

Lecture 6:

2.2. Ancient Empires: “Efflorescences” and Falls

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<<https://github.com;braddelong/public-files/blob/master/econ-135-lecture-6.pptx>>

Roadmap for the Next Week

6. Civilizational "Efflorescences" and Imperial Declines (Feb 11):

- **Read Before:** Willem M. Jongman (2007): *Gibbon was Right: The Decline and Fall of the Roman Economy* <<https://delong.typepad.com/jongman-gibbon-was-right.pdf>>
- **Read Before:** Peter Temin: *The Roman Market Economy*, Roman Growth <<https://delong.typepad.com/files/temin-roman-growth.pdf>>
- **Slides:** <<https://github.com;braddelong/public-files/blob/master/econ-135-lecture-6.pptx>>
- **Finish:** Assignment 4: Malthusian economies paper; due Feb 12

7. Why Was Pre-Industrial Progress so Slow on Average? (Feb 13):

- **Read Before:** Josh Ober (2019): *Agamemnon's Cluelessness*, selections <<https://delong.typepad.com/files/ober-agamemnon-selections.pdf>>
- **Read Before:** Moses Finley: *Technical Innovation and Economic Progress in the Ancient World* <<https://delong.typepad.com/finley-technical.pdf>>
- **Slides:** <<https://github.com;braddelong/public-files/blob/master/econ-135-lecture-7.pptx>>
- **Start:** Assignment 5: Simulations with the Solow growth model; due Feb 19 <<https://bcourses.berkeley.edu/courses/1487685/assignments/8065916>>

8. Commercial Revolutions (Feb 18):

- **Read:** Christopher Berry (2018): *Adam Smith: A Very Short Introduction* <<https://delong.typepad.com/files/berry-smith.pdf>>
- **Slides:** <<https://github.com;braddelong/public-files/blob/master/econ-135-lecture-8.pptx>>
- **Finish:** Assignment 5: Simulations with the Solow growth model; due Feb 19 <<https://bcourses.berkeley.edu/courses/1487685/assignments/8065916>>

Preview: Lecture 6: Ancient Empires

What I am going to cover:

- “Efflorescences”: prosperity in classical Greece and Rome
 - The rise of the Roman Empire
 - Review something...
 - The fall of the Roman Empire
 - What’s going to be on the exam?
 - What are the key takeaways?



Pre-Industrial “Efflorescences” (and Declines)

Ideas courtesy of Jack Goldsmith, Daron Acemoglu and James Robinson:

- The Malthusian model misses a great deal of the interesting action prior to the Industrial Revolution.
- An alternative explanation for why there was no long-run trend in living standards is the theory of ‘efflorescence and decline’
- I organize my thoughts about this with the two Malthusian equations, and with their bunch of variables and parameters: h , γ , β , ϕ , y^{sub} , s , δ , θ , and H that together determine y^{*mal} and L^{*mal}
- This is best thought of as a filing system for factors that may be important—given the importance of both capital and labor efficiency, the roles of ideas and of resources in producing labor efficiency, and Malthusian population dynamics, these are the things you should look at

The diagram illustrates the derivation of the Malthusian equilibrium population (L_t^{*mal}) and income level (y^{*mal}) from a base equation. The base equation is:

$$L_t^{*mal} = \left[\left(\frac{H_t}{y^{sub}} \right) \left(\frac{s}{\delta} \right)^\theta \left(\frac{1}{\phi} \right) \left[\frac{1}{(1+\gamma h/\delta)^\theta} \frac{1}{(1+\gamma h/\beta)} \right] \right]^\gamma$$

Annotations explain the components:

- The salience of capital in determining productivity**: Points to (H_t/y^{sub}) .
- The extent to which population depresses productivity**: Points to $(1+\gamma h/\beta)$.
- Nuisance terms**: Points to $(1+\gamma h/\delta)^\theta$ and $(1+\gamma h/\beta)$.
- The ratio of knowledge to subsistence income**: Points to $(s/\delta)^\theta$.
- The inverse of the taste for luxury**: Points to $(1/\phi)$.
- The ratio of savings to depreciation**: Points to $(s/\delta)^\theta$.
- The Malthusian equilibrium population**: Points to L_t^{*mal} .
- Sensitivity of productivity to population**: Points to $(1+\gamma h/\beta)$.
- Rate of useful ideas creation**: Points to $(1+\gamma h/\beta)$.
- True zpg subsistence**: Points to $(1+\gamma h/\delta)^\theta$.
- Malthusian equilibrium income level**: Points to y^{*mal} .
- Taste for luxuries**: Points to $(1+\gamma h/\delta)^\theta$.
- Responsiveness of population growth to prosperity**: Points to $(1+\gamma h/\beta)$.

The final equations shown are:

$$y^{*mal} = \phi y^{sub} \left(1 + \frac{n^{*mal}}{\beta} \right) = \phi y^{sub} \left(1 + \frac{\gamma h}{\beta} \right)$$

The Classical Greek Efflorescence

Emerging out of the Iron Dark Age of -1200 to -800:

- When the Greek city states emerged they did so with functional systems of governance which provided public goods, such as security for trade and investment.
- This initiated a period of sustained increases in living standards.
- While Ancient Greece did have a period of democracy, it was relative short (less than 200 years) compared to the duration of the polity and most citizens - slaves, poor citizens who couldn't afford their tax bill, women - could not participate.
- Greek institutions (rules according to which the society was organized) tended to be "extractive." For example, the economy was largely based upon slavery.

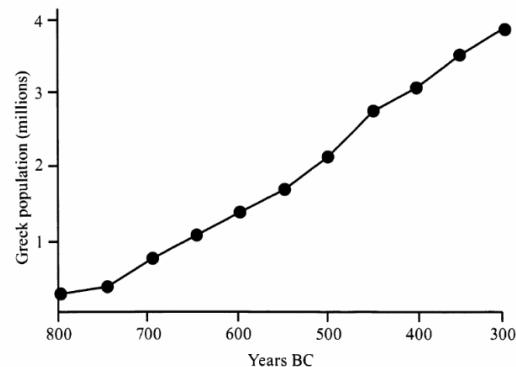
Table 1
Standard Periodization of Ancient Greek History

Name	Dates
Bronze Age	c. 3000–1200 BC
Late Bronze Age	c. 1600–1200 BC (also known as Mycenaean period)
Early Iron Age	c. 1200–700 BC (also known as Dark Age)
Archaic	c. 700–480 BC
Classical	480–323 BC
Hellenistic	323–30 BC
Early Empire	30 BC–AD 284
Late Empire	AD 284–526
Early Byzantine	AD 526–1081

Source: Morris, Ian (2004) "Economic Growth in Ancient Greece," Journal of Institutional And Theoretical Economics, 160, 709-742.

Population Went Up

Figure 10
ie Estimated Population of the Greek World (including the Aegean and western Mediterranean), 800–300 BC

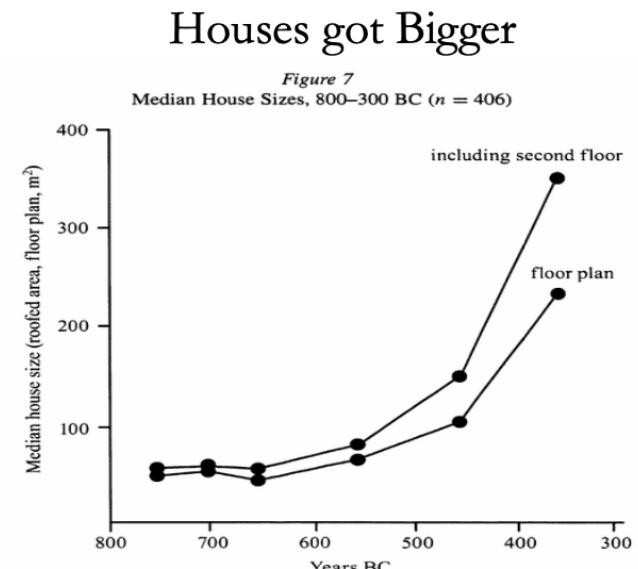
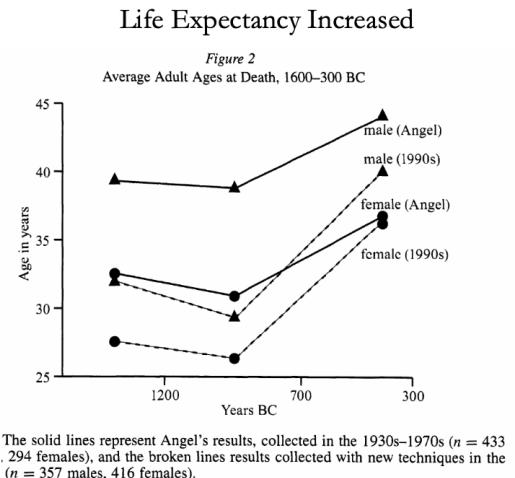


Source: Morris, Ian (2004) "Economic Growth in Ancient Greece," Journal of Institutional And Theoretical Economics, 160, 709-742.

The Classical Greek Efflorescence II

“Developmental” or “Extractive”?

