EC569 Economic Growth
Demographics (Lecture 10)

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Recap of Lecture 3

- Malthus:
  - Countries with large population relative to natural resources will be poorer
- Solow:
  - Countries with rapidly growing population will be poorer
  - Capital dilution
  - Population growth rate is exogenous

Overview

- Demographic transition
- Future population trends
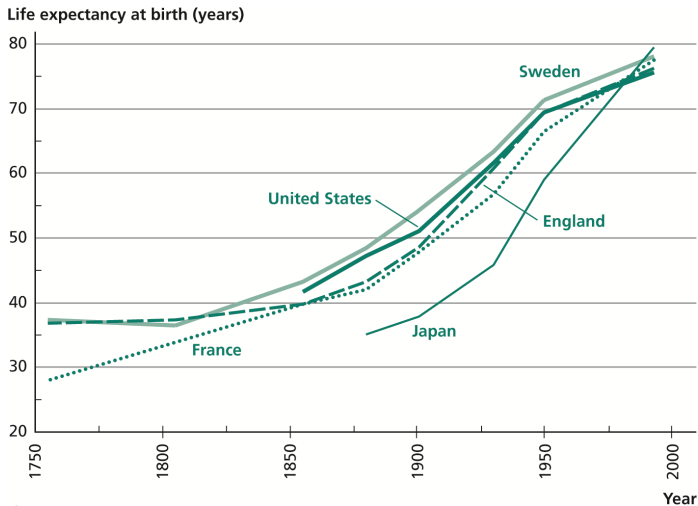- Population aging

Demographic Transition

- Demographic transition
  - The process by which a country's demographic (population) characteristics are transformed as it develops
  - mortality transition: changing patterns of death
  - fertility transition: changing patterns of birth
- Differences in population growth rates arise from the difference in the stages of demographic transition

Mortality Transition

- life expectancy at birth: how long a newborn baby is expected to live
  - increasing over time in all countries
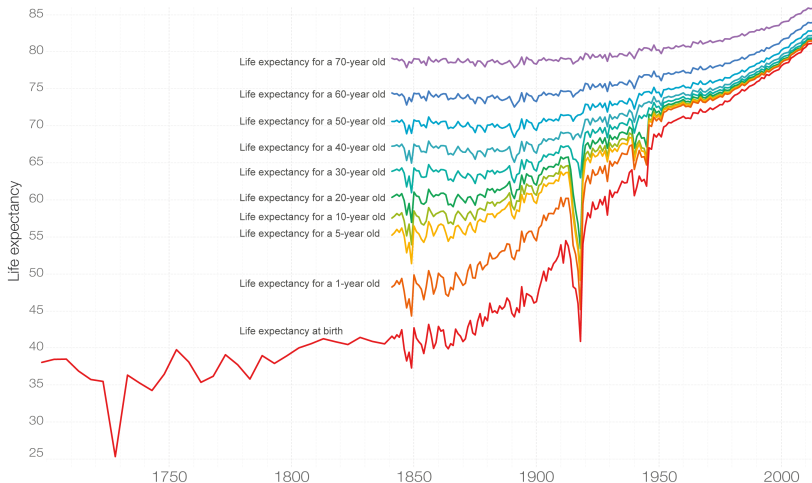 - increased earlier in developed countries

Figure 4.8: Life Expectancy in Developed Countries

Life expectancy at birth (years)

Labels on chart: Sweden, United States, England, Japan, France

Source: Livi-Bacci (1997).

Life Expectancy by Age in England and Wales, 1700-2013

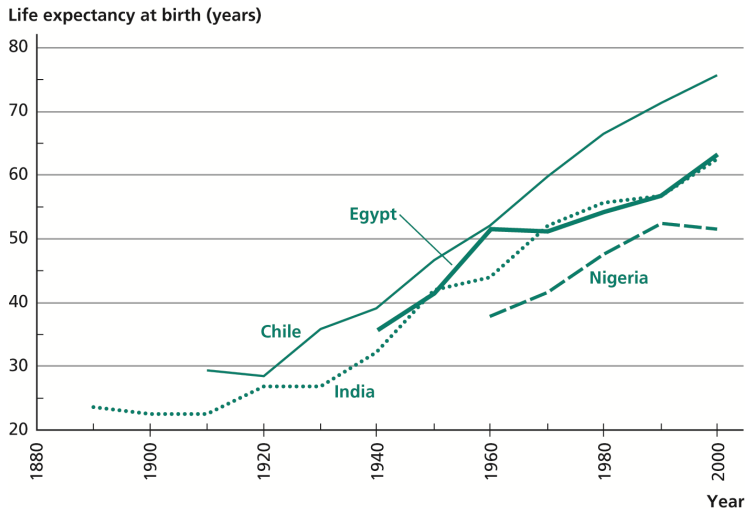Shown is the total life expectancy given that a person reached a certain age.

