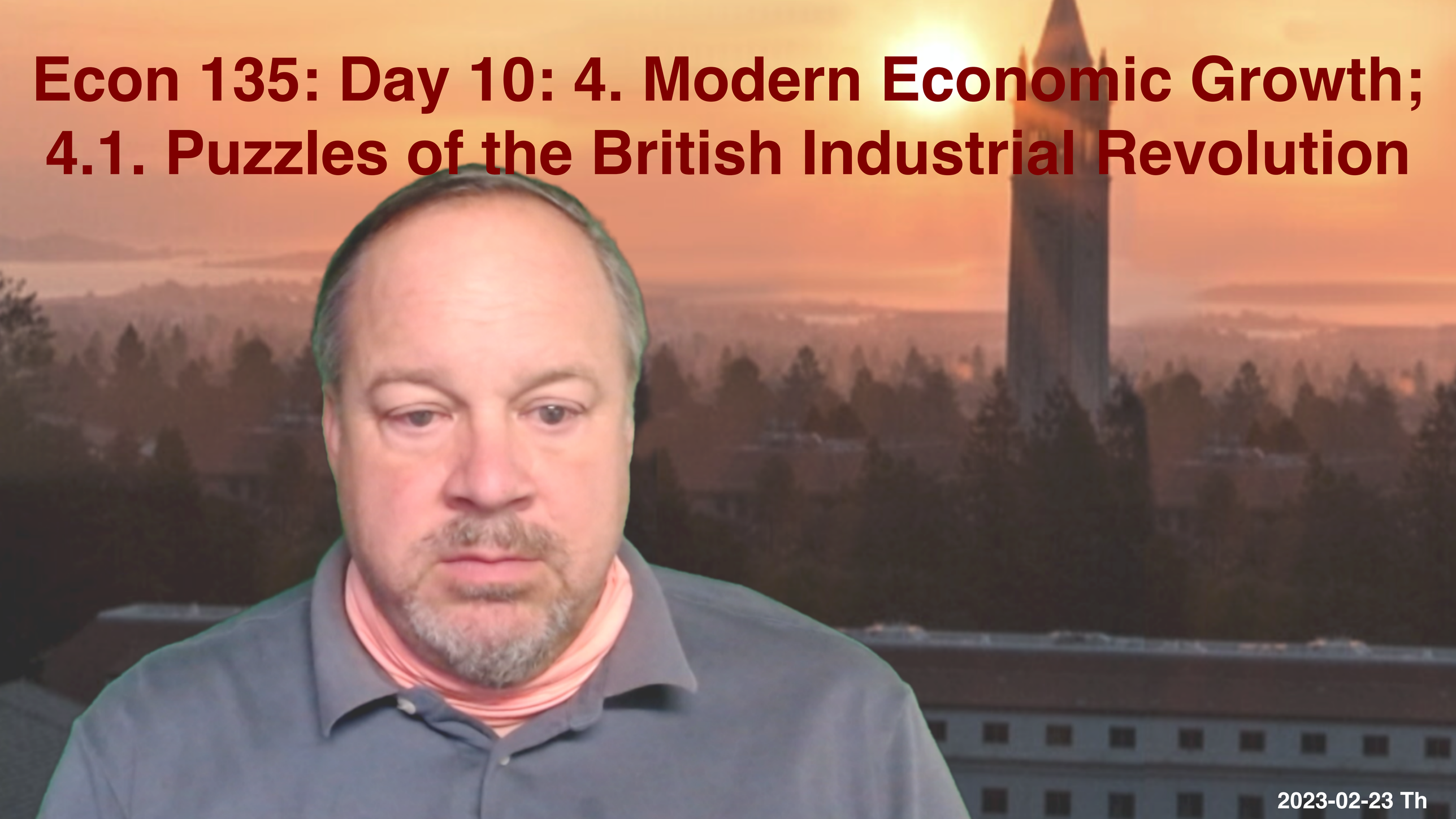
Econ 135: Day 10: 4. Modern Economic Growth; 4.1. Puzzles of the British Industrial Revolution



2023-02-23 Th

This Week…

Econ 135 S 2023: WEEK 6: Day 9 & Day 10: On the Eve of the Industrial Revolution; & The Puzzle of the Industrial Revolution

J. Bradford DeLONG

All Sections

Feb 20 at 10:38am

2022-02-21 Tu: Day 9: 3.5 On the Eve of the Industrial Revolution <https://bcourses.berkeley.edu/files/85438077/download?download_frd=1>
2022-02-23 Th Day 10: 4. Modern Economic Growth. 4.1. The Puzzle of the Industrial Revolution

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Required Readings:

Allen, chs, 2 & 3
Clark, ch. 10

Optional:

John Coatsworth (2008): *Inequality, Institutions & Economic Growth in Latin America*
Melissa Dell (2015): *Path Dependence in Development: Evidence from the Mexican Revolution*
Ian Morris: *Why the West Rules–For Now*, **chapter 3:** Taking the Measure of the Past
Robert Allen: *The Industrial Revolution: A Very Short Introduction*, *chs* 3, 5-6
Clark, chs, 11-13
David Landes (2006): *Why Europe and the West? Why Not China?*
Bateman & Weiss (1981): *A Deplorable Scarcity: The Failure of Industrialization in the Slave Economy*, ch. 1

