Demographic Trends and Implications for Greenhouse Gas Emissions

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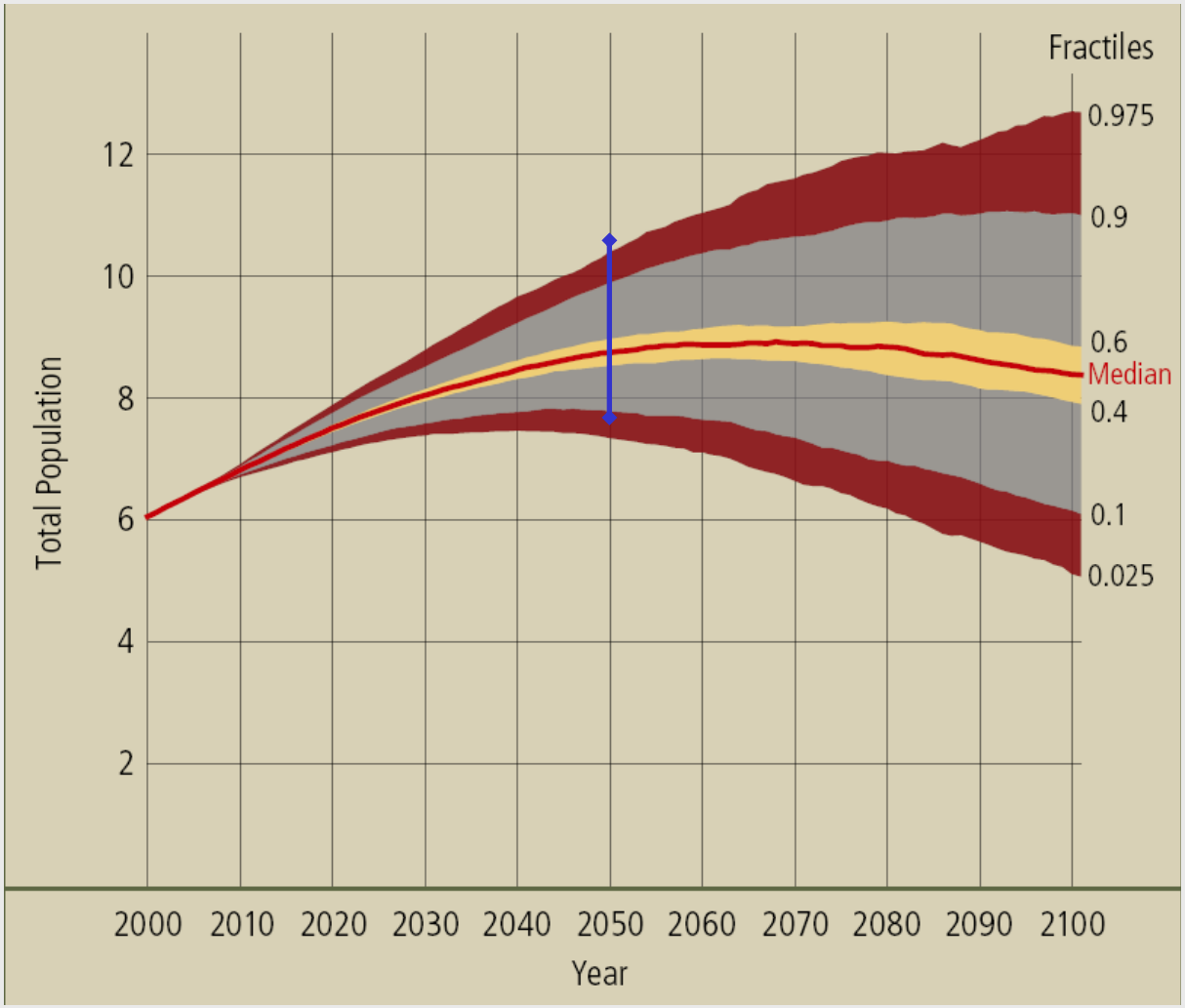
Demographic Trends and Emissions Implications

- Trends
  - Population size
  - Aging
  - Household Size
  - Urbanization
- Implications for Emissions
  - Uncertainty, learning, and optimal emissions
  - Aging, urbanization, and national emissions
  - Global emissions effects?

Projecting Population Size: World



UN 2006 Range

Source: Lutz et al., 2008.

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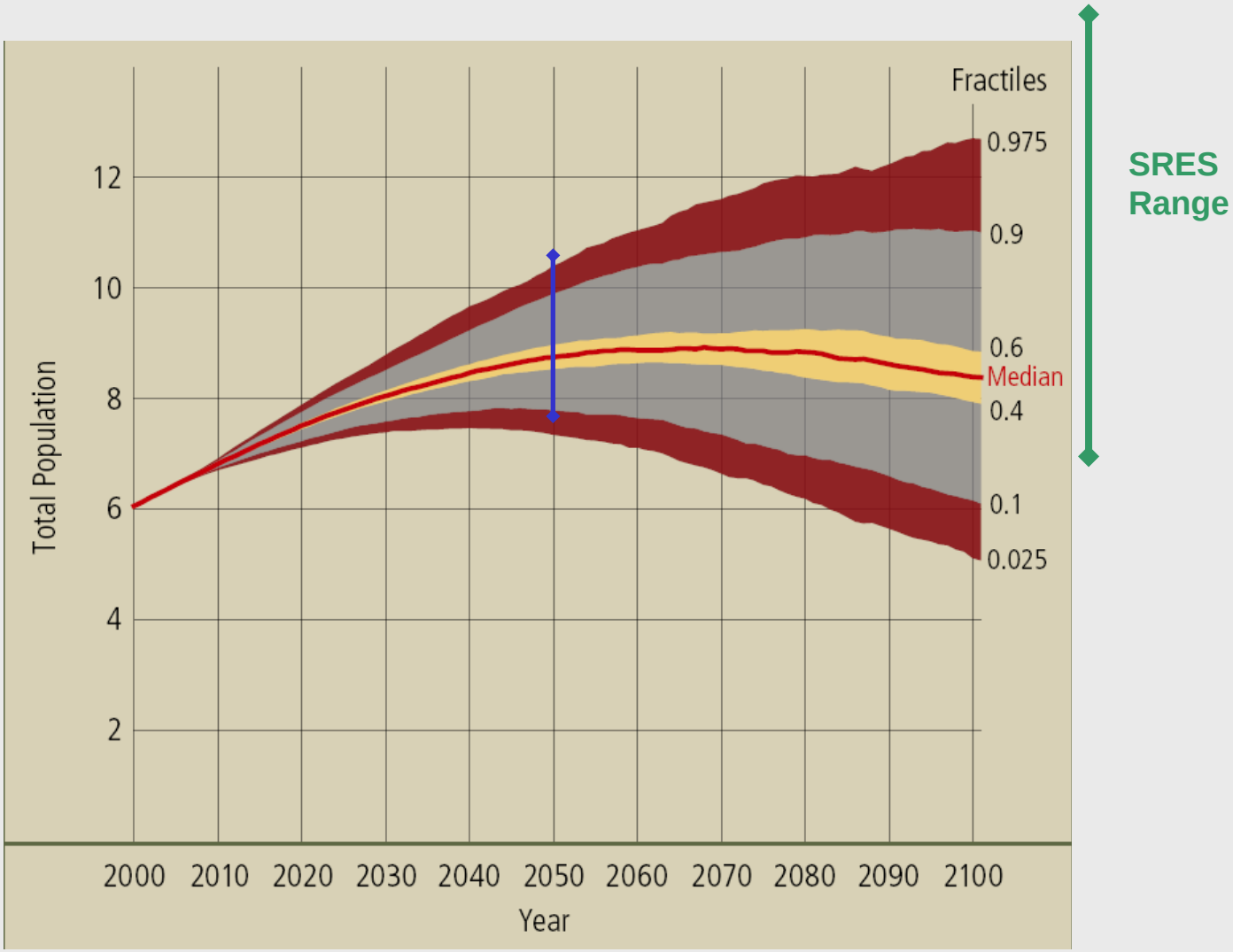
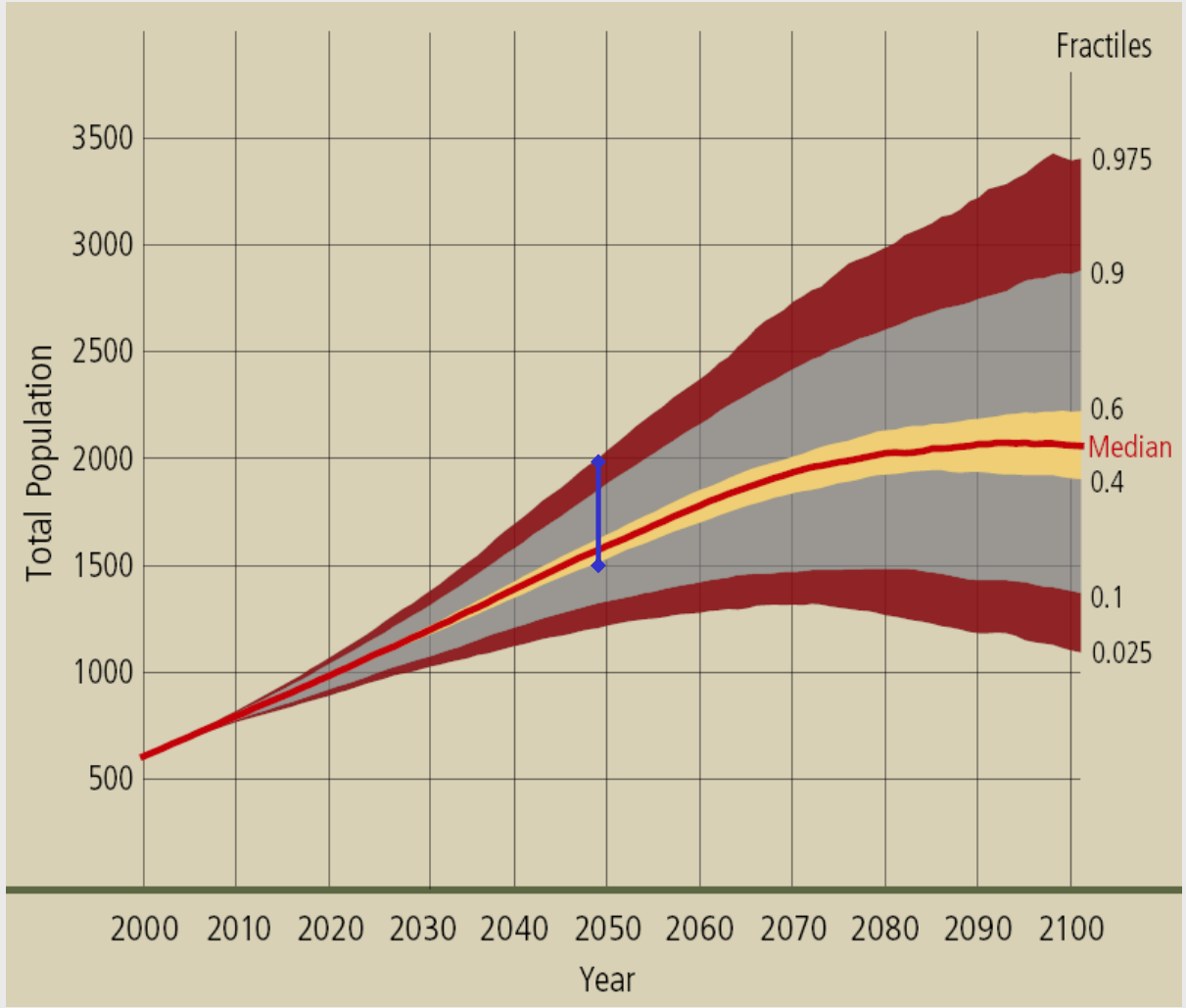


UN 2006 Range

Source: Lutz et al., 2008.

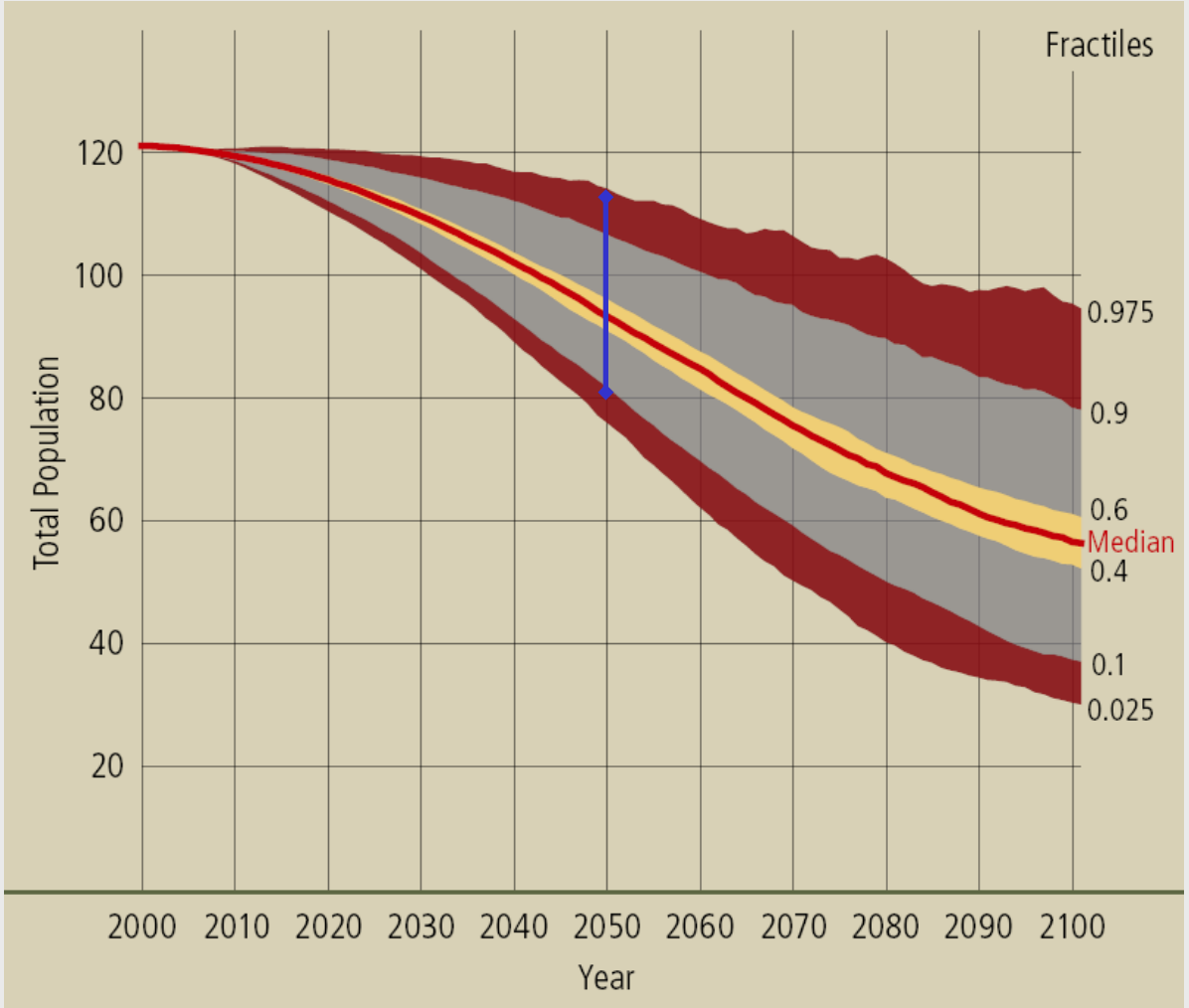
Sub-Saharan Africa



UN 2006 Range

Source: Lutz et al., 2008.