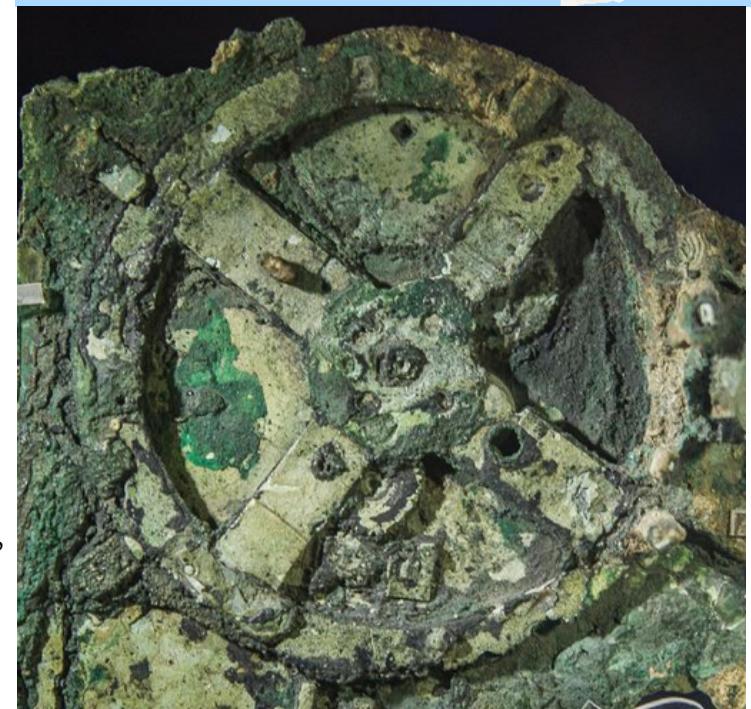
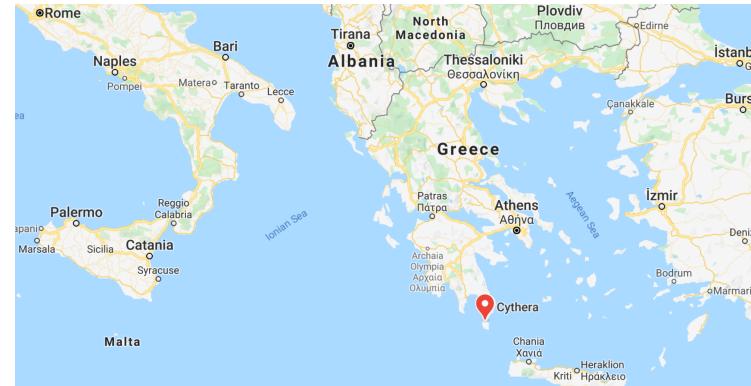
- Extractive political institutions concentrate political power in the hands of some group who can use that power to redistribute wealth and income to themselves. This resulting concentration of wealth tends to reinforce the initial set of political institutions.
- Roving bandits or stationary bandits?
- Acemoglu and Robinson hypothesize that growth was not sustained in ancient societies because their institutions were extractive, and extractive institutions are incompatible with sustaining growth in the long run.
- They argue that this is because extracting resources creates conflicts over who will control those resources, and it may also induce rebellion from below.
- In either case political instability can bring the government and economy down.



The Anti-Kythera Mechanism

What is this?

- Built between -150 and -70. Rhodes 13" x 7" x 4" wooden box
 - Gears—largest 5" in diameter
 - Inscriptions
- Wikipedia: "37 gear wheels enabling it to follow the movements of the Moon and the Sun through the zodiac, to predict eclipses and even to model the irregular orbit of the Moon, where the Moon's velocity is higher in its perigee than in its apogee. This motion was studied in the 2nd century BC by astronomer Hipparchus of Rhodes, and it is speculated that he may have been consulted in the machine's construction. The knowledge of this technology was lost at some point in antiquity. Similar technological works later appeared in the medieval Byzantine and Islamic worlds, but works with similar complexity did not appear again until the development of mechanical astronomical clocks in Europe in the fourteenth century..."



The Anti-Kythera Mechanism II

What is this?

- Brian Resnick: “A main gear would move to represent the calendar year, and would, in turn, move many separate smaller gears to represent the motions of the planets, sun, and moon. So you could set the main gear to the calendar date and get approximations for where those celestial objects would be in the sky on that date.... You, as a user, could input a few simple variables and it would yield a flurry of complicated mathematical calculations.... All the user had to do was enter the main date on one gear, and through a series of subsequent gear turns, the mechanism could calculate things like the angle of the sun crossing the sky. (For some reference, mechanical calculators—which used gear ratios to add and subtract—didn’t arrive in Europe until the 1600s)
...”



Cicero (-54): De Re Publica

"With the exception of the dream of Scipio, in the last book, the whole treatise was lost till the year 1822, when the librarian of the Vatican discovered a portion of them among the palimpsests in that library. What he discovered is translated here; but it is in a most imperfect and mutilated state. The form selected was that of a dialogue, in imitation of those of Plato..."

I.XIV:

- Then Philus said: "I am not about to bring you anything new, or anything which has been thought over or discovered by me myself. But I recollect that Caius Sulpicius Gallus, who was a man of profound learning, as you are aware, when this same thing was reported to have taken place in his time, while he was staying in the house of Marcus Marcellus, who had been his colleague in the consulship, asked to see a celestial globe which Marcellus's grandfather had saved after the capture of Syracuse from that magnificent and opulent city, without bringing to his own home any other memorial out of so great a booty; which I had often heard mentioned on account of the great fame of Archimedes; but its appearance, however, did not seem to me particularly striking. For that other is more elegant in form, and more generally known, which was made by the same Archimedes, and deposited by the same Marcellus in the Temple of Virtue at Rome."
- "But as soon as Gallus had begun to explain, in a most scientific manner, the principle of this machine, I felt that the Sicilian geometrician must have possessed a genius superior to anything we usually conceive to belong to our nature. For Gallus assured us that that other solid and compact globe was a very ancient invention, and that the first model had been originally made by Thales of Miletus. That afterward Eudoxus of Cnidus, a disciple of Plato, had traced on its surface the stars that appear in the sky, and that many years subsequently, borrowing from Eudoxus this beautiful design and representation, Aratus had illustrated it in his verses, not by any science of astronomy, but by the ornament of poetic description. He added that the figure of the globe, which displayed the motions of the sun and moon, and the five planets, or wandering stars, could not be represented by the primitive solid globe; and that in this the invention of Archimedes was admirable, because he had calculated how a single revolution should maintain unequal and diversified progressions in dissimilar motions.
- "In fact, when Gallus moved this globe, we observed that the moon succeeded the sun by as many turns of the wheel in the machine as days in the heavens. From whence it resulted that the progress of the sun was marked as in the heavens, and that the moon touched the point where she is obscured by the earth's shadow at the instant the sun appears opposite...."
- Scipio: "I had myself a great affection for this Gallus, and I know that he was very much beloved and esteemed by my father Paulus. I recollect that when I was very young, when my father, as consul, commanded in Macedonia, and we were in the camp, our army was seized with a pious terror, because suddenly, in a clear night, the bright and full moon became eclipsed. And Gallus, who was then our lieutenant, the year before that in which he was elected consul, hesitated not, next morning, to state in the camp that it was no prodigy, and that the phenomenon which had then appeared would always appear at certain periods, when the sun was so placed that he could not affect the moon with his light..."

The Rise of Rome

Roman Institutions are key to the rise of Rome:

- In 510BC, the citizens of Rome overthrew their king, Lucius Tarquinius Superbus, and created a republic.
- The state was run by elected officials:
 - Two consuls who had the job for one year
 - Other magistrates: praetors, aediles, proconsuls
 - Tribunes.
 - Offices were elected, annual, and held by multiple people at the same time
 - This greatly reduced the ability of any one person to consolidate or exploit his power.
- The institutions of the Republic contained a system of checks and balances which distributed power fairly widely.
- Even if elite patrician families had far more power, it was possible for non-elites, so called plebeians, to get to the top, and they constrained the power of the elites.
 - Then some plebeian families became equally elite...
 - The *nobles*

Roman assemblies:

- Centuriate: 193 centuries on the basis of military organization, weighted toward the rich. Elects the magistrates, declares war and peace
- Tribal: After 241 BC, 35 tribes on the basis of geographical location
- Plebeian: Non-patricians, run by Tribunes
- Senate

Roman institutions:

- Legions
 - Phalanx
 - Manipular
 - Marian
- Imperium
- Provinciae
- Proconsuls and propraetors

The Rise of Rome II

Roman Institutions are key to the rise of Rome:

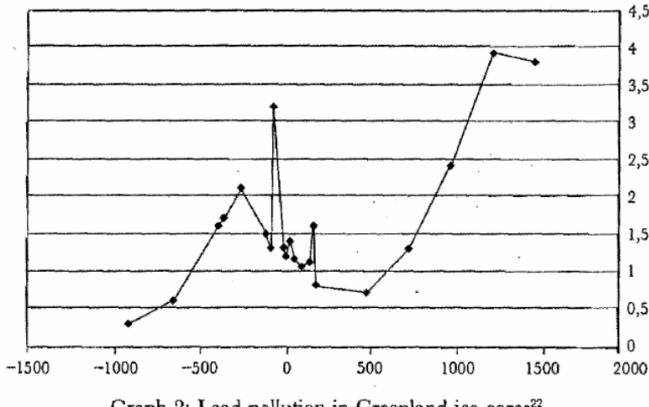
- Four key factors:
 - Militarism (on the part of elites competing for authority)
 - Mobilization (of the citizen mass)
 - Widely shared benefits (of conquest)
 - Incorporation (of conquered communities)
- Mammoth military and political expansion after -340, and substantial economic, expansion



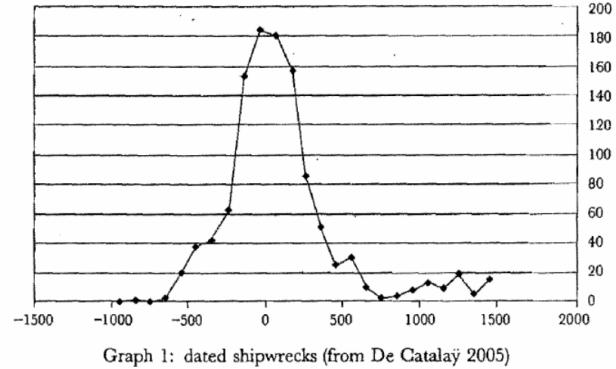
Measuring Roman Efflorescence

There are many interesting ways to track economic expansion:

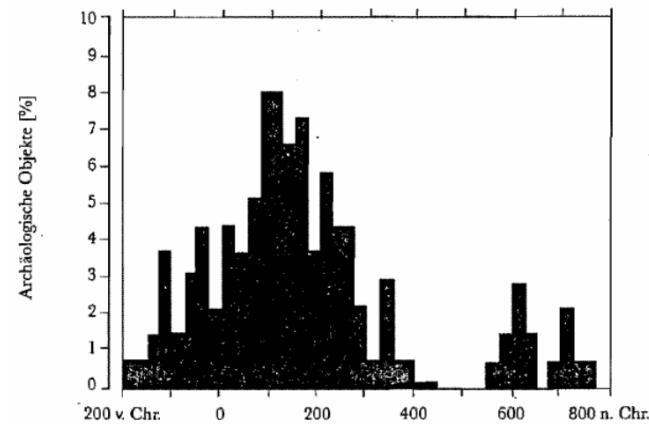
- Shipwrecks indicate trade, but they also track the movement of goods by fiat. For example, the citizens of Rome were kept happy by the free distribution of bread after 58BC. This was later extended to olive oil and even wine. This had to be shipped (mostly from Egypt and North Africa).
- The Romans also moved around taxes levied in the provinces and supplied their troops. Some argue that 2/3 of all the ‘trade’ was actually the state moving stuff around.
- For Roman citizens, economic institutions were quite good. However, the Italian economy was based on slavery (about 35% of the population of Italy were slaves at the time of the Emperor Augustus). There was little technological change.



