EC569 Economic Growth
Population and Economic Growth (Lecture 3)

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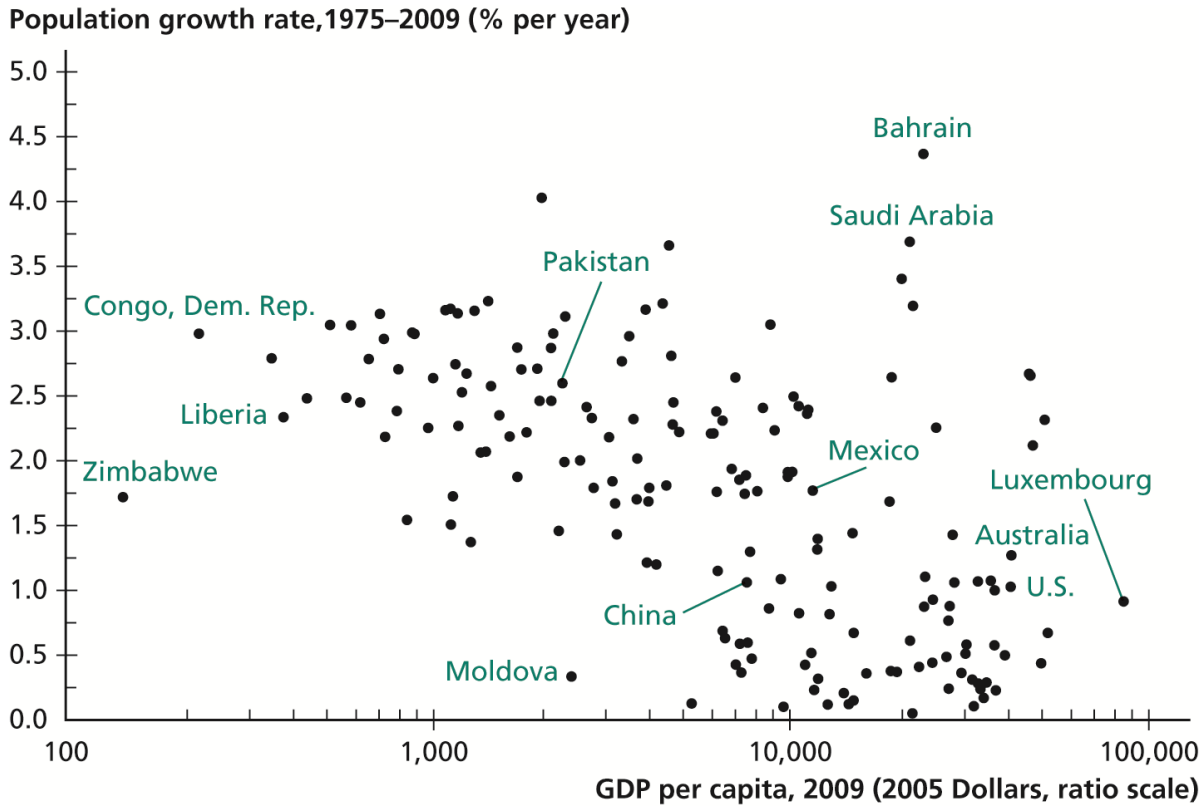
Impact of population on economic growth

Δ population $\Rightarrow$

- consumption needs of the economy (the number of mouths)
- productive capacity of the economy (the number of hands)

