

# Lecture 8:

## 3.1. Commercial Revolutions

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last revised: 2020-02-06

for presentation: 2020-02-13

Original course by Melissa Dell (Harvard Econ 1342), revised by Brad DeLong, research assistance by Anish Biligiri

# Roadmap for the Next Week

## 8. Commercial Revolutions (Feb 18):

- **Read:** Christopher Berry (2018): *Adam Smith: A Very Short Introduction*, chs. 1, 4-6 <<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>>

## 9. Industrial Revolutions I (Feb 20):

- **Read Before:** Robert Allen (2017): *The Industrial Revolution: A Very Short Introduction*, chs. 3, 5-6 <<https://delong.typepad.com/files/allen-industrial.pdf>>
- **Slides:** <<https://github.com;braddelong/public-files/blob/master/econ-135-lecture-9.pptx>>
- **Start:** Assignment 6: slow technological and organizational progress before 1500 paper; due Mar 1

## 10. Exam (Feb 25):

- **Instructor Reality Check**
- 60% short answers; 40% essay

## 11. Industrial Revolutions II (Feb 27):

- **Read Before:** Joel Mokyr (1990): Lever of Riches, chapter 5 “The Years of Miracles” <<https://delong.typepad.com/files/mokyr-lever-revolution.pdf>>
- **Read Before:** Karl Marx and Friedrich Engels (1848): The Communist Manifesto <<https://www.marxists.org/archive/marx/works/download/pdf/Manifesto.pdf>>
- **Finish:** Assignment 6: slow technological and organizational progress before 1500 paper; due Mar 1

# Preview of This Lecture

## 8. Commercial Revolutions (Feb 18):

- Administration
- Exploration and Conquest
- Review: ??
- Growth and Political Economy
- Adam Smith as Observer of the Growth Process
- Discussion
- Takeaways
- Preview of Next Lecture

# Administration

## Midterm Next Tuesday

- Instructor reality check...
- 60% 12 short-answer questions
- 40% essay
  - 60 sample short-answer questions: <[https://bcourses.berkeley.edu/courses/1487685/discussion\\_topics/5685922](https://bcourses.berkeley.edu/courses/1487685/discussion_topics/5685922)>
  - 30 sample questions and answers: <[https://bcourses.berkeley.edu/courses/1487685/discussion\\_topics/5687341](https://bcourses.berkeley.edu/courses/1487685/discussion_topics/5687341)>

## Assignment 5: DATA SCIENCE!!

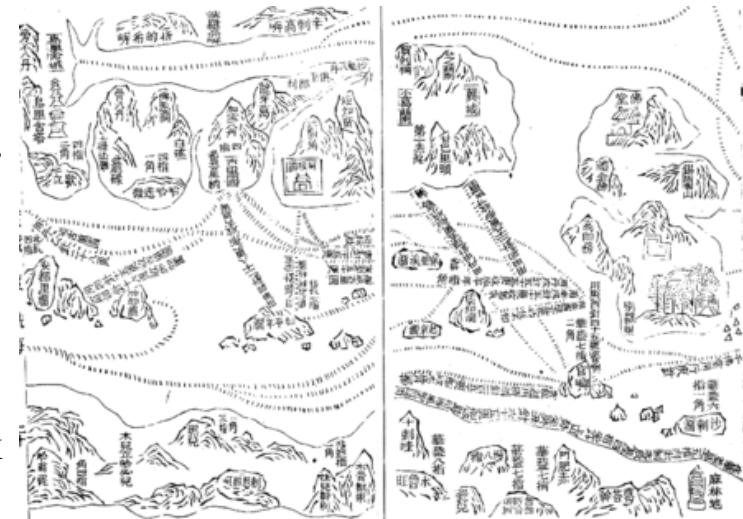
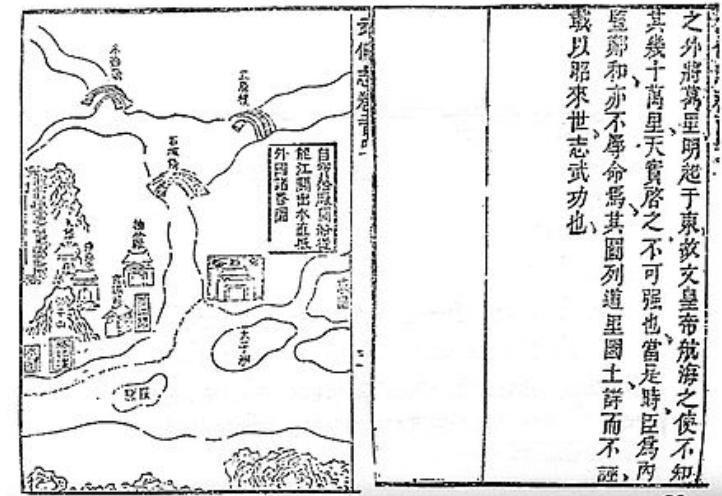
- Simulations with the Solow Model: <<https://bcourses.berkeley.edu/courses/1487685/assignments/8065916>>
  - Is this useful in understanding what is going on with the model?
  - Is this useful in understanding what is going on with the economy?
  - Is this useful in building tools that will be useful later on?

# Commercial Revolutions I

## Exploration and Conquest and Market

### Extension:

- **Zheng He:** 1405-33: 7 expeditions—300 ships ??, 30,000 crew??, as far as Malindi. 400 feet long??:
  - “We have traversed more than 100,000 li of immense water spaces and have beheld in the ocean huge waves like mountains rising in the sky, and we have set eyes on barbarian regions far away hidden in a blue transparency of light vapors, while our sails, loftily unfurled like clouds day and night, continued their course [as rapidly] as a star, traversing those savage waves as if we were treading a public thoroughfare...”, quoted in Louise Levathes (1996): *When China Ruled the Seas: The Treasure Fleet of the Dragon Throne, 1405–1433*
- **Bartolomeu Dias:** 1487-8: 3 ships, rounded the Cape of Good Hope at the southern tip of Africa. 80 feet long, 30 men/ship
- **Cristoforo Colombo:** 1492: 3 ships, 90 men.
- **Vasco da Gama:** 1498: 4 ships, 170 men to India and back



# Resources! And Political Economy!

## The Columbian Exchange

- Corn, the potato, chocolate, &c.: substantial boost to calories
- Benefits everywhere!
- But one-sided: Europe gains empire and resources wherever its ships can sail and cannon can shoot
- Sugar islands and the slave trade
  - 400 calories per Briton per day by 1750?
  - The underdevelopment of Africa
    - 12.5 million Atlantic African slave trade
    - (2 million Mediterranean, 4 million Black Sea, 1 million Viking, 17 million Indian Ocean, 30 million Graeco-Roman)

## The East Indies

- Spices—later silks, porcelain, cottons: 80% fall in real price
- Benefits everywhere
  - But benefits one-sided: disassembling a mountain of silver in Peru in order to import luxuries from China, India, Malaysia, and Indonesia...

## Political Economy

- The merchants of Bristol, the nabobs, the King of Spain: New wealth to add in to the scales...
- Inflation

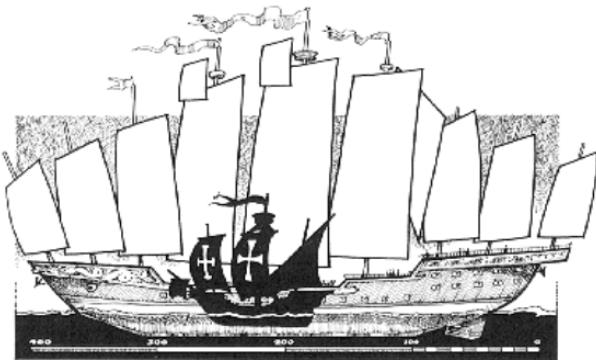
## “The Advanced West”

Date	Rate of Population and Labor Force Growth n	Rate of Efficiency-of-Labor Growth g	Increasing Resources p	Rate of Ideas-Stock Growth h
0	0.092%	0.000%	0.000%	0.046%
800	0.059%	0.000%	0.000%	0.029%
1500	0.163%	0.015%	0.000%	0.096%
1770	0.407%	0.125%	0.257%	0.200%
1870	0.847%	0.693%	0.405%	0.914%
2020	1.013%	1.922%	0.175%	2.341%

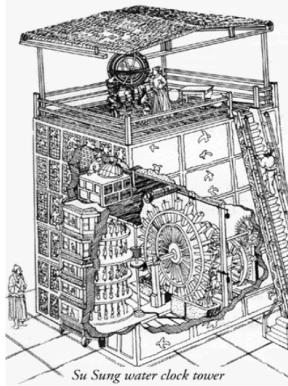
## The World

Date	Rate of Population and Labor Force Growth n	Rate of Efficiency-of-Labor Growth g	Rate of Ideas-Stock Growth h
0	0.122%	0.000%	0.061%
800	0.071%	0.000%	0.035%
1500	0.073%	0.000%	0.036%
1770	0.150%	0.074%	0.149%
1870	0.550%	0.167%	0.442%
2020	1.177%	1.473%	2.061%
2100	0.211%	1.894%	2.000%

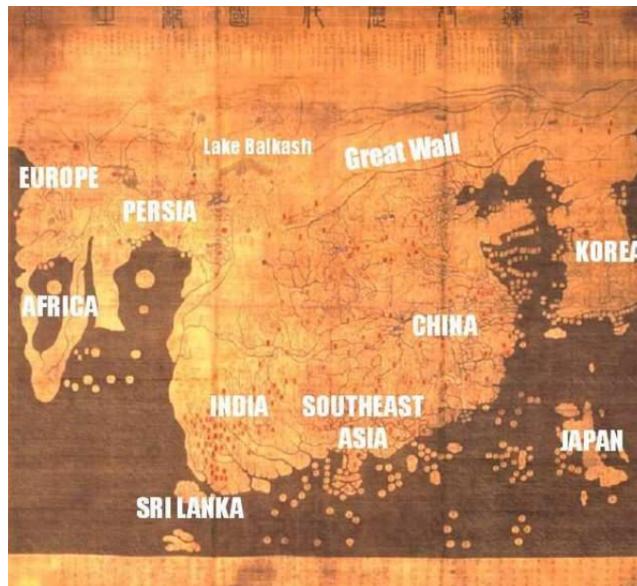
# The Early Modern Centrality of Sung, Yuan, Ming China



So Sung Water Clock from 1086 AD



"Chinese water clocks ... far exceeded in mechanical complexity, mastery of materials  
And mechanism, and accuracy of measurements anything that Europe had to offer circa 1100AD"  
Joel Mokyr (1990, p. 215).



- ▶ Mokyr (1990, Chapter 9) lists many of the ways in which China was more technologically advanced than Europe.
- ▶ Paper and paper money (1,000 years before Europe), printing, gunpowder were all invented first in China. The compass was invented in 960AD (In Europe it was not until about 1300 that a proper compass emerged). Blast furnaces and casting of iron dates to 200BC but arrived in Europe in the late 14th century. The spinning wheel arrived at about the same time in the 13th century.

# Pre-Industrial Innovations

Church building on the decline

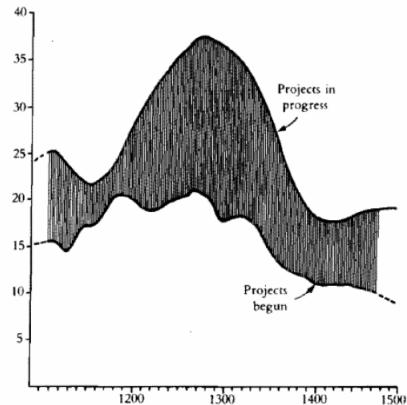


Fig. 3 Chronology of building major churches, 1100–1500

The lower curve (Projects begun) represents the average trend of major building projects begun at cathedrals and abbeys, by decade, based on a sample of eighty buildings. The upper curve represents the average trend of building projects in progress in each decade, based on a sample of forty buildings.

Source: Taken from R. Morris, *Cathedrals and abbeys of England and Wales* (London, 1979), p. 180



Source: Cipolla, Carlo M. (1993) *Before the Industrial Revolution*, 3rd Edition, New York: W.W. Norton & Co. p. 149.

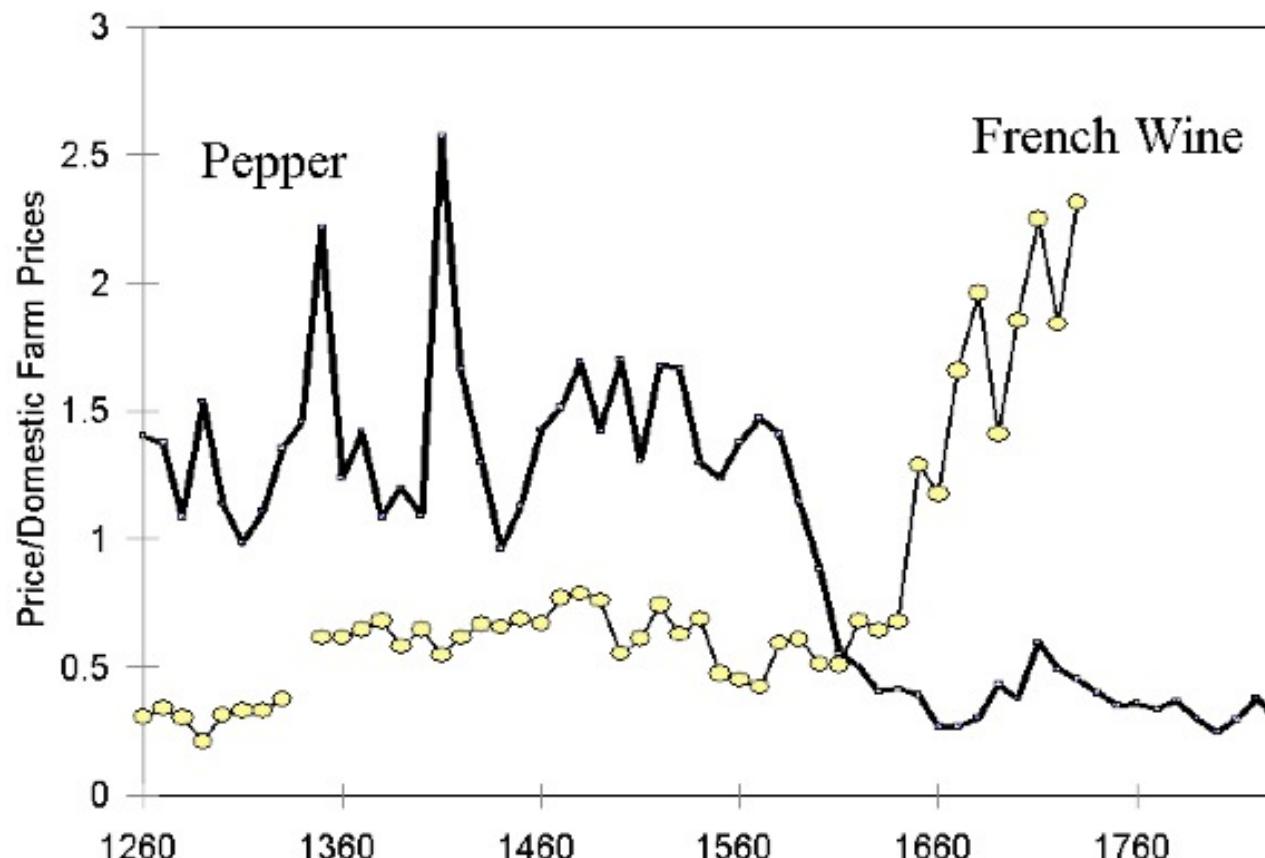
## TECHNOLOGY

Table 6.1 Emergence of new industrial applications of the vertical water wheel to c. 1550

