Introduction

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Object of economic growth theory

- Dynamics of per capita aggregate income across long time, and space.
- Main questions
  - what is the meaning of "long time" (millenia, century, decennials) ?
  - what are the main factors explaining economic growth ?
  - why rates of growth differ along historical time ?
  - why the rates of growth differ among countries ?
  - why countries hold inequalities in the GDP per capita while having similar rates of growth ?

Main growth factors

By increasing degree of variability

- Physical and biological environments: geography, size, resources, biology;
- Population: demography, human capital, social capital;
- Technology: learning by doing, R&D (as an independent activity);
- Aggregation: externalities, public goods ;
- Economic institutions: inclusive/exclusive, financial institutions, trade openness, patent protection;
- Political Institutions: in a broad sense (inclusive/exclusive, rule of law, enforcement, accountability) or a narrow sense (government intervention, governance)
- Luck (good or bad)

Phases of economic growth

Secular long run perspective:

1. Malthusian trap and first globalization (goods) : (almost) constant rates of growth (6000 BCE to 1700 CE)
2. Industrial Revolution: transition with modest increases in the rate of growth
3. Modern economic growth and second globalization (goods): rapid economic growth and Great Divergence: post 1820 and until 1990 (according to some authors)
4. Great convergence and third globalization (ideas): post 1990
5. Nature strikes back: eventual natural limits to growth ?

