

# World population change over time

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# Outline

- Five contemporary aspects of importance of demography
- Demographic transition
- Age-sex structure
- Global population trends (extra)

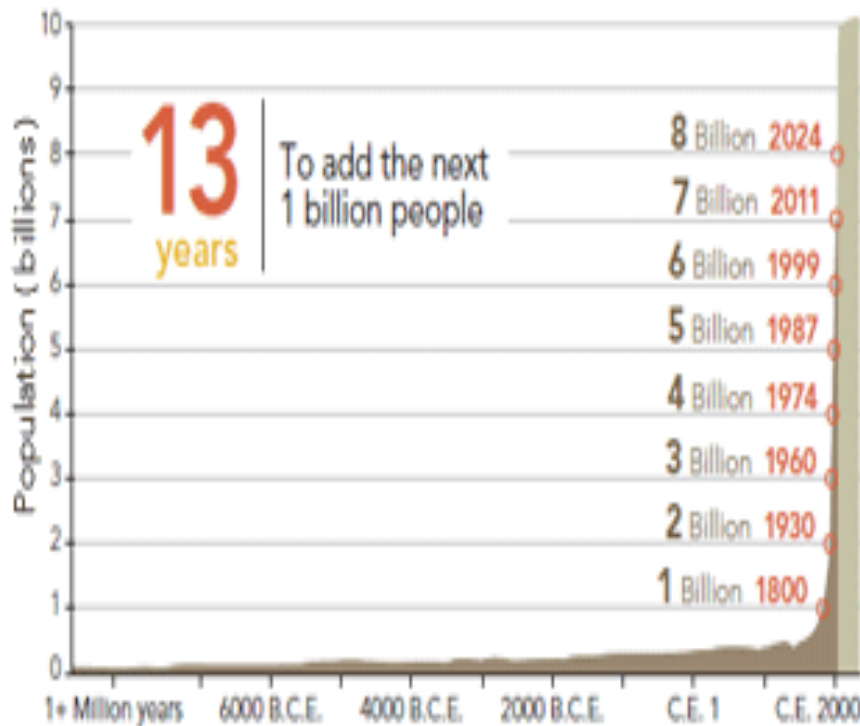
# Five contemporary aspects of importance of demography

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 ageing

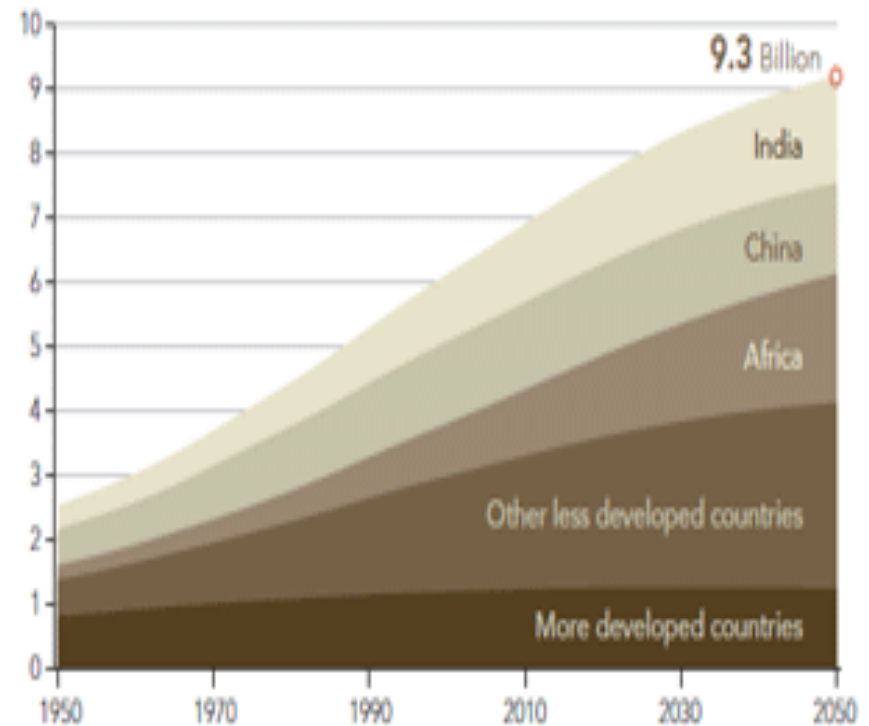


# 1. The greatest demographic change in human history

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



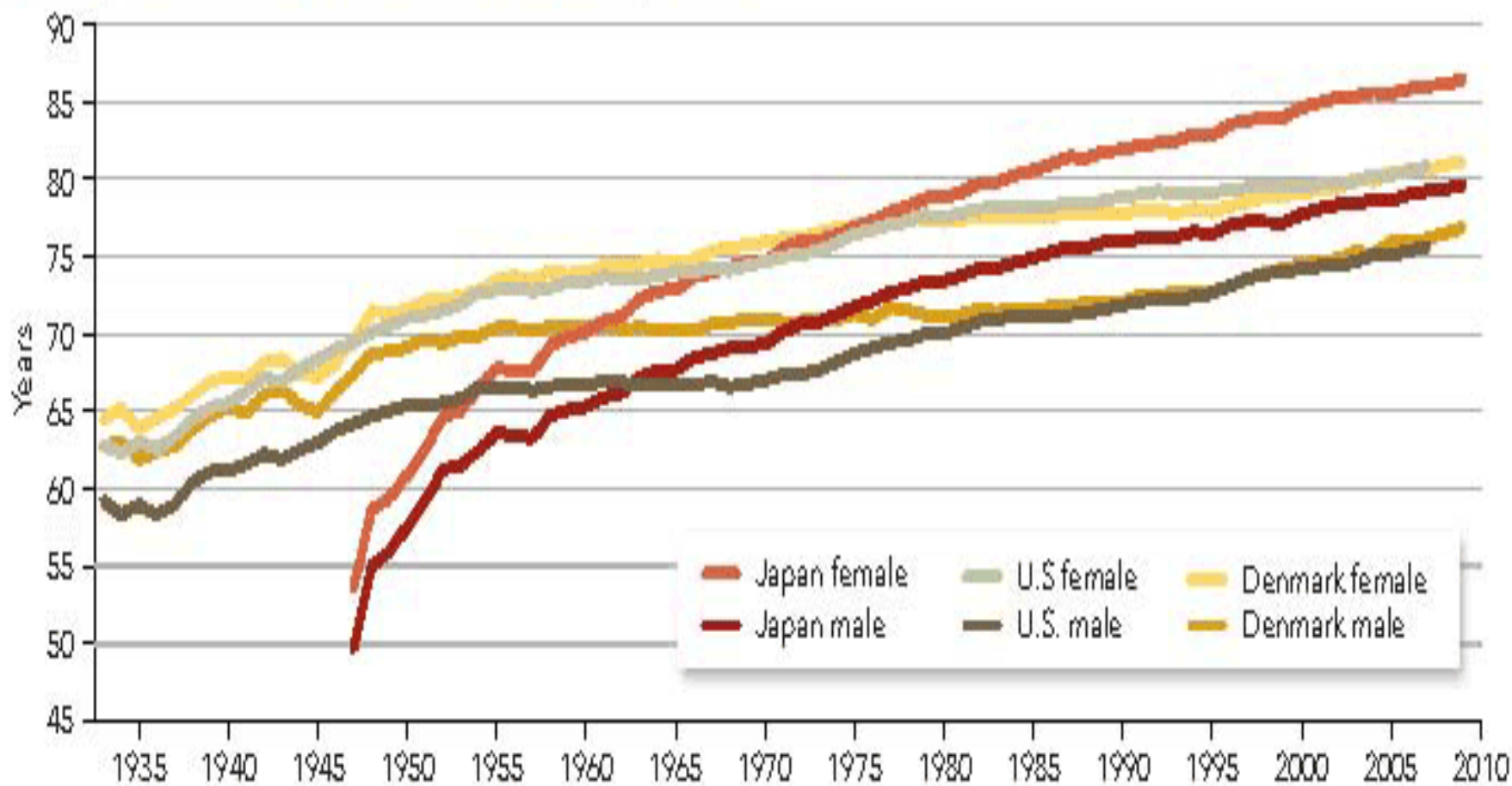
## 2. Spectacular gains in life expectancy

- Over the past two centuries
- Especially since the end of WWII
- Most important thing in human history
- Consequence and cause of a new way of viewing the world
- Transitions that accompanied it have been enormously transformative



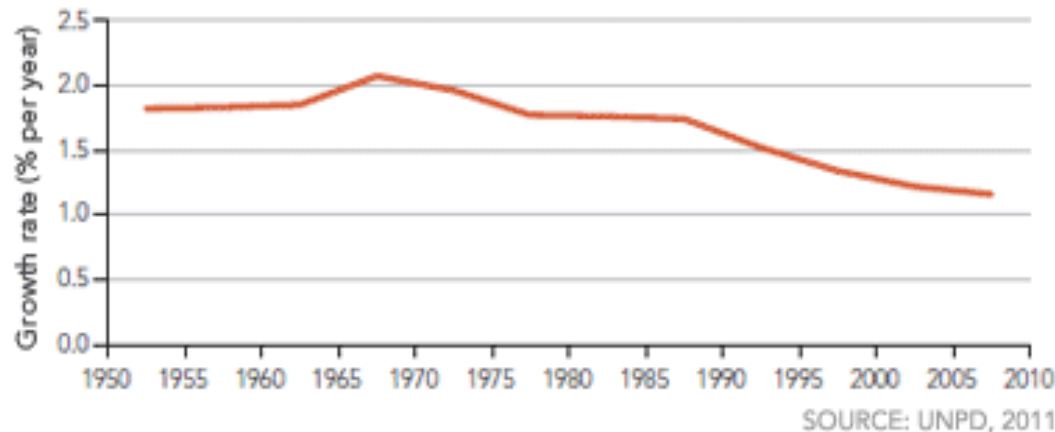
# Rise in life expectancy

Longer Lived With Each Passing Year



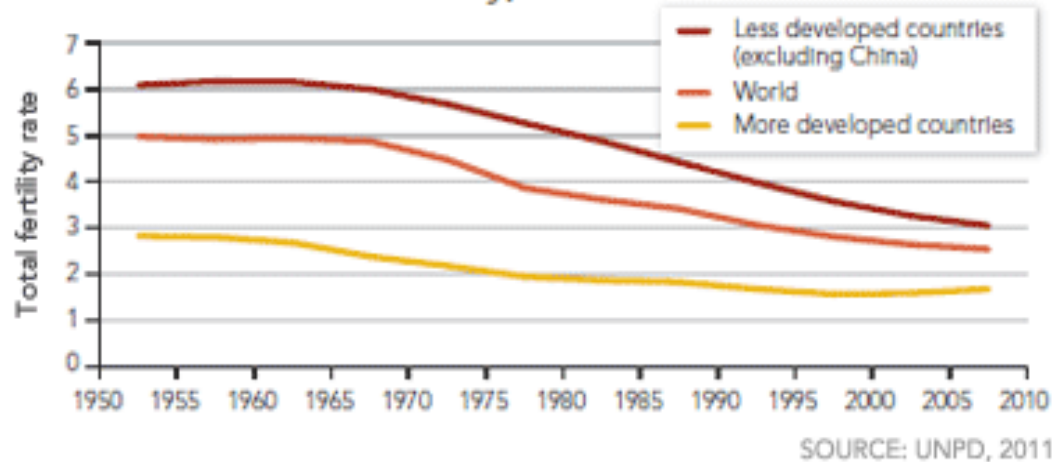
# 3. Below replacement fertility

Population Growth Rate, 1950–2010



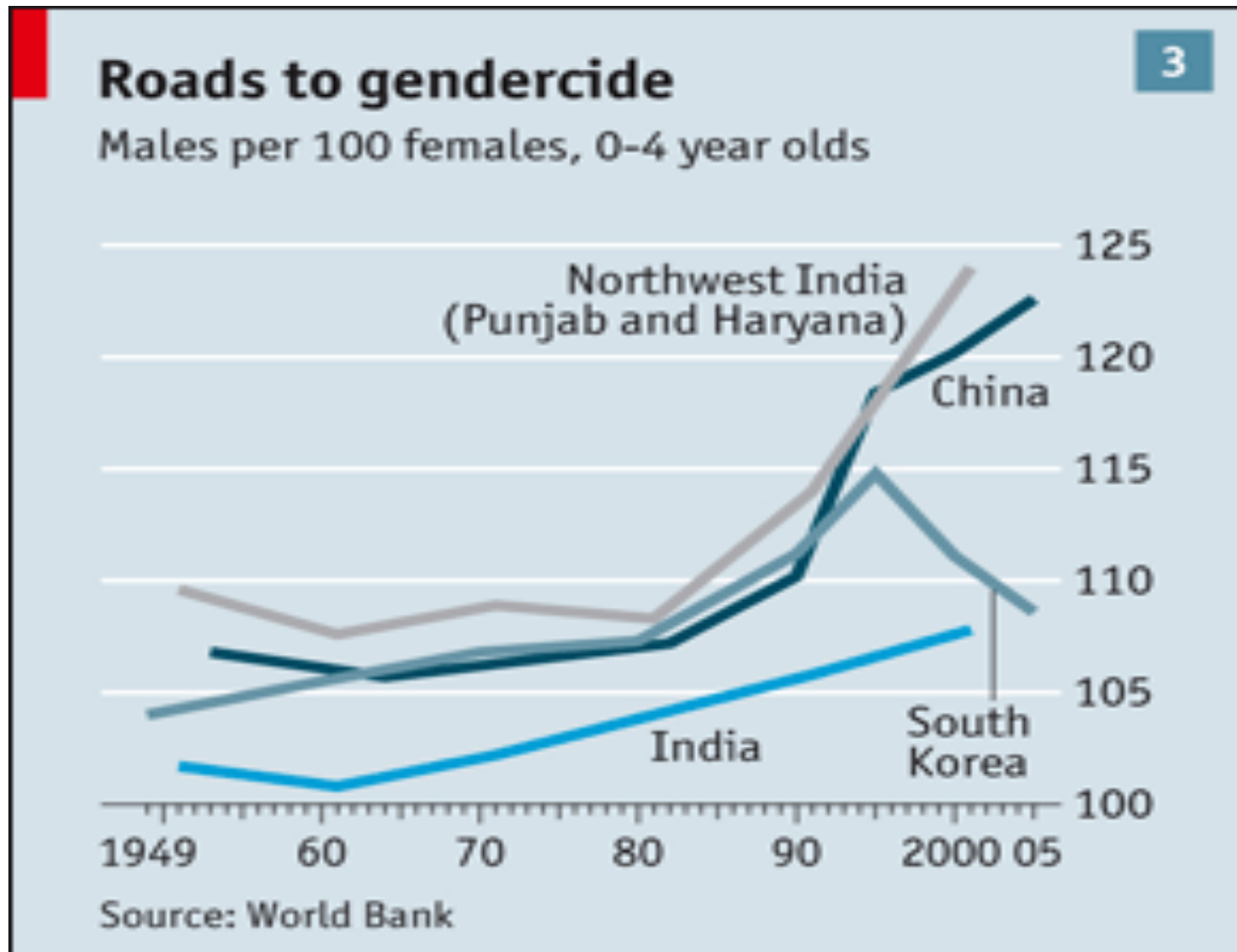
**Tipping point.** The period of most rapid population growth is behind us. Since its peak in 1965–70, the growth rate has declined, falling roughly by half in 40 years as women have had fewer children.