Today's Lecture: The Industrial Revolution & Modern Economic Growth

- Steps to Modern Economic Growth (which could have been bypassed? which were essential? when and why did other civilizations than the Dover Circle stall out?)
- Was the key simply "capitalism"?
- What the Industrial Revolution and what followed unleashed.
- We follow Bob Allen's theory: what it is.
- Was the Industrial Revolution by itself ***that*** big a deal?
- Was it a good thing for those trapped in it?
  - Imperial-Commercial & Industrial-Revolution Age inequality.
  - Plantation slavery.
  - African growth retardation.

Prerequisites for Modern Economic Growth

- The industrial research lab
- The modern corporation
- The global market economy
- The engineering profession
- The machine tool industry
- Bob Allen's four policies:
  - Banks
  - Schools
  - Railroads, and other infrastructure
  - Appropriate tariffs
- Laws to be changed for general utility
- Laws not to be changed for the benefit of powerbrokers
- Steampower
- Coal
- Cotton
- Sugar
- Capitalist mode of production
- Freedom of occupation
- Nothing by claim–by experiment only
- Global trade
- Columbian exchange
- Rule of law
- Tinkering metalworking culture
- Merchants and makers have a political voice
- Printing
- Codified law [Rome]
- Science [Hellenistic Greece]
- Commercial society
- Philosophy
- Bureaucracy
- Coinage
- Trade
- Division of labor
- Writing
- Settlement

The Industrial Revolution: 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…

Adam Smith Had No Clue…

- We have market economies throughout Eurasia, at least—i.e., places where becoming a merchant drawing on sophisticated artisanal producers is a road to wealth, even if not *the* road…
- We have governments smart enough—or constrained enough—not to kill the goose that lays the golden eggs, at least not quickly…
- We have what looks like worldwide growth at a faster pace after 1500—one that calls forth a demographic response…
  - Commercial Revolution sees shared global prosperity—but with Atlantic Europe grabbing the lion's share primarily via empire…
- Post-1770 in the North Atlantic we have growth that outruns any possible demographic response, and triggers the demographic transition…
- Why? And how?
  - Post-1870 we have a further acceleration to modern economic growth…

Longest-Run Global Economic Growth

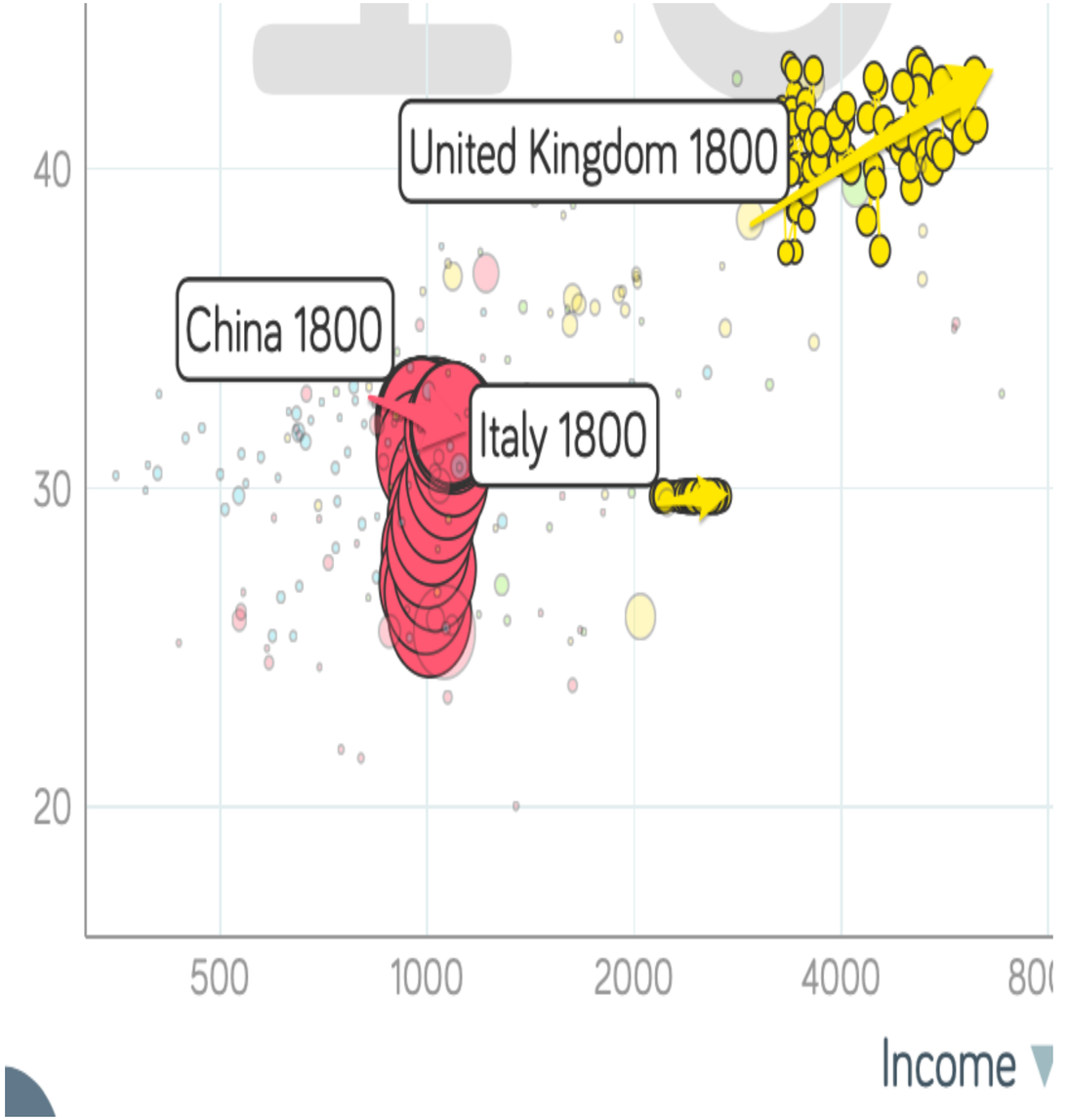
Date	Technological Ideas-Stock Growth Rate h	Technological Ideas Stock Level H (1870 = 1)	Average Annual Real Income per Capita y	Total Human Population P (millions)	Total Real World Income Y (billions)
-48000	0.002%	0.011	$1,200	0.2	$0.24
-8000	0.003%	0.036	$1,200	2	$2.4
-6000	0.009%	0.043	$900	5	$4.5
-3000	0.018%	0.074	$900	15	$14
-1000	0.030%	0.136	$900	50	$45
150	0.060%	0.272	$900	200	$180
800	0.014%	0.297	$900	240	$216
1500	0.052%	0.429	$900	500	$450
1770	0.149%	0.643	$1,100	750	$825
1870	0.442%	1.000	$1,300	1300	$1,690
2010	2.159%	20.557	$11,600	6900	$80,040