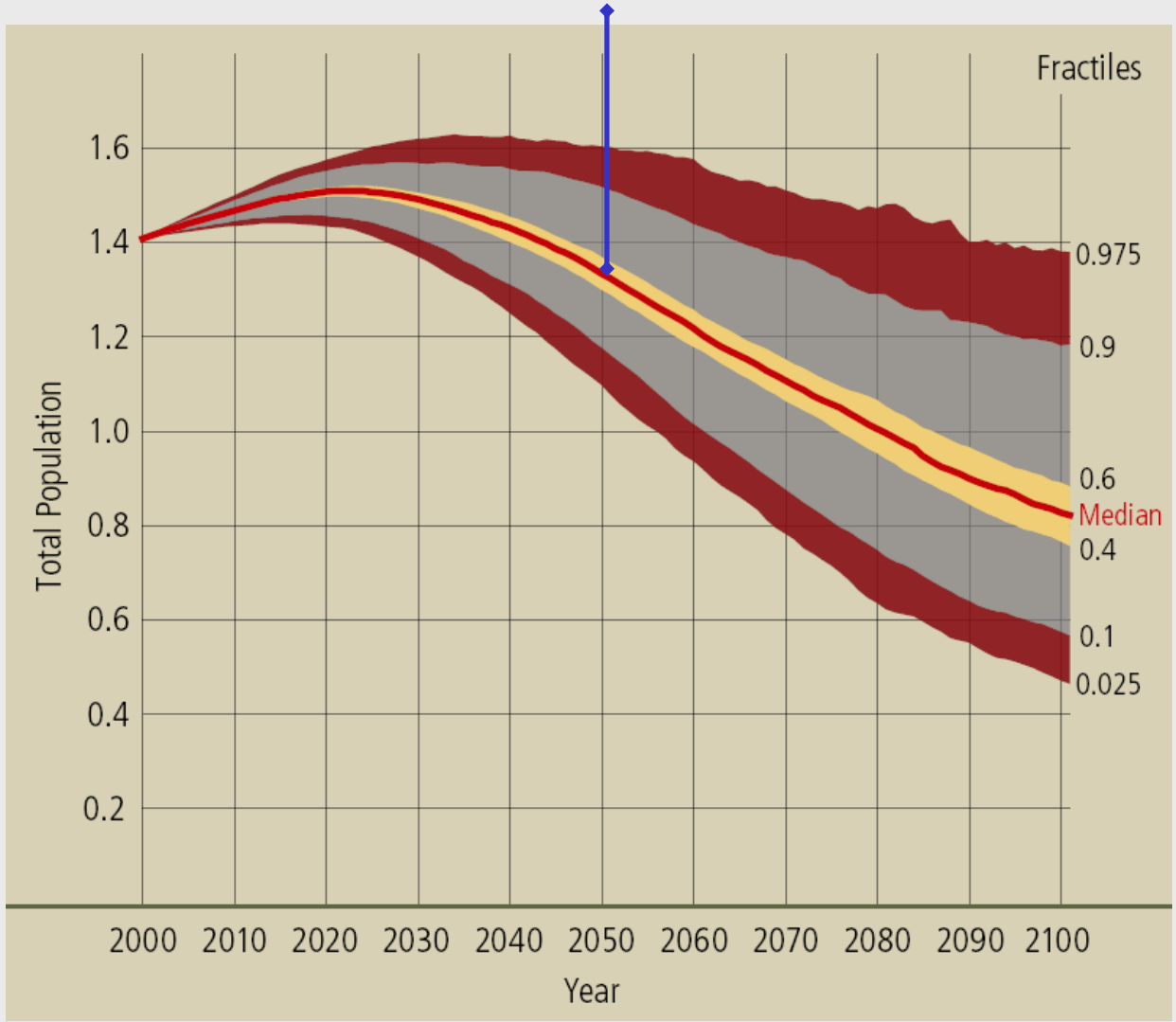
Eastern Europe



UN 2006 Range

Source: Lutz et al., 2008.

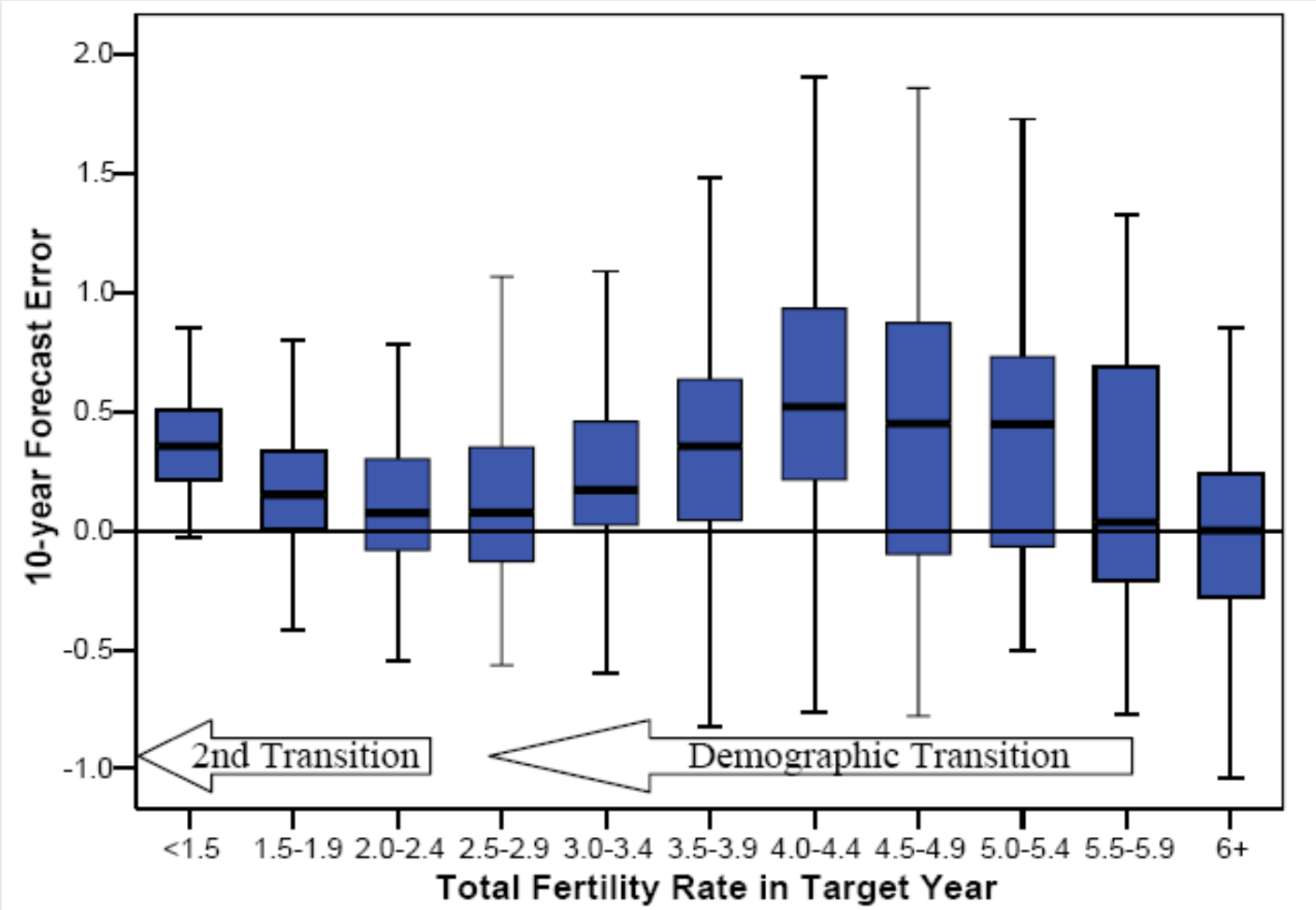
China+



UN 2006 Range

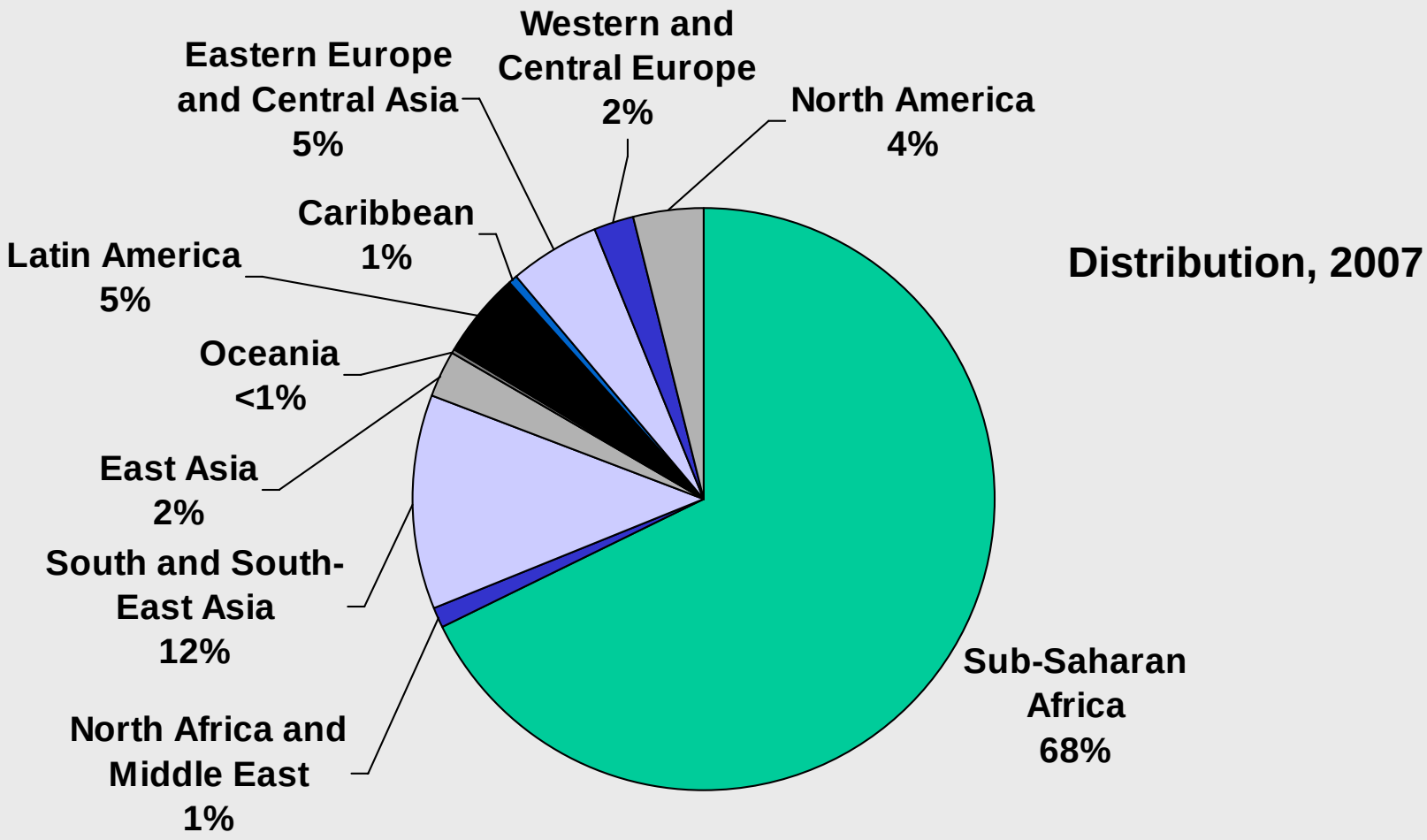
Source: Lutz et al., 2008.

Population Projections



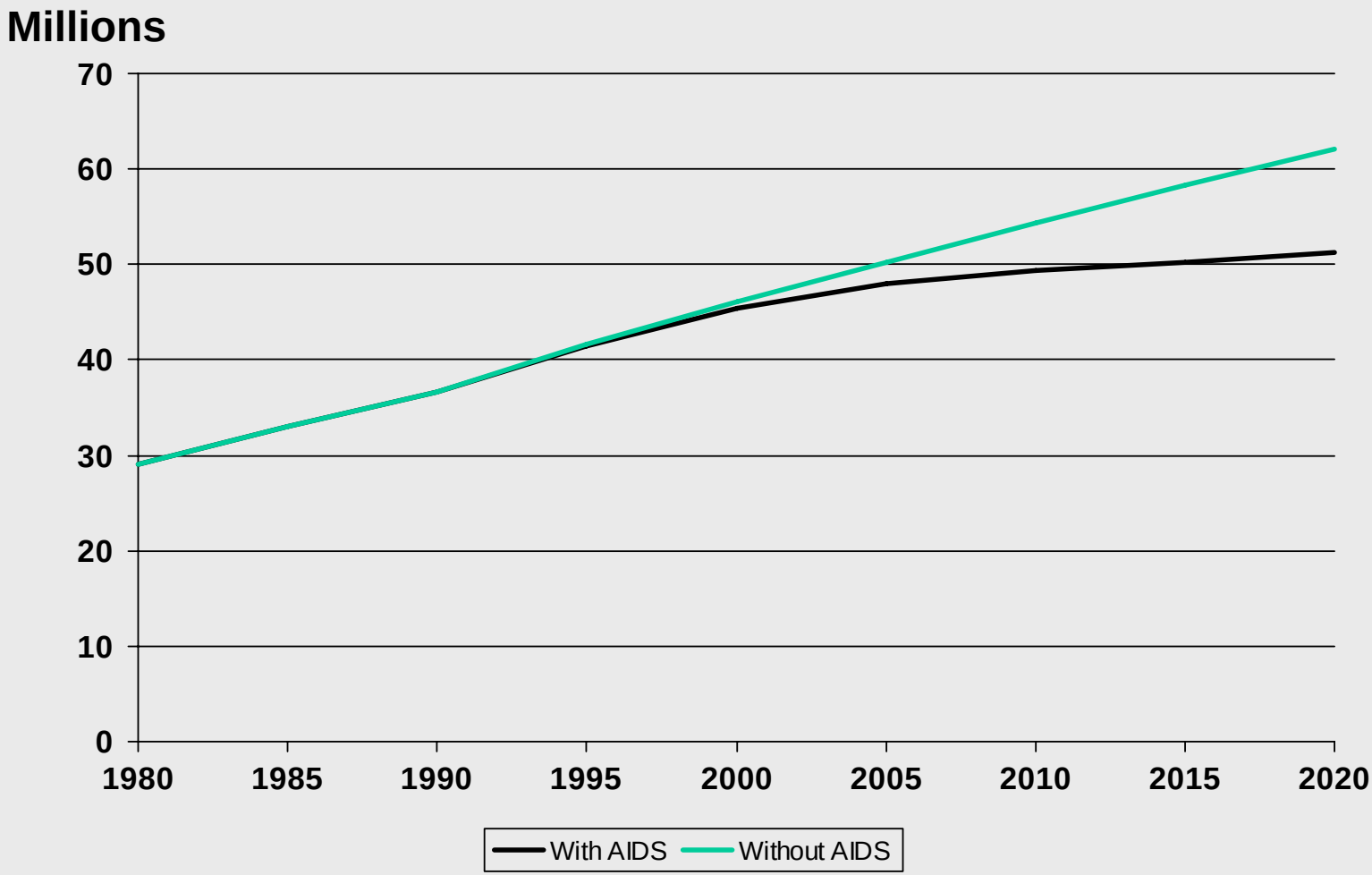
Source: Oppenheimer, O'Neill, & Webster, 2008.