Global Decline in Fertility, 1950–2010



**More women, fewer kids.** The global fertility rate has dropped from 5 to 2.5 in roughly 50 years, and the average woman in developing countries (outside of China) now has three children, down from six.

## 4. Unbalanced sex ratios at birth



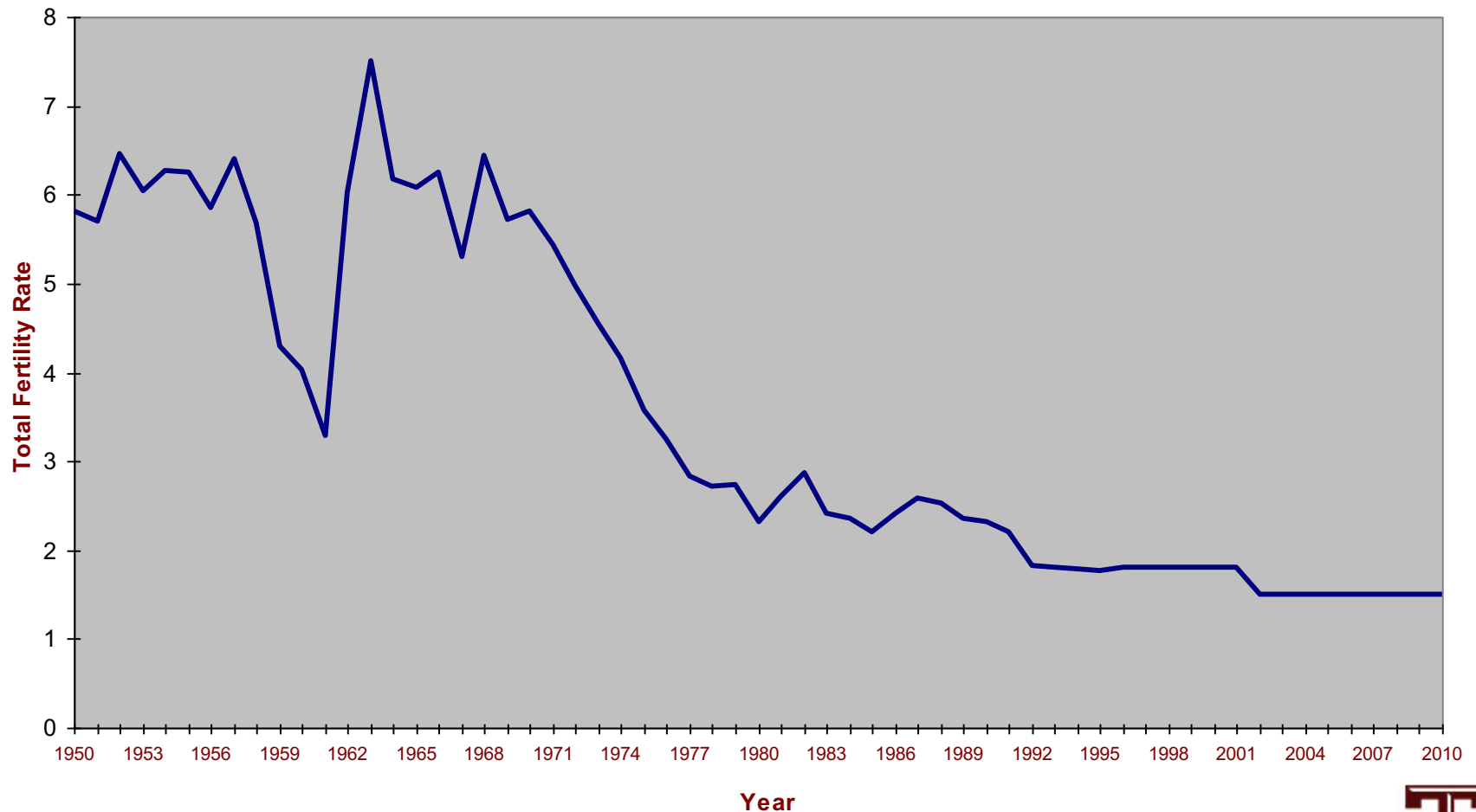
# Sex ratio at birth in China

- 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

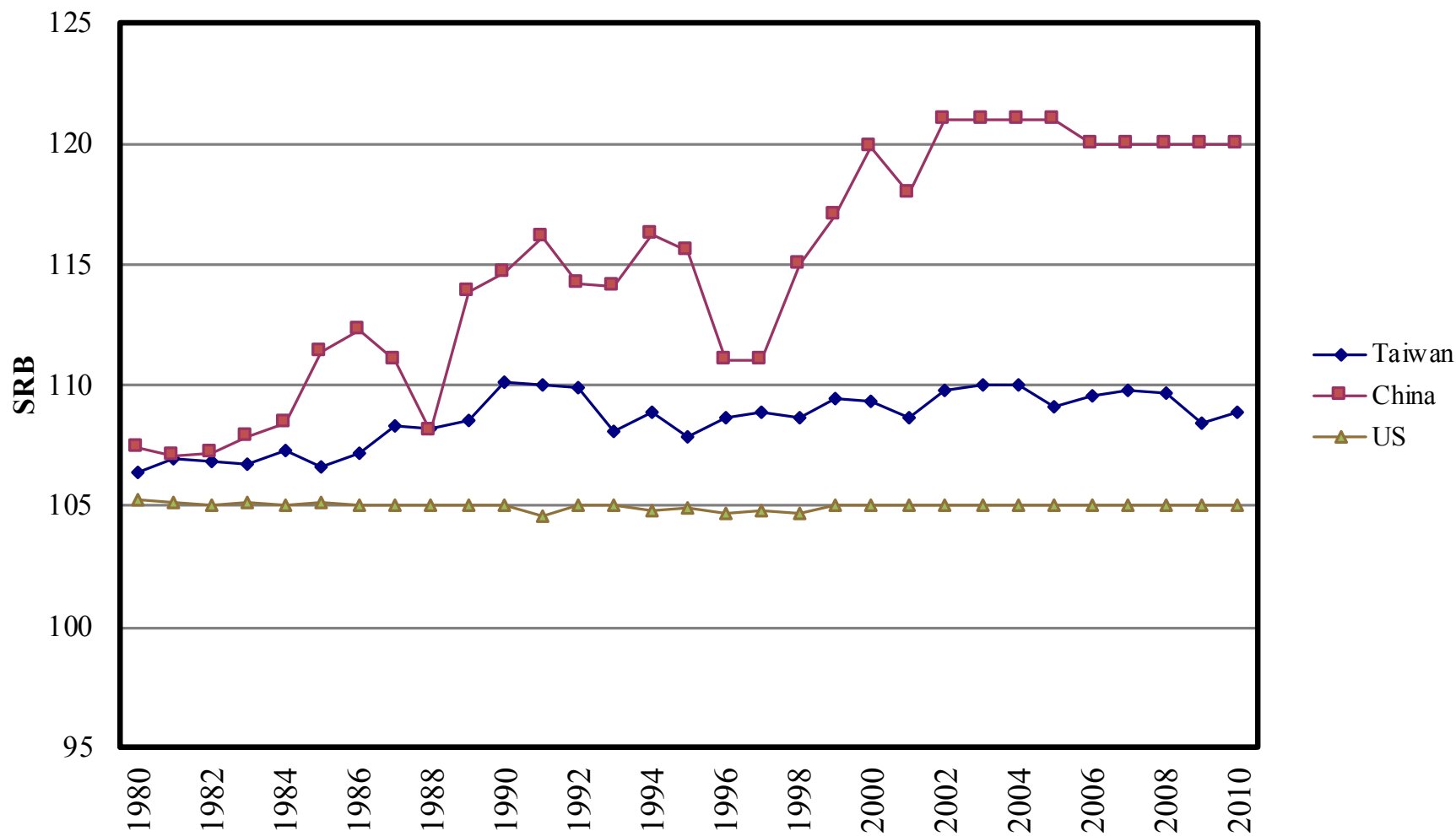




# Total fertility rates in China, 1950–2010



# Sex ratios at birth, Taiwan, China, and United States



# 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



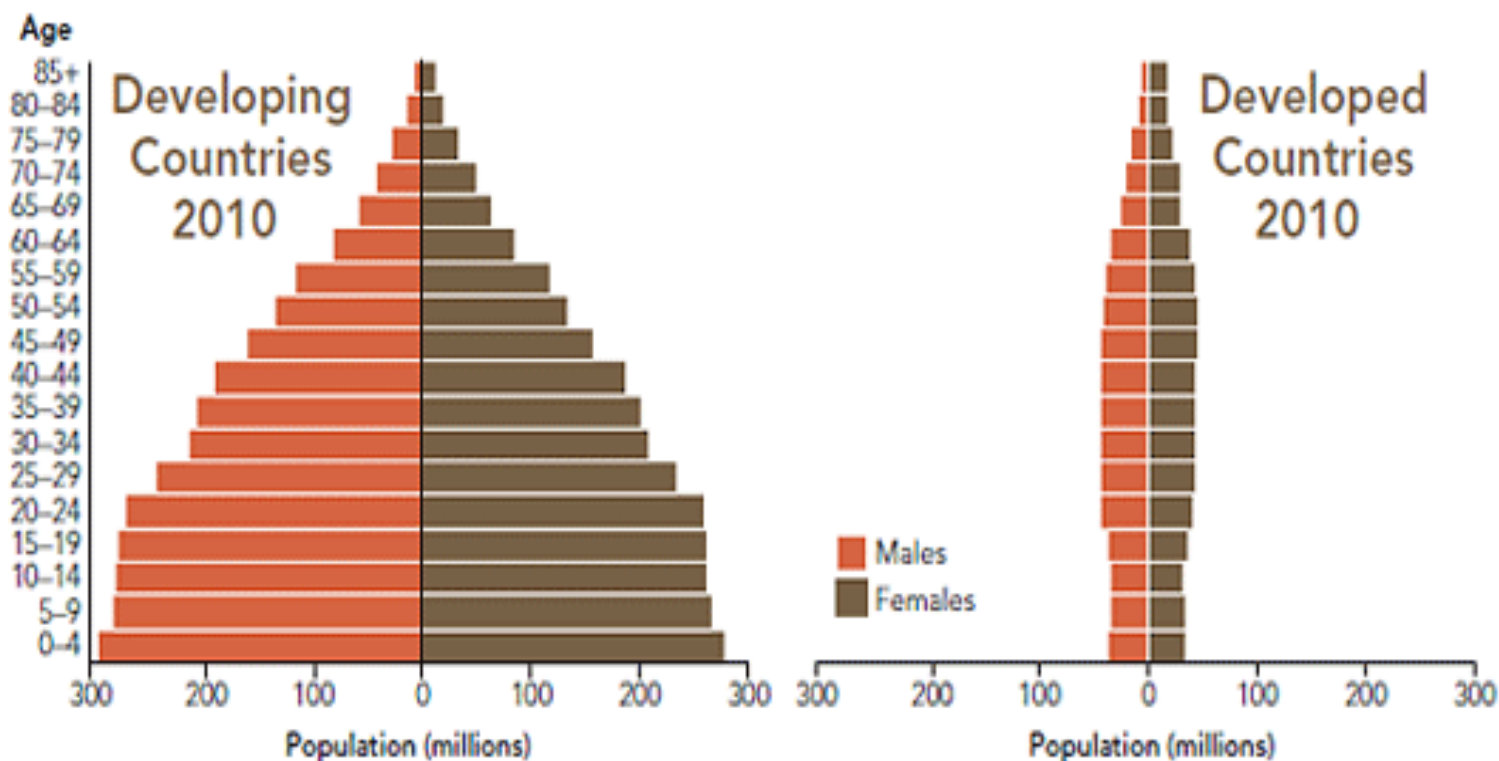
# HIV

- 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 ageing



SOURCE: UNPD, 2011

## By the numbers

**43%**

Population <15,  
sub-Saharan Africa

**3%**

Population 65+,  
sub-Saharan Africa

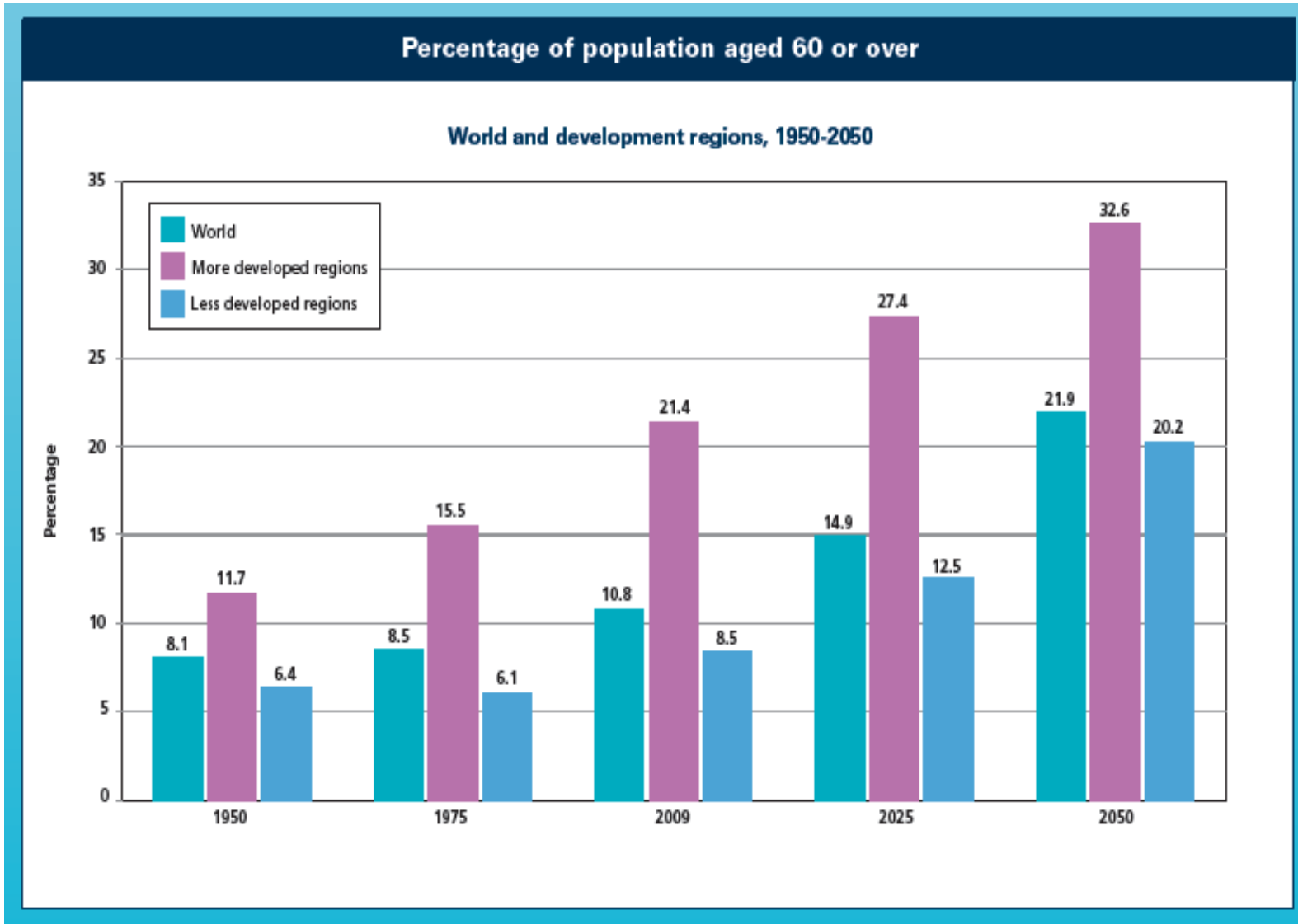