Type of mill	Date of first occurrence	Location
Beer	861	N.W. France
Hemp	990	S.E. France
Fulling	962	Italy
	820?	Switzerland?
Iron	1025?	S. Germany
	1197	S. Sweden
Oil	c. 1100	S.E. France
Ore-stamping	1135	N. Italy
Tanning	1138	N.W. France
Sugar	1176?	Sicily?
Cutlery (grinding and polishing)	1204	N.W. France
Saw	1204	N.W. France
Mechanical bellows	1214	Styria
Mustard	c. 1250	S.E. France
Poppy	1251	N.W. France
Paper	1276	N. Italy
Mine-pumping (chain type)	1315	Moravia
Mortar	1321	S. Germany
Turning (lathes)	1347	S.E. France
Pigment (paint)	1348	N.W. France
Blast furnace	1384	Belgium
Pipe-boring	c. 1480	S. Germany
Rolling and slitting	1443	Cent. France
Wire	1351?	S. Germany
	1489	S. Germany
Gem-polishing	1534	N.W. France

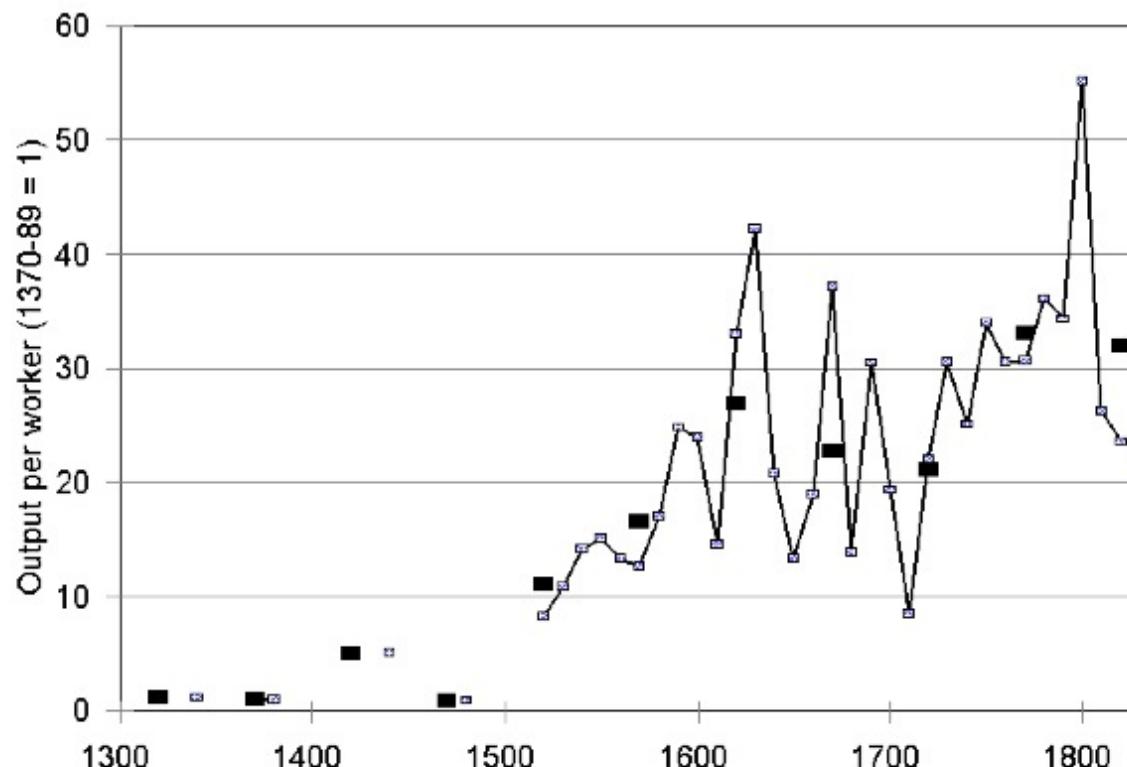
# Clark, “The Secret History of the Industrial Revolution”

**Figure 17: The Prices of Pepper and French Wine relative to Domestic Farm Products**



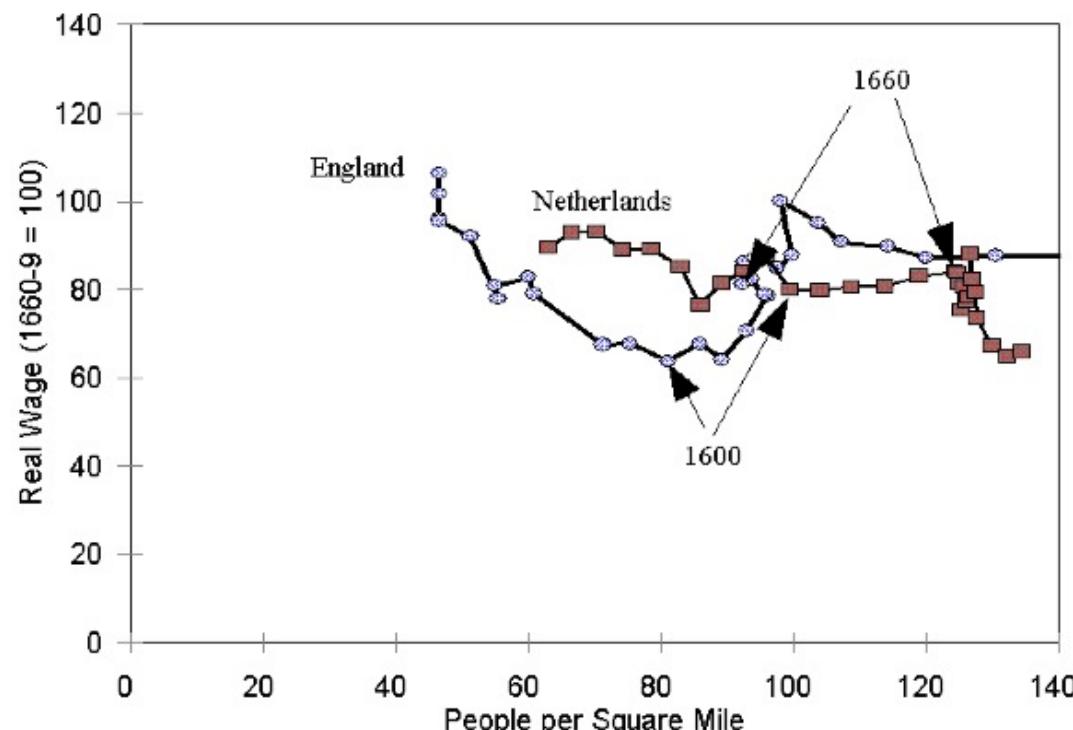
# Clark, “The Secret History of the Industrial Revolution”

Figure 16: Output per worker in printing, 1340-1839

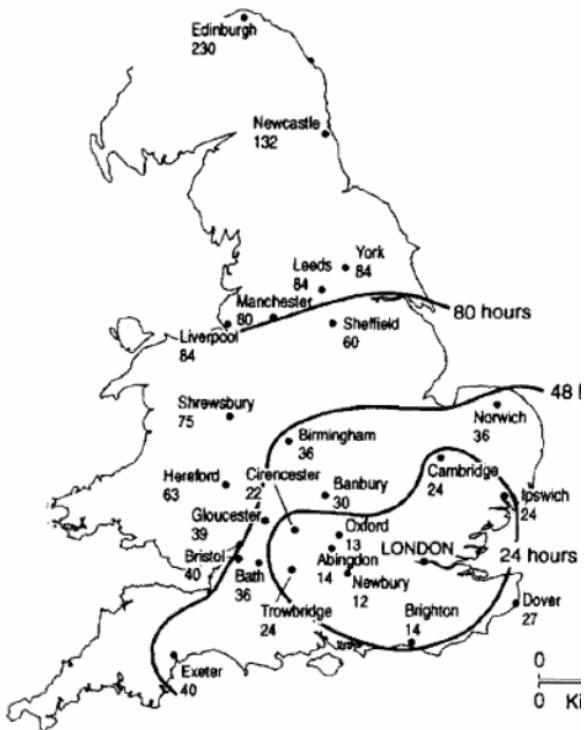


# Clark, “The Secret History of the Industrial Revolution”

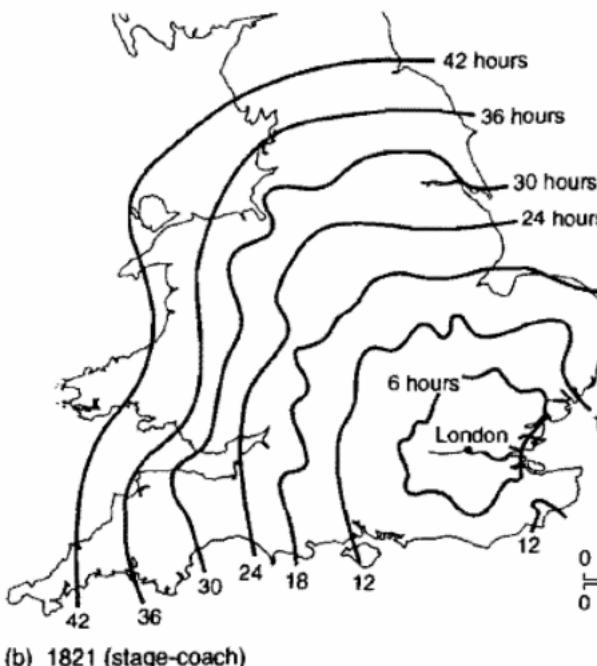
Figure 18: Wages versus Population, England and the Netherlands, 1500-1789



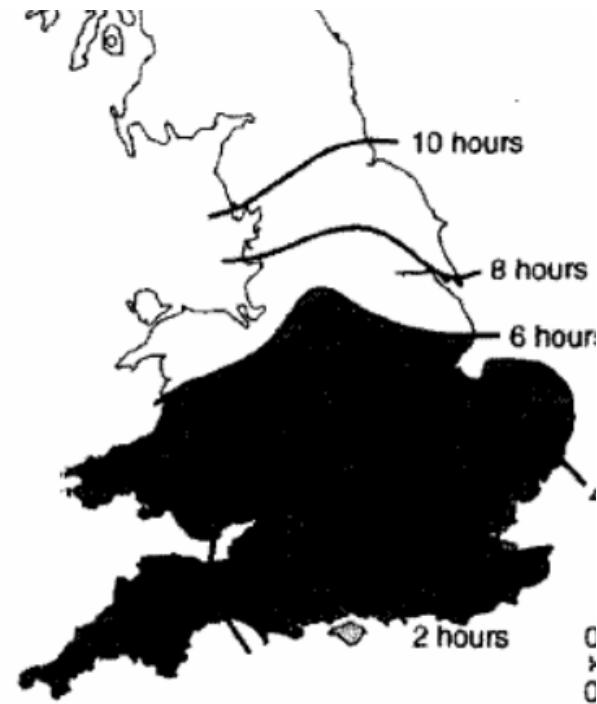
# Travel Time



(a) 1750 (stage-coach)



(b) 1821 (stage-coach)



(c) 1845 Railway travel

# Review: What Should We Review Today?

## A number of possibilities:

- Essay...
  - Practice:
  - Fair:
- The grand overview of the history of economic growth
- Models:
  - The Solow growth model
  - Malthusian forces
  - “Two heads (almost) twice as good as one” & “low-hanging fruit is picked first” & “institutions matter a lot”
- Malthusian economics
  - & “class power”
- Measuring prosperity relative to “subsistence”
- Ancient empires (& their rise & fall)

# Commercial Revolutions II

## Growth and Political Economy:

- 1500 more years of invention...
- Gunpowder empires:
  - Late medieval warfare is rock-paper-scissors: castles, knights, footmen, archers, horse-archers | dense forests, open forest, steppe, oases
  - Early firearms are no use against horse-archers—or camel-archers
  - Early firearms are a lot of use as a substitute for crossbows or longbows
  - Early cannon are a lot of use against castles
- Feudal lords can no longer stand against drilled national armies
  - A new game of rock-paper-scissors: musket-pike-cavalry-trace italienne
  - England and parcellized sovereignty
  - France and major lords
  - Germany and the role of Sicily and the Pope
- Bureaucrats, taxes, and absolutist monarchs

# The Peculiarity of England

- ▶ Following the collapse of feudalism in Western Europe, political power re-centralized.
- ▶ The decline of serfdom and feudalism weakened the lords relative to the king, who centralized power.
- ▶ In England this happened significantly during the Tudor Dynasty, which came to power in 1485 after a long civil war called the Wars of the Roses. This was a conflict between the House of York and the House of Lancaster. It was elites fighting over who was going to extract rents from the population.
- ▶ Soon the nature of political conflict began to change in England.

# The Development of the English State

- ▶ The first two Tudor Kings Henry VII and Henry VIII made fundamental changes to the state.
- ▶ Henry VIII via Thomas Cromwell, his chief minister between 1532 and 1540, engineered what Geoffrey Elton called the 'Tudor Revolution of Government.'
- ▶ Until the early 16th Century there was little distinction between the King's household and the executive, between the King's resources and that of the state. Cromwell gave the King's household specific well defined tasks and separated key departments which became nascent bureaucratic institutions. He formed the key Privy Council, the members of which were members of a national institution, not personal companions of the reigning monarch.

# Establishing an Effective Monopoly of Violence: Wars of the Roses

- ▶ The War of the Roses, a civil war between the House of York and the House of Lancaster, ended when King Richard III was defeated and killed at the Battle of Bosworth 22 August, 1485.
- ▶ Henry Tudor was crowned Henry VII.
- ▶ Richard's army: The Duke of Norfolk had around 3,000 spearmen and archers on the right flank, protecting the cannon. Richard's group, comprising 3,000 infantry, formed the centre. The Earl of Northumberland's 4,000 men guarded the left flank. The Stanleys 6,000 men were on Dadlington Hill.
- ▶ What happened?

# Establishing an Effective Monopoly of Violence: Implications of the Treason of the Stanleys

- ▶ **Conclusion:** Richard III did not have a monopoly of violence.
- ▶ In fact the War of the Roses came at the end of a long period of 'bastard feudalism' which had seen the central state become weaker while the armed lords became more powerful.

*"Government at the center relinquished the reins, and the institutions of law and order fell under the sway of overly-powerful individuals with armed men at their backs. The famous evils of this time were all the result of this. Livery (the equipping of armed retainers with their lords' uniform and badge to signify their sole allegiance), maintenance (the lord's support for his followers in courts of law) . . . embracery (the corruption and intimidation of judges)." (Elton (1991, p. 6)*

# Marcher Lords: Warwick the Kingmaker

- **Adam Smith:** “The great Earl of Warwick is said to have entertained every day, at his different manors, 30,000 people; and though the number here may have been exaggerated, it must, however, have been very great to admit of such exaggeration. A hospitality nearly of the same kind was exercised not many years ago in many different parts of the Highlands of Scotland...

# Establishing an Effective Monopoly of Violence: Elimination of Livery

- ▶ The project to eliminate 'liveried retainers' was not new. Henry IV and Edward IV had passed legislation to restrict the distribution of livery and the retaining of followers but these measures were not enforced.
- ▶ Henry VII's strategy was more subtle. Rather than initially banning livery, a statute of 1504 stated that it had to be licensed by the king. Henry wanted to first gain control over armed retainers, indeed he had relied on them to keep order and his throne early in his reign.
- ▶ Nevertheless, he set a path towards a much stronger monopoly on violence and by 1558 liveried retainers were incorporated into the local militias under the control of the centrally appointed lord lieutenants.
- ▶ This was a critical phase in the establishment of a monopoly of violence by the central state.

