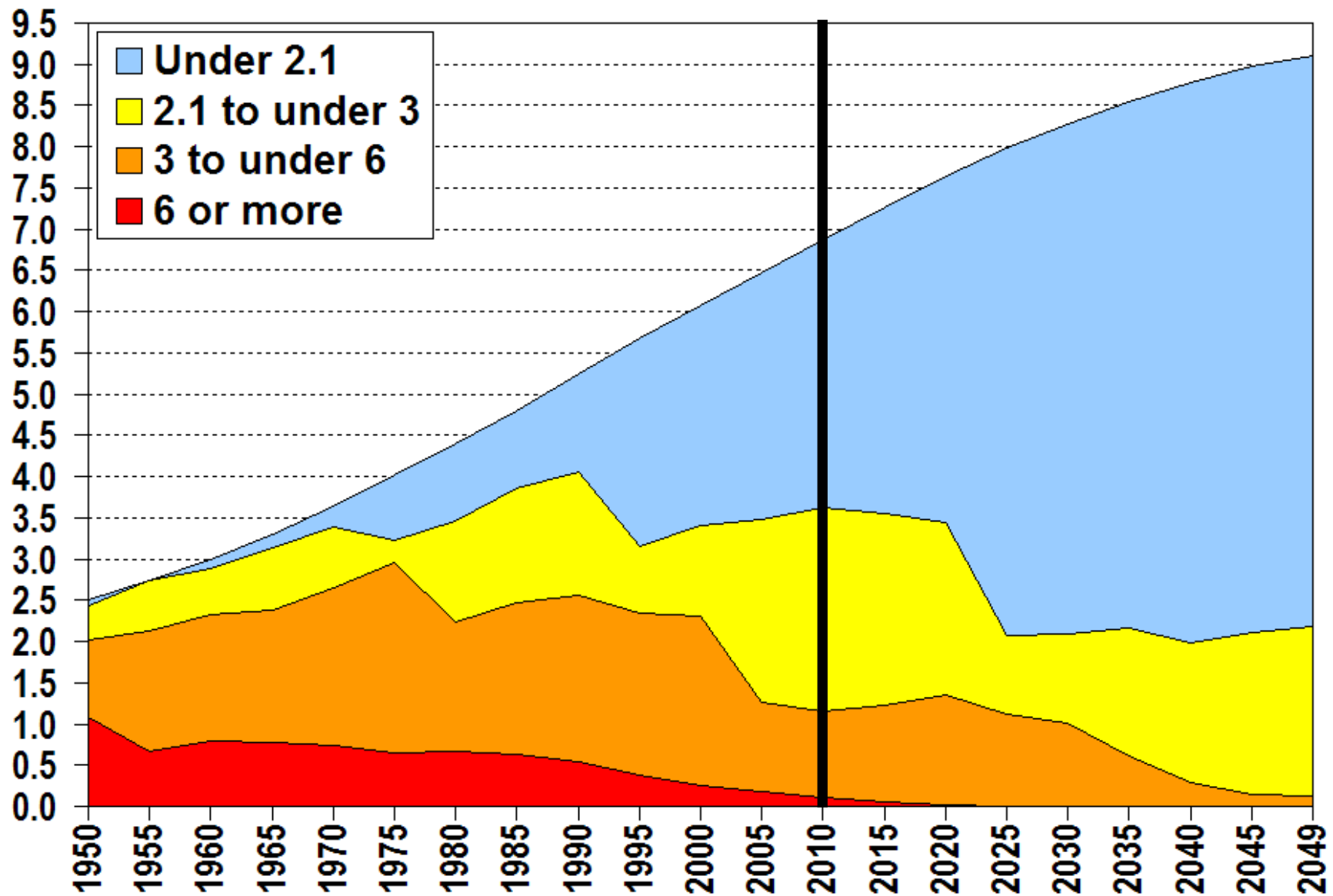
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World population by Total Fertility, 1950-2049

1





All colored countries are below 2.1 TFR, 1950-2050

1

1950 - 2050

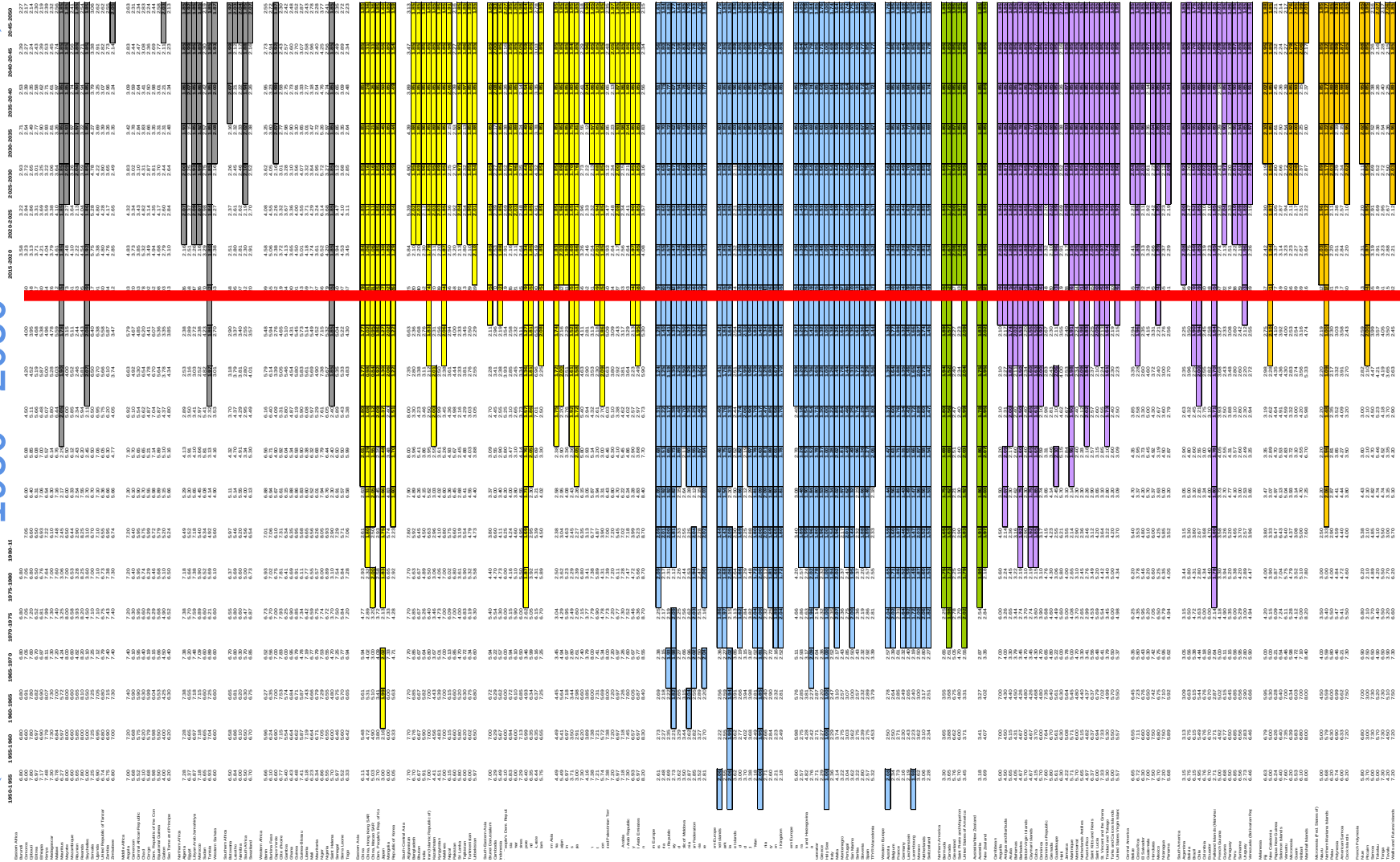
Africa

Asia

Europe

Latin America

Caribbean



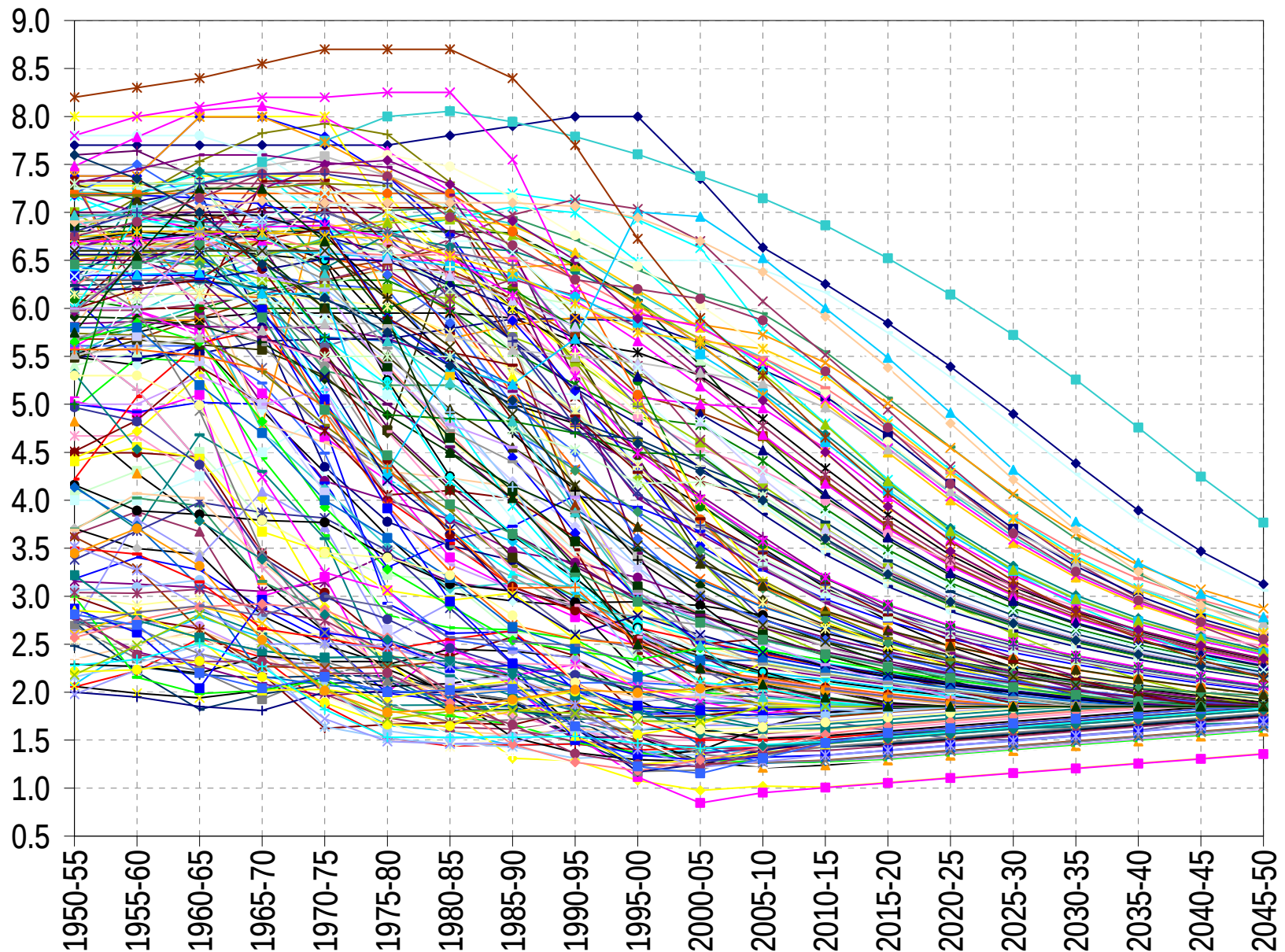
230 Countries



2

Problems in WPP fertility projections:

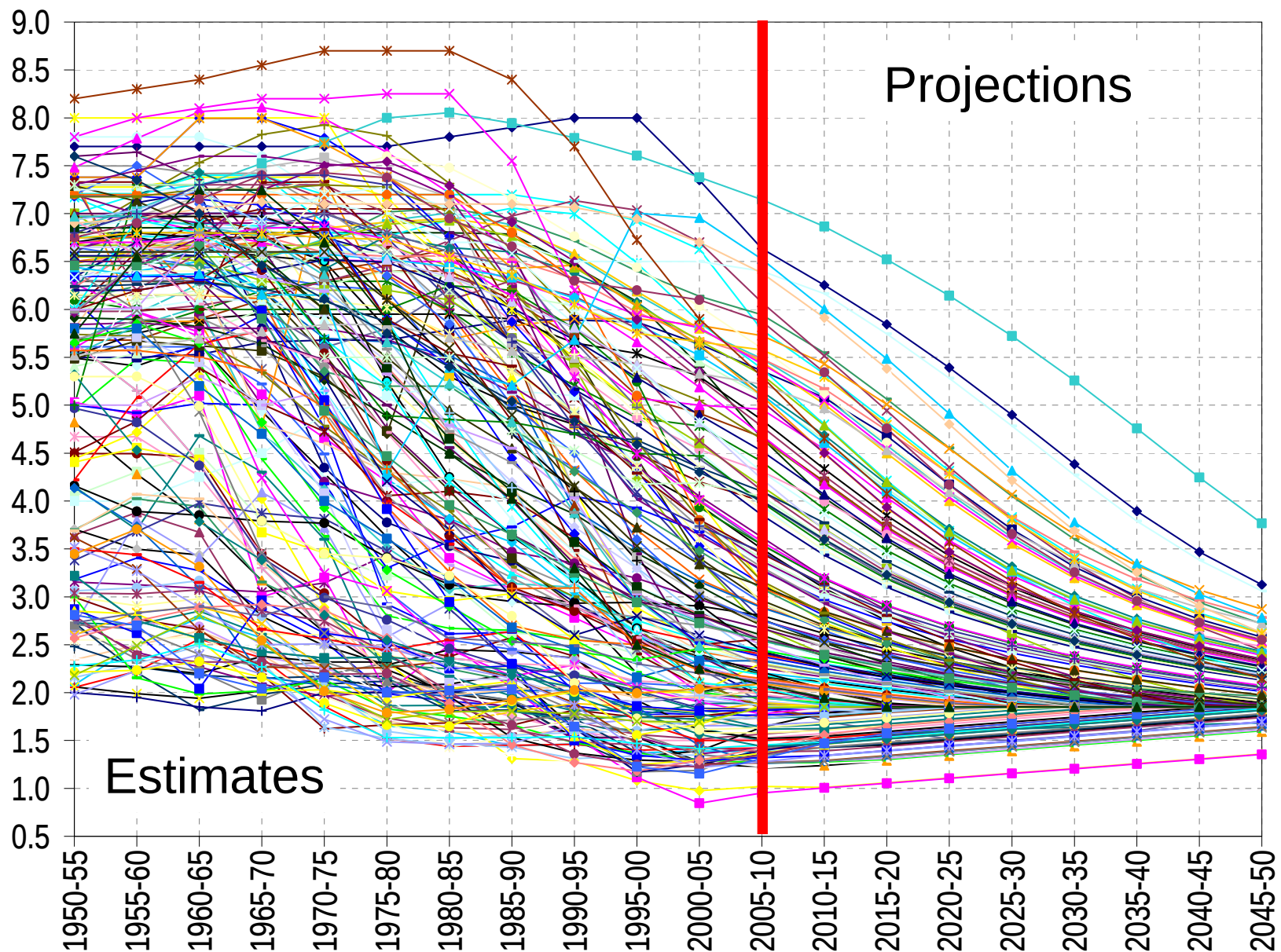
- a) Increasing number of **sub-replacement** countries
- b) Early **conversion** towards TFR 1.85





WPP 196 Countries: Total Fertility, 1950-2050

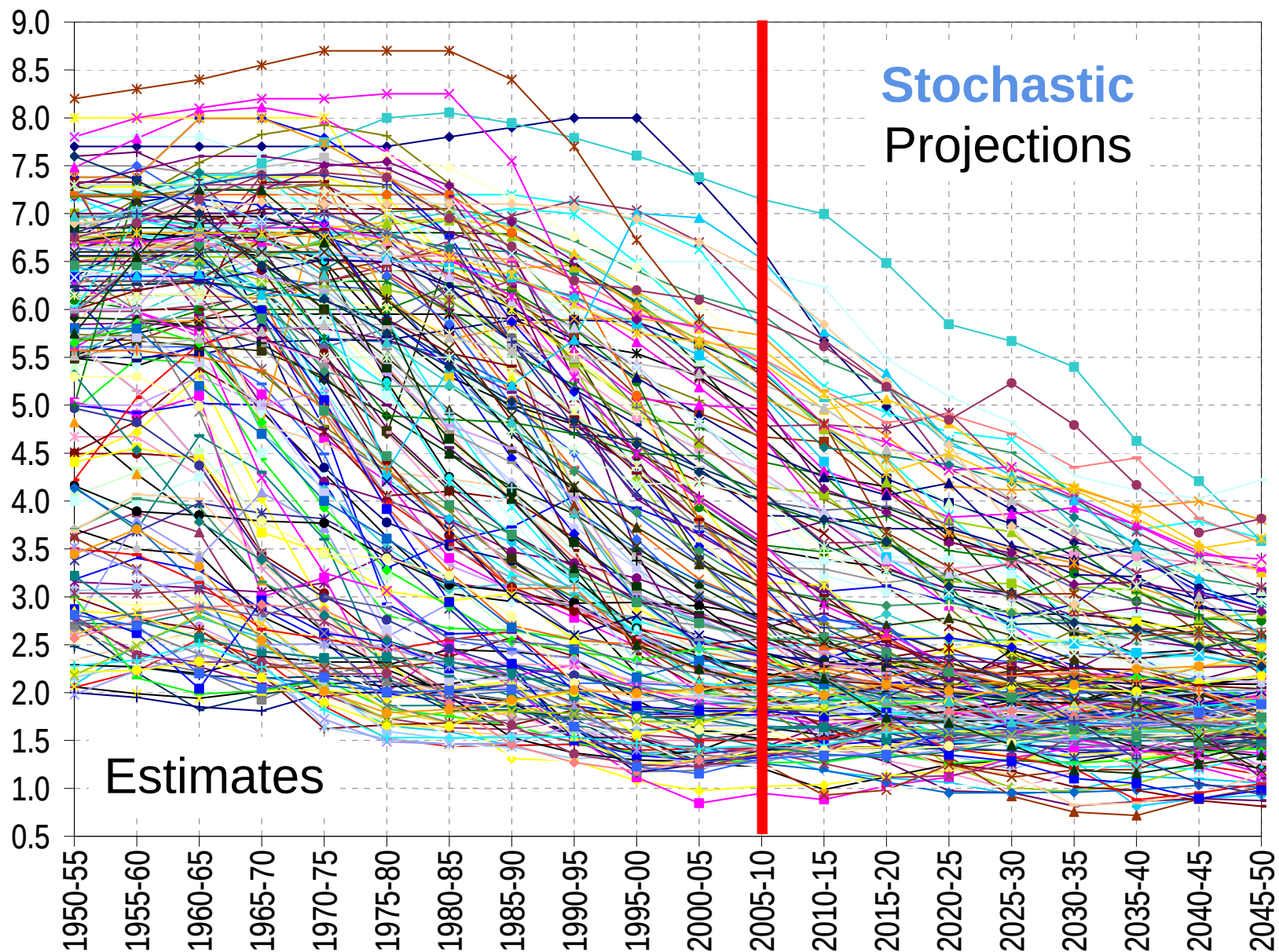
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WPP 196 Countries: Total Fertility, 1950-2050

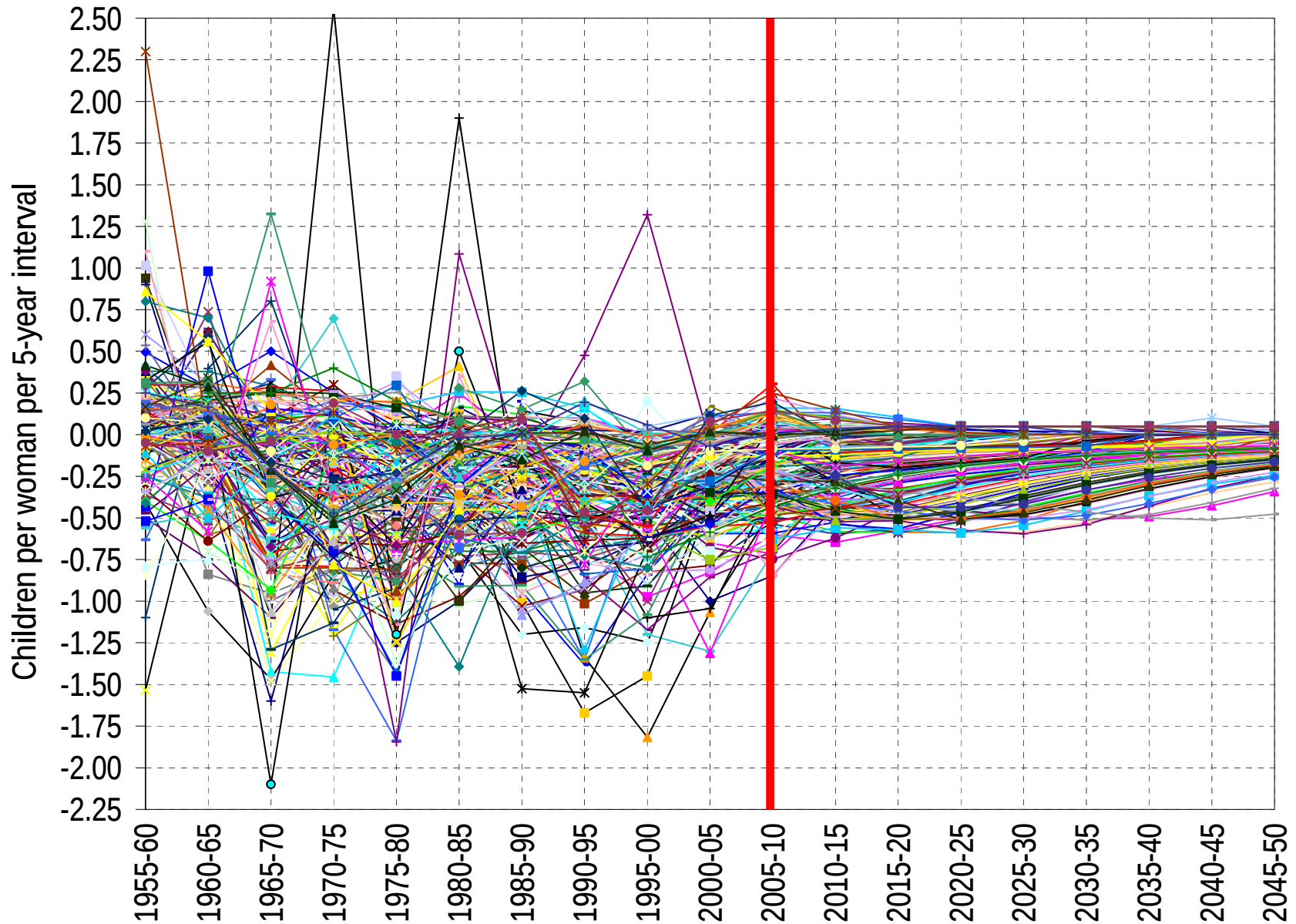
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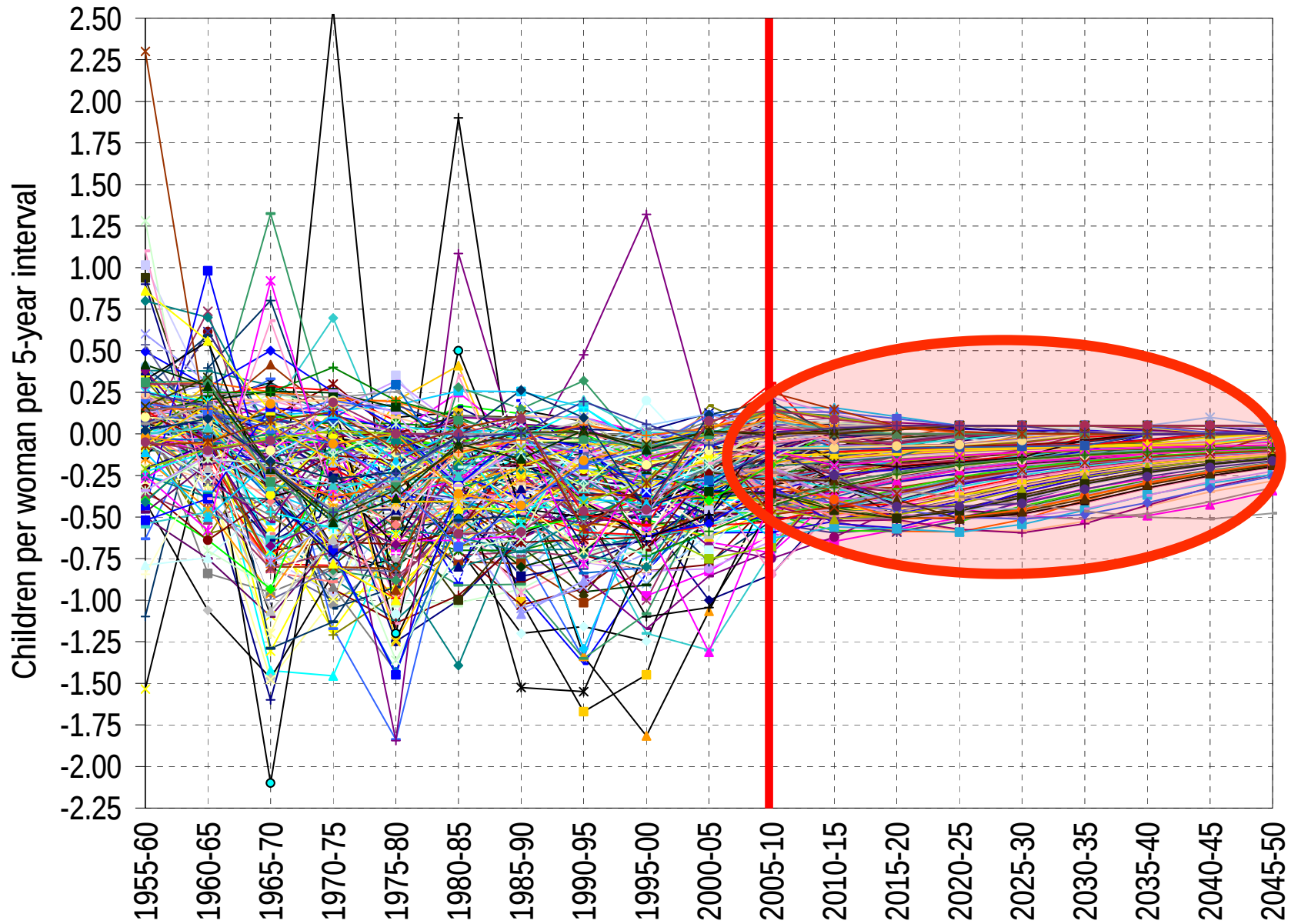
196 countries: Change in Total Fertility, 1950-2050