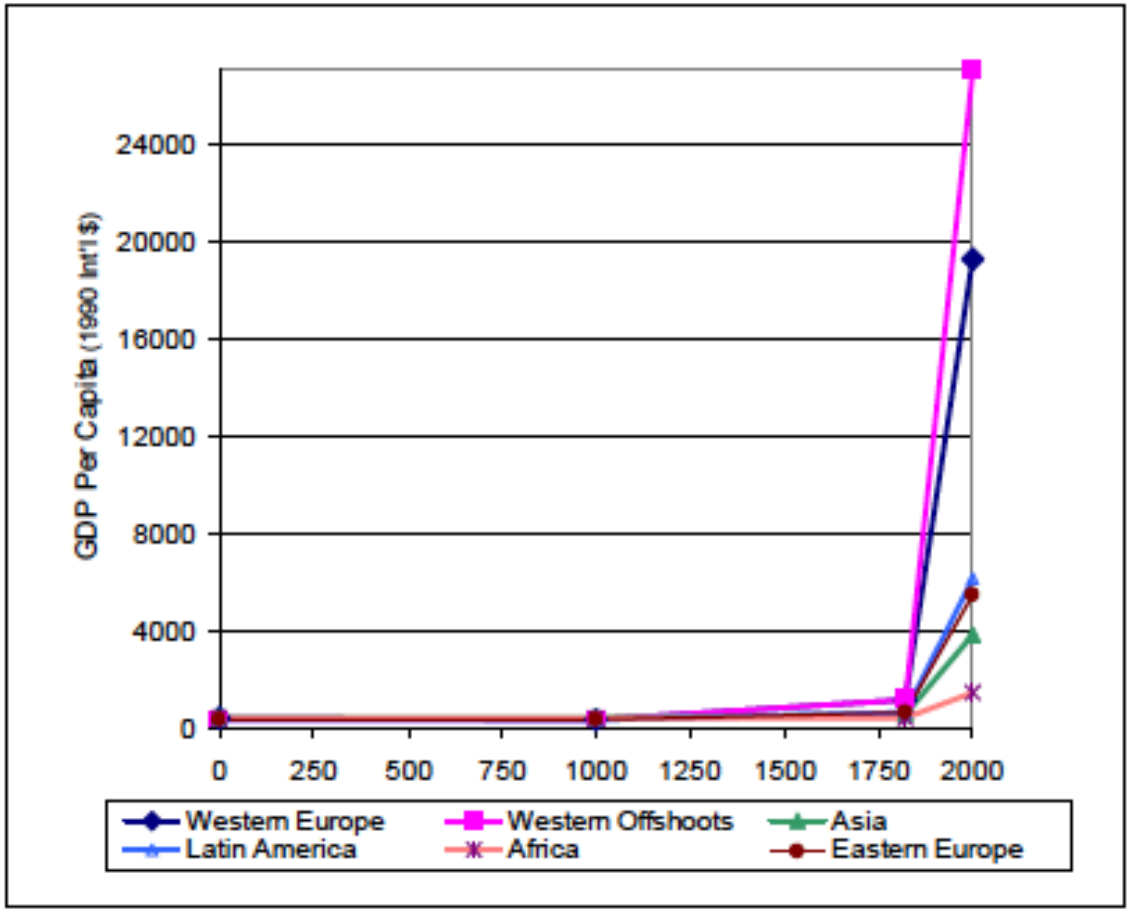


Figure 1: The Evolution of Regional Income Per Capita, 1-2000 CE
(Source: Maddison, 2003)

Figure: Maddison on the evolution of income per capita

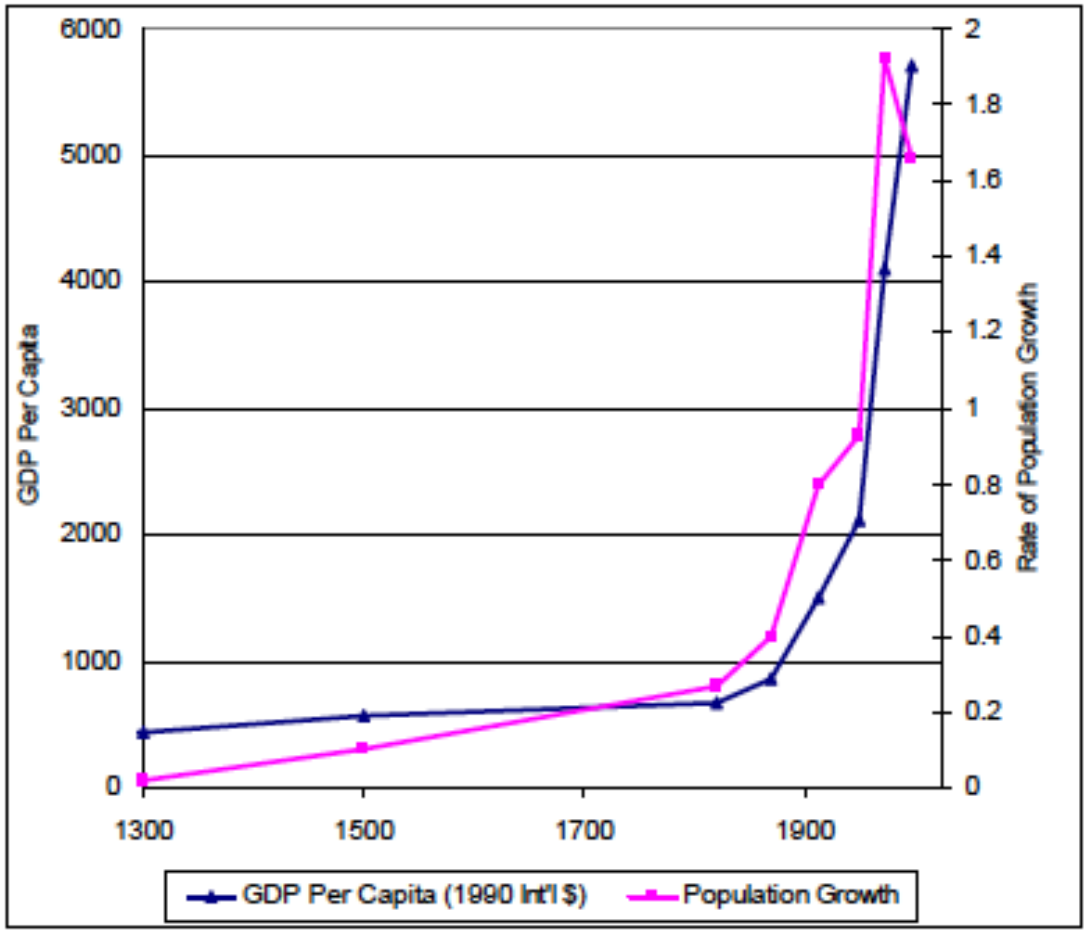


Figure 4: World Population Growth and Income Per Capita
(Source: Maddison, 2001)