# Dissolution of the Monasteries and English Social Order

- ▶ Henry VIII broke with the Roman Catholic Church and expropriated the land of the Church.
- ▶ This made the state stronger and it had a fundamental impact on the social structure.

Table v *Distribution of landownership in England: percentages of cultivated land owned*

	Mid 15th century (1436)	Late 17th century (1688)	
Aristocracy and gentry } Great magnates	15–20	15–20	
	Middling and lesser gentry	25	45–50
Yeomen, family farmers and other small owners	20	25–33	
Church }	25–35	5–10	
Crown }			

Sources: Mingay, 1976, p. 50. Cooper, 1967.

The English Social Hierarchy in 1688 according to Gregory King, take from D.C. Coleman (1977) *The Economy of England 1450-1750*, OUP.

TABLE I  
*Gregory King's estimate of population and wealth, England and Wales, 1688*

Number of families	Ranks, Degrees, Titles, and Qualifications	Heads per family	Number of persons	Yearly income per family
160	Temporal Lords	40	6400	2800
26	Spiritual Lords	20	520	1000
800	Baronets	16	12800	880
600	Knights	13	7800	650
300	Esquires	10	30000	450
12,000	Gentlemen	8	96000	280
5000	Persons in Offices	8	40000	240
5000	Persons in Offices	6	30000	120
2000	Merchants and Traders by Sea	8	16000	400
8000	Merchants and Traders by Sea*	6	48000	200
10,000	Persons in the Law	7	70000	140
2000	Clergymen	6	12000	60
800	Clergymen	5	40000	45
40,000	Freeholders	7	280000	84
140,000	Freeholders	5	700000	50
150,000	Farmers	5	750000	44
16,000	Persons in Sciences and Liberal Arts	5	180000	60
40,000	Shopkeepers and Tradesmen	4½	240000	45
60,000	Artisans and Handicrafts	4	240000	40
5000	Naval Officers	4	20000	80
4000	Military Officers	4	16000	60
511,586		5½	2675520	67
50,000	Common Seamen	3	150000	20
364,000	Labouring People and Out Servants	3½	275000	15
400,000	Cottagers and Paupers	3½	300000	6·5
35,000	Common Soldiers	2	70000	14
849,000		3½	2795000	10·5
	Vagrants		30000	
849,000		3½	2825000	10·5
511,586	Increasing the Wealth of the Kingdom	5½	2675520	67
849,000	Decreasing the Wealth of the Kingdom	3½	2825000	10·5
1,360,586		5	500520	

Source: *Two Tracts by Gregory King*, ed. G. E. Barnett (Baltimore, 1936).

# 1348 and All That...

- Stephen Broadberry (2013): “Accounting for the Great Divergence” <http://tinyurl.com/dl20140114a>

**TABLE 4: GDP per capita levels in Europe and Asia (1990 international dollars)**

	England/ GB	Holland/ NL	Italy	Japan	China	India
730				483		
900				534		
980					1,328	
1086		754			1,244	
1120					962	
1150				603		
1280	679			560		
1300	755		1,482			
1400	1,090	1,245	1,601		948	
1450	1,055	1,432	1,668	554	946	
1500	1,114	1,483	1,403		909	
1570	1,143	1,783	1,337		898	
1600	1,123	2,372	1,244	791	852	682
1650	<u>1,110</u>	2,171	1,271	838		638
1700	1,563	1,403	1,350	879	843	622
1750	1,710	<u>2,440</u>	1,403	818	737	573
1800	2,080	1,752	1,244	876	639	569
1850	2,997	2,397	1,350	933	600	556

**TABLE 7: Female age of first marriage**

	Period	Range	Unweighted average
England	1600-1849	23.4 to 26.5	25.4
Japan	1680-1860	18.8 to 24.6	22.1
China	1550-1931	17.2 to 20.7	18.6
India	1911-1931	12.9 to 13.3	13.0

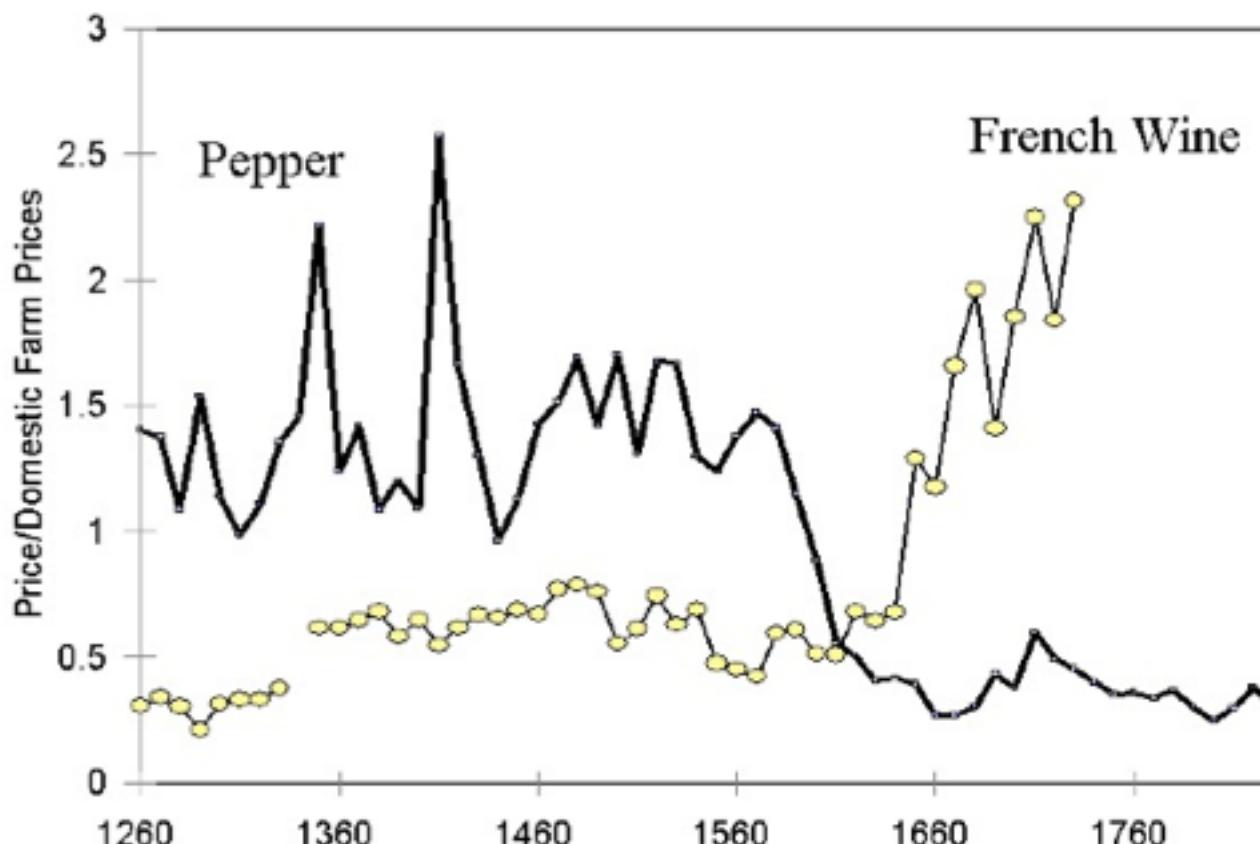
**TABLE 6: Annual days worked per person in England**

	Period	Blanchard/Allen and Weisdorf	Clark and van der Werf	Voth
	1433	165		
	1536	180		
	1560-1599		257	
	1578	260		
	1584	210		
	1598	259		
	1600-1649		266	
	1650-1699		276	
	1685		312	
	1700-1732		286	
	1733-1736		295	
	1760			258
	1771		280	
	1800			333
	1830			336
	1867-1869		293-311	
	1870		318	

# Transport!

- Gregory Clark (2001), “The Secret History of the Industrial Revolution”

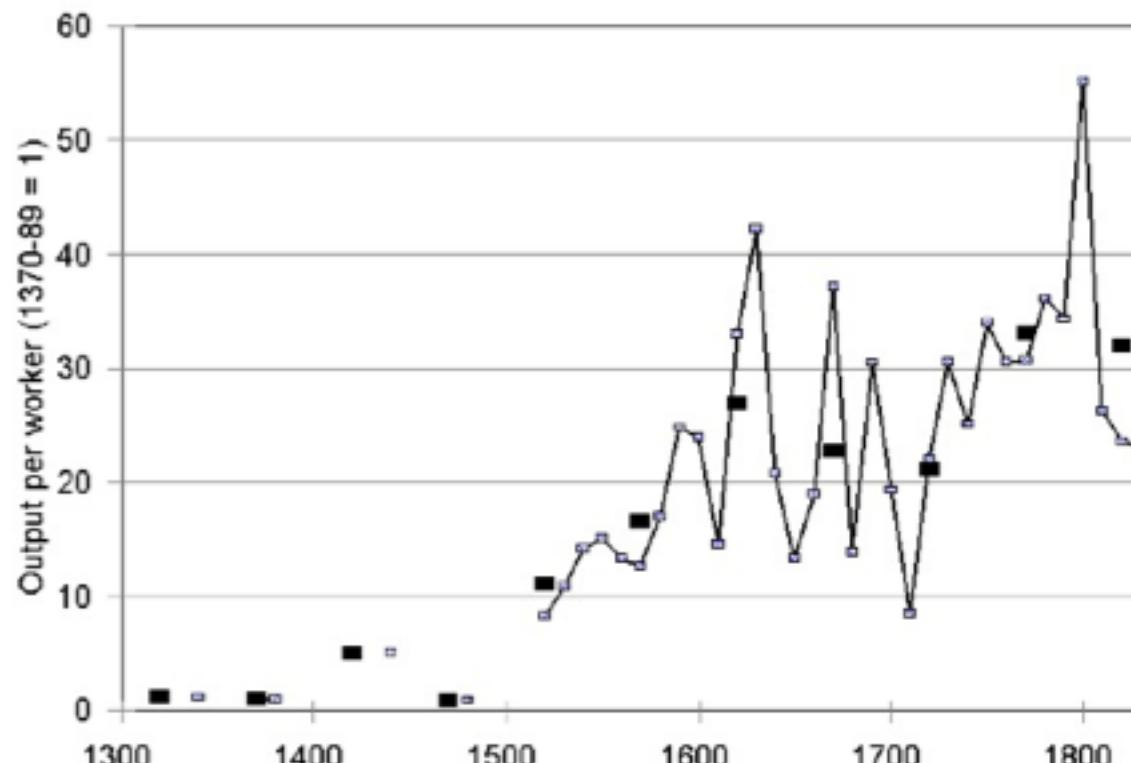
**Figure 17: The Prices of Pepper and French Wine relative to Domestic Farm Products**



# Printing!

- Gregory Clark (2001), “The Secret History of the Industrial Revolution”

**Figure 16: Output per worker in printing, 1340-1839**



# Robert Allen (2008): The Biology of Agriculture Plays a Huge Role...

- Robert Allen (2008), “The Nitrogen Hypothesis and the English Agricultural Revolution: A Biological Analysis,” *Journal of Economic History* 68, pp. 182-210. <http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=1741020&fullTextType=RA&fileId=S0022050708000065>
  - Rice vs. dry-scrub wheat (plus olive, grape) vs. temperate-boreal forest wheat (cf.: Fernand Braudel)
  - Animal-centered agriculture
  - Evidence-based agriculture
    - The difficulty of doing evidence-based agriculture
  - The importance of the cheap axe
  - The importance of the heavy plow

# **Jeremiah Dittmar (2011): The Printing Press as an Agent of Change...**

- Jeremiah E. Dittmar (2011), “Information Technology and Economic Change: The Impact of the Printing Press,” *Quarterly Journal of Economics* 126 (August): 1133–1172.  
<http://qje.oxfordjournals.org/content/126/3/1133.abstract>
  - Information economics visits the 1500s...
  - How much of a difference can a small sector—1% of GDP—actually make?
  - What are the economic benefits of books, anyway?
    - What does this tell us about the market system as optimal societal structure?

# Jeremiah Dittmar (2011): The Printing Press as an Agent of Change... II

- Dittmar's Test: Compare (especially over the period 1500– 1600) population growth of cities that did and did not adopt the printing press before 1500.
- Why are Dittmar's IV estimates so big? 0.6 per century—a near doubling—as opposed to 0.2?

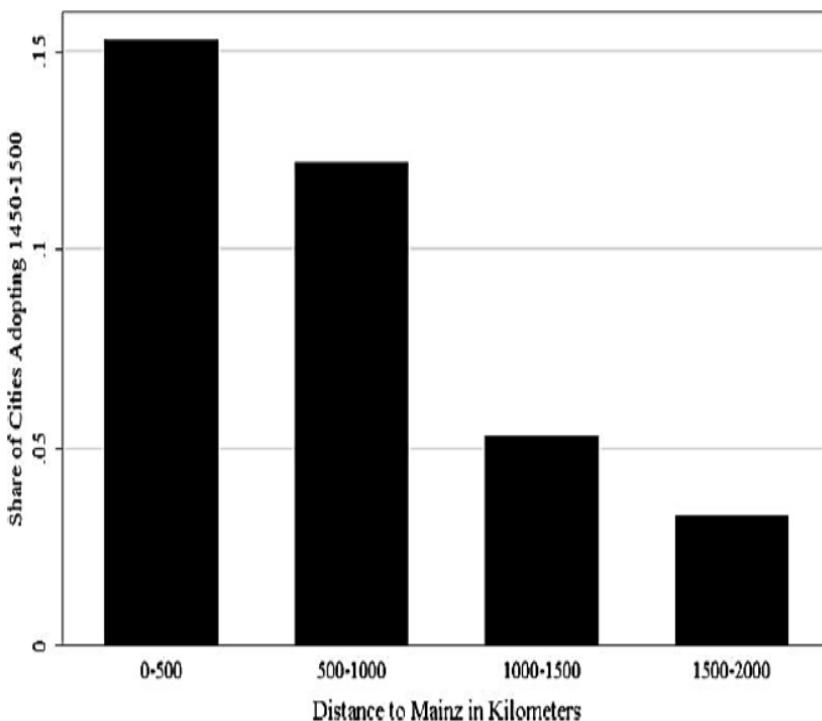


FIGURE IV

TABLE VII  
INSTRUMENTAL VARIABLE ANALYSIS OF PRINTING AND LOG CITY GROWTH

Regression Model	(1)	(2) 1st Stage Adopt Print 1450–1500	(3) 2nd Stage City Growth 1500–1600
Log Distance to Mainz	-0.06*** (0.01)		
Adopt Print 1450–1500		0.58** (0.29)	
Observations	410	410	410
R squared	0.34	0.15	0.15
F Statistic (IV)	20.74***	82.07***	82.07***

Note. The dependent variable in the first stage is an indicator variable that takes the value of 1 for cities that adopted the printing press 1450–1500. The dependent variable in the second stage is log population growth:  $\ln\left(\frac{POP_{1600}}{POP_{1500}}\right)$ . Distance from Mainz in log kilometers is the instrumental variable for print adoption 1450–1500. Regressions control for: log city population in 1500, port location, navigable rivers, location on Roman sites, political capitals, city latitude, city longitude, the interaction between latitude and longitude, and the DeLong–Shleifer freedom index of regional institutions. The Data Appendix provides detailed descriptions of these variables. Sample restricted to balanced panel of cities with population observed 1500–1800 in economies with at least one print city. Heteroskedasticity-robust standard errors clustered by country in parentheses. Significance at the 90%, 95%, and 99% confidence levels are indicated by \*, \*\*, and \*\*\*.

