

# World population change over time

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**September 04–09, 2024**  
**Population and Society (SOCI 312)**

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# Outline

- Five contemporary aspects of importance of demography
- Demographic transition



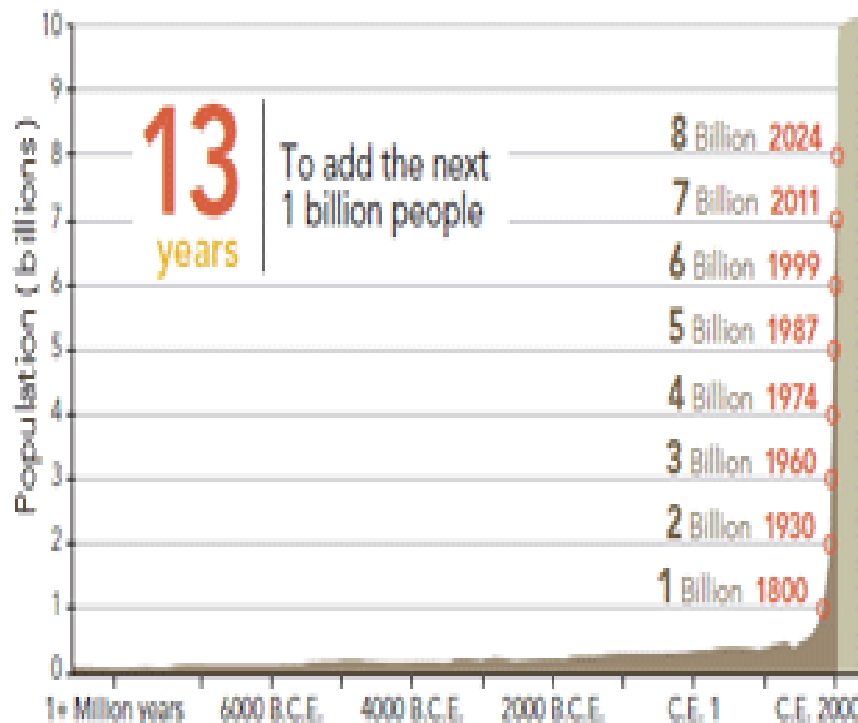
# Five contemporary aspects of importance of demography

1. The greatest demographic change in human history
2. Spectacular gains in life expectancy
3. Below replacement fertility
4. Unbalanced sex ratios at birth
5. Population aging

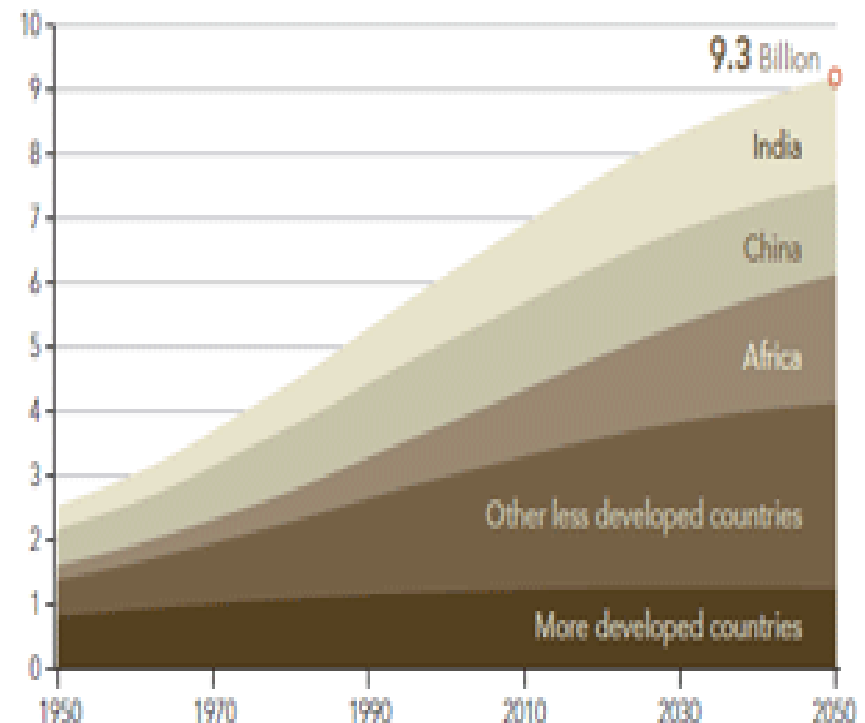


# 1. The greatest demographic change in human history

## Historic and Projected Population Growth



## World Population Growth, 1950–2050 (medium variant)



SOURCES: CARL HAUB, POPULATION REFERENCE BUREAU (PRB), 2010; U.N. POPULATION DIVISION (UNPD), 2011

SOURCE: UNPD, 2011

## 2. Spectacular gains in life expectancy

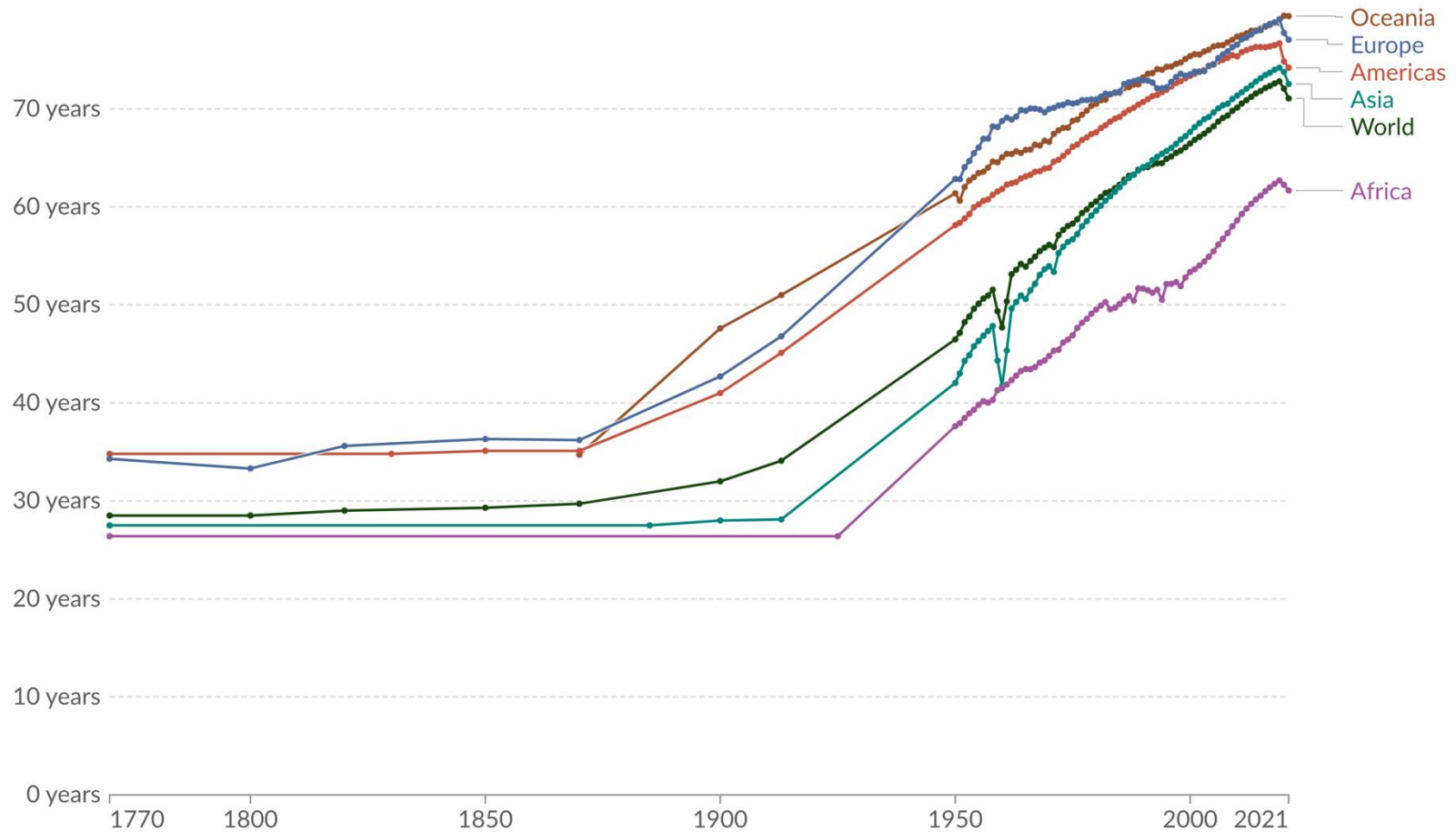
- Significant decline in mortality over the past two centuries
- Particularly since the end of World War II
- One of the most important developments in human history
- Both a consequence and driver of a new worldview
- The resulting transitions have been profoundly transformative



# Life expectancy

The period life expectancy<sup>1</sup> at birth, in a given year.

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Data source: UN WPP (2022); HMD (2023); Zijdeman et al. (2015); Riley (2005)

OurWorldinData.org/life-expectancy | CC BY

**1. Period life expectancy:** Period life expectancy is a metric that summarizes death rates across all age groups in one particular year. For a given year, it represents the average lifespan for a hypothetical group of people, if they experienced the same age-specific death rates throughout their whole lives as the age-specific death rates seen in that particular year. Learn more in our article: "Life expectancy" - What does this actually mean?