**16%**

Population <15,  
Europe

**16%**

Population 65+,  
Europe

# 5. Population ageing

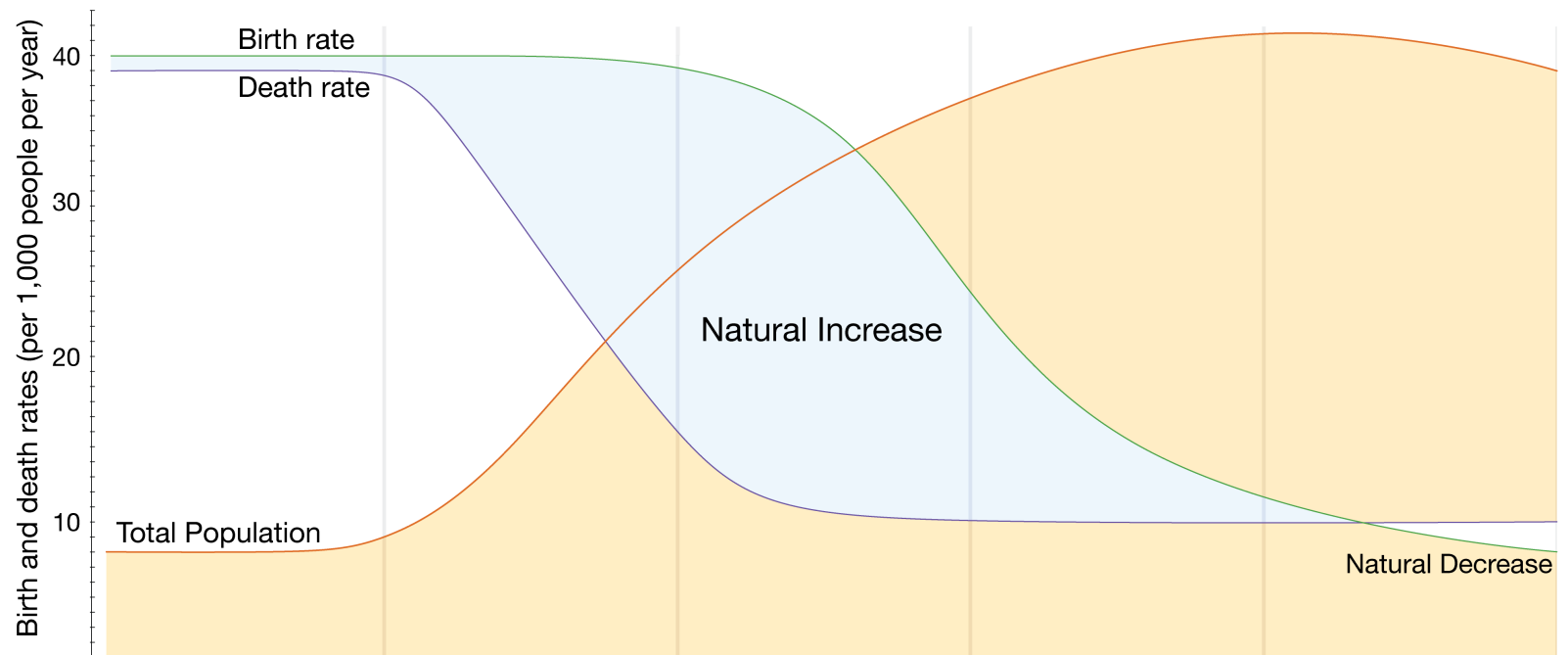




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# Demographic transition

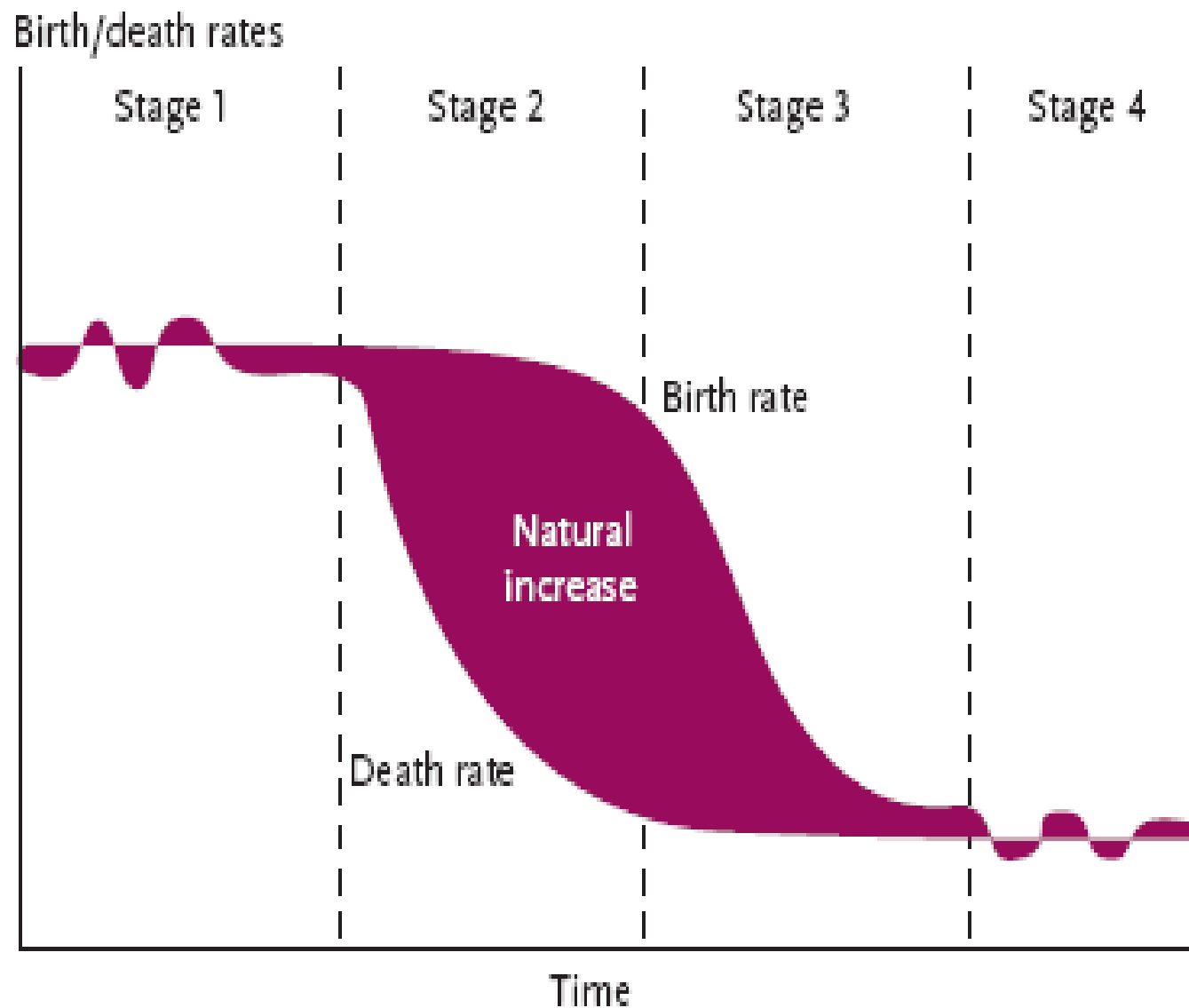
Our World  
in Data



	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
<b>Birth rate</b>	High	High	Falling	Low	Very low
<b>Death rate</b>	High	Falls rapidly	Falls more slowly	Low	Low
<b>Natural increase</b>	Stable or slow increase	Very rapid increase	Increase slows down	Stable or slow increase	Stable or slow decrease

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# The Classic Stages of Demographic Transitions

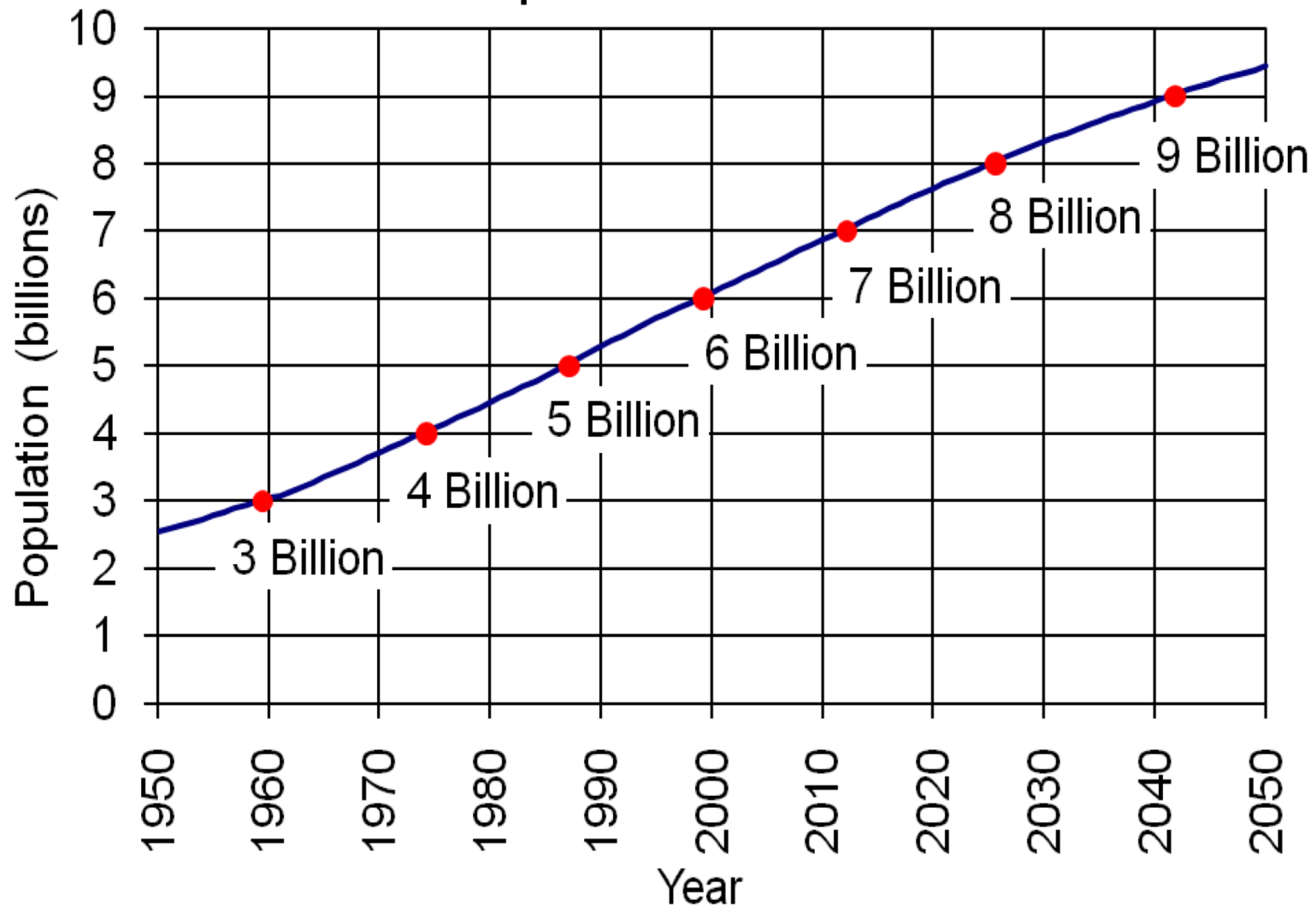




# Population storm

<b>Year</b>	<b>Population in billions</b>	<b>Annual rate of growth</b>	<b>Annual increase 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>