Figure: Maddison on the evolution of population

Ancient growth experience

Malthusian trap

- low rates of growth: between 0% and 0.5%
- rises in income implied rises in population (not income p.c.)
- negative correlation between population growth and real wages
- big impact of demographic changes and (ex Black-Death (1347-1350)) and institutions (ex. different responses to it in E and W Europe);

Ancient growth experience

Malthusian trap

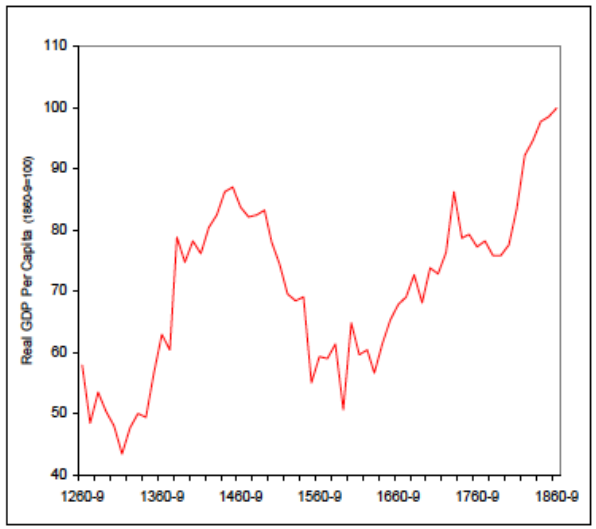


Figure 2: Fluctuations in Real GDP Per Capita in England, 1260-1870 CE
(Source: Clark, 2005)

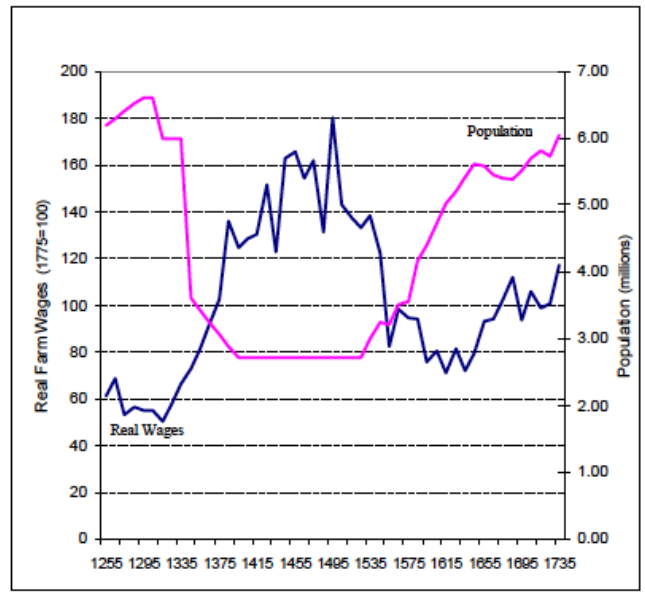


Figure 5: Population and Real Wages in England, 1250-1750 CE
(Source: Clark, 2005)

Figure: Clark on the UK's population and real wages

Ancient growth experience

Limits to growth

- labor was the main factor of production
- land had an impact on growth because of decreasing returns;
- there were some gains in productivity, although not related to a purposeful activity as R&D;

Ancient growth experience

First globalization

- there was not a large difference of GDP per capita around the world

Table: Ratio richest to poorest region: before the great divergence

1000	1500	1820
1.1:1	2:1	3:1

- E Asia was richer
- first globalization: a first decoupling between production and consumption took place with trade in a small number of (luxury) goods (Silk road)
- physical distance was a major factor

Modern economic growth

Capital accumulation

- modern economic growth: permanent positive rates of growth;
- it may have started in the UK around 1800;
- it was contemporaneous with a demographic revolution, but growth became independent from the growth population;
- non-Malthusian features: rise in wages and almost stationary rate of return of capital
- two driving forces: increases in productivity and capital accumulation (physical, human, social)
- physical capital accumulation: massive
- technologic progress: rise in productivity as a purposeful activity
- unprecedented accumulation of human capital: schooling
- social capital: institutions (protection of property rights, contract enforcement, reduction of transactions costs, reduction of uncertainty, etc)
- non-renewable natural resources: no decreasing returns ?