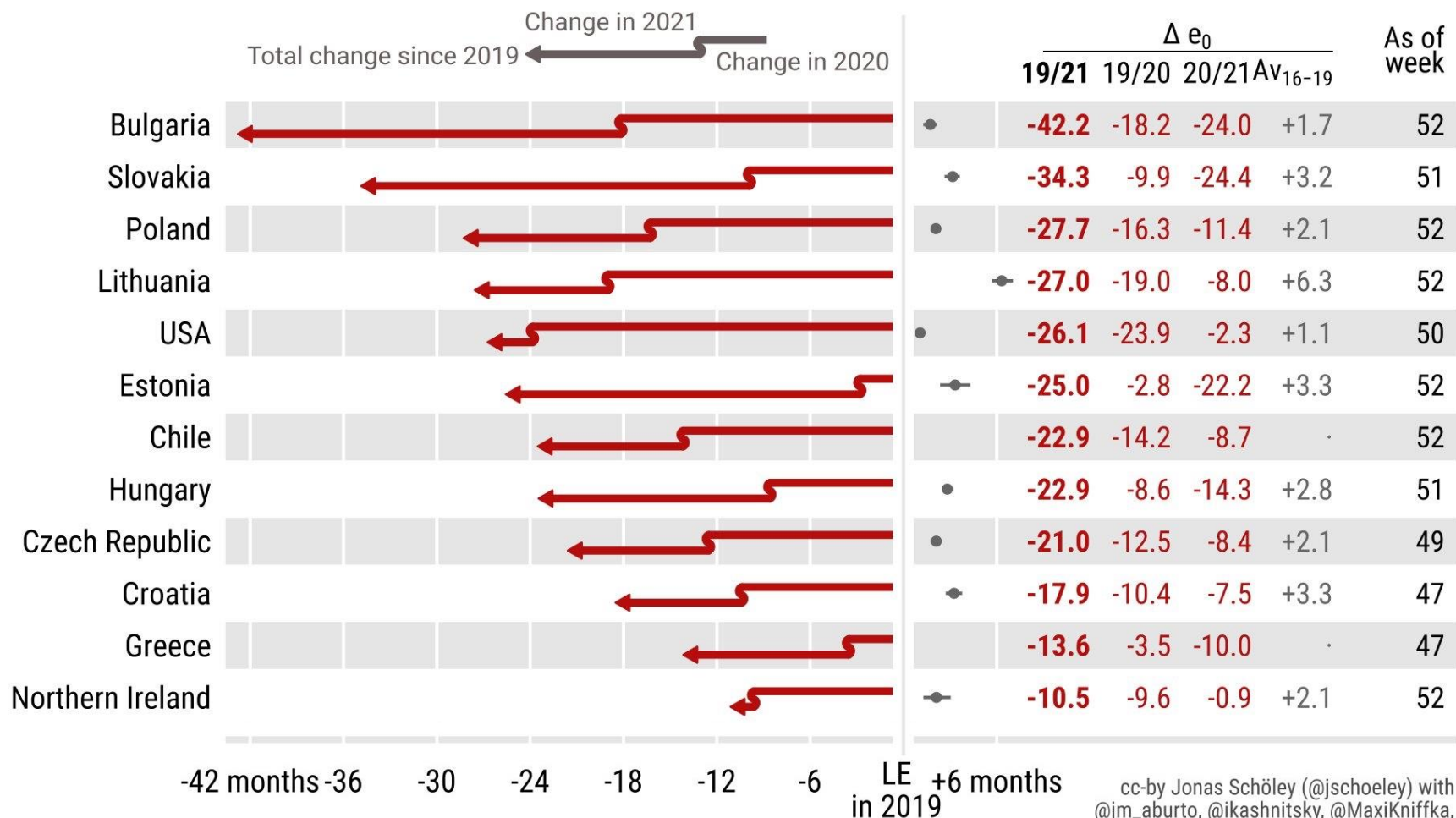


# Life expectancy bounce-backs amid continued losses

## Life expectancy changes since the start of the COVID-19 pandemic

Estimates for 2021 are adjusted for the weeks with missing data

Grey dots mark the average annual life expectancy change 2016 to 2019



calculated from STMF weekly death counts collected by mortality.org

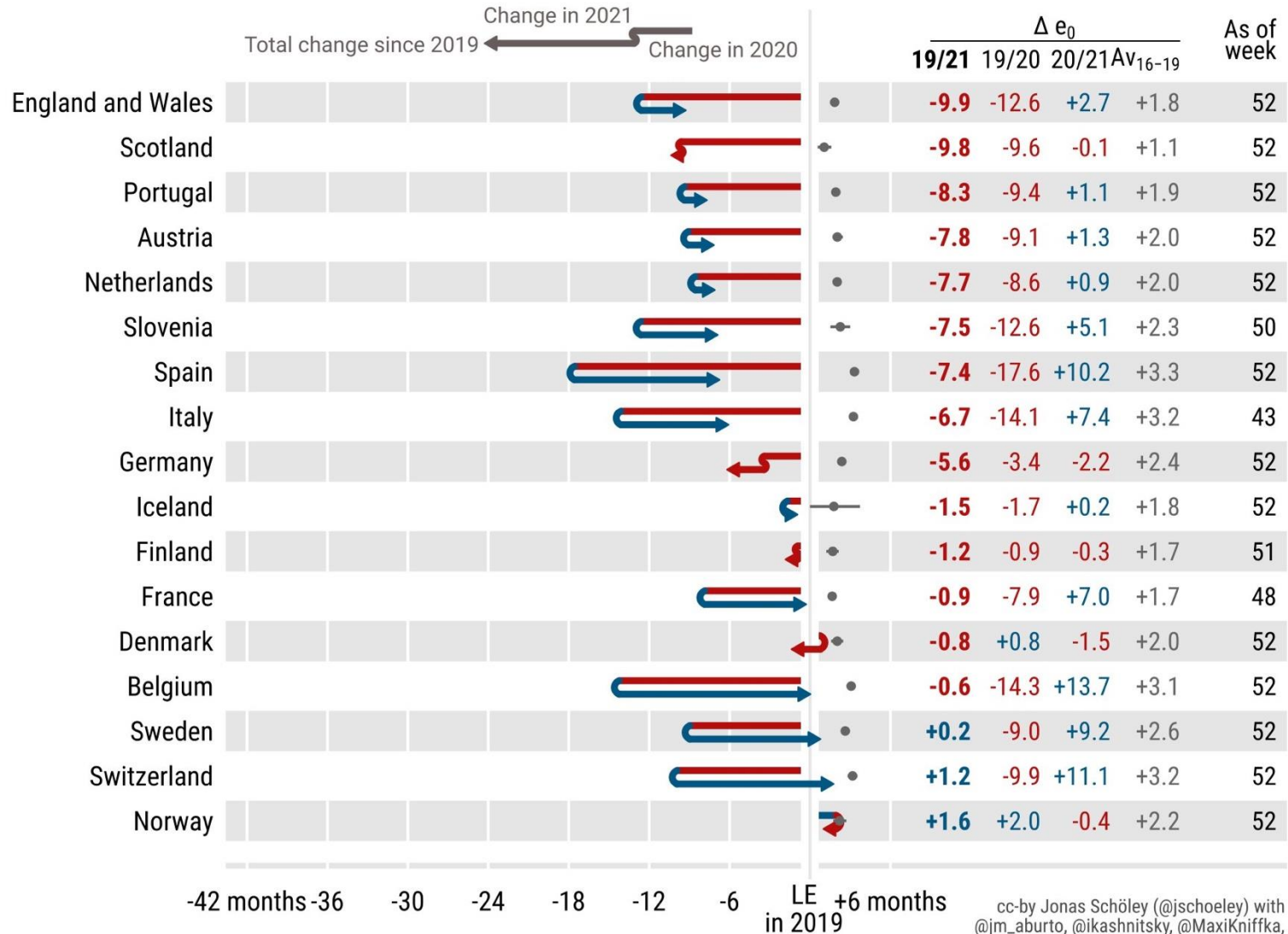
cc-by Jonas Schöley (@jschoeley) with @jm\_aburto, @ikashnitsky, @MaxiKniffka, @luyin\_zhang, Hannaliis Jaadla, @drjennodowd, @ridhikash07



# Life expectancy bounce-backs amid continued losses

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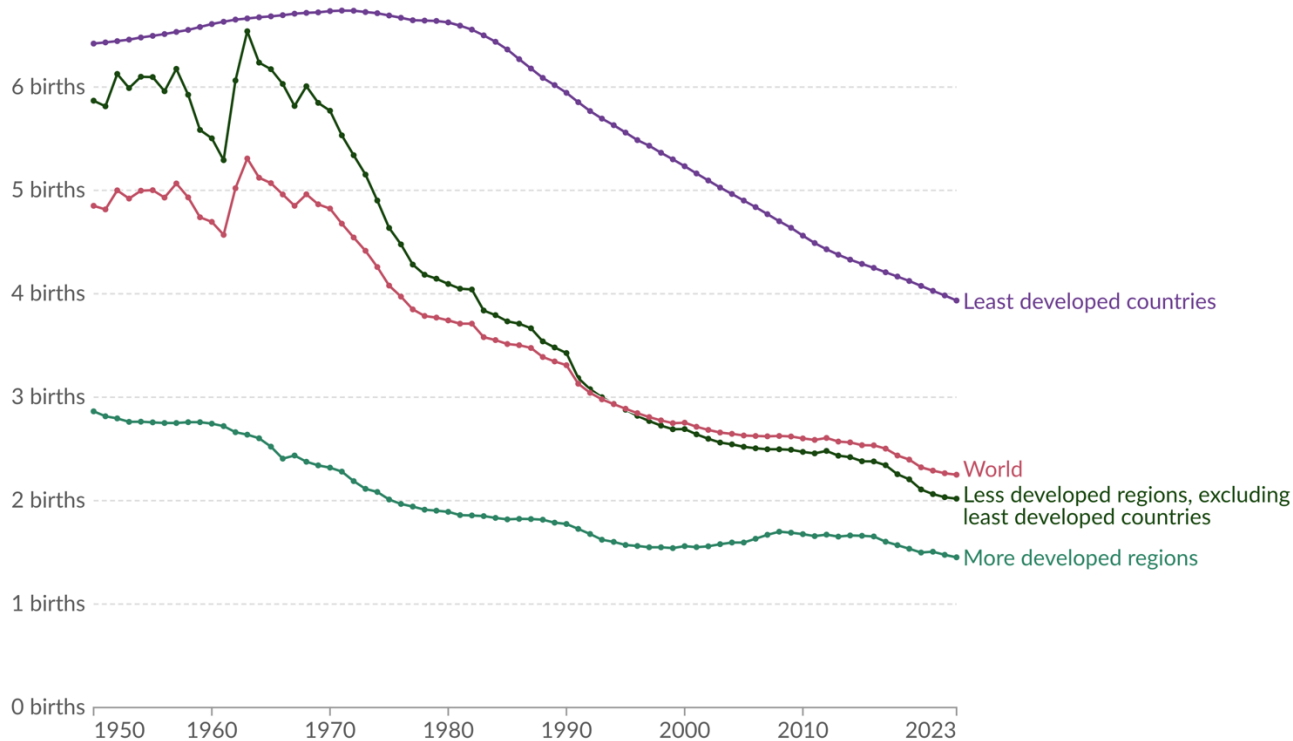


# 3. Below replacement fertility

## Fertility rate: children per woman

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The fertility rate<sup>1</sup>, expressed as the number of children per woman, is based on age-specific fertility rates in one particular year.



