World population change over time

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Outline

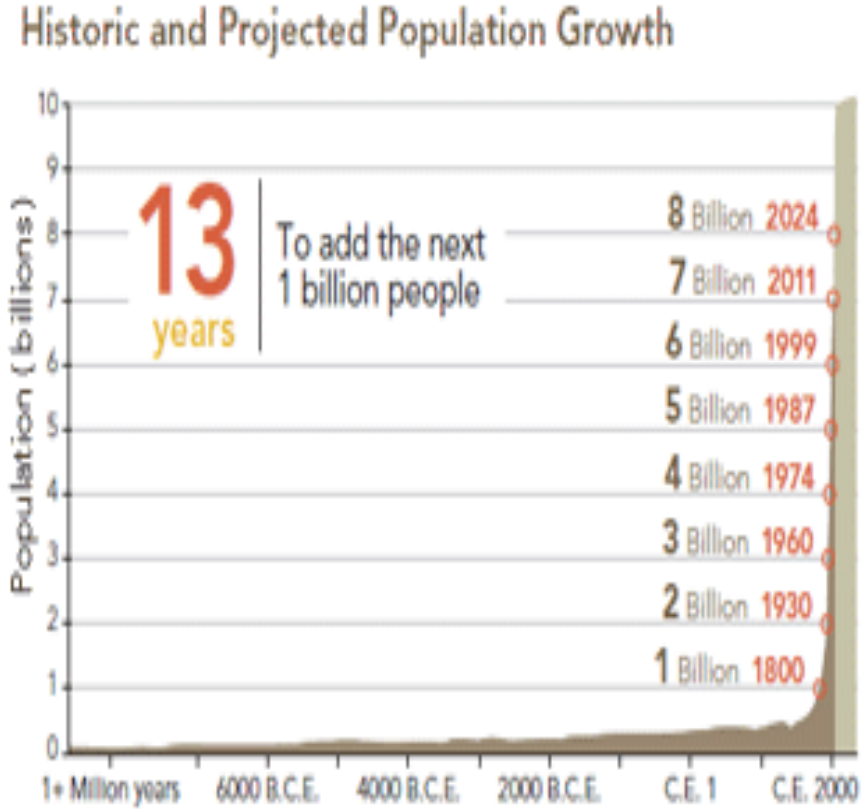
- Five contemporary aspects of importance of demography
- Demographic transition
- Global population trends (extra)

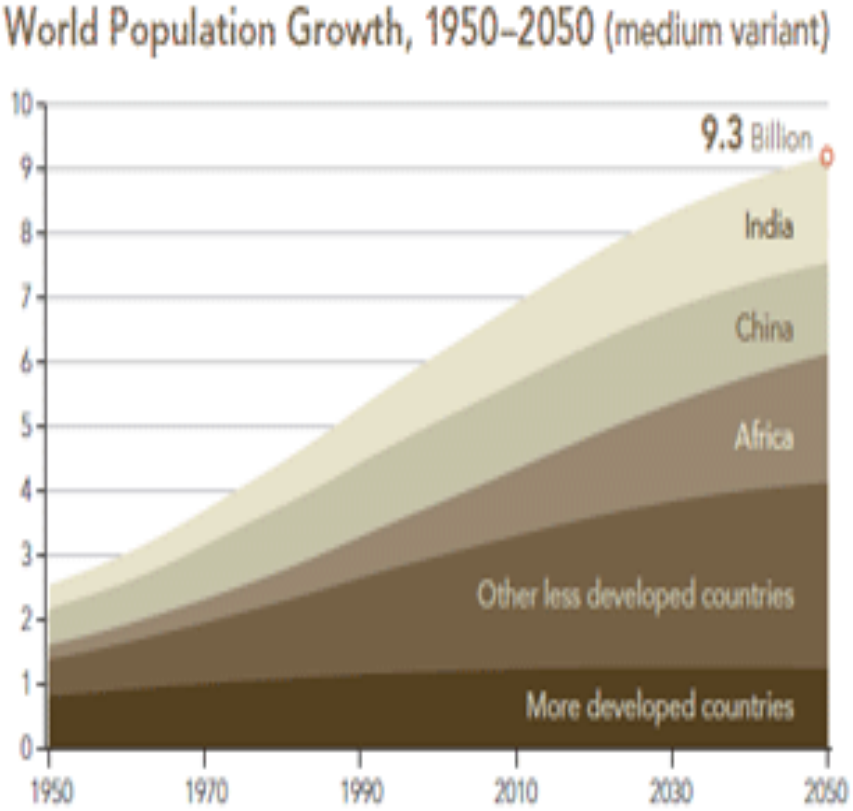
Five contemporary aspects of importance of demography

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

Source: Poston, Bouvier, 2017.

1. The greatest demographic change in human history



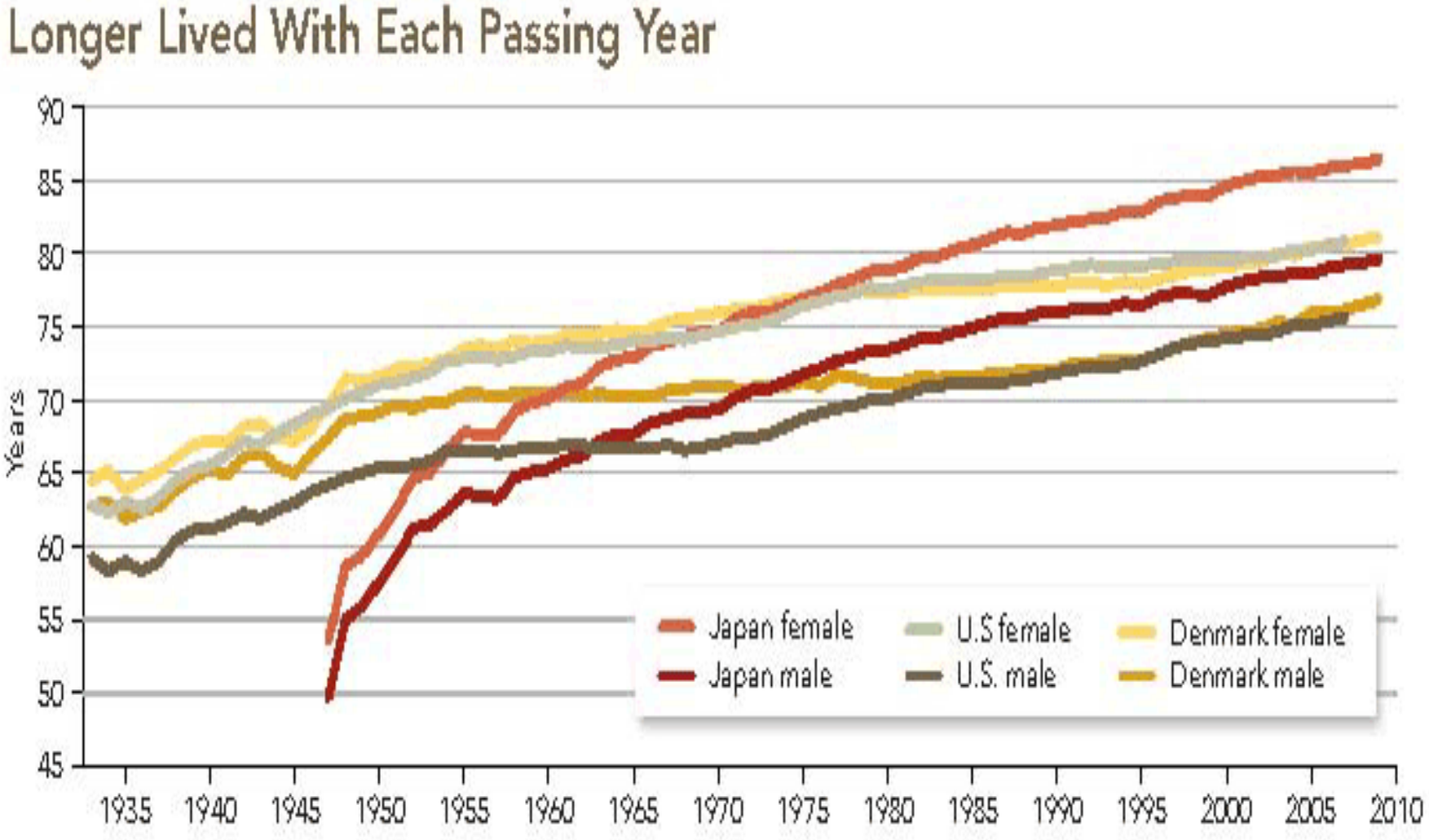


Source: Poston, Bouvier, 2017.

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

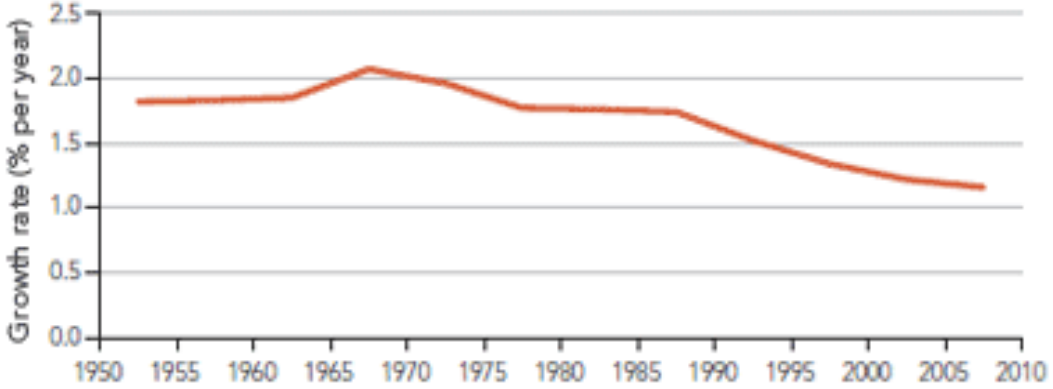
Rise in life expectancy



Source: Poston, Bouvier, 2017.