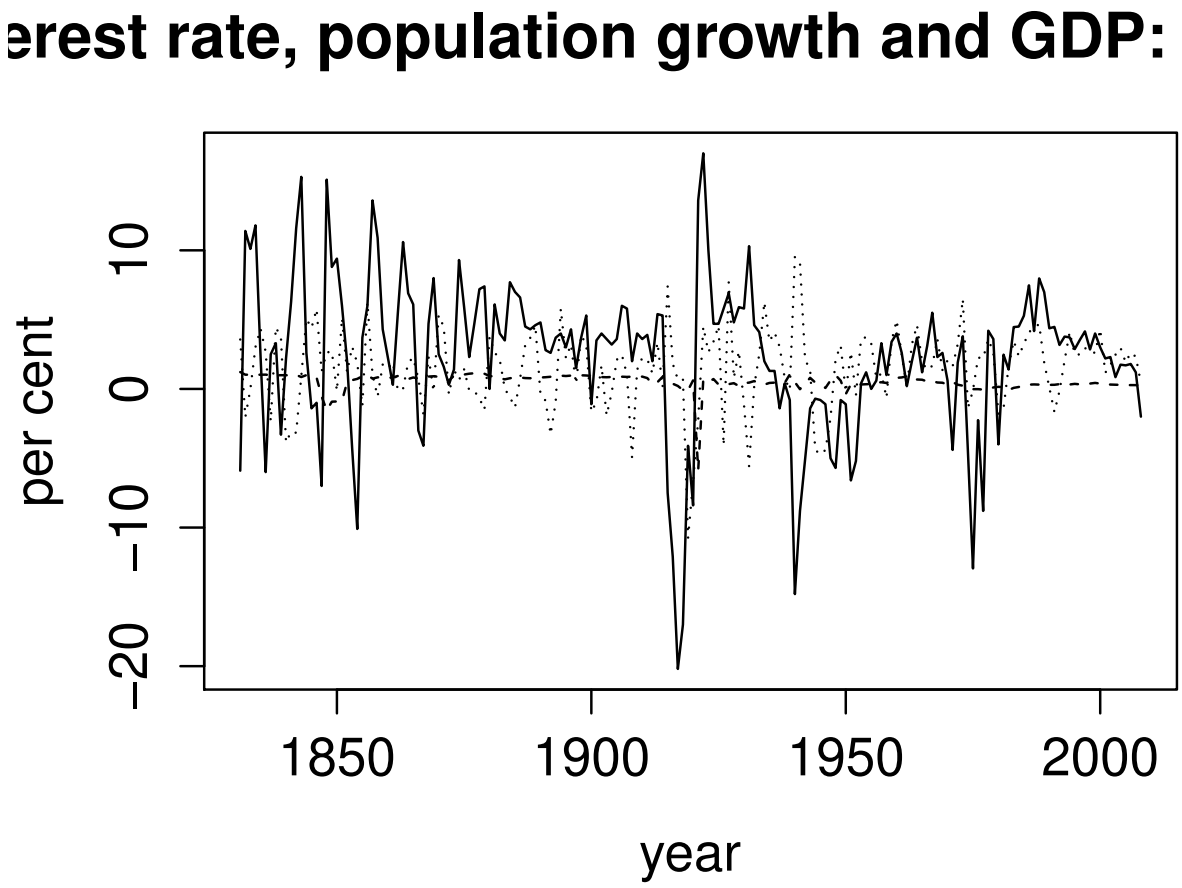


Figure: UK: post-Malthusian population and GDP growth rates

Modern economic growth

Great divergence

- *The Great divergence*:

Table: Ratio richest to poorest region: after the great divergence

1820	1870	1913	1950	2001
3:1	5:1	9:1	15:1	18:1

- increase in disparities and change of the economic center
- second globalization (inter-industrial trade): huge reduction in transport costs lead to an increase in the trade in **goods** and the Ricardo comparative advantage mechanism start working massively;
- relative free capital movement re-inforced this movement and lead to an international alignment of interest rates;
- increasing agglomeration of economic activity in a few centers (at national and international levels)

Present epoch ?

Great convergence

- technical progress driven by IT lead to a reduction of costs in the movement of **ideas**
- third globalization (intra-industrial trade): a large part of international trade is related to the supply chains of some multinational corporations;
- allowed high increases in wages in a few (7) countries (technology from the "North" and wages from the "South") and competition between countries for parts of the supply chains;
- institutional consequences: rebalances of the inclusive/exclusive attitudes throughout the world ?
- limits to growth because of environmental consequences ?