Life expectancy for a 70-year old

Life expectancy for a 60-year old

Life expectancy for a 50-year old

Life expectancy for a 40-year old

Life expectancy for a 30-year old

Life expectancy for a 20-year old

Life expectancy for a 10-year old

Life expectancy for a 5-year old

Life expectancy for a 1-year old

Life expectancy at birth

Life expectancy (y-axis)

1750   1800   1850   1900   1950   2000

Figure 4.9: Life Expectancy in Developing Countries

Life expectancy at birth (years)

Egypt

Nigeria

Chile

India

Year

Life expectancy globally and by world regions since 1770

Our World in Data

Legend:
- Europe
- Oceania
- Americas
- Asia
- World
- Former Soviet Union
- Africa

Source: Life expectancy – James Riley for data 1990 and earlier; WHO and World Bank for later data (by Max Roser)
OurWorldInData.org/life-expectancy/ • CC BY-SA

Explaining the mortality transition

- improvements in standard of living
  - quantity and quality of food
  - housing
  - frequent washing of clothes
- improvement in public health
  - modern sewage and water supply systems
  - securing of clean water and food
  - draining of mosquito-infested swamps
- improvements in medical treatments
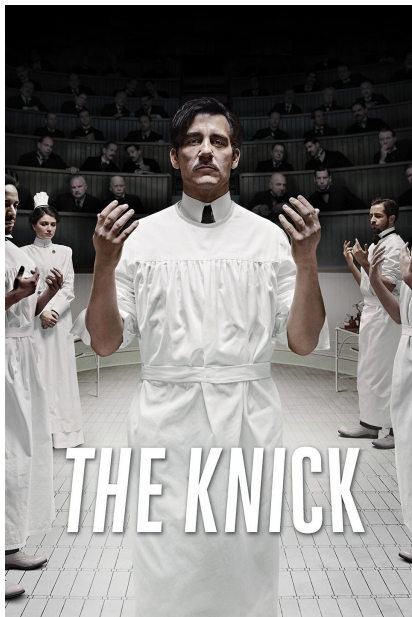
Mortality Transition: Developed vs Developing Countries

- More rapid in developing countries
  - LE in India: 26.9 years in 1930, 55.6 years in 1980
  - LE in France: 27.9 years in 1755, 56.7 years in 1930
- Happened at lower income levels in developing countries
  - LE in India: 55.6 years in 1980 ($1,239 income per capita, 2010 dollars)
 - LE in France: 56.7 years in 1930 ($4,998 income per capita)

Mortality Transition: Developed vs Developing Countries, cont'd

- Developed countries: these 3 developments came one at a time (Robert Fogel)
  - 1775–1875: better nutrition
  - The second half of 19th century: modern sewage and water supply systems
  - 20th century: improvements in medical treatment
- Developing countries: almost all at once
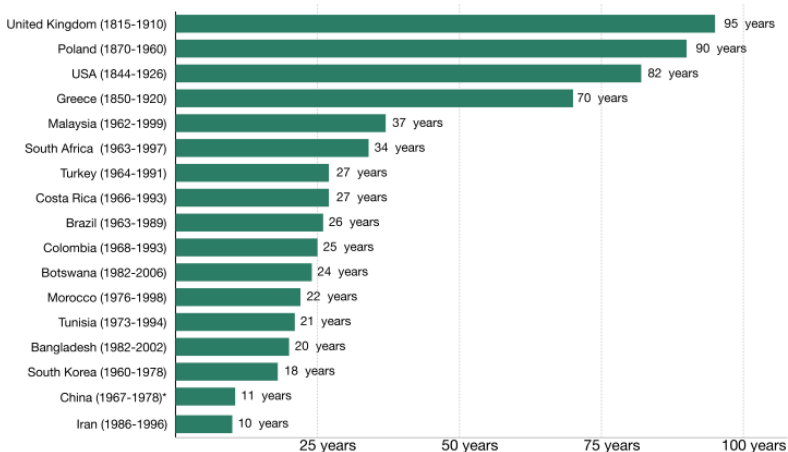
Fertility transition