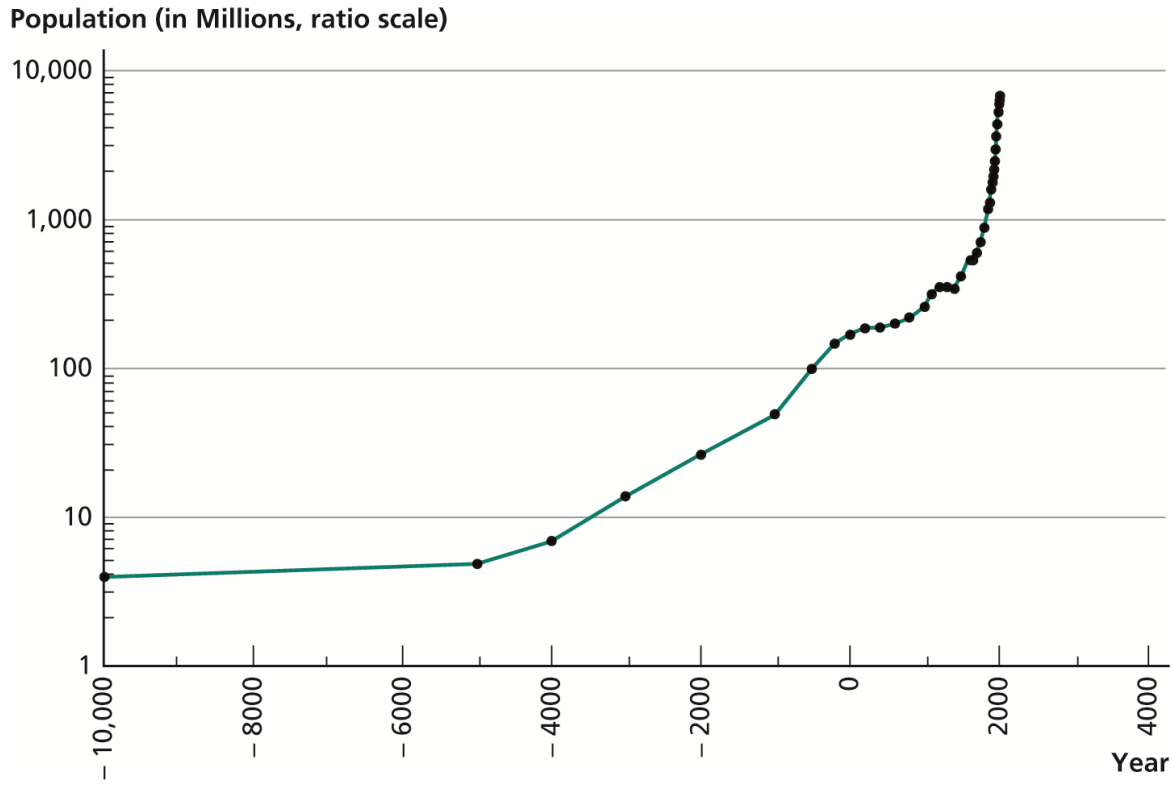
Figure 4.1: Relationship Between Income per Capita and Population Growth



Source: Heston et. al. (2011).

Graph from: Weil (2013)

Figure 4.2: World Population, 10,000 B.C. to A.D. 2010



Source: Kremer (1993).

Graph from: Weil (2013)

Population growth rate

- 10,000 B.C. – 1 A.D. : .04%
- 1 A.D. – 1800: .09%
- 1800 – 1900: .6%
- 1900 – 1950: .9%
- 1950 – 2000: 1.8%

Malthusian Model vs Solow Model

Malthus:

- Land is fixed
- Level of population is relevant

Solow:

- Capital is reproducible
- Growth rate of population is relevant

Population growth in the Solow Model

- Law of motion for capital per worker

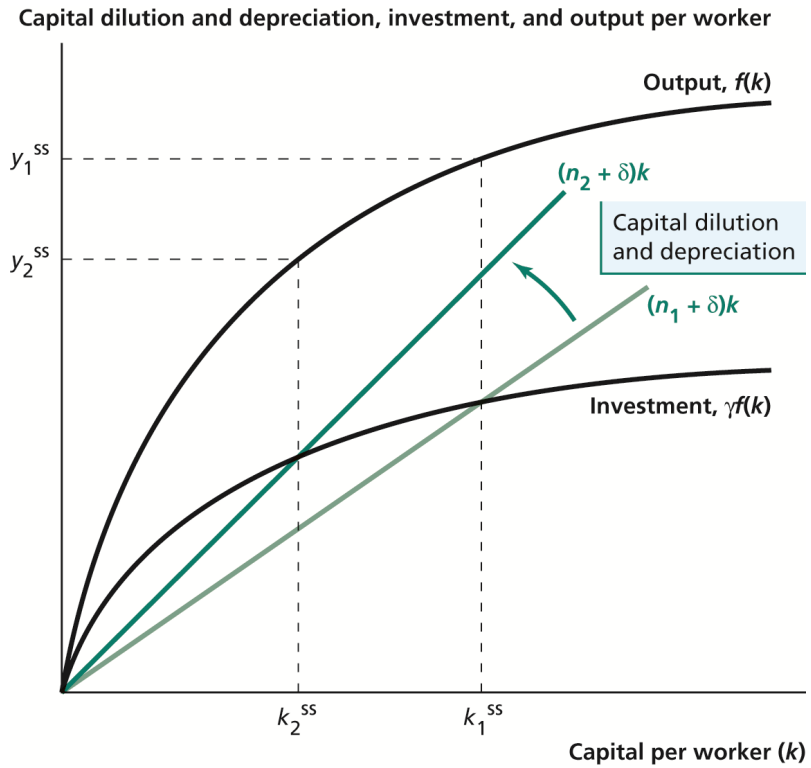
$$\dot{k} = \gamma f(k) - (\delta + n)k,$$

  where n is the population growth rate.
- At the steady state

$$\gamma f(k^*) = (\delta + n)k^*$$

- As $n \uparrow$, $k^* \downarrow$
- Countries with high population growth are poorer.
- Higher population growth dilutes per-worker capital stock more quickly
- Lower steady state level of output per worker

Figure 4.7: The Solow Model Incorporating Population Growth



The figure shows how raising the population growth rate from n_1 to n_2 affects the steady-state level of capital per worker (k) and the steady-state level of output per worker (y).

