Age and sex composition

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Outline

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- Theoretical and substantive issues of age and sex
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Introduction

- Age and sex are the most important and relevant characteristics of populations for demographers

- Fertility, mortality, and migration
  - These components produce the population's age and sex structure, which in turn influences the demographic processes

- Division of labor in traditional societies
  - Based almost entirely on age and sex

- First characteristics we recognize
  - Are age and sex of an approaching person, mainly on the basis of appearances

- Life course, socioeconomic, demographic development
  - Changes in age and sex distribution have implications for these studies
  - Age and sex allow us to compare the timing of events

Concepts of age and sex

- Age is an ascribed and changeable characteristic
  - In population censuses, it is usually defined in terms of the age of a person at his/her last birthday
  - UN definition: estimated or calculated interval of time between the date of birth and the date of the census, expressed in complete solar years

- Sex is an ascribed characteristic and, for most people, unchangeable
  - For most people, sex is fixed at birth, but there are some who do change their sex

Sex versus gender

- Sex
  - For the most part though not always, is an ascribed variable whose designation is based on biology

- Gender
  - It is more often used when discussing nonbiological differences between males and females
  - For example, differences between males and females in migration, marriage, divorce, and labor force participation

- Demographers
  - Tend to use the term sex when discussing both biological and nonbiological differences

Theoretical and substantive issues of age and sex

- Age and sex structure of a population helps to understand demographic history of a population

- Persons of the same age constitute a group or cohort who were born during the same period
  - Therefore, they have been exposed to similar historical facts and conditions

- These experiences also differ according to sex

- Income, home ownership, occupation, or group membership are likely to vary by age and sex

Age, sex, and fertility

- The demographic processes themselves vary significantly by age and sex

- With regard to fertility, more males are born than females, usually around 105 males for every 100 females

- The fecundity of females and males occurs within certain ages
  - For females, between the ages of 15 to 49
  - For males, usually a few years later and up to age 79

Age, sex, and mortality

- Females have lower death rates than males at every age of life

- This differential has been observed through the centuries and may be attributed to both behavioral and genetic causes
  - Males are more prone than females to engage in health or life risk-taking behaviors, such as cigarette smoking
  - Estrogen (female's primary hormone) protects the heart and blood vessels
  - Testosterone, in contrast, tends to promote higher blood pressure, suppress the effectiveness of the immune system, and increase thrombosis

Age, sex, and migration

- Migration is age-selective, with the largest numbers of migrants found among young adults

- Especially in developing countries
  - Long-distance migration has tended to favor males
  - Short-distance migration usually favors females

- With increasing gender equity in a society, migration rates tend to be similar by sex

Age, sex, and organization

- Age and sex structure of human populations sets important limits with respect to sustenance organization

  - The demographic structure of age and sex contains the possibilities and sets the limits of organized group life (Amos Hawley)

- The degree to which a population's age and sex structure limits the kinds of sustenance activities is an important analytical issue

  - It is not well explored or understood

Examples of theories

- **Ansley J. Coale**
  - Development of marriage patterns by age

- **Louis Henry**
  - Description of fertility patterns by age in the absence of voluntary fertility control

- **Andrei Rogers**
  - Mathematical model for migration patterns by age

- **Stable population theory**
  - The most powerful and elegant formal mathematical theory in demography
  - It incorporates a population's age and sex structure, particularly age

Stable population theory

- It considers a closed population
  - A population in which migration does not occur
- If a population experiences constant age-specific fertility and mortality rates
  - It develops a constant age distribution and grows at a constant rate, irrespective of its initial age distribution
  - Demographers sometimes indicate that stable populations forget their past
- Age distribution of a stable population depends on
  - The underlying age-specific mortality rates
  - The rate of growth

Stationary population

- Stationary population is a stable population in which the birth rate equals the death rate

- This results in no change in the size of the population

- It is also considered in the absence of migration

Population pyramid

- A population pyramid
  - It is a graphic representation of the age/sex structure of the population
  - It is also called "age/sex pyramid"
  - Due to changes in the shape of population distributions, it has been simply called "age/sex structure"

- A population pyramid is nothing more than two ordinary histograms (bar graphs)
  - They represent male and female populations
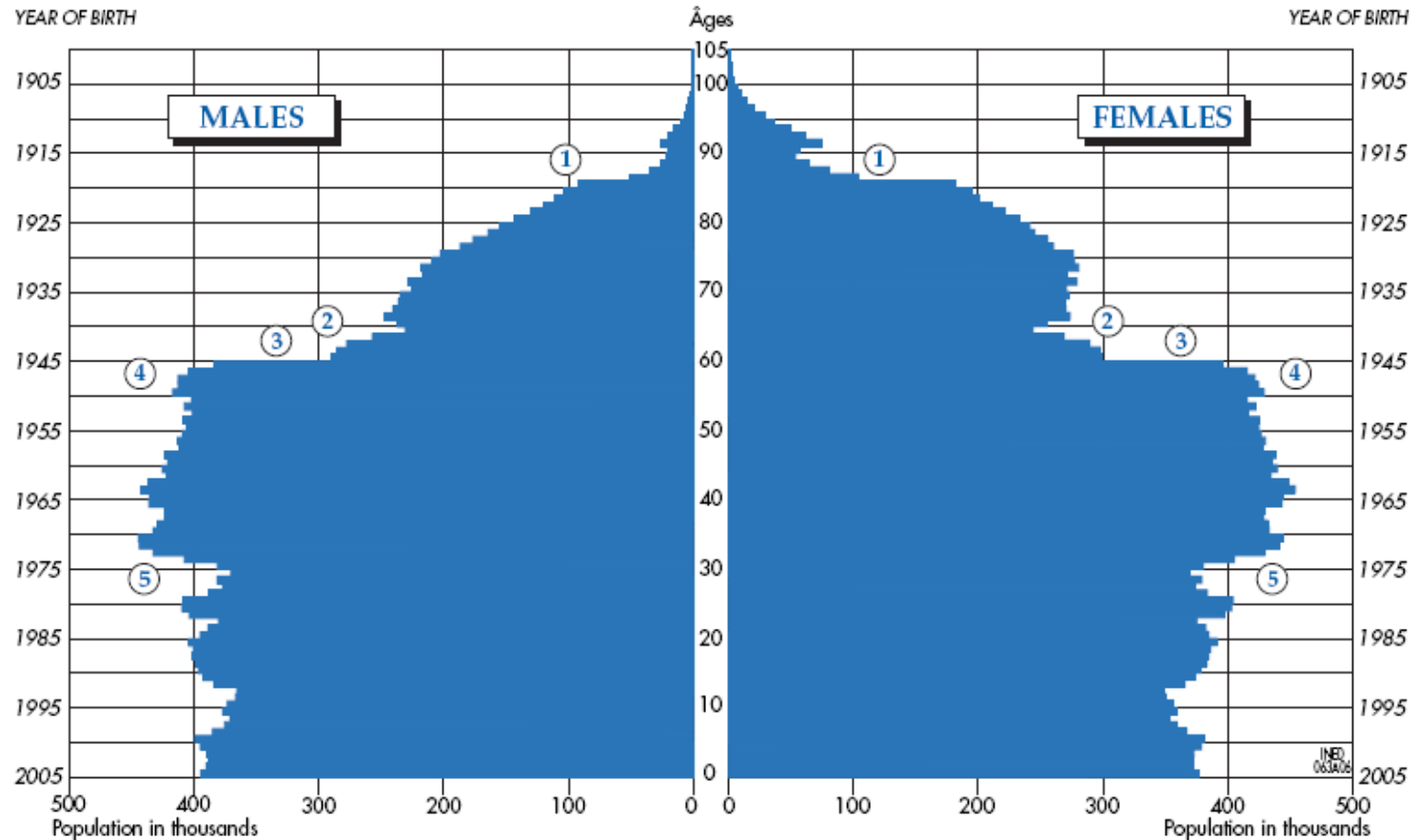 - Usually, demographers use 1- or 5-year age categories

