Unit 2
Technological Change, Population and Growth

Hui-Jun Chen

The Ohio State University

December 26, 2022

Introduction

Economics Reasoning

How could we understand the "Hocky-stick" growth?

- Recall the Interactive figure: https://tinyco.re/3290463
- Two facts we want to explain:
  1. rapid growth starting from 1800s, and
  2. stagnation in the centries before 1800s
- In econ, we usually use **model** to understand Economics phenomenon.
- We will build two models to explain both facts above.
- Further reading: https://tinyurl.com/4upjz46u

Economics Model

Anecdotic Illustration of Economics Model

Build your own world (similar to real world) so that you know every detail!

Formal Illustration of Economics Model

- Model is an alternative economy which only the *essential feature* of the economy that are **relevant to the question** are maintained
- To see deeper mechanism in real world, we need simplification
- Necessary evil to omit many real world details $\Rightarrow$ endless debate!

assumptions that (we think) matters $\Rightarrow$ How agent act with each other & assumptions $\Rightarrow$ Outcome / Equilibrium $\Rightarrow$ Assumptions Changes?

- **Equilibrium**: all forces within model are balanced unless *external force* is introduced

What makes a good model?

Friedman's critique: model are judged by prediction power

- Clarity: is the logic and causality understandable?
- Prediction power: match data?
- Communication: what we (dis-)agree about?

ALL models are fake, only some are useful, i.e., elucidates the underlying mechanism that people implicitly follows

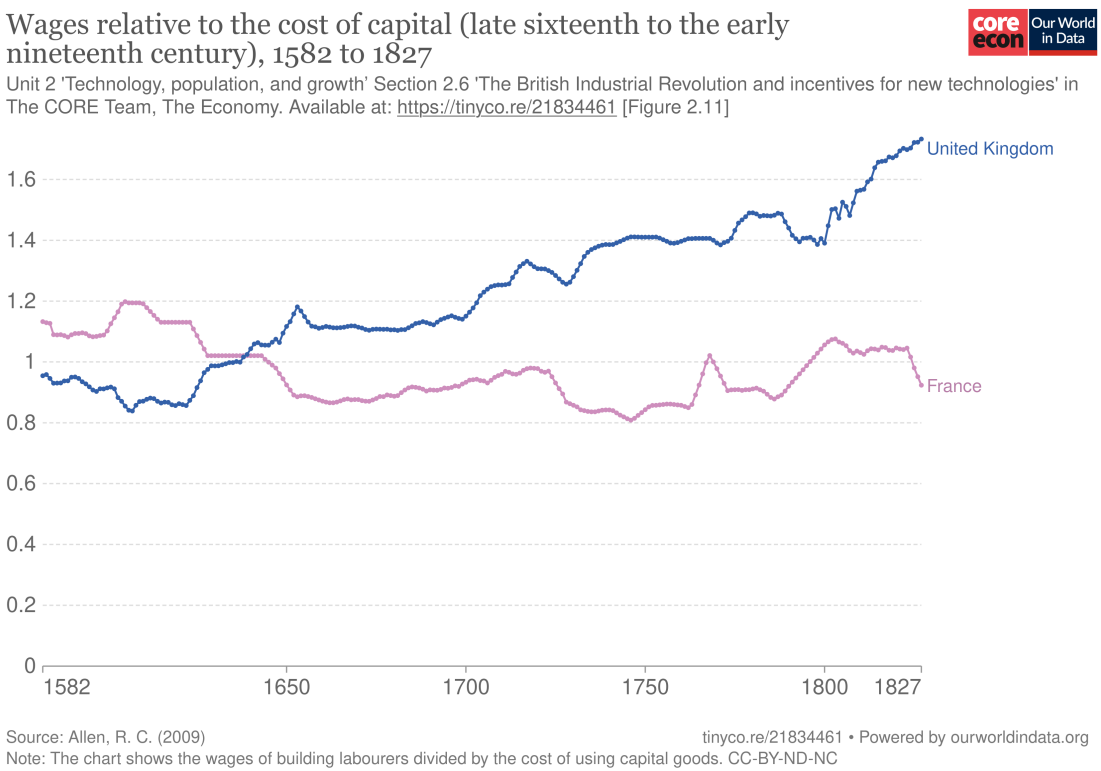
Key concepts

- Ceteris paribus and other simplifications help us focus on the variables of interest. We see more by looking at less.
- Incentives matter, because they affect the benefits and costs of taking one action as opposed to another.
- Relative prices help us compare alternatives.
- Economic rent is the basis of how people make choices.