Diagram from: Weil (2013)

Income Differences

Suppose country i and country j differ only in population growth rate.

$$y_i^* = A^{1/(1-\alpha)} \left(\frac{\gamma}{n_i + \delta} \right)^{\alpha/(1-\alpha)} h$$

$$y_j^* = A^{1/(1-\alpha)} \left(\frac{\gamma}{n_j + \delta} \right)^{\alpha/(1-\alpha)} h$$

$$\frac{y_i^*}{y_j^*} = \left(\frac{n_j + \delta}{n_i + \delta} \right)^{\alpha/(1-\alpha)}$$

Quantitative predictions:

- Supporse $\delta = 5\%$, $\alpha = 1/3$, hence $\alpha/(1-\alpha) = 1/2$
- $n_i = 0\%$ and $n_j = 4\%$

$$\frac{y_i^*}{y_j^*} = \left(\frac{.04 + .05}{.00 + .05} \right)^{1/2} \approx 1.34$$

Income per capita in country i would be 34% higher than income per capita in country j

What's the unrealistic critical assumption of the Solow model in this topic?

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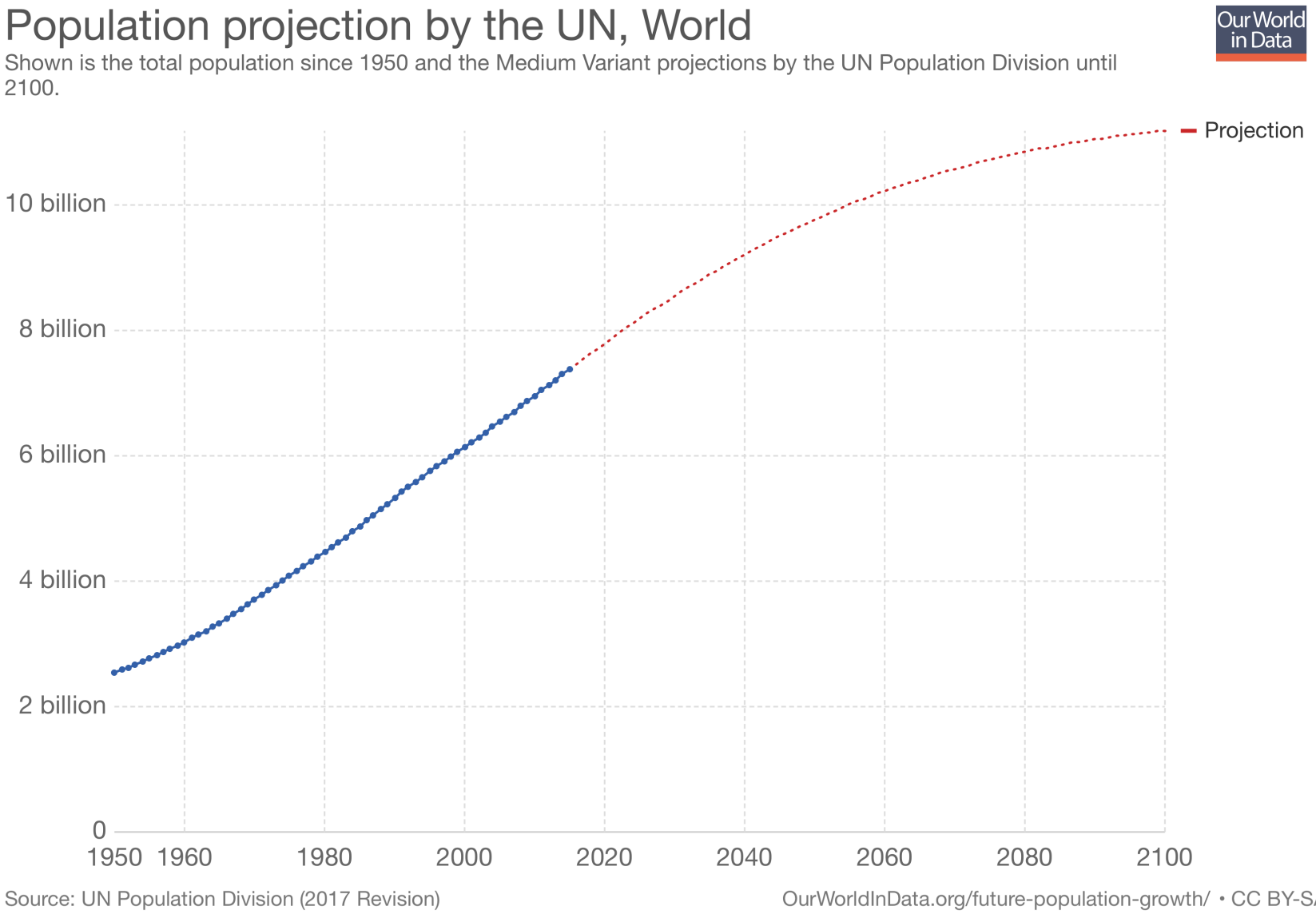
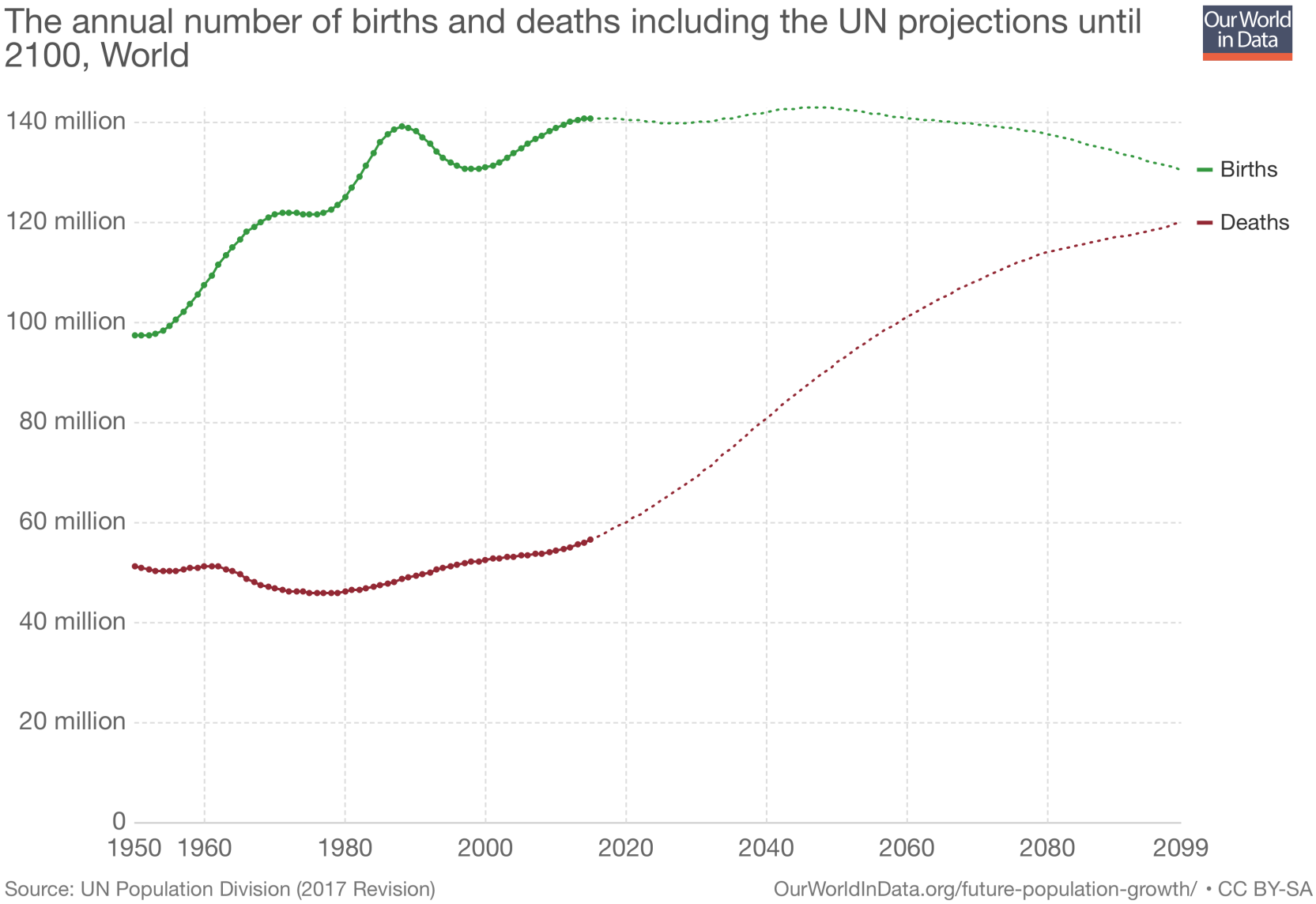
Constant population growth rate