United States - 2015
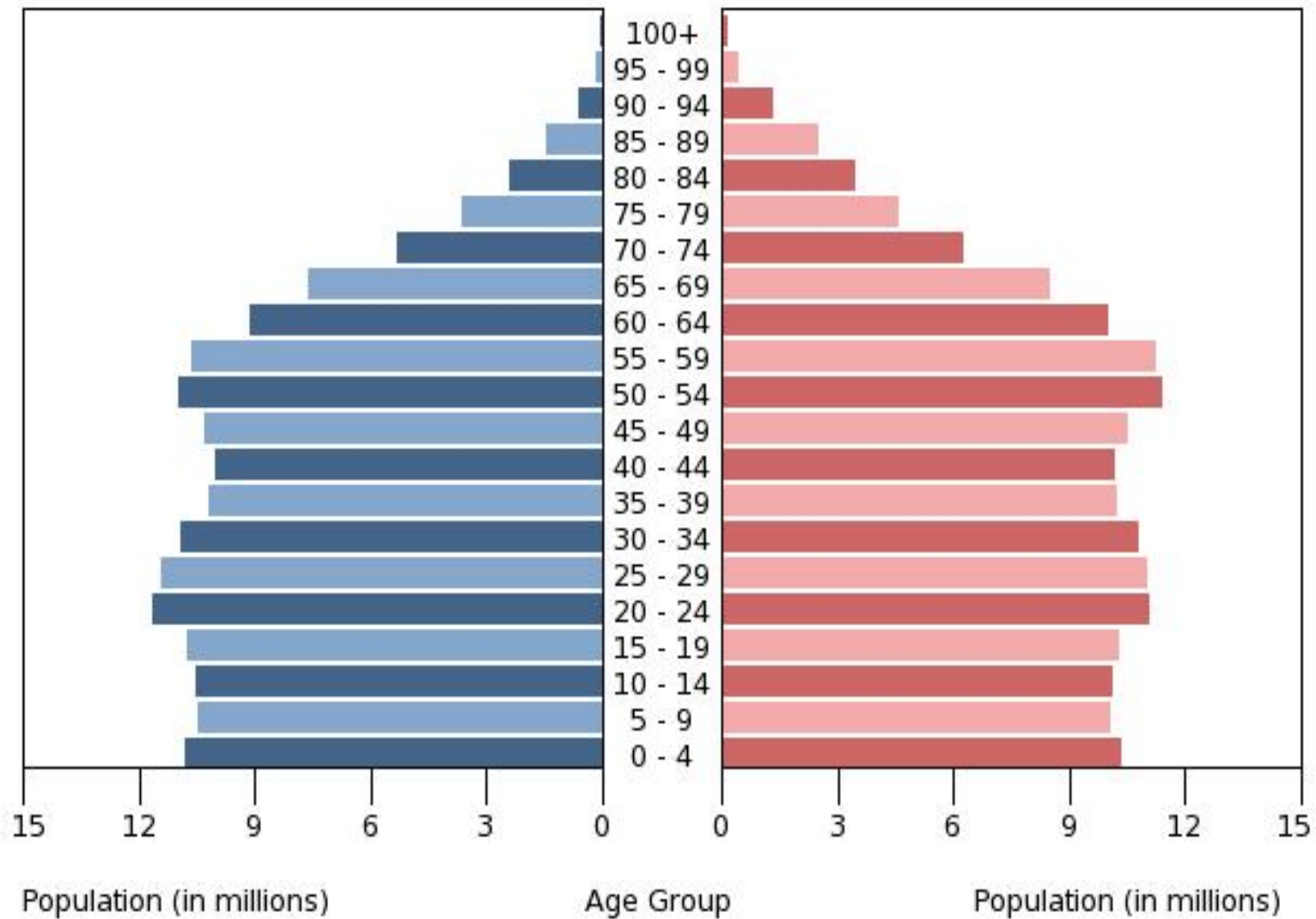
Source: U.S. Bureau of the Census, International Data Base.

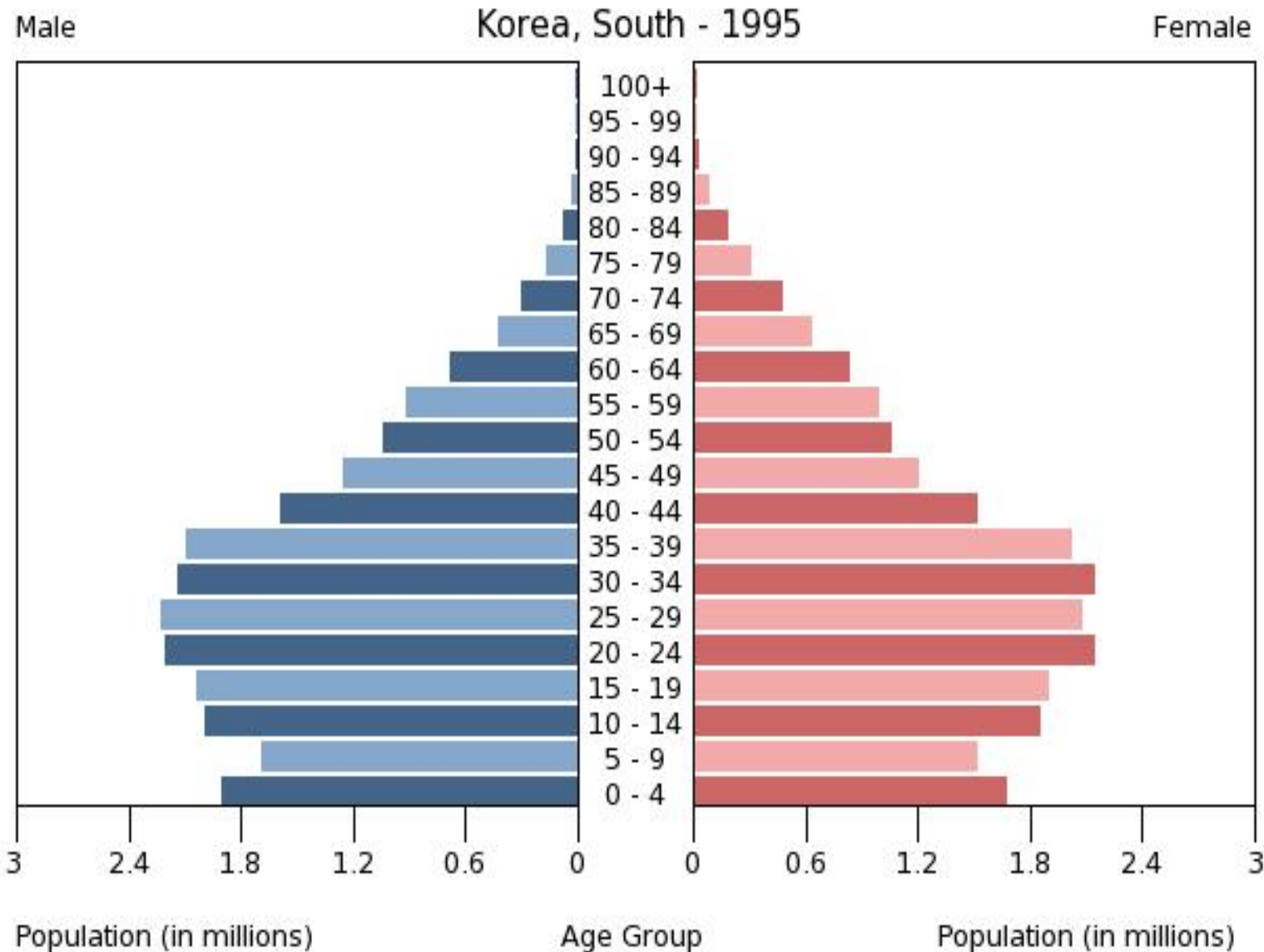# POPULATION OF FRANCE
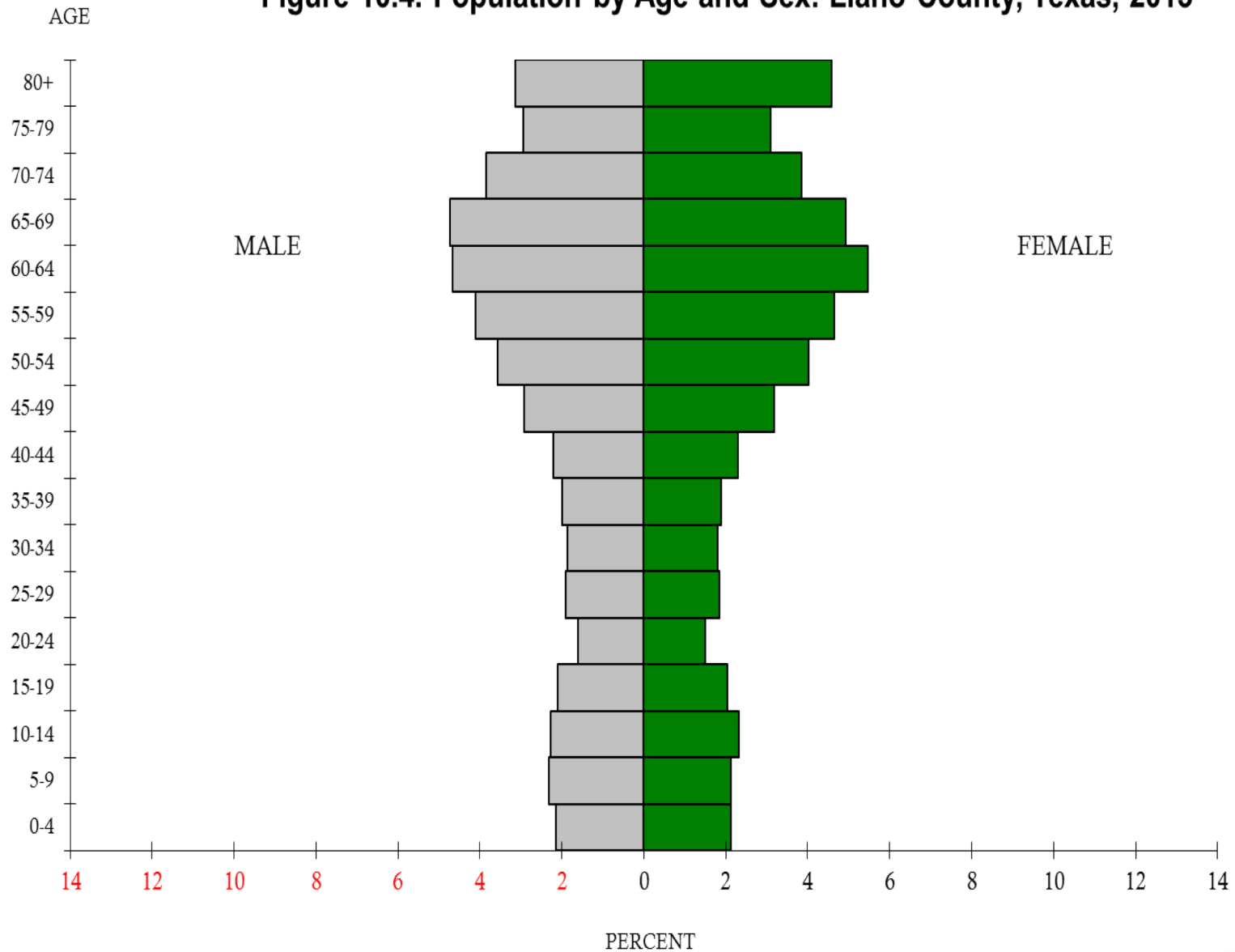PROVISIONAL ESTIMATE ON 1 JANUARY 2006