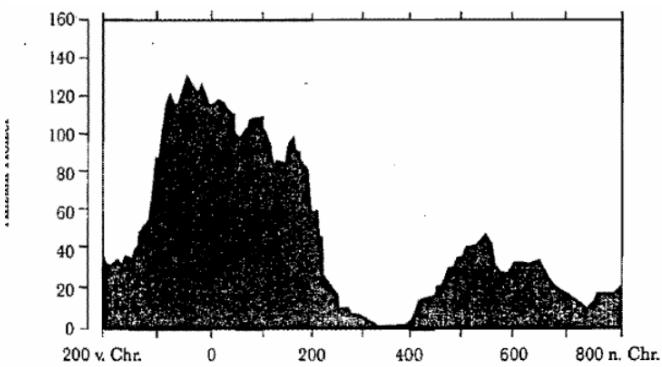
Graph 2: Lead pollution in Greenland ice cores²²



Graph 1: dated shipwrecks (from De Catalay 2005)



Graph 4: archaeological finds in western Germany (Trier laboratory)



Graph 3: dated wood remains from western Germany (Trier laboratory)

Source: Jongman, Willem M. (2007) “Gibbon was Right: The Decline and Fall of the Roman Economy,” in O. Hekster et. al. eds. *Crises and the Roman Empire*, Brill.

Pottery Mountain in Rome

53 million broken amphorae



Republic to Empire

Political transition:

- The expansion of Rome's conquests created inequality and increasing political instability.
- There were calls for the redistribution of land and power.
- For example, Plebeian Tribune Tiberius Gracchus started to develop very 'populist' political platforms which threatened the senatorial elites.
- The culmination of this was civil war, the dictatorship of Julius Caesar, and finally the creation of the Empire under Augustus.
 - First the *principate*
 - Then the *dominate*
- Augustus reformed the army, removing it as a bastion of plebeian power.
- His successor Tiberius stripped the assemblies of powers and gave them to the senate—and then neutered the senate
- A semi-hereditary monarchy replaced the Republic:
 - "May good success attend the Roman senate and people and myself. I hereby adopt as my son Marcus Ulpius Nerva Traianus..."
- This was a move towards more "extractive" political institutions and though it stabilized things for awhile, there was an eventual movement towards even more extractive economic institutions

Always Scribble, Scribble, Scribble! Eh! Mr. Gibbon?

Beste, *Memorials*:

- The Duke of Gloucester, brother of King George III, permitted Mr. Gibbon to present to him the first volume of *The History of the Decline and Fall of the Roman Empire*. When the second volume of that work appeared, it was quite in order that it should be presented to His Royal Highness in like manner. The prince received the author with much good nature and affability, saying to him, as he laid the quarto on the table,
 - “Another damned thick, square book! Always, scribble, scribble, scribble! Eh! Mr. Gibbon?”

Always Scribble, Scribble, Scribble! Eh! Mr. Gibbon?

Five Good Emperors: Nerva-Trajan-Hadrian-Antonius Pius-Marcus Aurelius:

- If a man were called to fix the period in the history of the world, during which the condition of the human race was most happy and prosperous, he would, without hesitation, name that which elapsed from the death of Domitian to the accession of Commodus.
 - The vast extent of the Roman empire was governed by absolute power, under the guidance of virtue and wisdom.
 - The armies were restrained by the firm but gentle hand of four successive emperors, whose characters and authority commanded involuntary respect.
 - The forms of the civil administration were carefully preserved by Nerva, Trajan, Hadrian, and the Antonines, who delighted in the image of liberty, and were pleased with considering themselves as the accountable ministers of the laws.
 - Such princes deserved the honor of restoring the republic, had the Romans of their days been capable of enjoying a rational freedom.
- The labors of these monarchs were overpaid by
 - the immense reward that inseparably waited on their success;
 - by the honest pride of virtue, and
 - by the exquisite delight of beholding the general happiness of which they were the authors.

Aelius Aristides

The Roman Oration:

- Whatever the seasons make grow and whatever countries and rivers and lakes and arts of Hellenes and non-Hellenes produce are brought from every land and sea, so that if one would look at all these things, he must needs behold them either by visiting the entire civilized world or by coming to this city. For whatever is grown and made among each people cannot fail to be here at all times and in abundance. And here the merchant vessels come carrying these many products from all region in every season and even at every equinox, so that the city appears a kind of common emporium of the world.
- Cargoes from India and, if you will, even from Arabia the Blest one can see in such numbers as to surmise that in those lands the trees will have been stripped bare and that the inhabitants of these lands, if they need anything, must come here and beg for a share of their own. Again one can see Babylonian garments and ornaments from the barbarian country beyond arriving in greater quantity and with more ease than if shippers from Naxos or from Cythnos, bearing something from those islands, had but to enter the port of Athens. Your farms are Egypt, Sicily and the civilized part of Africa.
- Arrivals and departures by sea never cease, so that the wonder is not that the harbor has insufficient space for merchant vessels, but that even the sea has enough, if it really does.
- And just as Hesiod said about the ends of the Ocean, that there is a common channel where all waters have one source and destination, so there is a common channel to Rome and all meet here, trade, shipping, agriculture, metallurgy, all the arts and crafts that are or ever have been, all the things that are engendered or grow from the earth. And whatever one does not see here neither did nor does exist. And so it is not easy to which is greater, the superiority of this city in respect to the cities that now are or the superiority of this city respect to the empires that ever were...

Three Great Plagues

But the demands of the empire for revenue and of the upper class for resources remain the same:

- Antonine Plague (smallpox?): Antonine ⇒ Severian dynasty
- Plague of St. Cyrian (Ebola-like?): Things fall completely apart, then Diocletian: between Philip the Arab and Diocletian, 18 emperors in 35 years, plus two breakaways; 12 of the 18 were assassinated
- Plague of Justinian (Bubonic): Flavius Apion...

Big Ideas: Lecture 6: Ancient Empires

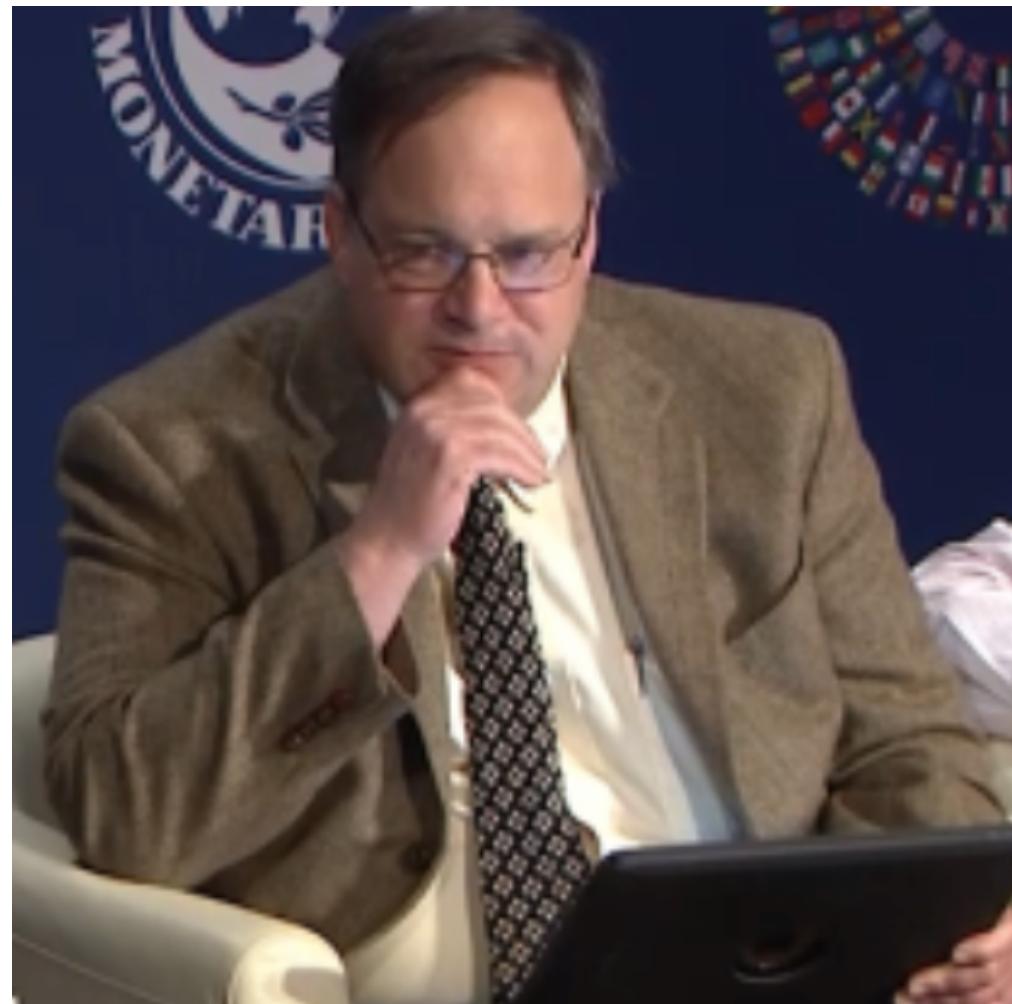
Takeaways from this lecture:

- OK: What should the takeaways from this lecture be?