Data source: UN, World Population Prospects (2024)

OurWorldinData.org/fertility-rate | CC BY

**1. Fertility rate:** The total fertility rate is a period metric. It summarizes fertility rates across all age groups in one particular year. For a given year, the total fertility rate represents the average number of children that would be born to a hypothetical woman if she (1) lived to the end of her childbearing years, and (2) experienced the same age-specific fertility rates throughout her whole reproductive life as the age-specific fertility rates seen in that particular year. It is different from the actual average number of children that women have. The fertility rate should not be confused with biological fertility, which is about the ability of a person to conceive. [Read more: Fertility rate](#)

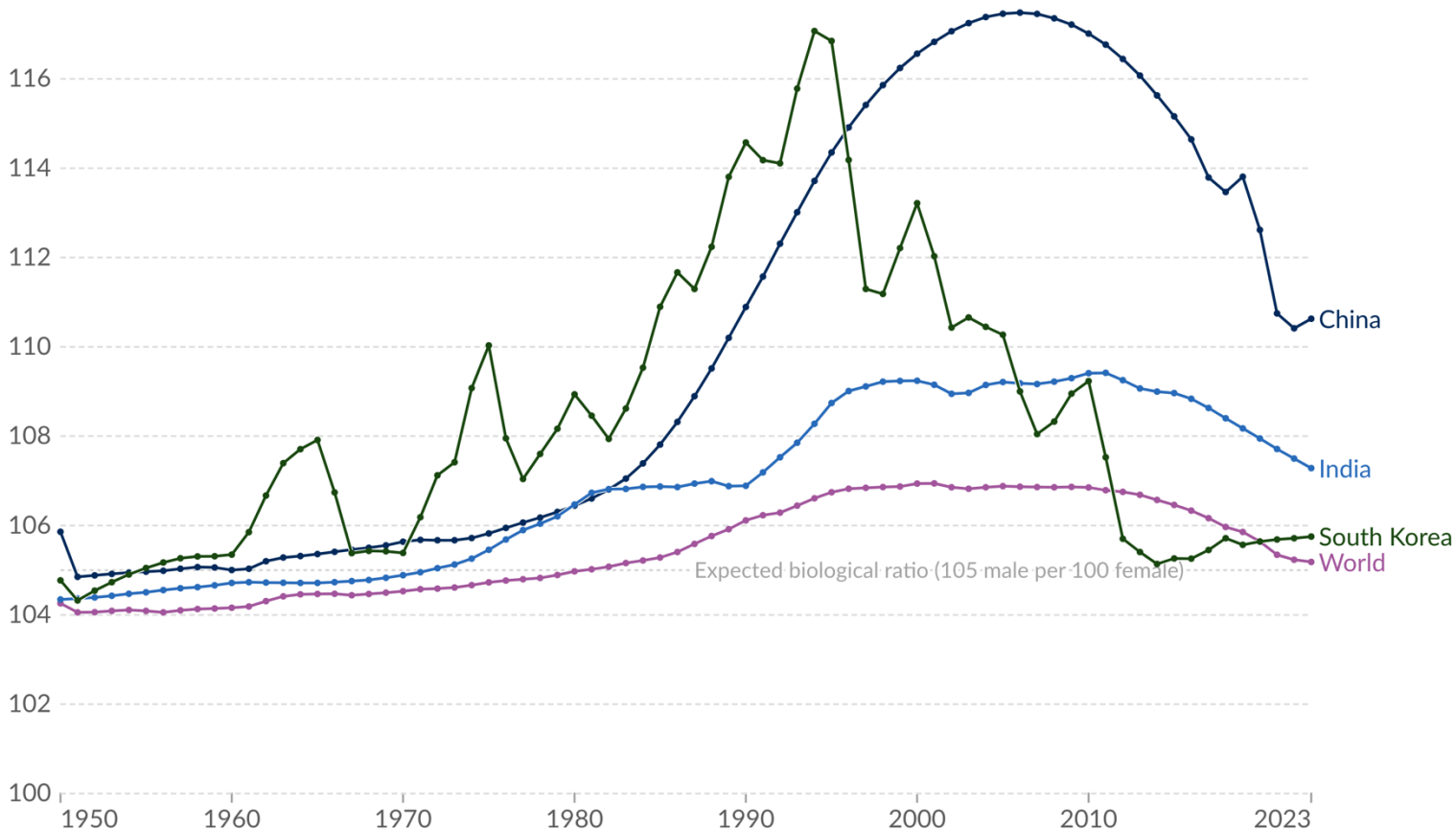


# 4. Unbalanced sex ratios at birth

## Sex ratio at birth, 1950 to 2023

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The sex ratio at birth is measured as the number of newborn boys for every 100 newborn girls. Higher values indicate a much higher number of newborn boys than girls.



Data source: UN, World Population Prospects (2024)

OurWorldinData.org/gender-ratio | CC BY



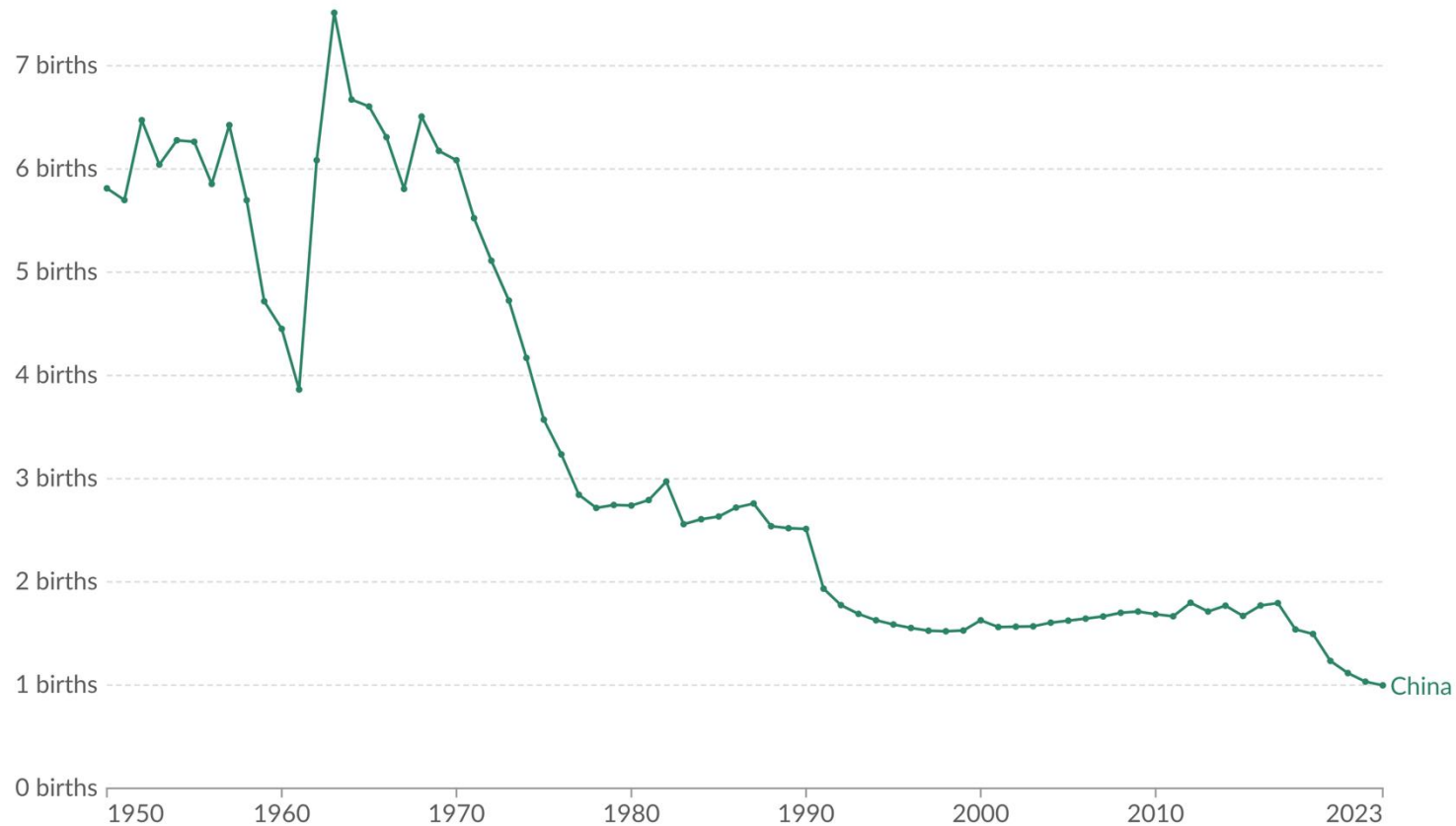
# Sex ratio at birth in China

- Biologically normal level of sex ratio at birth
  - Around 105 males for every 100 females
- Several societies have much higher SRBs
  - Rapid fertility transition
  - Son preference
  - Available technology to determine sex of the fetus
  - Ease of access to abortion



# Fertility rate: children per woman

The fertility rate<sup>1</sup>, expressed as the number of children per woman, is based on age-specific fertility rates in one particular year.



Data source: UN, World Population Prospects (2024)

OurWorldinData.org/fertility-rate | CC BY

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# The destiny of China is already set

- Why does China have high SRBs?
  - Pre-natal sex identification via sonar technology, followed by female-specific abortion
- What will be the result of the high SRBs?
  - Between 1983 and 2010 over 41 million extra boys were born than girls
  - Larger number of bachelors in China than the total population of California in 2010 (37 million) or Texas (25 million)



# What might happen if boys don't marry?

- Most men unable to find sex partners will be poor, uneducated, unemployed, and migrate from rural to urban areas
- Some likely consequences
  - Increase in crime, violence
  - Increase prostitution
  - Increase of STDs mainly among unmarried men
  - Unprecedented spread of HIV





# HIV

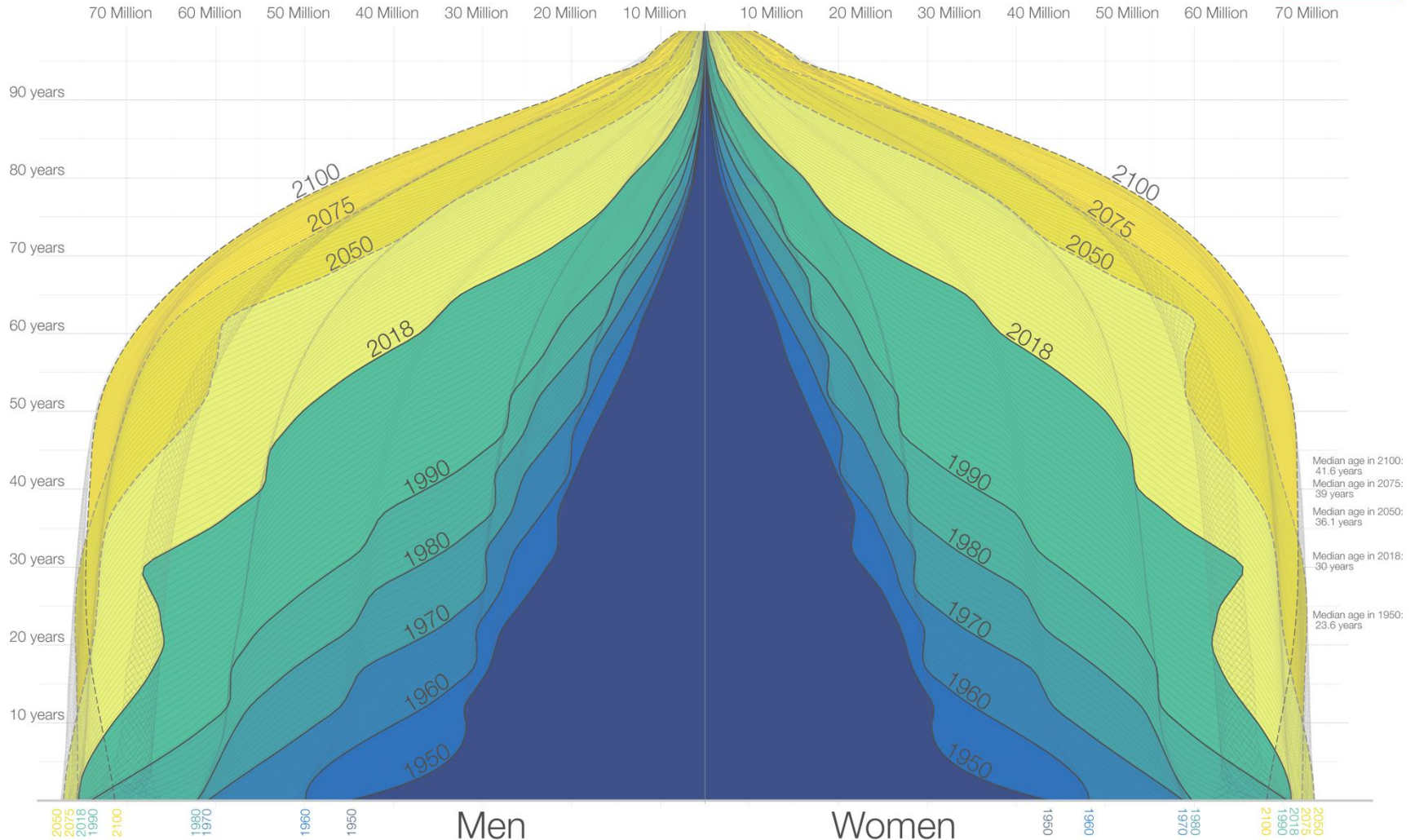
- In sub-Saharan Africa
  - In 2013, 24.7 million adults infected with HIV
    - This is almost 71% of adult infections worldwide
  - In 2010
    - Around 1.2 million people died from AIDS
    - 1.9 million people became infected with HIV
- China could equal or exceed these numbers by 2020–2030
  - The country is beginning to take seriously the issue of HIV/AIDS and a possible epidemic