Source: Pison, 2006: 3, reprinted with permission of Institut National d'études Démographiques (INED).

Korea, South - 1995

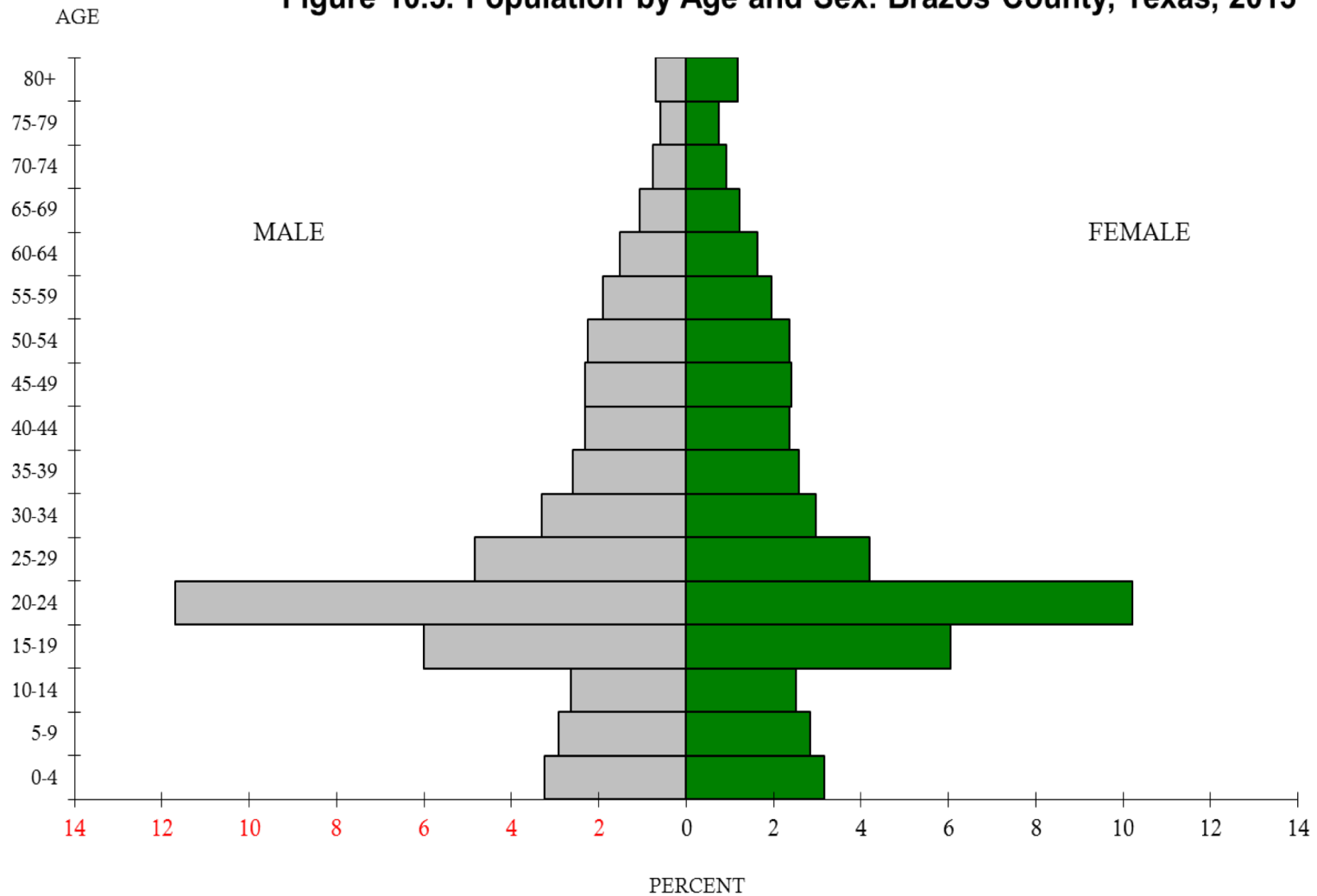Source: U.S. Bureau of the Census, International Data Base.

Figure 10.4. Population by Age and Sex: Llano County, Texas, 2013

Source: U.S. Bureau of the Census. Figure prepared by Dudley L. Poston.

Figure 10.5. Population by Age and Sex: Brazos County, Texas, 2013

Source: U.S. Bureau of the Census. Figure prepared by Dudley L. Poston.