Catch Our Breath...

- Ask a couple of questions?
- Make a couple of comments?
- Any more readings to recommend?



Review: Long-Run Patterns: Global *h, g, & n*

Date	ideas Level H	Total Real World Income Y (billions)	Average Real Income per Capita y (per year)	Total Human Population L (millions)	Rate of Population and Labor Force Growth n	Rate of Efficiency-of-Labor Growth g	Rate of Ideas-Stock Growth h
-68000	1.0	\$0	\$1,200	0.1			
-8000	5.0	\$3	\$1,200	2.5	0.005%	0.000%	0.003%
-6000	6.3	\$6	\$900	7	0.051%	-0.014%	0.011%
-3000	9.2	\$14	\$900	15	0.025%	0.000%	0.013%
-1000	16.8	\$45	\$900	50	0.060%	0.000%	0.030%
0	30.9	\$153	\$900	170	0.122%	0.000%	0.061%
800	41.1	\$270	\$900	300	0.071%	0.000%	0.035%
1500	53.0	\$450	\$900	500	0.073%	0.000%	0.036%
1770	79.4	\$825	\$1,100	750	0.150%	0.074%	0.149%
1870	123.5	\$1,690	\$1,300	1300	0.550%	0.167%	0.442%
2020	2720.5	\$90,000	\$11,842	7600	1.177%	1.473%	2.061%

Long-Run Patterns: “Western” h , g & n

Global Growth: The Industrializing West (2019)

Date	ideas Level H	Total Real Income Y (billions)	Average Real Income per Capita y (per year)	Total “West” Population L (millions)	Rate of Population and Labor Force Growth n	Rate of Efficiency-of-Labor Growth g	Increasing Resources ρ	Rate of Ideas-Stock Growth h
-68000	1.0	\$0.01	\$1,200	0.005				
-8000	4.5	\$0.12	\$1,200	0.1	0.005%	0.000%	0.000%	0.002%
-6000	4.7	\$0.18	\$900	0.2	0.035%	-0.014%	0.000%	0.003%
-3000	7.5	\$0.45	\$900	0.5	0.031%	0.000%	0.000%	0.015%
-1000	15.0	\$1.80	\$900	2	0.069%	0.000%	0.000%	0.035%
0	23.7	\$4.50	\$900	5	0.092%	0.000%	0.000%	0.046%
800	30.0	\$7.20	\$900	8	0.059%	0.000%	0.000%	0.029%
1500	58.9	\$25.00	\$1,000	25	0.163%	0.015%	0.000%	0.096%
1770	101.0	\$105.00	\$1,400	75	0.407%	0.125%	0.257%	0.200%
1870	252.0	\$490.00	\$2,800	175	0.847%	0.693%	0.405%	0.914%
2020	8439.5	\$40,000.00	\$50,000	800	1.013%	1.922%	0.175%	2.341%

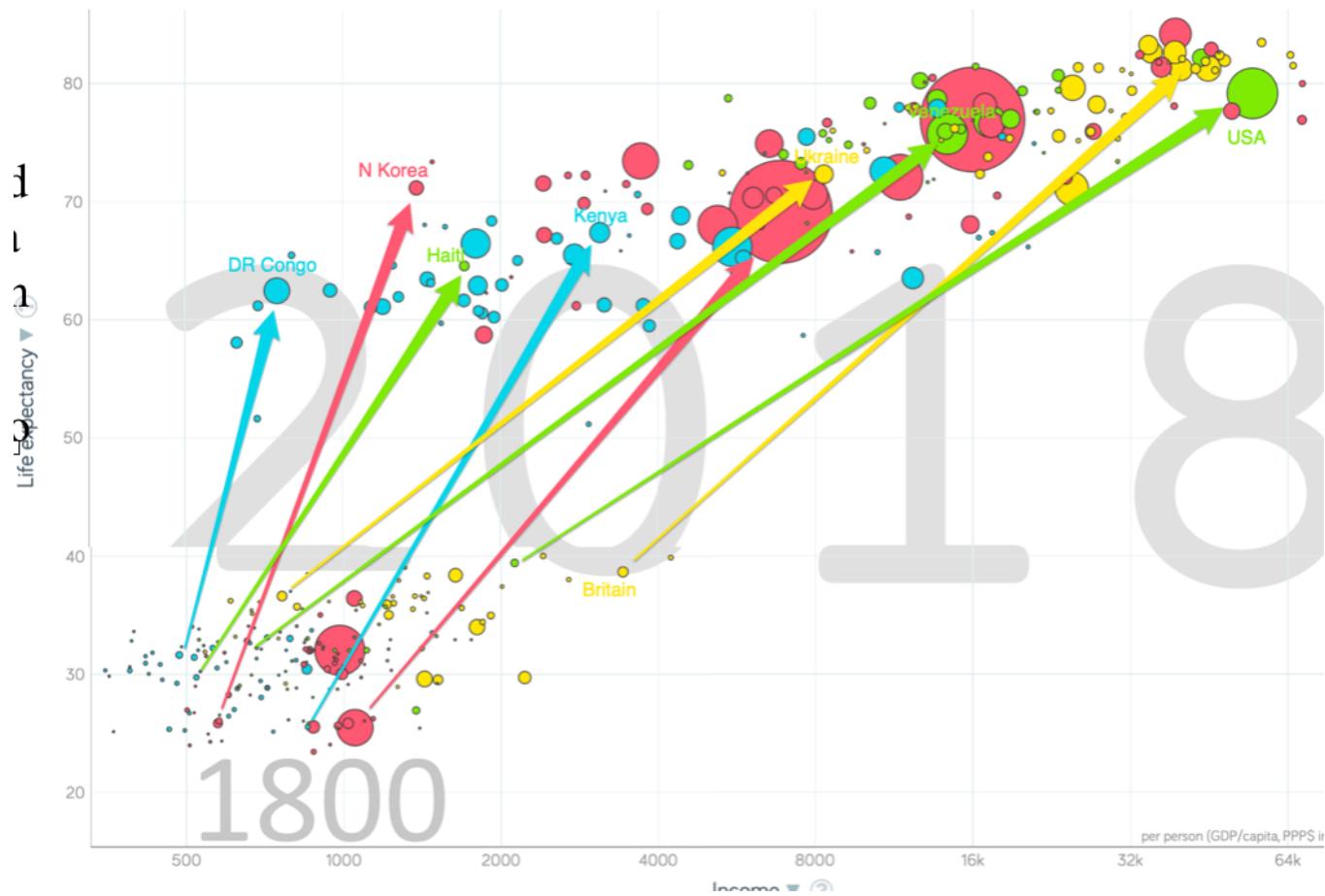
Where does the “ ρ ” come from?

- “Ghost acreage”—conquest and resource utilization (sugar islands, timberlands, cottonlands, etc.)
- Cultural expansion—Australia, Canada, New Zealand, & U.S.; Spain & Italy & Scandinavia; plus Japan, Korea, Taiwan, Hong Kong, & Singapore

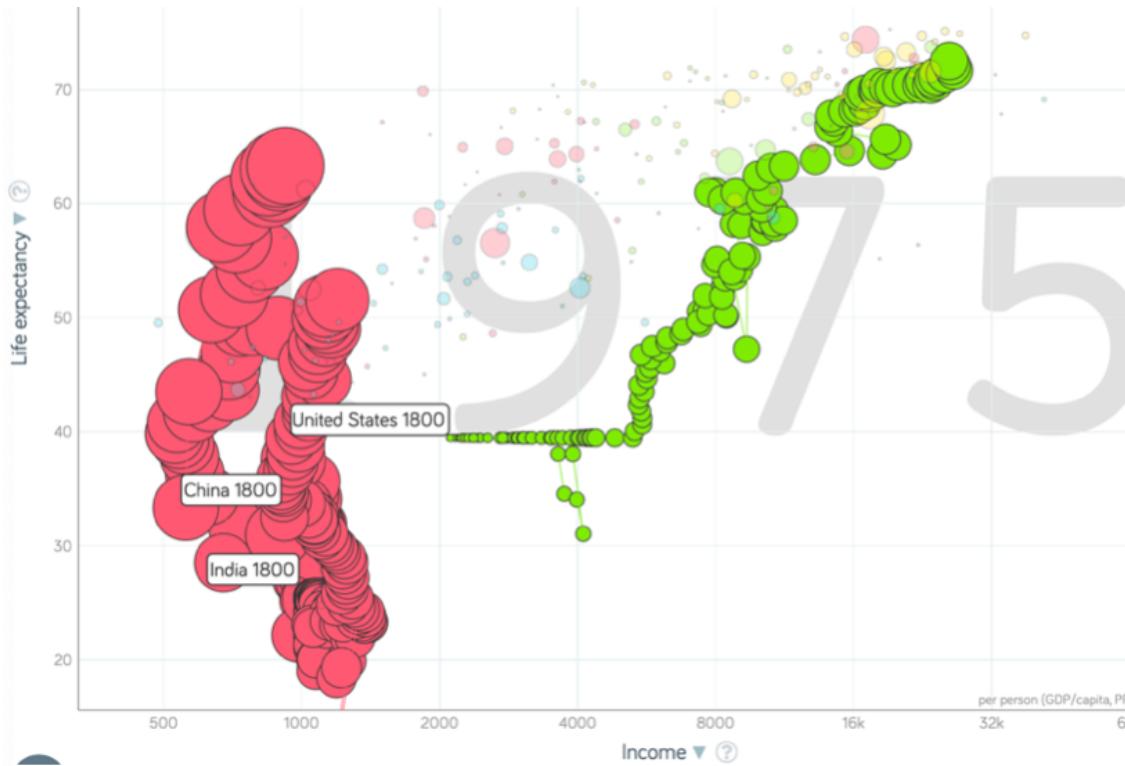
One Figure: A Great Divergence

From 1800 to 2018:

- The dots start with a 3-1 spread in incomes and a 10-year spread in life expectancy.
- All the arrows go up.
- Some arrows—mostly those already to the right—go right fast.
- Other arrows go right slowly.