# 5. Population aging

## The Demography of the World Population from 1950 to 2100

Shown is the age distribution of the world population – by sex – from 1950 to 2018 and the *UN Population Division's* projection until 2100.



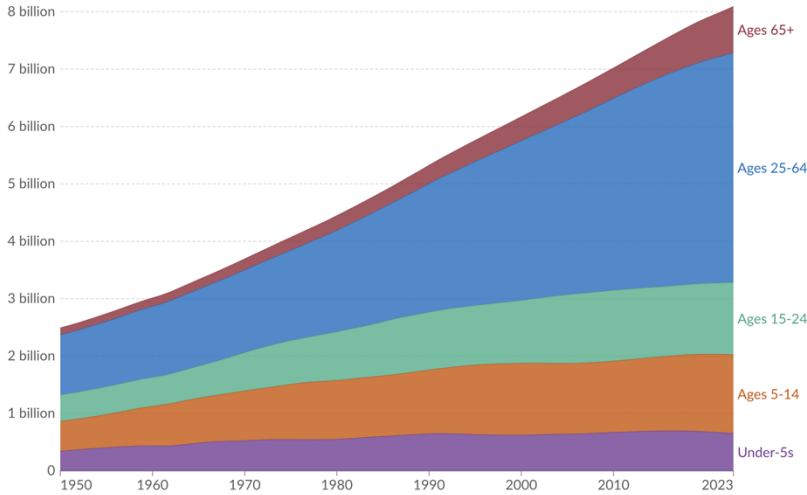
Data source: United Nations Population Division – World Population Prospects 2017; Medium Variant.

The data visualization is available at [OurWorldinData.org](https://ourworldindata.org), where you find more research on how the world is changing and why.

Licensed under CC-BY by the author Max Roser.

## Population by age group, World

Our World in Data

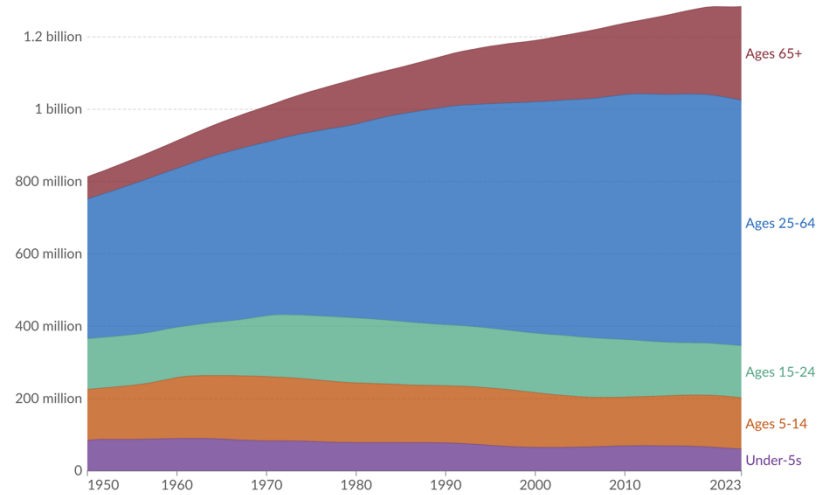


Data source: UN, World Population Prospects (2024)

OurWorldinData.org/population-growth | CC BY

## Population by age group, More developed regions

Our World in Data

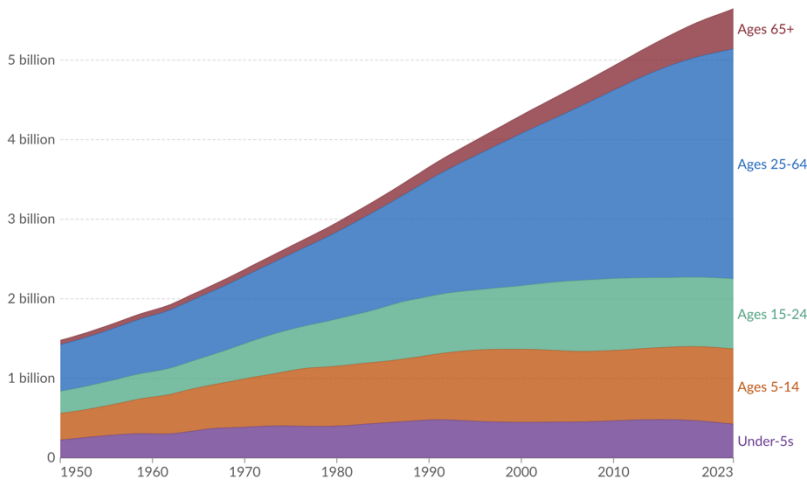


Data source: UN, World Population Prospects (2024)

OurWorldinData.org/population-growth | CC BY

## Population by age group, Less developed regions, excluding least developed countries

Our World in Data

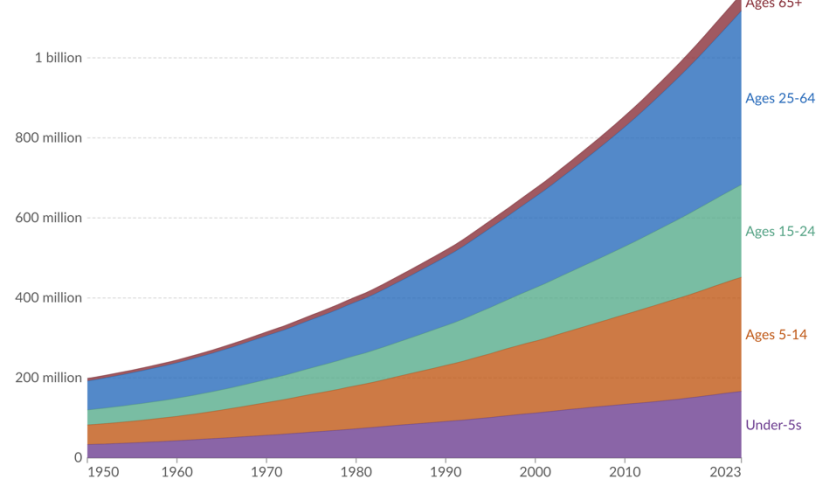


Data source: UN, World Population Prospects (2024)

OurWorldinData.org/population-growth | CC BY

## Population by age group, Least developed countries

Our World in Data

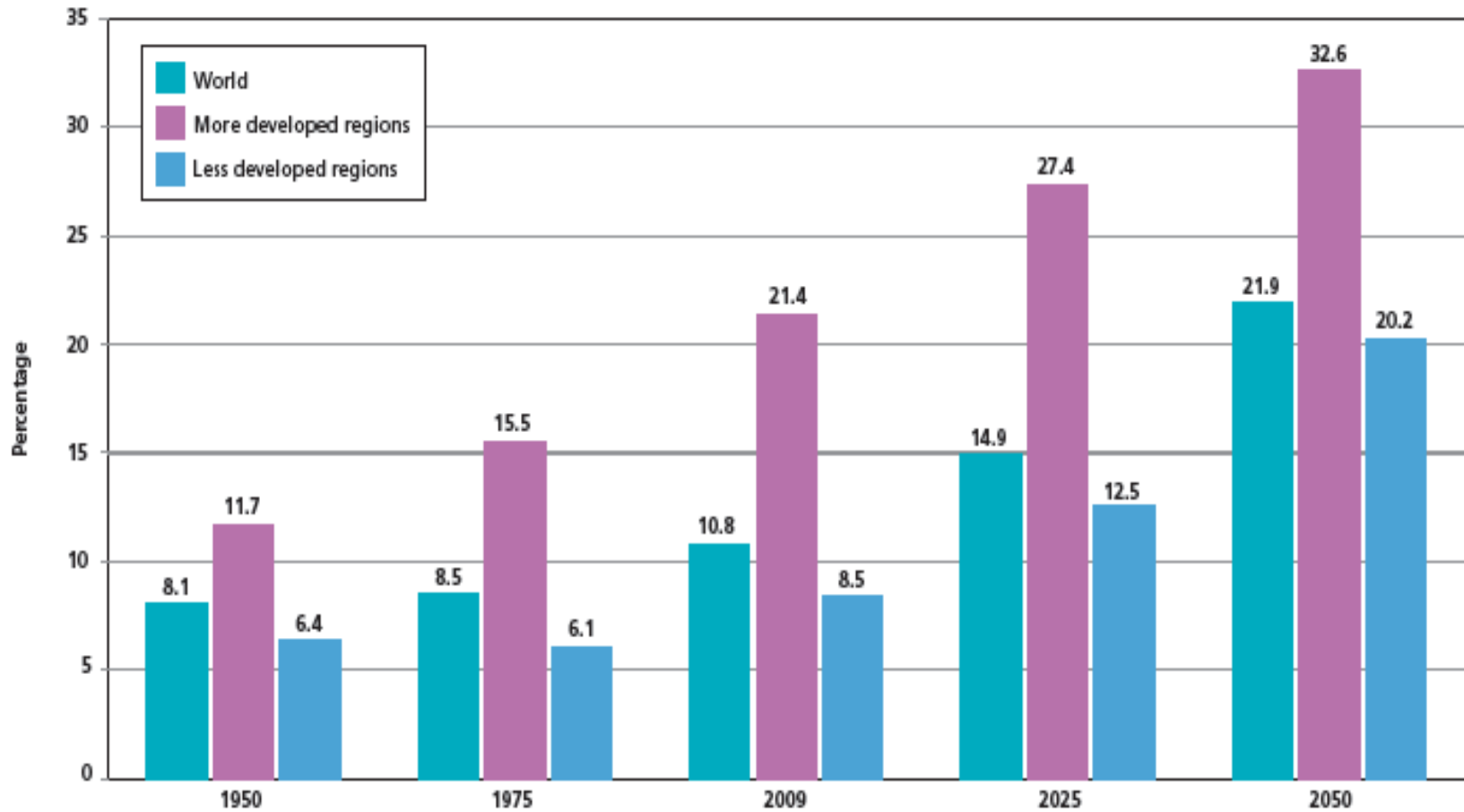


Data source: UN, World Population Prospects (2024)