Age dependency

- A popular measure of age structure is the dependency ratio (DR)
  - It is the ratio of the dependent-age population
    - Both young (persons 0–14 years old)
    - And old (persons 65+ years old)
  - To the working-age population
    - Persons 15–64 years old
  - It is usually multiplied by a constant of 100
- The higher the ratio
  - The more people each worker has to support
- The lower the ratio
  - The fewer the number of dependents

YDR and ADR

- Demographers usually split the dependency ratio into
  - Youth-dependency ratio (YDR or Youth-DR)
  - Old-age dependency ratio (Old Age-DR), also known as the aged-dependency ratio (ADR or Aged-DR)

- Numerator
  - The numerator of the YDR is the population 0–14
  - The numerator of the ADR is the population 65+

- Denominator is the same: population 15–64

- YDR plus ADR equals the DR

Age dependency

Values of Youth-Dependency Ratio, Old-Age-Dependency Ratio, and
Total Dependency Ratio, Selected Countries of the World, 2014

Country	Youth-DR	Old-Age-DR	Total DR
Macao	13.6	9.9	23.5
South Korea	21.6	13.5	35.1
China	20.5	16.4	36.9
Russia	22.5	18.3	40.8
Spain	22.4	26.9	49.3
United States	28.4	20.9	49.3
Mexico	42.4	9.1	51.5
Italy	21.5	32.3	53.8
Japan	21.3	42.6	63.9
Nigeria	83.0	5.7	88.7
Gambia	88.5	3.8	92.3
Uganda	96.0	4.0	100.0
Chad	100.0	4.1	104.1
Niger	106.4	6.4	112.8

Source of Data: Population Reference Bureau, 2014

Youth-dependency ratios, China and the United States, 1950–2050
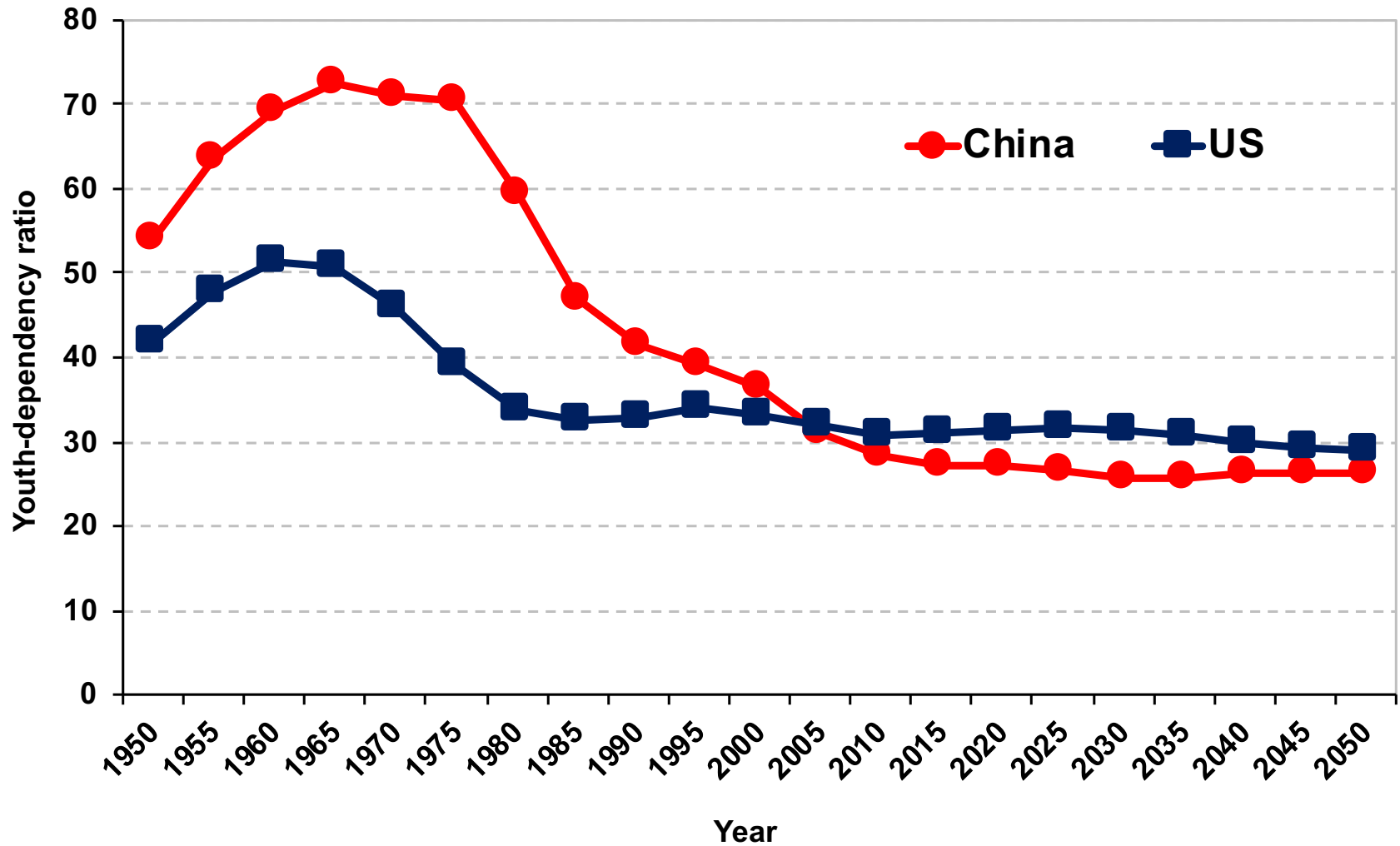
Aged-dependency ratios, China and the United States, 1950–2050
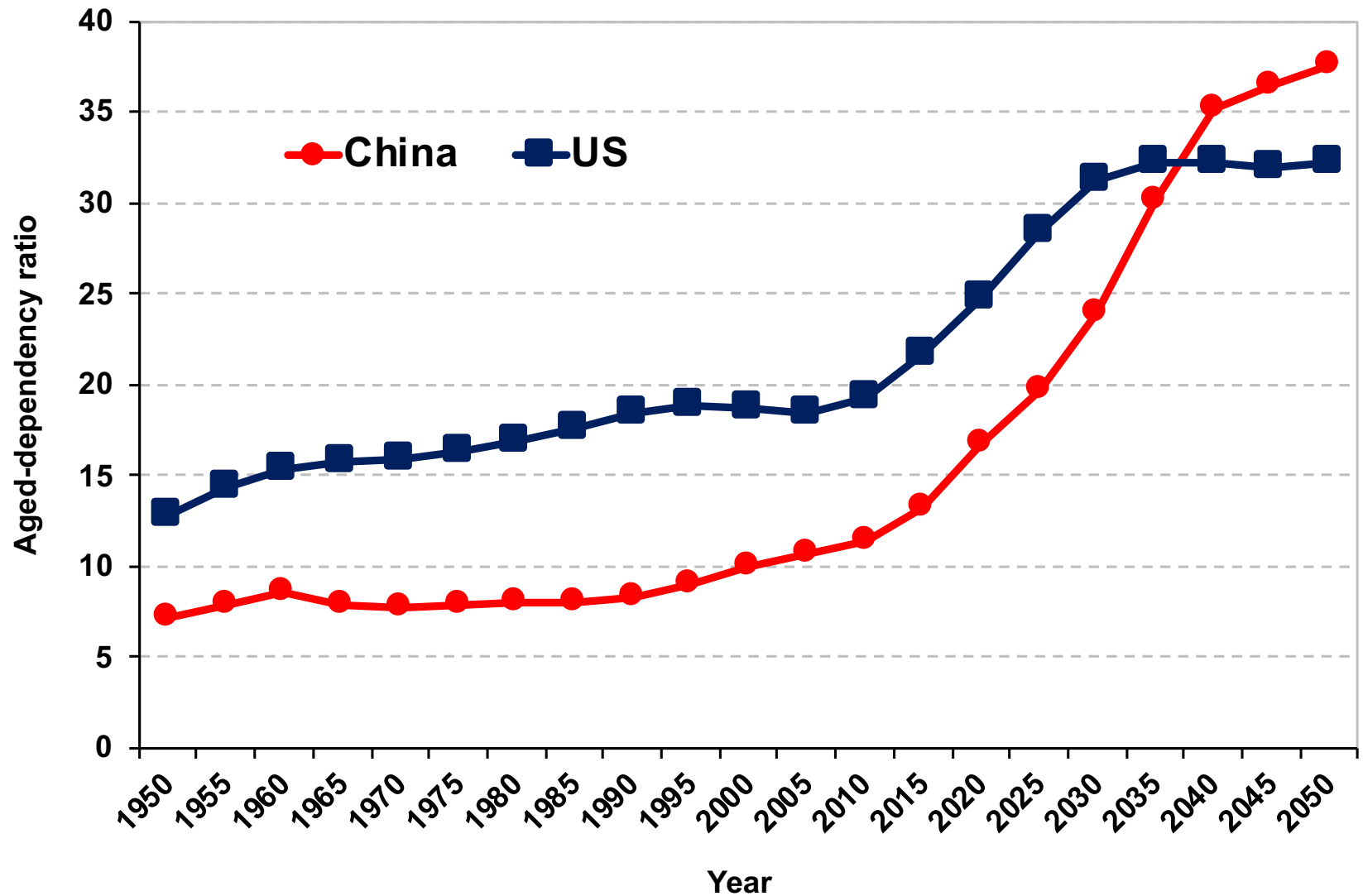
Age heaping