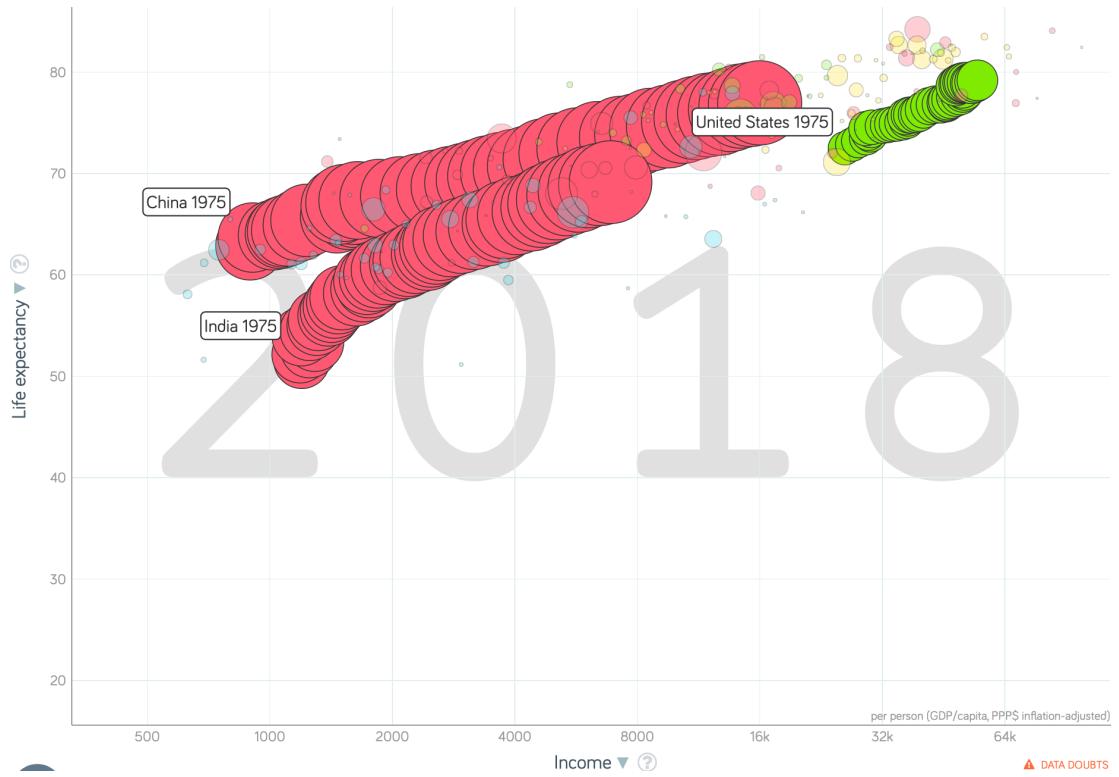
China and India and America, 1800-1975



From 1800 to 1975:

- Measured living standards and productivity levels improve fourteen-fold in the United States...
- ...& less than 30% in China & India...
- ...in spite of economic, transport, and cultural globalization...
- This is crazy!
- A “great divergence”
 - Not only were China & India relatively poor in 1800, they fell further behind thereafter

China and India and America, 1975–2018



From 1975-2018:

- Measured living standards and productivity levels...
- ... $54.9/25.9 = 2.12$ in America...
- ... $16.0/0.9 = 17.8$ in China...
- ... $6.9/1.2 = 5.8$ in India...

Review: Solow Model Basics

Lecture Notes: <<https://www.bradford-delong.com/2020/01/lecture-notes-the-solow-growth-model-the-history-of-economic-growth-econ-135.html>>

$$(2.1.2) \quad Y = \kappa^\theta E L ; \quad (2.1.3) \quad y = \kappa^\theta E ; \quad (2.1.1) \quad \kappa = \frac{K}{Y}$$

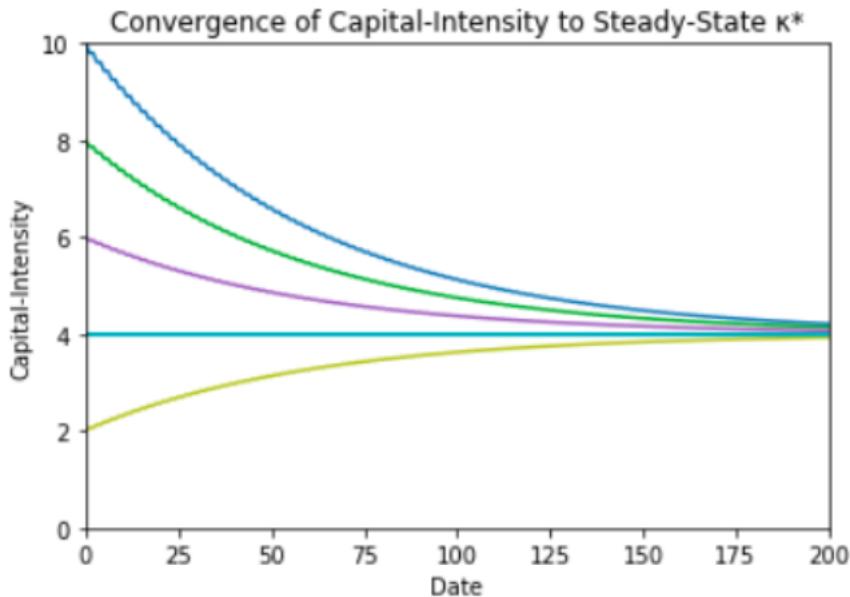
$$\frac{dE}{dt} = gE \quad \frac{dL}{dt} = g_L L = nL \quad \frac{dK}{dt} = sY - \delta K = \left(\frac{s}{\kappa} - \delta \right) K$$

$$(1.16) \quad \kappa^* = \frac{s}{n+g+\delta}$$

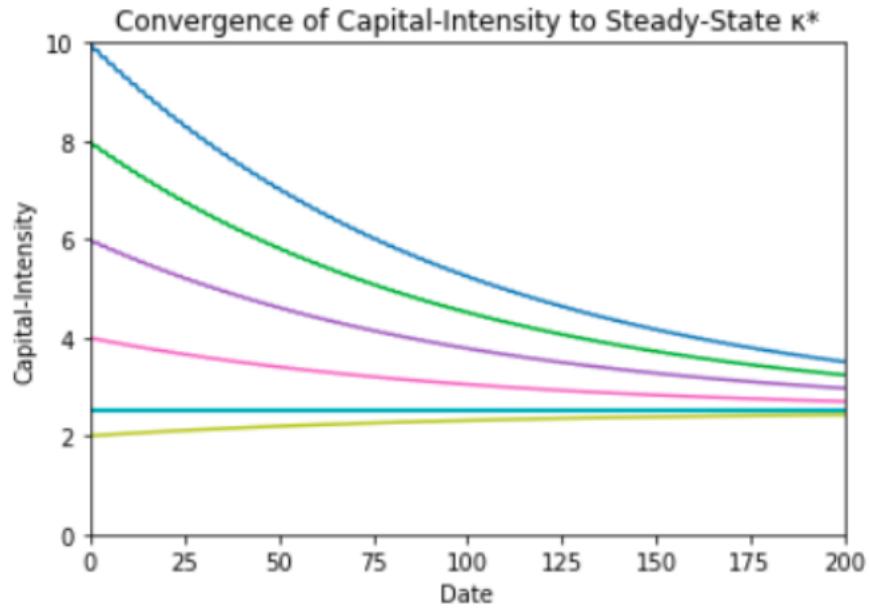
This κ^* we define as the steady-state *balanced-growth equilibrium* value of capital-intensity in the Solow growth model. If the capital-intensity $\kappa = \kappa^*$, then it is constant, and the economy is in balanced growth, with Y and K growing at the rate $n+g$, E and y growing at the rate g , and L growing at the rate n .

$$(1.18) \quad \frac{d\kappa}{dt} = -\frac{n+g+\delta}{1+\theta}(\kappa - \kappa^*)$$

Solving the Model



```
k_max = 10
κ = k_max
for i in range(5):
    cg = κ_convergence_graph(κ_0=κ, s = 0.20, n = 0.01,
                             g = 0.015, δ = 0.025, θ = 1/2, T = 200)
    cg.draw()
    κ = κ-2
```



```
k_max = 10
κ = k_max
for i in range(5):
    cg = κ_convergence_graph(κ_0=κ, s = 0.15, n = 0.02,
                             g = 0.015, δ = 0.025, θ = 2, T = 200)
    cg.draw()
    κ = κ-2
```

Along the Balanced-Growth Path

Everything except κ —which is constant—grows at a constant proportional rate: either n , or g , or $n+g$;

- Labor force L grows at n
- Income per worker y and the efficiency of labor E grow at g
- Total income Y and the capital stock K grow at $n+g$

$$E_t^* = e^{gt} E_0$$

$$L_t^* = e^{nt} L_0$$

$$Y_t^* = (\kappa^*)^\theta E_t L_t = (\kappa^*)^\theta e^{gt} E_0 e^{nt} L_0 = (s/(n + g + \delta))^\theta e^{gt} E_0 e^{nt} L_0$$

$$K_t^* = \kappa^* Y_t^* = (s/(n + g + \delta))^{(1+\theta)} e^{gt} E_0 e^{nt} L_0$$

$$y_t^* = (\kappa^*)^\theta E_t = (\kappa^*)^\theta e^{gt} E_0 = (s/(n + g + \delta))^\theta e^{gt} E_0$$

Review: Solow-Malthus Model Basics

How do we make sense of the fact that people were ingenious and inventive back before 1500, and yet standards of living did not increase?