3. Below replacement fertility

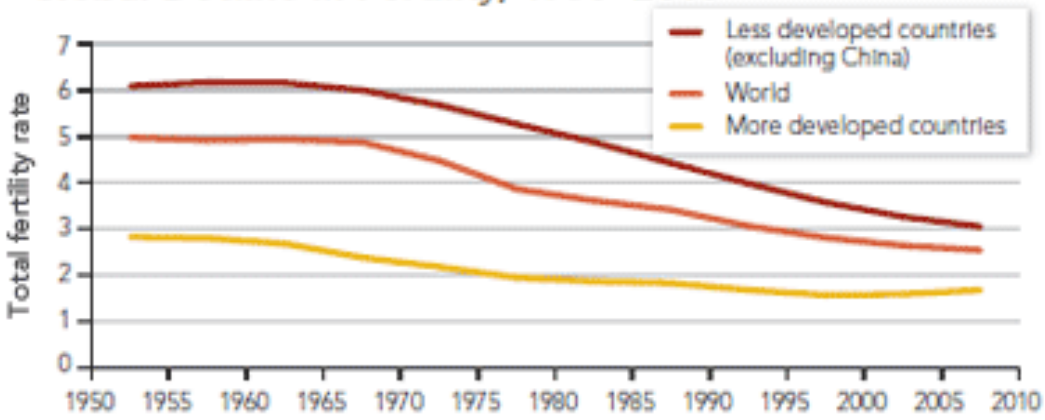
Population Growth Rate, 1950–2010



SOURCE: UNPD, 2011

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

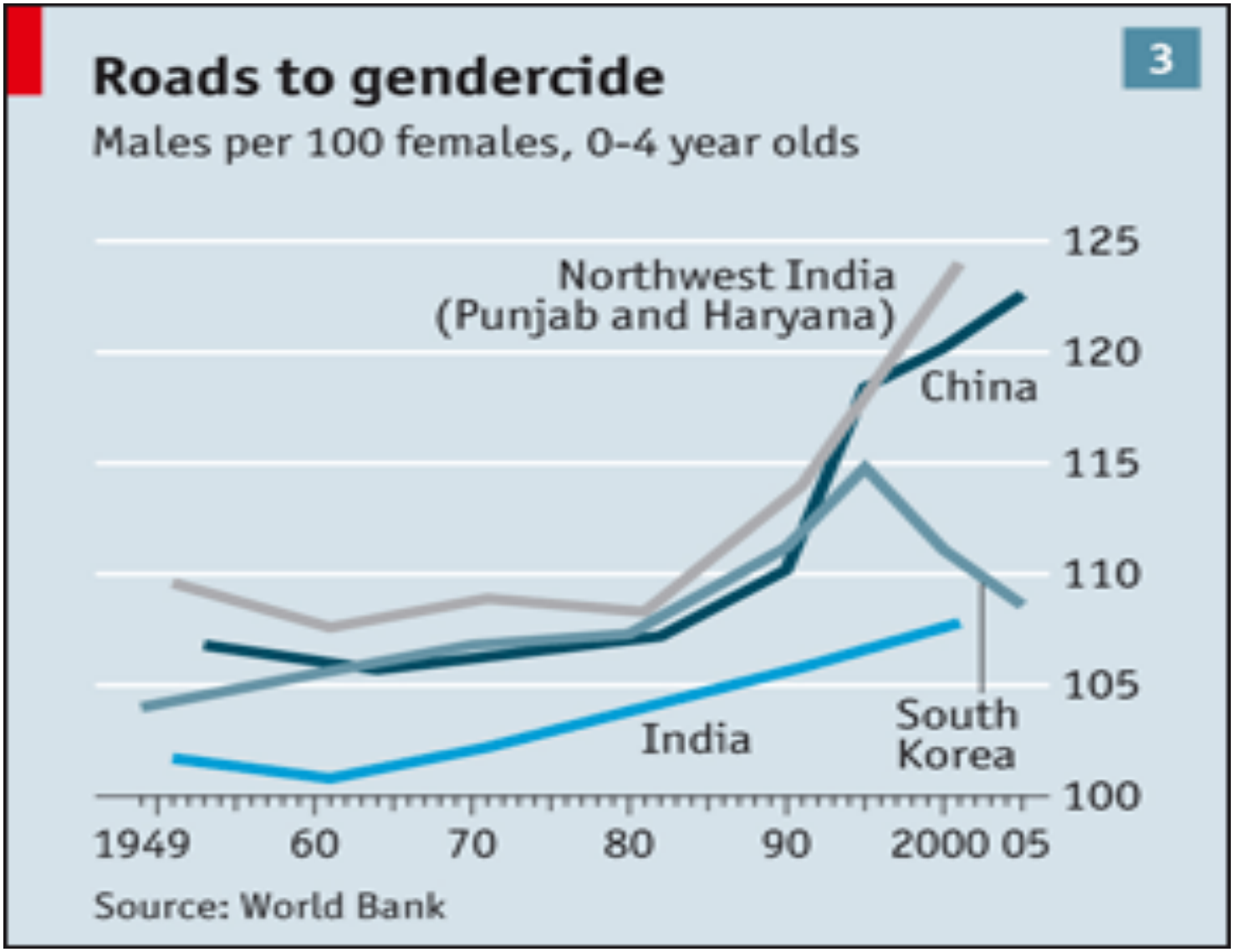


SOURCE: UNPD, 2011

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.

Source: Poston, Bouvier, 2017.

4. Unbalanced sex ratios at birth



Source: Poston, Bouvier, 2017.

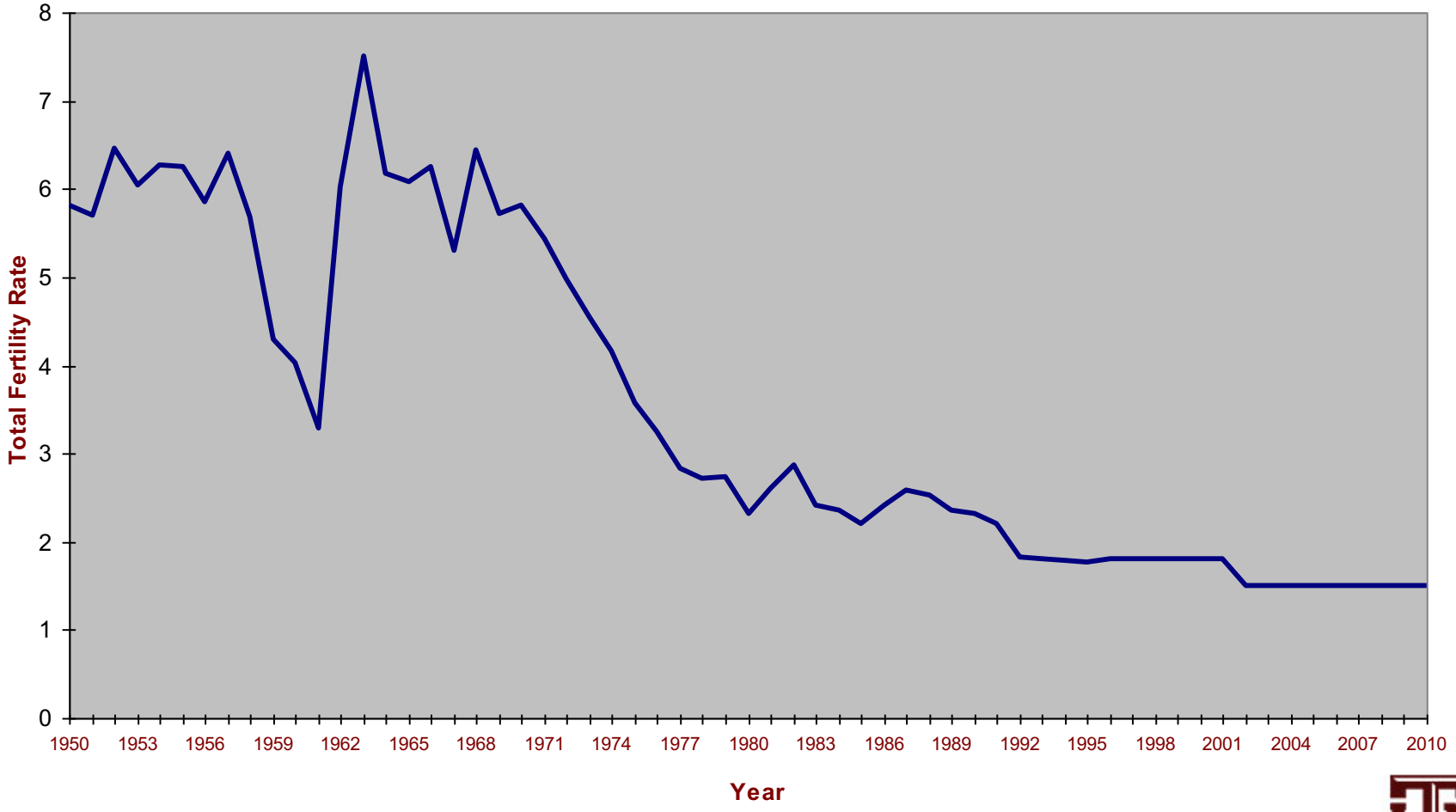
Sex ratio at birth in China

- 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

Source: Poston, Bouvier, 2017.

Total fertility rates in China, 1950–2010



Source: Poston, Bouvier, 2017.

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)

Source: Poston, Bouvier, 2017.

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

Source: Poston, Bouvier, 2017.

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

Source: Poston, Bouvier, 2017.

5. Population ageing

By the numbers

43% Population <15, sub-Saharan Africa

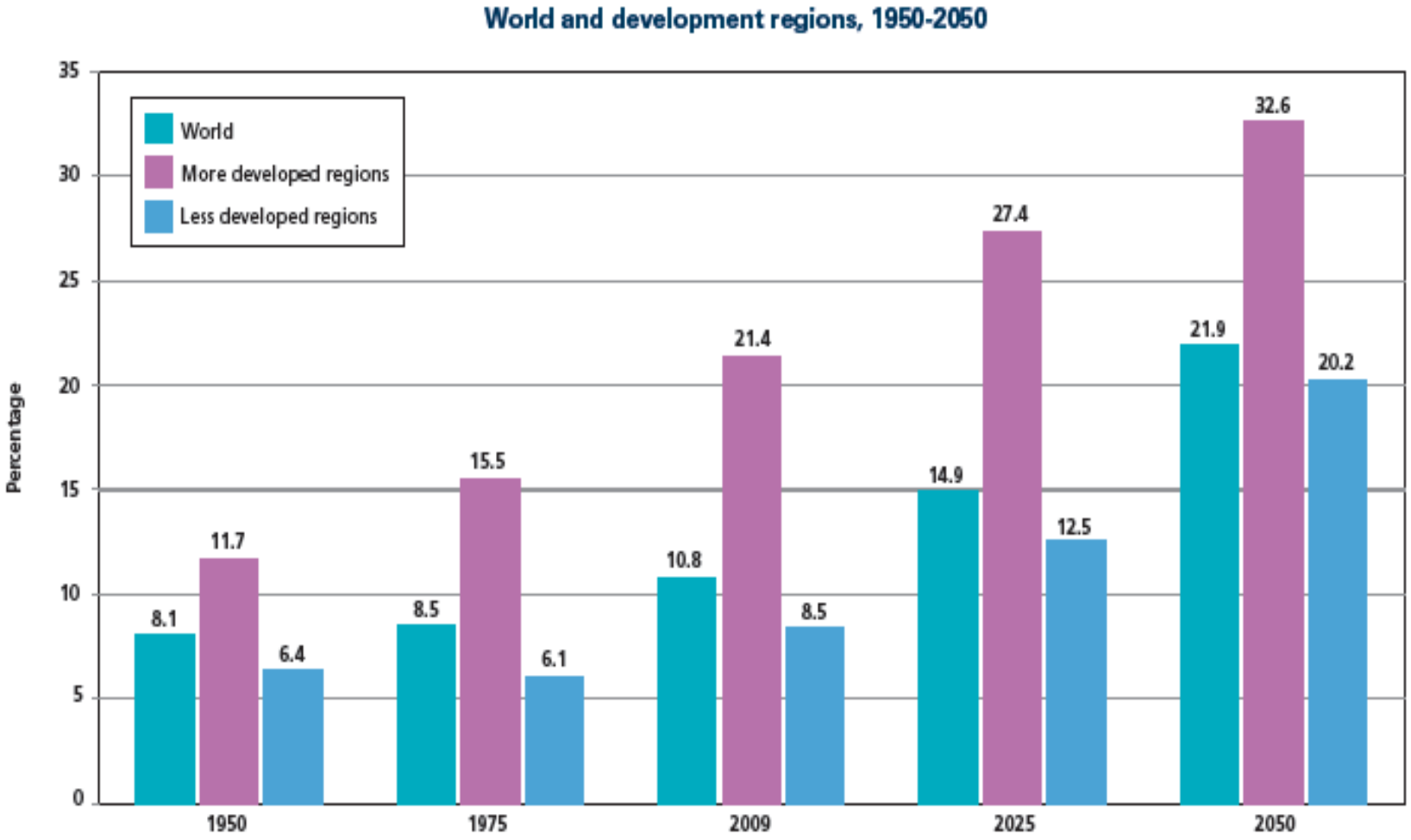
3% Population 65+, sub-Saharan Africa

16% Population <15, Europe

16% Population 65+, Europe

Source: Poston, Bouvier, 2017.