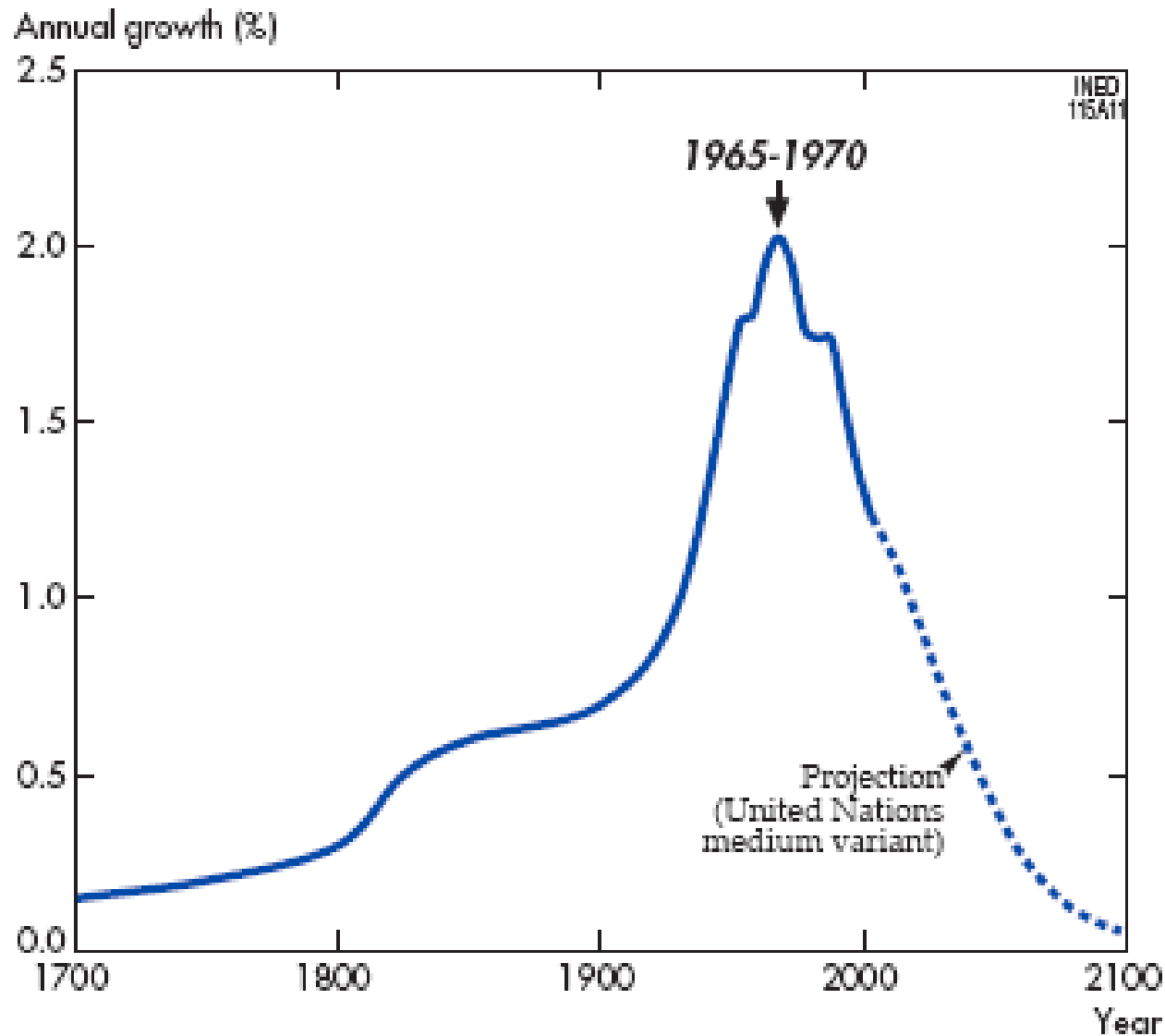
# World Population: 1950-2050



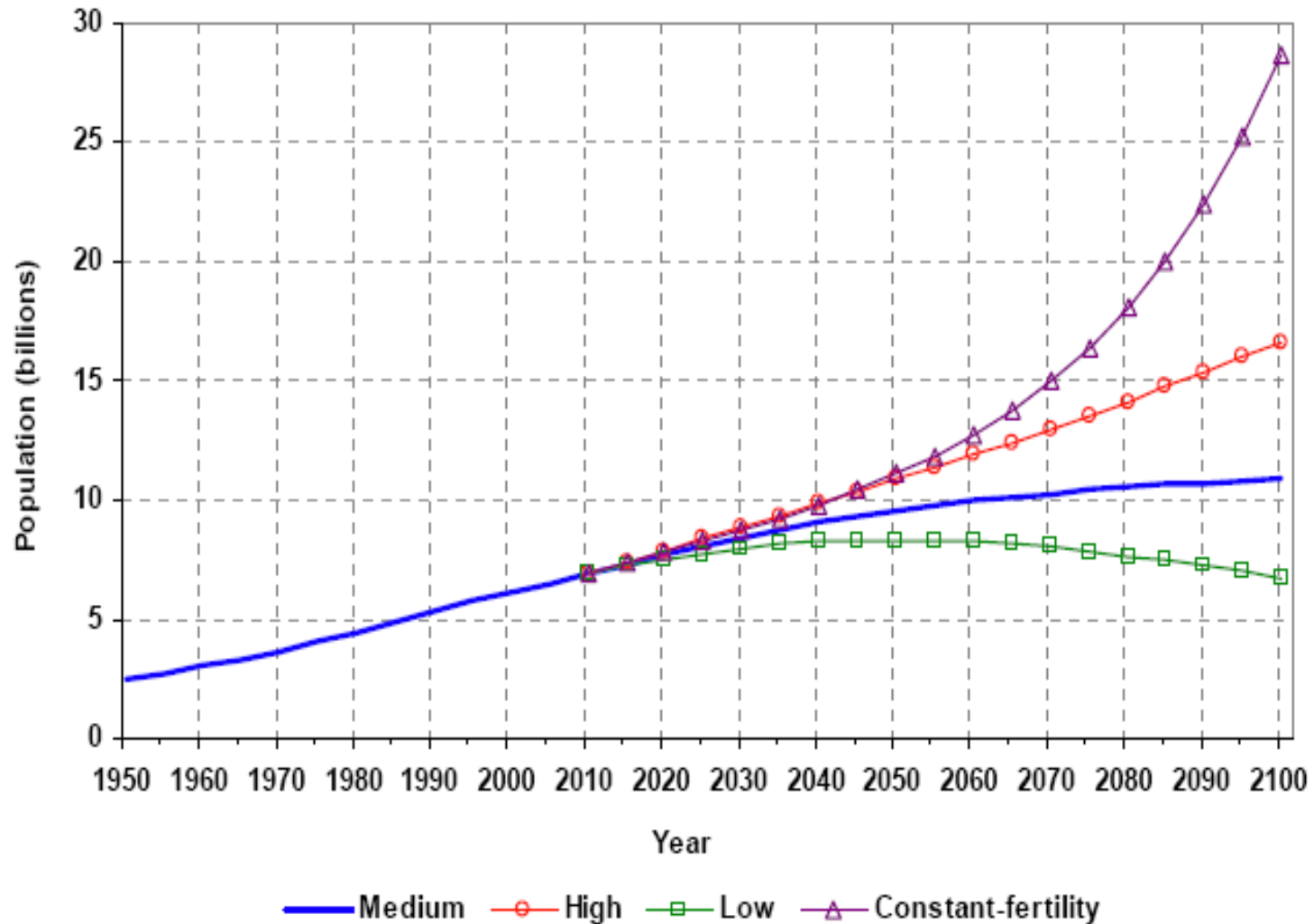
Source: U.S. Census Bureau, International Data Base, June 2011 Update.