Why "Hocky-stick" Growth?

The need to develop technology

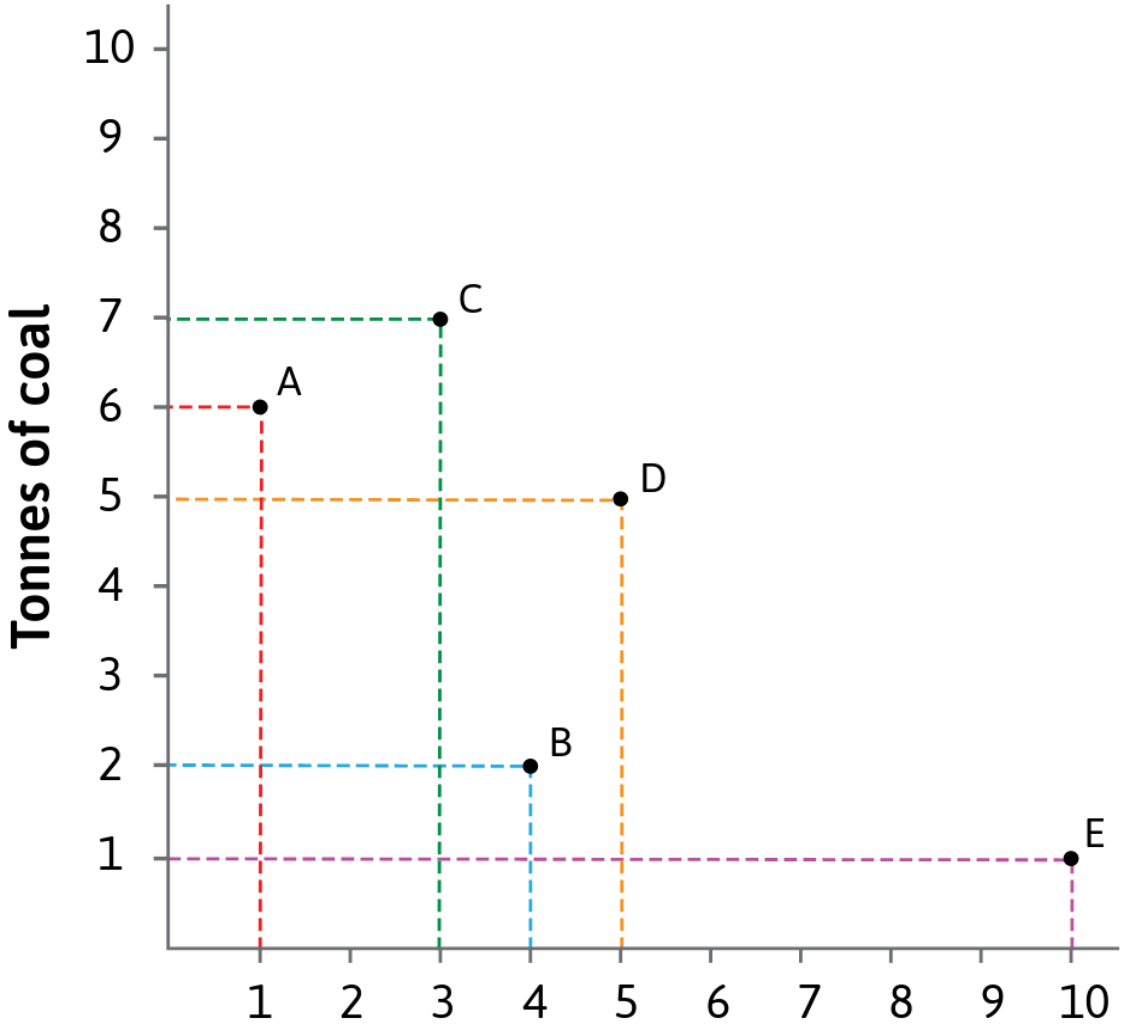
- There are two inputs for textiles: energy (coal) and labor
- Britain v.s. France: wage is higher yet coal is cheaper
- $\Rightarrow$ incentive to invent steam machine, lower average cost