2





196 countries: Change in Total Fertility, 1950-2050





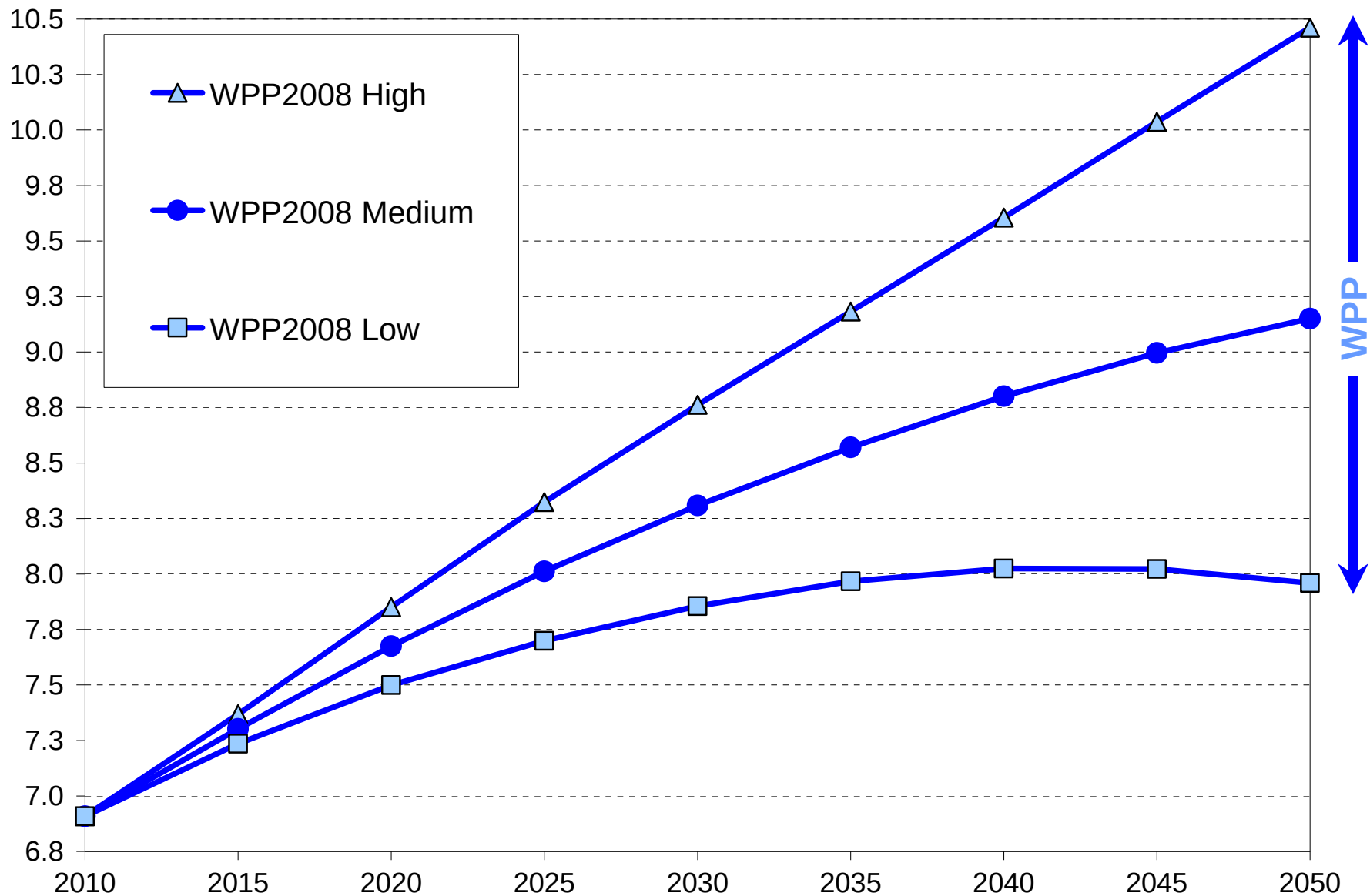
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Stochastic WPP population projections
based on Bayesian Hierarchical Models
of fertility and mortality projection:
First test runs



World: Stochastic population projections

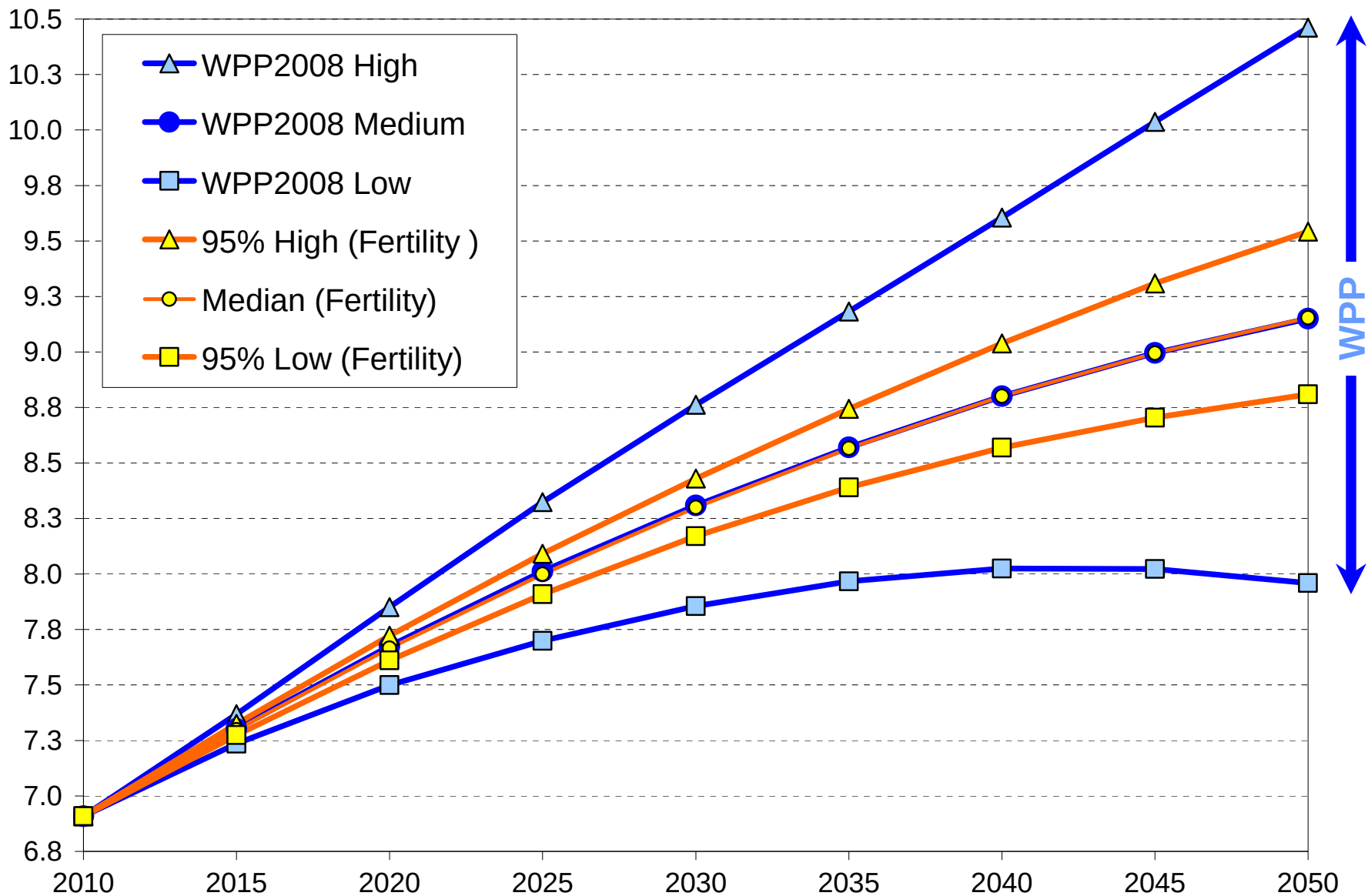
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World: Stochastic population projections

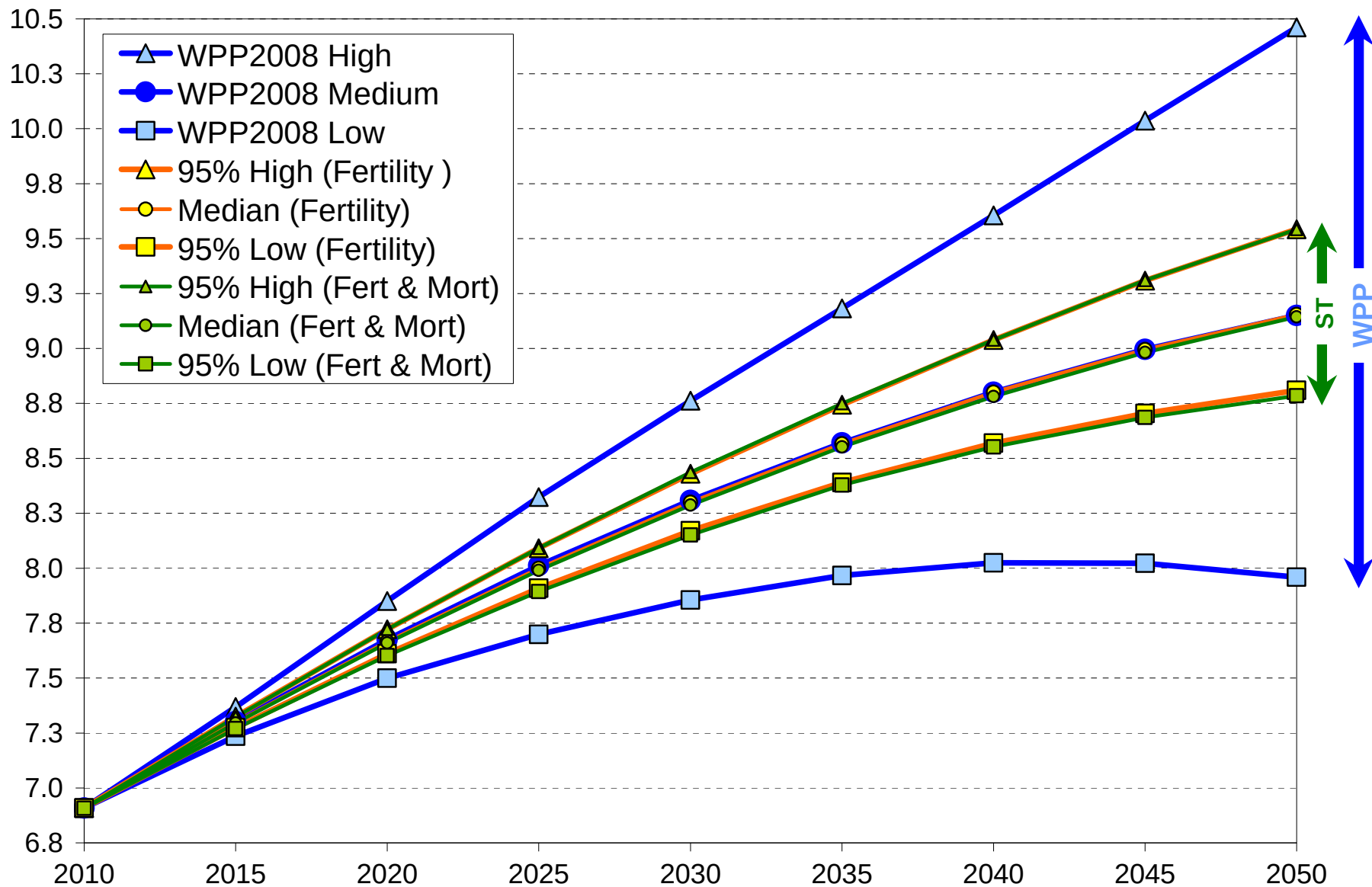
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World: Stochastic population projections