People Living with HIV, by Region



Slide from Population Reference Bureau
Note: Total exceeds 100 percent due to rounding.
Source: UNAIDS, *AIDS Epidemic Update*, December 2007.

South Africa's Population With and Without AIDS



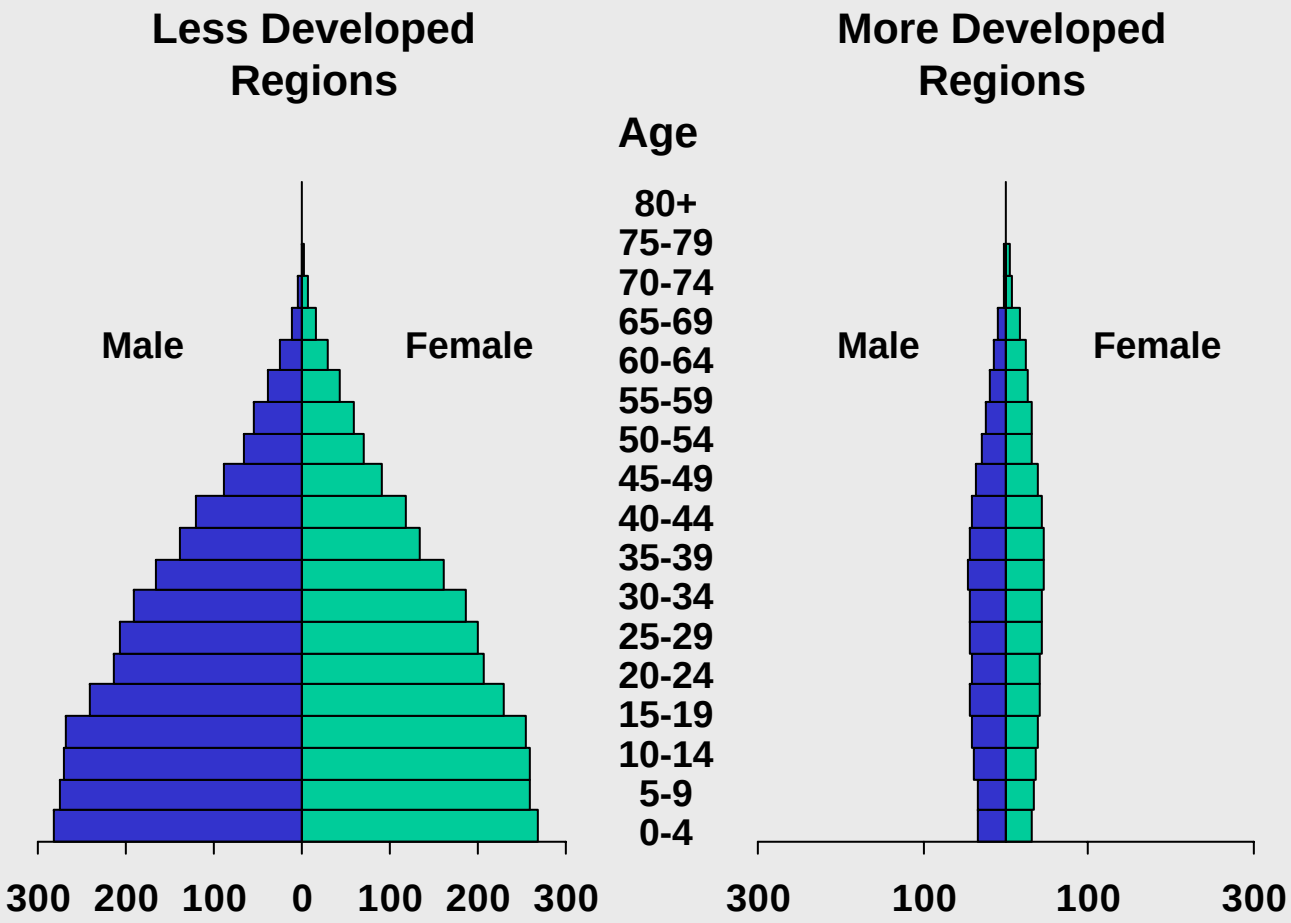
Slide from Population Reference Bureau

Source: United Nations, *World Population Prospects: The 2006 Revision* (CD-ROM Edition—Extended Dataset), 2007.

Age Distribution of the World's Population

Population Structures by Age and Sex, 2005

Millions



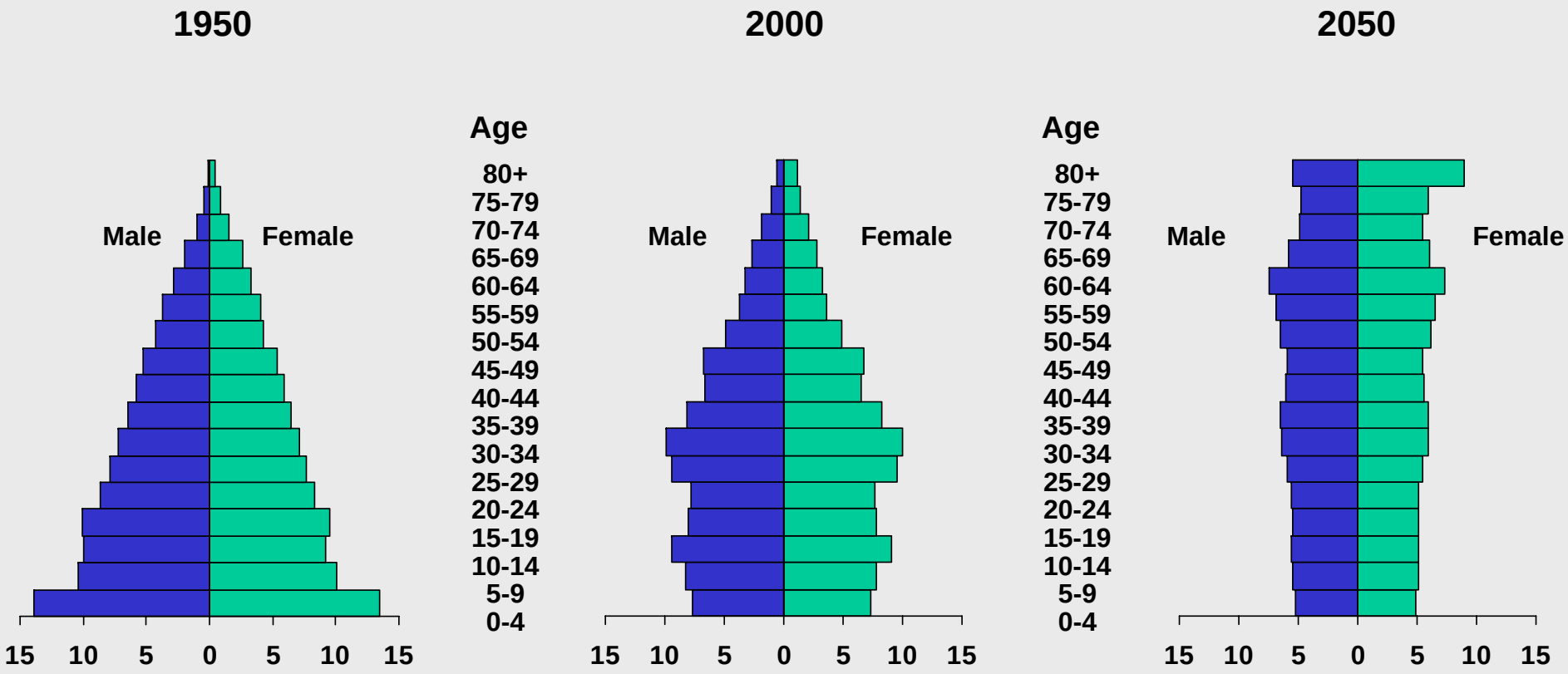
Slide from Population Reference Bureau

Source: United Nations, *World Population Prospects: The 2004 Revision*, 2005.

China's Age Distribution

Population Structures by Age and Sex

Millions

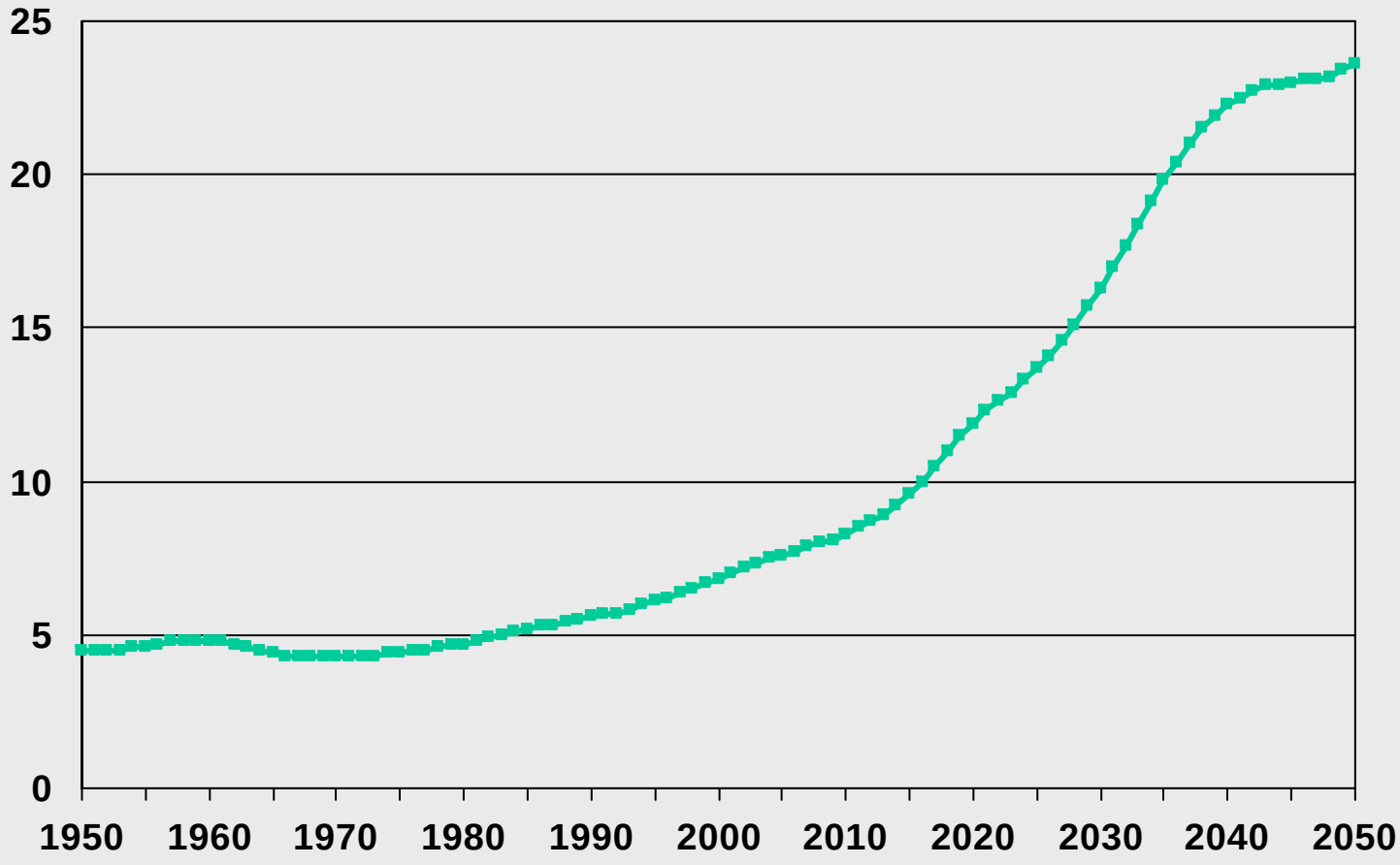


Slide from Population Reference Bureau

Source: *World Population Prospects: The 2004 Revision* (2005).