- Total fertility rate: how many babies a representative woman would have over her lifetime
  - decreasing over time in all countries
  - decreased earlier in developed countries

Figure 4.10: Total Fertility Rate in the United States, 1860–2008

Total fertility rate
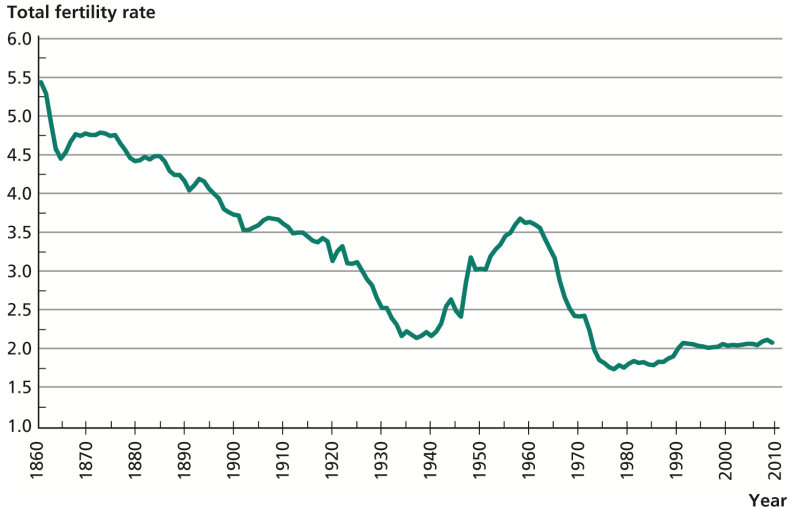
Sources: Coale and Zelnik (1963), Wade (1989).

How long did it take for fertility to fall from more than 6 children per woman to fewer than 3 children per woman?

Country (years)	Years
United Kingdom (1815-1910)	95 years
Poland (1870-1960)	90 years
USA (1844-1926)	82 years
Greece (1850-1920)	70 years
Malaysia (1962-1999)	37 years
South Africa (1963-1997)	34 years
Turkey (1964-1991)	27 years
Costa Rica (1966-1993)	27 years
Brazil (1963-1989)	26 years
Colombia (1968-1993)	25 years
Botswana (1982-2006)	24 years
Morocco (1976-1998)	22 years
Tunisia (1973-1994)	21 years
Bangladesh (1982-2002)	20 years
South Korea (1960-1978)	18 years
China (1967-1978)*	11 years
Iran (1986-1996)	10 years

25 years   50 years   75 years   100 years

* The one-child-policy in China was introduced after the decline of the total fertility rate below 3. It was introduced between 1978 and 1980.

Data source: The data on the total fertility rate is taken from the Gapminder fertility dataset (version 6) and the World Bank World Development Indicators.
The interactive data visualization is available at OurWorldinData.org. There you find the raw data and more visualizations on this topic.   Licensed under CC-BY-SA by the author Max Roser.

Explaining the fertility transition

- improvements in birth control methods
- mortality reduction: survival rate of women
- income and substitution effects: wage increase
- resource flows between parents and children: Social Security
- quality-quantity trade-offs: human capital accumulation

Population Growth

Net rate of reproduction:

- number of daughters that each girl who is born can be expected to give birth to
  - given the mortality rate of women at each age
  - given the fertility rate of women at each age
  - given the fraction of live birth that are girls

- NRR $= 1$ implies constant population in the long run

Demographic transition and population growth

- decrease in mortality leads to high population growth (NRR)
- decrease in fertility rates leads to low population growth (NRR)
- population growth (NRR) has been declining in most countries

Figure 4.11: Fertility, Mortality, and the Net Rate of Reproduction in Sweden
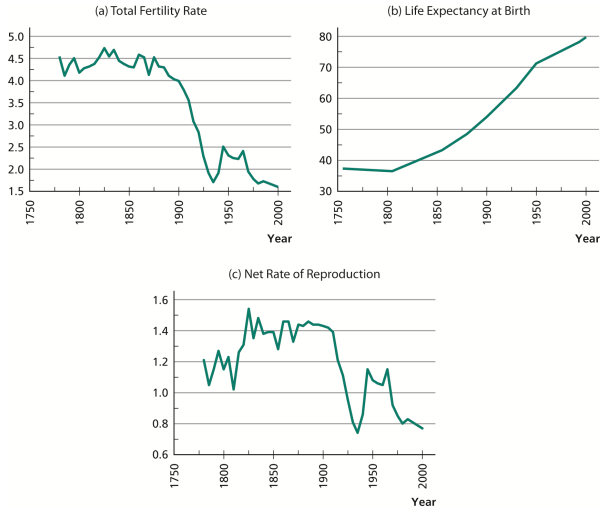
Figure 5.1: World Population, 1850–2150