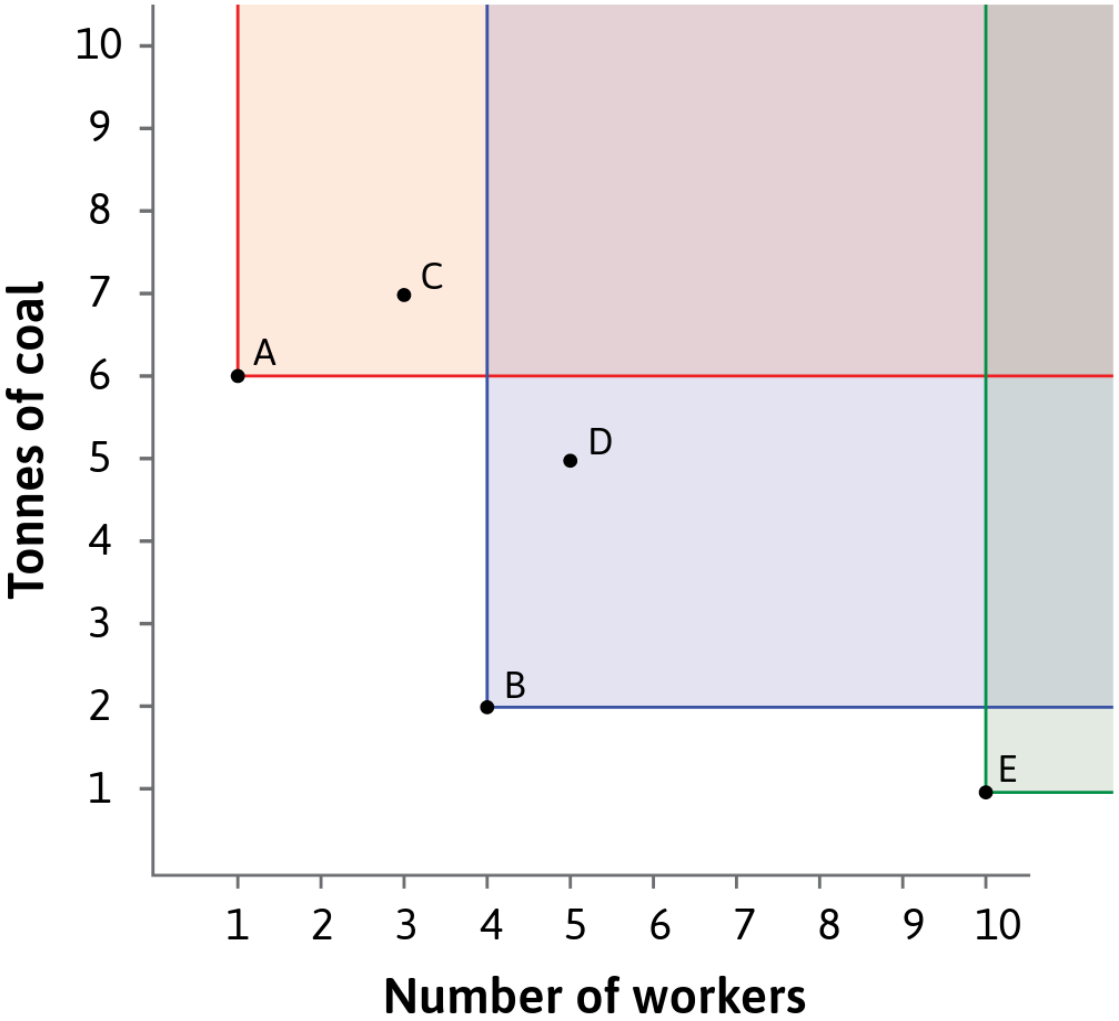
Modelling Technology

Inputs $\overset{\text{Technology}}{\Longrightarrow}$ Outputs

- All A-E produce 100 cloth
- A: relatively energy-intensive
- E: relatively labor-intensive