- Although population did increase—slowly
- Other parts of the model
- Balanced-growth equilibrium
- Convergence to equilibrium
- Lecture notes: <<https://nbviewer.jupyter.org/github/braddelong/long-form-drafts/blob/master/solow-model-5-pre-industrial.ipynb>>
 - datahub: <<http://datahub.berkeley.edu/user-redirect/interact?account=braddelong&repo=long-form-drafts&branch=master&path=solow-model-5-pre-industrial.ipynb>>

Understanding the Solow-Malthus Equilibrium: Population and Labor Force

$$L_t^{*mal} = \left[\left(\frac{H_t}{y^{sub}} \right) \left(\frac{s}{\delta} \right)^\theta \left(\frac{1}{\phi} \right) \left[\frac{1}{(1+\gamma h/\delta)^\theta} \frac{1}{(1+\gamma h/\beta)} \right] \right]^\gamma$$

The Malthusian equilibrium population

The ratio of knowledge to subsistence income

The salience of capital in determining productivity

The ratio of savings to depreciation

Nuisance terms

The inverse of the taste for luxury

The extent to which population depresses productivity

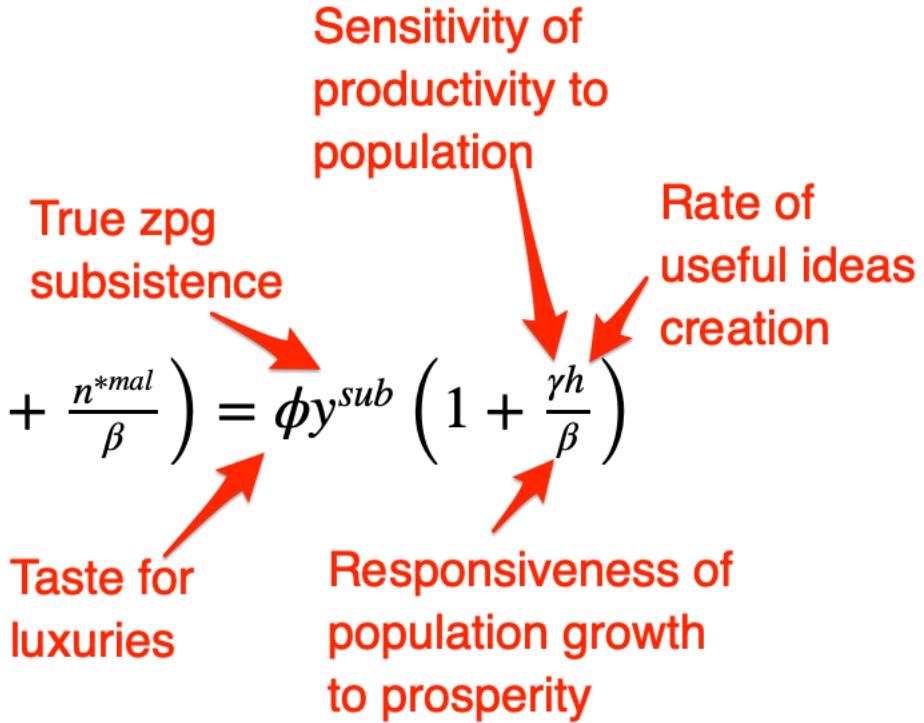
Notes:

-

Understanding the Solow-Mathus Equilibrium: Prosperity

Malthusian equilibrium income level

$$y^{*mal} = \phi y^{sub} \left(1 + \frac{n^{*mal}}{\beta} \right) = \phi y^{sub} \left(1 + \frac{\gamma h}{\beta} \right)$$



Notes:

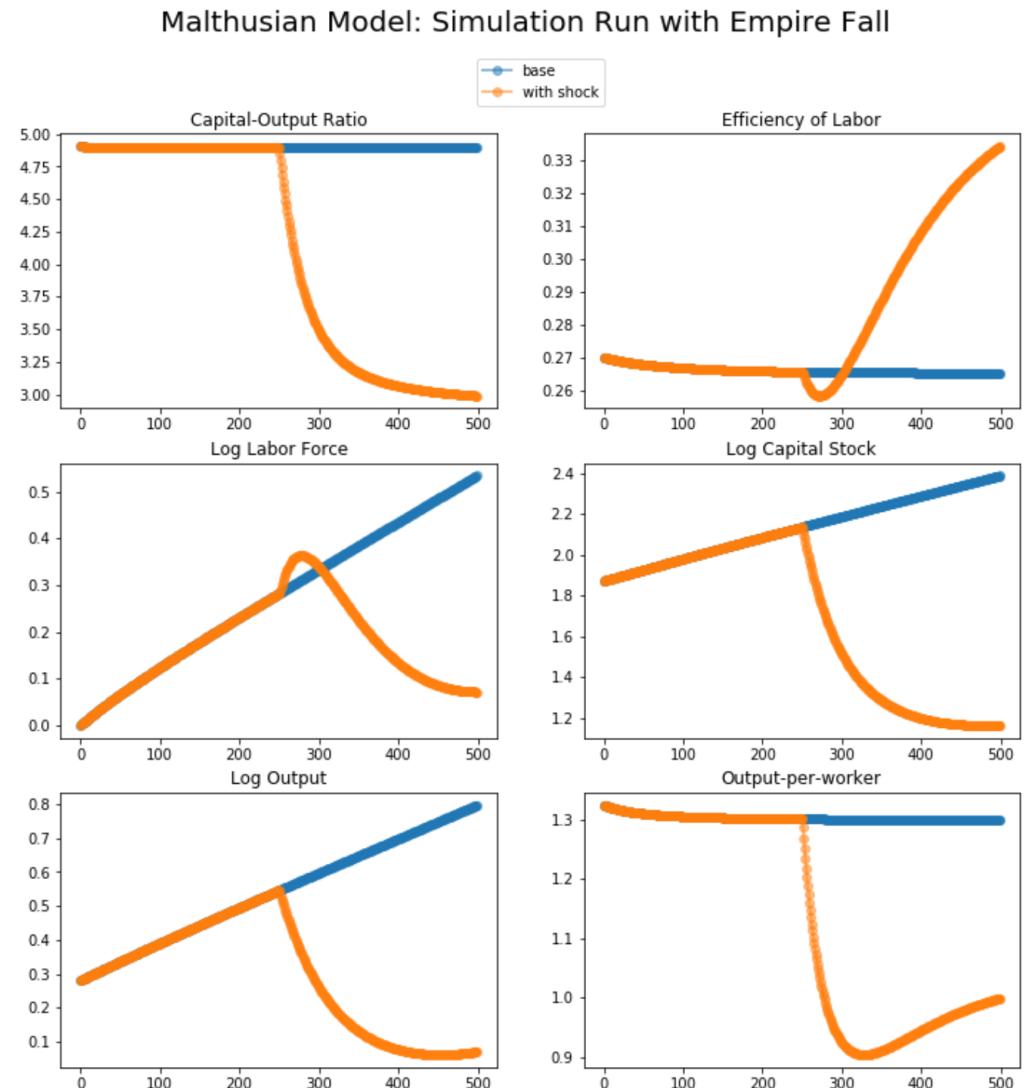
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Steady-State and Along the Transition Path

The fall of an empire:

- <https://nbviewer.jupyter.org/github/braddejong/LS2019/blob/master/2019-10-14-Ancient_Economies.ipynb>

- A decline in inequality, taste for luxuries, and taste for urban living:
 $\Delta\varphi = -0.25$
- A decline in law-and-order that produces a sharp fall in the savings rate: $\Delta s = -0.10$



Review: Determinants of Technological and Organizational Progress

How do we make sense of the fact that technological and organizational progress was so slow back then and is so (relatively) rapid now?

- Two heads are (almost) better than one
 - But that does not quite work
- Add in additional drag from first picking low-hanging fruit
- What causes the increase in L_{stem} ?
- What institutions make it profitable for n_{stem} to be higher?
- Plus:
 - Learning by doing
 - Productivity through embodiment
 - Technology transfer through contact

$$\frac{dp}{dt} = \frac{\pi p^2}{1-\alpha}$$

$$\frac{dH/dt}{H} = \delta L_{stem}^\lambda H^{\phi-1}$$

$$h^* = \frac{\lambda n}{1-\phi}$$

$$H^* = \left(\frac{\delta(1-\phi)}{\lambda} \right)^{1/(1-\phi)} \left(\frac{1}{n} \right)^{1/(1-\phi)} L_{stem}^{\lambda/(1-\phi)}$$

Review: Class and Conflict: at the End of the Middle Ages, Elsewhere, and Elsewhere

What was “feudalism” and how did it end?

- Marc Bloch’s definitions:
 - A subject peasantry
 - Widespread use of the service tenement (i.e., the fief) instead of a salary (or of private property plus taxation and then purchase)
 - The supremacy of a caste of specialized warriors
 - Ties of obedience and protection which bind man to man
 - Within the warrior class, these ties assume the distinctive form called vassalage
 - Fragmentation of authority
 - Disorder and private war
 - But also, other forms of association, family, and state surviving...
- By the late Middle Ages feudalism was a stable system
- Trade and population expanded
- What data we have shows the number and size of cities increasing



The Population of England

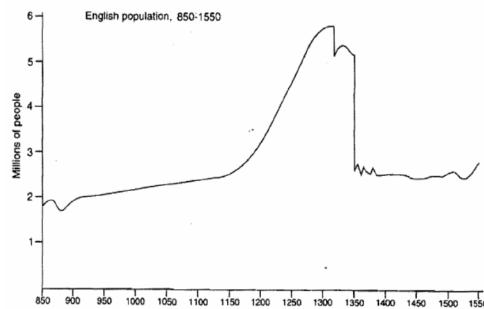


Figure 2. English population, 850-1550. A speculative reconstruction. The figures from 850 to 1086 are pure speculation. The subsequent figures are based on Domesday (1086), the Poll Tax (1377), the subsidies (1324-5) and the military survey (1322), and by extrapolation from manorial records of tenant deaths and payments of headpennies and common fines.

Sources: J. Hatcher, *Plague, Population and the English Economy, 1348-1550* (1977); R. M. Smith, 'Human Resources', in G. Astill and A. Grant (eds), *The Countryside of Medieval England* (Oxford, 1988); E. A. Wrigley and R. S. Schofield, *The Population History of England*,

Source: Dyer, Christopher (2002) *Making a Living in the Middle Ages*, Yale University Press. p. 235.