Source: United Nations Population Division (2000).
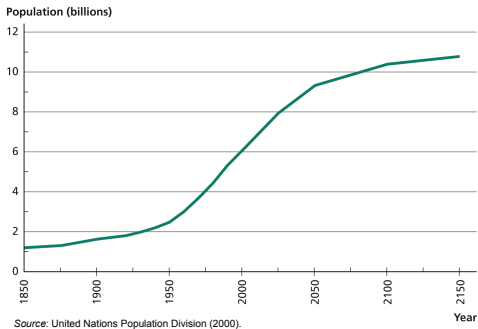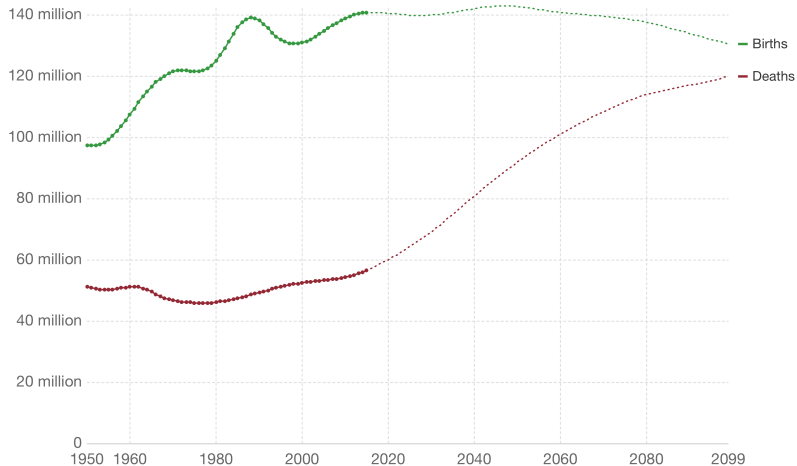
Population growth rate per year:

- 1950–2000: 1.8%
- 2000–2050: .8% (expected)
- 2050–2010: .2% (expected)

Future Population Trends

Forecasting population

- forecasting mortality
- forecasting fertility

The annual number of births and deaths including the UN projections until 2100, World

Our World in Data

- Births
- Deaths

140 million
120 million
100 million
80 million
60 million
40 million
20 million
0

1950 1960 1980 2000 2020 2040 2060 2080 2099

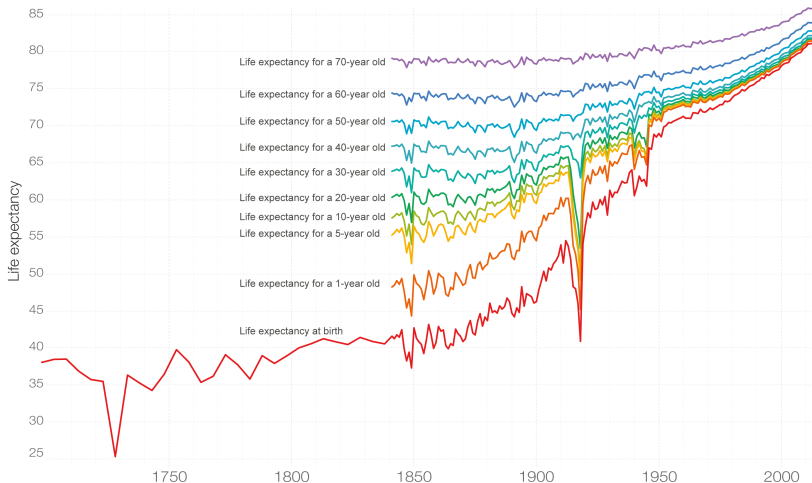OurWorldInData.org/future-population-growth/ • CC BY-SA

Forecasting mortality

- child mortality rate is already very low
  - easy to predict, not much big effect
  - in the US, a newborn girl has a 97% chance of living to age 45
  - in India, a newborn girl has 82% chance of living to age 45
- increase in life expectancy leads to population aging
  - harder to predict to predict improvements in old-age mortality
  - less important in predicting population size

Life Expectancy by Age in England and Wales, 1700-2013

Shown is the total life expectancy given that a person reached a certain age.