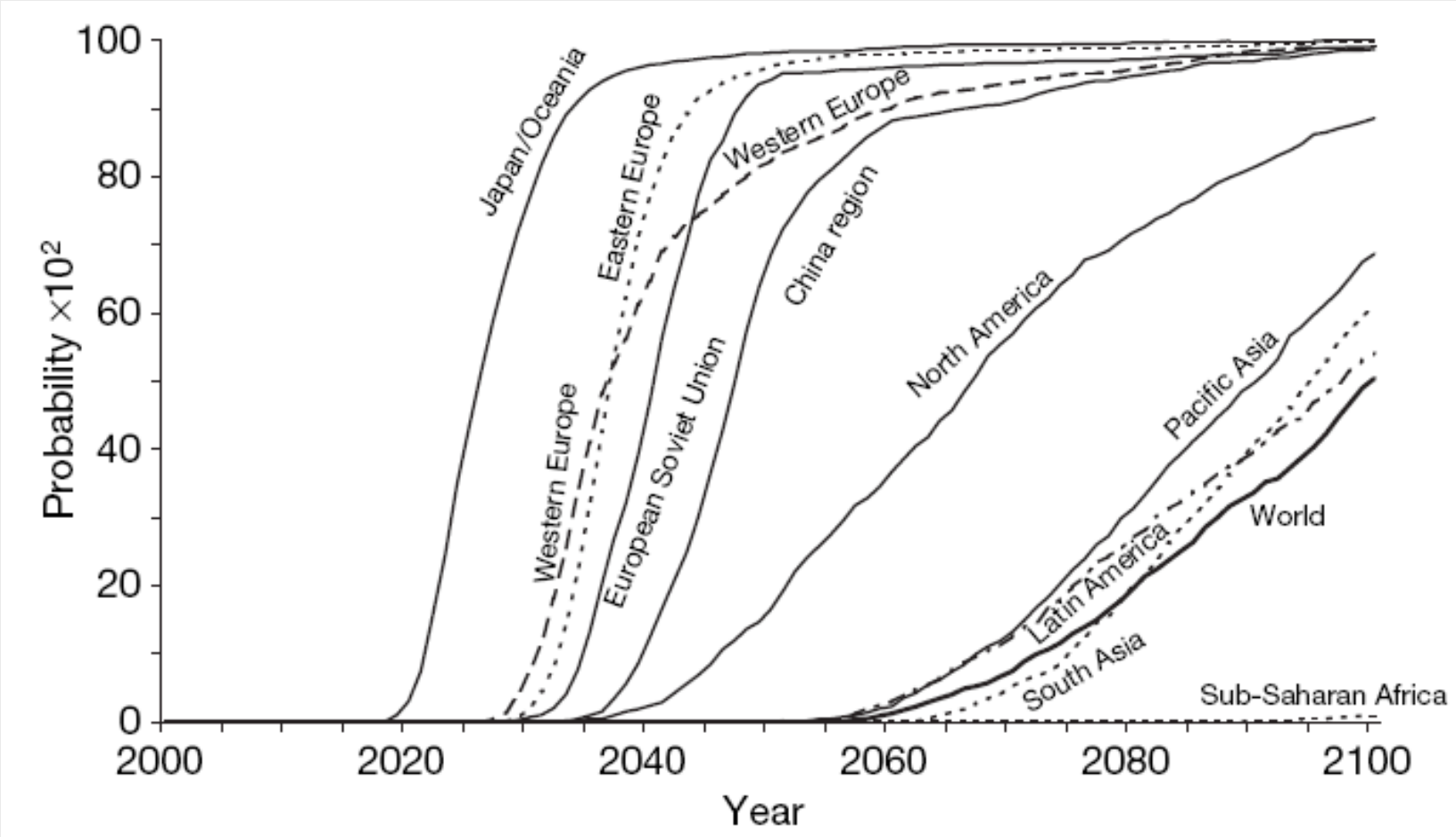
Aging in China

Percent of Elderly (65+) in China's Population, 1950-2050



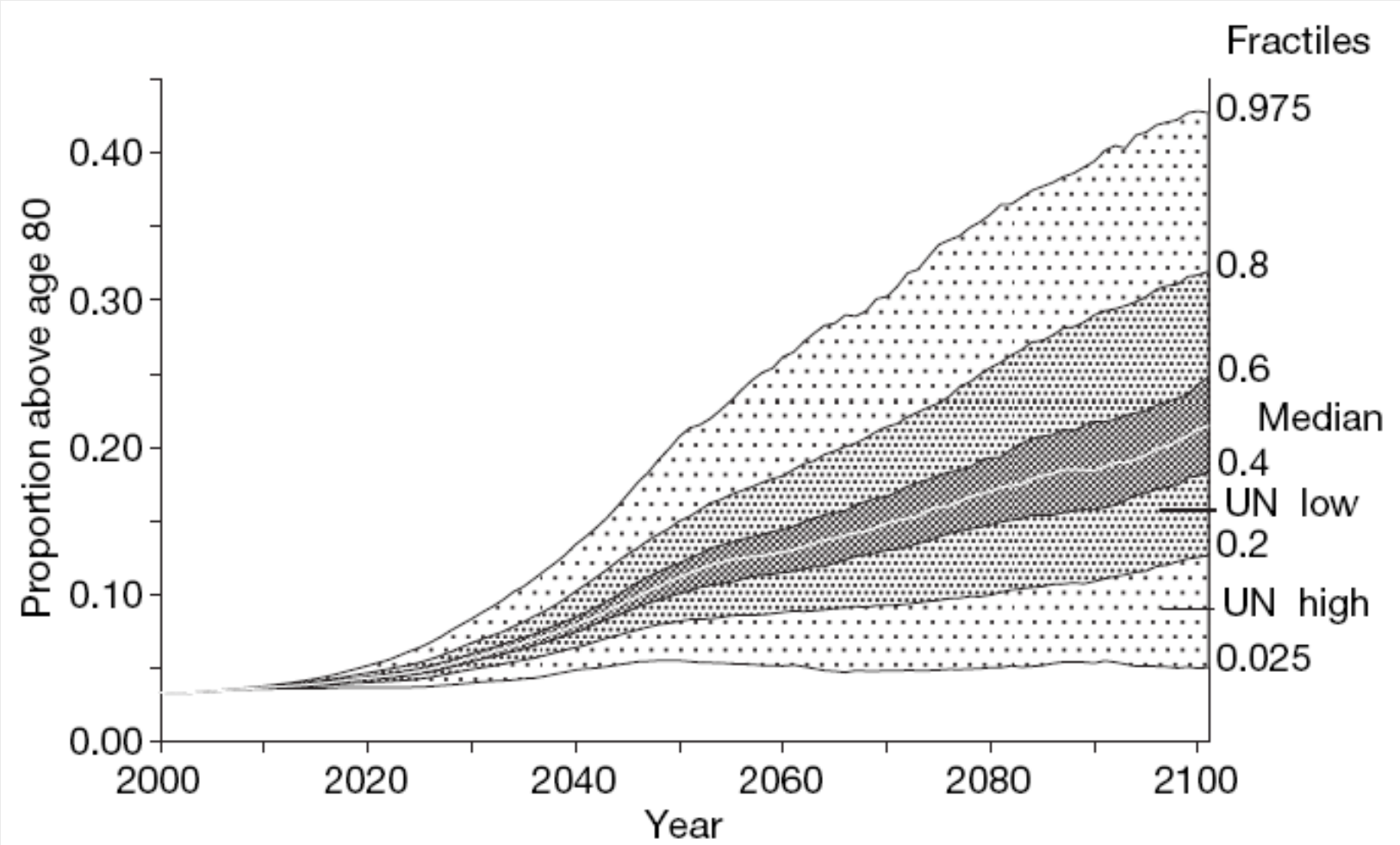
Source: *World Population Prospects: The 2004 Revision* (2005).

Ageing: Likelihood of 1/3 population 60+



Source: Lutz, Sanderson & Scherbov, 2008.

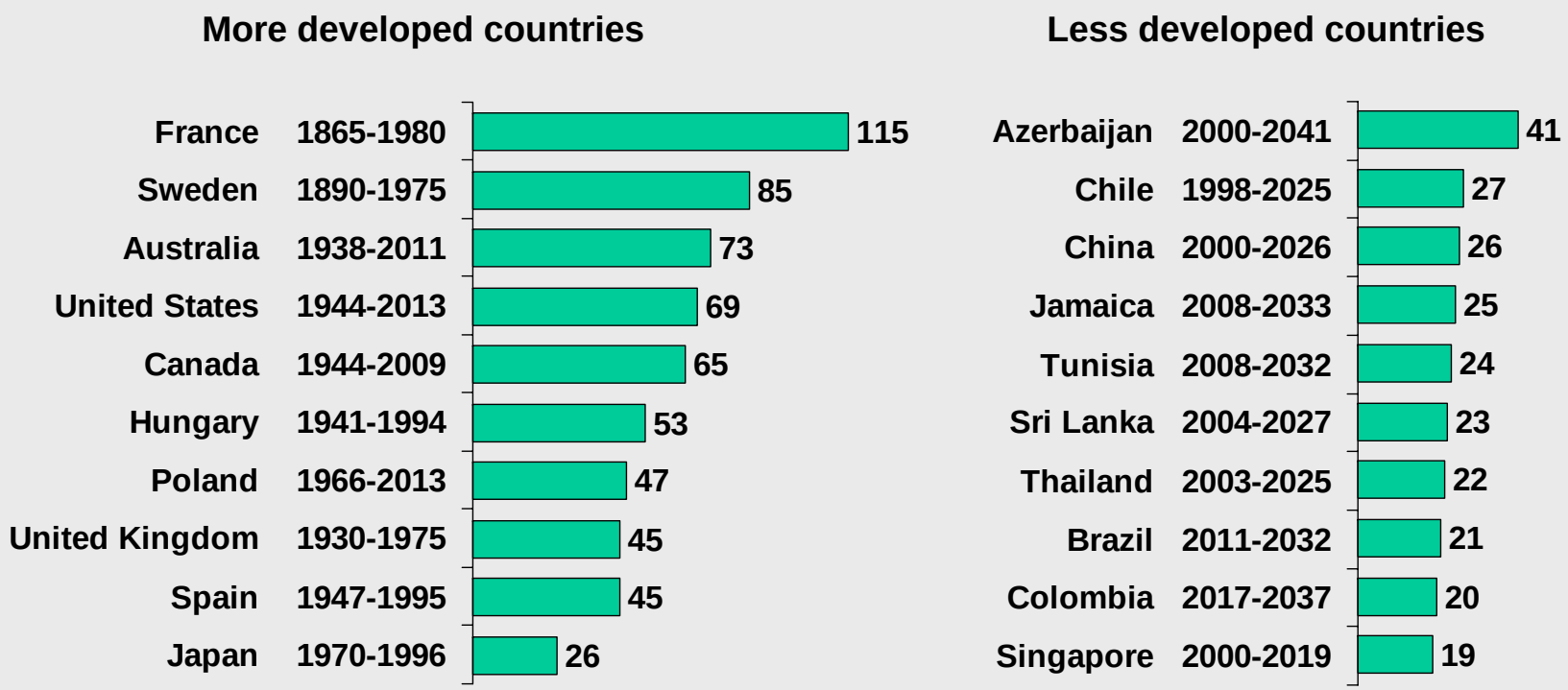
Projected Aging, Western Europe



Source: Lutz, Sanderson & Scherbov, 2008.

Speed of Population Aging in Selected Countries

Number of Years for Percent of Population Age 65 or Older to Rise from 7% to 14%



* Dates show the span of years when percent of population age 65 or older rose (or is projected to rise) from 7 percent to 14 percent.

Source: K. Kinsella and Y.J. Gist, *Older Workers, Retirement, and Pensions: A Comparative International Chartbook* (1995) and K. Kinsella and D. Phillips, "The Challenge of Global Aging," *Population Bulletin* 60, no. 1 (2005).