# World population growth rates



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



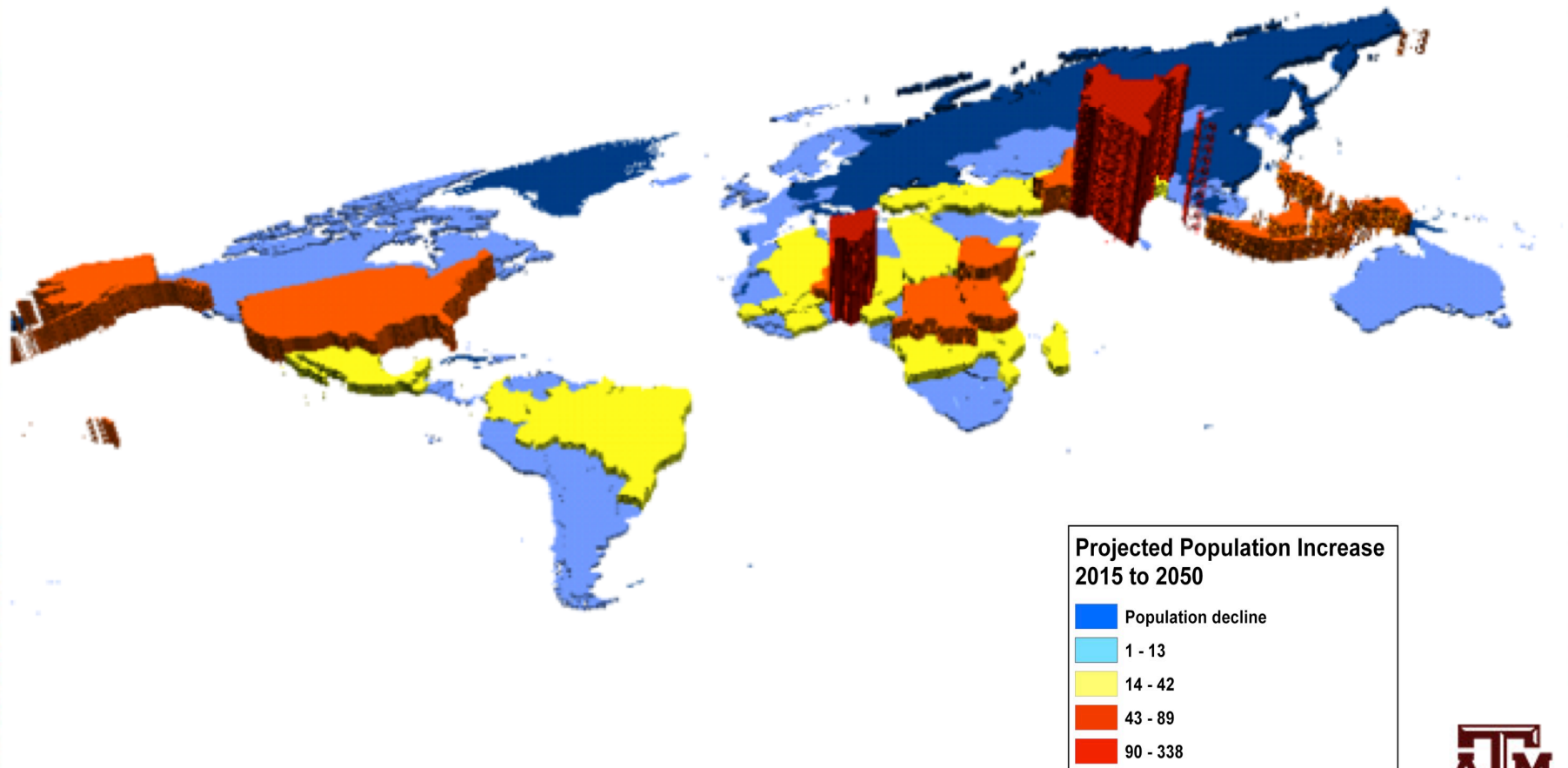
# Population growth

- 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

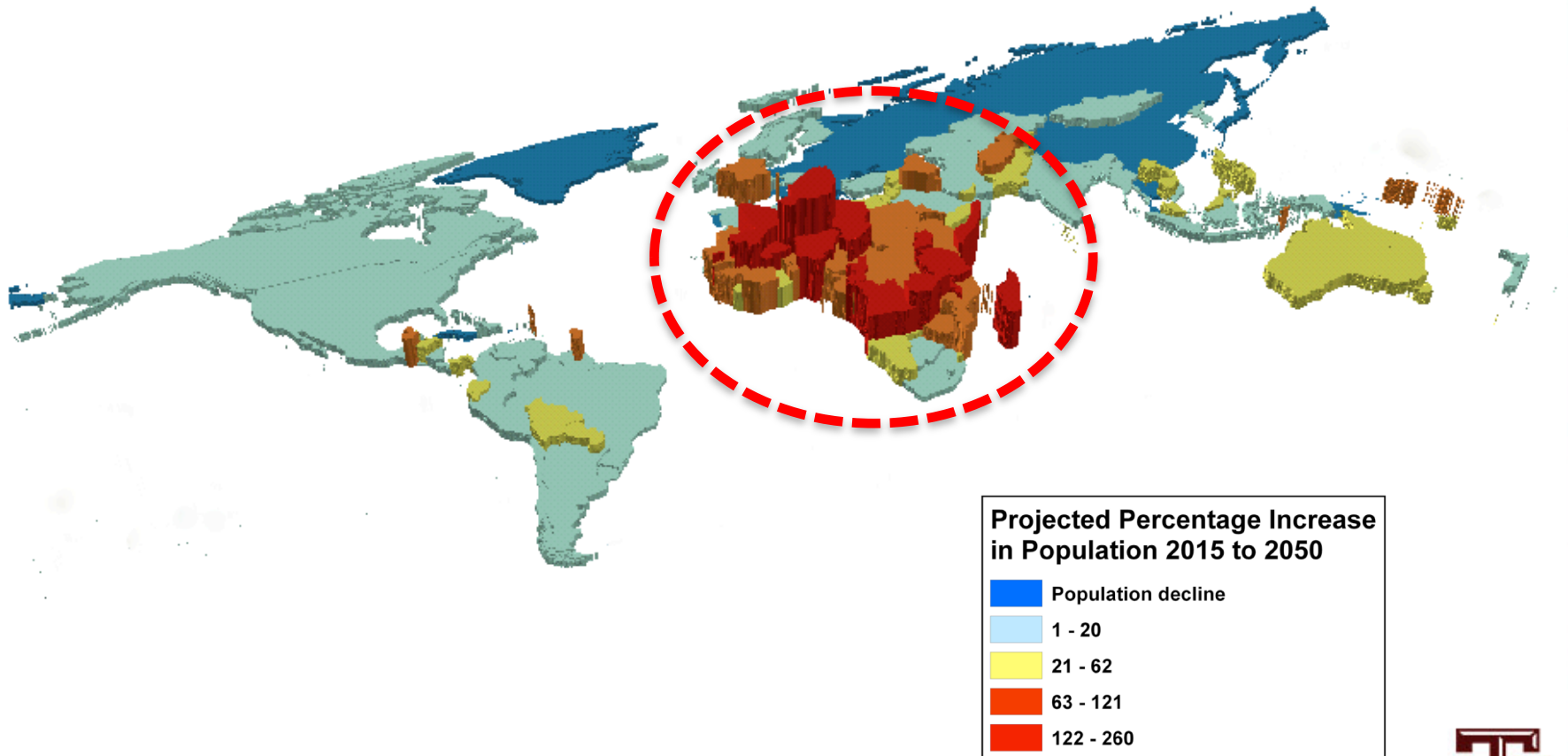




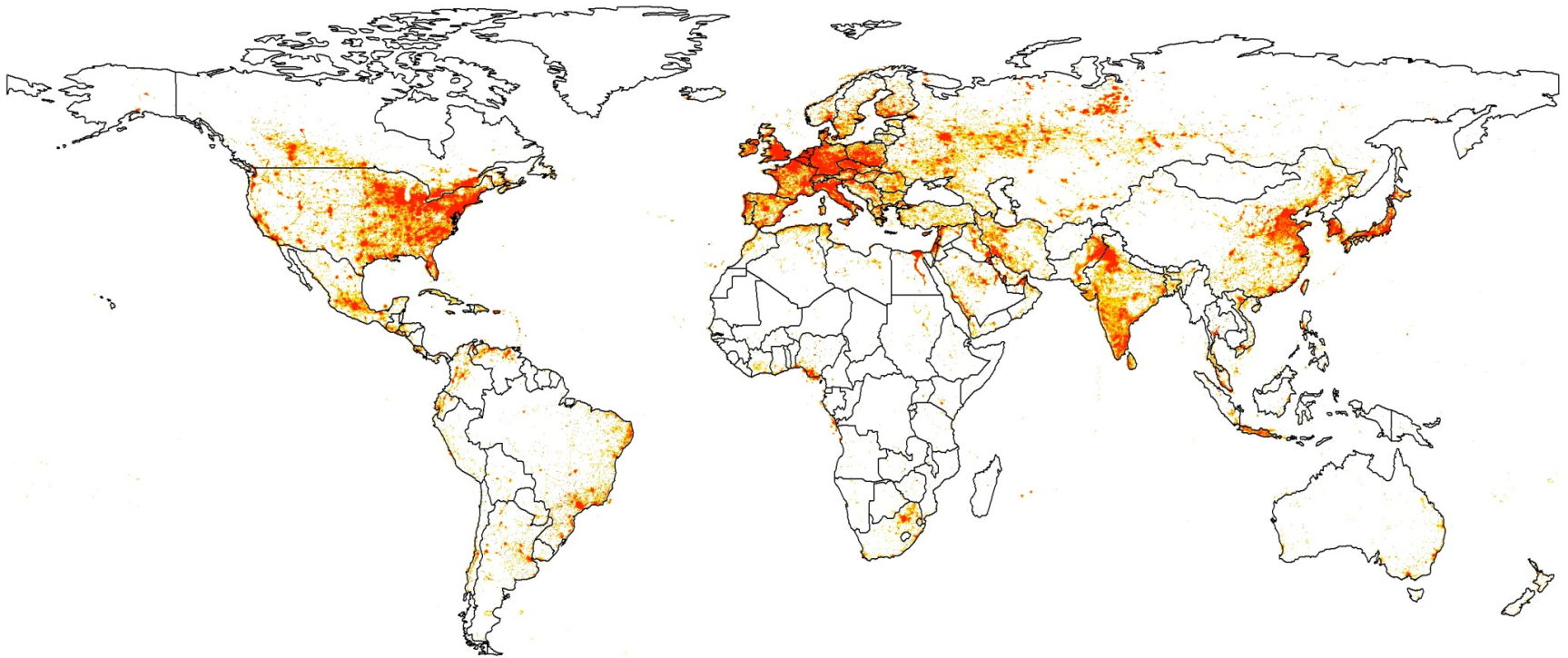
# Population increase 2015–2050

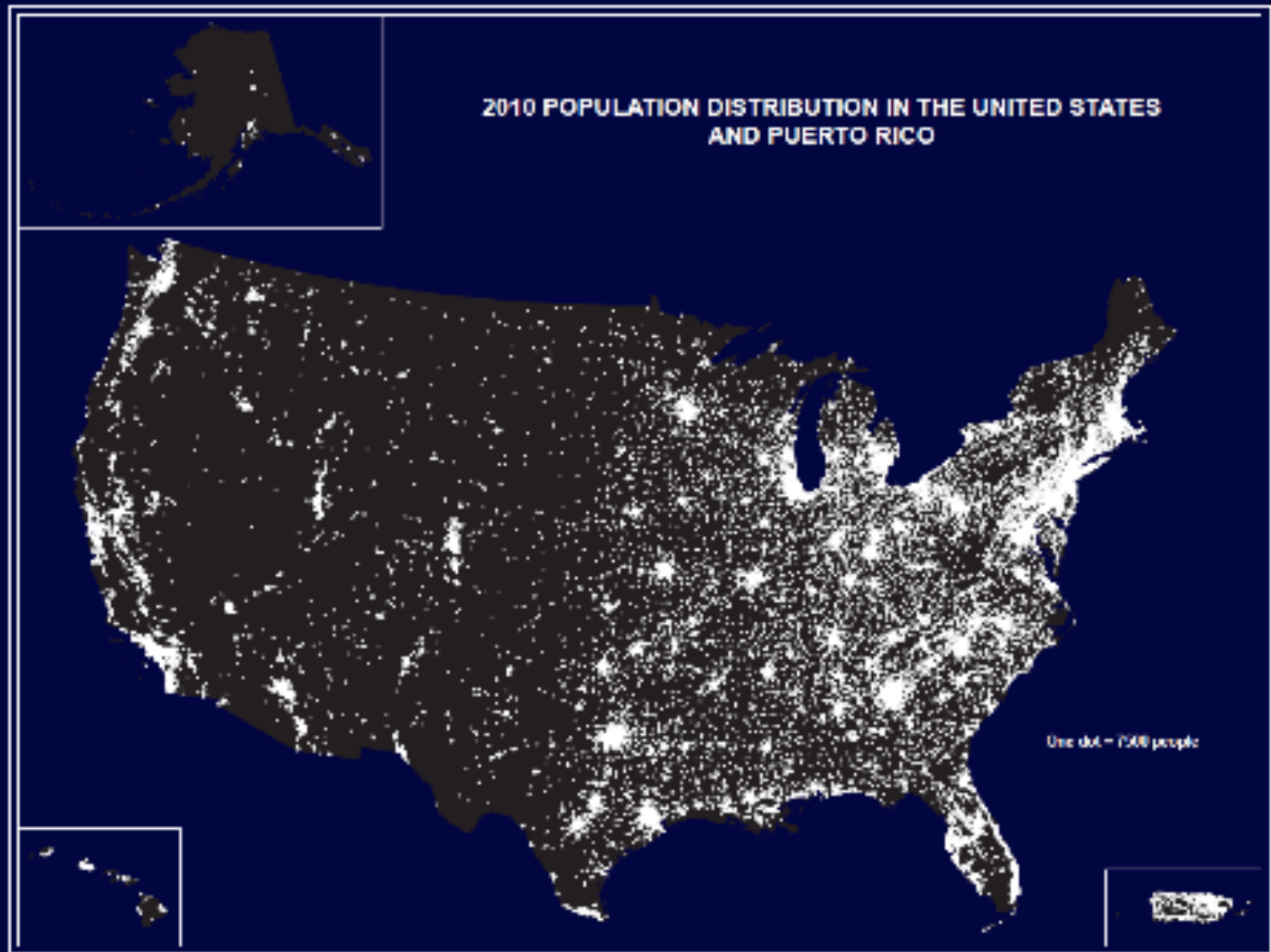


# Percentage population increase 2015–2050



# Geographic distribution of world's population, 2015





# The past is a foreign country (1/3)

Indicators	1910	2010
World population (billions)	1.8	6.9
U.S. population (millions)	92	309
U.S. percent of world total	5.1%	4.5%
U.S. life expectancy	52	81
U.S. children per woman	3.5	1.9





# The past is a foreign country (2/3)

U.S. indicators	1910	2010
Immigrants from Italy (1900–1909); (2000–2010)	1.2 million	28,000
Immigrants from Mexico (1900–1910); (2000–2010)	123,000	1.7 million (legal immigrants)
% Foreign-born	14.7%	12.9%
% Urban	46%	81%



# The past is a foreign country (3/3)

U.S. indicators	1910	2010
Number of passenger cars	450,000	190 million
% Population under 15	32.1%	19.8%
% Population 65+	4.3%	13.0%
Average persons per household	4.4	2.6
% High school graduates	~10%	87%







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# Age-sex structure

- The most important characteristics that tell us about population structure are age and sex
- They are known as the demographic characteristics
- Age and sex are tied in with the three demographic processes
  - Fertility, mortality, migration

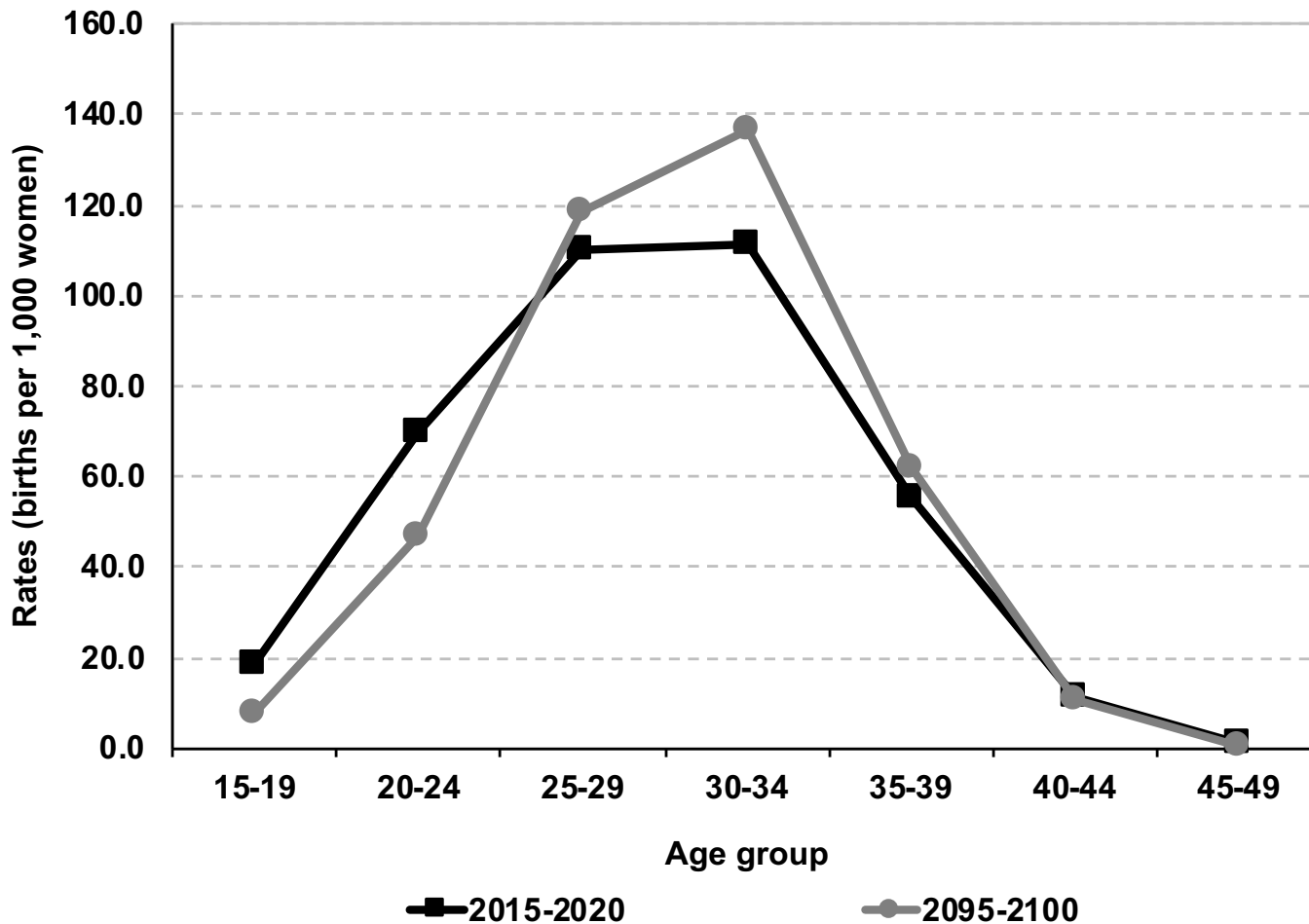


# Fertility varies by age and sex

- Fertility (actual production of children)
  - More males are born than females
  - Normal sex ratio at birth (SRB): around 105 boys per 100 girls
- Fecundity (ability to produce children)
  - Females: between ages of around 15 and 49
  - Males: between ages of around 15 and 79



# Age-specific fertility rates, United States



Source: United Nations, World Population Prospects 2017  
<https://esa.un.org/unpd/wpp/Download/Standard/Population/> (medium variant).