- Demographers use data from single years of age to determine whether there are irregularities or inconsistencies in the data

- **Age heaping** happens if a population tends to report certain ages (e.g., those ending in 0 or 5) at the expense of other ages

- Age heaping tends to be more pronounced among populations or population subgroups with low levels of education

Examples of age heaping

- In some cultures, certain numbers and digits are avoided

- For example, "13" is frequently avoided in the West because it is considered unlucky

  – Hotels in the US and in some Western countries sometimes do not have floors designated as 13

- The numeral "4" is avoided in Korea and China, since it has the same sound as the word/character for "death"

  – Many hotels in China, South Korea, and some other East Asian countries do not have floors designated as 4

Whipple's Method (WM)

- WM measures preference for the terminal digits of "0" and "5", usually in the age range of 23 to 62

$$WM = \frac{\sum(P_{25} + P_{30} + \cdots + P_{55} + P_{60})}{\sum(P_{23} + P_{24} + P_{25} + \cdots + P_{60} + P_{61} + P_{62})} * 5 * 100$$

 - Technically, WM could have the following values
    - 0, when the digits 0 and 5 are not reported
    - 100, when there is no preference for 0 or 5
    - 500, when only digits 0 and 5 are reported
  - Based on real data about age distribution
    - <105, highly accurate
    - 105–109.9, fairly accurate
    - 110–124.9, approximate
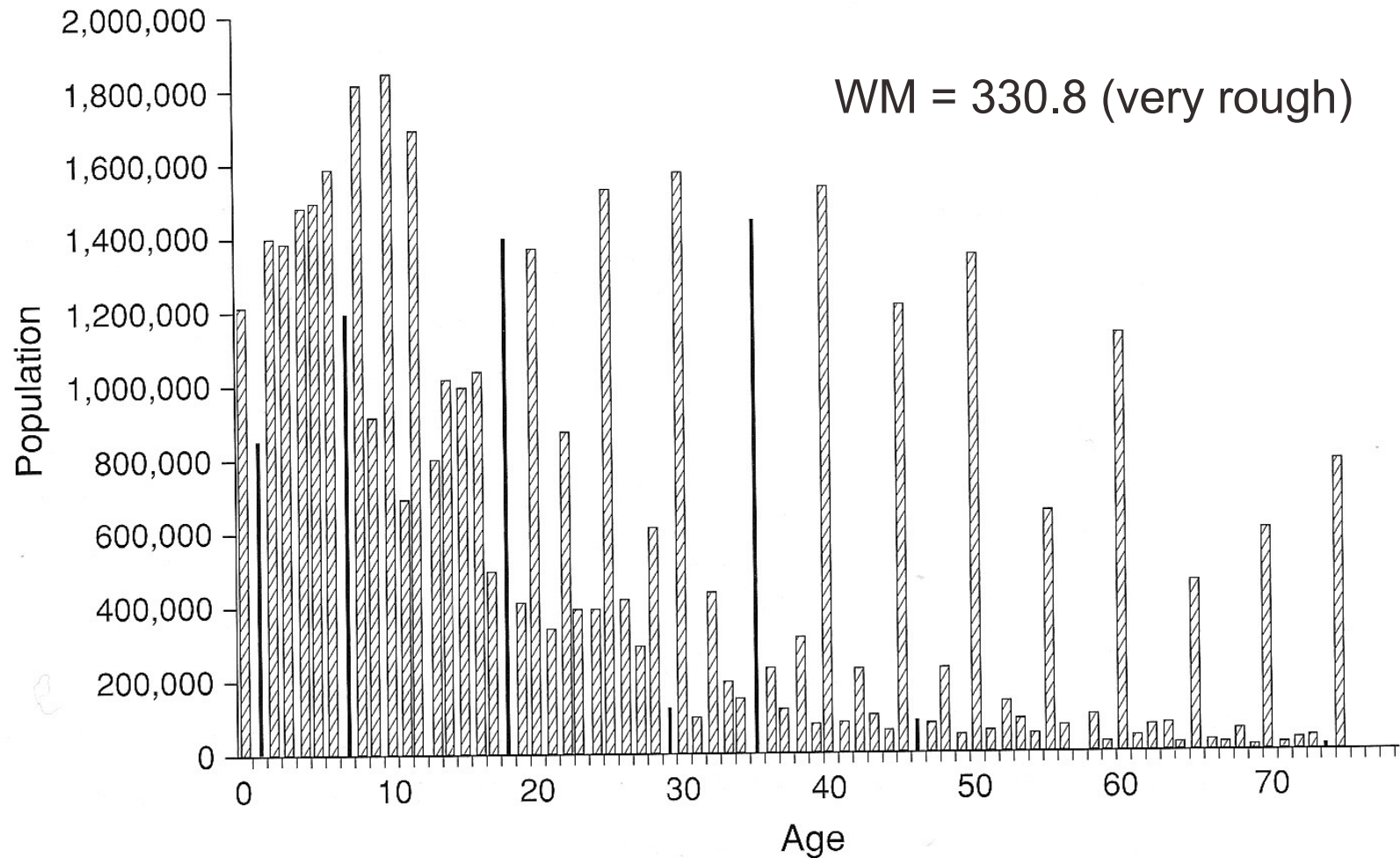   - 125–174.9, rough
    - 175+, very rough

Single years of age, female population, Republic of Korea, 1995

WM = 100.1 (highly accurate)
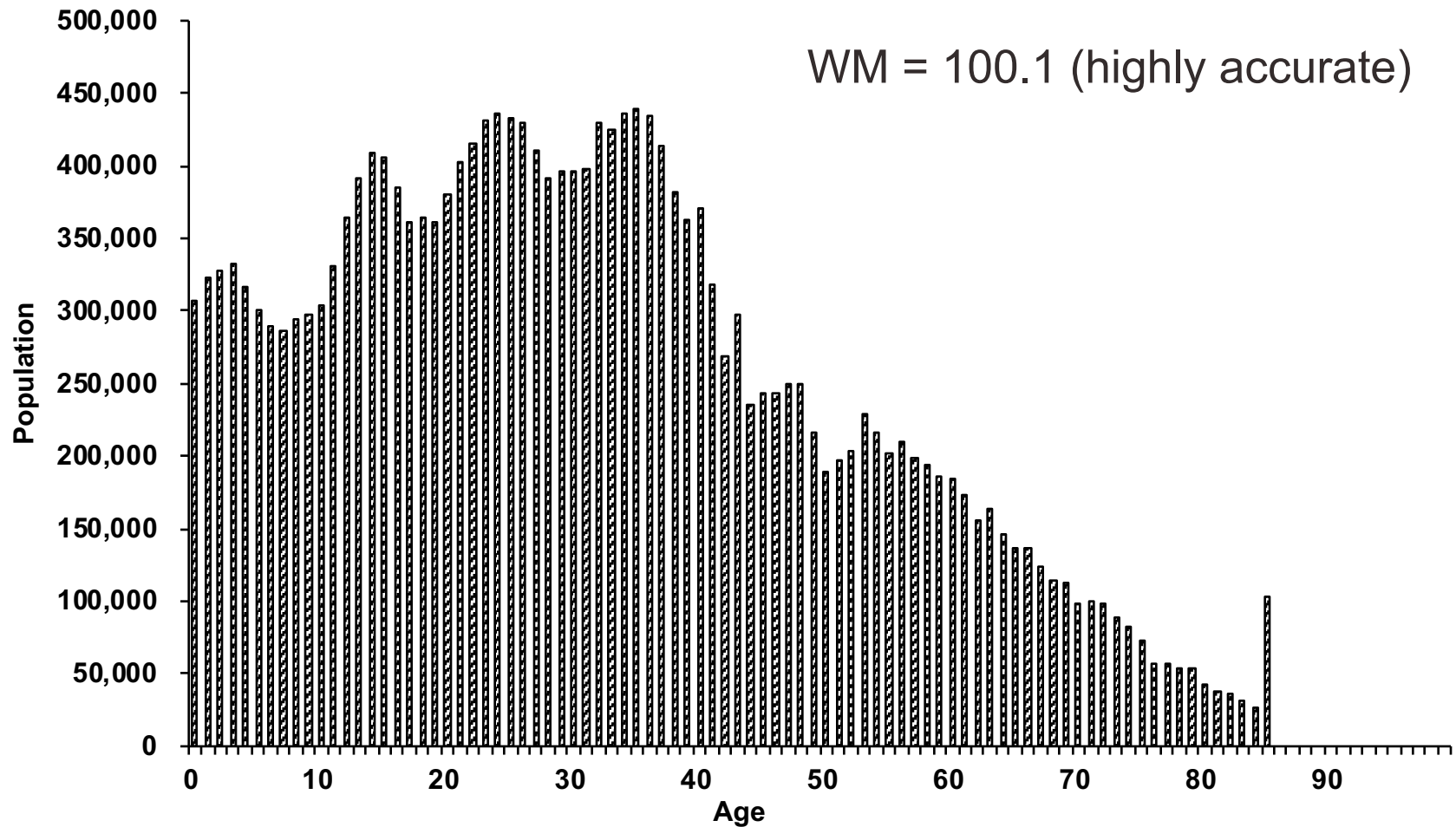
Source: Population Reference Bureau, 2014