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## Percentage of population aged 60 or over

World and development regions, 1950-2050

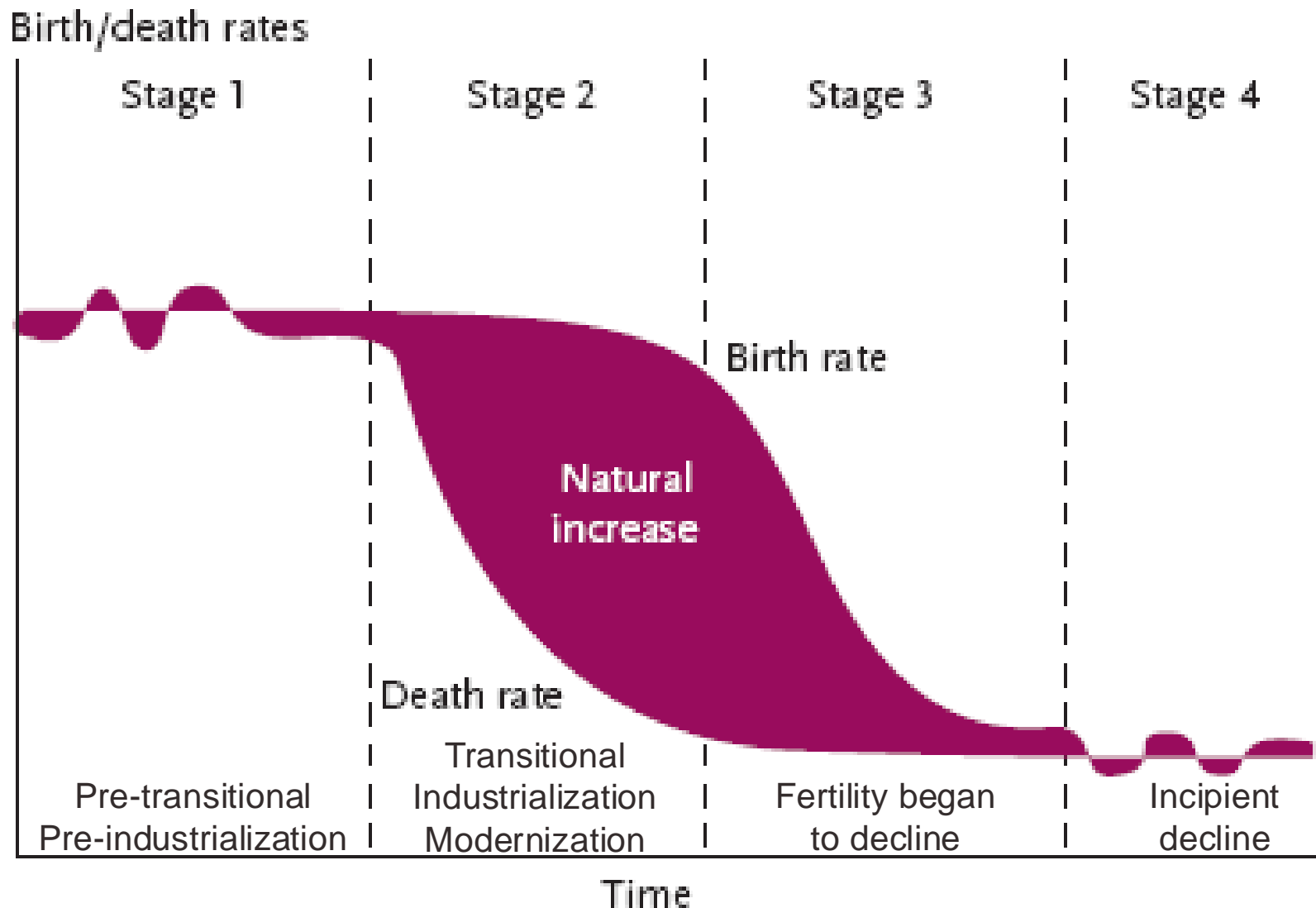






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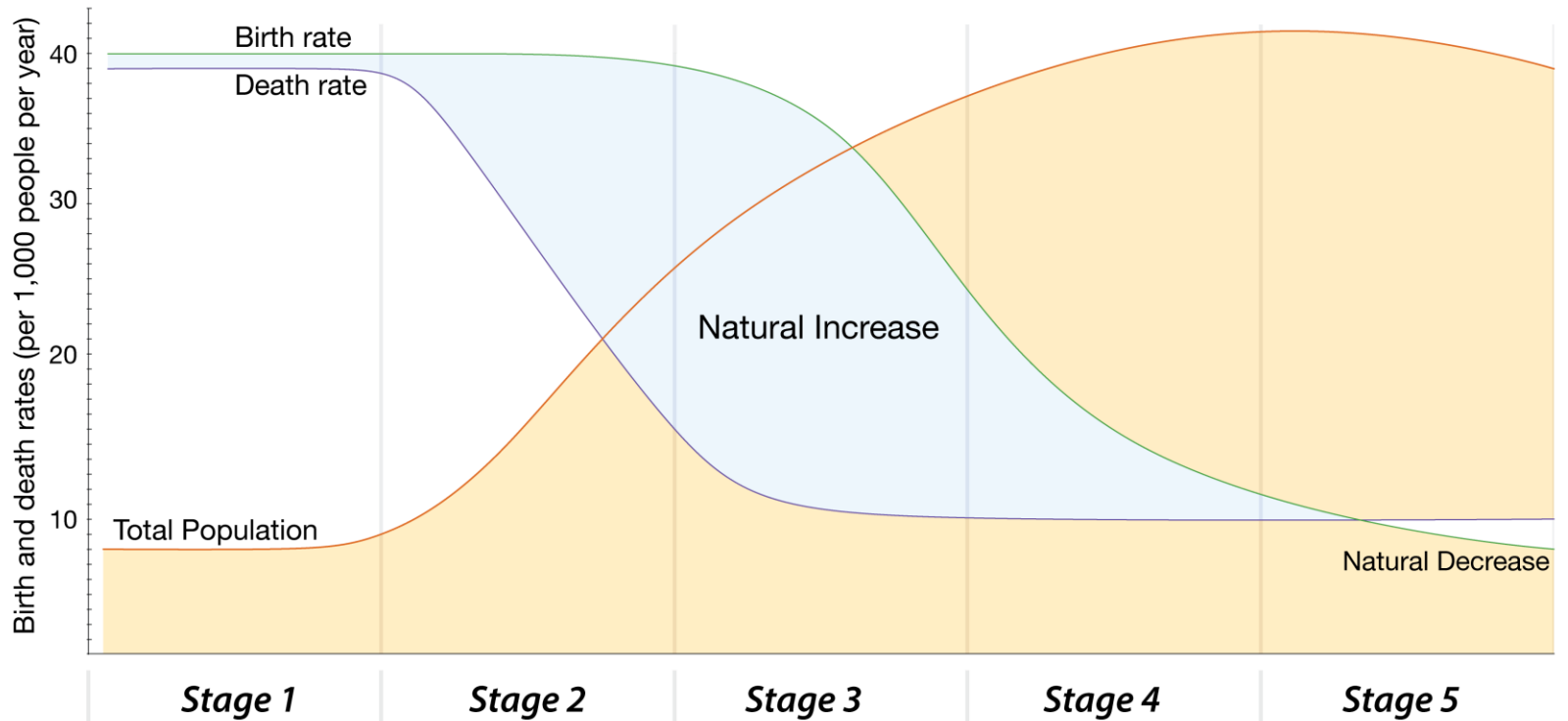
# Demographic transition





# Demographic transition

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**Birth rate**

High

High

Falling

Low

Very low

**Death rate**

High

Falls rapidly

Falls more slowly

Low

Low

**Natural increase**

Stable or slow increase

Very rapid increase

Increase slows down

Stable or slow increase

Stable or slow decrease

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# Doubling times

- Doubling time: time it would take a population to double at a given growth rate if the exponential model were exactly true (rule of 69.3)

$$K(t) = \exp(Rt) K(0)$$

$$K(T_{\text{double}}) = 2K(0) = \exp(R T_{\text{double}}) K(0)$$

$$2 = \exp(R T_{\text{double}})$$

$$\log(2) = R T_{\text{double}}$$

$$T_{\text{double}} = \log(2) / R \approx 0.6931 / R$$

- Halving time: if growth rate is negative, we would get how many years population would decrease by half



# World population and doubling times

| Date      | Population    | Growth rate<br>(R) | Doubling time<br>$\approx (0.6931 / R)$ |
|-----------|---------------|--------------------|---|
| 8000 B.C. | 5 million     | 0.000489           | 1417 years                              |
| 1 A.D.    | 250 million   | -0.000373          | -1858 years                             |
| 600       | 200 million   | 0.000558           | 1272 years                              |
| 1000      | 250 million   | 0.001465           | 473 years                               |
| 1750      | 750 million   | 0.004426           | 157 years                               |
| 1815      | 1,000 million | 0.006957           | 100 years                               |
| 1950      | 2,558 million | 0.018753           | 37 years                                |
| 1975      | 4,088 million | 0.015937           | 43 years                                |
| 2000      | 6,089 million |                    |   |