3





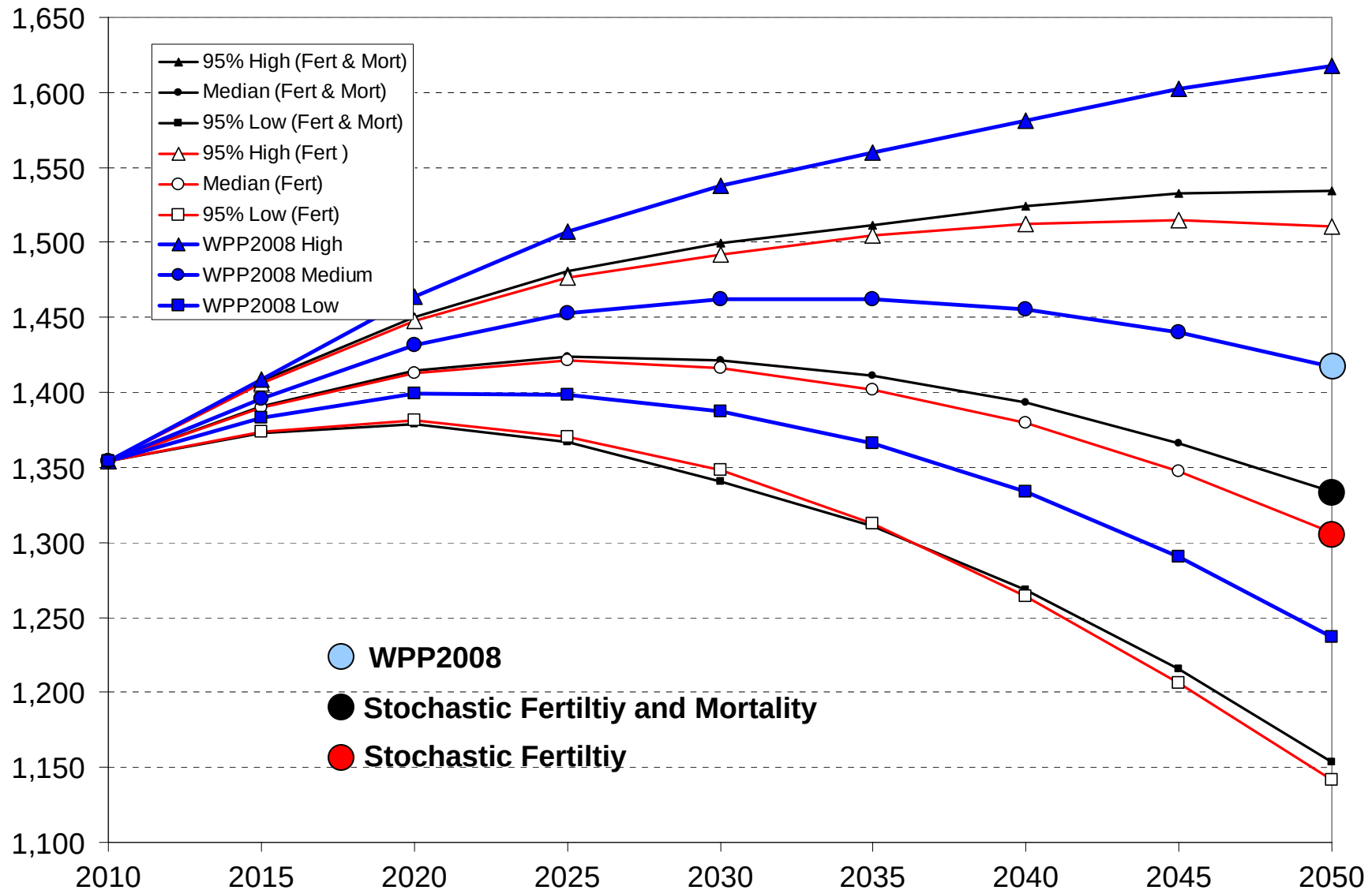
- Stochastic **Median** and WPP **Medium Variant** almost **identical**
- **Little difference** between projections with
 - a) only stochastic fertility or
 - b) stochastic fertility + mortality
- **Confidence interval** of stochastic projection **much smaller** than $\frac{1}{2}$ child rule for low and high variant



Stochastic population projections

3

China





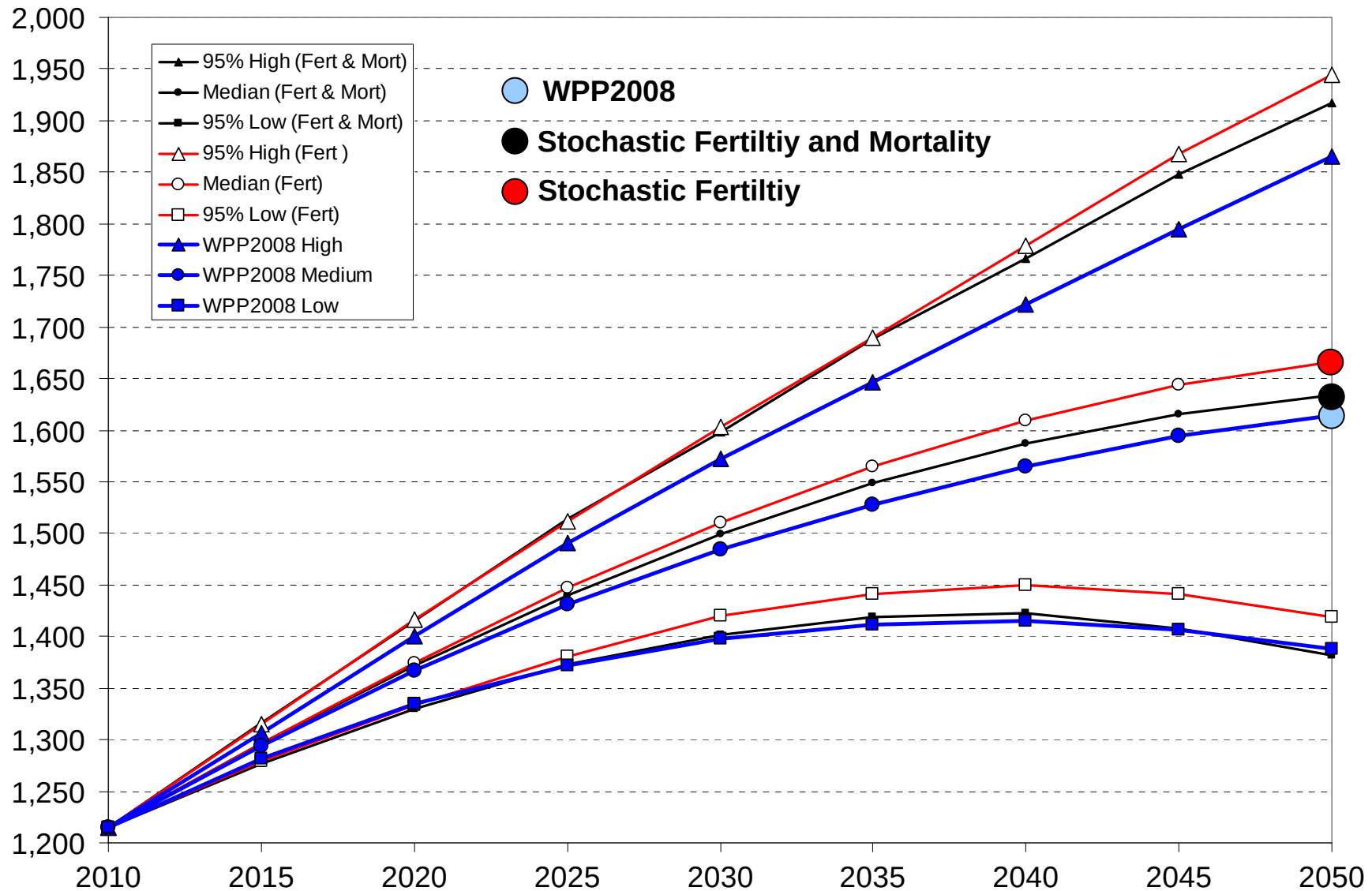
- Little difference between projections with
 - a) only stochastic fertility or
 - b) stochastic fertility + mortality
- Median of stochastic projection roughly 100 million lower than medium WPP2008



Stochastic population projections

3

India





Stochastic population projections: India

3

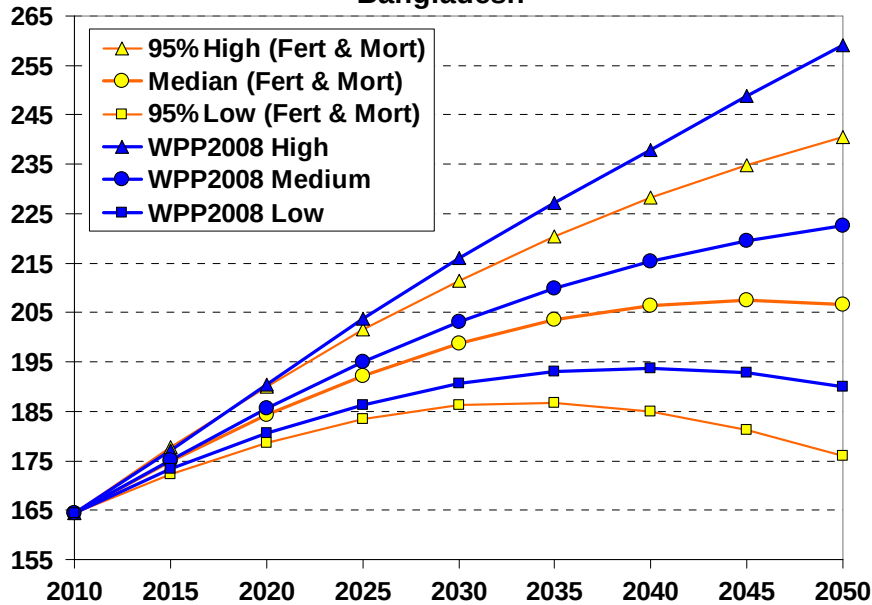
- Little difference between projections with
 - a) only stochastic fertility or
 - b) stochastic fertility + mortality
- Median of stochastic projection roughly 55 million higher than medium WPP2008