Single years of age, male population, Pakistan, 1981
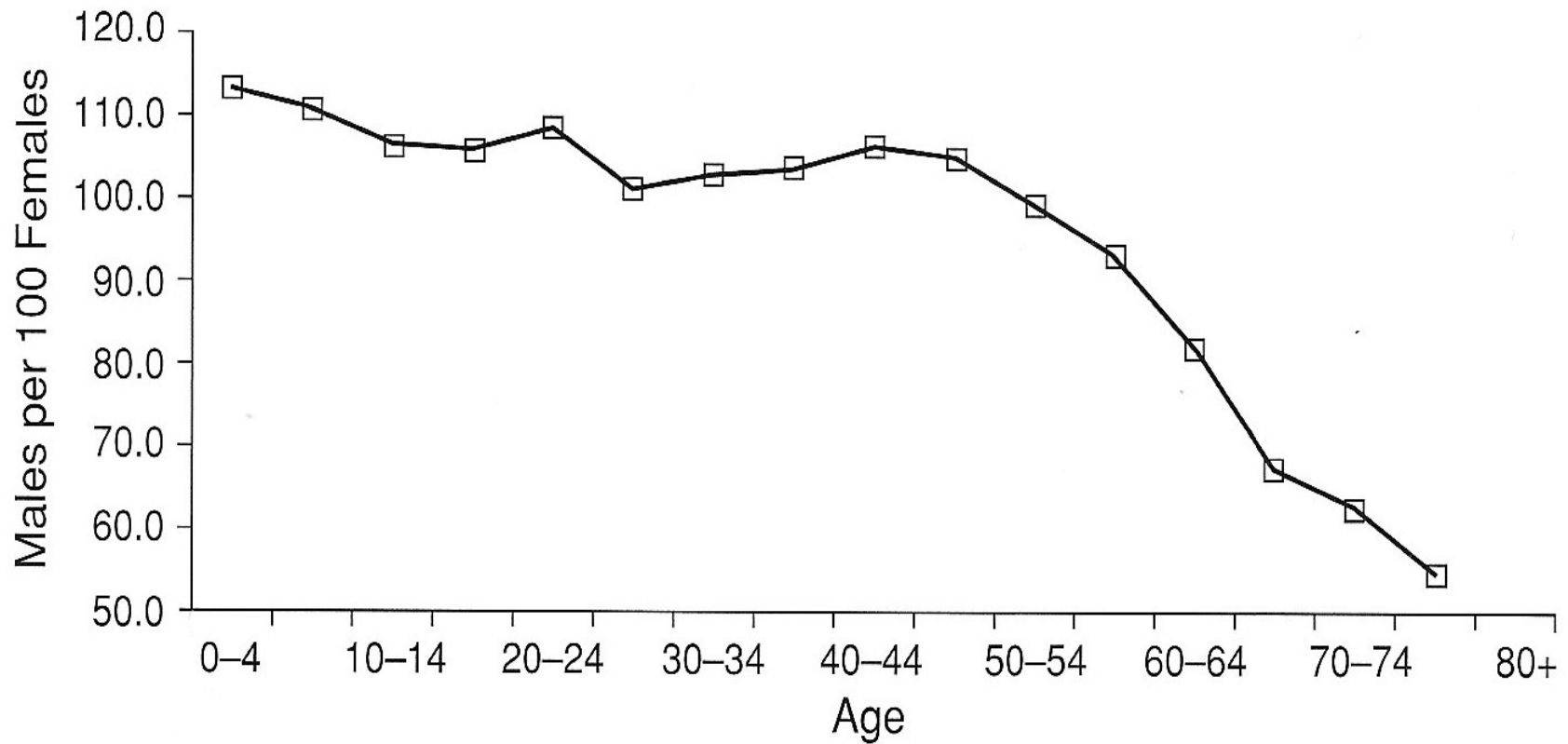

WM = 330.8 (very rough)

Source: U.S. Bureau of the Census, International Data Base. Figure prepared by Dudley L. Poston.

Sex structure

- The sex ratio (SR) is the most popular index of sex composition in demographic analyses
  - It is defined as the number of males per 100 females
  - SR above 100 indicates an excess of males
  - SR below 100 indicates an excess of females

- In general, national sex ratios tend to fall in the narrow range from about 95 to 102
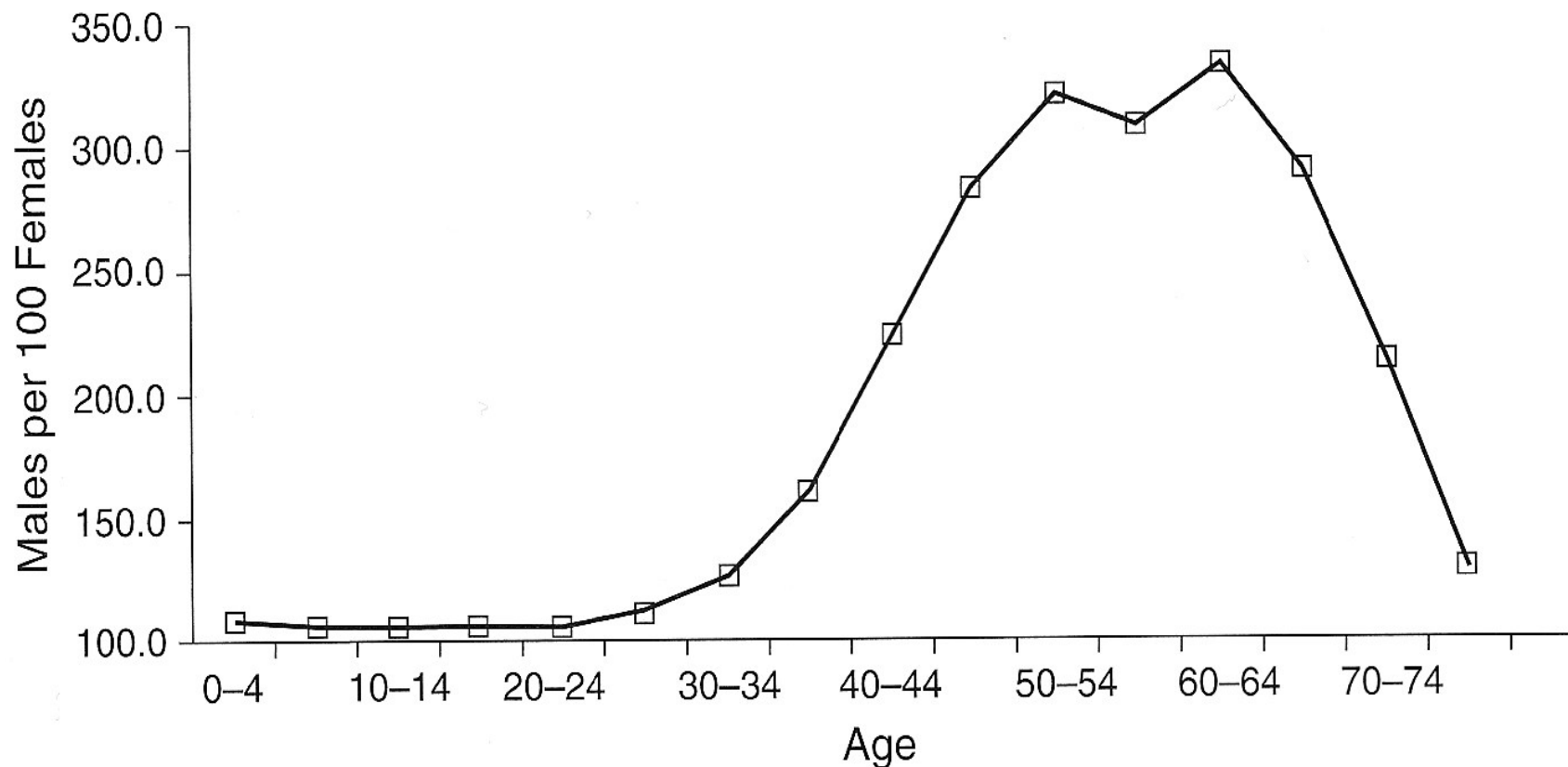 - National sex ratios outside the range of 90 to 105 should be viewed as extreme