Percentage of population aged 60 or over



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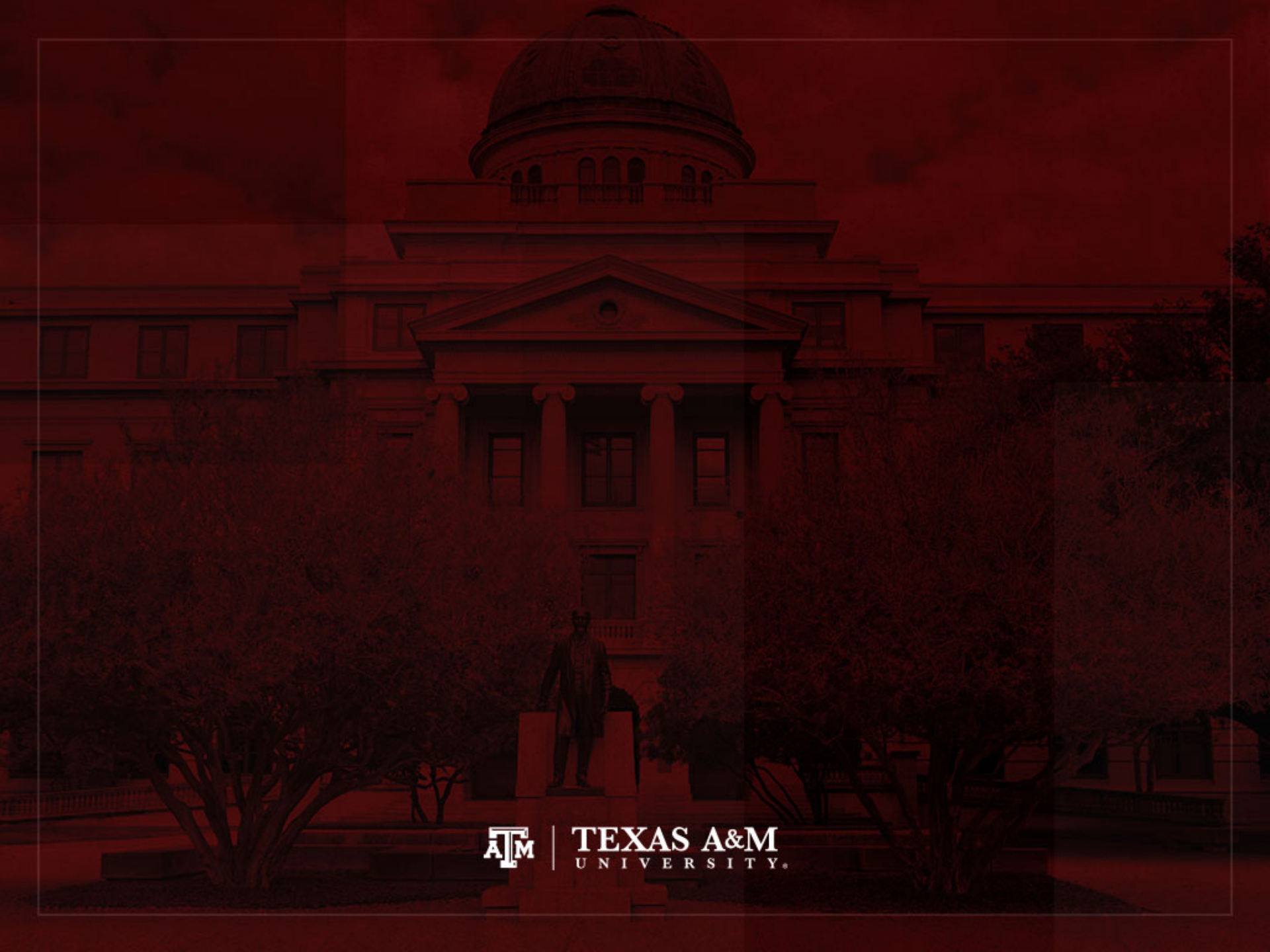
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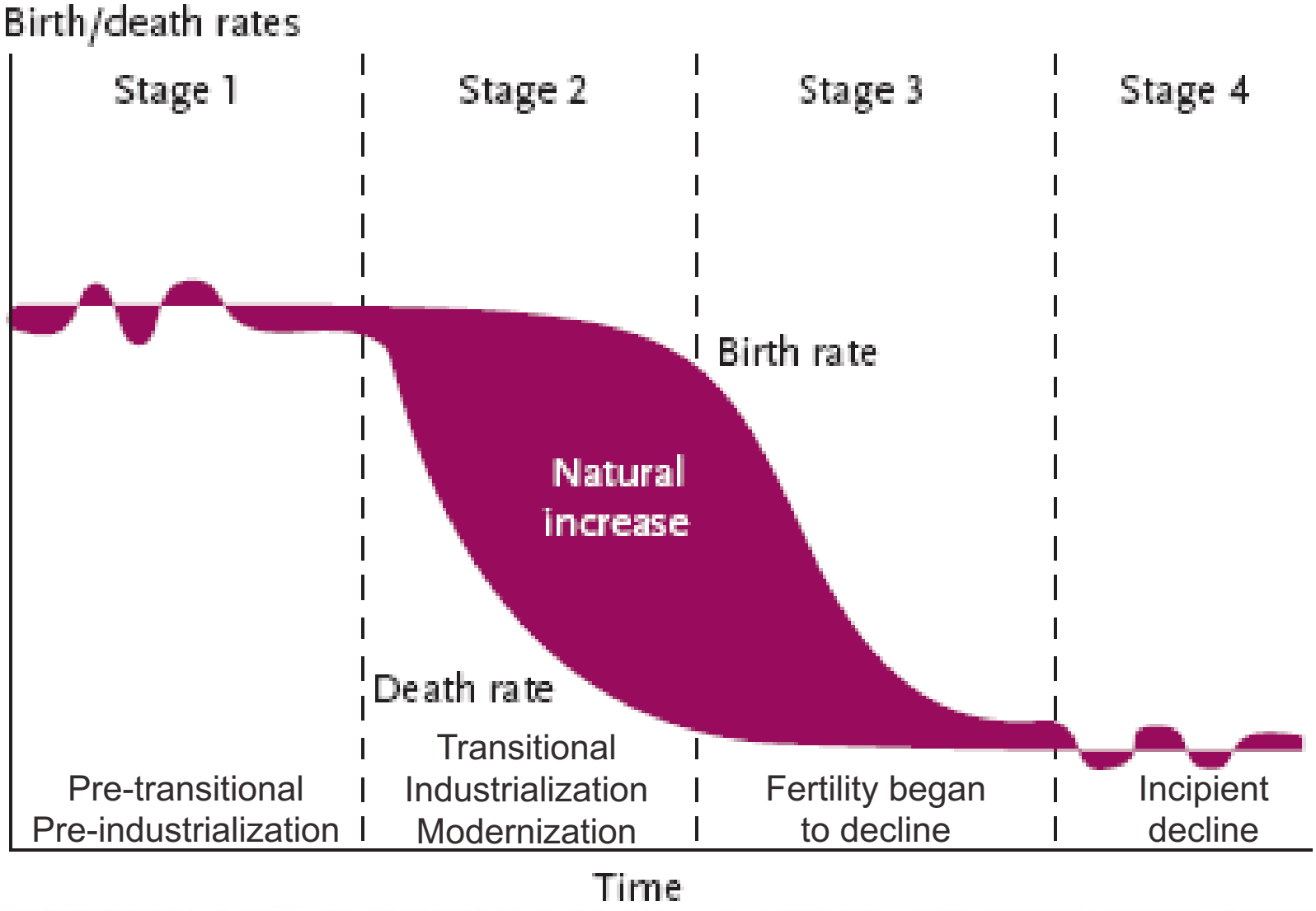
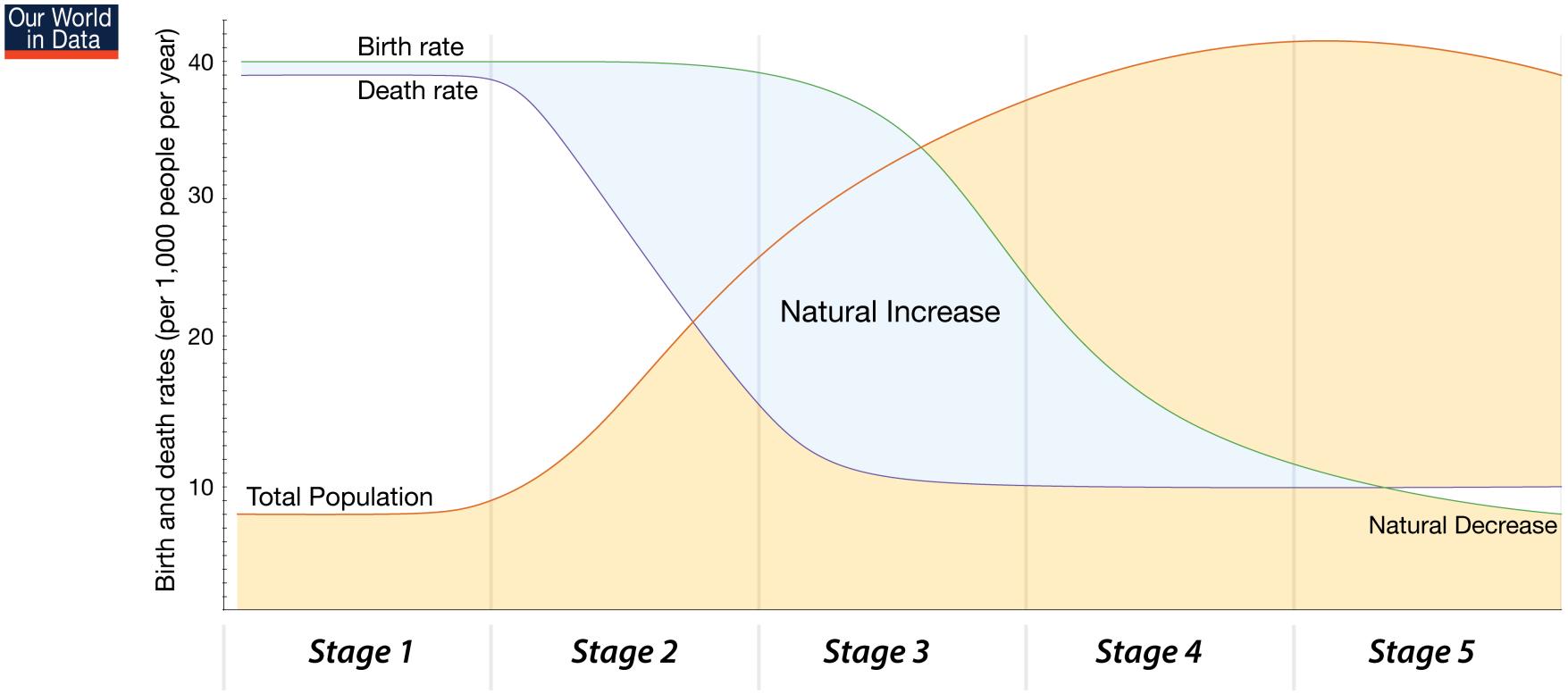
Demographic transition