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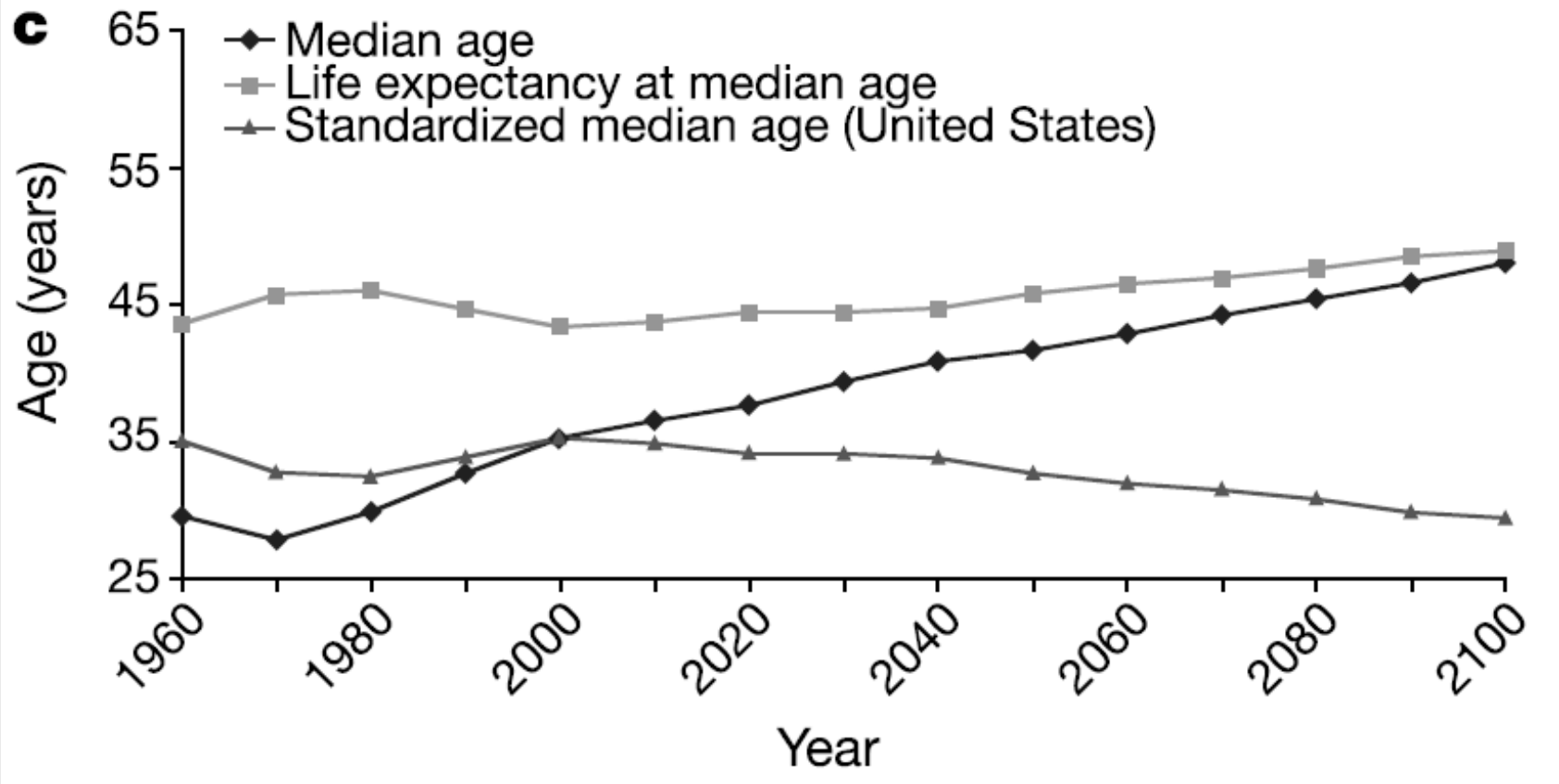
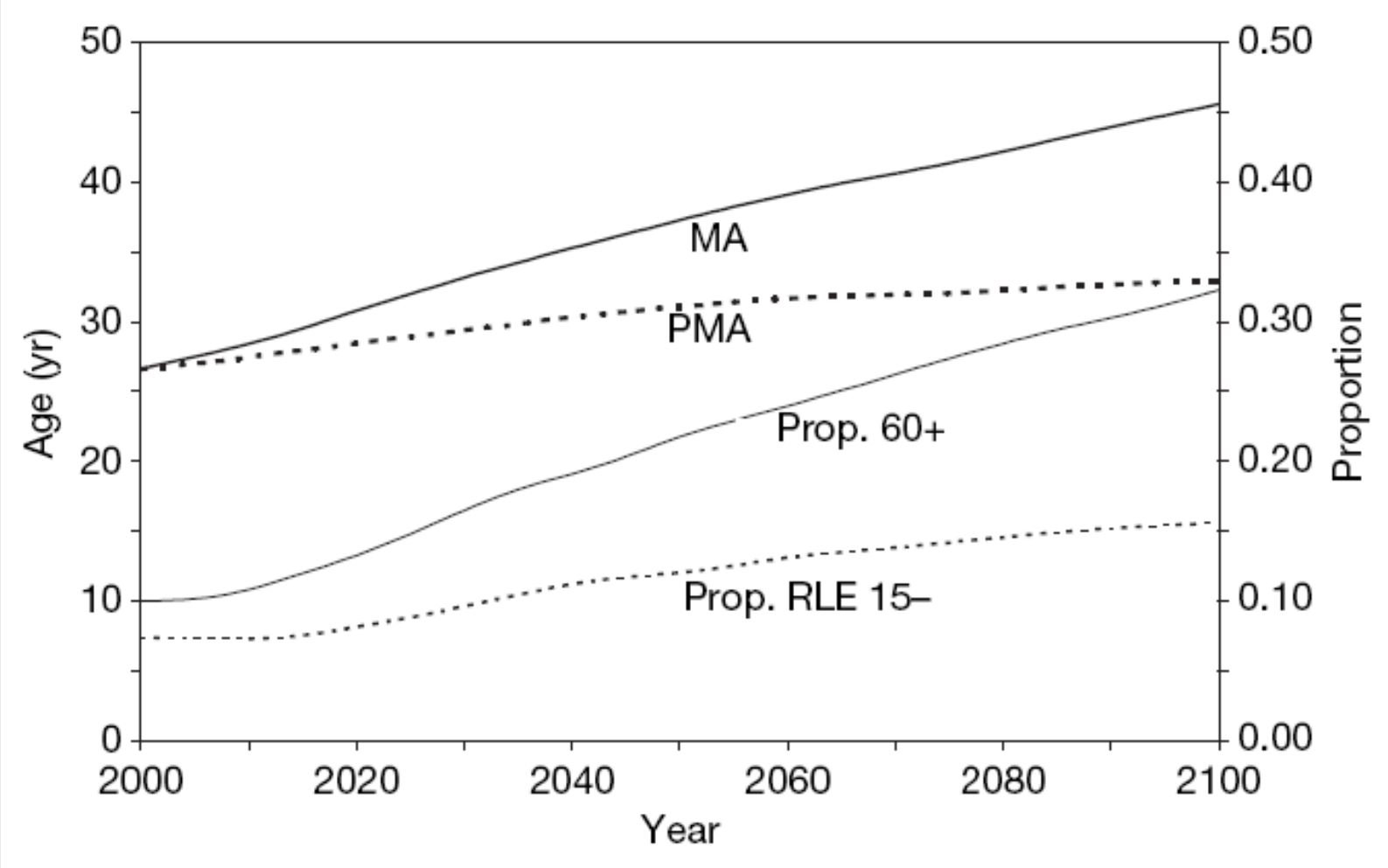
Alternative measures of aging, U.S.



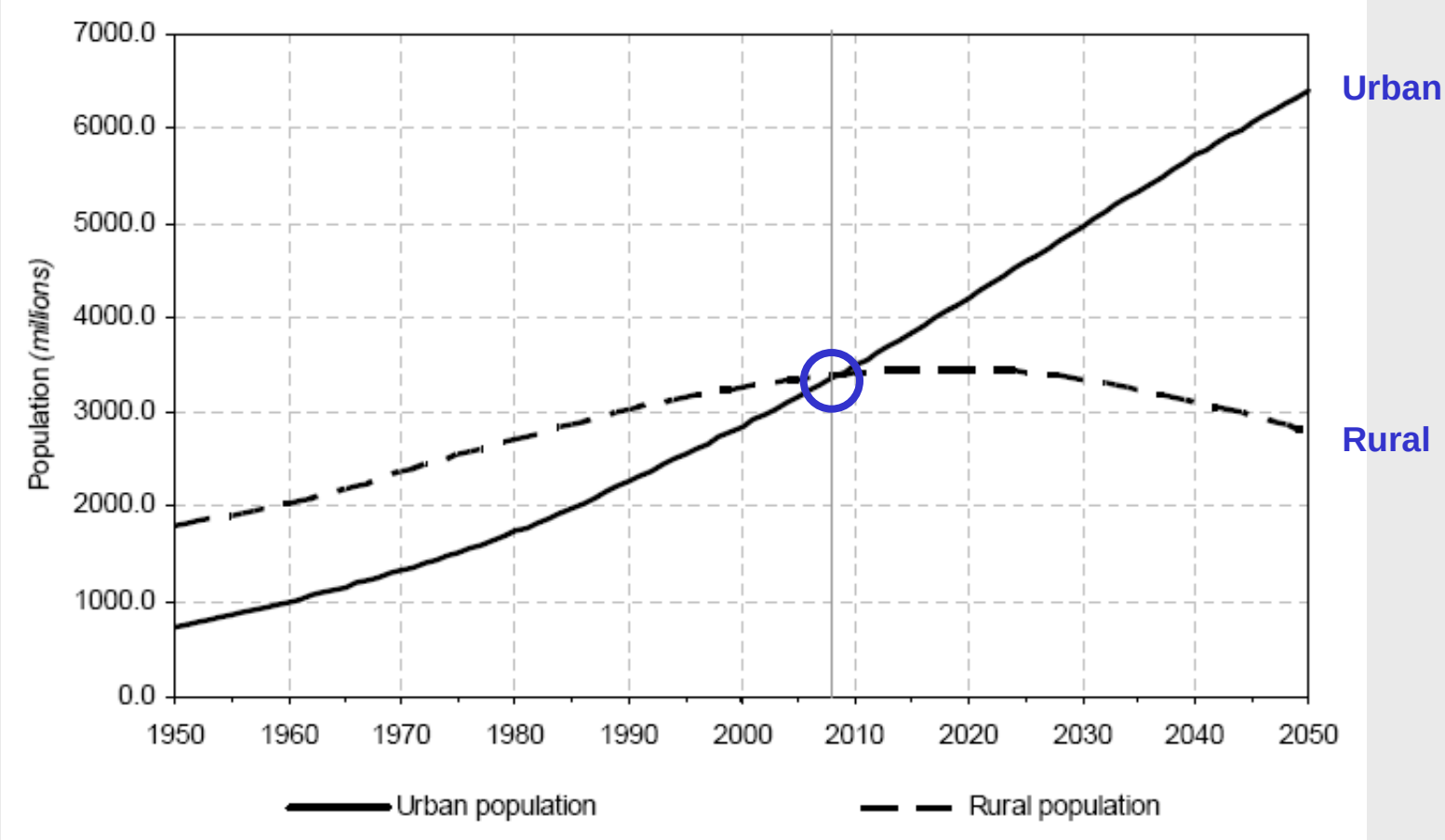
Source: Sanderson & Scherbov, 2005.

Alternative measures of aging, World



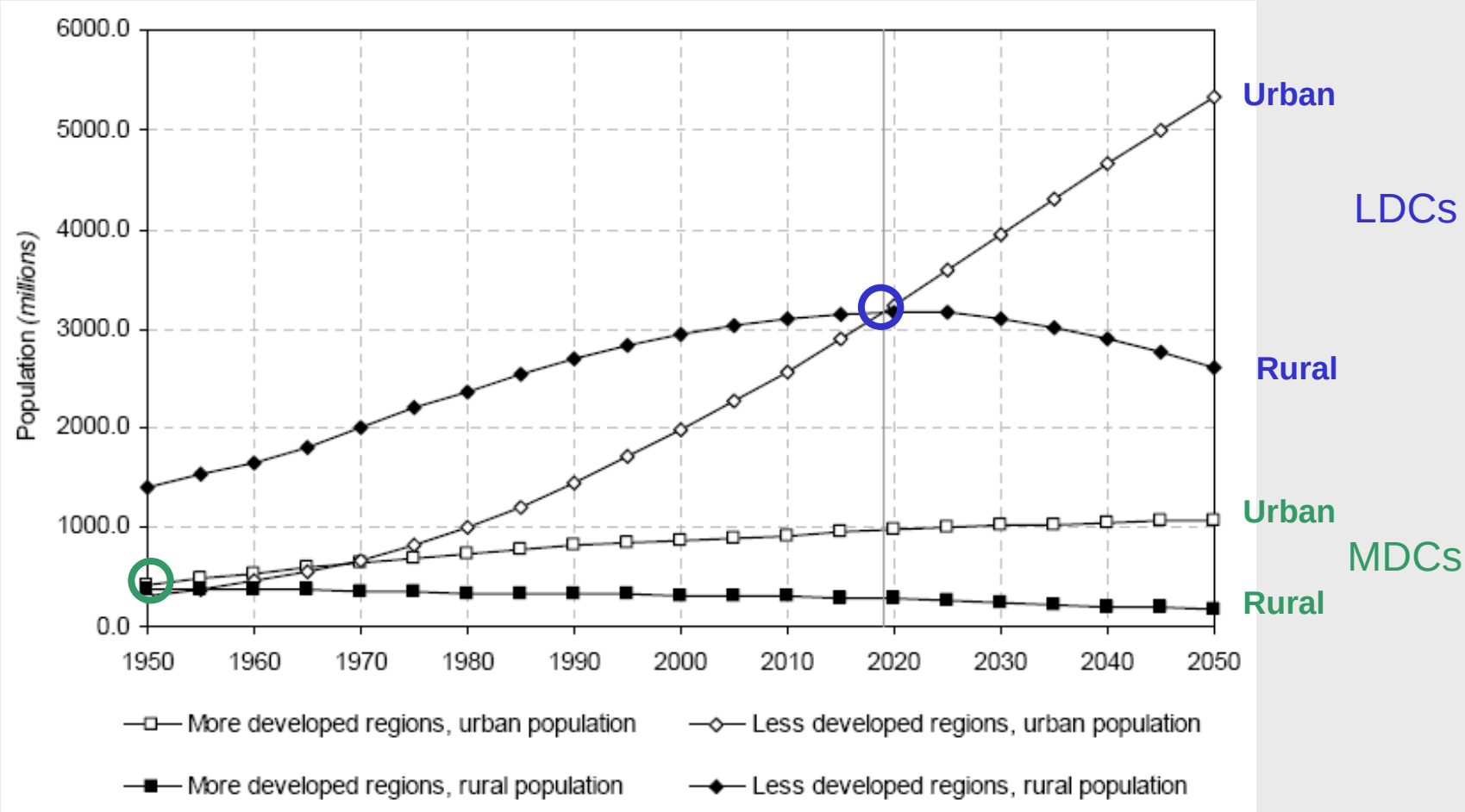
Source: Lutz, Sanderson & Scherbov, 2008.

Urbanization, Global



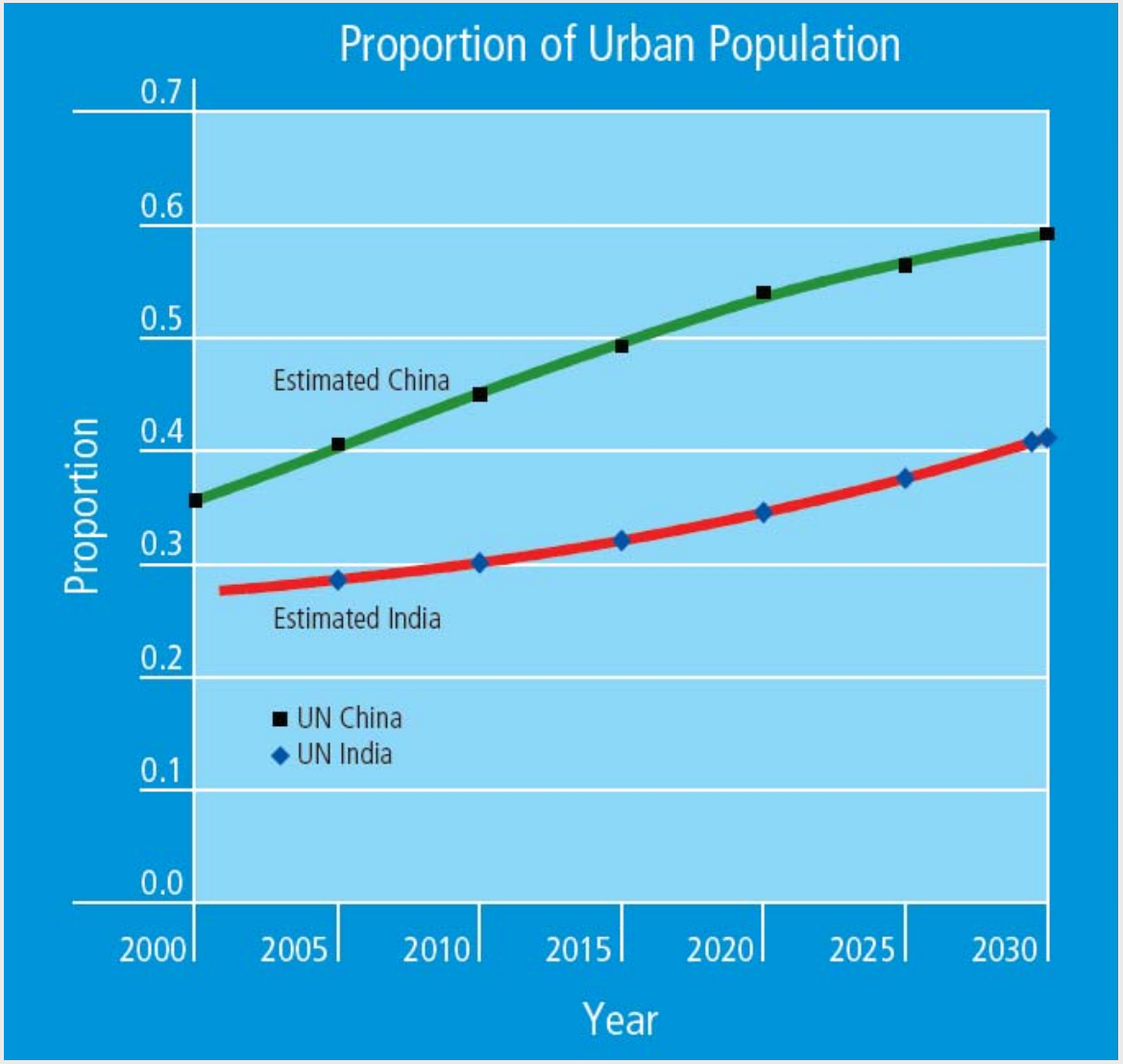
Source: UN, 2007.