# DeLong and Shleifer (1993) and Acemoglu *et al.* (2005): Merchants Rule! OK?

- J. Bradford DeLong and Andrei Shleifer (1993), “Princes and Merchants: European City Growth Before the Industrial Revolution,” Journal of Law & Economics 36, pp. 671-702. <http://www.jstor.org/stable/725804>
  - In which genre is this paper?
  - The “freedom of the citizen” genre...
  - The “character of the elites” genre...

# DeLong and Shleifer II

- It's a big deal...

The total population living in western European cities of 30,000 or more in 1650 was 4.7 million. Had each of the nine regions experienced an additional century and a half of absolutist rule before 1650, this urban population would have been reduced by two million according to the regression in line 1 of Table 3. In such a scenario Europe in 1650 might well have played the same role in world history that it had played in 1000: a poor and barbarous backwater compared to the high civilizations of Islam, India, and China, rather than a continent on the verge of three centuries of world domination.

Conversely, had all of western Europe been free of absolutist rule over 1050–1650, then the regression in line 1 of Table 3 predicts that Europe in 1650 would have had a total urban population of nearly 8 million and would have had forty additional cities with more than 30,000 inhabitants. Such a heightened level of commerce and urban civilization might have triggered the Industrial Revolution considerably earlier.

# DeLong and Shleifer III

- Northern Italy in 1500-1650 is “surprising” as absolutist then
- England 1650-1800 is “surprising” as non-absolutist then
- WTF?! with the Italian urban boom 1050-1200
- Econometric problems
  - Normal distribution —we have only 45 observations, and 30 degrees of freedom...
  - The file-drawer problem...

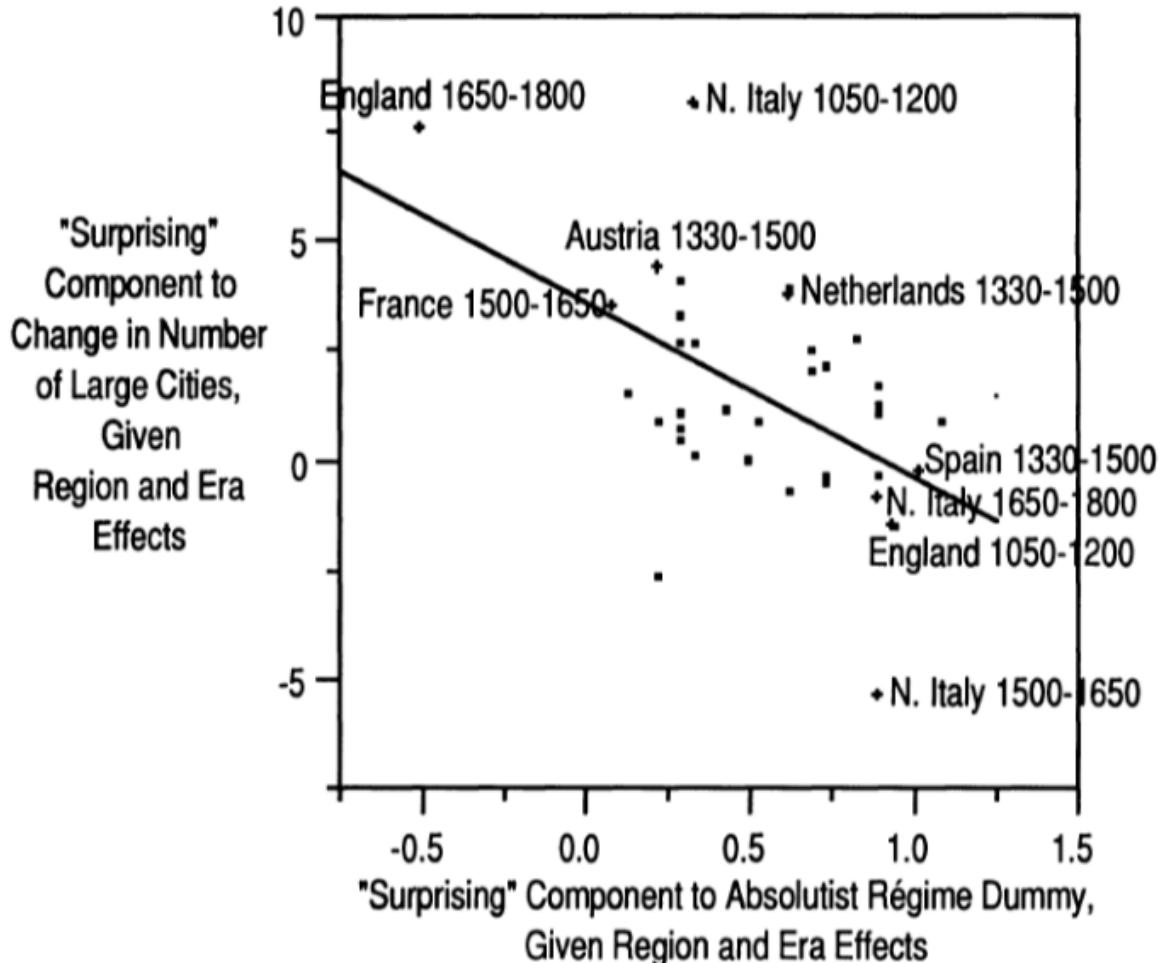


FIGURE 1.—Partial scatter of change in number of cities against absolutist regime

# Acemoglu, Johnson, and Robinson

- Daron Acemoglu, Simon Johnson, and James Robinson (2005), "The Rise of Europe: Atlantic Trade, Institutional Change, and Economic Growth," American Economic Review 95:3, pp. 546- 79. [http://www.jstor.org/stable/  
i387682](http://www.jstor.org/stable/i387682)
  - What are the direct effects of “Atlantic trade”?
  - What do AJR claim are the indirect effects?
  - Why do they think the indirect effects are materially large?
  - What would convince you they were right (or wrong)?

# Acemoglu, Johnson, and Robinson: Urbanization and Atlantic Trade

VOL. 95 NO. 3

ACEMOGLU ET AL.: THE RISE OF EUROPE

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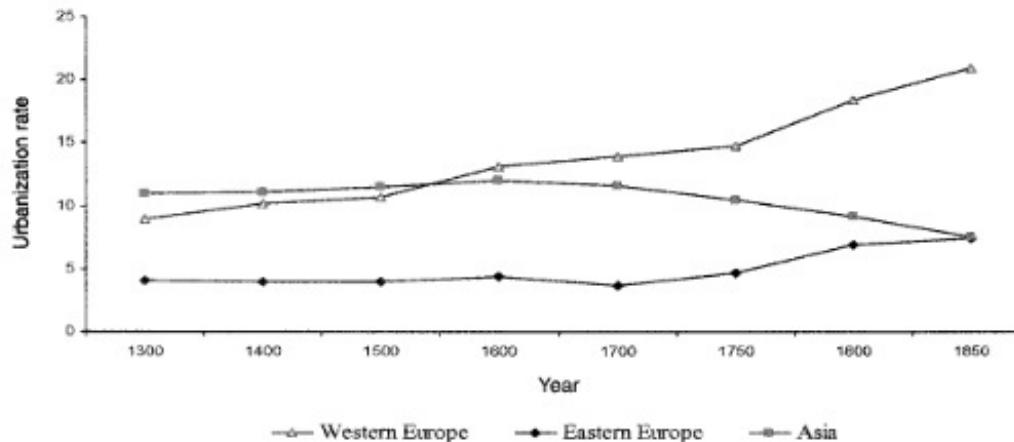


FIGURE 1A. WESTERN EUROPE, EASTERN EUROPE, AND ASIA: URBANIZATION RATES, WEIGHTED BY POPULATION, 1300–1850

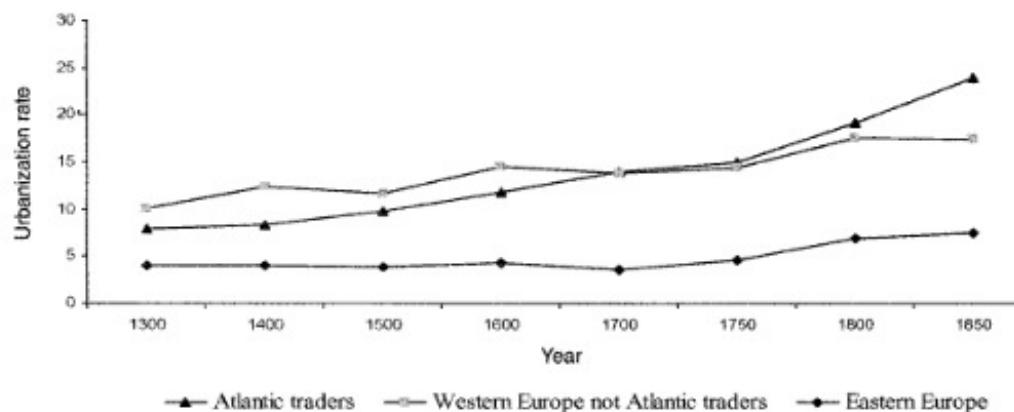


FIGURE 1B. ATLANTIC TRADERS, WEST EUROPEAN COUNTRIES NOT ATLANTIC TRADERS, AND EASTERN EUROPE:  
URBANIZATION RATES, WEIGHTED BY POPULATION, 1300–1850

# AJR

Barry R. Weingast, 1989). The critical political institutions were those that constrained the power of the monarchy and allied groups.<sup>5</sup> Checks on royal power and prerogatives emerged only when groups that favored them, that is commercial interests outside the royal circle, became sufficiently powerful politically. From 1500, and especially from 1600, onward, in countries with nonabsolutist initial institutions and easy access to the Atlantic, the rise in Atlantic trade enriched and strengthened commercial interests outside the royal circle and enabled them to demand and obtain the institutional changes necessary for economic growth.

We now investigate whether, as implied by our hypothesis, it was predominantly societies with less absolutist initial institutions (and relatedly, those without widespread royal granted monopoly rights in overseas trade) that took advantage of the opportunities offered by Atlantic trade. We also investigate the related hypothesis of North and Thomas (1973) and Jones (1981) that post-1500 developments largely reflect divergence between societies that had very different political institutions at the turn of the fifteenth century. This differs from our hypothesis, which emphasizes the *interaction* between initial political institutions and Atlantic trade.

# AJR

*Spain, Portugal and France.*—There is general agreement that Spanish and Portuguese political institutions at the turn of the sixteenth century were more absolutist than those in

Britain and the Netherlands, and did not experience similar reform.<sup>29</sup>

A key difference between these cases and the British-Dutch patterns is the organization of trade which, in turn, reflected differences in political institutions. Throughout this period, the granting of trade monopolies was a central tool for the rulers to raise revenue. When the power of the monarchs was constrained, they were unable to use this fiscal tool. For example, the English Parliament successfully blocked many attempts of both Tudor and Stuart monarchs to create such monopolies (Christopher Hill, 1969). Consequently, in Britain “most trade was carried on by individuals and small partnerships, and not by the Company of Merchant Adventurers, the Levant Company ... or others of their kind” (Davis, 1973a, p. 41). At least by 1600 there was quite free entry into the British merchant class (R. G. Lang, 1974). In contrast, Rondo Cameron (1993, p. 127) describes the Portuguese situation as follows: “The spice trade in the East Indies of the Portuguese Empire was a crown monopoly; the Portuguese navy doubled as a merchant fleet, and all spices had to be sold through the *Casa da India* (India House) in Lisbon ... no commerce existed between Portugal and the East except that organized and controlled by the state.” (See also Charles R. Boxer, 1985; Earl J. Hamilton, 1948.) Similarly, in Spain colonial trade was a monopoly of the Crown of Castile

# AJR

Our hypothesis is that Atlantic trade—the opening of the sea routes to the New World, Africa, and Asia and the building of colonial empires—contributed to the process of West European growth between 1500 and 1850, not only through direct economic effects, but also indirectly by inducing fundamental institutional change. Atlantic trade in Britain and the Netherlands (or, more appropriately, in England and the Duchy of Burgundy) altered the balance of political power by enriching and strengthening commercial interests outside the royal circle, including various overseas merchants, slave traders, and various colonial planters. Through this channel, it contributed to the emergence of political institutions protecting merchants against royal power.<sup>21</sup> Our hypothesis also implies that the tendency for institutional change to emerge should have been much stronger in societies with existing checks on royal power than in countries with absolutist regimes and monarchy-controlled trade monopolies, because in these latter countries Atlantic trade did not enrich and strengthen merchant groups outside the royal circle as much, and did not disturb the political status quo.

# Commercial Revolutions III

## We Have a Very Keen-Eyed Contemporary Observer:

- **Read:** Christopher Berry (2018): *Adam Smith: A Very Short Introduction*, chs. 1, 4-6  
[<https://delong.typepad.com/files/berry-smith.pdf>](https://delong.typepad.com/files/berry-smith.pdf)
- The market economy as a game changer
- Commercial society:
  - Hunter, shepherd, agricultural, and commercial stages...
  - “It is Smith’s explicit reference to a ‘commercial society’ that is distinctive and Smith here is a pioneer...”
  - Agrarian-Age power lies with the owners of land, and government is ‘a combination of the rich to oppress the poor’
  - Commercial society sees the growth of the rule of law—and a government that can enforce its property-rights order against local notables, roving bandits, *and its own functionaries* ...

# Why the Emergence of “Commercial Society”

## 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 lords...” *Origin of the Family...*
- It was in the kings’ and their bureaucracies’ interests—and they were (sometimes) able to make it stick.

# Why the Emergence of “Commercial Society” II

## **Adam Smith, according to Berry:**

- “The feudal lords were masters... settled disputes, enforced discipline, and commanded their tenants to fight on their behalf.... [But] when foreign commerce introduced... what Smith deliberately calls frivolous and useless goods (he mentions diamond buckles) the lords sold off their land or granted long leases... undermine[d] their power to command and their ability to act as judges because those who had been previously dependent became independent: ‘For the gratification of the most childish, the meanest and the most sordid of all vanities’... these landlords gradually bartered away their whole power and authority (WN 419)...
- “Smith calls this change a ‘revolution of the greatest importance to the publick happiness’ (WN 422)
  - But it was not brought about with the deliberate aim to further the public good...
  - It was, rather, an example of unintended consequences.
- This made possible the ‘regular administration of justice’.
- The establishment of that uniformity is crucial
- Without it a commercial society is not possible

# Marcher Lords: Warwick the Kingmaker

- **Adam Smith:** In a country where there is no foreign commerce, nor any of the finer manufactures, a man of £10,000 a-year cannot well employ his revenue in any other way than in maintaining, perhaps, 1000 families, who are all of them necessarily at his command. In the present state of Europe, a man of £10,000 a-year can spend his whole revenue, and he generally does so, without directly maintaining twenty people, or being able to command more than ten footmen, not worth the commanding...
- Indirectly, perhaps, he maintains as great, or even a greater number of people.... The quantity of precious productions for which he exchanges his whole revenue be very small, the number of workmen employed in collecting and preparing it must necessarily have been very great.... He indirectly pays all those wages and profits, and thus indirectly contributes to the maintenance of all the workmen and their employers.....
- Though he contributes, therefore, to the maintenance of them all, they are all more or less independent of him, because generally they can all be maintained without him...