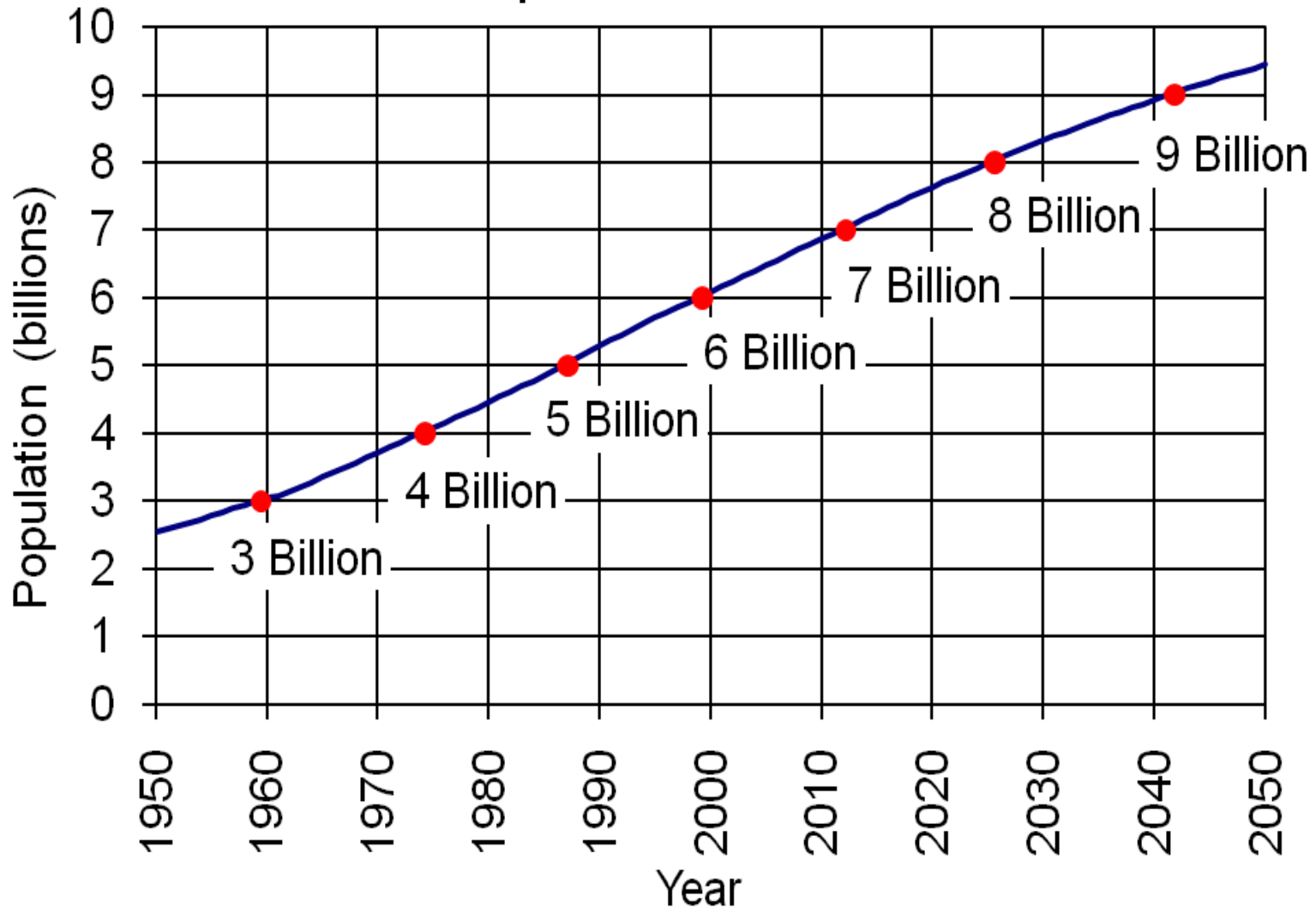
Source: Estimates drawn from Cohen (1995) and IDB (2012). Wachter 2014, p. 25.



# Population storm

| <b>Year</b> | <b>Population<br/>in billions</b> | <b>Annual rate<br/>of growth</b> | <b>Annual increase<br/>in millions</b> |
|-------------|-----------------------------------|----------------------------------|--|
| <b>1804</b> | <b>1</b>                          | <b>0.4</b>                       | <b>4</b>                               |
| <b>1927</b> | <b>2</b>                          | <b>1.1</b>                       | <b>22</b>                              |
| <b>1960</b> | <b>3</b>                          | <b>1.3</b>                       | <b>52</b>                              |
| <b>1974</b> | <b>4</b>                          | <b>2.0</b>                       | <b>75</b>                              |
| <b>1987</b> | <b>5</b>                          | <b>1.6</b>                       | <b>82</b>                              |
| <b>2000</b> | <b>6</b>                          | <b>1.4</b>                       | <b>77</b>                              |
| <b>2011</b> | <b>7</b>                          | <b>1.2</b>                       | <b>80</b>                              |
| <b>2024</b> | <b>8</b>                          | <b>0.9</b>                       | <b>73</b>                              |
| <b>2040</b> | <b>9</b>                          | <b>0.7</b>                       | <b>59</b>                              |
| <b>2061</b> | <b>10</b>                         | <b>0.4</b>                       | <b>38</b>                              |

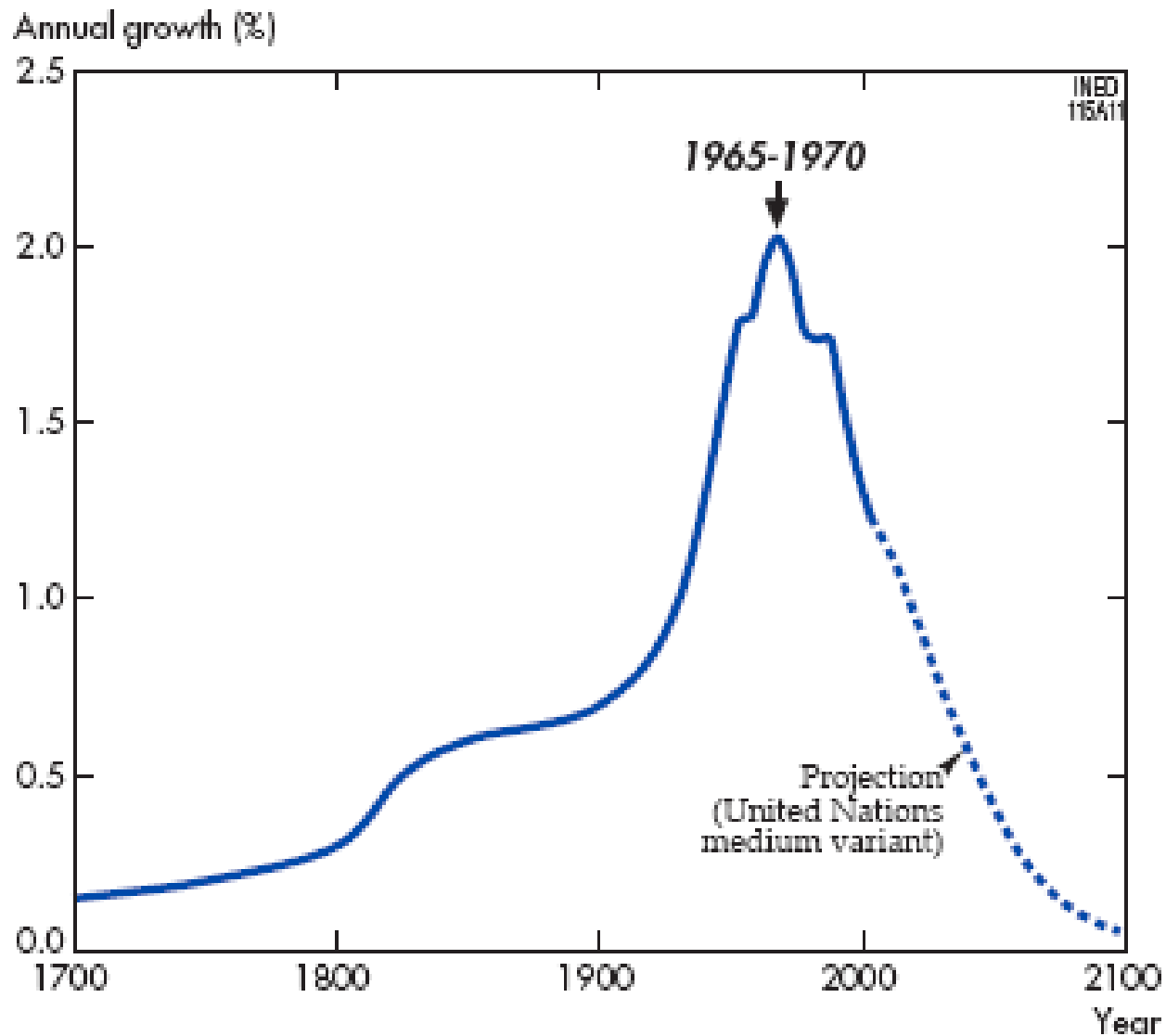
# World Population: 1950-2050



Source: U.S. Census Bureau, International Data Base, June 2011 Update.