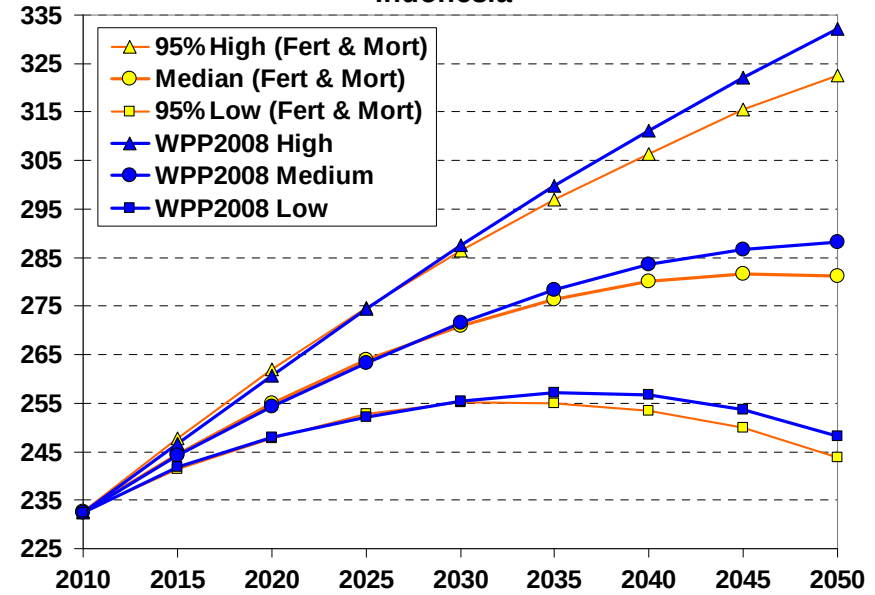
Stochastic population projections

3

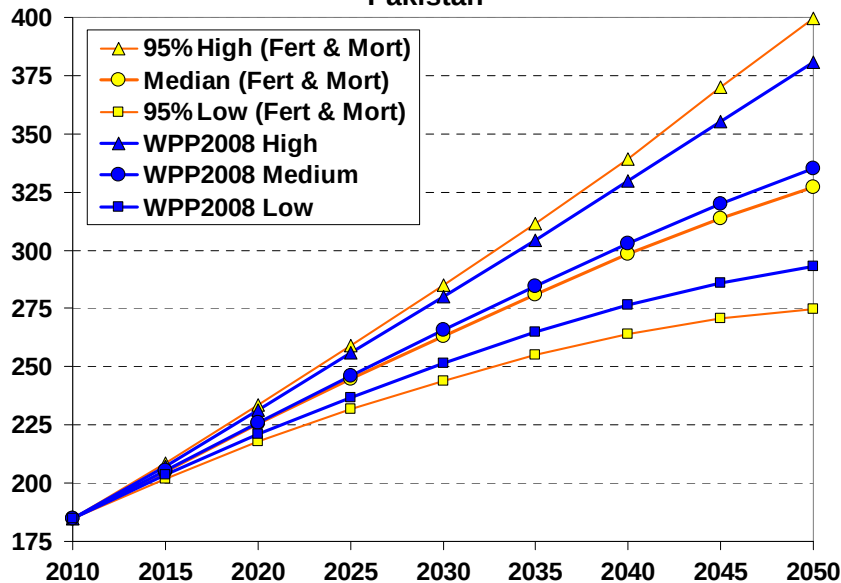
Bangladesh



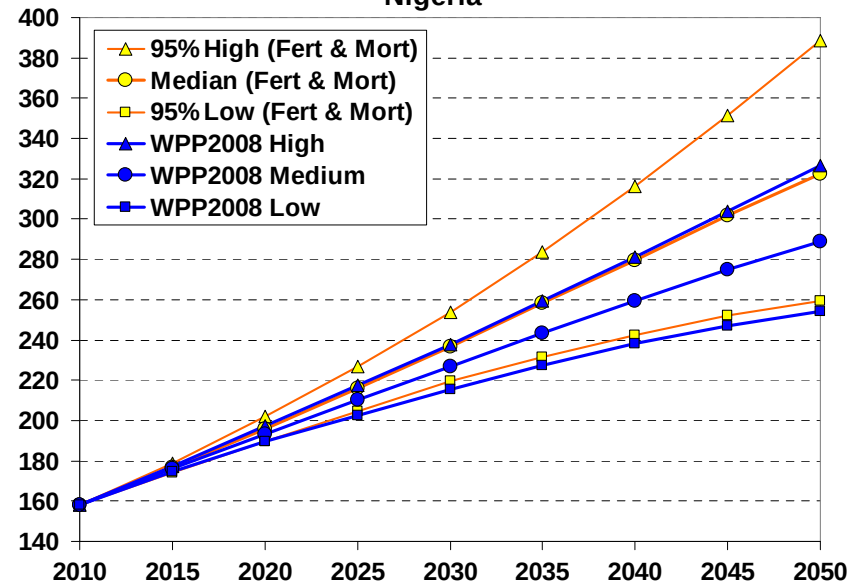
Indonesia



Pakistan



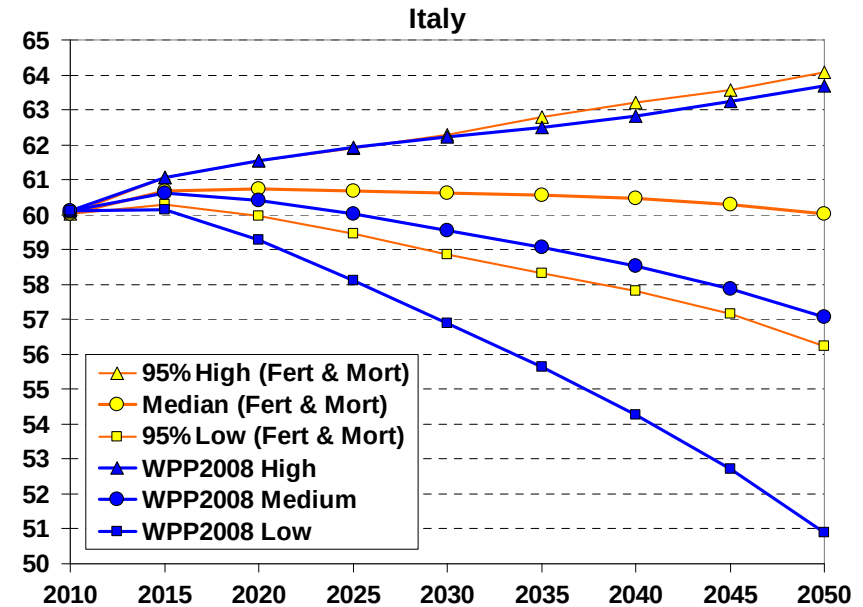
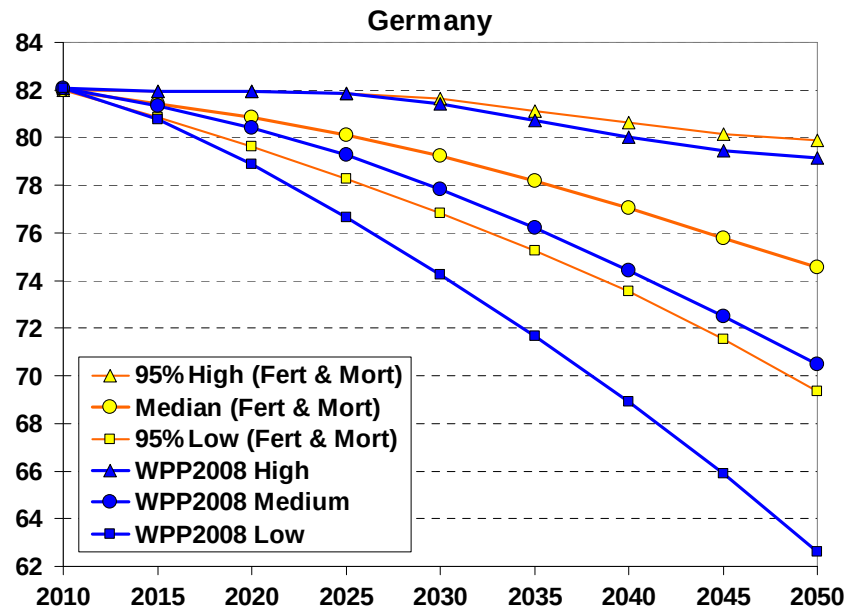
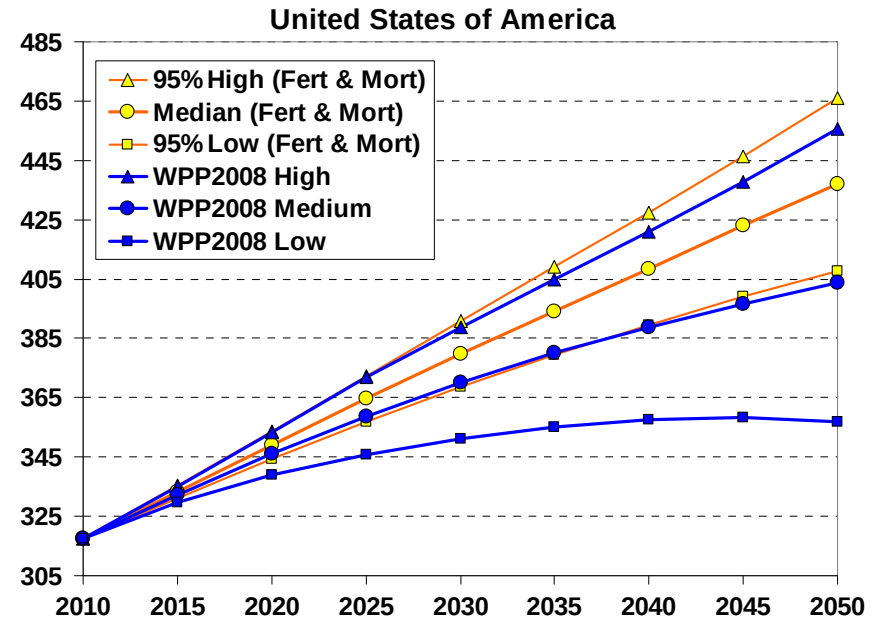
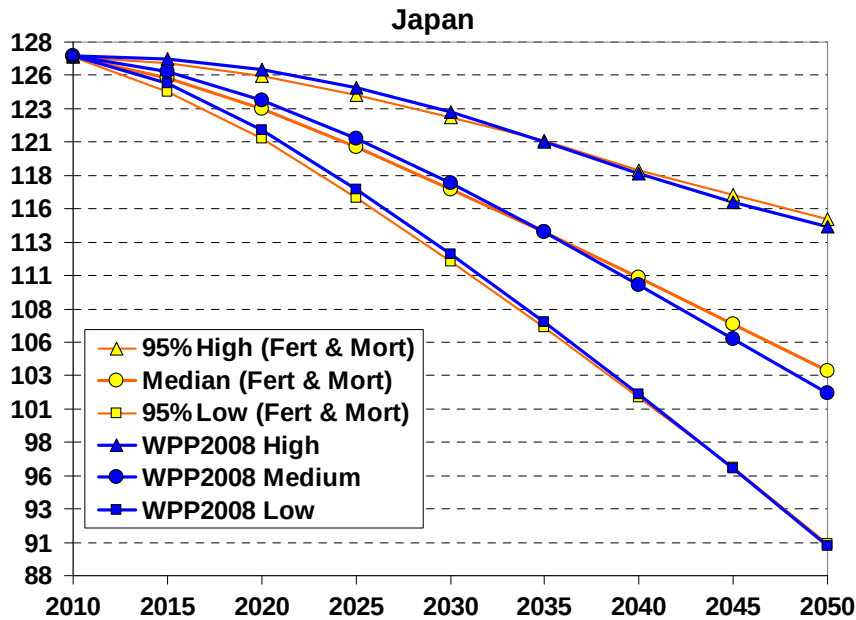
Nigeria





Stochastic population projections

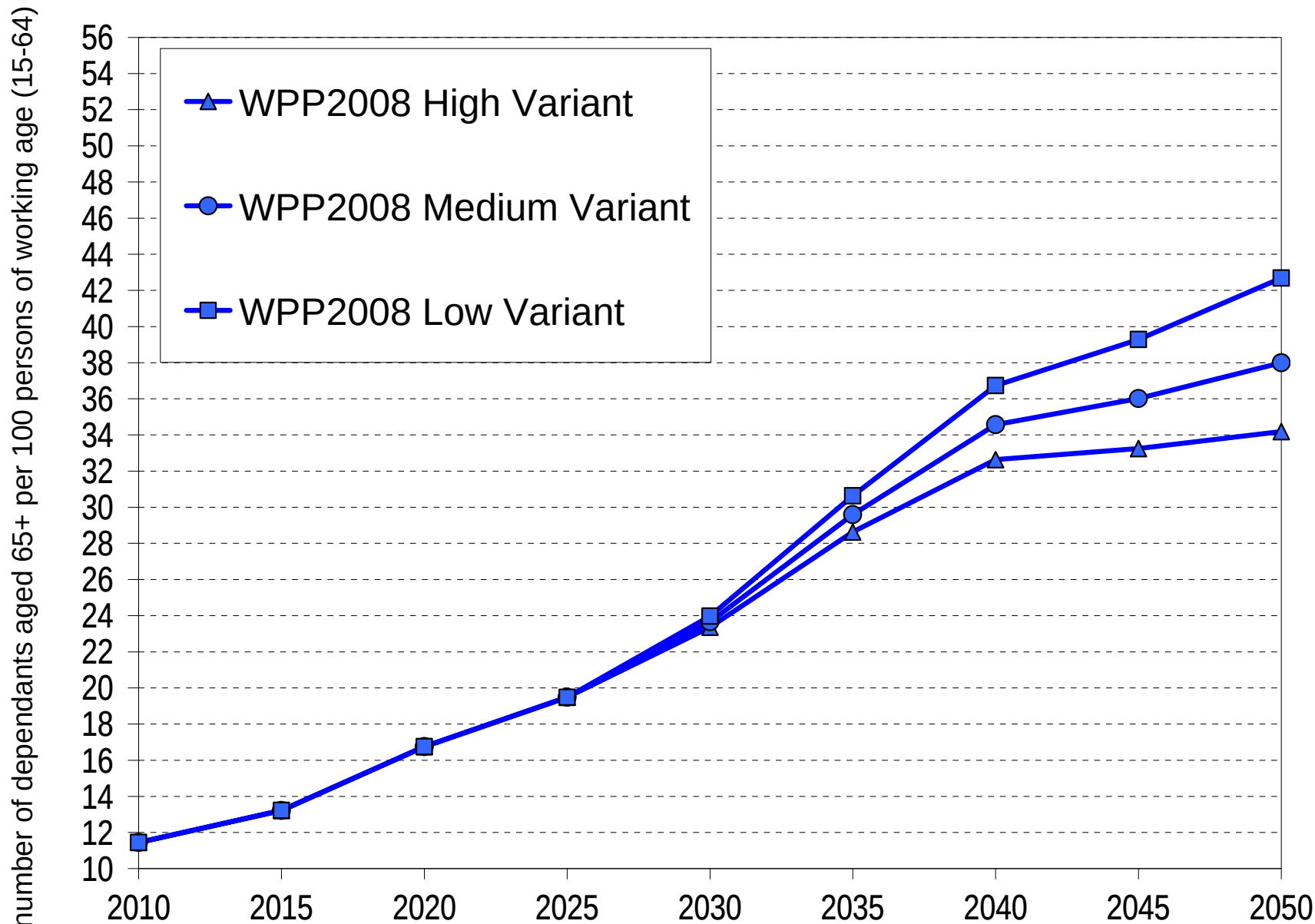
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China: Old-age dependency ratio