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Life expectancy at birth

Life expectancy

Forecasting Fertility

- replacement fertility rate: the fertility rate consistent with constant population
  - RFR ≈ 2.1 (developed countries)
  - mortality before women's childbearing years
- fertility in rich countries
  - TFR in OECD in 2009 is 1.74 < RFR
  - no guarantee that this will return to RFR level...
- fertility in poor countries
  - TFR in SSA in 2000-2005 is 5.50 > RFR
  - very likely to decline but no guarantee that it will approach the RFR level

Demographic momentum

- # of newborns = TFR × # of reproductive age women
- population can continue to grow even when TFR falls if the # of reproductive age women are increasing
- past changes in TFR affects population growth with a (predictable) lag

Figure 5.3: Total Fertility Rate in Japan: Actual versus Forecast

Total fertility rate

Actual TFR

1977 Forecast

1987 Forecast

1982 Forecast

1992 Forecast

1997 Forecast

Year
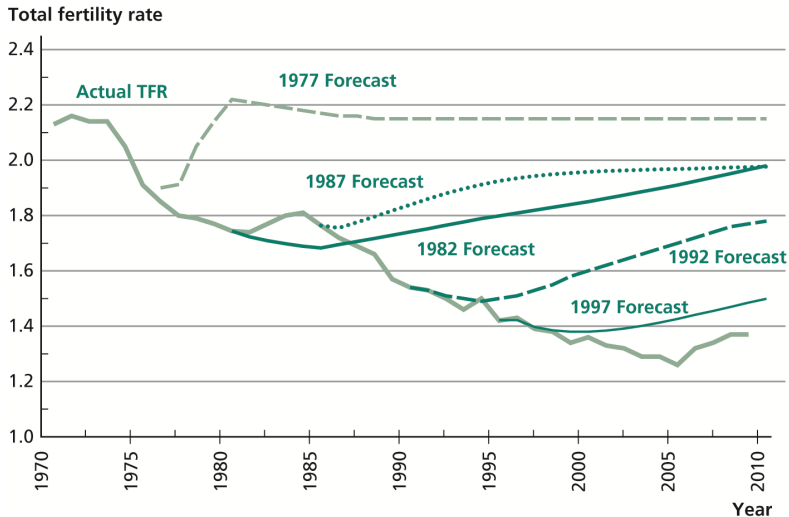
Source: Yashiro (1998).

Table 5.1: Fertility in the Developing World

	2004 Population (millions)	Total Fertility Rate, 1970–1975	Total Fertility Rate, 2000–2005
All developing countries	5093.60	5.50	2.90
Sub-Saharan Africa	689.6	6.80	5.50
Arab States	310.50	6.70	3.70
East Asia & Pacific excluding China	636.10	5.45	3.19
China	1307.99	4.90	1.70
South Asia excluding India	441.00	6.21	3.94
India	1087.12	5.40	3.10
Latin America and the Caribbean	548.30	5.10	2.60

Source: United Nations Development Program (2007).

The Economic Consequences of Demographic Change

- Slowdown in population growth $\Rightarrow \downarrow$ capital dilution $\Rightarrow \uparrow$ economic growth
- Fewer natural resources per capita $\Rightarrow \downarrow$ output per capita
- Aging of population

Population Aging

- Median age of global population will rise
  - 26.5 in 2000 to 36.2 in 2050
  - mainly due to decline in mortality
- Age structure will shift over 2000-2050
  - fraction of children will fall and that of old will rise
  - fraction of working age population will fall in developed countries
  - fraction of working age population will not fall immediately due to demographic momentum
- Higher burden on social security services

Population Aging

- GDP per worker

$$y = \frac{\text{GDP}}{\# \text{ of workers}}$$

- GDP per capita

$$\tilde{y} = \frac{\text{GDP}}{\text{total population}} = y \times \frac{\# \text{ of workers}}{\text{total population}}$$

- a decrease in the fraction of working age population leads to a decline in GDP per capita

Table 5.3: Some Cases of Population Aging

Country	Time Period	Percentage of Population Aged 20–64 in the First Year	Percentage of Population Aged 20–64 in the Last Year	Effect of Aging on Growth of Income per Capita (% per Year)
Japan	2000–2020	62.3	54.9	−0.6
Malaysia	1980–2010	45.9	54.1	0.6
Mexico	1985–2015	42.7	57.7	1.0
Thailand	1990–2010	55.2	62.3	0.6
Turkey	1990–2010	49.2	63.2	0.8
Bangladesh	2000–2020	47.1	59.8	1.2

Source: U.S. Bureau of Census International Database.