English Wool and Cloth Exports

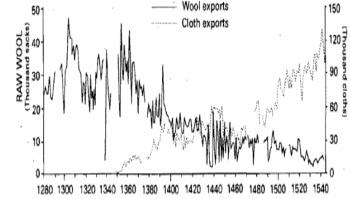


Figure 4. English exports of wool and cloth, 1279-1540 (cloth exports are only consistently recorded from the mid-fourteenth century).

Sources: E. M. Carus-Wilson and C. Colenou, *England's Export Trade 1275-1547* (Oxford, 1963); E. M. Carus-Wilson, *Medieval Merchant Ventures* (1954).

Source: Dyer, Christopher (2002) *Making a Living in the Middle Ages*, Yale University Press. p. 244.

A Four-Cornered Fight

Kings, Lords, Commons, & Peasants:

- Class alliances, class power, and class conflict...
- Plus ideological legitimations...
- Friedrich Engels: “Exceptional periods, however, occur when the warring classes are so nearly equal in forces that the state power, as apparent mediator, acquires for the moment a certain independence in relation to both. This applies to the absolute monarchy of the seventeenth and eighteenth centuries, which balances the nobility and the bourgeoisie against one another; and to the Bonapartism of the First and particularly of the Second French Empire, which played off the proletariat against the bourgeoisie and the bourgeoisie against the proletariat. The latest achievement in this line, in which ruler and ruled look equally comic, is the new German Empire of the Bismarckian nation; here the capitalists and the workers are balanced against one another and both of them fleeced for the benefit of the decayed Prussian cabbage Junker-squires...”
- This is not just in exceptional periods...
- The relative autonomy of the state is the rule, not the exception...

Review: Malthusian Models and Reality

$$\frac{dE/dt}{E} = \frac{d \ln(E)}{dt} = g = h - \frac{n}{\gamma}$$

$$\frac{dL/dt}{L} = \frac{d \ln(L)}{dt} = n = \beta \left(\frac{y}{\phi y^{sub}} - 1 \right)$$

$$y^{*mal} = \kappa^* E = \left(\frac{s}{n+g+\delta} \right) E$$

$$L_t^{*mal} = \left[\left(\frac{H_t}{y^{sub}} \right) \left(\frac{s}{\delta} \right)^\theta \left(\frac{1}{\phi} \right) \left[\frac{1}{(1+\gamma h/\delta)^\theta} \frac{1}{(1+\gamma h/\beta)} \right] \right]^\gamma$$

The diagram illustrates the factors influencing the Malthusian equilibrium population L_t^{*mal} . Red arrows point from various text labels to specific components of the equation:

- The ratio of knowledge to subsistence income points to $\left(\frac{H_t}{y^{sub}} \right)$.
- The salience of capital in determining productivity points to $\left(\frac{1}{(1+\gamma h/\delta)^\theta} \right)$.
- The extent to which population depresses productivity points to $\left(\frac{1}{(1+\gamma h/\beta)} \right)$.
- Nuisance terms points to $\left(\frac{1}{\phi} \right)$.
- The inverse of the taste for luxury points to $\left(\frac{s}{\delta} \right)^\theta$.
- The ratio of savings to depreciation points to $\left(\frac{s}{\delta} \right)^\theta$.
- The Malthusian equilibrium population points to L_t^{*mal} .

$$y^{*mal} = \phi y^{sub} \left(1 + \frac{n^{*mal}}{\beta} \right) = \phi y^{sub} \left(1 + \frac{\gamma h}{\beta} \right)$$

The diagram illustrates the factors influencing the Malthusian equilibrium income level y^{*mal} . Red arrows point from various text labels to specific components of the equation:

- Malthusian equilibrium income level points to y^{*mal} .
- Sensitivity of productivity to population points to $\left(1 + \frac{\gamma h}{\beta} \right)$.
- Rate of useful ideas creation points to $\left(1 + \frac{\gamma h}{\beta} \right)$.
- True zpg subsistence points to ϕy^{sub} .
- Taste for luxuries points to n^{*mal} .
- Responsiveness of population growth to prosperity points to $\left(1 + \frac{\gamma h}{\beta} \right)$.

Eastern Europe and the “Second Serfdom”

Eastern Europe after 1348:

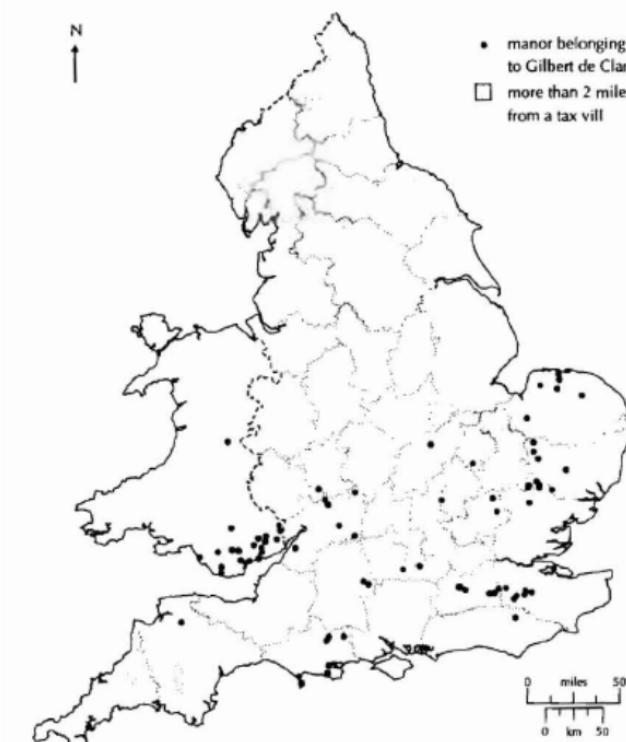
- The plague seems to have hit most of Europe, and the percentage of people killed was similar across space.
- After the plague, landlords in Eastern Europe started to take over large tracts of land and expand their holdings, which were already larger than those in Western Europe.
- Towns were weaker and less populous and rather than becoming freer, workers began to see their already existing freedoms encroached on: the Domar hypothesis at work.
- This contrasts with the English case, and with Western Europe more generally.
- This phenomenon is known as the Second Serfdom, to distinguish it from the original serfdom which had happened in the early Middle Ages.
- The effects became especially pronounced after 1500, when Western Europe began to demand the agricultural goods which the East produced such as wheat, rye and livestock.
- 80 percent of the imports of rye into Amsterdam came east from the Elbe, Vistula and Oder river valleys. Soon half of the Netherlands' booming trade was with Eastern Europe.
- Eastern landlords ratcheted up their control over the labor force to expand their production.
- The historical literature emphasizes that the Second Serfdom was distinct and more intense than the original
- Lords increased the taxes they levied on their tenants. In Mecklenberg in Eastern Germany in 1500, peasants owed only a few days unpaid labor services a year to landowners. By 1550 this was one day a week and by 1600 three days per week. Workers' children had to work for the lord for free for several years.
- In Hungary, landlords legislated one day a week of unpaid labor services for each worker. In 1550 this was raised to 2 days per week. By the end of the century it was 3 days. Serfs subject to these rules made up 90% of the rural population by this time.

Feudal Power and Lordly Competition in England After the Black Death

What kept English lords from being able to keep a lid on wages post-1348?

- What was it that allowed the Spanish settlers in Mexico to keep wages so low, when in England after the Black Death the state had been incapable of enforcing the Statute of Laborers and stopping wages from rising?
- The economic historian Bruce Campbell has proposed that this may have been because of the differential organization of landholdings in Britain, which increased competition between landowners for workers after the Black Death.
- After invading England, William the Conqueror rewarded his army by providing them with feudal landholdings.
- In an effort to prevent these nobles from becoming powerful regional warlords who could challenge the king's power, each noble received landholdings scattered across the country
- (The exception was along the Scottish and Welsh borders), where nobles were given large plots for defensive purposes
- This division of landholdings meant that in a given region, there were many landholders in close proximity.
- This created intense competitive pressures for labor, particularly in the wake of the Black Death
- This contrasts to Mexico, where conquistadors were granted vast contiguous tracts of land called encomiendas

The Manors of Lord Gilbert de Clare (1314)



(a) Estate of Gilbert de Clare, earl of Gloucester and Hertford, 1314.

Is Malthus Right? II

At the macro level, yes; but there are lots of interesting meso- and small-scale puzzles:

- In addition, measures of good government, such as proxies for constraints on the executive, are correlated with urbanization in this period.
- For example, DeLong and Shleifer (1993) showed there was a strong correlation between form of government and urbanization in the pre-modern world
 - Charles Wilson (1967): *Trade, Society, and the State*: "The two areas which in 1500 represented the richest and most advanced concentrations of trade, industry and wealth were the quadrilateral formed by the Italian cities Milan, Venice, Florence and Genoa; and the strip of the Netherlands that ran from Ypres north-east past Ghent and Bruges up to Antwerp. It was not merely coincidence that these were the areas where the tradesmen of the cities had been most successful in emancipating themselves from feudal interference and in keeping at bay the newer threat of more centralized political control offered by the new monarchies. In the fleeting intervals between the storms of politics and war, men here glimpsed the material advance that was possible when tradesmen were left in peace unflattered by the attentions of strategists who regarded their activities as the sinews of war..."