Urbanization, Industrialized & Developing



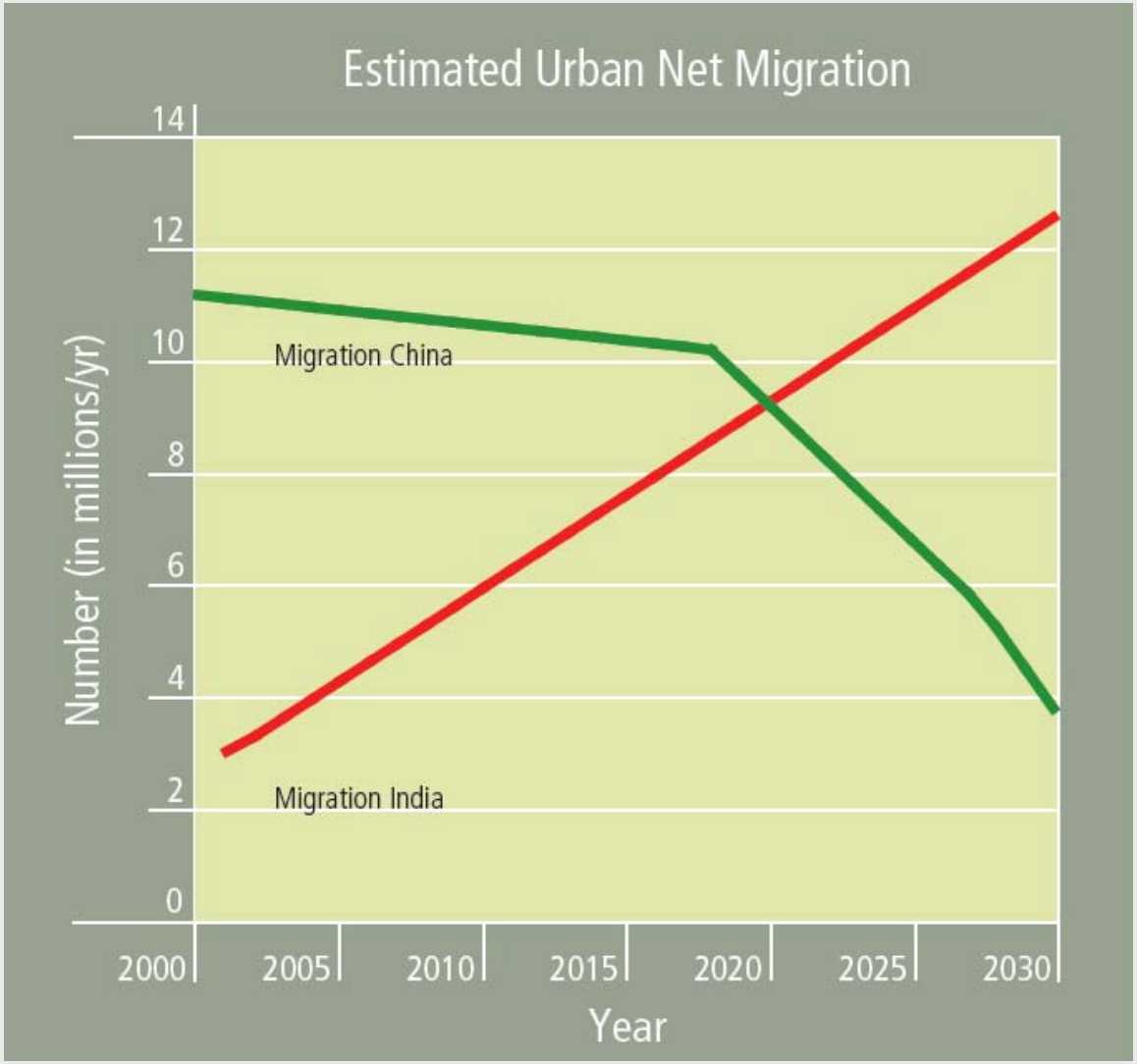
Source: UN, 2007.

Inverting UN Urbanization Projections



Source: O'Neill and Scherbov, 2007.

Inverting UN Urbanization Projections



Source: O'Neill and Scherbov, 2007.

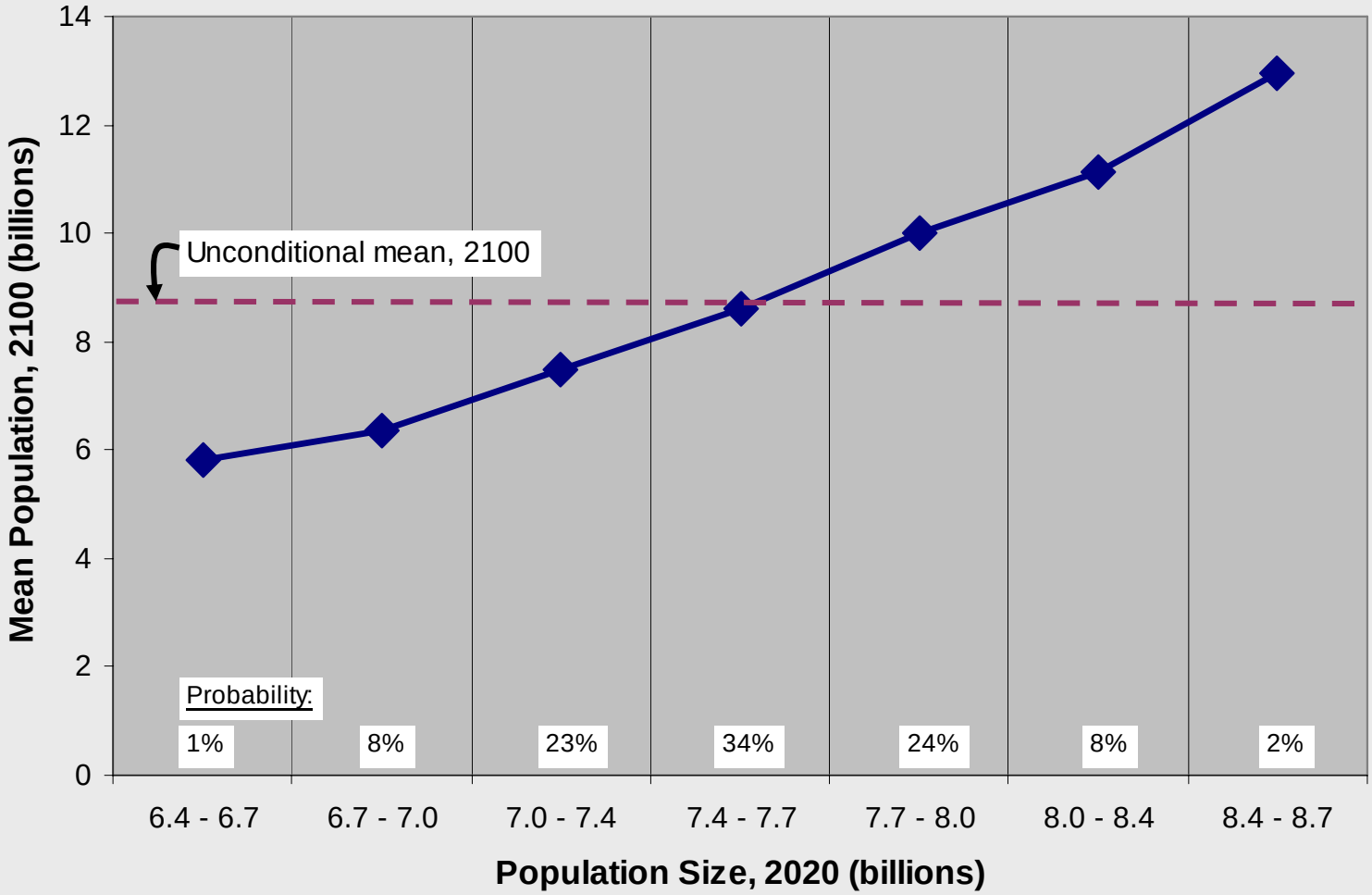
Trends Summary

- Divergent trends in population size
- Globally, less growth than previously expected
- Aging everywhere, older in industrialized countries, faster in developing countries
- Declines in household size in developing countries, trends unclear in industrialized countries
- Urbanization in developing countries, projections not well developed

Implications for Emissions

- Uncertainty and learning
- Aging, urbanization, and national emissions
- Toward global emissions implications

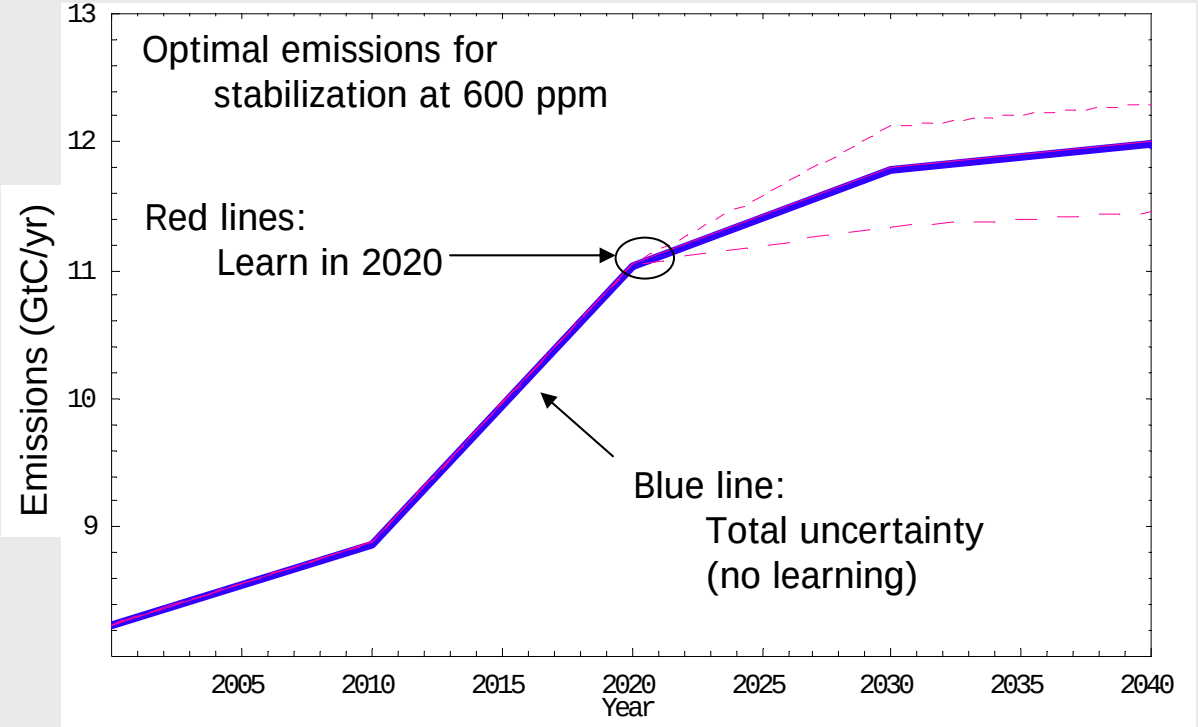
Population Learning: An Example



Source: O'Neill & Sanderson, 2008.

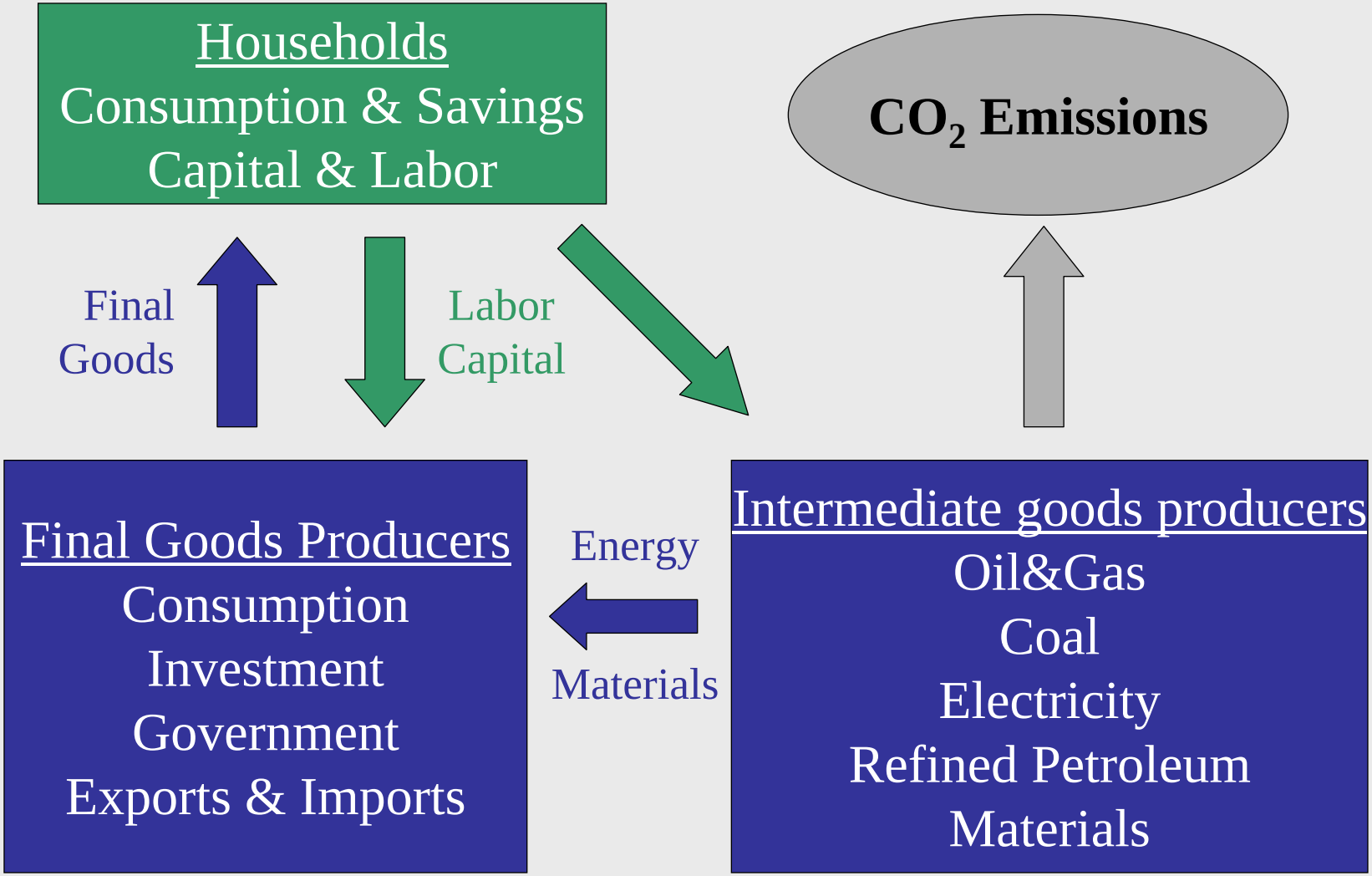
Managing Uncertainty: Preparing to Respond to New Information