Graph from: ourworldindata.org



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The Malthusian Model

- Thomas Malthus (1766–1834), Essay on the Principle of Population (1798)
- Limited quantity of available resources (land) would limit potential fertility and hence population.
- Explains why living standards and population did not change much before 19th century

No reproducable capital

The Malthusian Model, cnt'd

Small population relative to the available land

$\Downarrow$

People are better off

$\Downarrow$

Faster population growth

$\Downarrow$

Amount of land available per person falls

$\Downarrow$

People become poorer

$\Downarrow$

Limit population growth

$\Downarrow$

Reach level of income commensurate with constant population

Figure 4.3: The Malthusian Model

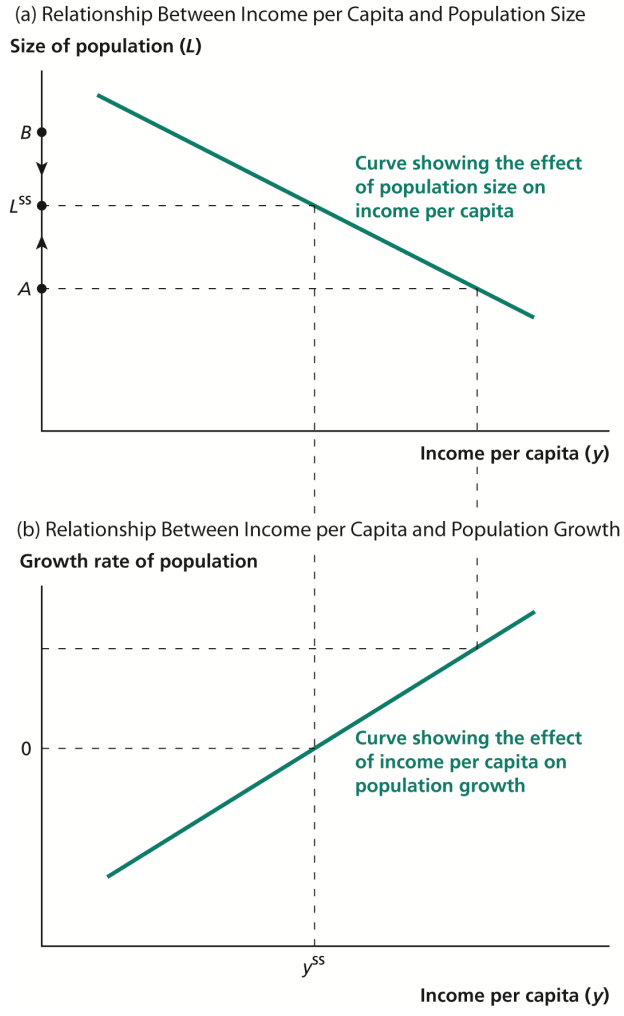


Diagram from: Weil (2013)

Figure 4.4 Effect of Productivity Improvement in the Malthusian Model

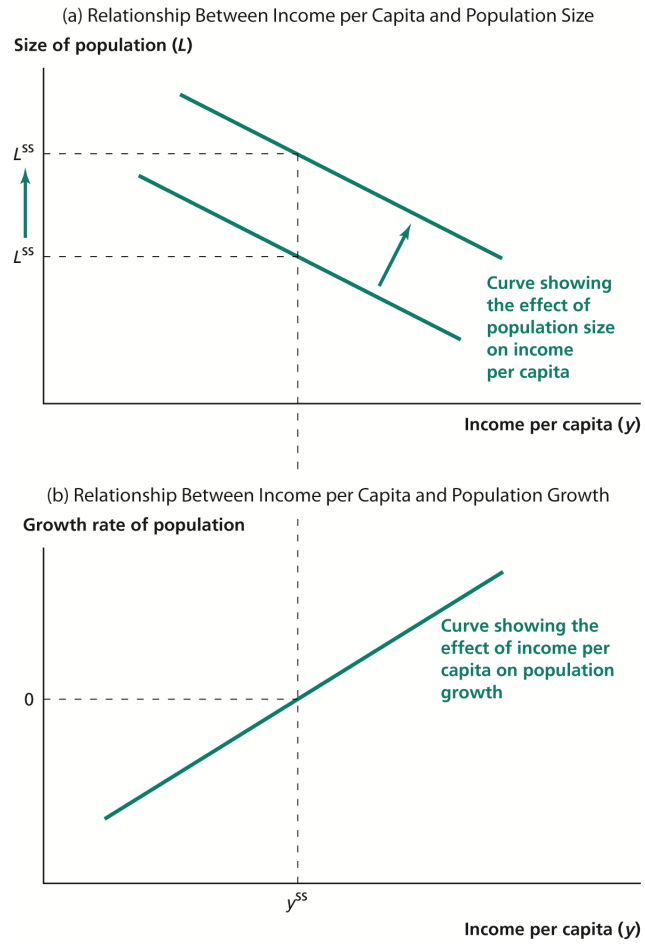


Diagram from: Weil (2013)