Growth theory: Some puzzles

Puzzle 1: on the exponential structure of growth

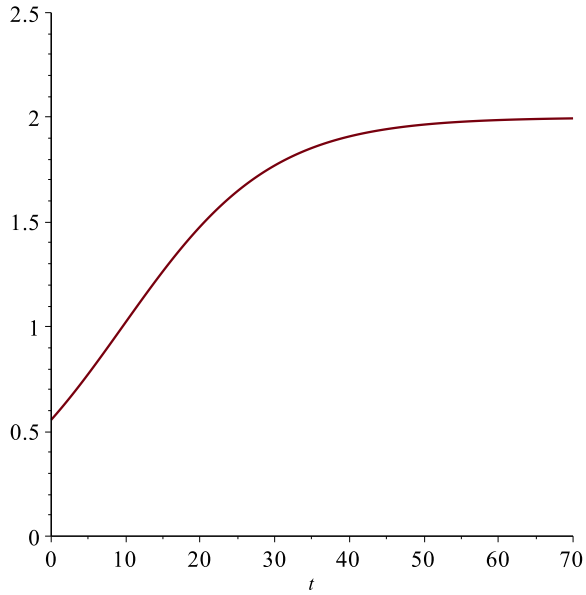
- Long run growth arises only for a very particular mathematical structure:
- Let

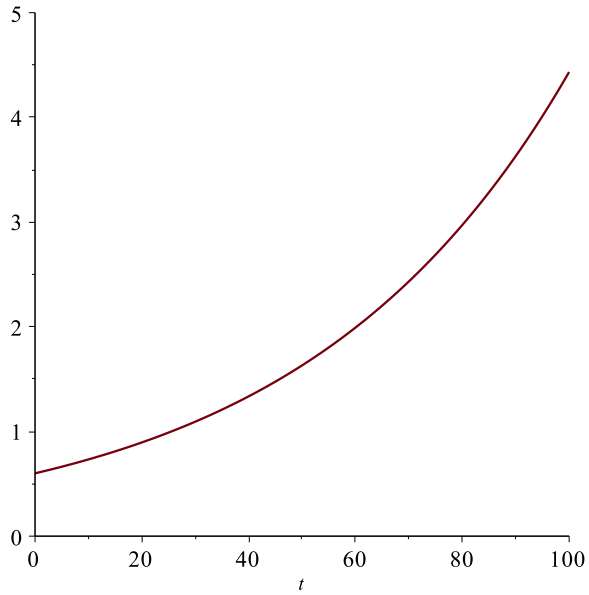
$$\dot{y} \equiv \frac{dy(t)}{dt} = \mu(y)$$

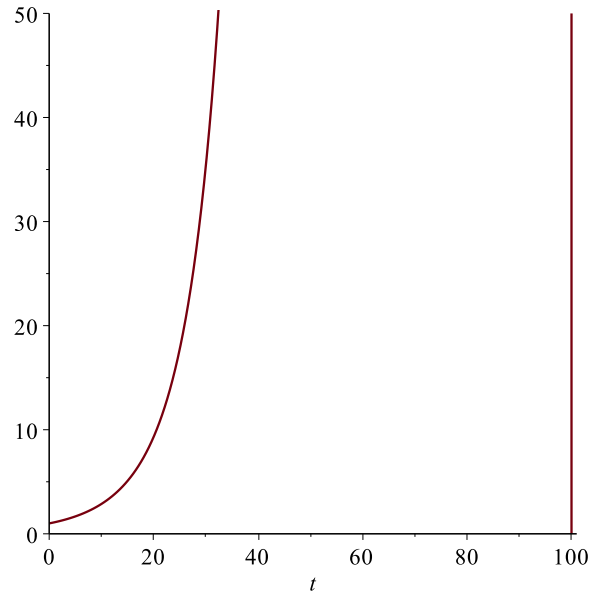
  - logistic growth: $\mu(y) = \alpha y(\beta - y)$ short run (transition growth) but no long-run growth
  - exponential growth: $\mu(y) = \mu y$, long run growth ($y(t) \to \infty$ in **infinite** time)
  - power law growth: $\mu(y) = y^{\phi}$ with $\phi > 1$, long run growth ($y(t) \to \infty$ in **finite** time)
- razor edge property of growth models: although the exponential case is very particular it this the structure underlying (almost) all growth theories