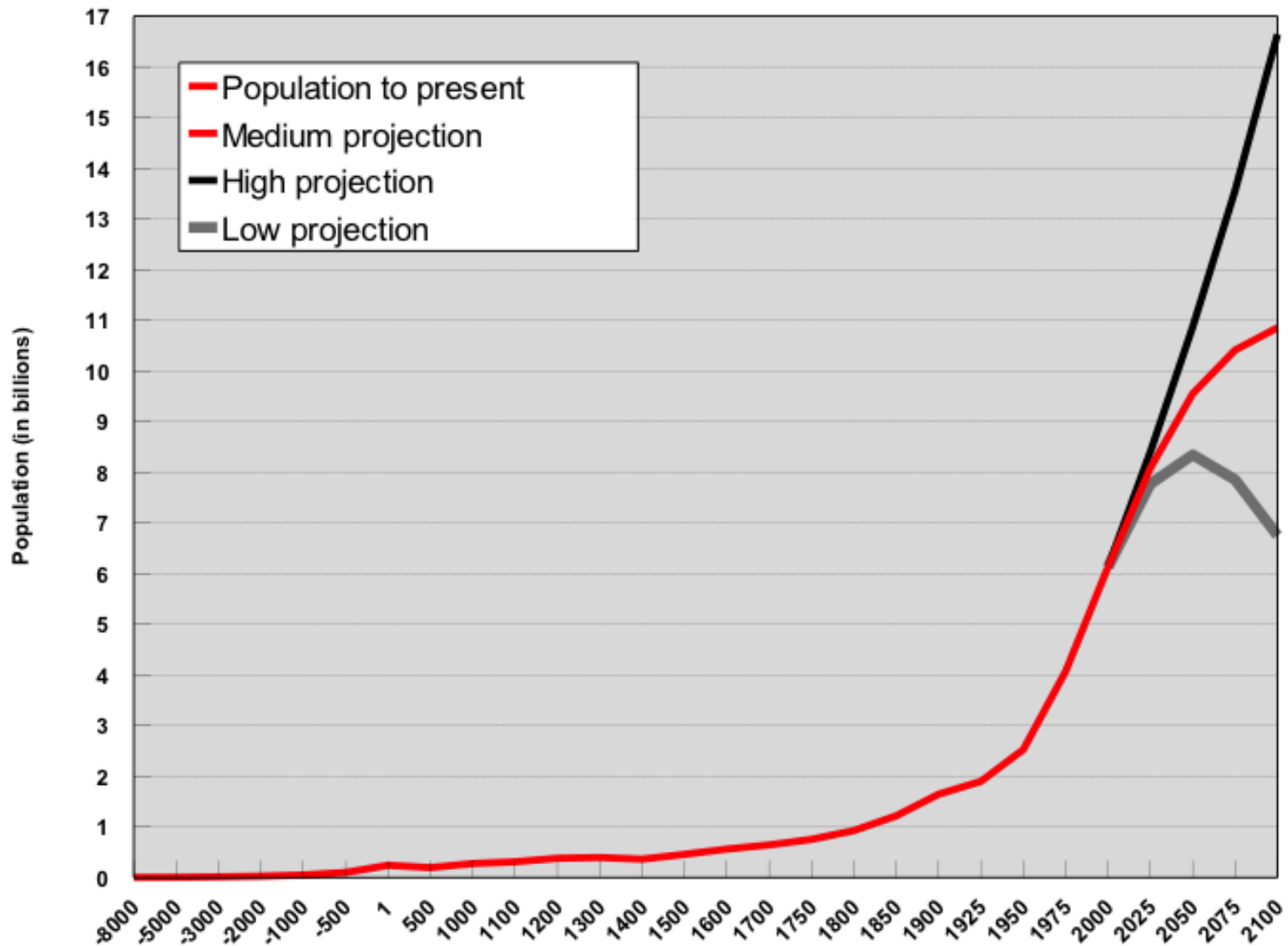


# World population growth rates

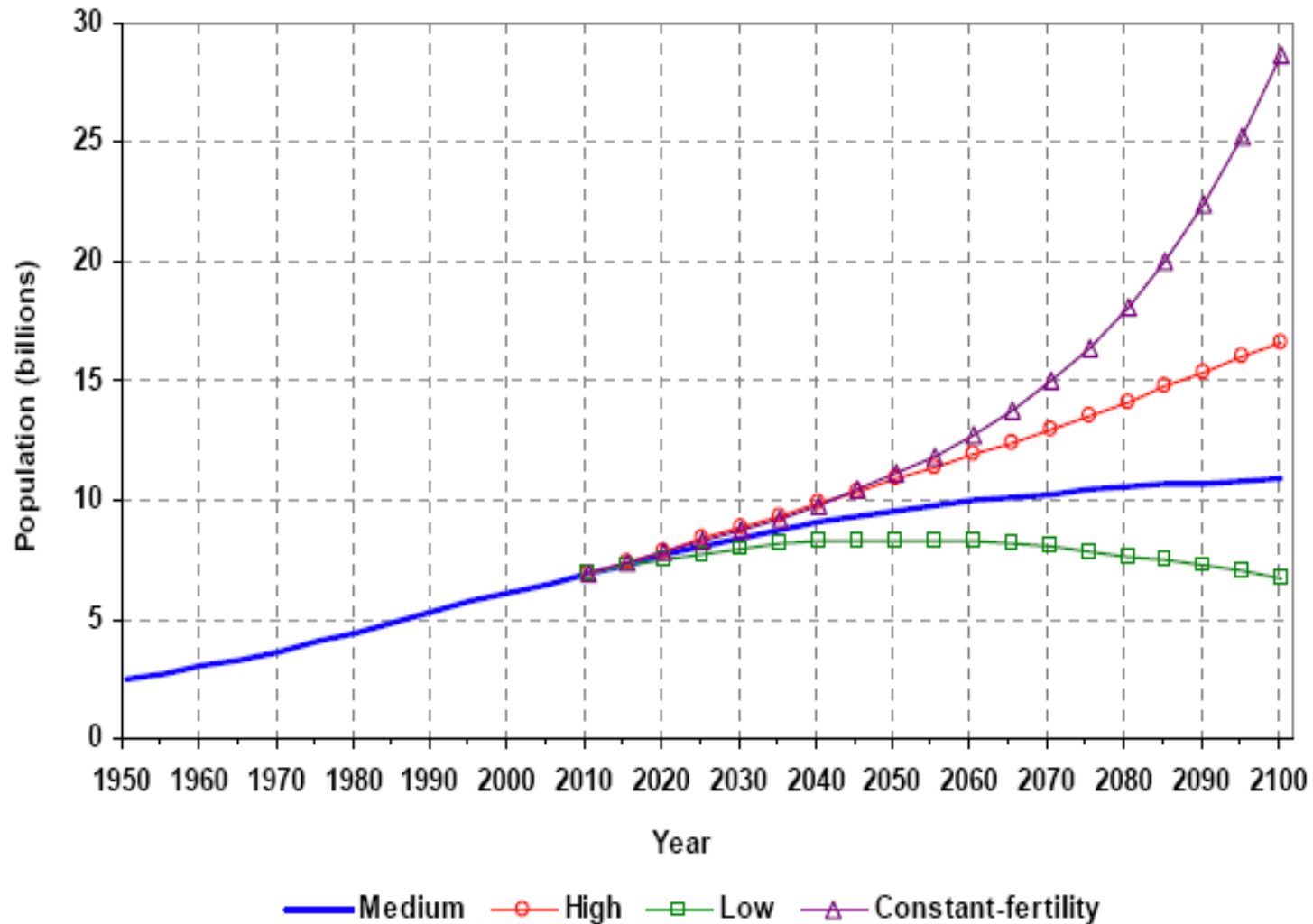




# World's population exploded in size



# Population of the world according to different projections and variants, 1950–2100



# Population size in billions

| <b>Continent</b> | <b>2013</b> | <b>2050</b> | <b>2100</b> |
|------------------|-------------|-------------|-------------|
| America          | 1           | 1           | 1           |
| Europe           | 1           | 1           | 1           |
| Africa           | 1           | 2           | 4           |
| Asia             | 4           | 5           | 5           |
| <b>Total</b>     | <b>7</b>    | <b>9</b>    | <b>11</b>   |



# Population size in billions

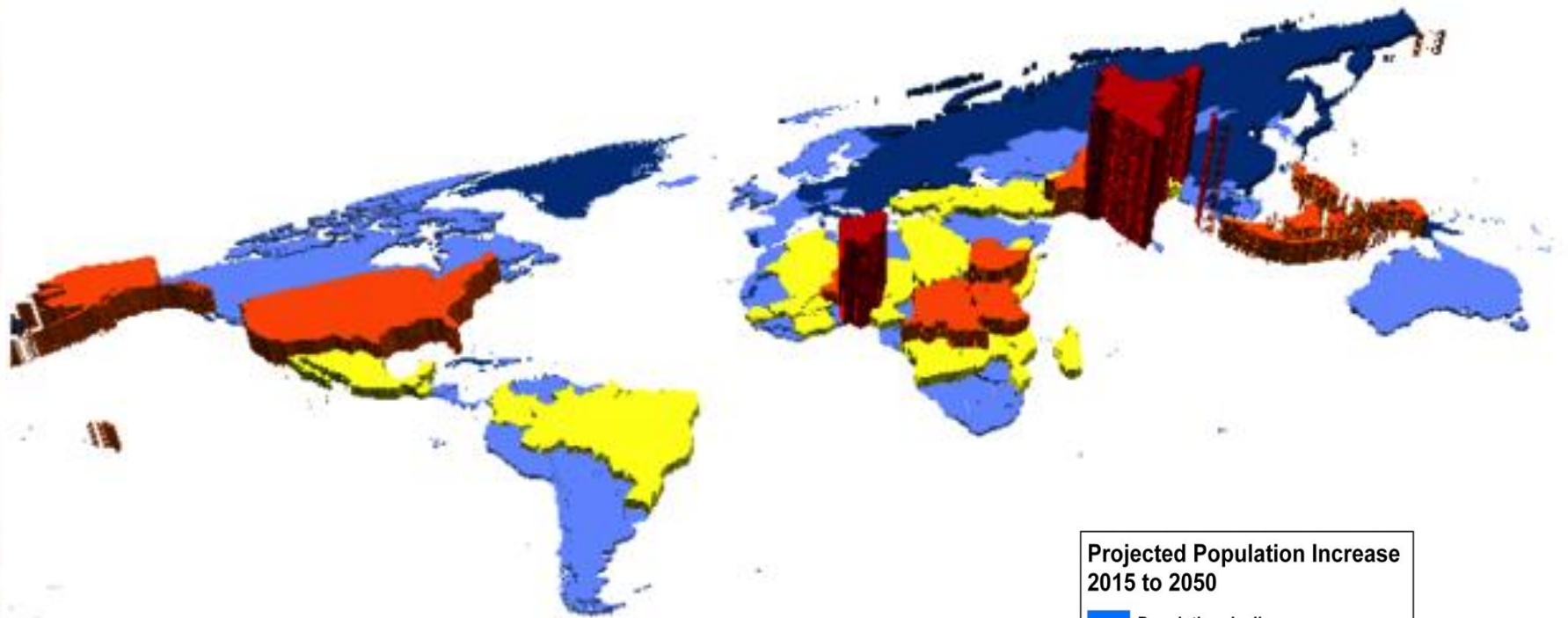
| Age group    | 2013     | 2024     | 2050     | 2100      |
|--------------|----------|----------|----------|-----------|
| 75+          |          |          |          | 1         |
| 60–74        | 1        | 1        | 1        | 2         |
| 45–59        | 1        | 1        | 2        | 2         |
| 30–44        | 1        | 2        | 2        | 2         |
| 15–29        | 2        | 2        | 2        | 2         |
| 0–14         | 2        | 2        | 2        | 2         |
| <b>Total</b> | <b>7</b> | <b>8</b> | <b>9</b> | <b>11</b> |

# Population growth

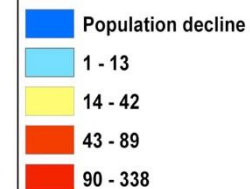
- The world's population will continue to increase for the rest of our lives
- Virtually all of it will take place in cities of developing countries



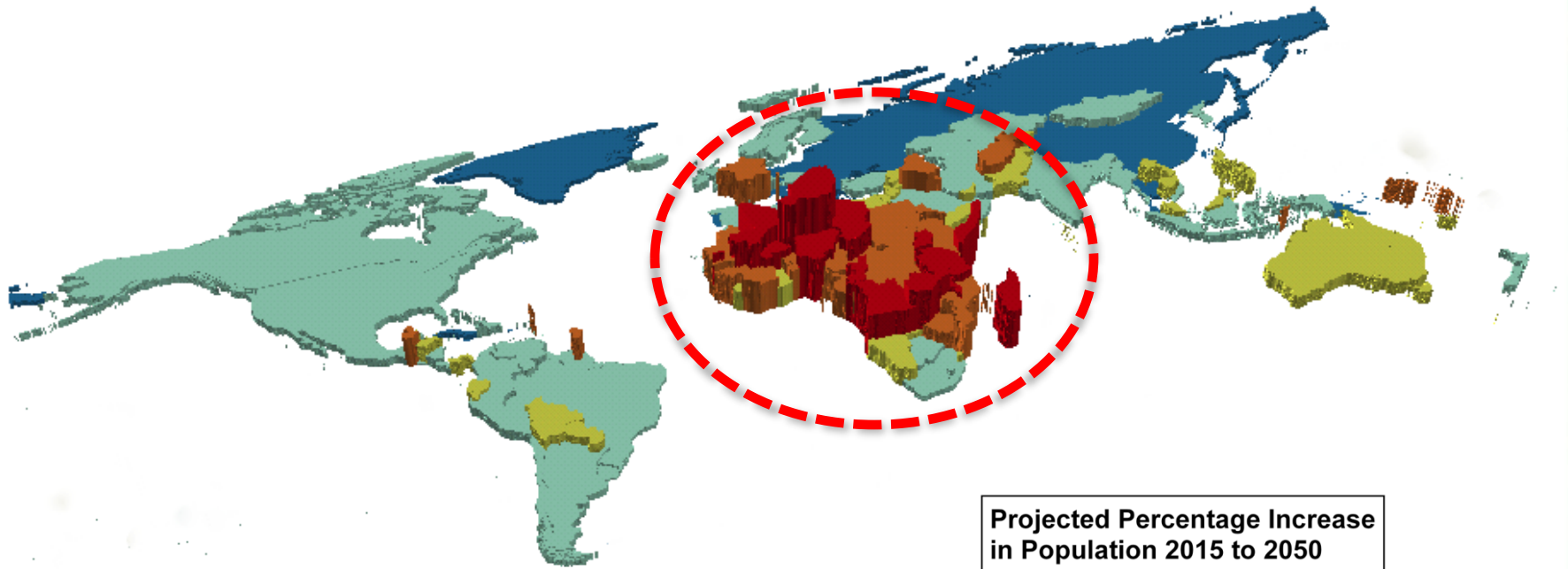
# Population increase 2015–2050



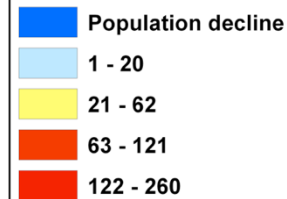
Projected Population Increase  
2015 to 2050