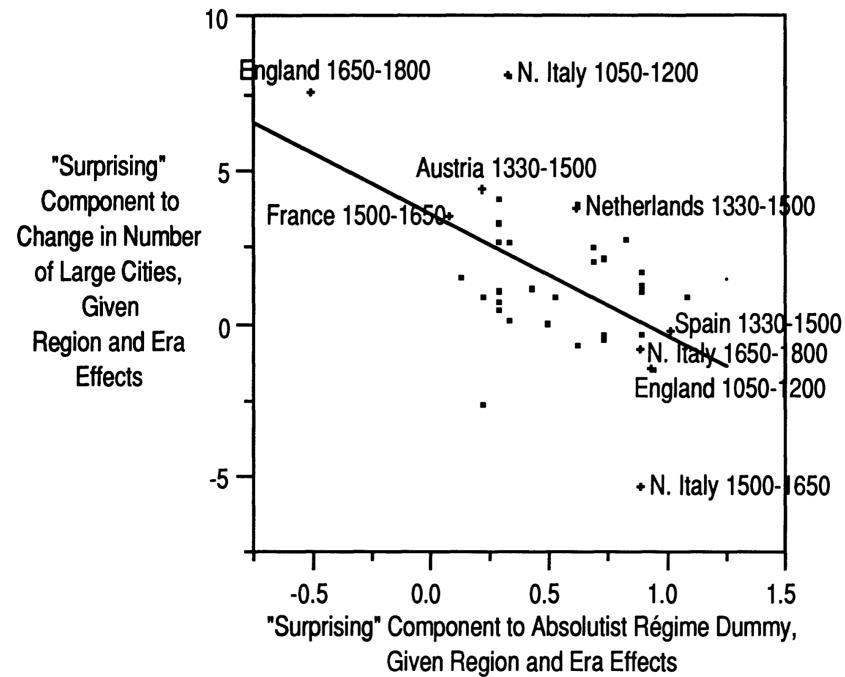


FIGURE 1.—Partial scatter of change in number of cities against absolutist regime

Malthus: Summing Up

On the broadest scale only:

- The simple Malthusian model may indeed capture some realities.
- If labor markets are competitive, population growth may indeed induce a decline in wages.
- Or if there is a fixed amount of land and few opportunities for labor intensive cultivation systems, a population increase may lead to a decline in output per worker.
- However, the reality is typically much more messy.
 - How wages respond to changes in income will depend on *institutions*.
 - Thus the overwhelming likelihood that institutional or cultural factors also shaped pre-modern growth
 - It was not simply being dictated by the Malthusian relationship between births, deaths, and income.

Review: “Subsistence”

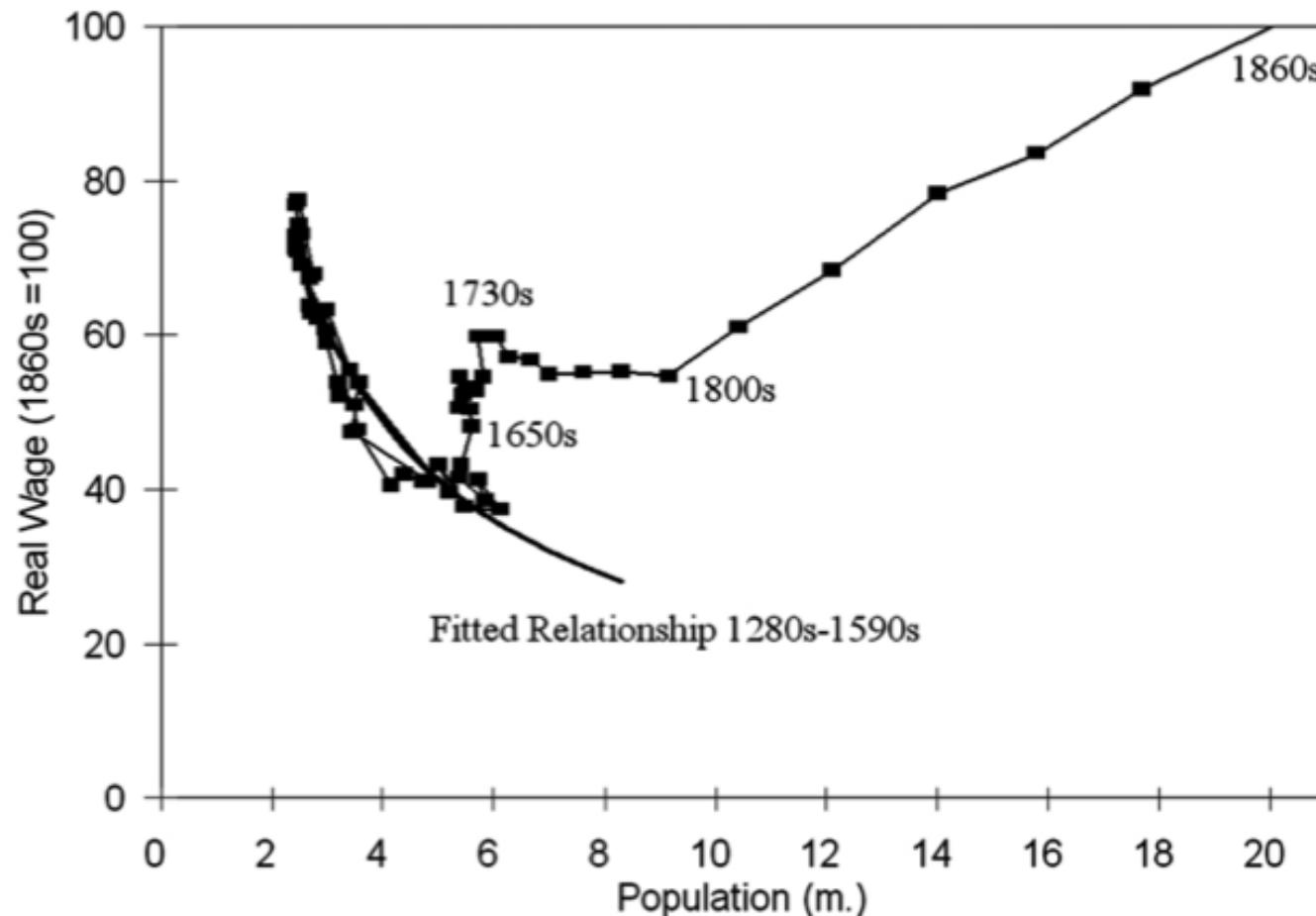


FIG. 5.—Real wages vs. population on the new series, 1280s–1860s. The line summarizing the trade-off between population and real wages for the preindustrial era is fitted using the data from 1260–69 to 1590–99. Sources: population, same as for fig. 3; real wage, table A2.

“Bare-Bones”

Table 2. Bare-bones subsistence basket of goods

	quantity per man per year	calories per day	protein (grams) per day
food			
grain	167 kg	1657	72
beans	20 kg	187	14
meat	5 kg	34	3
butter	3 kg	60	0
total		1938	89
non-food			
soap	1.3 kg		
linen/cotton	3 metres		
candles	1.3 kg		
lamp oil	1.3 litres		
fuel	2.0 Million British Thermal Units		

From Clark & Allen:

- "Manual workers"—70% of median, 50% of average income
- In 1800: the English population in 1800 is a very rich pre-industrial population
- 70% of spending spent on food
 - 30-40% grains
 - 20% meat and dairy
- “Bare-bones” subsistence
- Cities: Malthus rules, but it takes centuries—and other things can and do happen

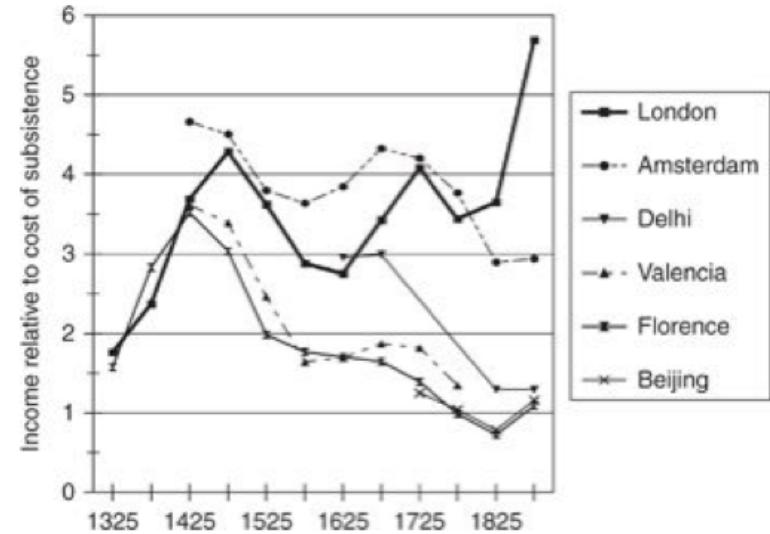


TABLE A3
PERCENTAGE OF EXPENDITURES BY CATEGORY, MANUAL WORKERS, 1734–1854

Category	1734 (Vanderlint)	1787–96 (Horrell)	1840–54 (Horrell)	Assumed Here
Food and drink	54.4	75.4	61.7	67.0
Bread and flour	12.5	17.5	23.5	18.5
Barley	0	3.6	.0	1.0
Oats and oatmeal	0	9.9	1.5	2.0
Peas	0	1.0
Potato	0	6.3	4.0	4.0
Rice	0	.0	.2	.5
Farmaceous	12.5	37.8	29.7	27.0
Meat (beef, mutton, pork)	16.7	11.8	9.8	10.0
Fish	0	.1	.2	.5
Bacon	0	.2	1.8	1.0
Eggs	0	.0	.3	.5
Meat	16.7	12.1	12.1	12.0
Milk	2.1	5.9	2.7	4.0
Cheese	2.1	2.7	1.9	2.5
Butter	4.2	6.2	4.1	5.0
Dairy	8.4	14.8	8.7	11.5
Sugars	..	4.2	4.5	4.5
Beer/cider	12.5	2.8	1.7	6.5
Tea	0	3.4	2.2	2.5
Coffee	0	.0	1.0	1.0
Drink	12.5	6.2	4.9	10.0
Salt	1.0
Spices (pepper/vinegar)	1.0
Other food	4.2	.6	2.1	.0
Housing/housewares	7.2	5.3	10.9	8.0
Fuel	5.6	4.4	4.8	5.0
Light	2.1	4.0
Soap	2.15
Light and soap	4.2	3.8	5.2	4.5
Services	8.2	.1	2.5	2.5
Tobacco	0	.0	.7	1.0
Other (clothing, bed linen)	20.5	11.0	14.2	12.0

Source.—Vanderlint (1734, 76–77), Horrell (1996, 568–69, 577).

Note.—The boldface entries are the sums for each major category of food, such as farmaceous or meat. These groupings of items are the ones whose price levels are reported in table A4.