Growth theory: Some puzzles

Puzzle 1: on the exponential structure of growth







Some puzzles

Puzzle 2: growth and distribution

- Consider the former equation

$$dy(t) = \mu(y)dt$$

- let $\rho(y,t)$ be the density of population having the income $y \in [y_0(t), y_1(t)] \in (0,\infty)$, such that

$$\int_0^\infty \rho(y,t)dy = 1,$$

- the dynamics of the distribution is given by

$$\frac{\partial \rho(y,t)}{\partial t} + \frac{\partial}{\partial y}\left(\mu(y)\rho(y,t)\right) = 0$$

- we can calculate the average per capita income and the variance

$$y(t) = \int_0^\infty \rho(y,t)ydy,\ \sigma(t) = \int_0^\infty \rho(y,t)(y-y(t))^2 dy$$

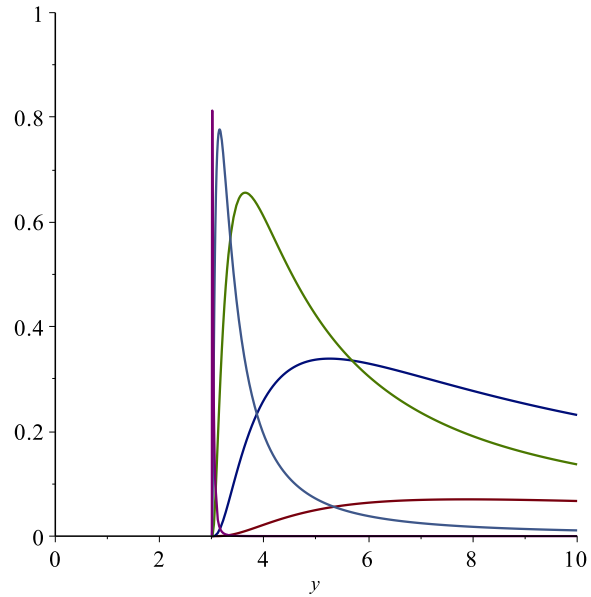
Some puzzles

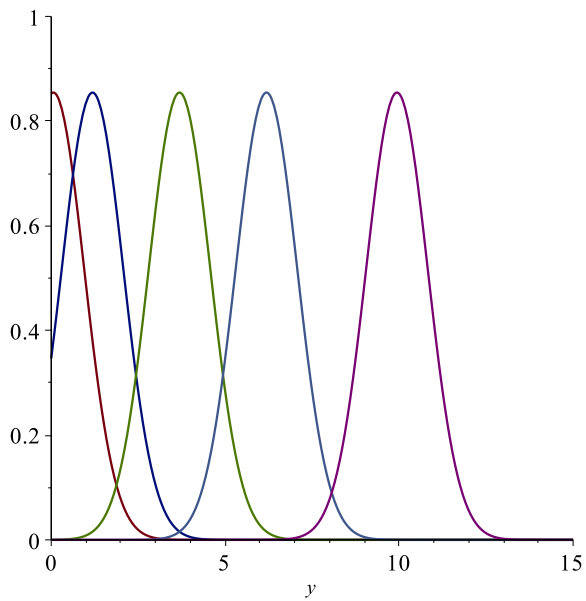
Puzzle 2: growth and distribution

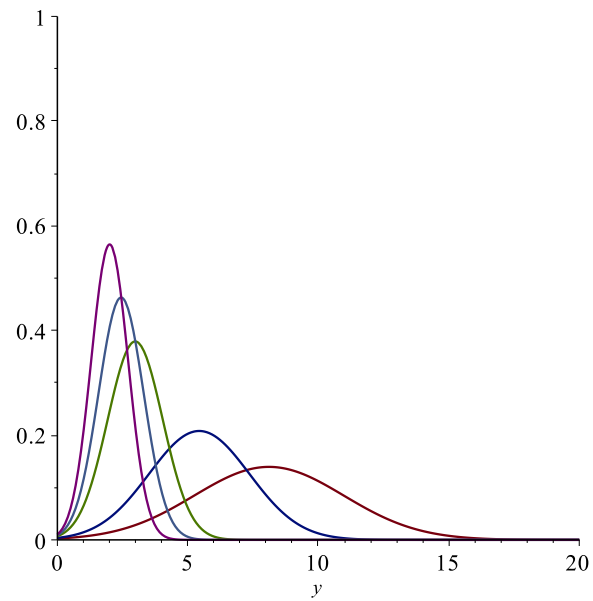
- there are three important properties that interest us
  - long run growth: does $\lim_{t\to\infty} y(t) = \infty$?
  - ergodicity: does $\lim_{t\to\infty} \sigma(t) = \bar{\sigma}$ finite and constant (independent from the initial distribution) ?
  - inequality: does $\sigma(t) = 0$ or $\lim_{t\to\infty} \sigma(t) = 0$?
- examples, starting from an initial heterogeneous distribution:
  - case1: ergodicity, long run equality, but no growth: $\mu(k) = ay(b - y)$ for $a > 0$ and $b > 0$
  - case 2: permanent ergodicity and inequality and growth: $\mu(k) = \bar{\mu}$ constant
  - case 3: no ergodicity, increasing equality and growth: $\mu(k) = \mu k$
- can we have long-run growth without an increase in inequality ?

Some puzzles

Puzzle 2: growth and distribution







Some historical facts

Inequality

- Inequality in the very long run: Scheidel (2017) and Milanovic (2016)

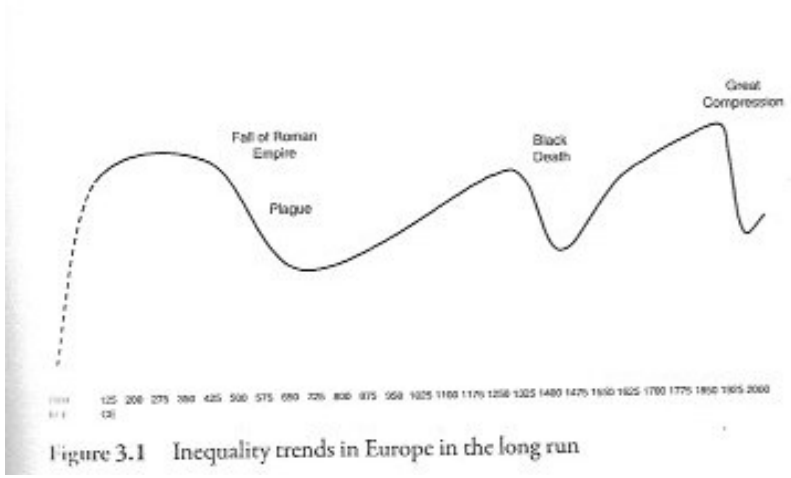


Figure 3.1 Inequality trends in Europe in the long run

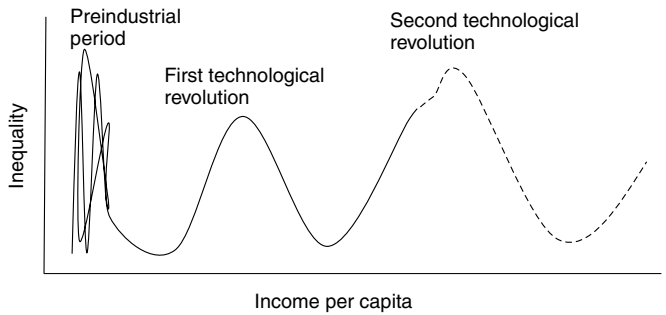


FIGURE 2.4. Expected pattern of changes in inequality versus income per capita from the preindustrial through the postindustrial period and into the future (dotted line)

- Pre IR: compression (short) and distension (longer) periods
- Post IR: distension (IR - WWI, 1970 - present) and

References

- Long-run growth facts: Maddison (2007)
- Stylized facts on economic growth: (Acemoglu, 2009, ch. 1, 2) , (Barro and Sala-i-Martin, 2004, ch. 10,11,12)
- Pre-modern and modern economic growth: (Galor, 2011, ch 2)
- Inequality: Milanovic (2016), Scheidel (2017)

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