Sex ratios by age group, Republic of Korea, 1995

Sex ratios by age group, United Arab Emirates, 2000

United Arab Emirates - 2015

Source: U.S. Bureau of the Census, International Data Base.

Sex ratio at birth

- Most societies have sex ratios at birth (SRBs) of around 105

  - 105 boys are born for every 100 girls

- But China, Taiwan, South Korea, India, and several other Asian countries have been reporting abnormally high SRBs since the 1980s

  - A main intervention is prenatal sex identification followed by gender-specific abortion

China and Taiwan

- China and Taiwan have a Confucian patriarchal tradition where son preference is strong and pervasive

- Birth-planning policies, socioeconomic changes, and industrial transformations have been responsible for the rapid decline in fertility

- Ultrasound technology enables the prenatal determination of sex

Sex ratios at birth,
Taiwan, China, U.S., 1980–2010
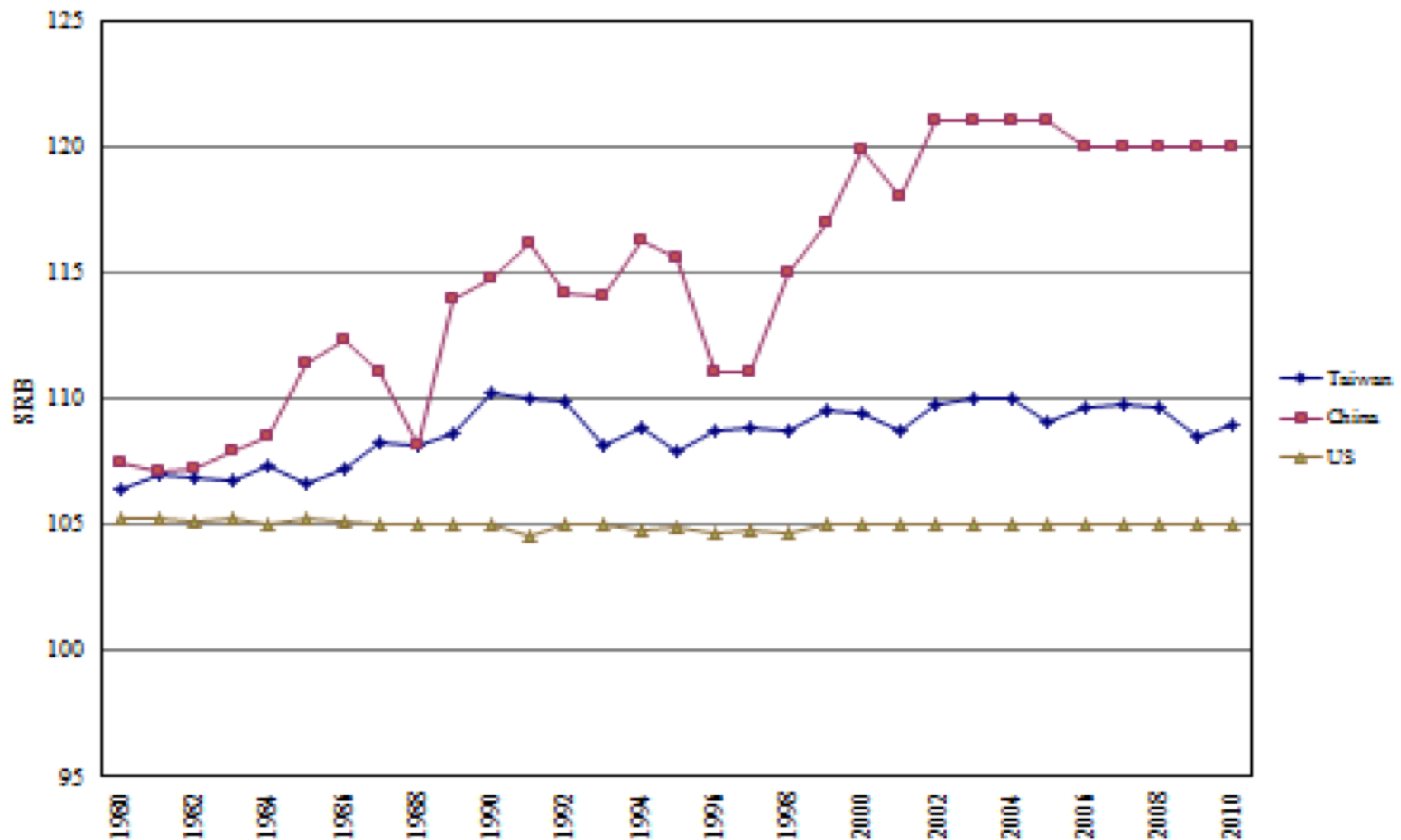
Population aging

- Large numbers of elderly persons is not a problem if there are large numbers of producers

  - It is a problem when the ratio of elderly to producers becomes high, generating socioeconomic problems

- In 2020, projections indicate more than one billion older persons (60+) in the world

  - 23.4% will be in China and 7.4% in the US

- In 2020, projections indicate almost 149 million oldest-old people (80+)

  - 19.4% in China and 8.9% in the US
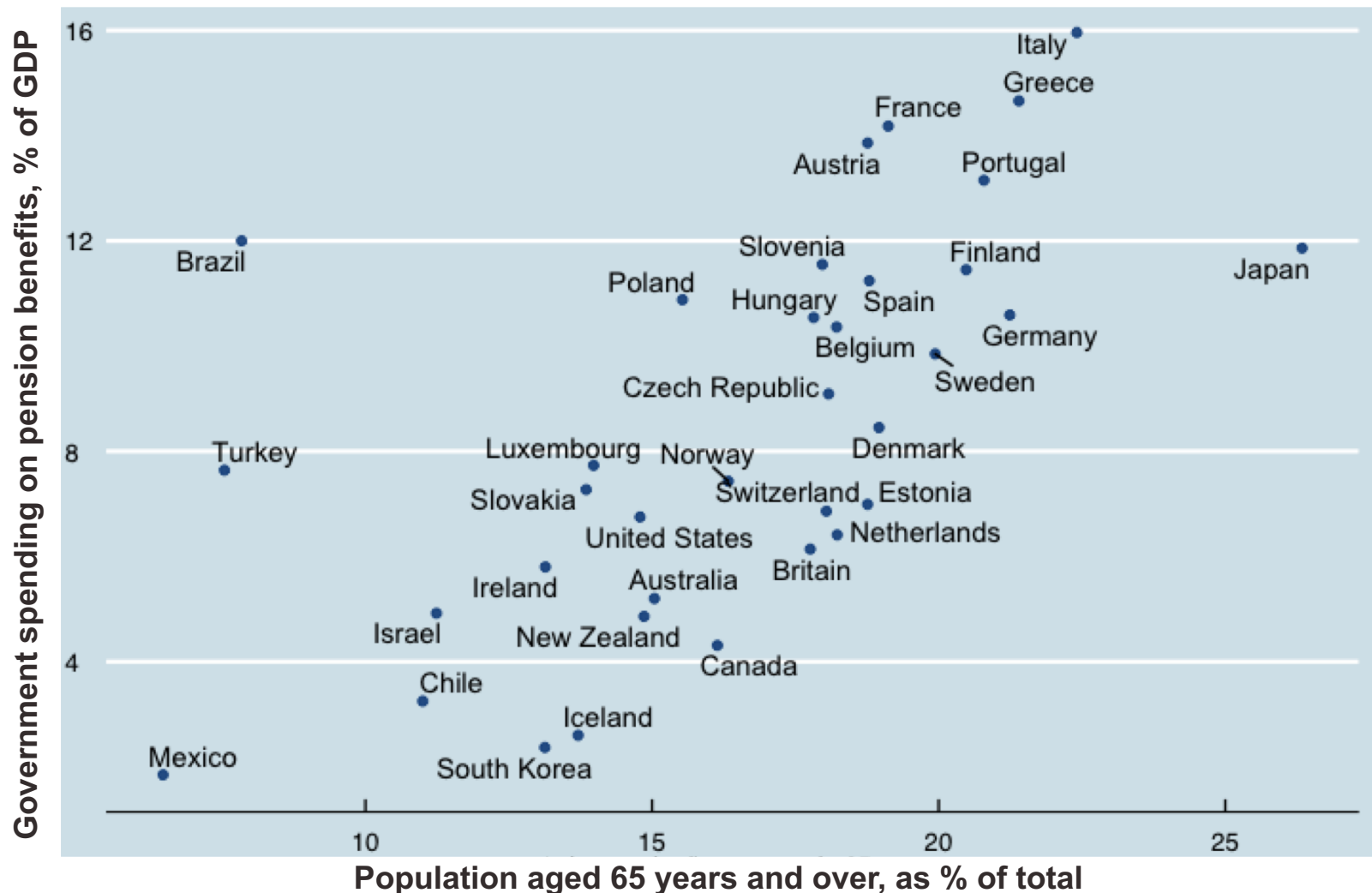
World, China, United States