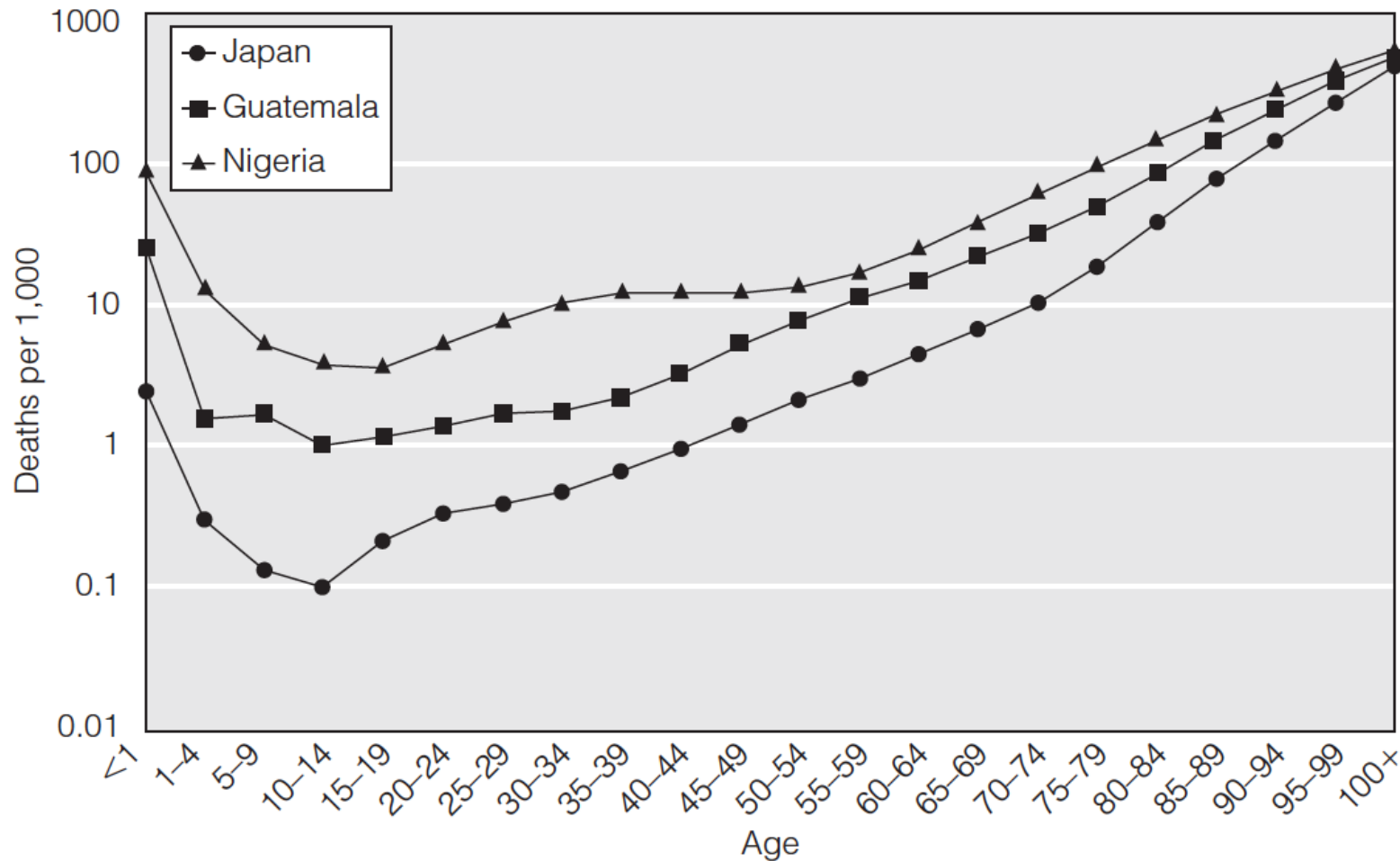


# Mortality varies by age and sex

- Females have lower death rates than males at every age of life
- Death rates are high in the first year of life and then drop to very low levels
  - In modern populations, death rates do not reach the level of the first year of life for another 50–60 years
- Cause-specific mortality is often age related



# Age-specific mortality rates, 2011



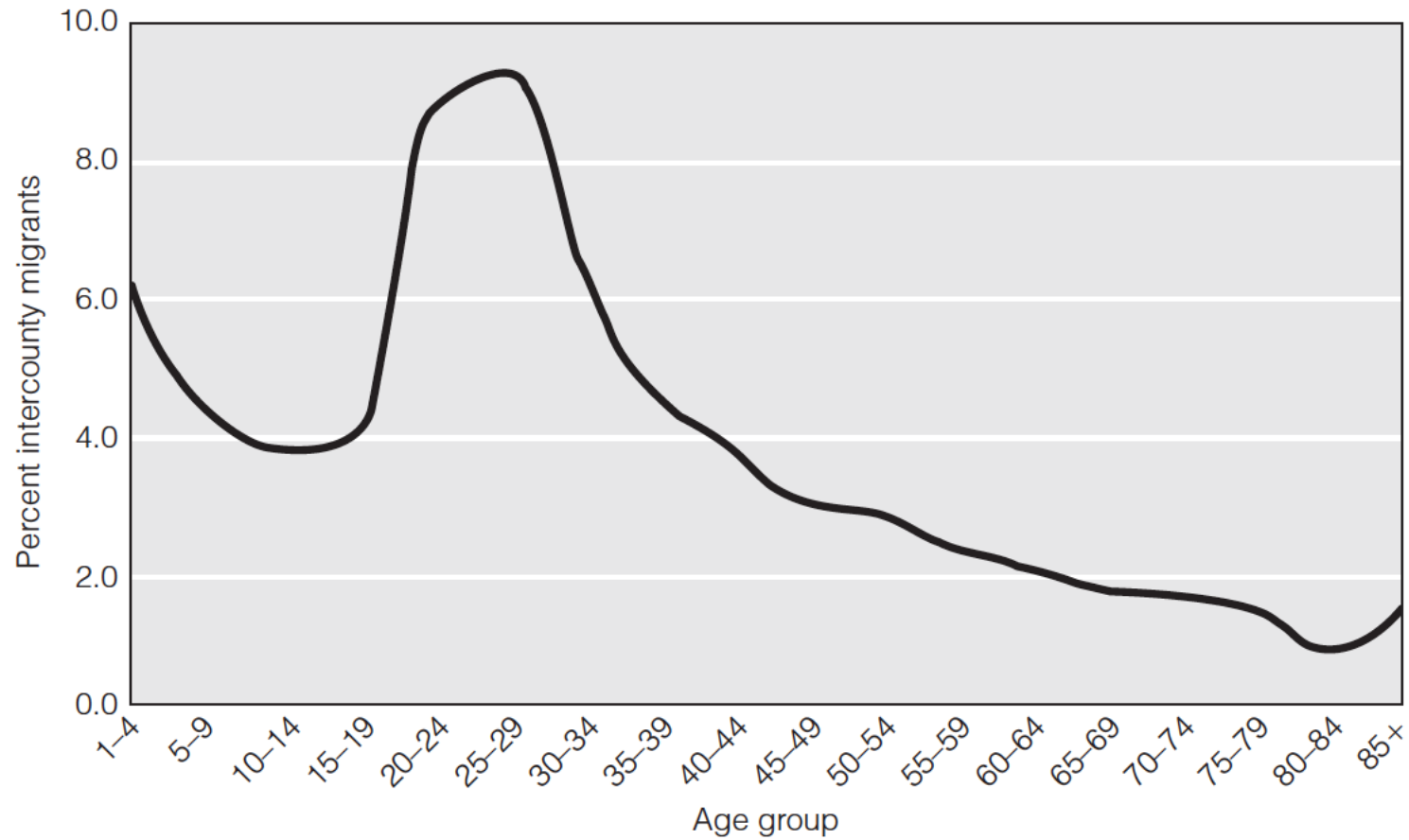
# Migration varies by age and sex

- Sex is related to distance of migration
  - Long-distance migration tended to favor males
  - Short-distance migration tended to favor females
  - With increases in gender equity, migration of females and males tend to be similar
- Internal migration has highest rates among young adults





# Age-specific migration rates, United States, 2011–2012



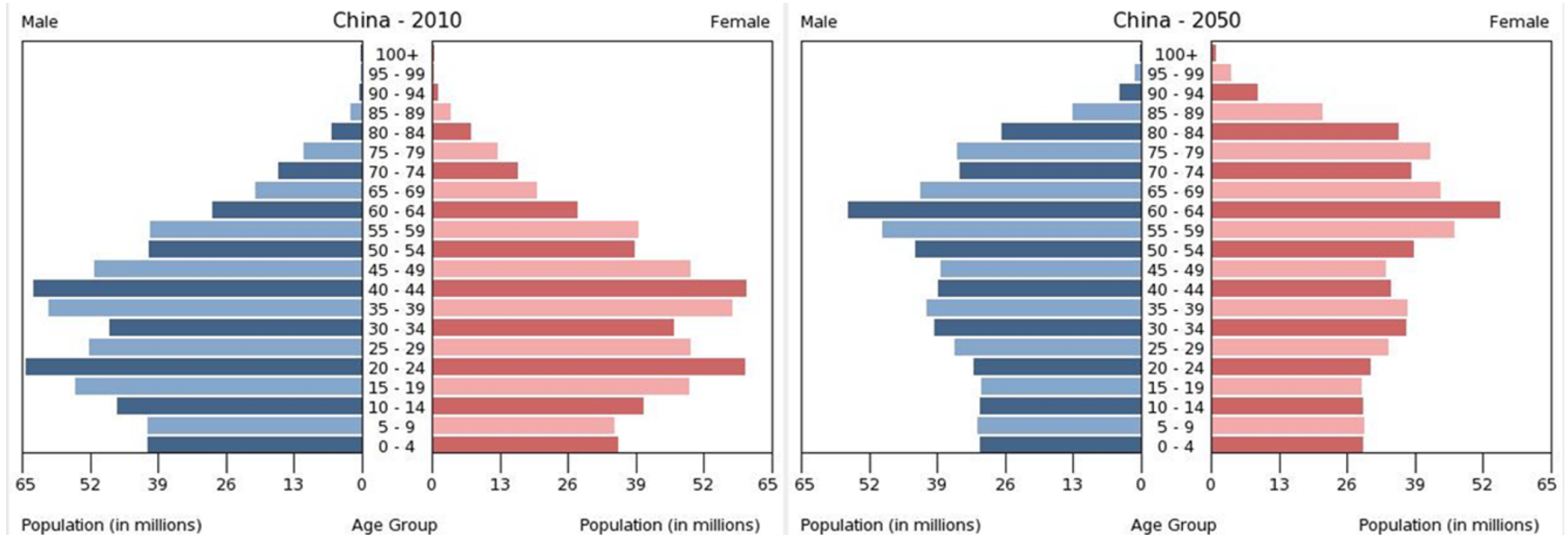
**India - 2010**

Age Group	Male Population (millions)	Female Population (millions)
100+	1	1
95-99	2	2
90-94	3	3
85-89	4	4
80-84	5	5
75-79	6	6
70-74	8	8
65-69	10	10
60-64	12	12
55-59	15	15
50-54	18	18
45-49	22	22
40-44	26	26
35-39	30	30
30-34	34	34
25-29	38	38
20-24	42	42
15-19	46	46
10-14	50	50
5-9	54	54
0-4	55	55

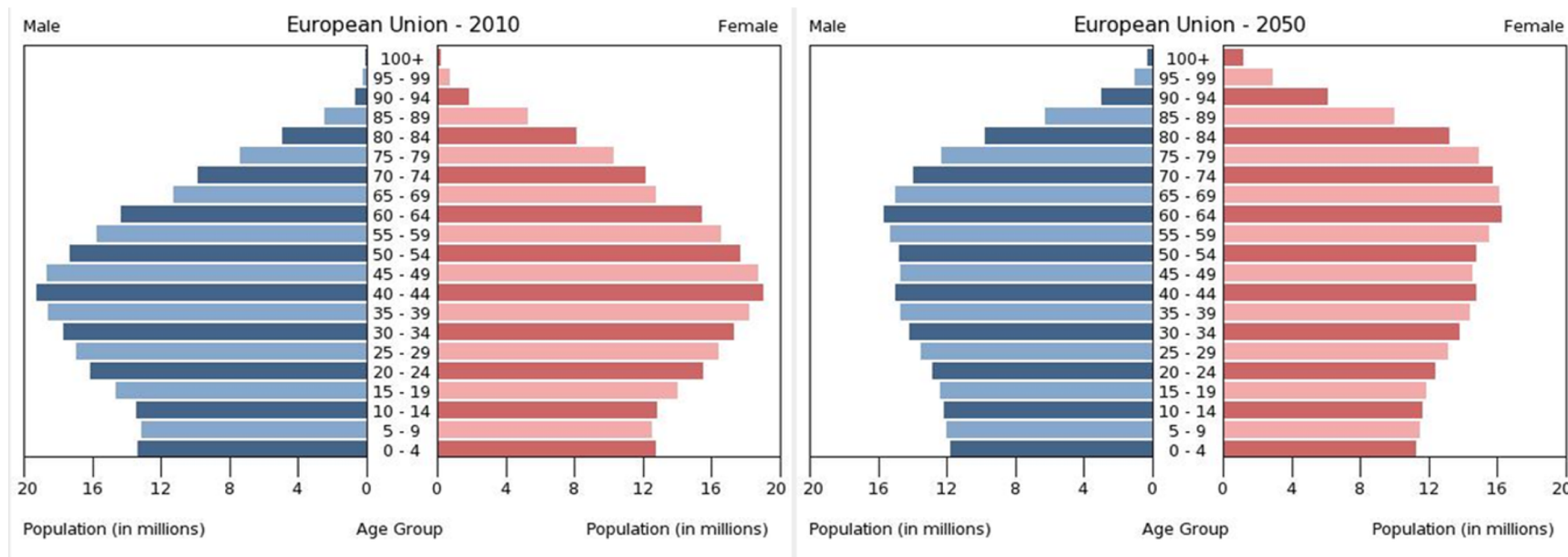
**India - 2050**

Age Group	Male Population (millions)	Female Population (millions)
100+	10	10
95-99	8	8
90-94	6	6
85-89	4	4
80-84	3	3
75-79	2	2
70-74	2	2
65-69	3	3
60-64	4	4
55-59	5	5
50-54	6	6
45-49	7	7
40-44	8	8
35-39	9	9
30-34	10	10
25-29	11	11
20-24	12	12
15-19	13	13
10-14	14	14
5-9	15	15
0-4	16	16