Some Technology are Inferior



- Tech C is dominated by A, and Tech D is dominated by B
- C produce the same output as A, but use more input

Firm's Behavior

- Firm's Objective: maximizing profit ($\neq$ minimizing cost)
- Profit $=$ revenue $-$ costs
- If revenue if fixed (?!), then maximizing profit $=$ minimizing cost
- cost $=$ wage $\times$ workers $+$ price of coal per ton $\times$ numbers of ton
  - $c = w \times L + p \times R$
- **Isocost line**: the combination of (L, R) that yields same cost c, given market prices w and p
- To draw the line, we rearrange the cost function into

$$R = \frac{c}{p} - \underbrace{\frac{w}{p}}_{\text{relative price}} L$$

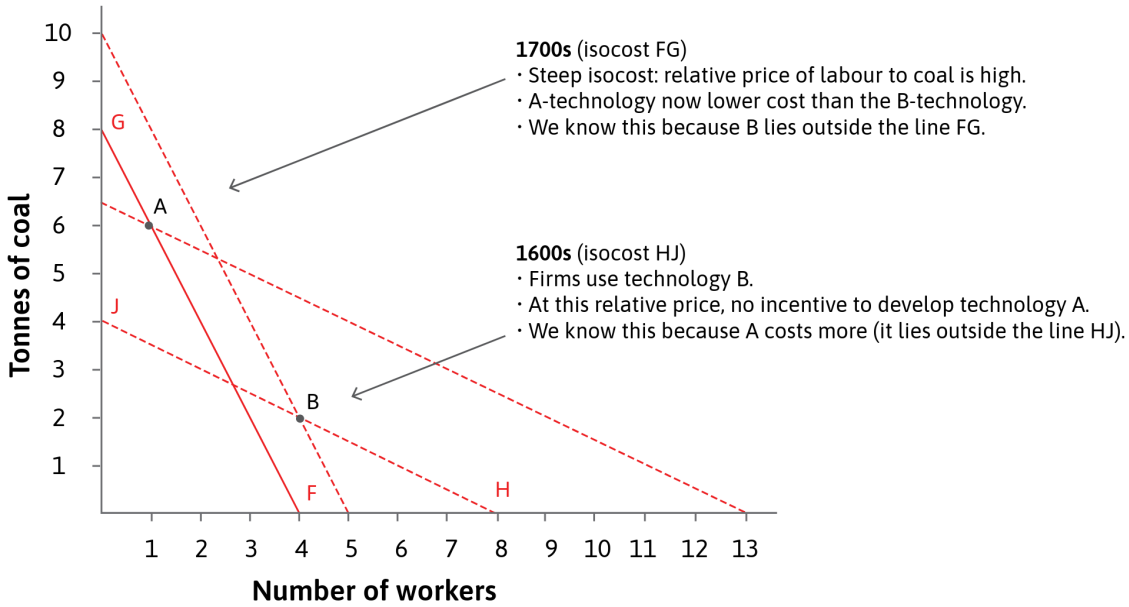
Change in relative price

- Interactive figure: https://tinyurl.com/2fsfzcm3

- Original at pt B, with isocost line $\overline{JH}$, $\frac{w}{p} = \frac{10}{20} = \frac{1}{2}$

- Relative price increases such that $\frac{w}{p} = \frac{10}{5} = 2$, isocost line steeper

- Cost increase if still stay at labor-intensive tech B $\Rightarrow$ move to energy-intensive tech A