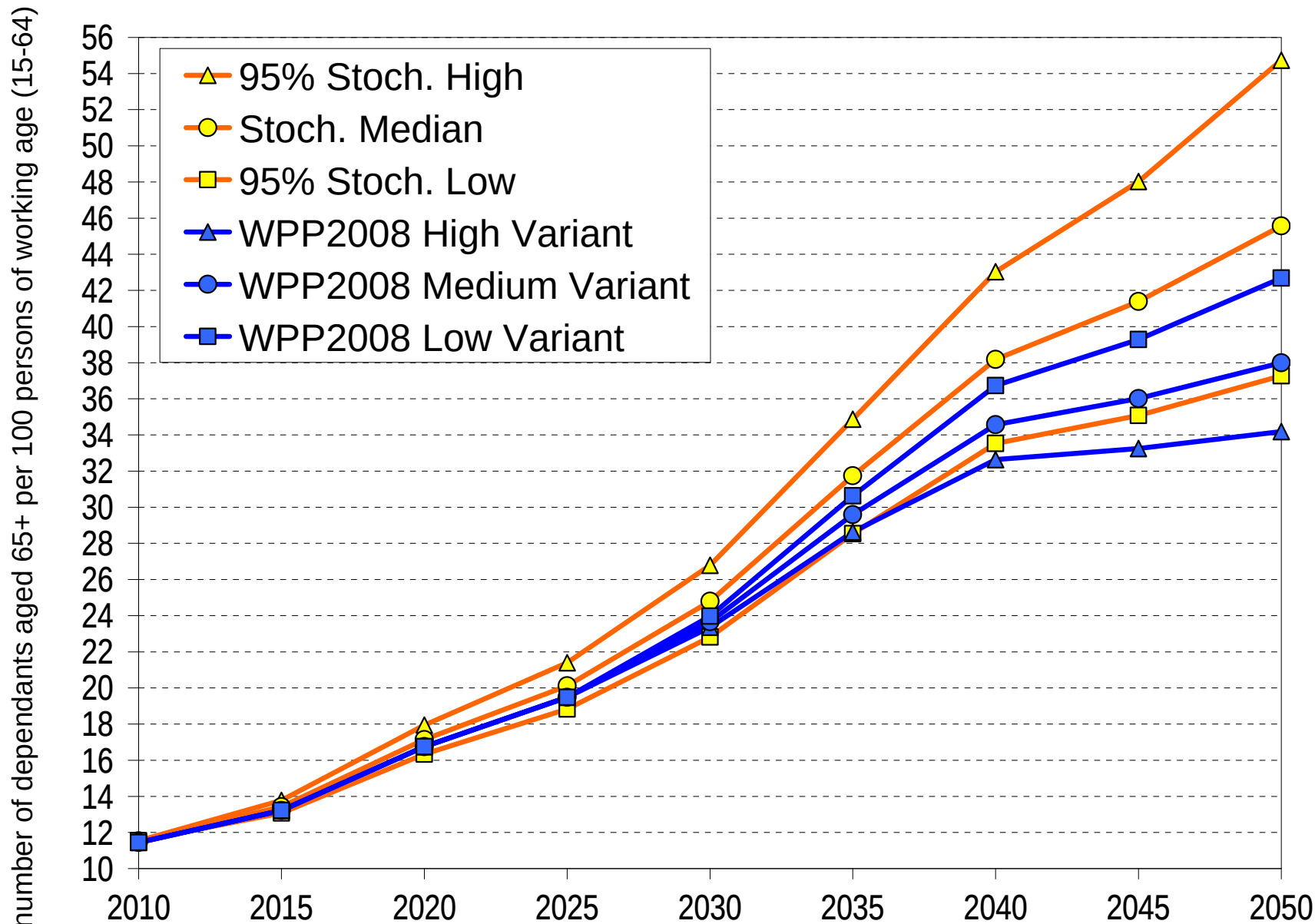
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China: Old-age dependency ratio

3





China: Old-age dependency ratio

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- Stochastic median of old-age dependency ratio is higher than medium variant
- Stochastic confidence interval of old-age dependency ratio is larger than the high and low range of WPP



4

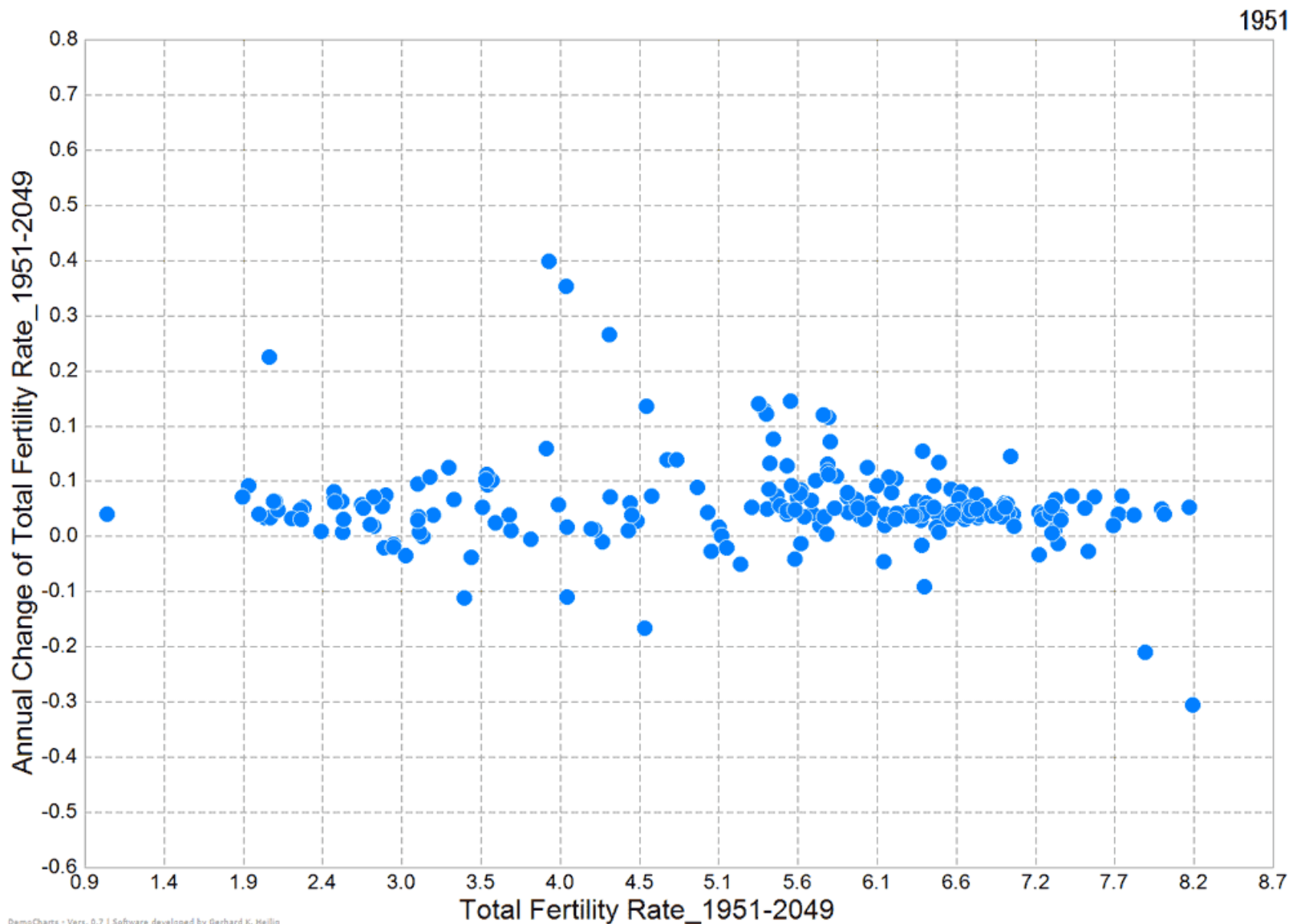
Remarks about Heterogeneity

Conclusions



Total Fertility by change in TFR, 1951-1949

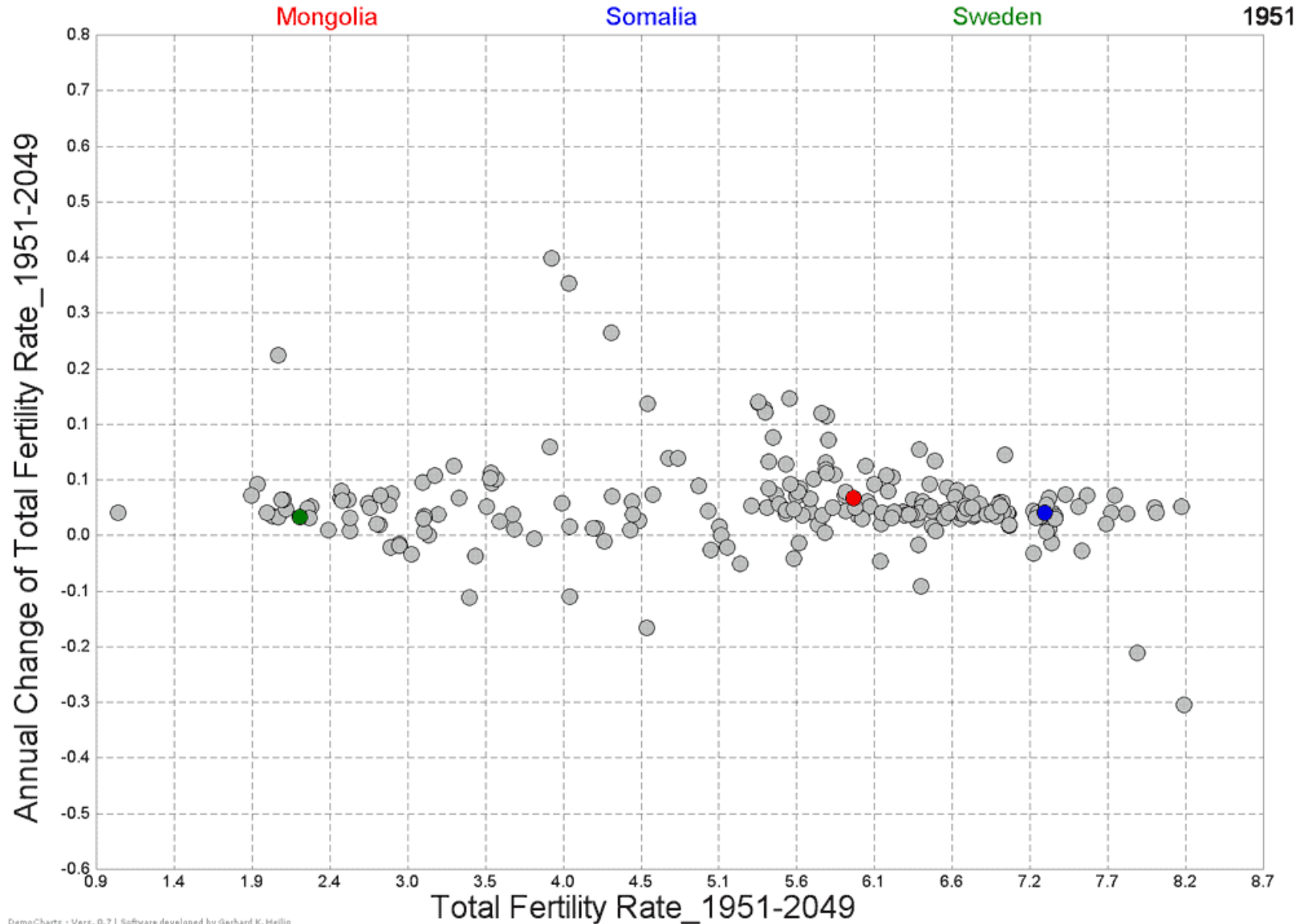
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Total Fertility by change in TFR, 1951-1949