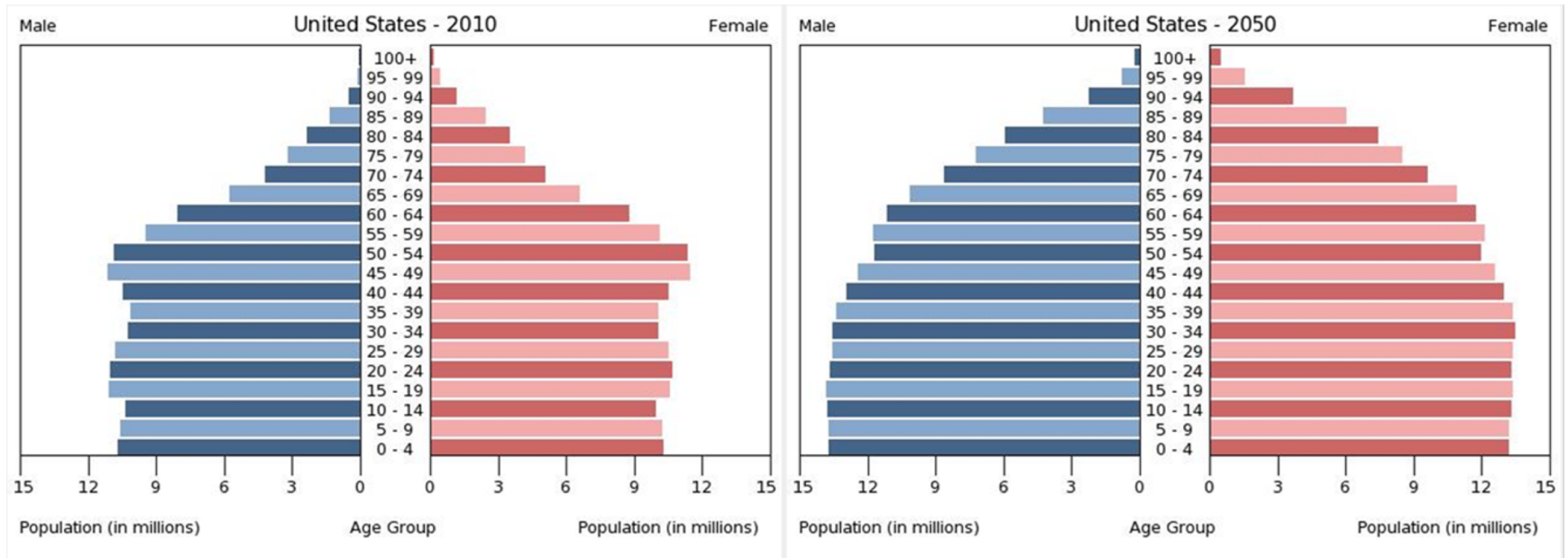
# Population structure by age and sex, China, 2010–2050



# Population structure by age and sex, European Union, 2010–2050



# Population structure by age and sex, United States, 2010–2050







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# Global population trends

(Weeks 2015, Chapter 2, pp. 25–57)

- World population growth
  - A brief history
  - How fast is the world's population growing now?
  - Power of doubling — How fast can populations grow?
  - Why was early growth so slow?
  - Why are more recent increases so rapid?
  - How many people have ever lived?
- Geographic distribution of world's population
- Global variation in population size and growth



# Brief demographic history

- Human beings have been around for at least 200,000 years, perhaps much longer
- For almost all of that time, humans were hunter-gatherers living a primitive existence
  - High fertility, high mortality, slow population growth
- Population on the eve of Agricultural Revolution (aka Neolithic Agrarian Revolution) 10,000 years ago is estimated at about 4 million



# Agricultural Revolution

- Probably due to hunting-gathering populations' growth
  - Pushed the limit of their carrying capacity
- Previously, use of land extensively
  - Over tens of thousands of years humans moved to remote corners of the earth in search of sustenance
- People began to use resources intensively
  - Lead to agricultural lifestyle that has characterized society for the past 10,000 years



# Historical population growth

- Between 8000 B.C. and 5000 B.C.
  - 333 people added each year
- By 500 B.C., major civilizations (China, Greece)
  - 100,000 people added each year
- By 1 A.D., almost 250 million people
  - 300,000 people added each year



# Variations in mortality

- Between 3rd and 5th centuries A.D.
  - Increases in mortality led to declining population
  - In the Mediterranean as Roman Empire collapsed
  - In China as the Han empire collapsed
- Population growth recovered until the plague arrived in Europe by middle of the 14th century

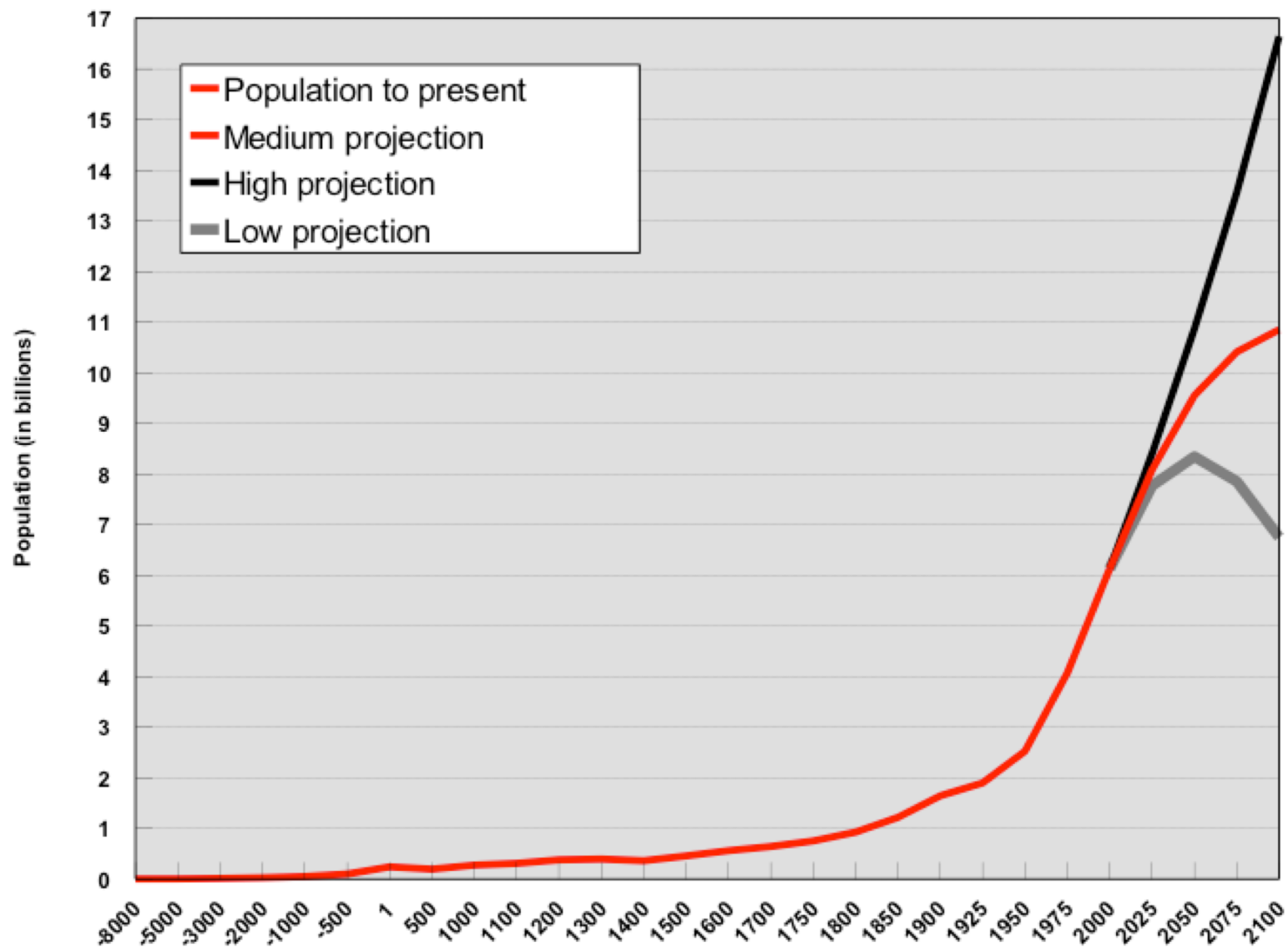


# Industrial Revolution

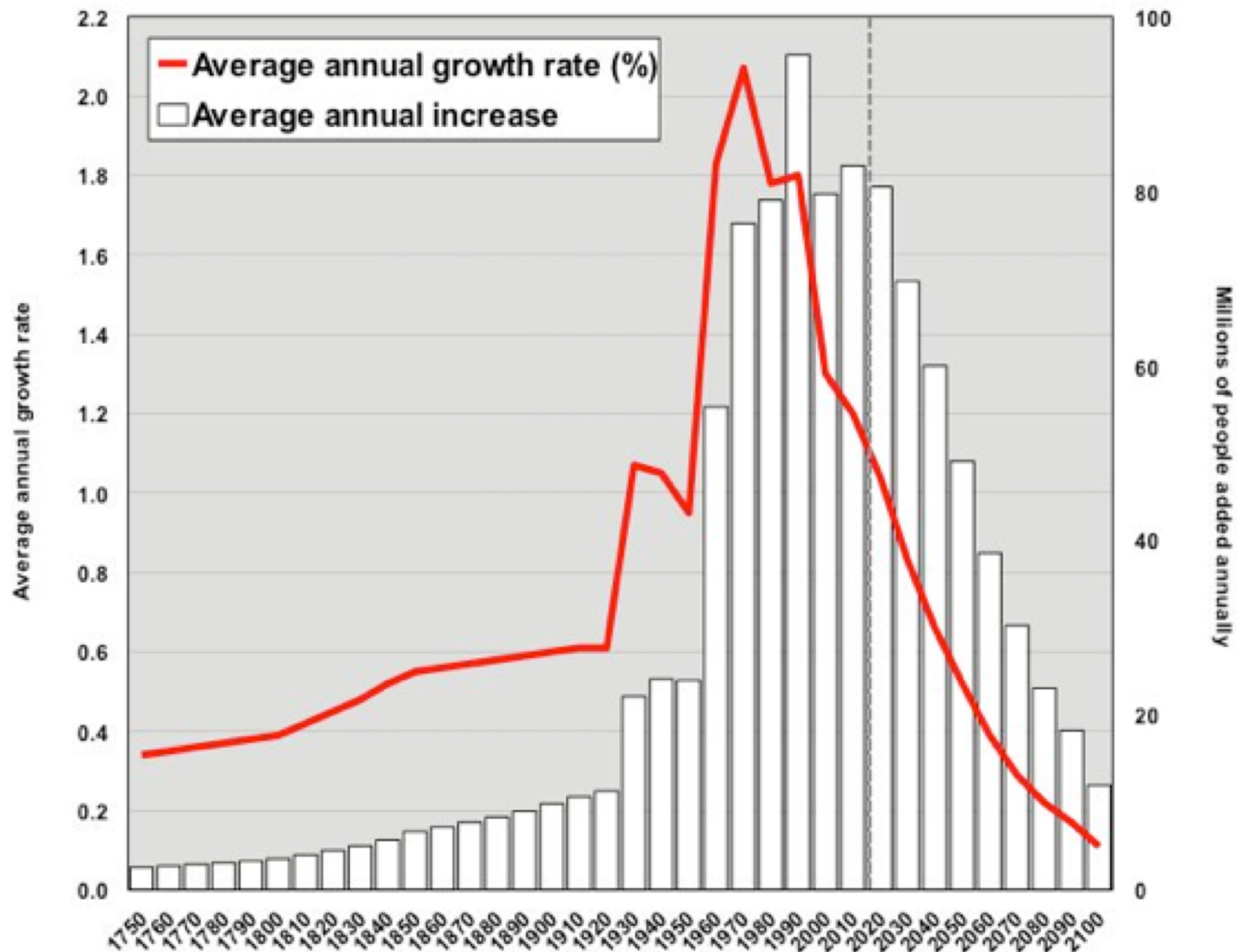
- Middle of 18th century
  - Eve of Industrial Revolution
  - World's population approaching 1 billion
  - Increasing by about 2.2 million every year
- Since the beginning of the Industrial Revolution
  - Approximately 250 years ago
  - Size of world's population increased dramatically



# World's population exploded in size



# Annual growth rate & annual increase





# Population increase by time period

Time period	Births	Deaths	Natural increase
Year	134,176,254	56,605,700	77,570,553
Day	367,606	155,084	212,522
Hour	15,317	6,462	8,855
Minute	255	108	148
Second	4.3	1.8	2.5



# Why was early growth slow?

- During the hunting-gathering phase, life expectancy was very low: ~ 20 years
- More than half of children born died before their 5th birthday
- The average woman who survived the reproductive years would have to bear nearly 7 children to assure that 2 survived to adulthood