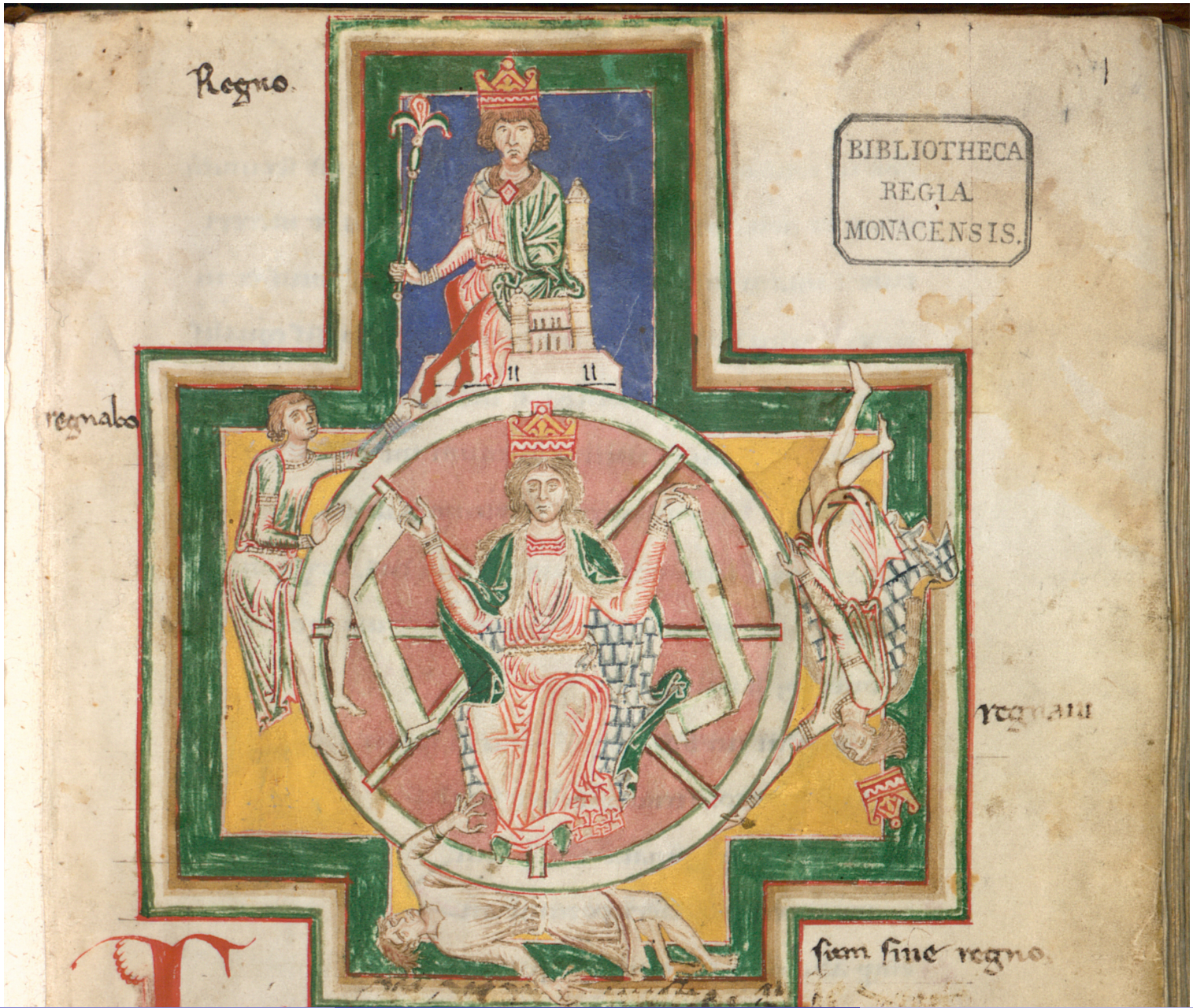
Why Stagnation?

Malthusian Trap

- Law of diminishing return: increment of output $\downarrow$ as input $\uparrow$
  - e.g. Study effort is lower from 50 $\rightarrow$ 60 compared with 90 $\rightarrow$ 100
- Production function also exhibit diminishing average product of labor:

$$\begin{array}{ccc} \text{Harvest more} & \Rightarrow & \text{Farmer income} \uparrow \\ \Uparrow \text{(random)} & & \Downarrow \\ \text{Population} \downarrow & & \text{Living standard \& Population} \uparrow \\ \Uparrow & & \Downarrow \\ \text{Farmer income} \downarrow & \Leftarrow & \text{Limited land cause average return} \downarrow \end{array}$$