Source: Poston, Bouvier, 2017.

Demographic transition



	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
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*

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)

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

$$K(T_{double}) = 2K(0) = \exp(RT_{double})\, K(0)$$

$$2 = \exp(RT_{double})$$

$$\log(2) = RT_{double}$$

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

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

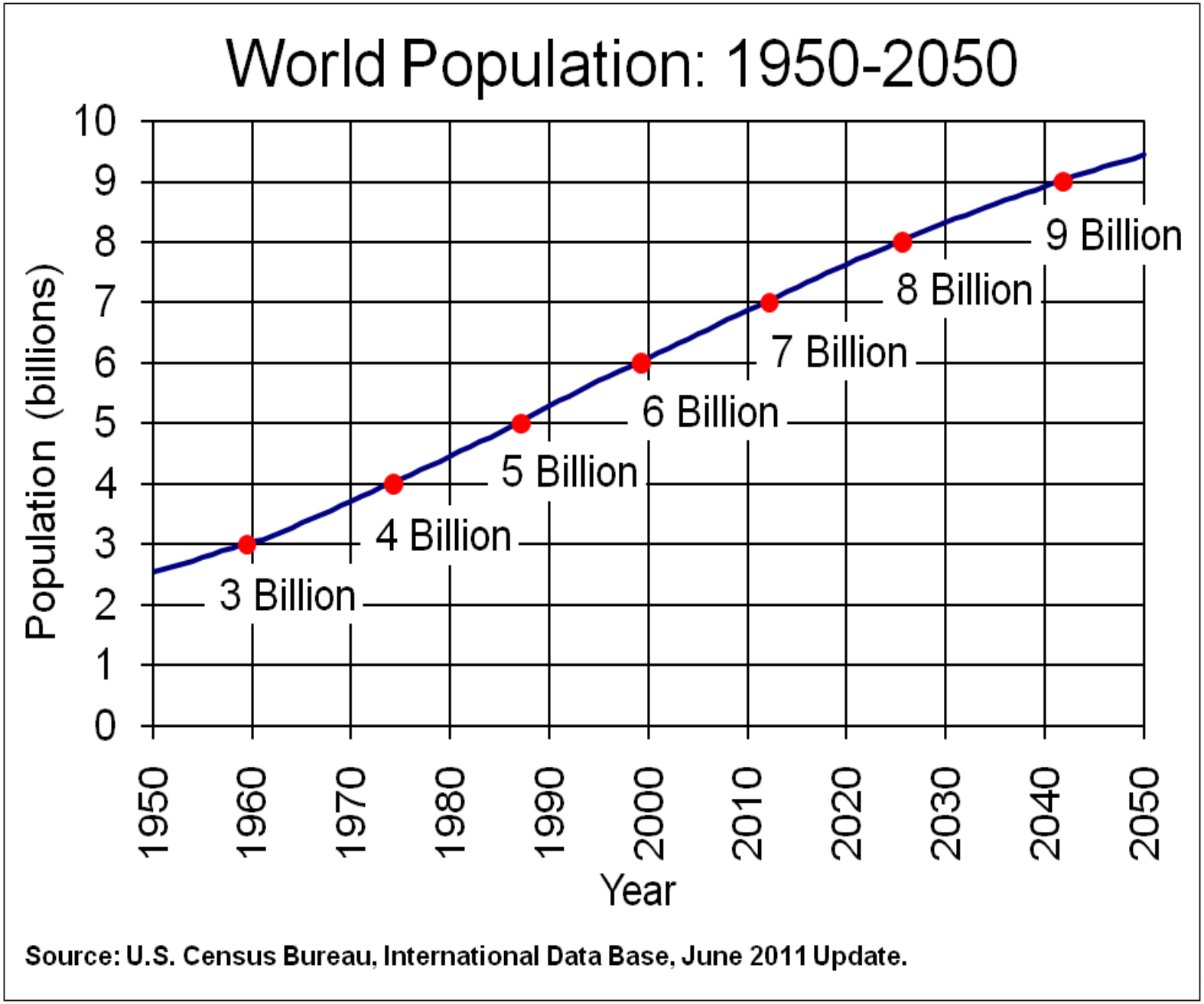
World population and doubling times

Date	Population	Growth rate (R)	Doubling time ≈ (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.