# Percentage population increase 2015–2050

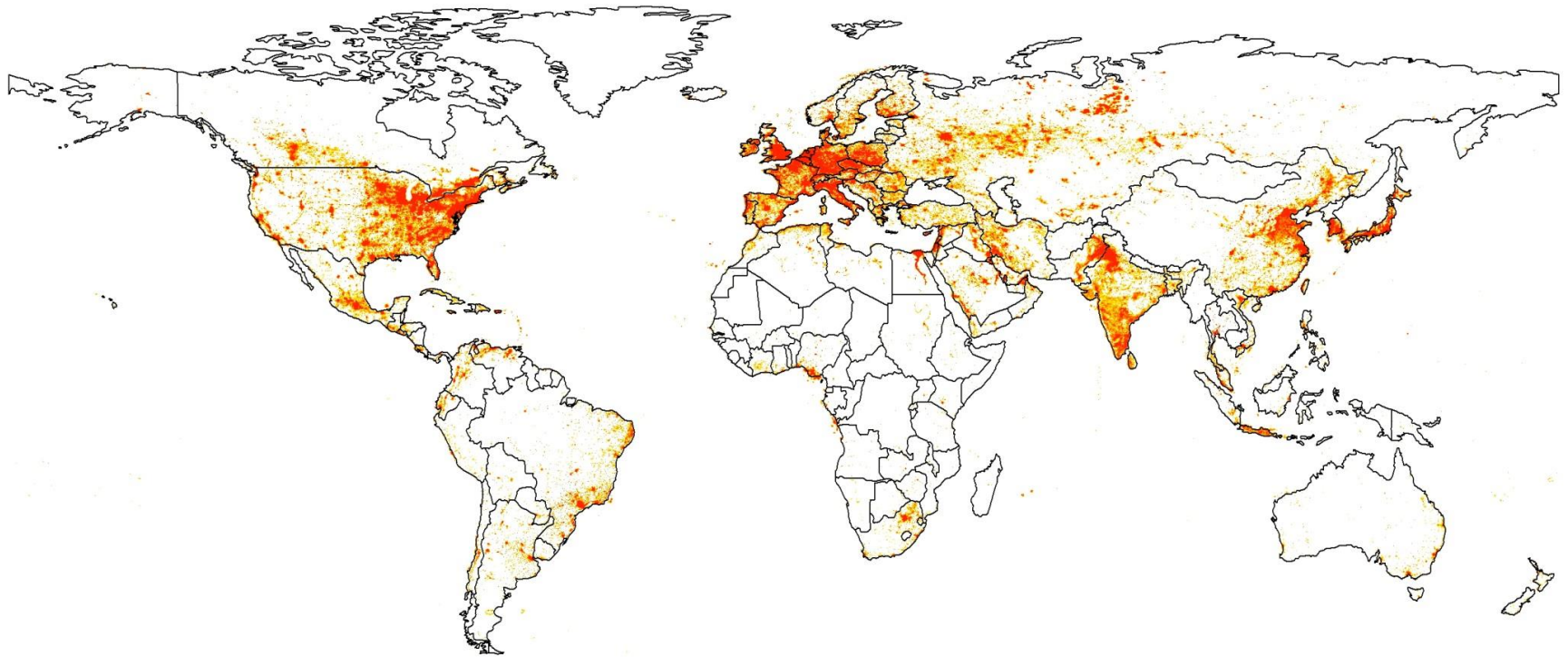


**Projected Percentage Increase  
in Population 2015 to 2050**





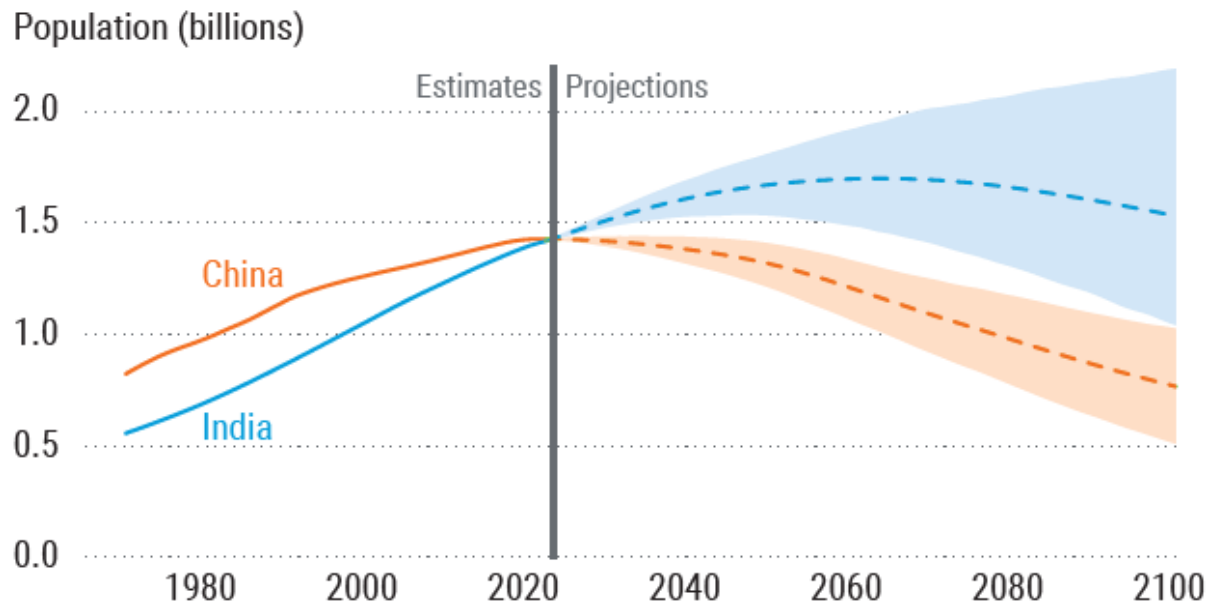
# Geographic distribution of world's population, 2015



# In April 2023, India's population surpassed the population of mainland China

Figure 1

**Trends in total population for China and India, estimates for 1970-2022 and projections for 2023-2100 (with 95 per cent prediction intervals)**

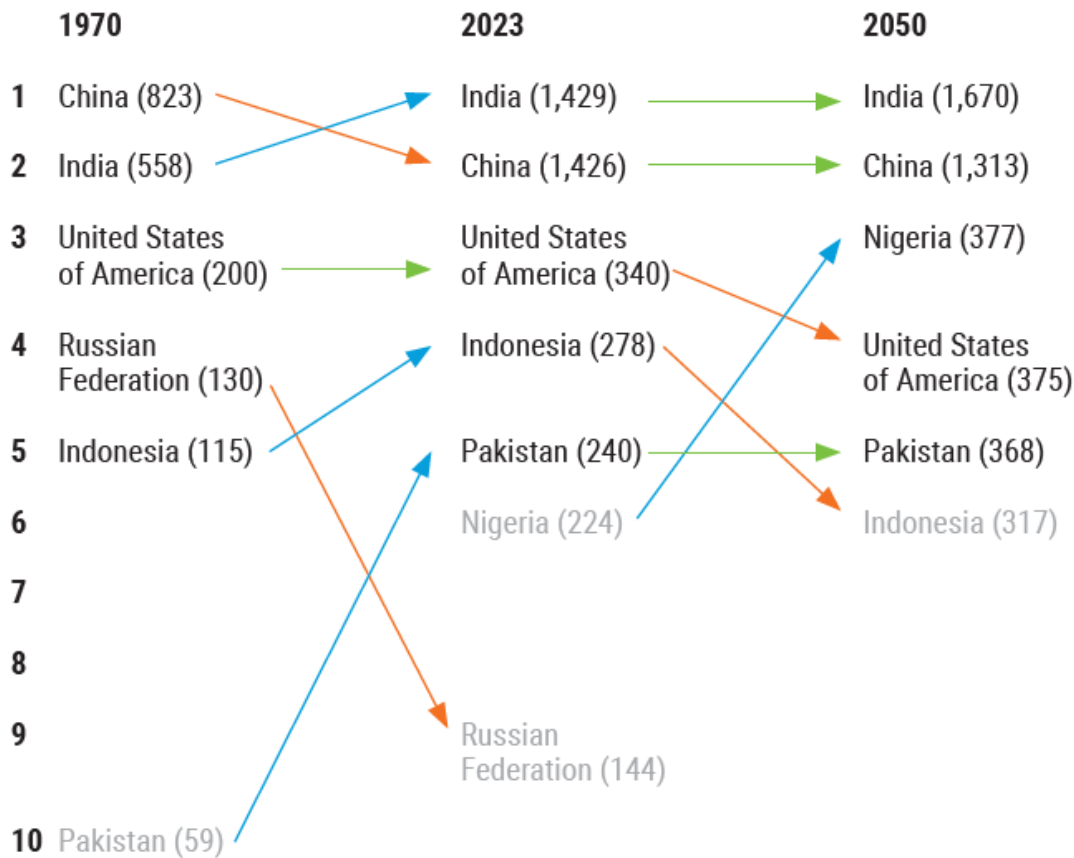


**Data source:** United Nations, *World Population Prospects 2022*, <https://population.un.org/wpp/>.



Figure 2

## Top five most populous countries, estimates for 1970 and projections for 2023 and 2050



**Note:** Numbers in parentheses refer to total population (in millions) on 1 July of the referenced year.

**Data source:** United Nations, *World Population Prospects 2022*, <https://population.un.org/wpp/>.



# References

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