Effects of productivity improvement in the Malthusian Model

Productivity improvement

$\Downarrow$

Higher living standards

$\Downarrow$

Population growth

$\Downarrow$

Standard of living goes down

$\Downarrow$

New steady state with larger population and same level of income per capita as before

Effects of productivity improvement in the Malthusian Model,cont'd

- In A.D. 1000, China was the most technologically advanced country in the world
- High population density in China
- Similar living standards in Europe and China
- Introduction of potato into Ireland
- Increase in productivity
- After 1750, potato became the primary Irish staple
- Population of island tripled
- Little improvement in the standard of living

Figure 4.5 Effect of 'Moral Restraint' in the Malthusian Model

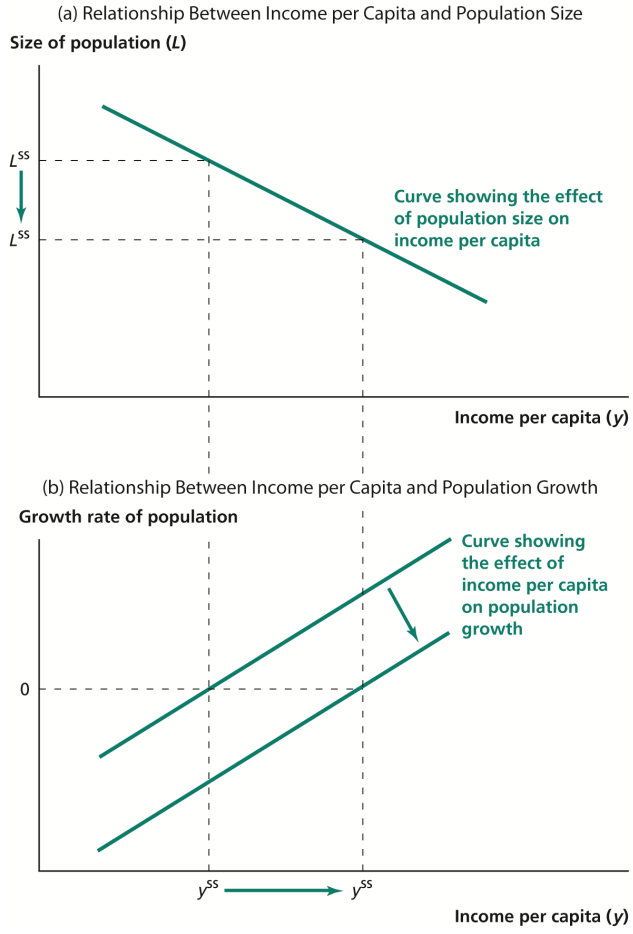
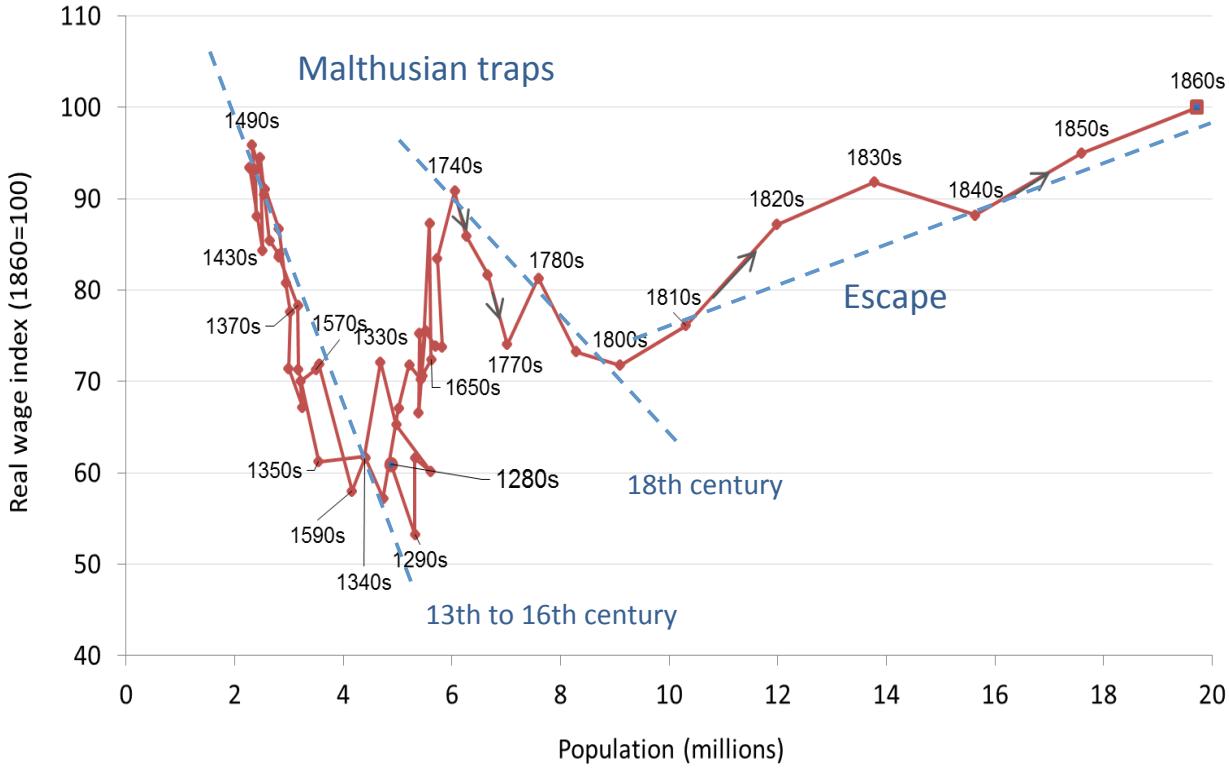