# Once You Have the Preconditions for “Commercial Society”...

## Commercial Revolution Prosperity:

- “Universal opulence which extends itself to the lowest ranks of the people...”
- Because of the division of labor...
- Possible only in a well-governed society...
- Berry: “Through the division of labour ten individuals could make 48,000 pins a day— equivalent to 4,800 each. But if each individual performed all the tasks required (drawing, straightening, cutting, pointing the wire, and so on) then less than twenty would have been manufactured. He gives three reasons for this: increased dexterity that comes from reducing each individual’s task to ‘one simple operation’; time-saving that stems from not having to transfer from one task to the next; and inventing better ways of executing the task prompted by the concentration on one task...”
- Division of labor depends on the extent of the market...
- And self-interest: “it is not from the benevolence of the butcher, the brewer or the baker that we expect our dinner, but from their regard to their own interest. We address ourselves not to their humanity but to their self- love and never talk to them of our own necessities but of their advantages. Nobody but a beggar chuses to depend chiefly upon the benevolence of his fellow-citizens...”

# **Smith's “System of Natural Liberty”**

**Depends on Universal Principles: Smith according to Berry:**

- A ‘science of human nature’.
- The self-interested hope of everyone to better their own condition.
- The moral principle that everyone is free.
- Individuals are the best judges of their own interests
- The outcomes of particular exchanges redound unintentionally to the general benefit.
- The ‘miserable poverty’ of the savage nations, as depicted in his Introduction, is left behind
- The twin blessings of opulence and freedom are experienced.

# But Smith's “System of Natural Liberty” Did Not Emerge Naturally...

**According to Smith: “The German and Scythian nations overran the western provinces of the Roman empire:**

- “Confusions... lasted for several centuries...
- “Rapine and violence... interrupted the commerce between the towns and the country...
- “The towns were deserted, and the country was left uncultivated...
- “The western provinces of Europe, which had enjoyed a considerable degree of opulence under the Roman empire, sunk into the lowest state of poverty and barbarism...
- “Great tracts... were... engrossed by particular families...
- “It seldom happens, however, that a great proprietor is a great improver... [is] sufficiently employed in defending his own territories, or in extending his jurisdiction and authority over those of his neighbours.
- “If he was an economist, he generally found it more profitable to employ his annual savings in new purchases...
- “If little improvement was to be expected from such great proprietors, still less was to be hoped for from those who occupied the land under them.... Slaves, but their slavery was of a milder kind than that known among the ancient Greeks and Romans, or even in our West Indian colonies.... They were not, however, capable of acquiring property. Whatever they acquired was acquired to their master, and he could take it from them at pleasure...
- “If great improvements are seldom to be expected from great proprietors, they are least of all to be expected when they employ slaves for their workmen.

# But Smith's “System of Natural Liberty” Did Not Emerge Naturally... II

**The pride of man makes him love to domineer:**

- “Nothing mortifies him so much as to be obliged to condescend to persuade his inferiors...
- “Wherever the law allows it, and the nature of the work can afford it, therefore, he will generally prefer the service of slaves to that of freemen...
- “The inhabitants of cities and towns were, after the fall of the Roman empire, not more favoured than those of the country...
- “The inhabitants of cities and burghs, considered as single individuals, had no power to defend themselves; but by entering into a league of mutual defence with their neighbours, they were capable of making no contemptible resistance...
- “The lords despised the burghers, whom they considered not only as a different order, but as a parcel of emancipated slaves, almost of a different species from themselves. The wealth of the burghers never failed to provoke their envy and indignation, and they plundered them upon every occasion without mercy or remorse. The burghers naturally hated and feared the lords...
- “The king hated and feared them too; but though, perhaps, he might despise, he had no reason either to hate or fear the burghers. Mutual interest, therefore, disposed them to support the king, and the king to support them against the lords. They were the enemies of his enemies, and it was his interest to render them as secure and independent of those enemies as he could...

# Discussion

## “Commercial Society” of the Eighteenth Century

- An extra 1500 years of invention and innovation, yes...
  - Scope of control...
  - Columbian Exchange...
- But, otherwise, how different from Antonine Rome or Sung China or Abbasid Mesopotamia?
  - It did occur in Antonine Rome...
  - Temin: no industrial revolution...

## Longest-Run Global Economic Growth (2019)

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
-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%

# **Big Ideas: Lecture 8: Commercial Revolutions**

## **Takeaways from this lecture:**

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

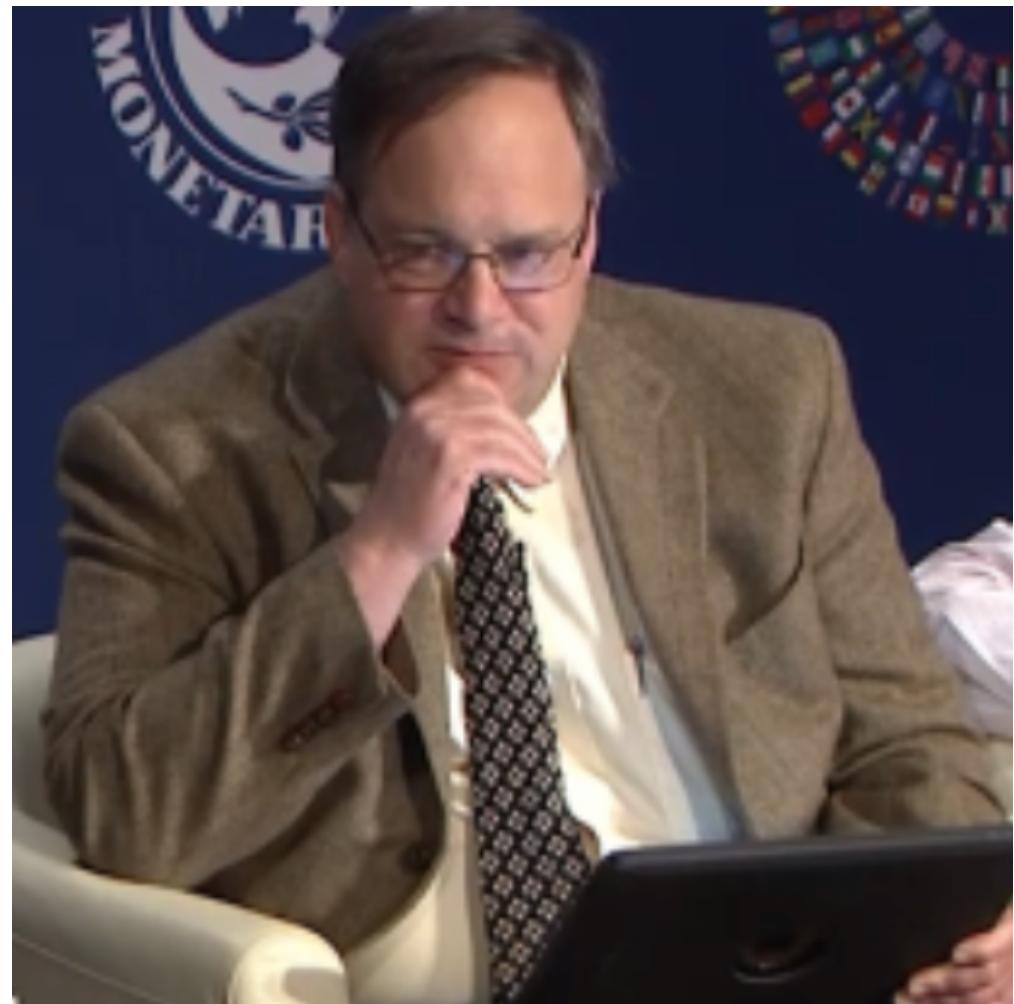
# Preview of Lecture 9: Industrial Revolutions I

## What I hope we will cover:

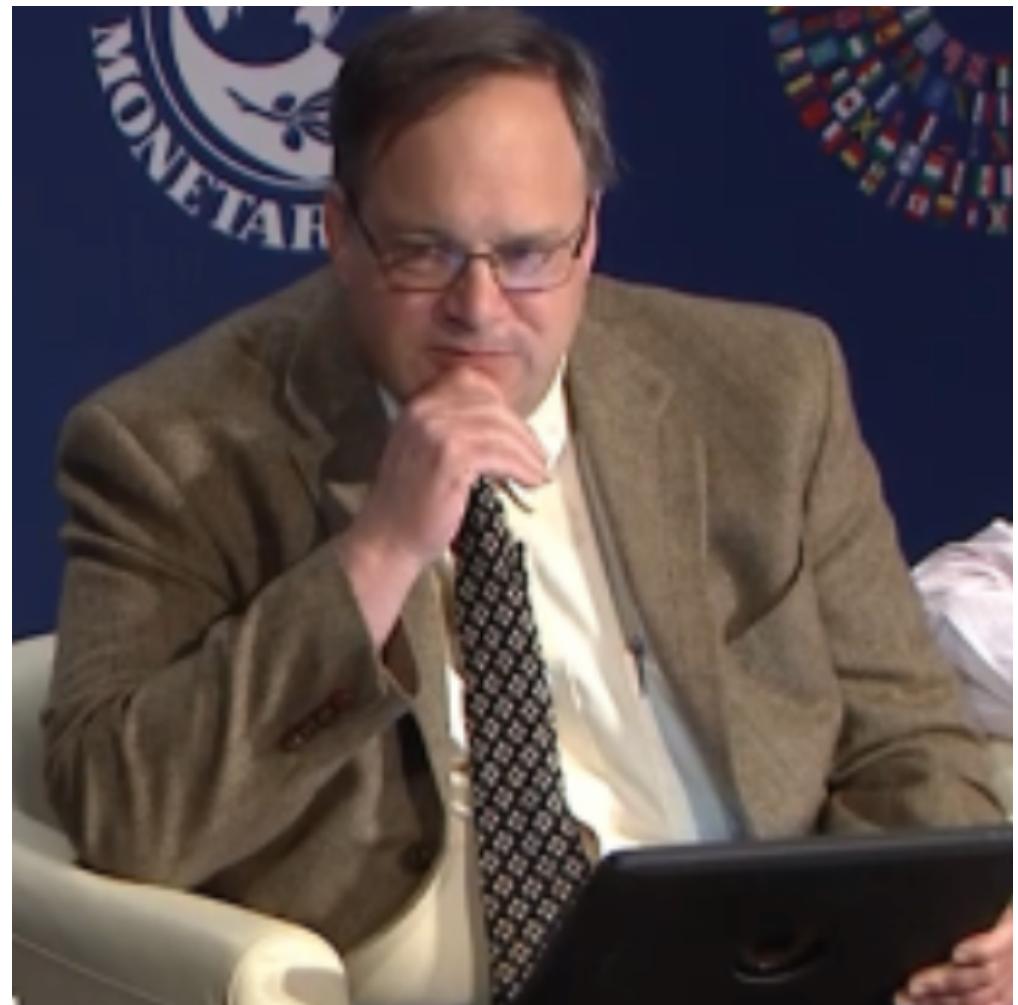
- Adam Smith had no clue of what was about to happen...,
- Science...
- Empire and commerce...
- Coal...
- “Institutions”

# Catch Our Breath...

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



# Notes



# Review: Why Was Pre-Industrial Progress so Slow on Average?

## Our readings:

- Willem M. Jongman (2007): Gibbon was Right: The Decline and Fall of the Roman Economy <<https://delong.typepad.com/jongman-gibbon-was-right.pdf>>
- Peter Temin: The Roman Market Economy, Roman Growth <<https://delong.typepad.com/files/temin-roman-growth.pdf>>
- Moses Finley: Technical Innovation and Economic Progress in the Ancient World <<https://delong.typepad.com/finley-technical.pdf>>
- Josh Ober (2019): Agamemnon's Cluelessness, selections <<https://delong.typepad.com/files/ober-agamemnon-selections.pdf>>

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%
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2020	2720.5	\$90,000	\$11,842	7600	1.177%	1.473%	2.061%

# Potential Points of View

## What are the possibilities here?:

- No puzzle—given how few heads they had, and given the absence of printing and the difficulty of controlled experiments, it is a miracle that they managed to advance technology as far as they did as fast as they did... (Kremer)
- No: there was something wrong. They had the wrong kind of society... (Finley, critiqued by Ober)
- No: something went wrong: civilization seems to be progressing up to the year 1... 0.013%/yr... 0.030%/yr... 0.061%/yr... & then it stalls out: instead of doubling to a Commercial Revolution rate of growth after the year 1, the rate of ideas growth halves again... (Jongman)

# Our Four Readings

## What possibilities do they argue for?:

- Jongman:

- “Population went down... production per man hour must have gone up.... The Roman Empire should have turned into a world of happy and prosperous peasants.... Reality was, of course, different... the emergence of a new social, political, and legal regime, where oppression replaces the entitlements of citizenship...”

- Temin:

- “The high ratio of wages to energy costs was not only absent in eighteenth-century continental Europe; it was absent as well in the Roman Empire.... There was no possibility of escaping from the Malthusian constraints... no possibility that industrialization could have begun in the ancient world...”

- Finley:

- “The pejorative judgments of ancient writers about labour, and specifically about the labour of the artisan, and of anyone who works for another, are too continuous, numerous, and unanimous, too wrapped up in discussions of every aspect of ancient life, to be dismissed as empty rhetoric. In other slave-owning societies for whom there is fuller documentation, these implications and their practical effects are unmistakable. Writing about the Great Trek, for example, Sir Keith Hancock said: 'The Boers very soon convinced themselves that artisans' work and slaves' work were the same thing—a conviction which struck such deep roots in their minds that their descendants in the nineteenth century left to British immigrants almost all the opportunities of skilled industrial employment in the expanding towns'. Or Tocqueville, whose 1831 notebooks are filled with the theme that 'slavery is even more prejudicial to the masters than to the slaves', because, as a leading Louisville merchant said to him, 'it deprives us of the energy and spirit of enterprise that characterizes the States that have no slaves'.... Comparisons must be made with caution and reserve. But this particular one seems to me to be valid and necessary...”

- Ober:

- “Greeks were quite capable of the kind of reasoning necessary to build and sustain a growing economy.... Ancient Greeks, as individuals and collectives, frequently employed... rationally instrumental reasoning in economic contexts. It is nonetheless undeniable that there is a body of classical literature that exemplifies the scorn for money-making that was emphasized by the Finley school. Those expressions of scorn underpin the theory of an essentially timeless and changeless ancient economy predicated on violent extraction and gift exchange.... The approach of the Socratic philosophers to economic rationality was fundamentally critical and normative.... For Finley and his school... any activity that was not grounded in status, and in [its] power relations... was... unmoored and ephemeral.... Economic activity aimed at increasing productivity, innovations aimed at increasing efficiency, and increased consumption—rather than securing the status of the relevant actors—were, thereby, rendered more or less invisible—and in any event, unworthy of detailed study. The result was, so I suppose, both a misunderstanding of the relevant texts and a misrepresentation of the underlying social reality...”

# Review: The Fall of Rome

## Economic Zenith, Then Economic Decline, Then Political Decline:

- While the existing data are somewhat contradictory, the consensus amongst archaeologists is the early 2nd century.
- A new social distinction between *honestiores* (high status) and *humiliores* (low status with different laws) was introduced.
- Citizens began to lose their rights and by the end of the 2nd century, they were being tied to the land as serfs
- The Barbarians were at the gates, but it seems reasonable to see this as an outcome of the weakening of Roman institutions
- Earlier Rome had defeated far more formidable and better organized enemies like the Carthaginians.
- Acemoglu and Robinson argue that the big fact about what preceded the decline is that political institutions moved in a much more extractive direction and this was followed by economic institutions.
- Jongman (“Gibbon was Right”) proposes that the Antonine plague which hit the Roman Empire around 160AD is the most likely explanation for the collapse of Rome.
- But Malthusian crises are supposed to increase living standards, not reduce them: so what is going on?