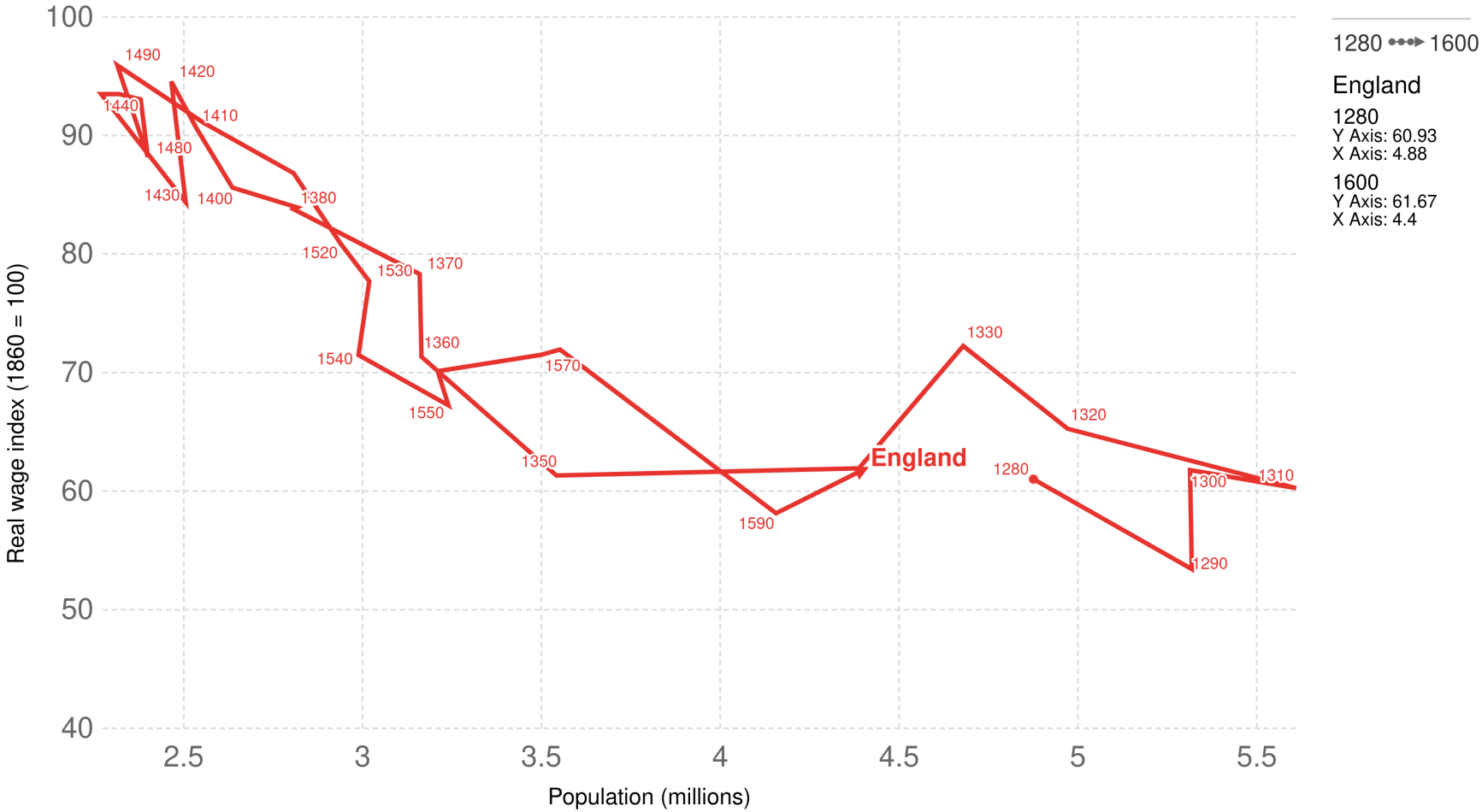
O Fortuna! (Carmina Burana)



Was Malthus Correct?

The Malthusian trap: Population and real wages, England, 1280 to 1600

Unit 2 'Technology, population, and growth' Section 2.9 'The Malthusian trap and long-term economic stagnation' in The CORE Team, The Economy. Available at: https://tinyco.re/20918330 [Figure 2.18]



Source: Clark (2005)

tinyco.re/20918330 • Powered by ourworldindata.org

Note: The data points at each year are calculated averages over the succeeding decade. CC-BY-ND-NC

How could we escape from Malthusian trap?

By improvement in technology to offset diminishing return!