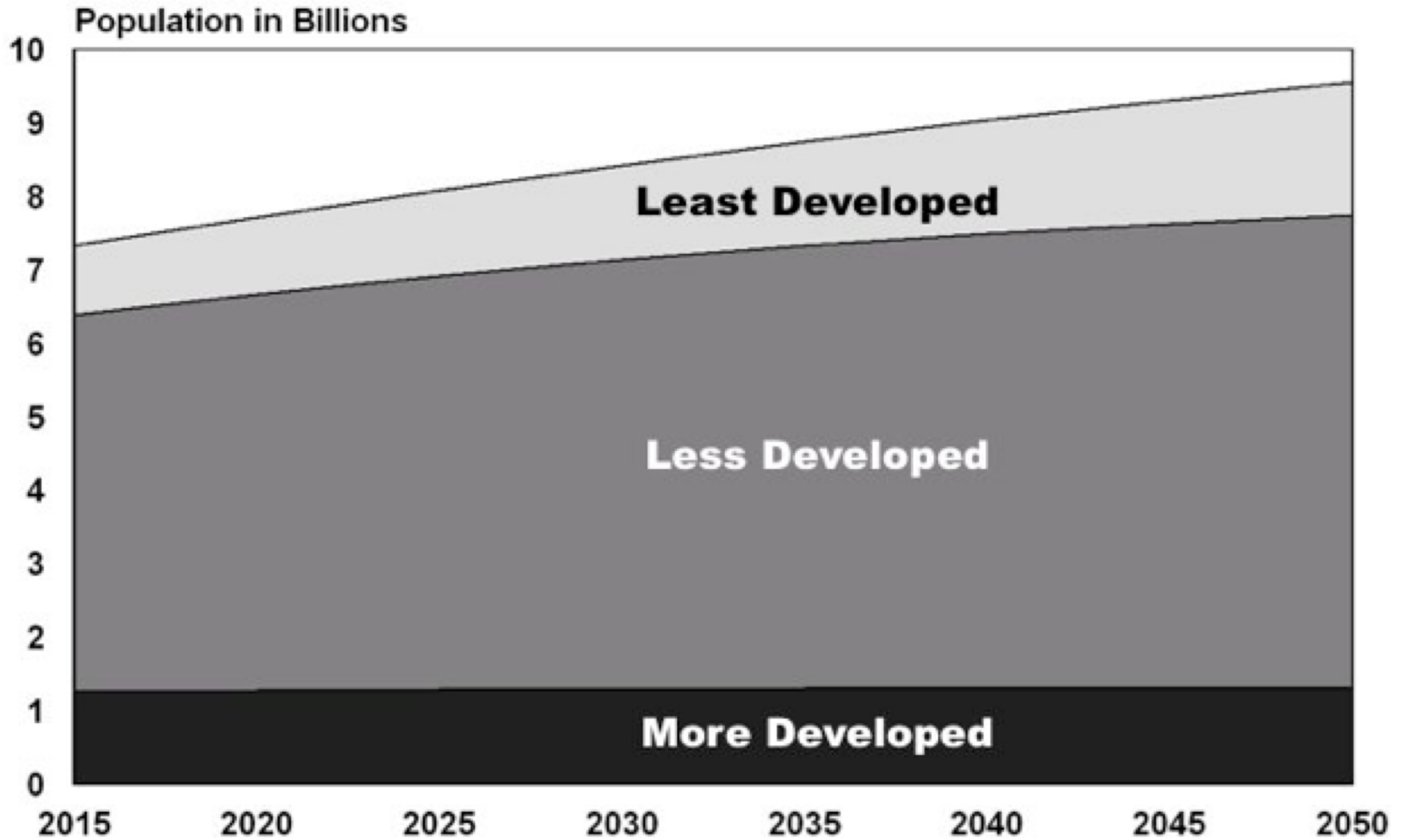


# Why are recent increases so rapid?

- Acceleration in population after 1750
  - Declines in death rate related to Enlightenment, scientific advances, and Industrial Revolution
  - Eating better, bathing more often, drinking cleaner water, and vaccinations were being discovered
- Continuing population increases
  - Dramatic declines in mortality without compatible decline in fertility, even though fertility was declining



# Population growth, 2015–2050



Medium variant fertility projections

# How many people ever lived?

- Current contribution to history's total population is relatively small, but steadily growing fraction of all people who have ever lived
- Formulas of Nathan Keyfitz suggest
  - 63 billion people have been born over the past 200,000 years
  - 7.3 billion alive in 2014 constitutes 11.7%
  - Lower percentages assume more years of human history, higher birth/death rates in earlier periods



# Geographic distribution

- Migration flows from rapidly growing areas into less rapidly growing ones
- European expansion: 14th to 20th centuries
  - Europe to North and South America and Oceania
  - Africa to Latin America, Caribbean and North America
- South to North migration: 20th & 21st centuries
  - Latin America and Asia to the United States
  - Asia to Canada
  - Africa, Asia, and Latin America to Europe



# Urban revolution

- In earlier decades, as population grew dense, people moved to less populated areas
  - In 1800, less than 1% of world's population lived in cities of 100,000 or more
- Now they move to urban areas
  - More than 1/3 of humans live in 100,000+ cities
  - More than 50% live in urban places of any size
  - Urbanization grew even without industrialization
    - People moved to areas where goods and services were exchanged



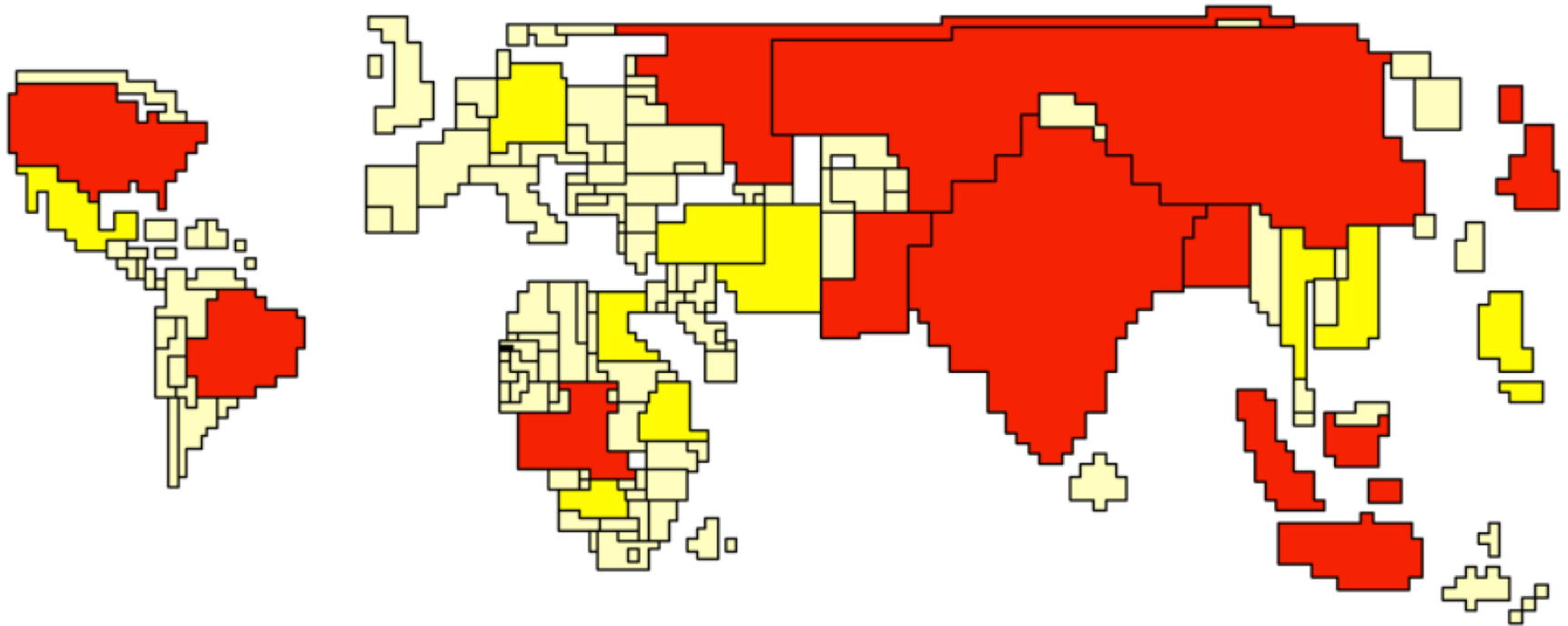


# 10 most populous countries, millions

Country			Country		
2015			2050		
1	China	1,402	1	India	1,620
2	India	1,282	2	China	1,385
3	United States	325	3	Nigeria	404
4	Indonesia	256	4	United States	401
5	Brazil	204	5	Indonesia	321
6	Pakistan	188	6	Pakistan	271
7	Nigeria	183	7	Brazil	231
8	Bangladesh	160	8	Bangladesh	202
9	Russia	142	9	Ethiopia	188
10	Japan	127	10	Philippines	157



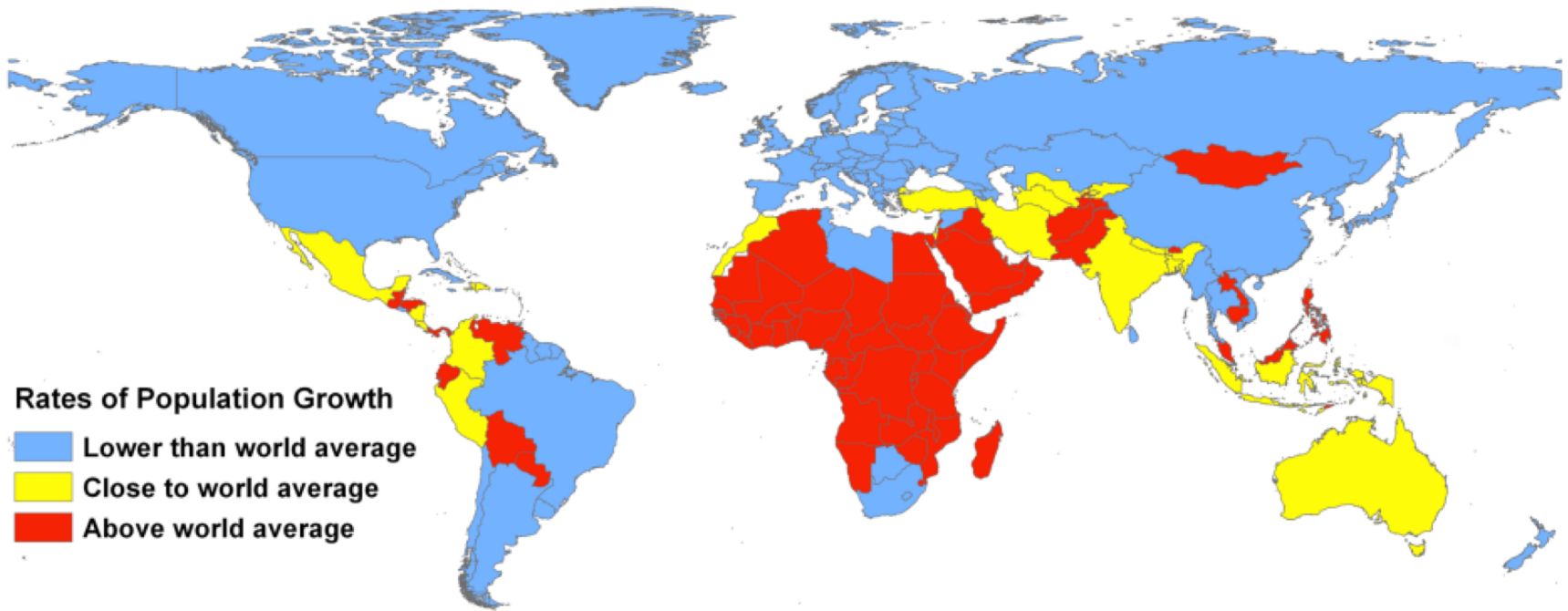
# Countries by population size, 2015



Top 10 countries  
11–20 countries  
All others



# Rates of population growth, 2012



# United States

- One of highest rates of population growth among rich nations
- Fertility slightly above replacement
- High life expectancy, although one of lowest among rich nations
- High levels of legal and undocumented immigration



# Canada

- Demographics are more like Europe than the U.S.
- Below replacement fertility
- Higher life expectancy than the U.S.
- Very high level of immigration per person (especially from Asia), which keeps the population growing



# Mexico

- Fertility rates have dropped a lot since the 1970s when the government started promoting family planning
- Life expectancy nearly as high as in the U.S.
- Net outmigration mainly to the U.S.
- Immigrants in the south from Central America
- Southern Mexico is heavily indigenous



# Central America

- Heavily indigenous
  - Higher than average fertility
  - Lower than average life expectancy
- Out-migration aggravated by socioeconomic (poverty) and security (crime) issues
- Costa Rica is an exception, with European-style demographics





# Brazil

- Accounts for half the population of South America
- Since the 1960s, it has experienced significant decline in fertility to below replacement level
- Predominantly Catholic country, but growing Protestant population
- Life expectancy is well above the world average



# Rest of South America

- Divided roughly in two groups
- Predominantly European-origin populations with European-style demographics
  - Argentina, Chile, Uruguay
- Other nations have larger fractions of indigenous population
  - Higher fertility and mortality



# Europe

- Experiencing depopulation, especially because
  - Russia and Germany have very low levels of fertility
  - Russia has experienced low life expectancy
- Eastern and southern
  - Fertility well below replacement level
  - High life expectancy
  - Lack of interest in receiving many immigrants
- Northern and western
  - Highest fertility levels: support for working mothers
  - Immigrants are not unwelcome: political issue



# Northern Africa and Western Asia

- Predominantly Muslim: exception of Israel
  - Rapid rates of population growth
    - Contributing to conflict in the region
  - Fertility is declining, but still above death rates
    - Young populations
- Iran (technically in South Asia) and Turkey
  - Populous and European-style demographics
  - Below-replacement fertility, high life expectancy
  - Southeastern Turkey: high fertility, low female literacy, similar to Syria and Iraq



# Sub-Saharan Africa

- The most rapidly growing region in the world
- Nigeria, Ethiopia, Congo: large and growing
- High birth rates, although generally declining
- Death rates: world's highest, but declining
- High incidence of HIV and Ebola
- Young populations and migration within region



# South and Southeast Asia

- 1/3 of the world's population
  - India, Pakistan, Bangladesh, Indonesia, Philippines, Vietnam, Thailand
- India projected to become most populous nation by middle of this century
  - Higher birth and death rates than China
- Indonesia (1<sup>st</sup>), India (2<sup>nd</sup>), Pakistan (3<sup>rd</sup>)
  - Highest numbers of Muslims in the world



# East Asia

- 1.6 billion people in all region
  - China has 1.4 billion
  - Japan, South Korea, Taiwan: next largest in pop. size
- Fertility is below replacement level
  - China had an official one-child policy
  - High life expectancy, but population will decline
- Immigration is not very popular
  - Low birth rate, aging population
  - Not supplemented by inflow of migrants





# Global demographic contrasts

- North-South divide
- South has higher birth rates, higher death rates, younger populations than north
- These differences and variability within the south will drive the future



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