World

Year	Total	Older (60+)	Oldest-Old (80+)
2010	6,866,054,000	771,641,000	106,177,000
2020	7,631,072,000	1,047,071,000	148,476,000
2030	8,315,758,000	1,403,525,000	209,296,000
2040	8,896,845,000	1,741,939,000	315,576,000
2050	9,376,417,000	2,082,998,000	446,610,000

China

Year	Total	Older (60+)	Oldest-Old (80+)
2010	1,330,141,000	171,050,000	19,658,000
2020	1,384,545,000	245,028,000	28,729,000
2030	1,391,491,000	349,324,000	42,482,000
2040	1,358,519,000	411,150,000	70,138,000
2050	1,303,723,000	459,525,000	113,890,000

United States

Year	Total	Older (60+)	Oldest-Old (80+)
2010	309,326,000	57,466,000	11,301,000
2020	333,896,000	76,986,000	13,163,000
2030	358,471,000	92,228,000	19,459,000
2040	380,016,000	98,962,000	27,615,000
2050	399,803,000	106,087,000	30,942,000

Government spending on pensions by population 65+

Y-axis: **Government spending on pension benefits, % of GDP**

X-axis: **Population aged 65 years and over, as % of total**

Data points labeled: Italy, Greece, France, Austria, Portugal, Brazil, Slovenia, Finland, Japan, Poland, Hungary, Spain, Germany, Belgium, Sweden, Czech Republic, Turkey, Luxembourg, Norway, Denmark, Switzerland, Estonia, Slovakia, United States, Netherlands, Ireland, Australia, Britain, Israel, New Zealand, Canada, Chile, Iceland, Mexico, South Korea

Cohorts and generations

- Cohort
  - Group of persons who have experienced a common event during a given time interval
  - Birth cohorts are sometimes referred to as generations

- Why study birth cohorts?
  - If you understand what distinctive opportunities and problems you have faced, you can find common ground with others in your generation and in other generations (Elwood Carlson)
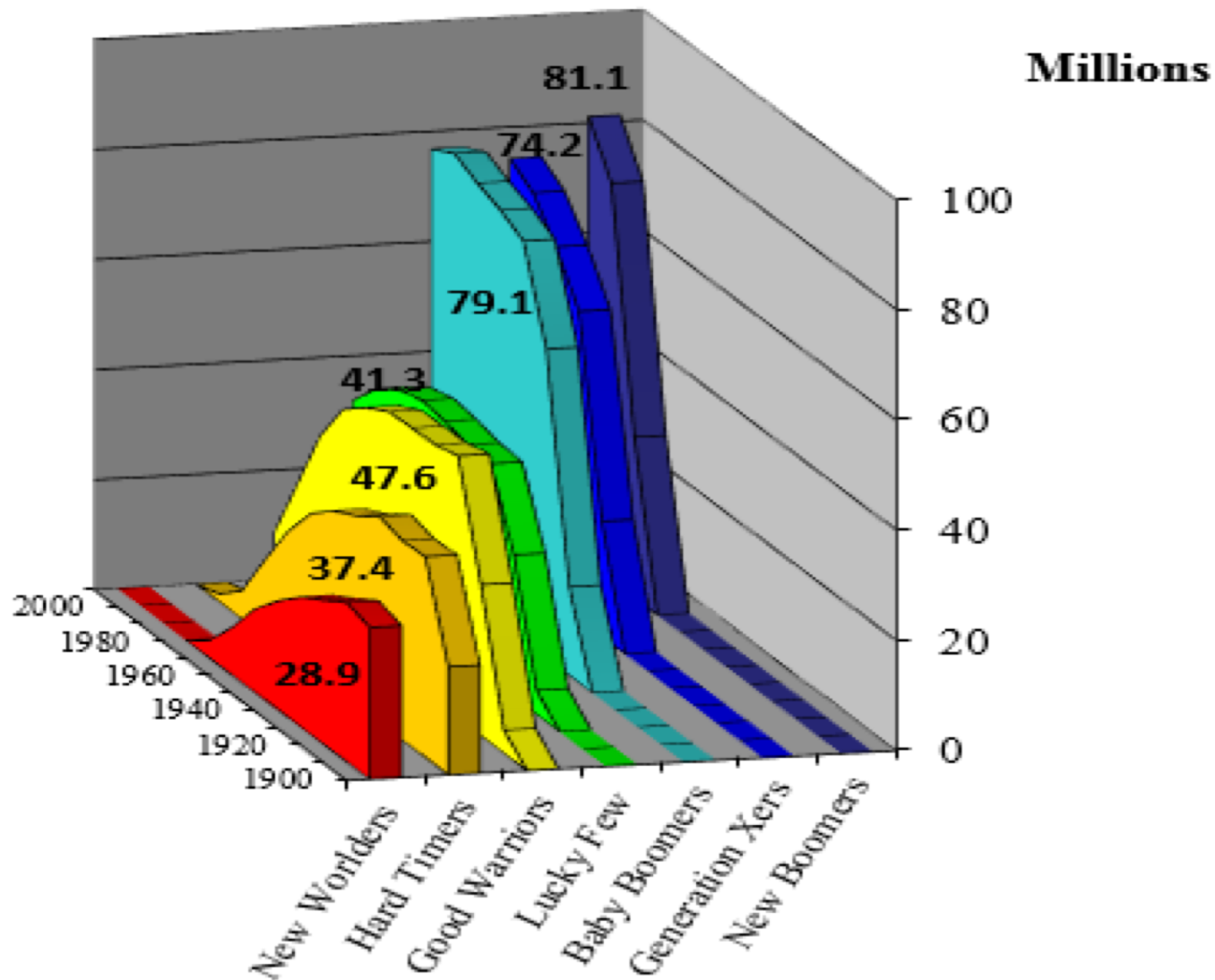
Lucky Few cohort

- **Lucky Few cohort**, born between 1929–1945

- They were fewer compared to the much larger number of persons in the cohort immediately following
  - Baby Boomer cohort, born between 1946–1964

- The smaller size of the Lucky Few has enabled them to enjoy higher employment rates and a greater variety of social opportunities than members in the preceding or following cohorts

Seven birth cohorts by size, 1900–2010

Millions

81.1
74.2
79.1
41.3
47.6
37.4
28.9

100
80
60
40
20
0

2000
1980
1960
1940
1920
1900

New Worlders
Hard Timers
Good Warriors
Lucky Few
Baby Boomers
Generation Xers
New Boomers

References

Poston DL, Bouvier LF. 2017. Population and Society: An Introduction to Demography. New York: Cambridge University Press. 2nd edition. Chapter 10 (pp. 266–311).