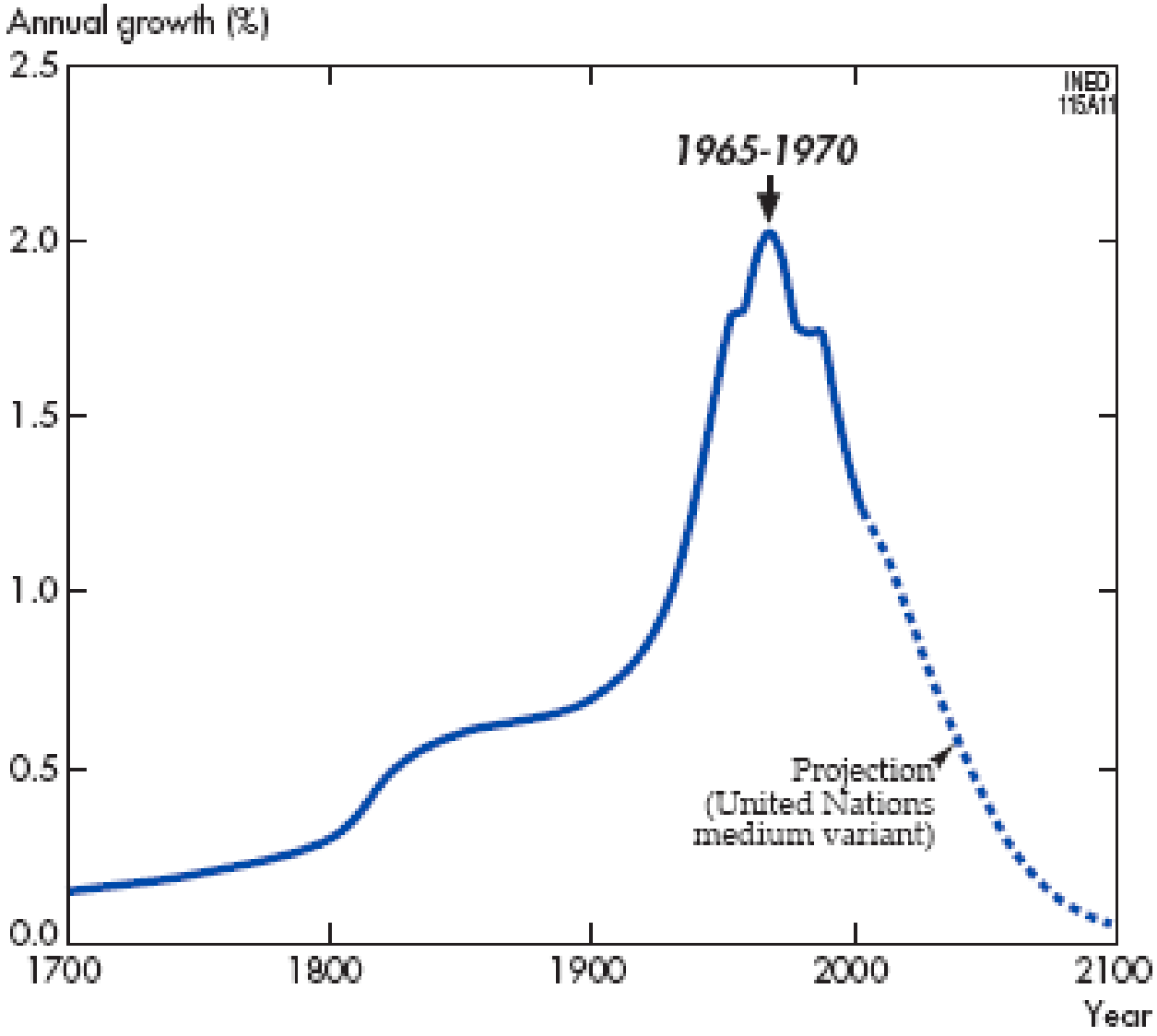
Population storm

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



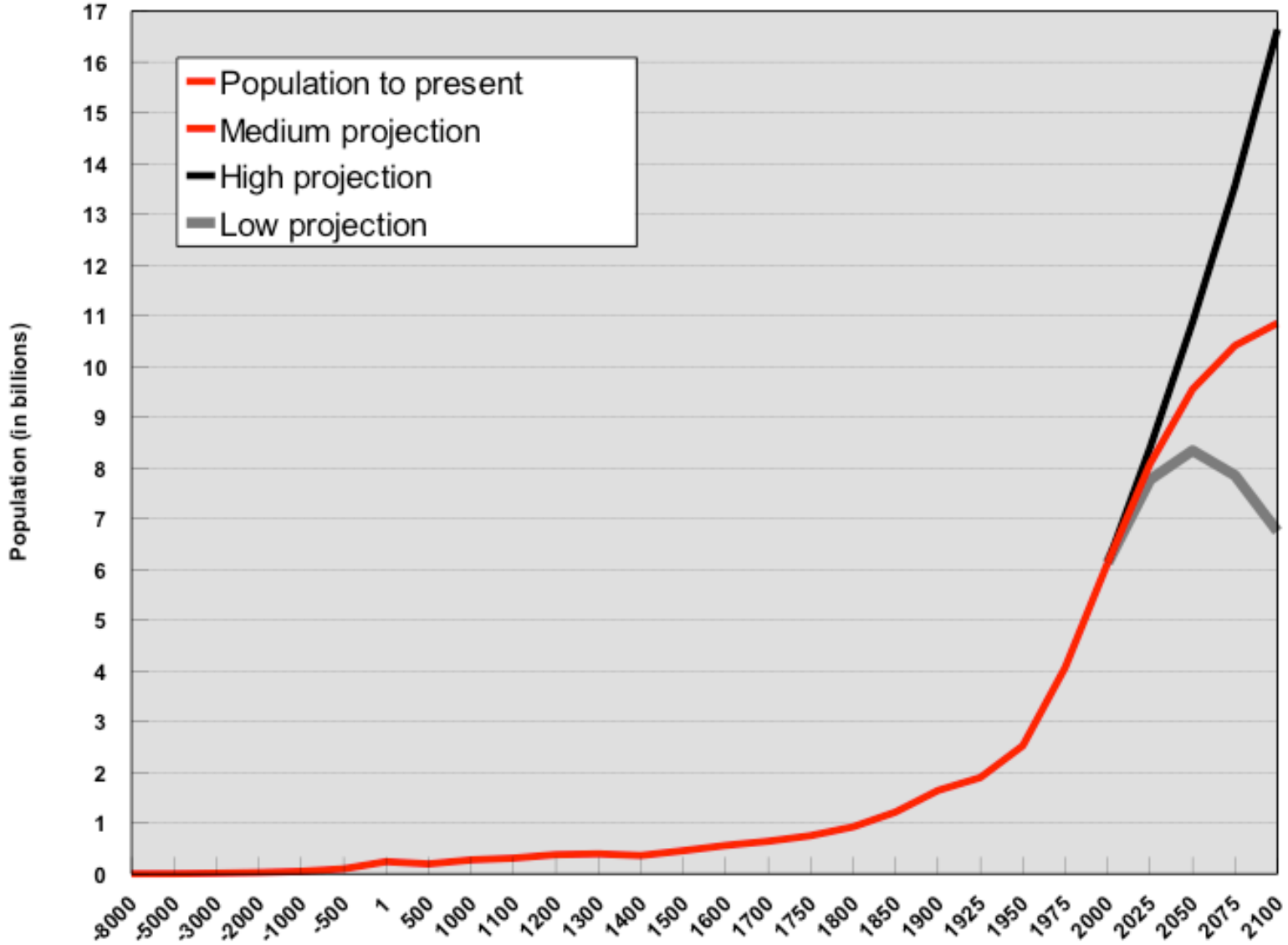
Source: Poston, Bouvier, 2017.

World population growth rates

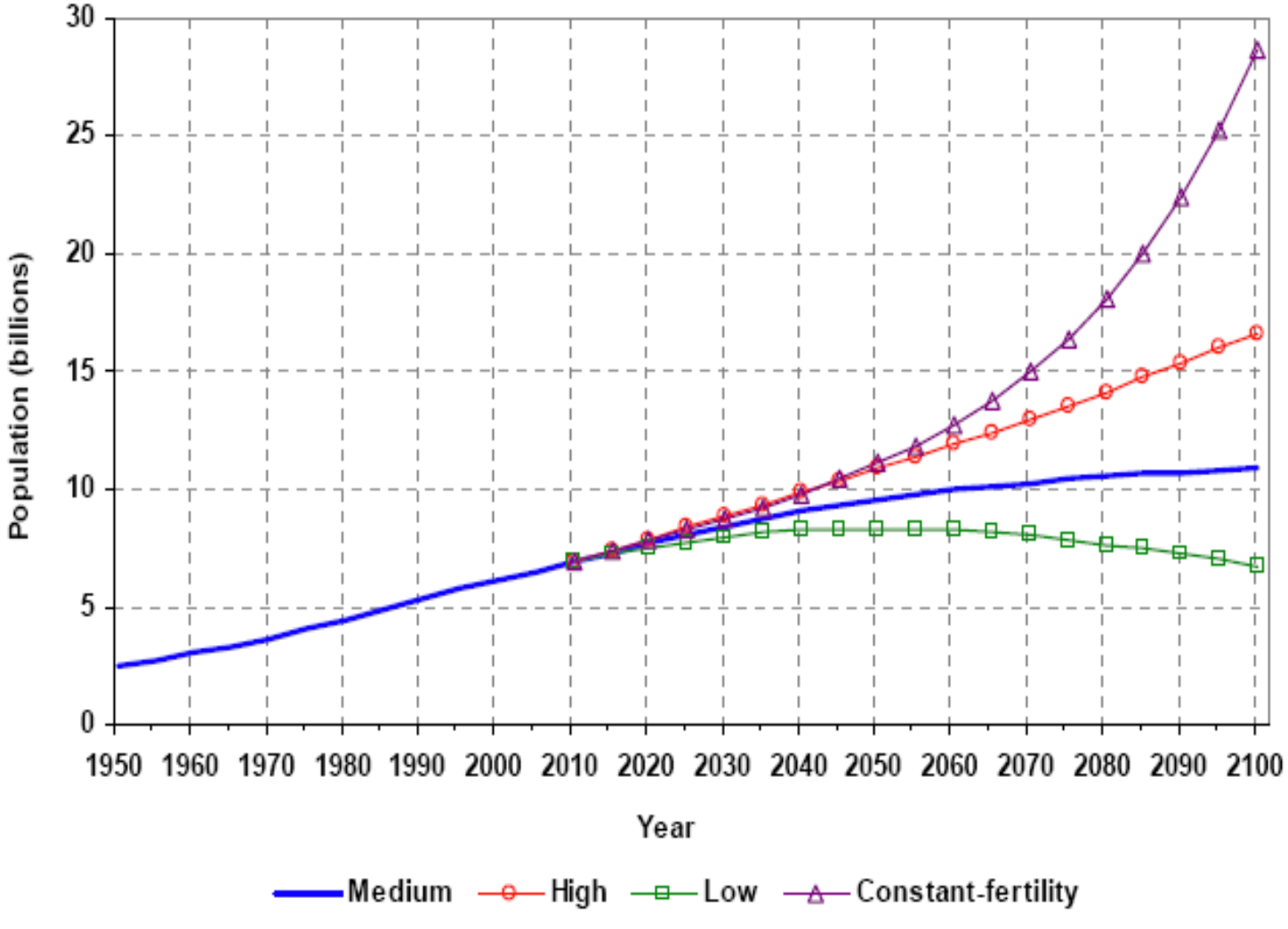


Source: Poston, Bouvier, 2017.

World's population exploded in size



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



Source: Poston, Bouvier, 2017.

Population size in billions

Continent	2013	2050	2100
America	1	1	1
Europe	1	1	1
Africa	1	2	4
Asia	4	5	5
Total	**7**	**9**	**11**

Source: Don't Panic: Hans Rosling Showing The Facts About Population (https://vimeo.com/79878808)

Population size in billions

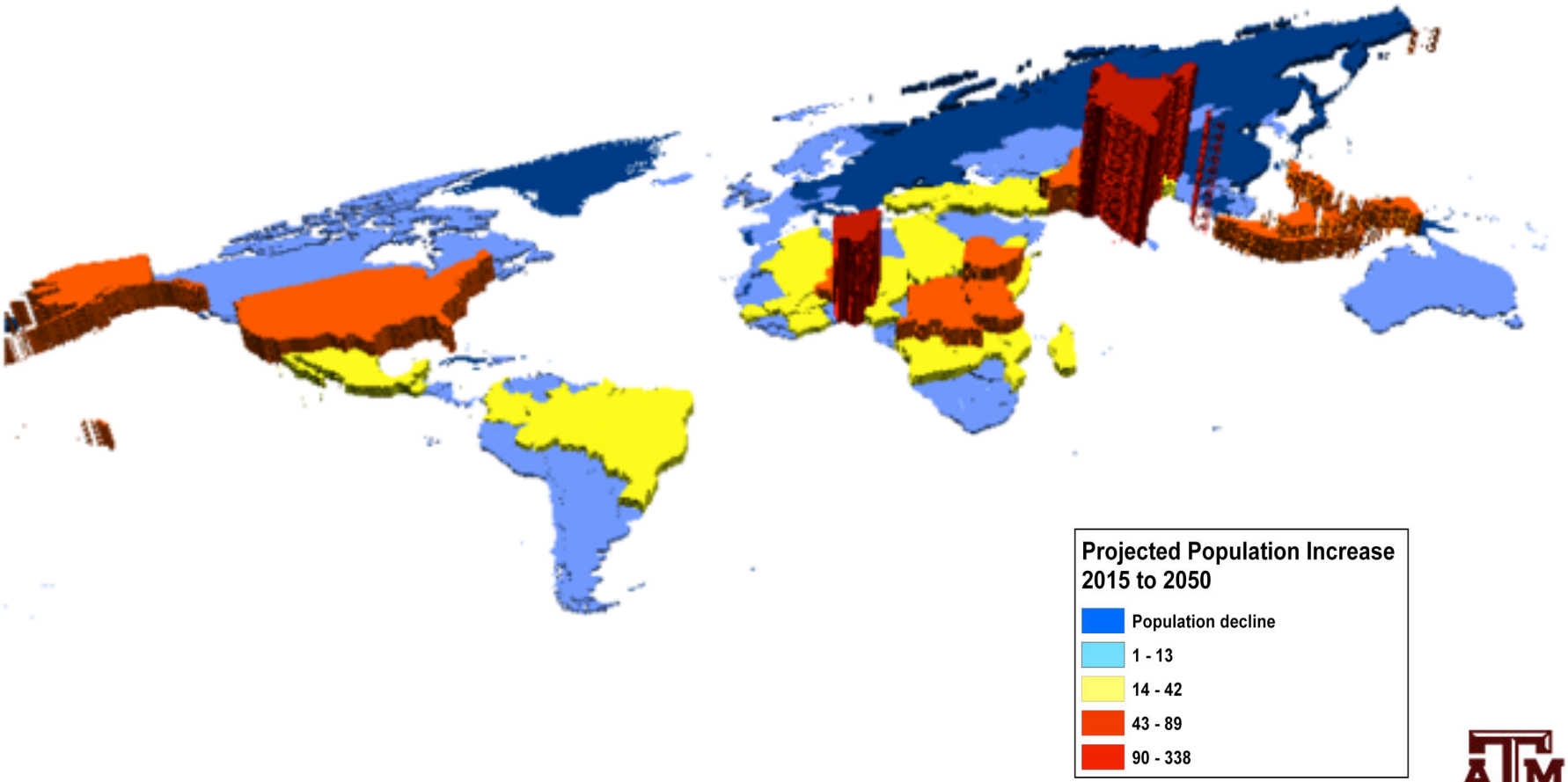
Age group	2013	2024	2050	2100
75+				1
60–74	1	1	1	2
45–59	1	1	2	2
30–44	1	2	2	2
15–29	2	2	2	2
0–14	2	2	2	2
Total	**7**	**8**	**9**	**11**