- Learning about outlook for future population growth occurs in 2020
- Potential for outlook to shift to faster or slower population growth modeled using probabilistic projections
- After 2020, substantial adjustments made to optimal emissions strategy depending on what is learned



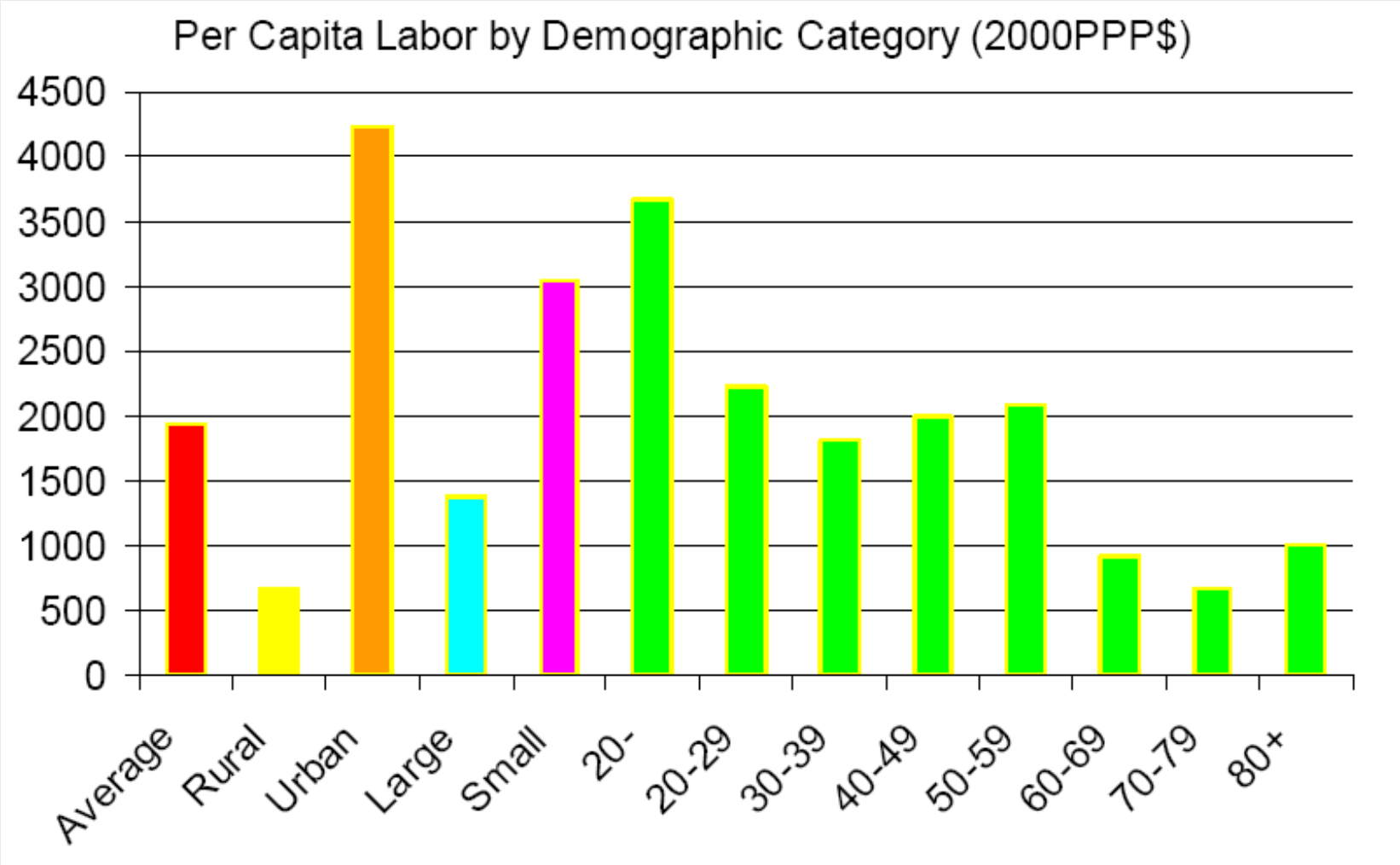
Source: O'Neill & Sanderson, 2008.

Population and Emissions: The PET Model



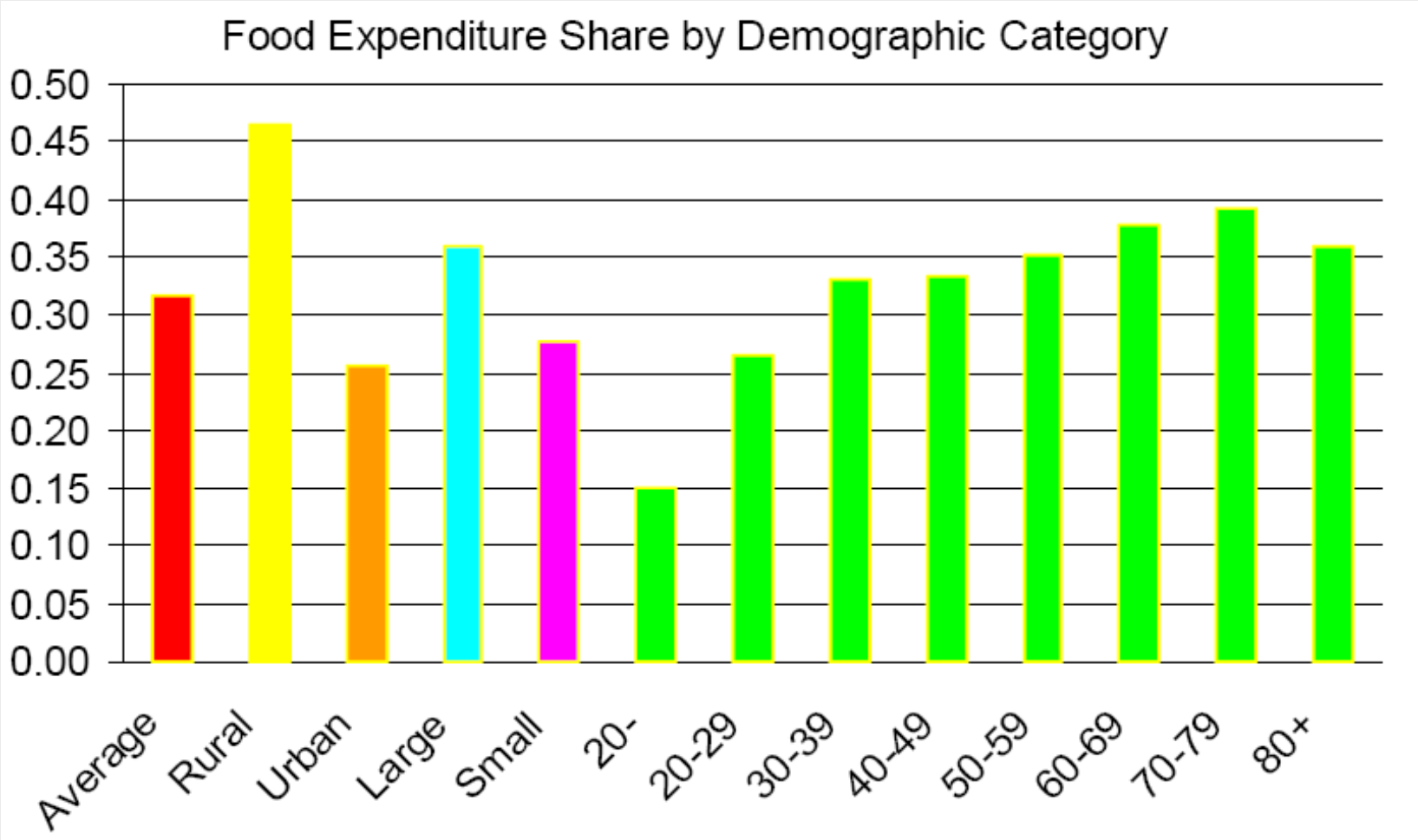
Source: Dalton et al., 2008; Dalton & Goulder, 1998.

Labor Income Heterogeneity, China, 2000



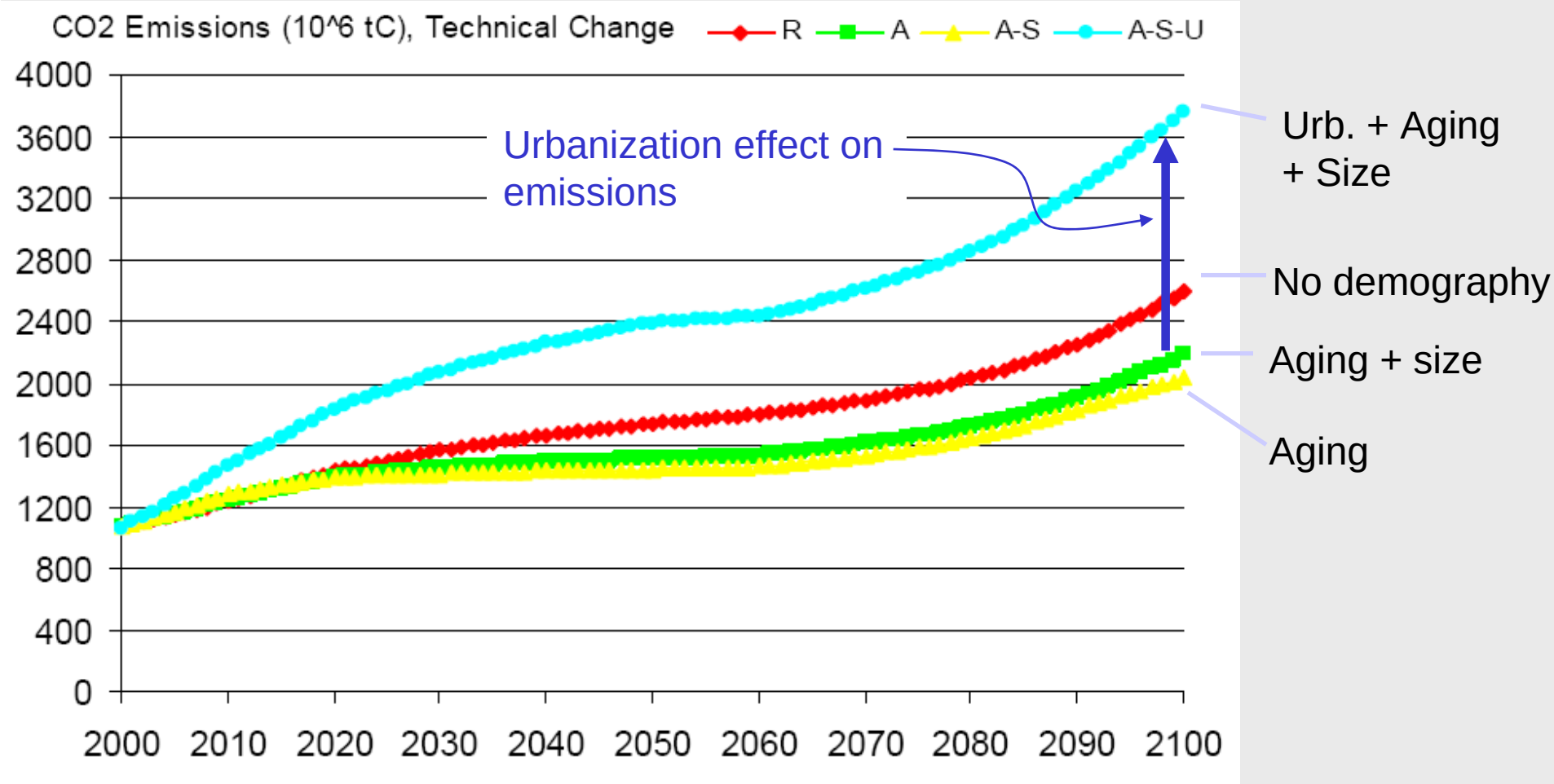
Source: Dalton et al., 2008.