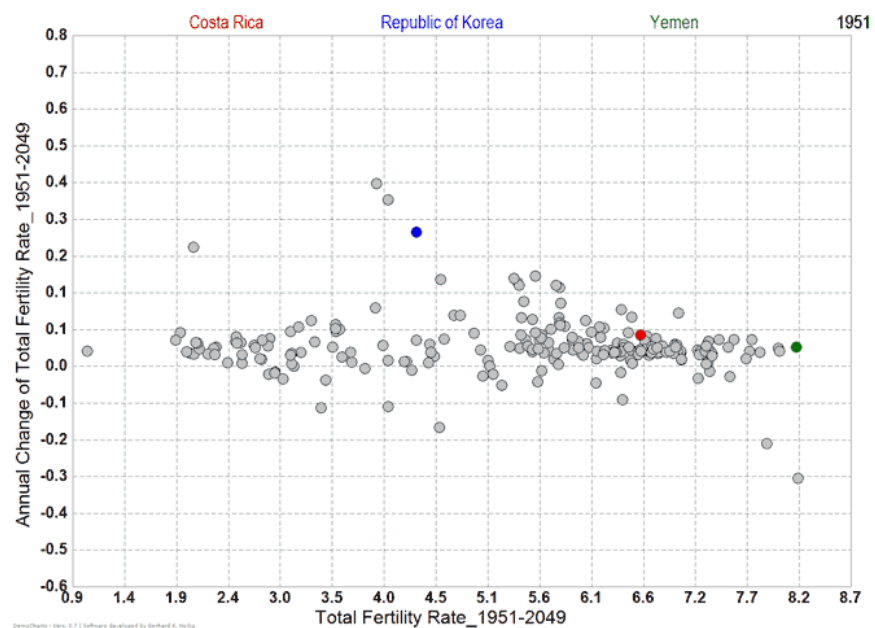
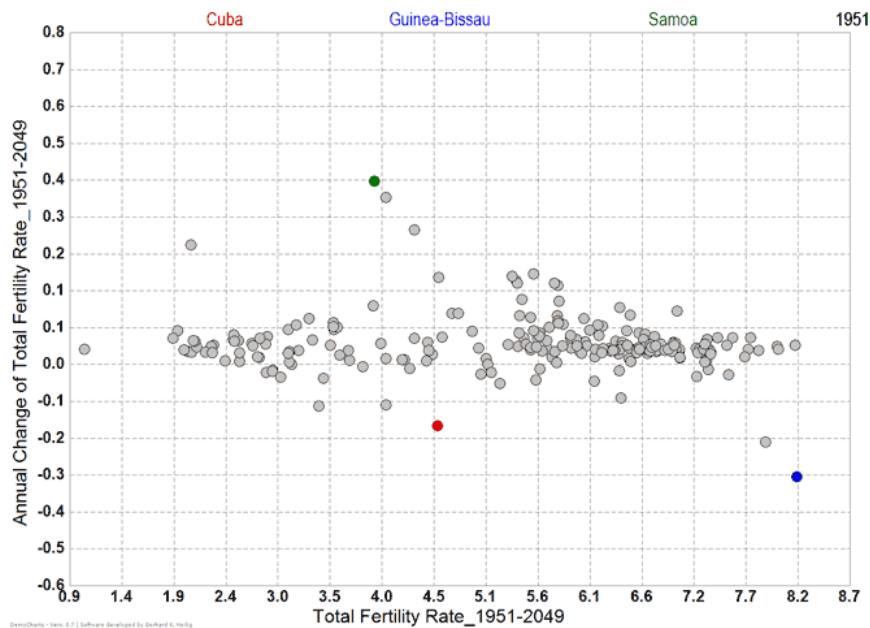
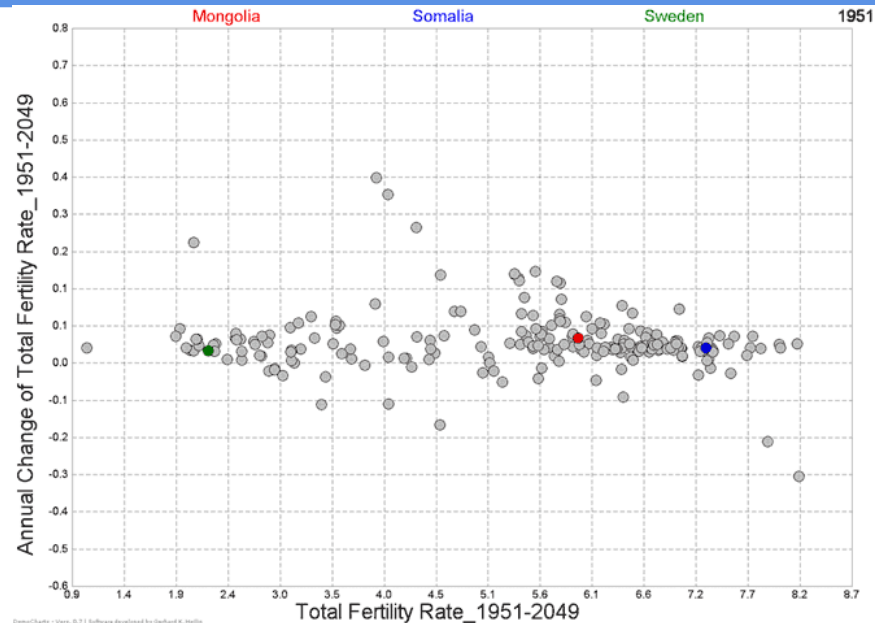
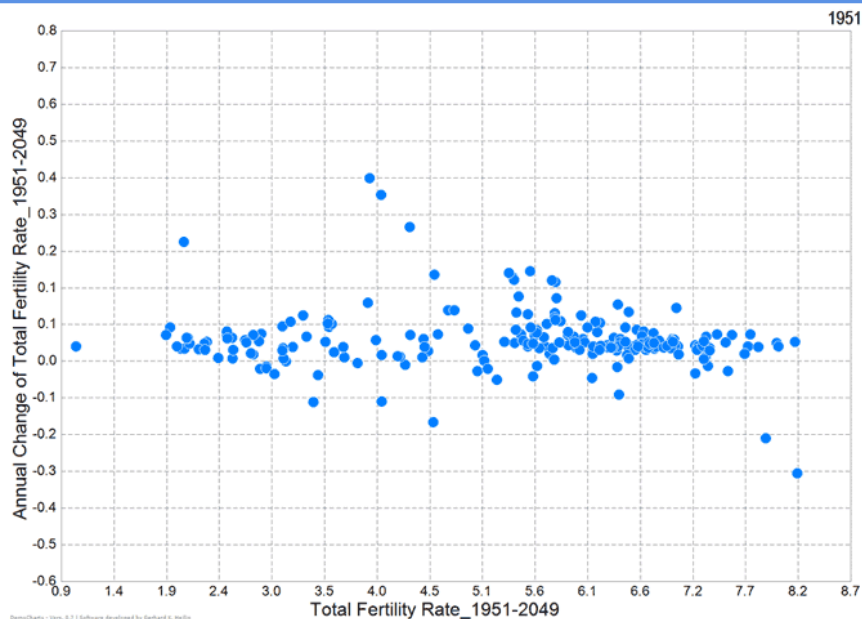
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Total Fertility by change in TFR, 1951-1949

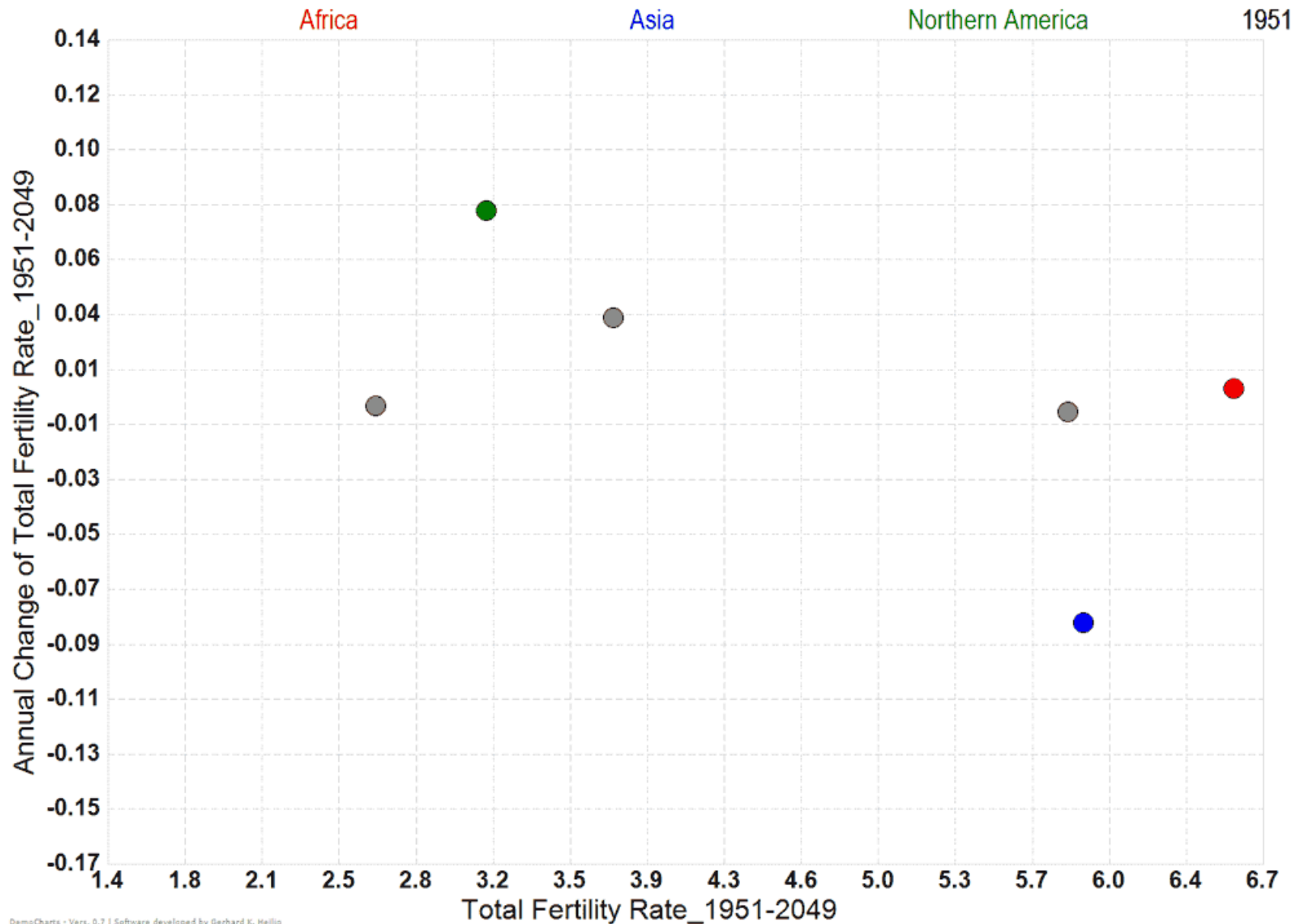
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Total Fertility by change in TFR, 1951-1949