Source: Don't Panic: Hans Rosling Showing The Facts About Population (https://vimeo.com/79878808)

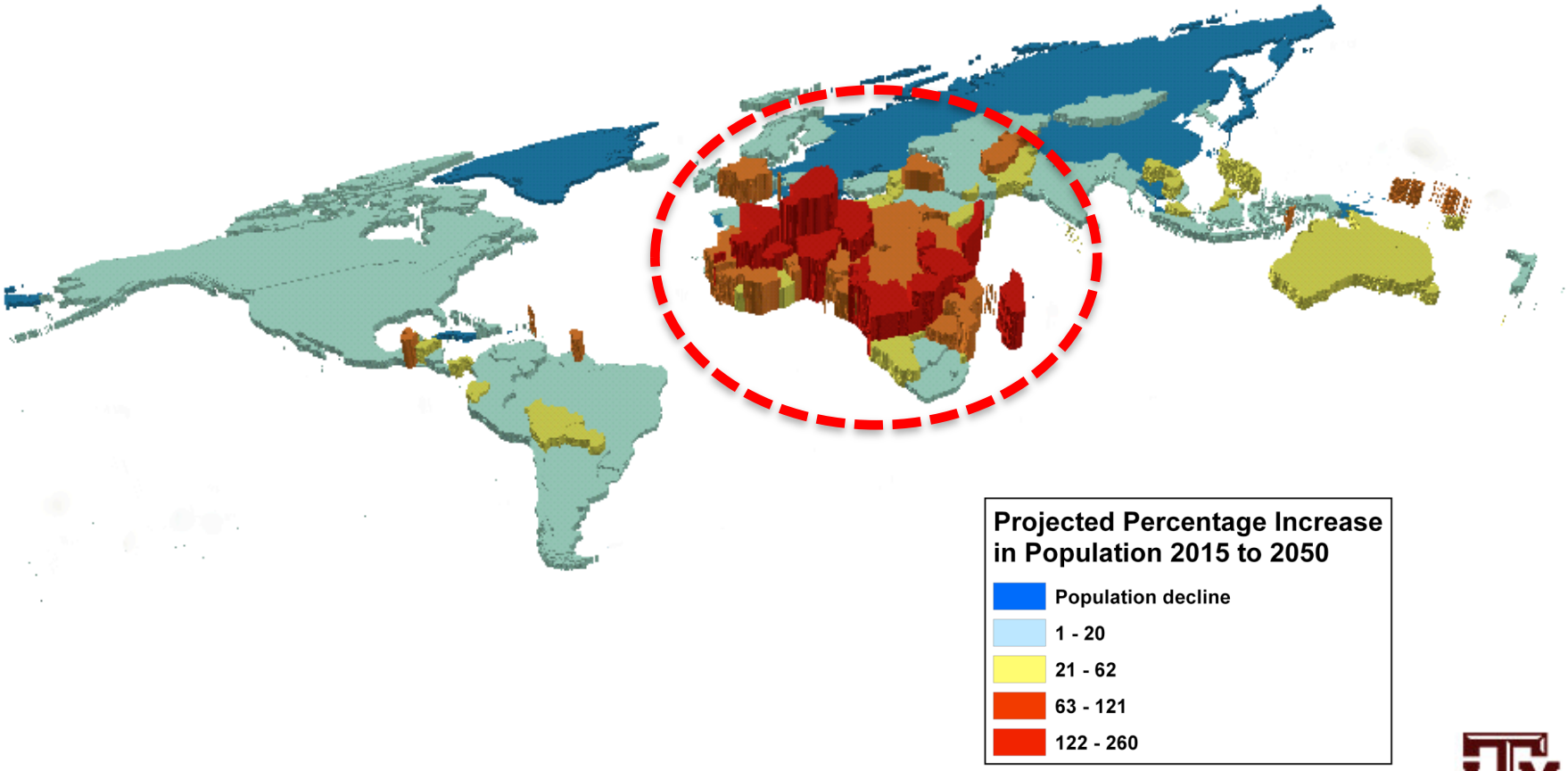
Population growth

- 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

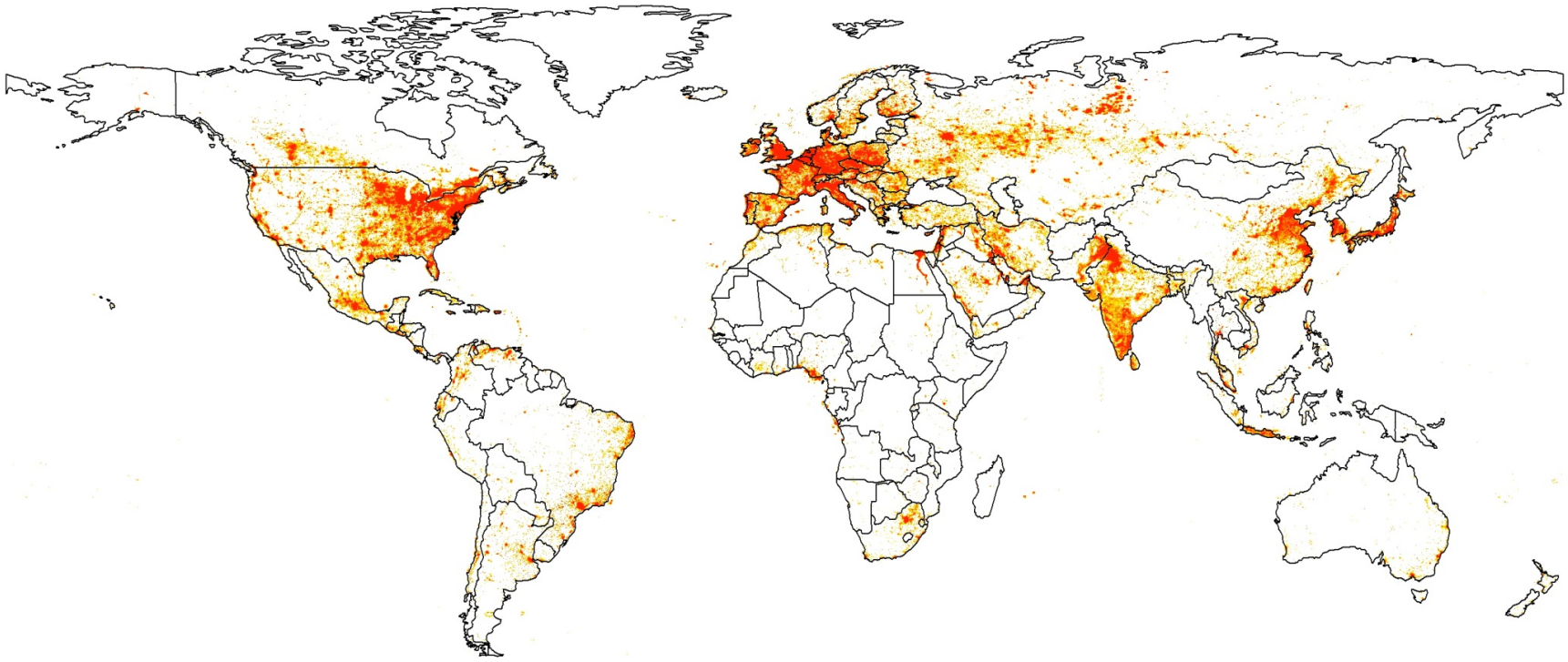
Population increase 2015–2050



Percentage population increase 2015–2050



Geographic distribution of world's population, 2015

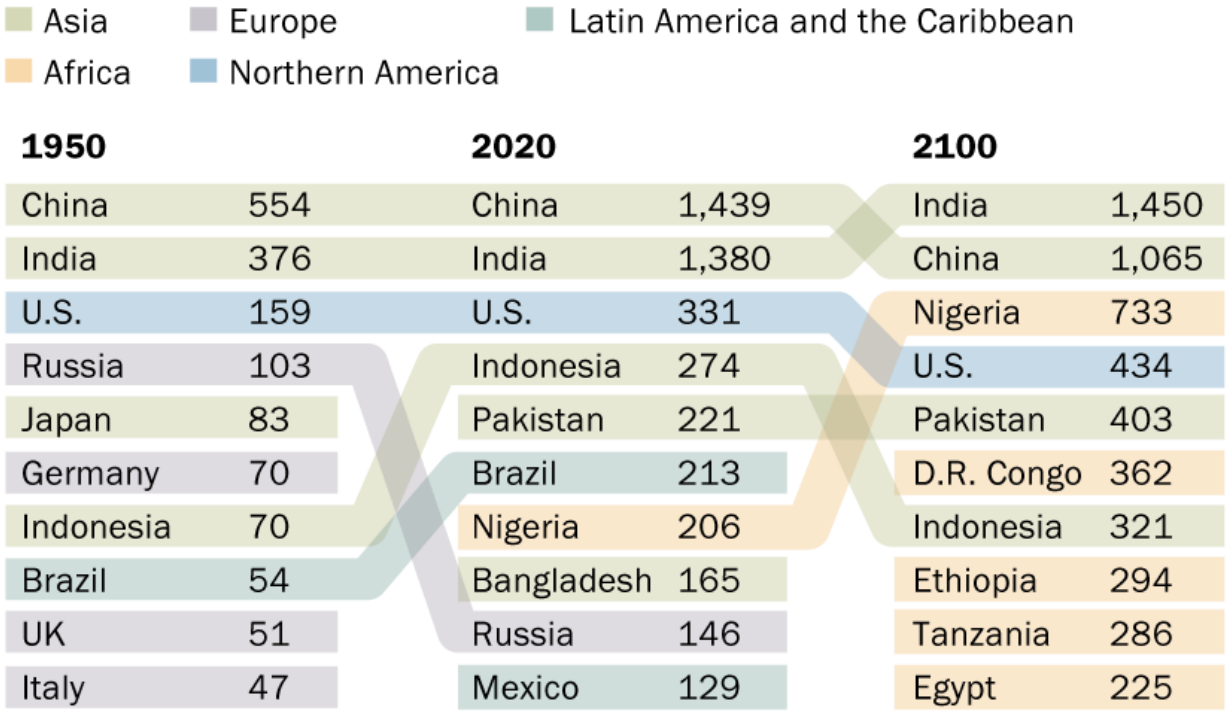


10 most populous countries, millions

	Country	2015		Country	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

By 2100, five of the world's 10 largest countries are projected to be in Africa

Countries with largest population, in millions



Note: Countries are based on current borders. In this data source, China does not include Hong Kong, Macau or Taiwan. Regions follow United Nations definitions and may differ from other Pew Research Center reports.
Source: United Nations Department of Economic and Social Affairs, Population Division, "World Population Prospects 2019."