Expenditure Heterogeneity, China, 2000



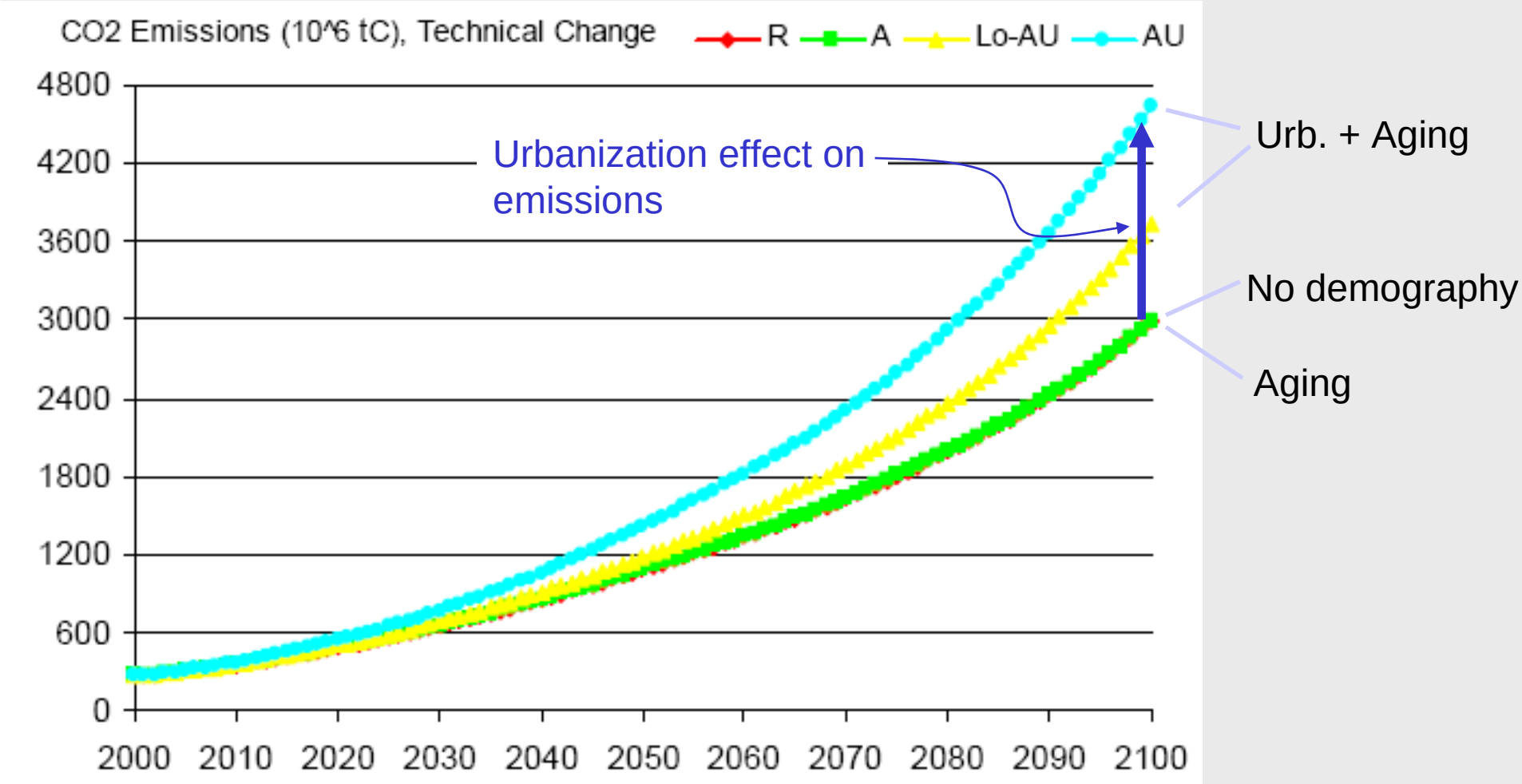
Source: Dalton et al., 2008.

Effects of Aging and Urbanization on Chinese CO_2 Emissions, B2 Scenario



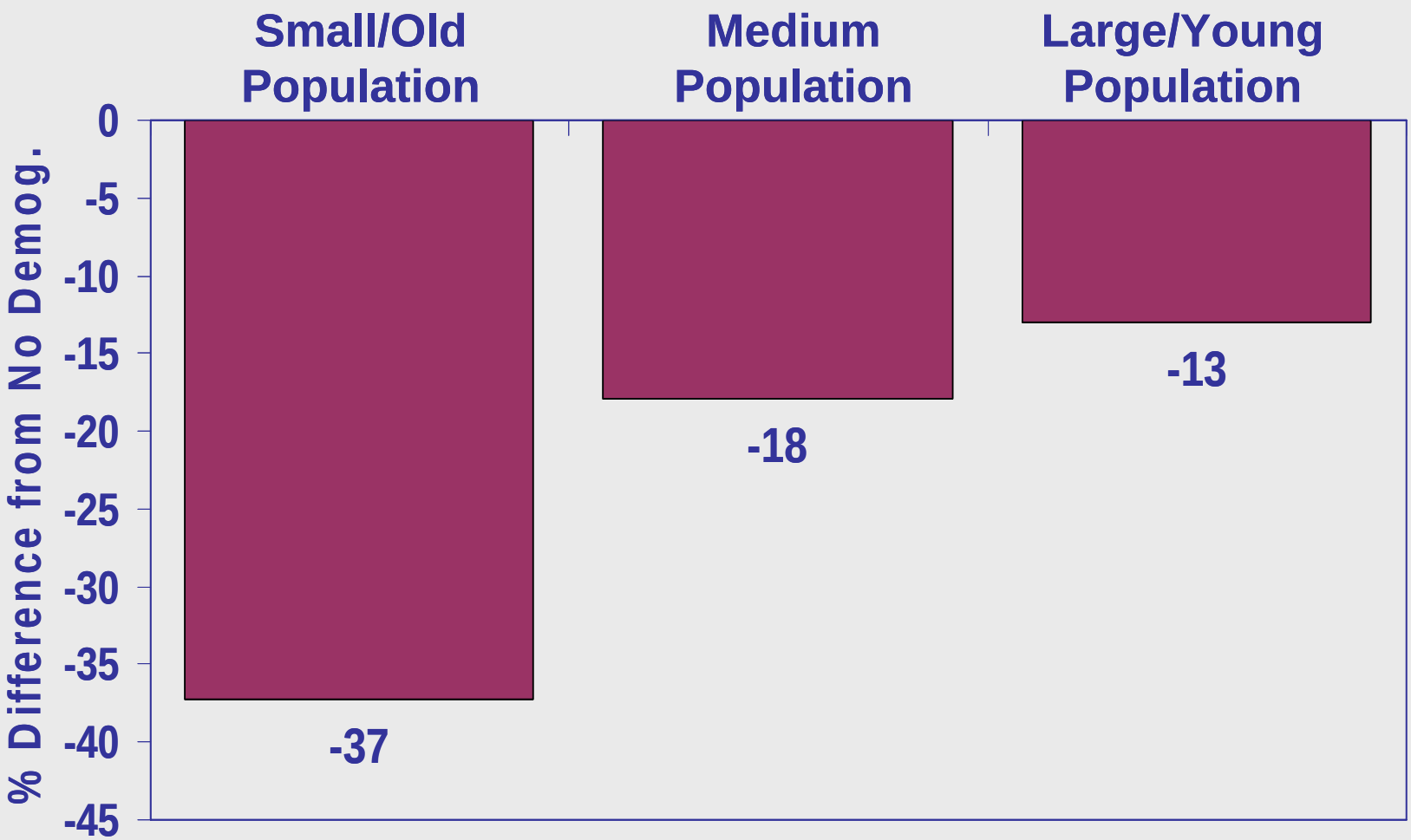
Source: Dalton et al., 2008.

Effects of Aging and Urbanization on Indian CO_2 Emissions, B2 Scenario



Source: Dalton et al., 2008.

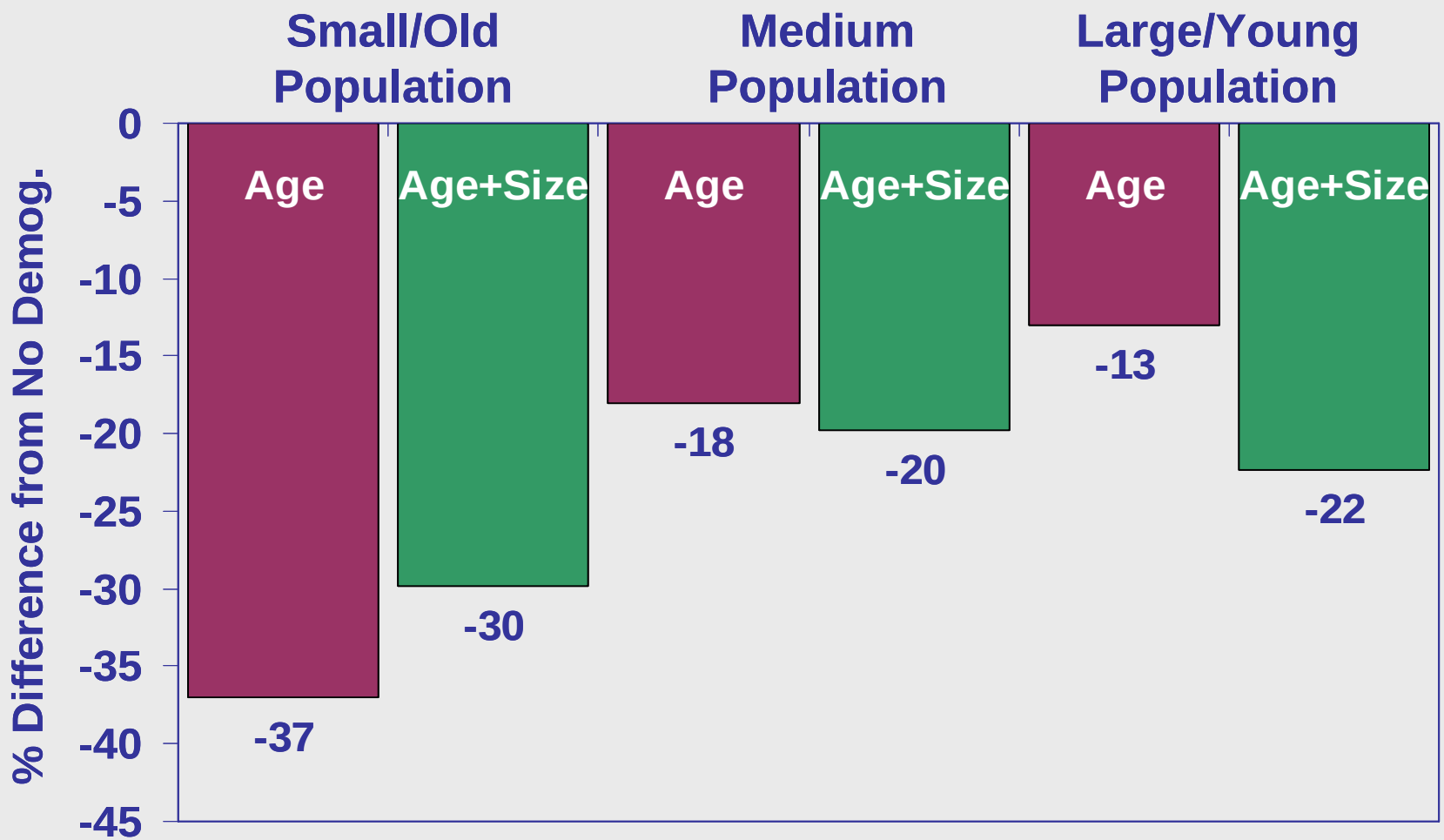
Effects of Aging on U.S. CO_2 Emissions in 2100



All emissions differences relative to case with no age or size changes.
No technological progress in this scenario.

Source: Dalton et al., 2008.

Effects of Aging and HH Size Changes on U.S. CO_2 Emissions in 2100

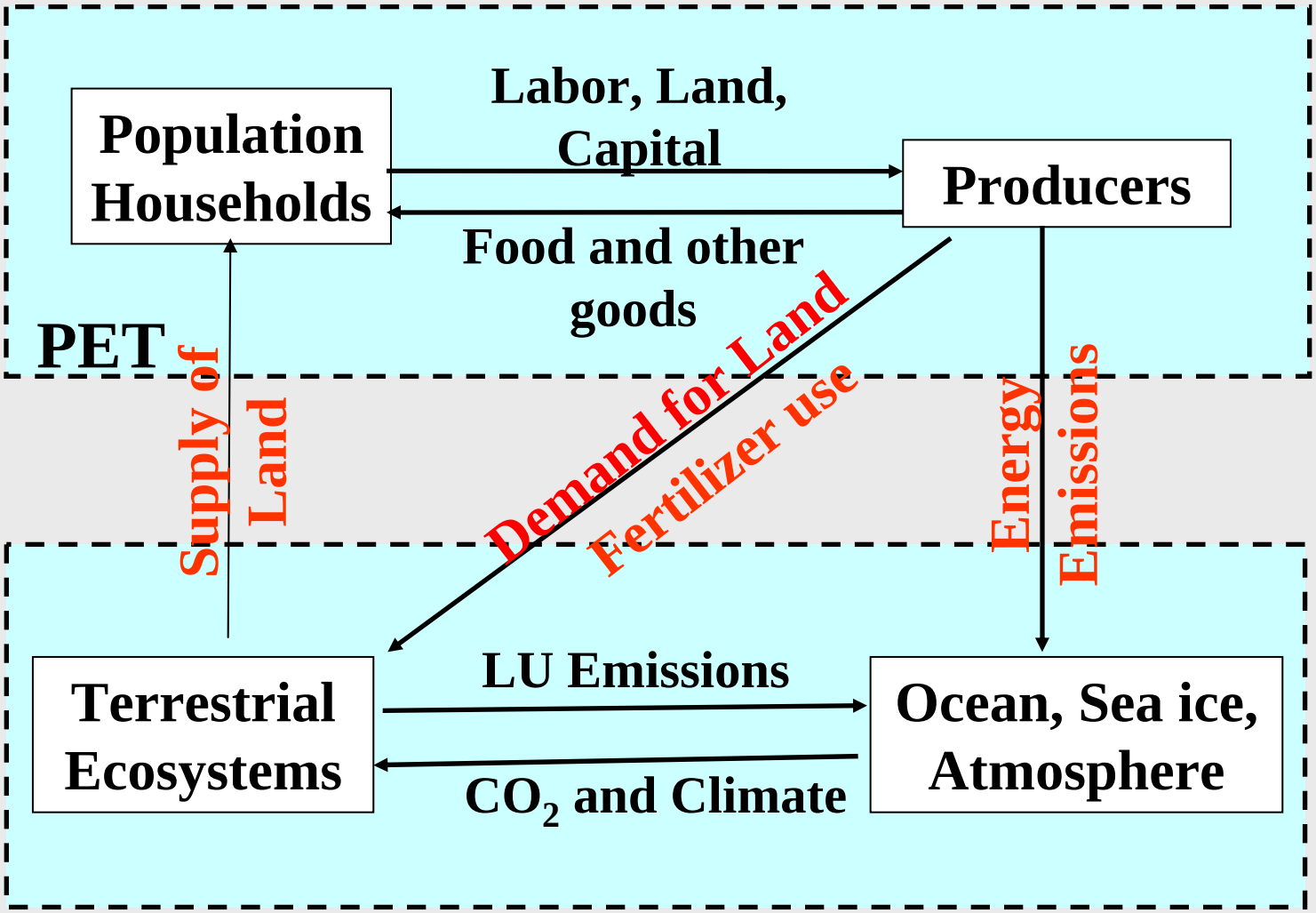


All emissions differences relative to case with no age or size changes.
No technological progress in this scenario.

Source: Dalton et al., 2008.

iPETS: Global, regionally disaggregated IA Model

(Integrated Population-Economy-Technology-Science Model)



Collaborators: O'Neill (NCAR); Dalton (NOAA); Jain (U. Illinois); Jiang (Brown U.); Pachauri/Fuchs/Zigova (IIASA)