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

Annotations pointing to the equation:

- Malthusian equilibrium income level
- True zpg subsistence
- Sensitivity of productivity to population
- Rate of useful ideas creation
- The salience of capital in determining productivity
- The extent to which population depresses productivity
- Nuisance terms
- The ratio of savings to depreciation
- The inverse of the taste for luxury
- Taste for luxuries
- Responsiveness of population growth to prosperity

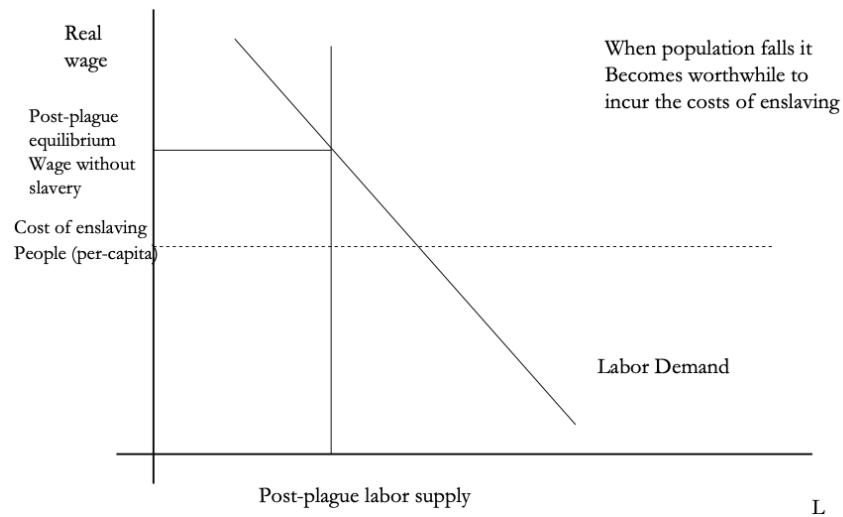
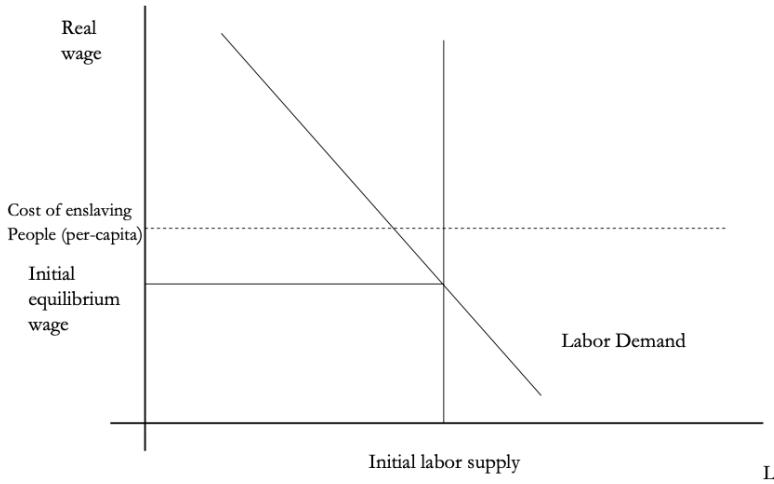
# Three Great Plagues

**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...

# The Domar Hypothesis

You can have a leisured upper class, or abundant land relative to labor, or free labor, but not all three at once:



# The Later Roman Empire

## How does it compare to the expanding Roman Republic?

- **Militarism:** in striking contrast to earlier days, a successful general is a threat to the emperor. Eighteen emperors in 35 years between Philip the Arab and Diocletian
- **Mobilization:** In order to extract resources from a smaller population, the people must be disarmed rather than mobilized.
- **Distribution:** The smaller pool of benefits needs to be hoarded for those with connections, not shared.
- **Incorporation:** You can join the Goths: you cannot join the Roman upper class unless you know someone...

# Dell's Summary of Acemoglu and Robinson on the Rise and Fall of Rome II

**For the Roman Empire, the collapse of Roman authority was pronounced, particularly in the West:**

- By 450AD all the trappings of Roman economic prosperity were gone.
- Money vanished from circulation.
- Urban areas were abandoned and buildings stripped of stone.
- The roads were overgrown with weeds.
- The only type of pottery which was fabricated was crude and hand made, not manufactured.
- People forgot how to use mortar and they also forgot how to read and write.
- Roofs were made of branches, not tiles.
- The Eastern Roman Empire lived on, but it contracted significantly with the rise of Islam in the 7th Century.

# Review: 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...

# Review: 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:**

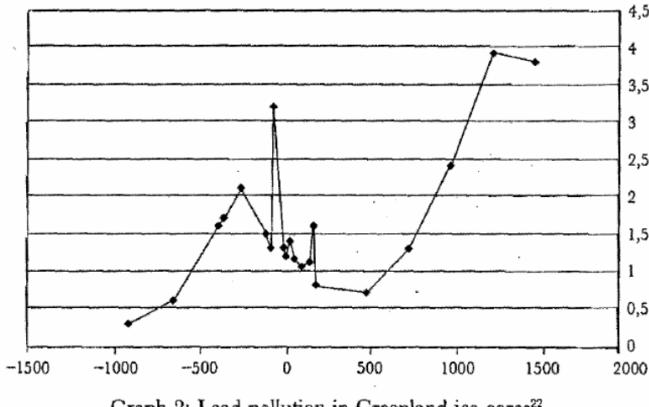
- Four key factors:
  - Militarism (on the part of elites competing for authority)
  - Mobilization (of the citizen mass)
  - Widely shared benefits (of conquest)
  - Incorporation (of conquered communities)
- Mammoth military and political expansion after -340, and substantial economic, expansion



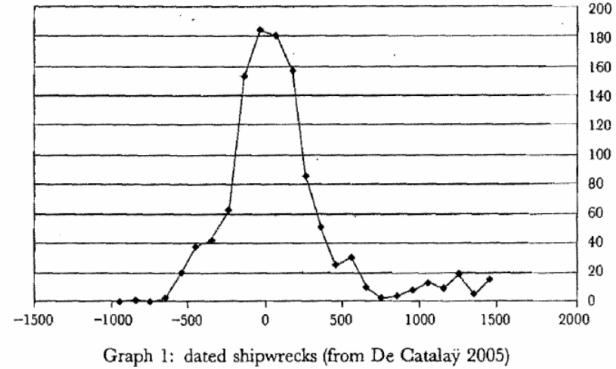
# Measuring Roman Efflorescence

**There are many interesting ways to track economic expansion:**

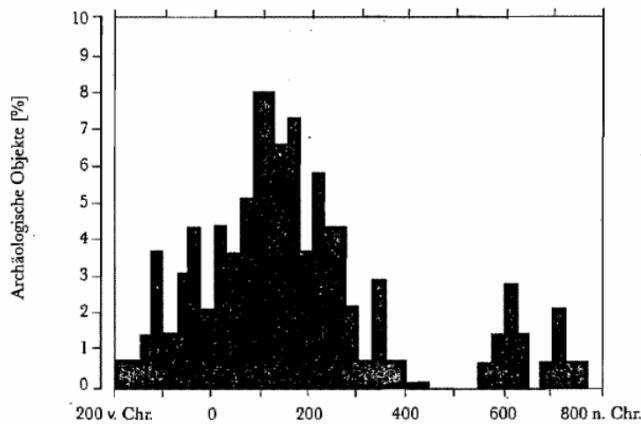
- Shipwrecks indicate trade, but they also track the movement of goods by fiat. For example, the citizens of Rome were kept happy by the free distribution of bread after 58BC. This was later extended to olive oil and even wine. This had to be shipped (mostly from Egypt and North Africa).
- The Romans 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.



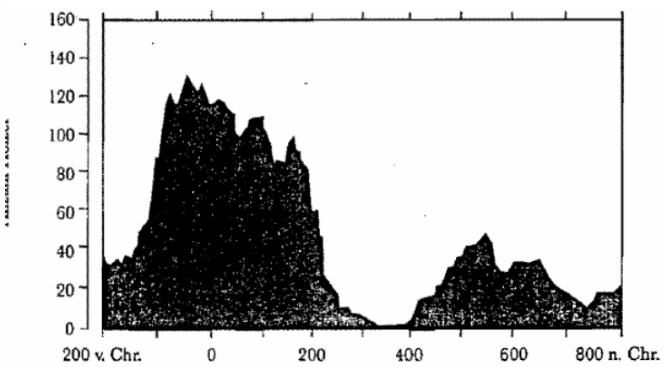
Graph 2: Lead pollution in Greenland ice cores<sup>22</sup>



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.

# Review: Pre-Industrial “Efflorescences”

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:  $h$ ,  $\gamma$ ,  $\beta$ ,  $\phi$ ,  $y^{sub}$ ,  $s$ ,  $\delta$ ,  $\theta$ , 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

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

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

# 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.

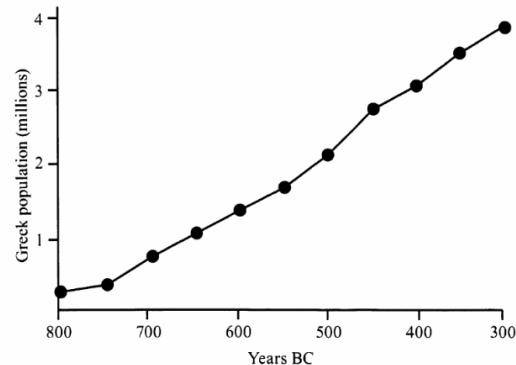
*Table 1*  
Standard Periodization of Ancient Greek History

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

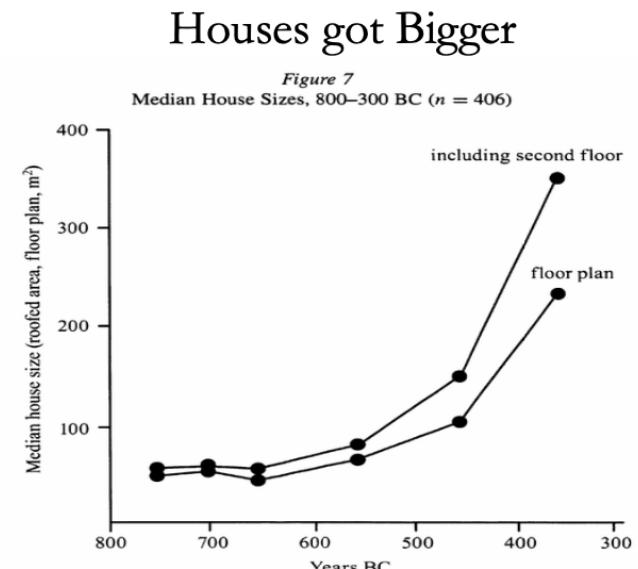
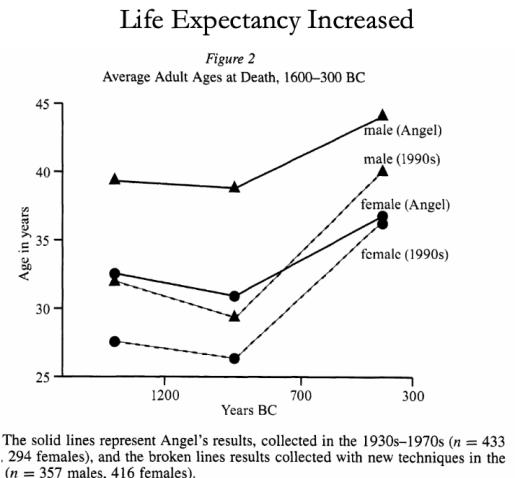


Source: Morris, Ian (2004) "Economic Growth in Ancient Greece," Journal of Institutional And Theoretical Economics, 160, 709-742.

# The Classical Greek Efflorescence II

## “Developmental” or “Extractive”?

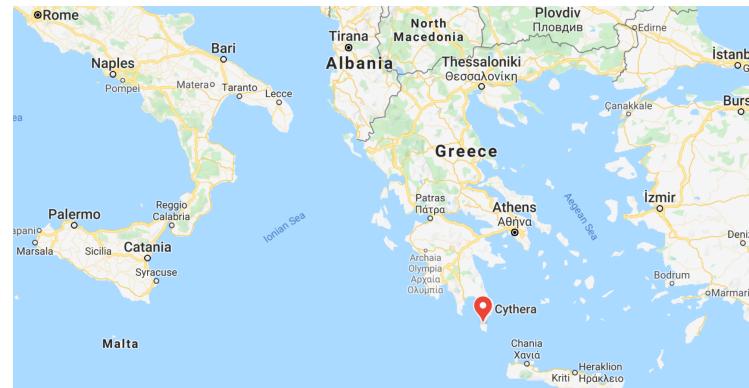
- Extractive political institutions concentrate political power in the hands of some group who can use that power to redistribute wealth and income to themselves. This resulting concentration of wealth tends to reinforce the initial set of political institutions.
- Roving bandits or stationary bandits?
- 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..."

# 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

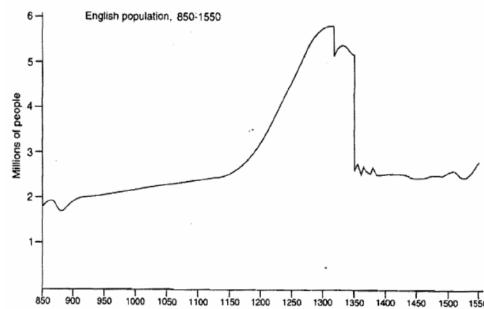


Figure 2. English population, 850-1550. A speculative reconstruction. The figures from 850 to 1086 are pure speculation. The subsequent figures are based on Domesday (1086), the Poll Tax (1377), the subsidies (1324-5) and the military survey (1322), and by extrapolation from manorial records of tenant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

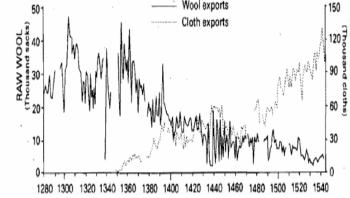


Figure 4. English exports of wool and cloth, 1279-1540 (cloth exports are only consistently recorded from the mid-fourteenth century).

Sources: E. M. Carus-Wilson and C. Colenou, *England's Export Trade 1275-1547* (Oxford, 1963); E. M. Carus-Wilson, *Medieval Merchant Venturers* (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  $L_t^{*mal}$ . The equation is:

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

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

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

The diagram illustrates the factors influencing the Malthusian equilibrium income level  $y^{*mal}$ . The equation is:

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

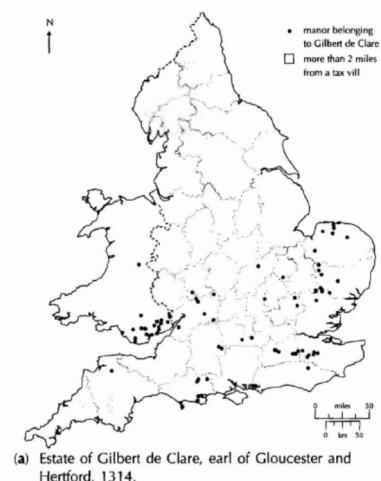
- Malthusian equilibrium income level ( $y^{*mal}$ ) is influenced by:
  - True zpg subsistence ( $\phi y^{sub}$ )
  - Sensitivity of productivity to population ( $\gamma h$ )
  - Rate of useful ideas creation ( $\beta$ )
  - Taste for luxuries ( $n^{*mal}$ )
  - Responsiveness of population growth to prosperity ( $\beta$ )

# Eastern Europe and the “Second Serfdom”

**The percentage of people killed in Europe 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 western Europe.
- Effects became especially pronounced after 1500, when Western Europe began to demand the agricultural goods which the East produced.
- Eastern landlords ratcheted up their control over the labor force to expand their production.
  - Mecklenberg: in 1500, peasants owed only a few days service a year; by 1600 this was three days/week; 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.
- 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 Statue of Laborers and stopping wages from rising?
  - William the Conqueror rewarded his army by providing them with parceled landholdings to prevent them from becoming powerful regional warlords (save for the “marcher lords” along the Scottish and Welsh borders).
  - Many landholders in close proximity created intense competitive pressures for labor in the wake of the Black Death.