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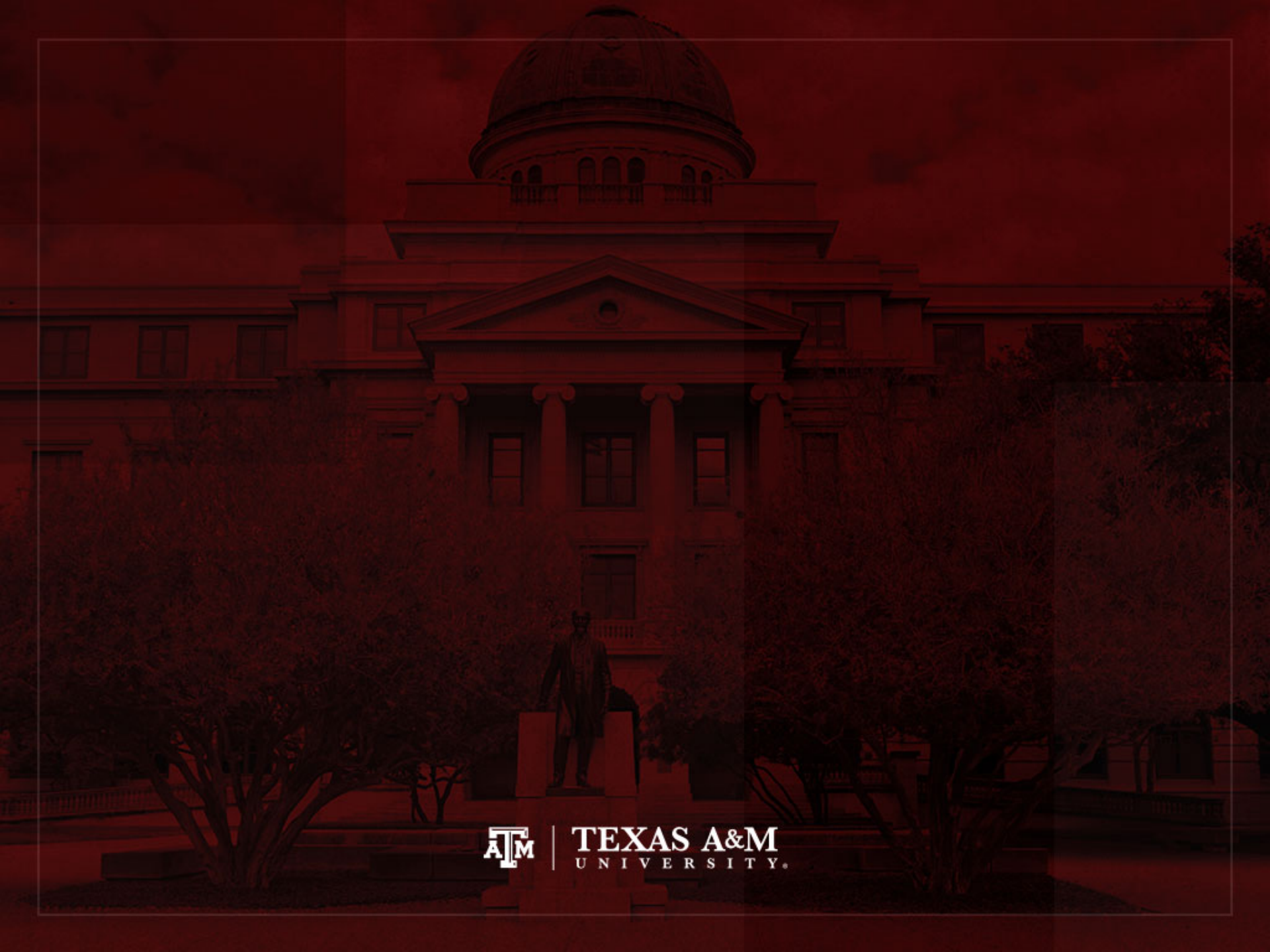
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Global population trends

(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

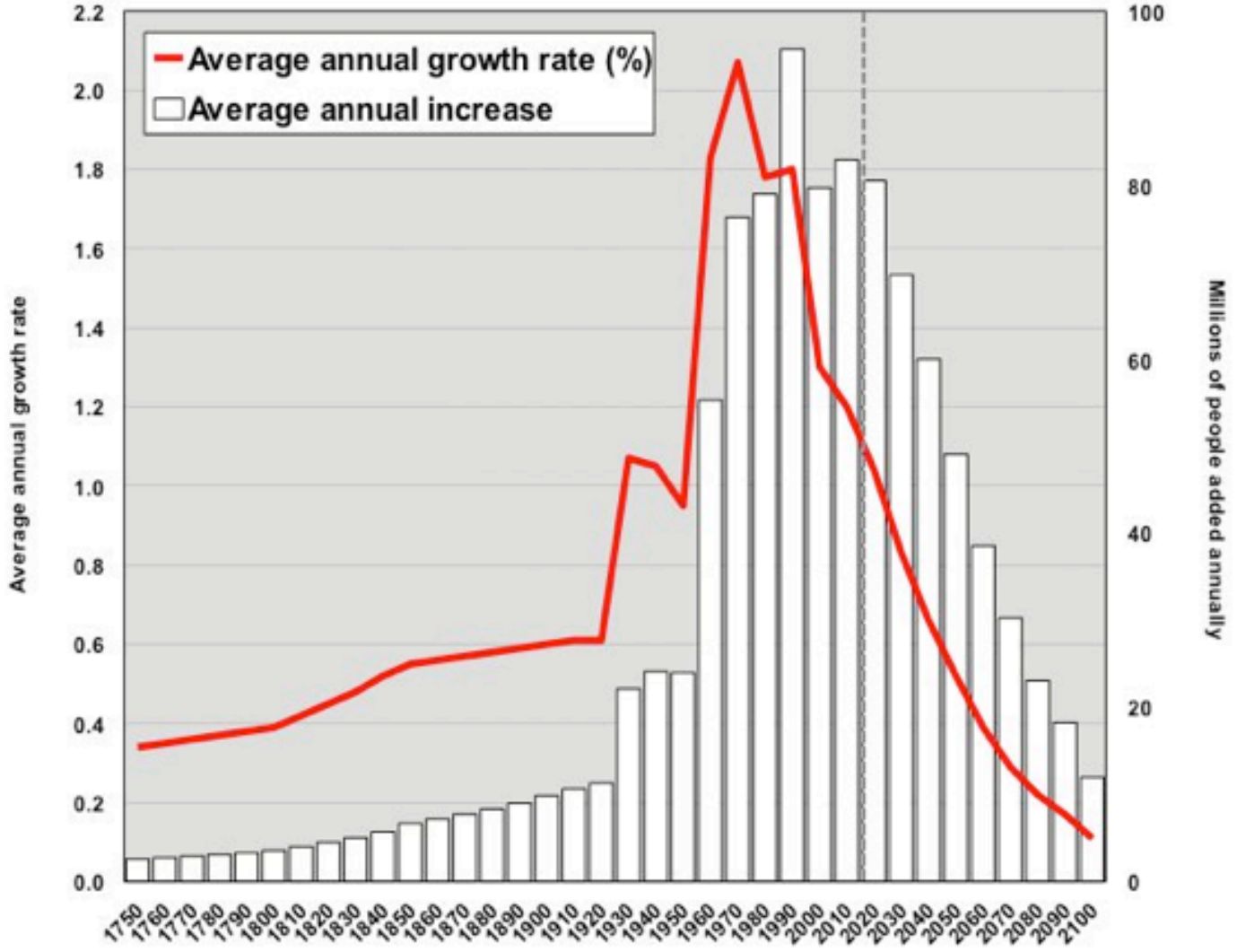
Variations in mortality

- 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

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

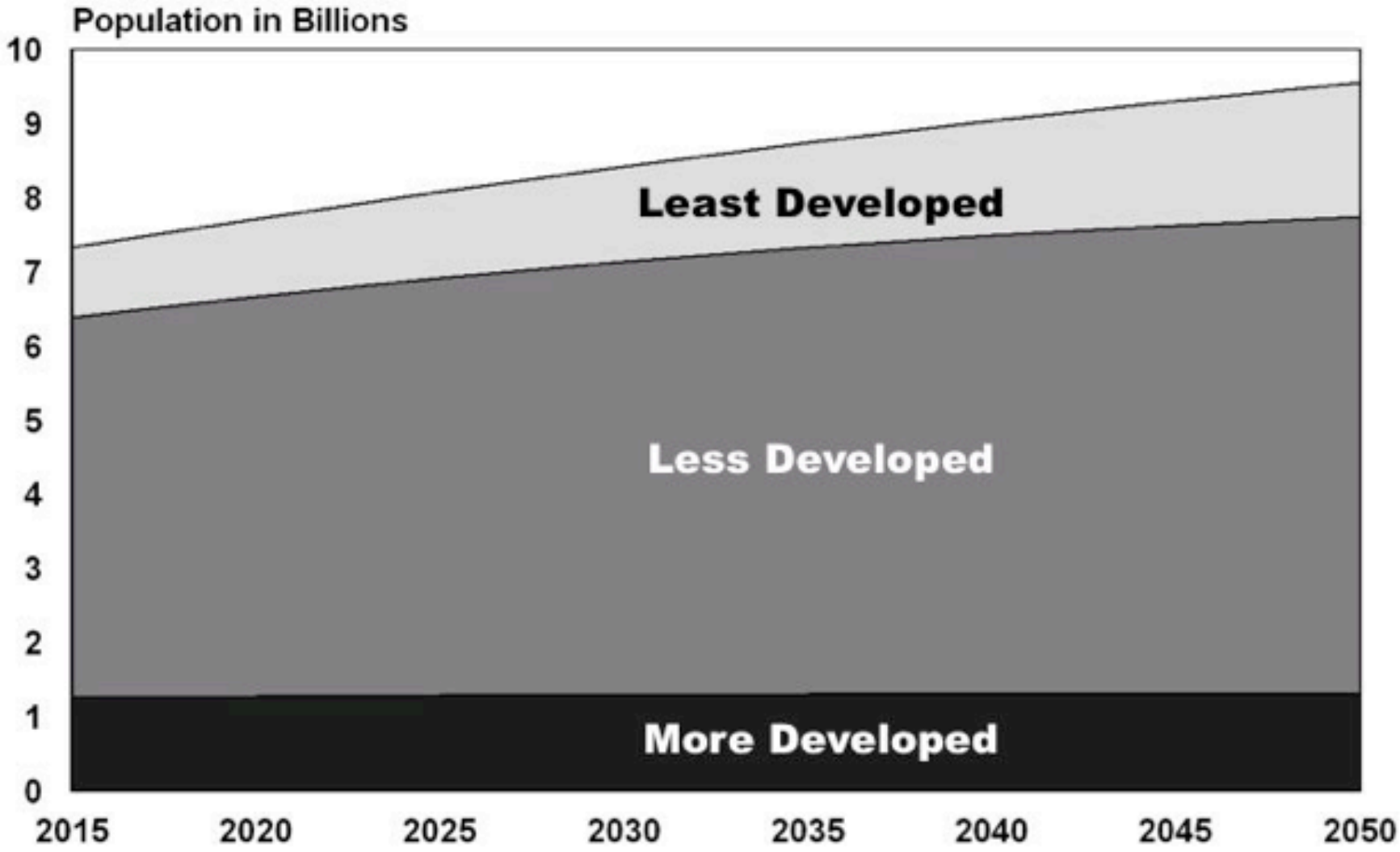
Why was early growth slow?