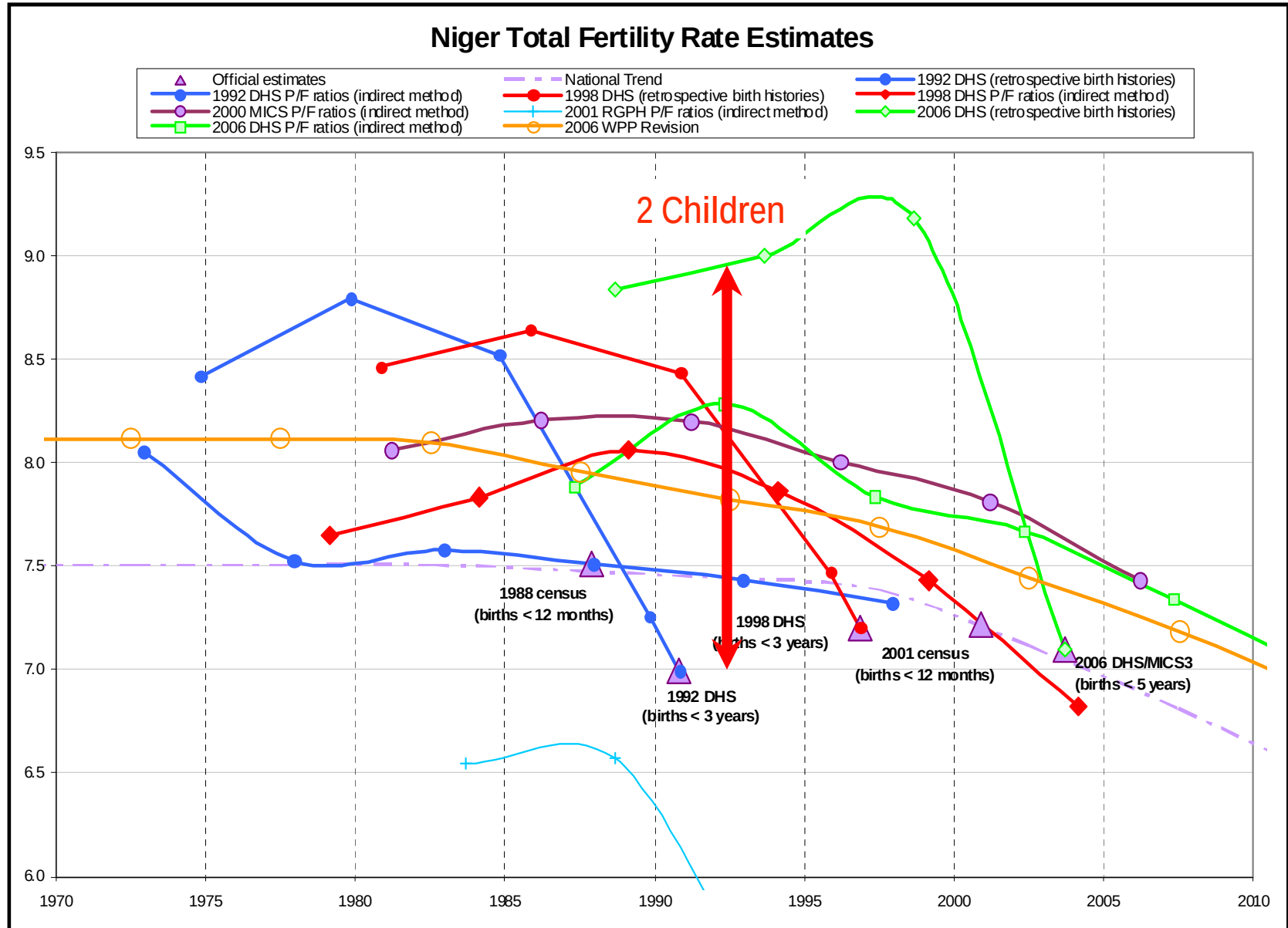
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Niger: Empirical data for fertility estimation

4





Conclusions

1

Stochastic projections could help us to avoid the unrealistic smoothing and compression of fertility projections and could preserve some of the heterogeneity between countries. They also „educate“ the public about the inherent uncertainty in all demographic projections.



Conclusions

2

Projections are only a small part of the WPP!

It is equally important to get the estimates right – particularly for recent years.

Incorrect fertility, mortality and population estimates for the base year affect future trends much more significantly than moderate improvements in our methodology.



The core problem for WPP projections
Is the increasing relevance of below-replacement
fertility projections, which are not based on
a theoretical model - such as the „fertility transition“
as represented in the double-logistic model.

Current fertility projections at the
below-replacement level are „theory poor“ and
based on mechanical models (Markov-chain)



4

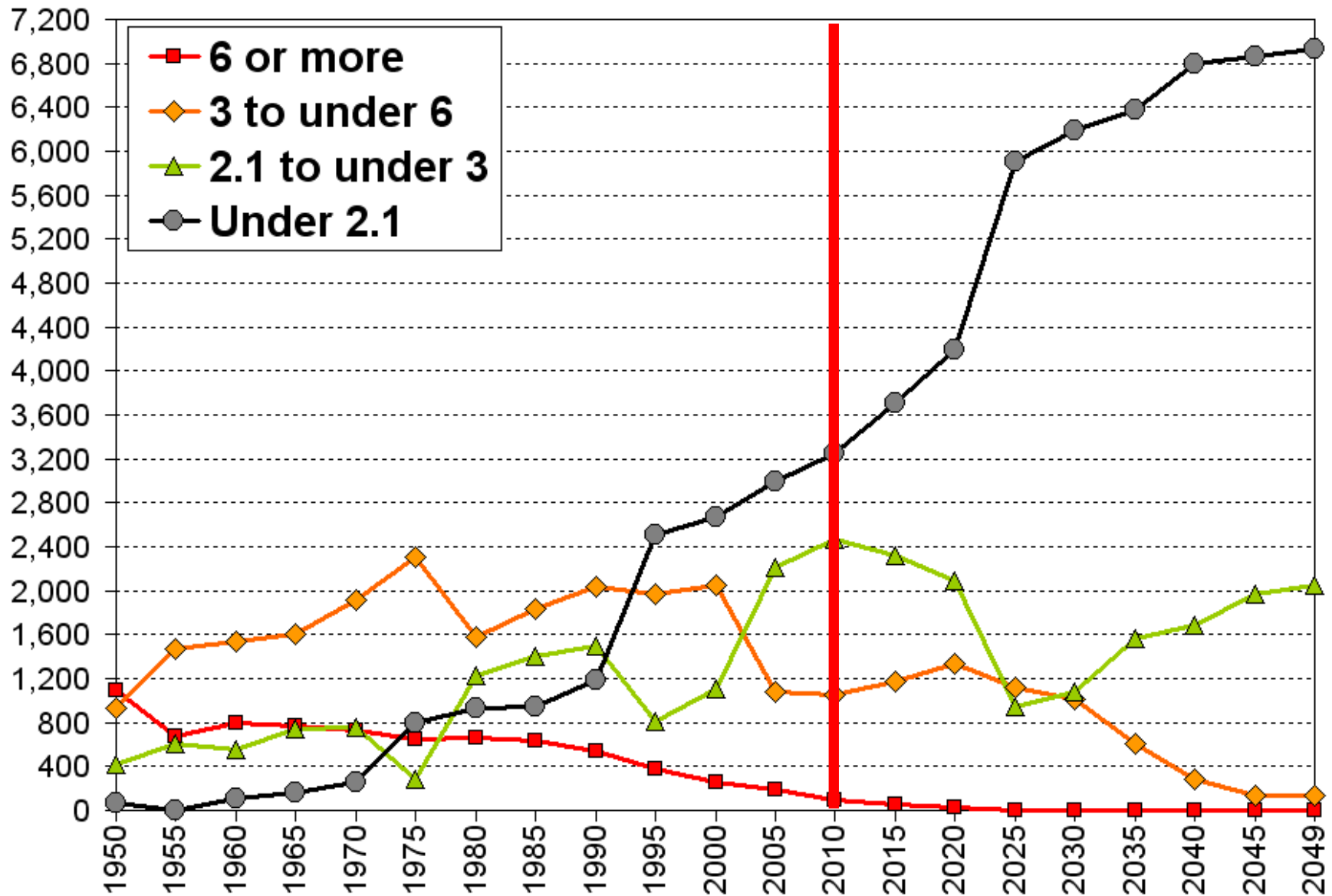
The implementation of a fully stochastic WPP requires **major** re-development of the current software and database tools.

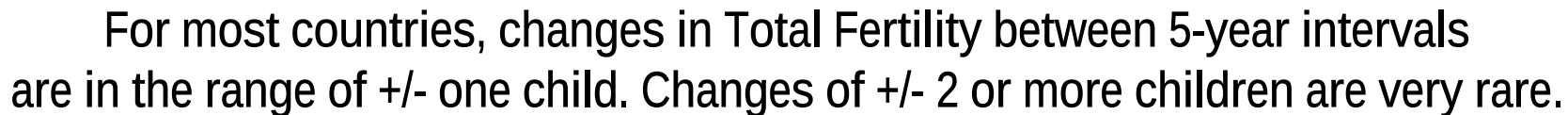




World Population by Total Fertility, 1950-2049

1

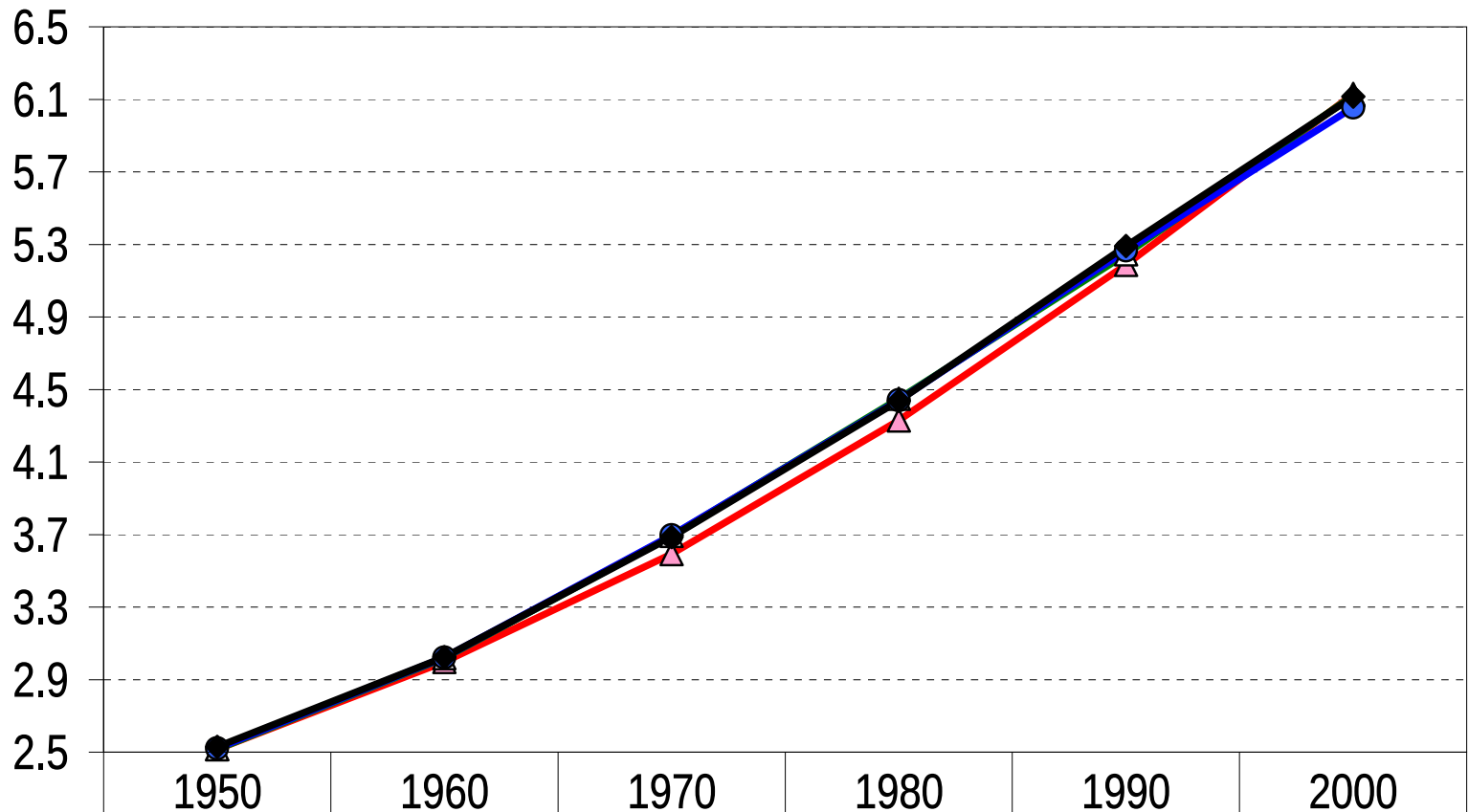






World: Population (in billions): Various WPP revisions

3



—△— WPP 1963	2,515	2,998	3,592	4,330	5,188	6,130
—△— WPP 1984	2,516	3,019	3,693	4,450	5,246	6,122
—●— WPP 1998	2,521	3,022	3,696	4,440	5,266	6,055
—◆— WPP 2008	2,529	3,023	3,686	4,438	5,290	6,115