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..."

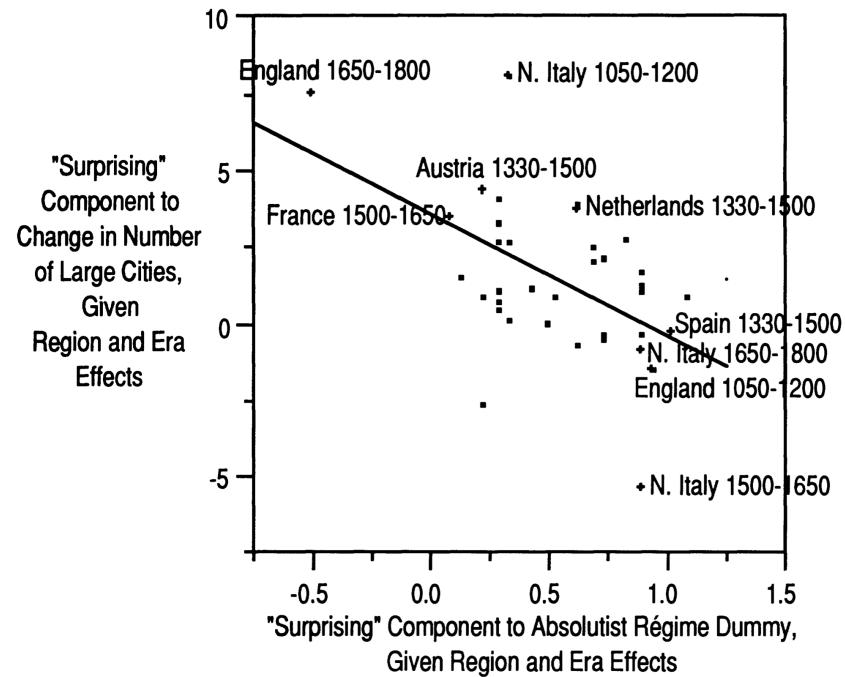


FIGURE 1.—Partial scatter of change in number of cities against absolutist regime

# 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”

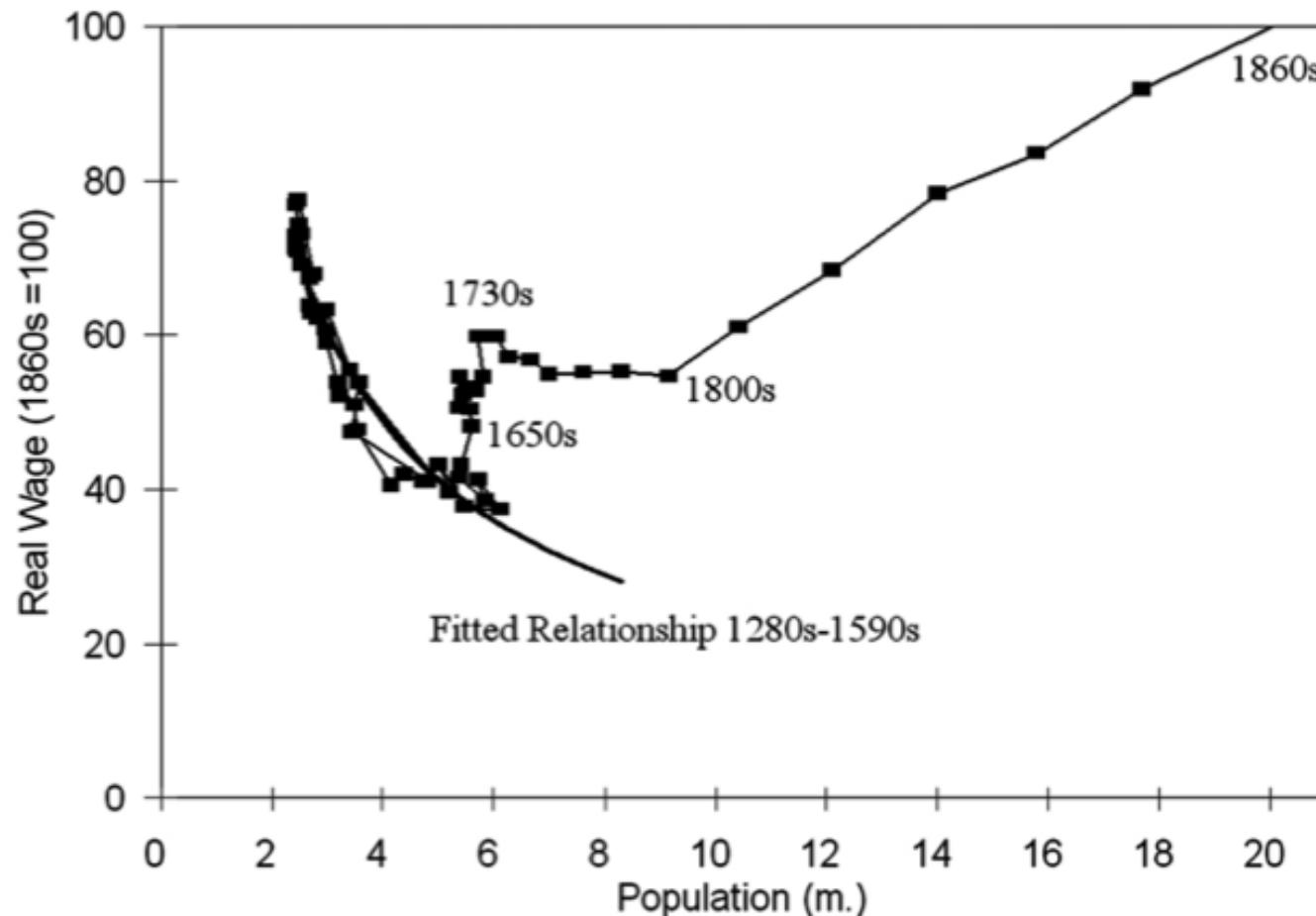


FIG. 5.—Real wages vs. population on the new series, 1280s–1860s. The line summarizing the trade-off between population and real wages for the preindustrial era is fitted using the data from 1260–69 to 1590–99. Sources: population, same as for fig. 3; real wage, table A2.

# “Bare-Bones”

Table 2. Bare-bones subsistence basket of goods

	quantity per man per year	calories per day	protein (grams) per day
<b>food</b>			
grain	167 kg	1657	72
beans	20 kg	187	14
meat	5 kg	34	3
butter	3 kg	60	0
total		1938	89
<b>non-food</b>			
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

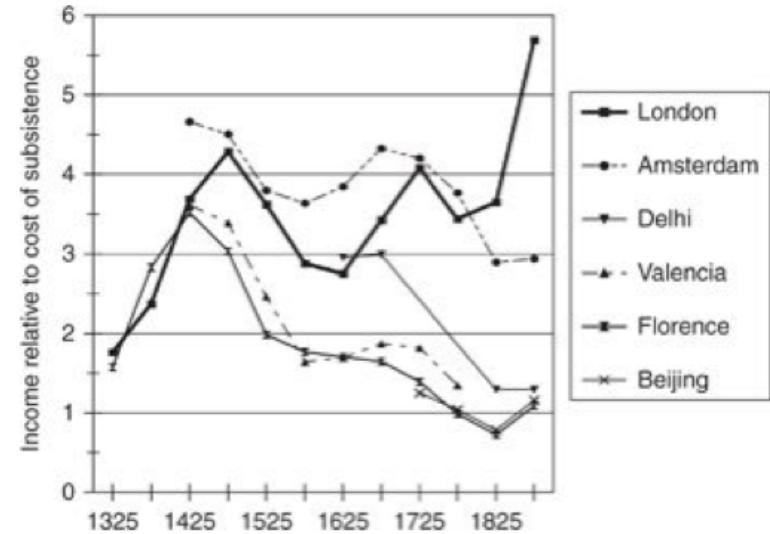


TABLE A3  
PERCENTAGE OF EXPENDITURES BY CATEGORY, MANUAL WORKERS, 1734–1854

Category	1734 (Vanderlint)	1787–96 (Horrell)	1840–54 (Horrell)	Assumed Here
<b>Food and drink</b>	<b>54.4</b>	<b>75.4</b>	<b>61.7</b>	<b>67.0</b>
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
<b>Farmaceous</b>	<b>12.5</b>	<b>37.8</b>	<b>29.7</b>	<b>27.0</b>
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
<b>Meat</b>	<b>16.7</b>	<b>12.1</b>	<b>12.1</b>	<b>12.0</b>
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
<b>Sugars</b>	<b>..</b>	<b>4.2</b>	<b>4.5</b>	<b>4.5</b>
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
<b>Drink</b>	<b>12.5</b>	<b>6.2</b>	<b>4.9</b>	<b>10.0</b>
Salt	..	..	..	1.0
Spices (pepper/vinegar)	..	..	..	1.0
Other food	4.2	.6	2.1	.0
<b>Housing/housewares</b>	<b>7.2</b>	<b>5.3</b>	<b>10.9</b>	<b>8.0</b>
Fuel	5.6	4.4	4.8	5.0
Light	2.1	..	..	4.0
Soap	2.1	..	..	.5
<b>Light and soap</b>	<b>4.2</b>	<b>3.8</b>	<b>5.2</b>	<b>4.5</b>
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.

# 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: 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

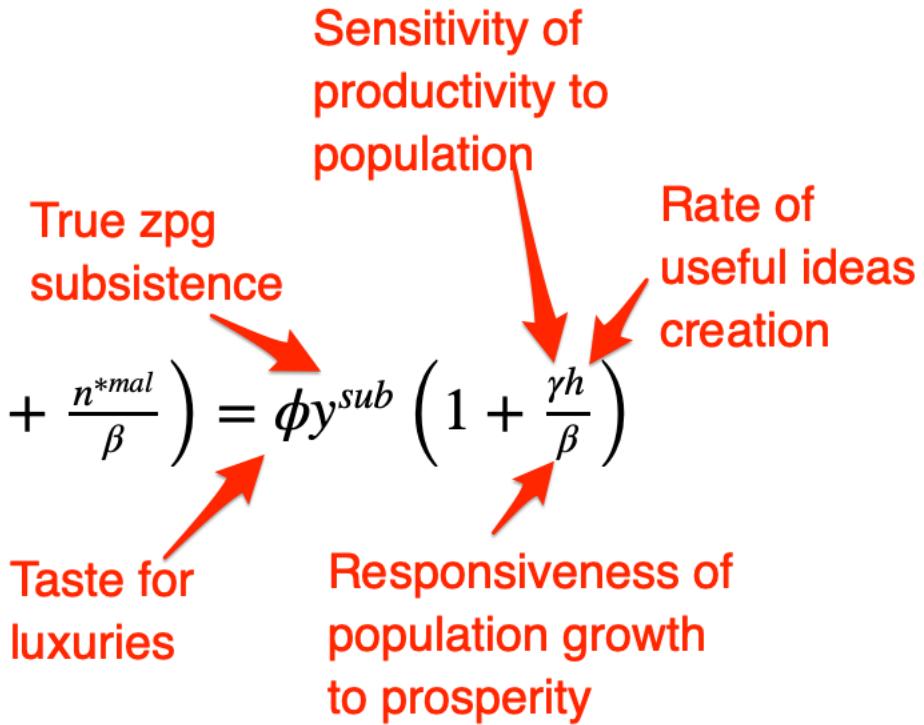
Notes:

-

# 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:

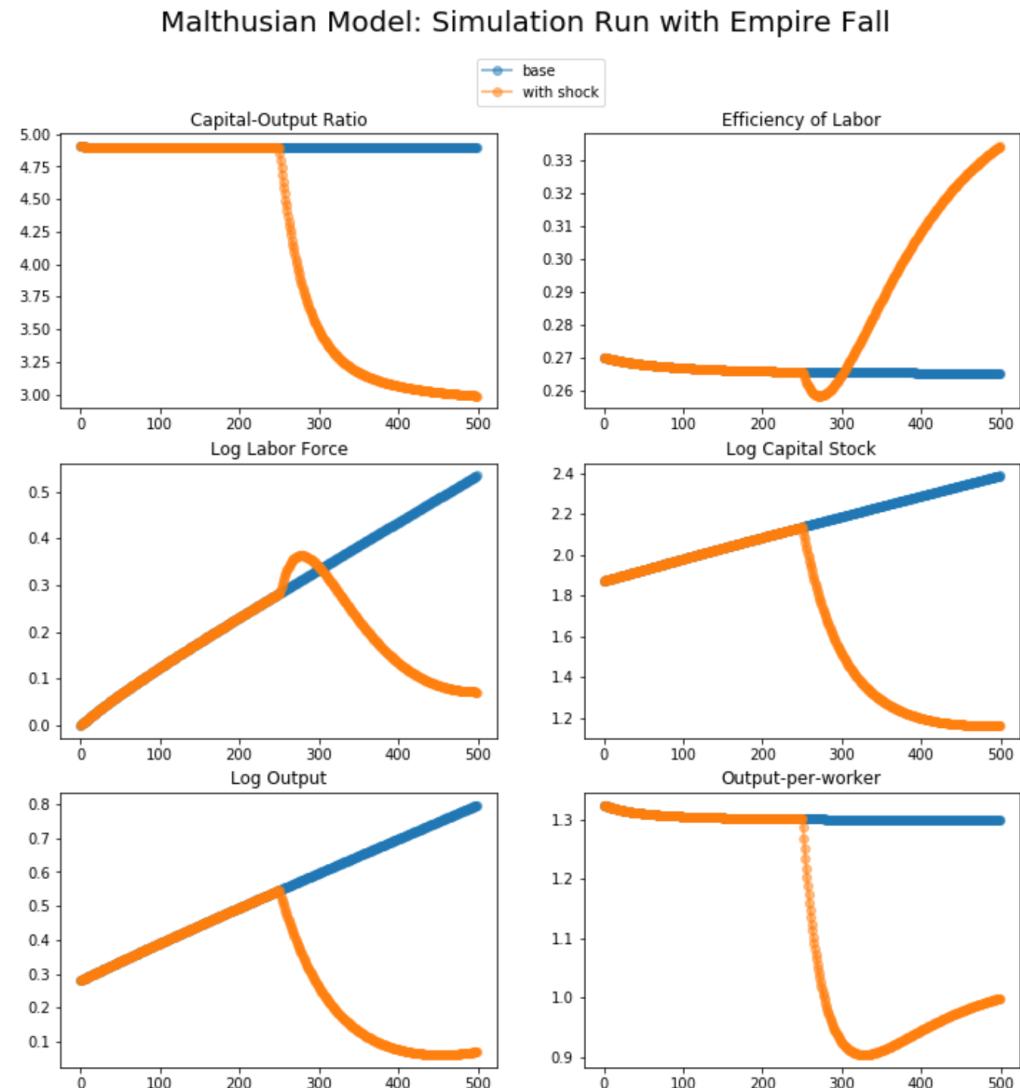
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# Steady-State and Along the Transition Path