Diagram from: Weil (2013)

Breakdown of the Malthusian Model

- Fixed land $\Rightarrow$
  (Higher population $\Rightarrow$ Decline in standard of living)
- Population will grow whenever income per capita is high

Figure 2.18. Escaping the Malthusian trap: Population and real wages in England (1280s-1860s).



Source: Bowles, S., Carlin, W. and Stevens, M. (2017). 'Technological Change, Population and Growth'. Unit 2 in The CORE Team, The Economy. Available at: http://www.core-econ.org.

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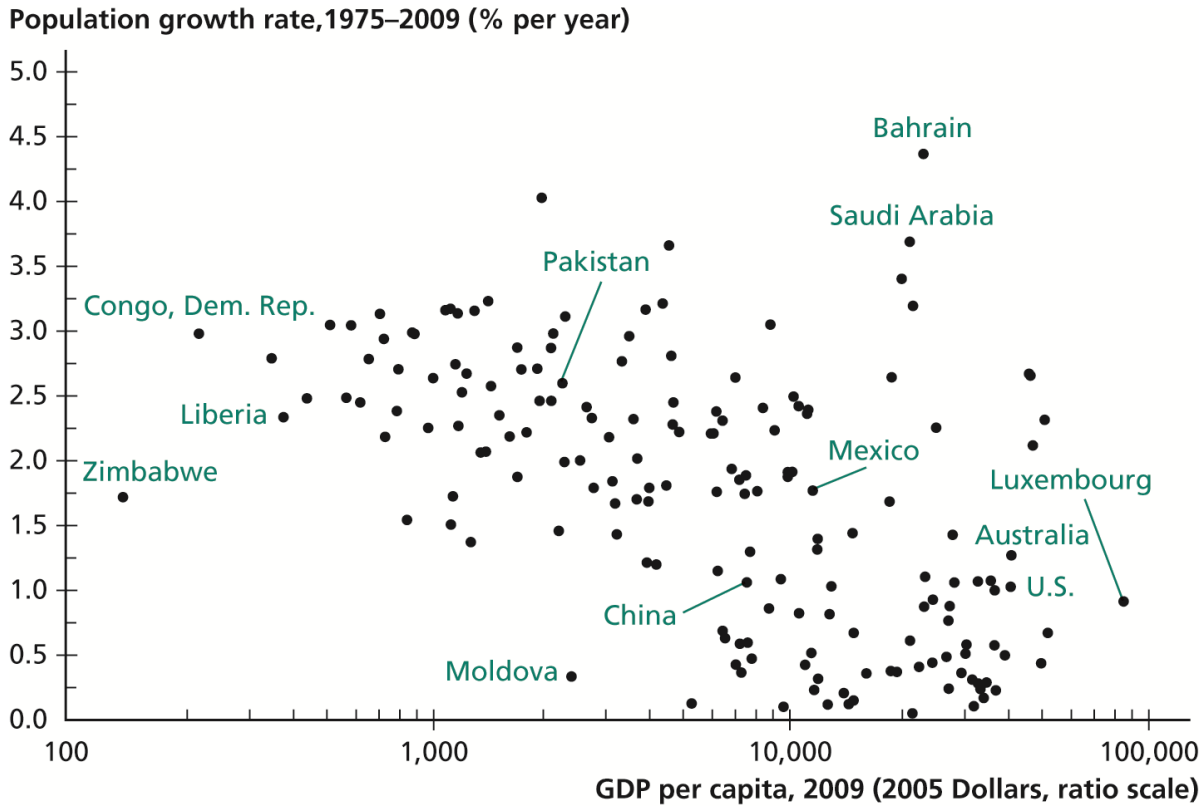
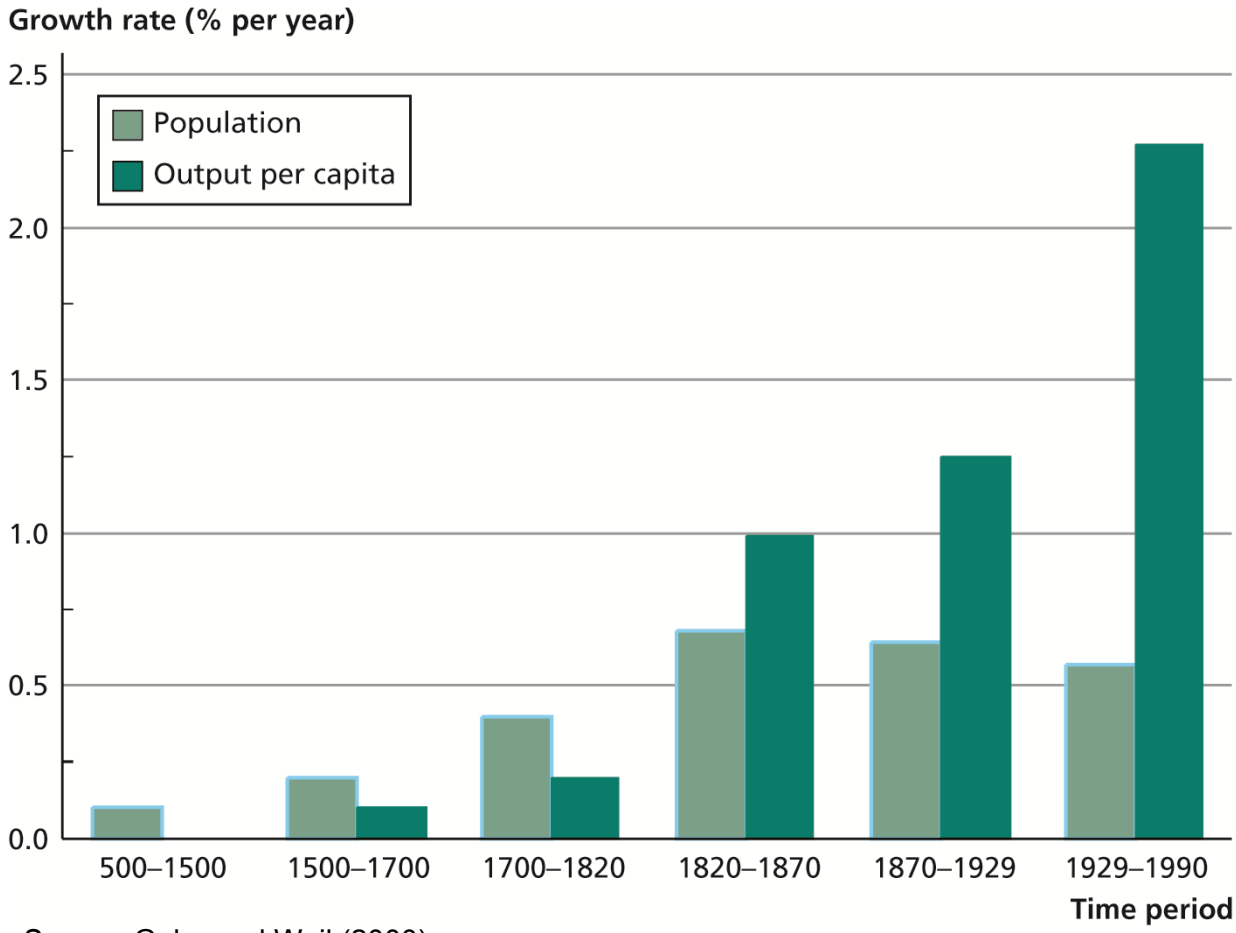


Source: Heston et. al. (2011).

Graph from: Weil (2013)

Figure 4.6: Breakdown of the Malthusian Model in Western Europe



Source: Galor and Weil (2000).

Graph from: Weil (2013)

Summary

- Malthusian model:
  - Population growth is endogenous
  - Cannot account for the population dynamics of the modern world
  - Cannot account for the negative correlation of population growth rate and income per capita
- Solow model
  - Accounts for the negative correlation of population growth rate and income per capita
  - Population growth rate is exogenous
  - Cannot account for the reduction in population growth rate as countries get richer