- 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

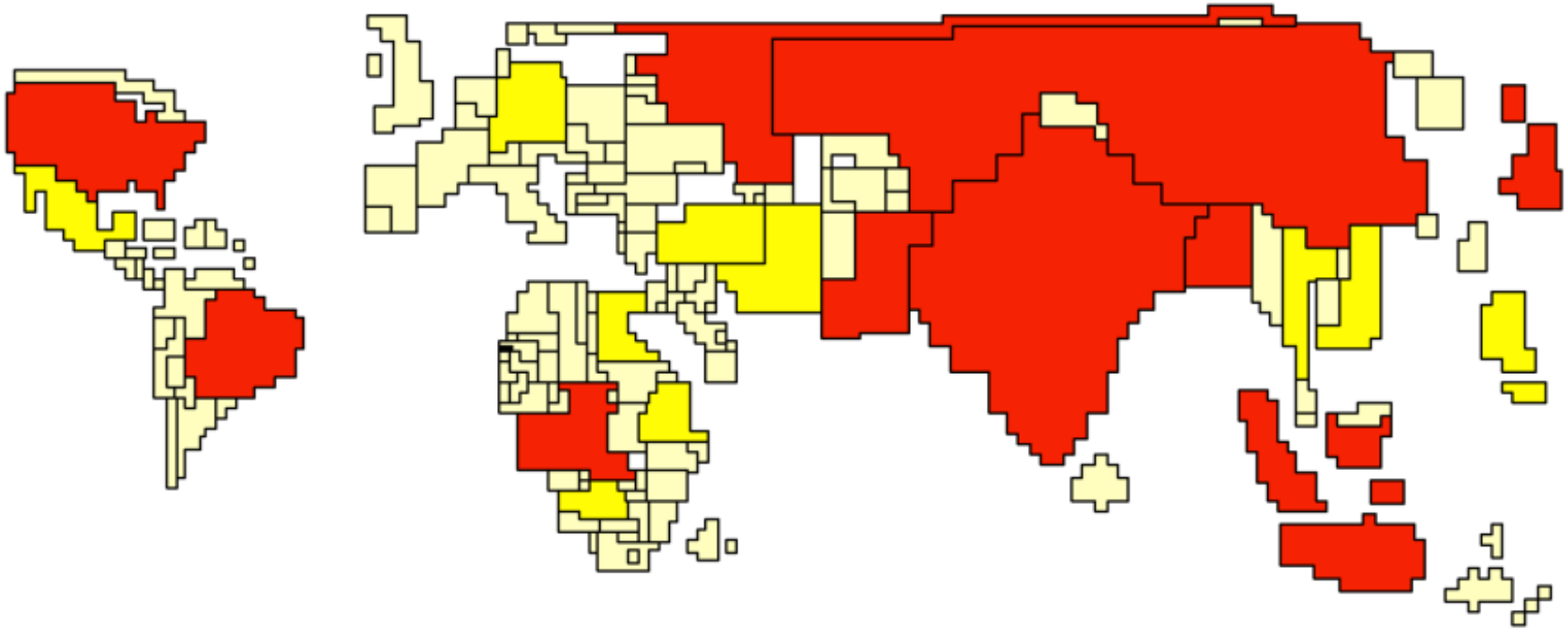
- Migration flows from rapidly growing areas into less rapidly growing ones
- European expansion: 14th to 20th centuries
  - Europe to North and South America and Oceania
  - Africa to Latin America, Caribbean and North America
- South to North migration: 20th & 21st centuries
  - Latin America and Asia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

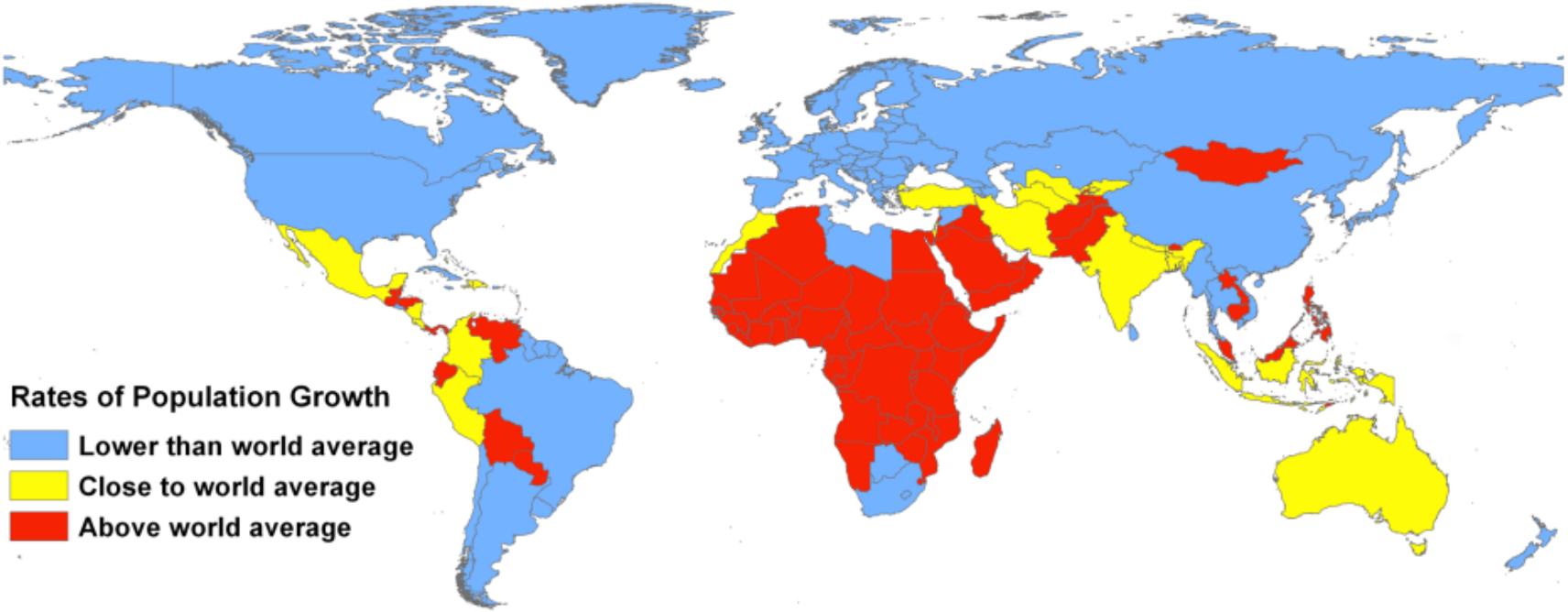
- Now they move to urban areas
  - More than 1/3 of humans live in 100,000+ cities
  - More than 50% live in urban places of any size
  - Urbanization grew even without industrialization
    - People moved to areas where goods and services were exchanged

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 (1st), India (2nd), Pakistan (3rd)
  - 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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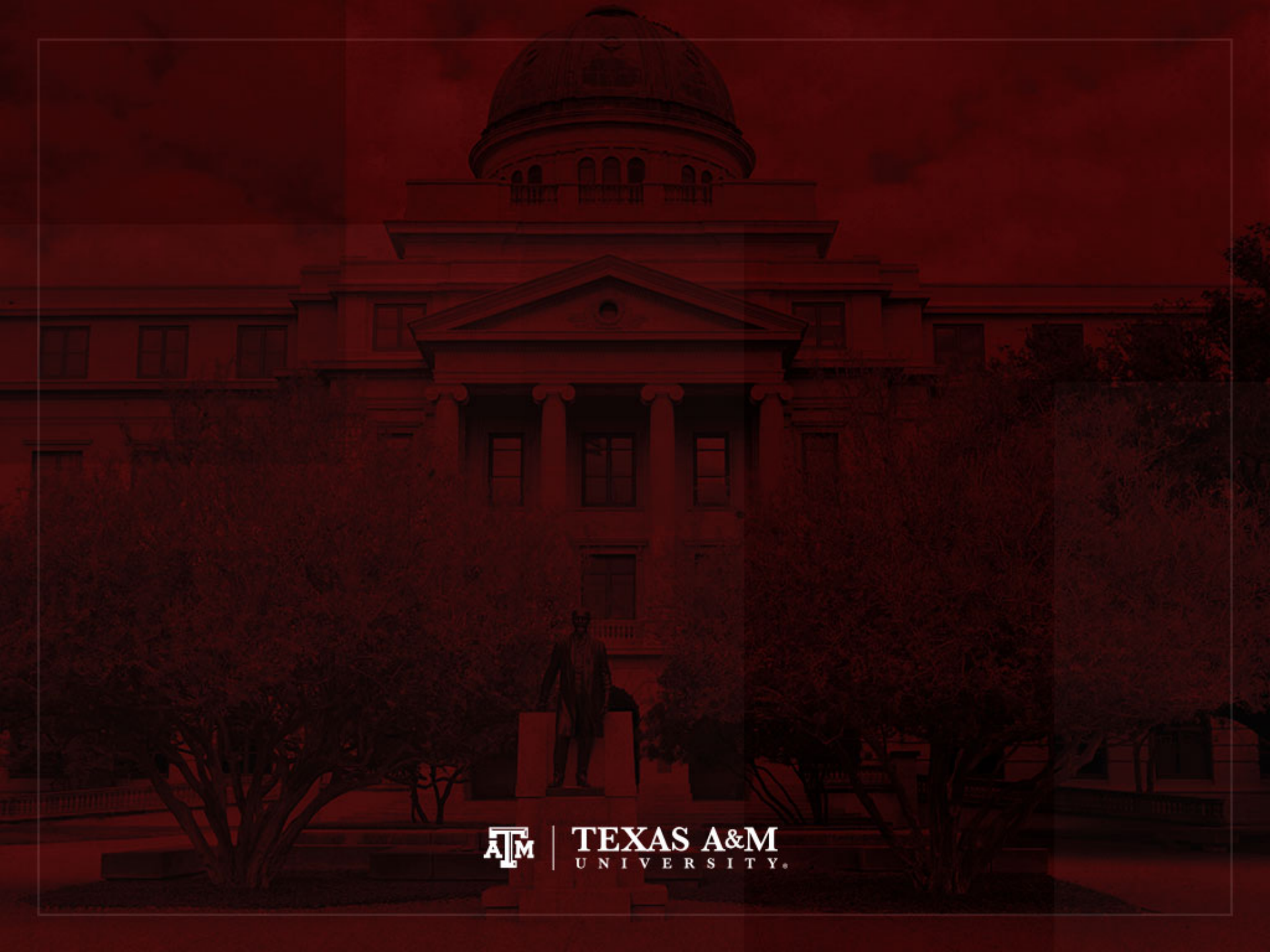
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