The fall of an empire:

- <[https://nbviewer.jupyter.org/github/braddejong/LS2019/blob/master/2019-10-14-Ancient\\_Economies.ipynb](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: 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>>

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

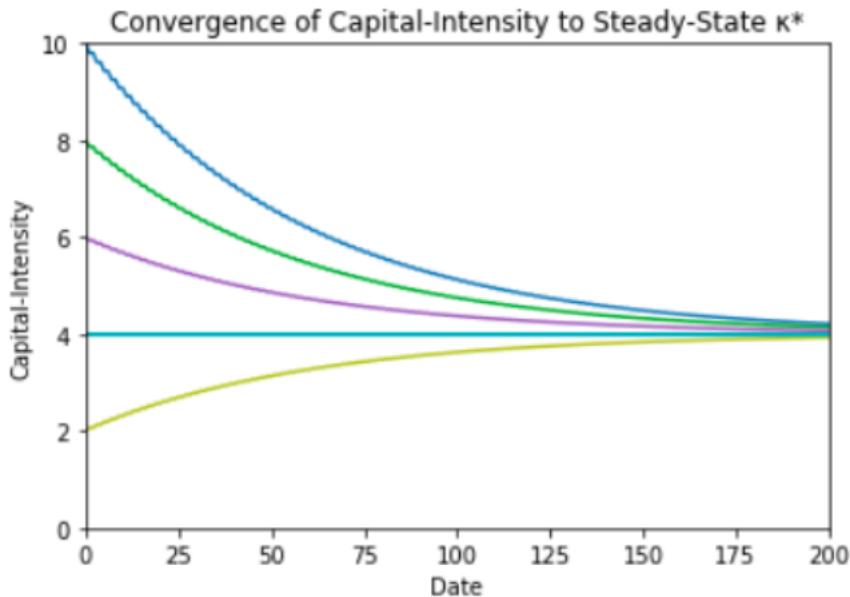
$$\frac{dE}{dt} = gE \quad \frac{dL}{dt} = g_L L = nL \quad \frac{dK}{dt} = sY - \delta K = \left( \frac{s}{\kappa} - \delta \right) K$$

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

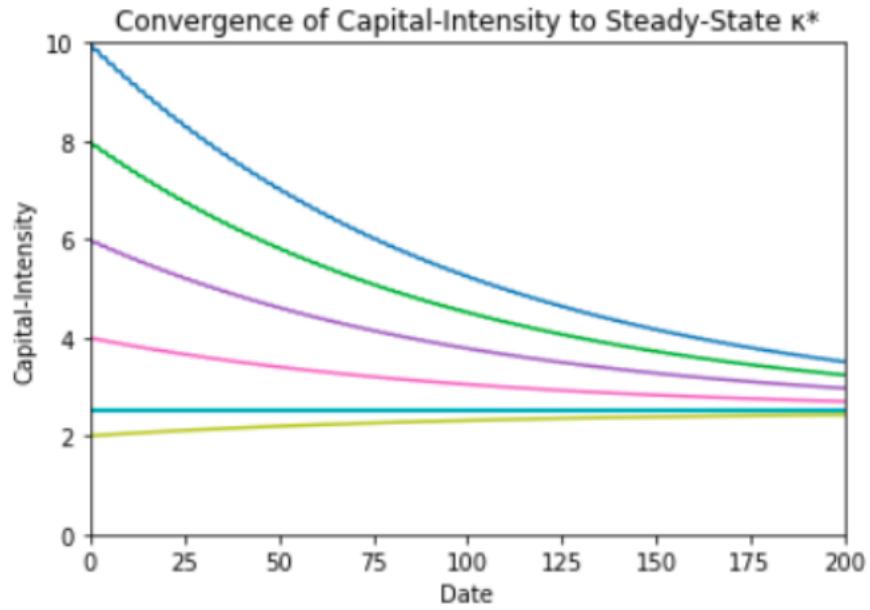
This  $\kappa^*$  we define as the steady-state *balanced-growth equilibrium* value of capital-intensity in the Solow growth model. If the capital-intensity  $\kappa = \kappa^*$ , then it is constant, and the economy is in balanced growth, with  $Y$  and  $K$  growing at the rate  $n+g$ ,  $E$  and 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

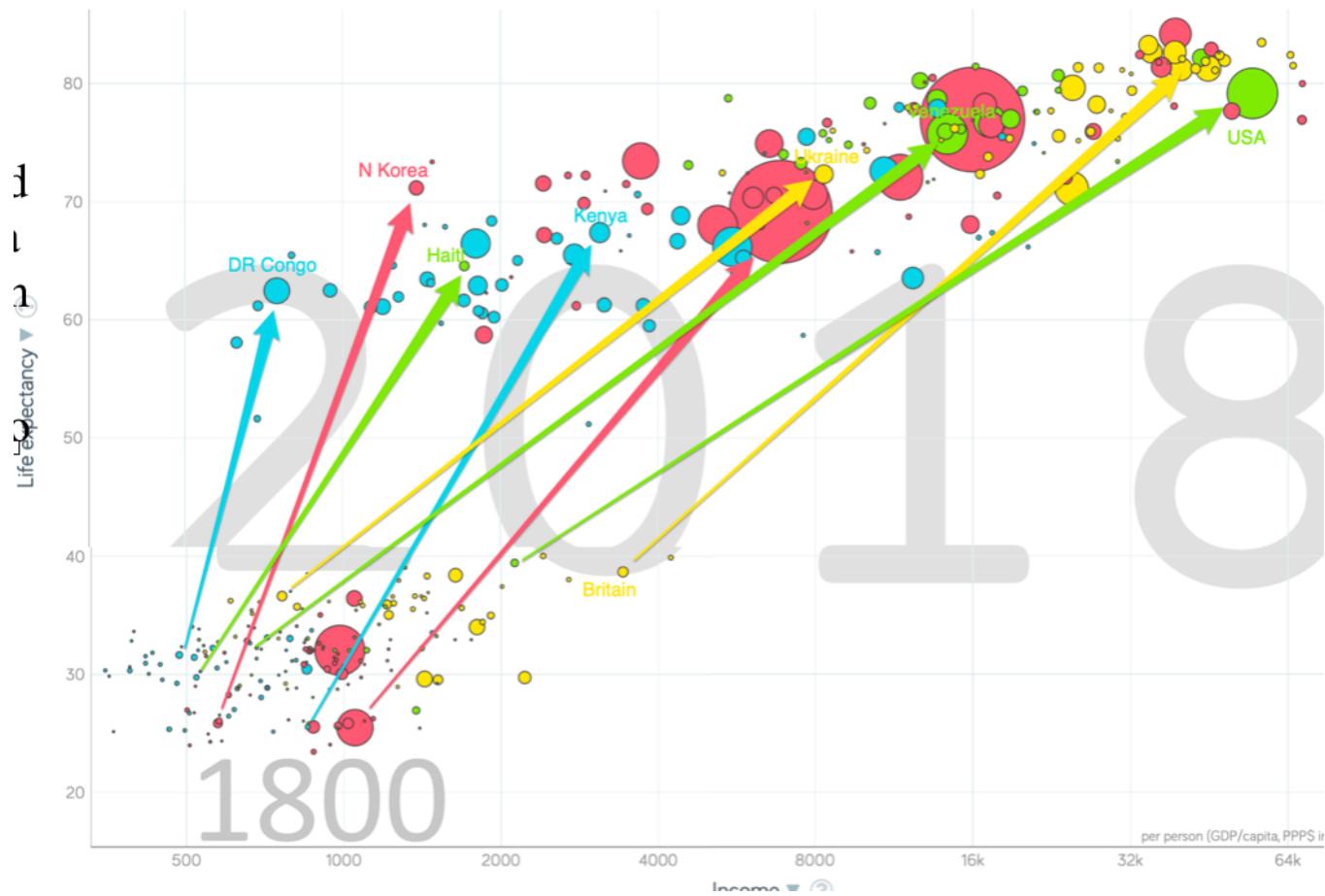
Where does the “ $\rho$ ” come from?

- “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

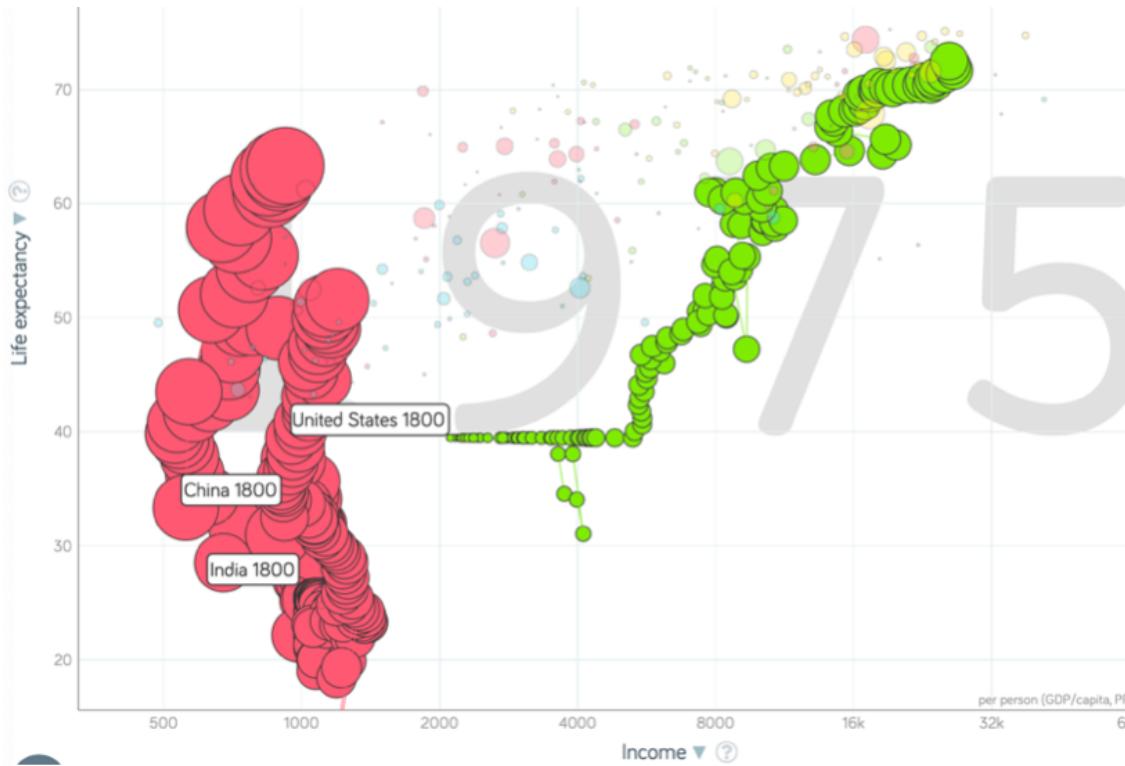
# One Figure: A Great Divergence

**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.



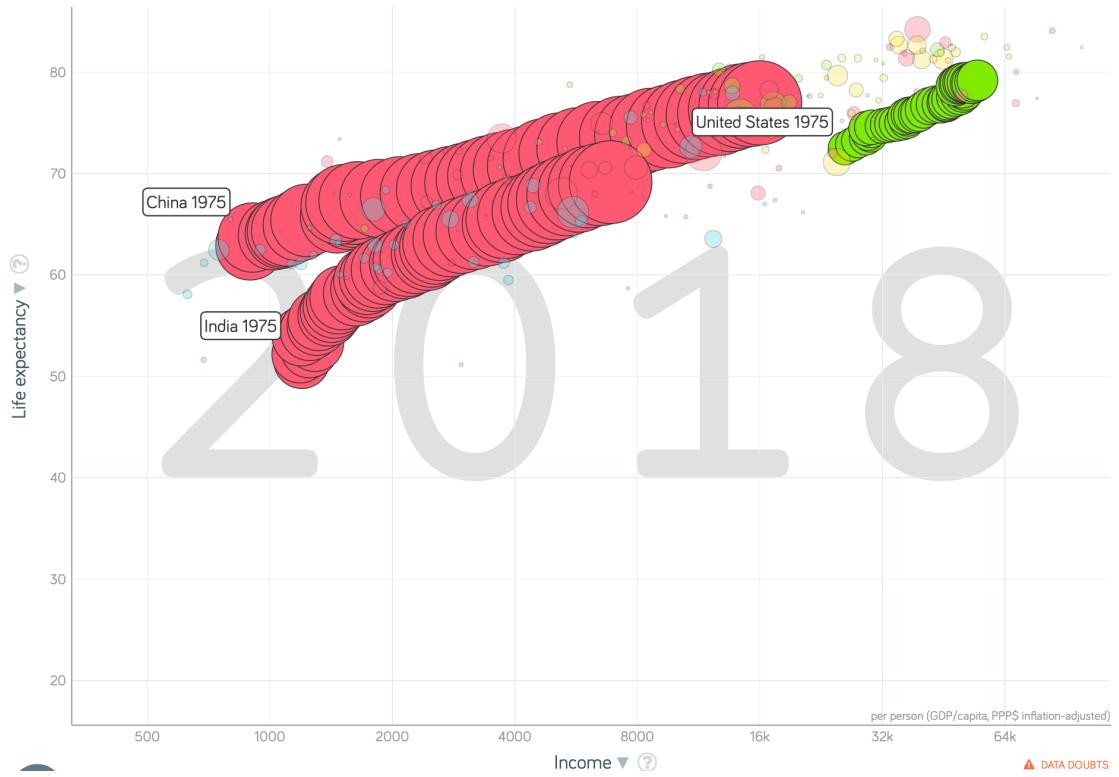
# China and India and America, 1800-1975



## 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...

# Greg Clark Being Contrarian

- There were lots of technological “revolutions” before the Industrial Revolution
- But they all petered out because of low price-elasticity of demand
- Coal-steam-cotton-machinery-textiles-rails were different
  - But even that was reaching limits to growth by 1870 or so...
  - The classic British Industrial Revolution more a comparative-advantage concentration of global manufacturing than true modern economic growth...

# Karl Marx (1867): The Key is “Capitalism”— Market Economy Plus...

- Karl Marx (1867), "The Secret of Primitive Capital Accumulation," Capital, Vol. 1, Part VIII, Chapters 26-32 <http://tinyurl.com/dl20090112k>
  - “We have seen how money is changed into capital; how through capital surplus-value is made, and from surplus-value more capital. But the accumulation of capital presupposes surplus-value; surplus-value presupposes capitalistic production; capitalistic production presupposes the pre-existence of considerable masses of capital and of labour power in the hands of producers of commodities. The whole movement, therefore, seems to turn in a vicious circle, out of which we can only get by supposing a primitive accumulation (previous accumulation of Adam Smith) preceding capitalistic accumulation; an accumulation not the result of the capitalistic mode of production, but its starting point...”
  - “The immediate producer, the labourer, could only dispose of his own person after he had ceased to be attached to the soil... the slave, serf, or bondsman of another. To become a free seller of labour power... he must further have escaped from the regime of the guilds.... The historical movement which changes the producers into wage-workers... their emancipation from serfdom and from the fetters of the guilds... alone exists for our bourgeois historians...”
  - “But... these new freedmen... [were also] robbed of all their own means of production, and of all the guarantees of existence afforded by the old feudal arrangements. And the history of this, their expropriation, is written in the annals of mankind in letters of blood and fire...”
- Workers *must* work for wages...
- Capitalists *must* invest and accumulate...