The Dover Circle

Date	Ideas-Stock Growth h	ideas Level H	Annual Real Income per Capita y	Population P (millions)	Total Real Income Y (billions)
-48000					
-8000	0.000%	0.0	$1,200	0.1	$0.12
-6000	0.003%	0.0	$900	0.2	$0.18
-3000	0.015%	0.1	$900	0.5	$0.45
-1000	0.035%	0.1	$900	2	$1.80
150	0.048%	0.2	$900	6	$5.40
800	0.022%	0.2	$900	8	$7.20
1500	0.096%	0.5	$1,000	25	$25.00
1770	0.200%	0.8	$1,400	75	$105.00
1870	0.914%	2.0	$2,800	175	$490.00
2010	2.514%	68.0	$50,000	800	$40,000.00

Global Divergence

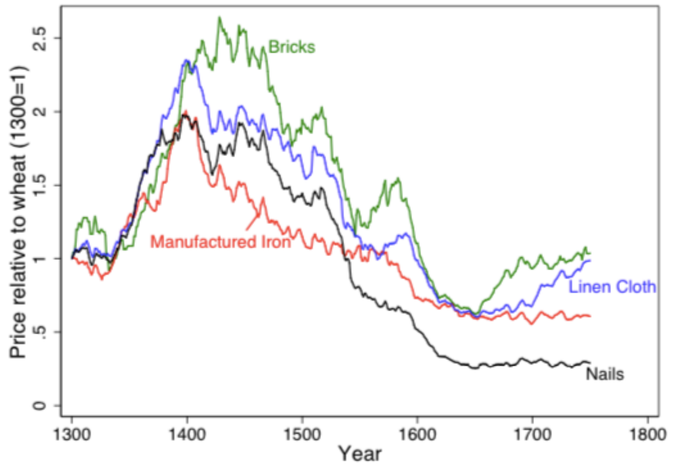
- Before 1500: Marco Polo
  - Asia miraculous & fabulous
- From 1500-1650 Europeans traveling to the high civilizations of Asia reported:
  - The princes and merchants were fabulously rich…
  - The people were prosperous and orderly
- From 1650-1750:
  - The princes and merchants were fabulously rich…
  - The people were orderly
- After 1750:
  - The princes were fabulously rich…
  - The people were destitute…
- Hans Rosling and Company: Gapminder
- 1800-1870 sees:
  - UK go from $3430 to $6040
  - Italy go from $2220 to $2640
  - China go from $984 to $1100



The Relocation of Global Industry to England

- Clark: “The population fed and clothed by English agriculture did not expand from 7.5 million to 21 million between 1760 and 1860… from 7.5 to 9.6 million…”
- Gets into the business of combining cotton, imported food, coal, and British and Irish workers to make the world’s textiles, iron, machines, and ‘protection’…
- A huge shift…

Figure 9: Prices of manufactured goods relative to wheat for England, 1300-1750



Notes: Price data from Clark (2005). All prices are relative to the price of wheat; the 25-year moving average is depicted.

Table 13: Agricultural Consumption per Person in England, 1700s to 1860s

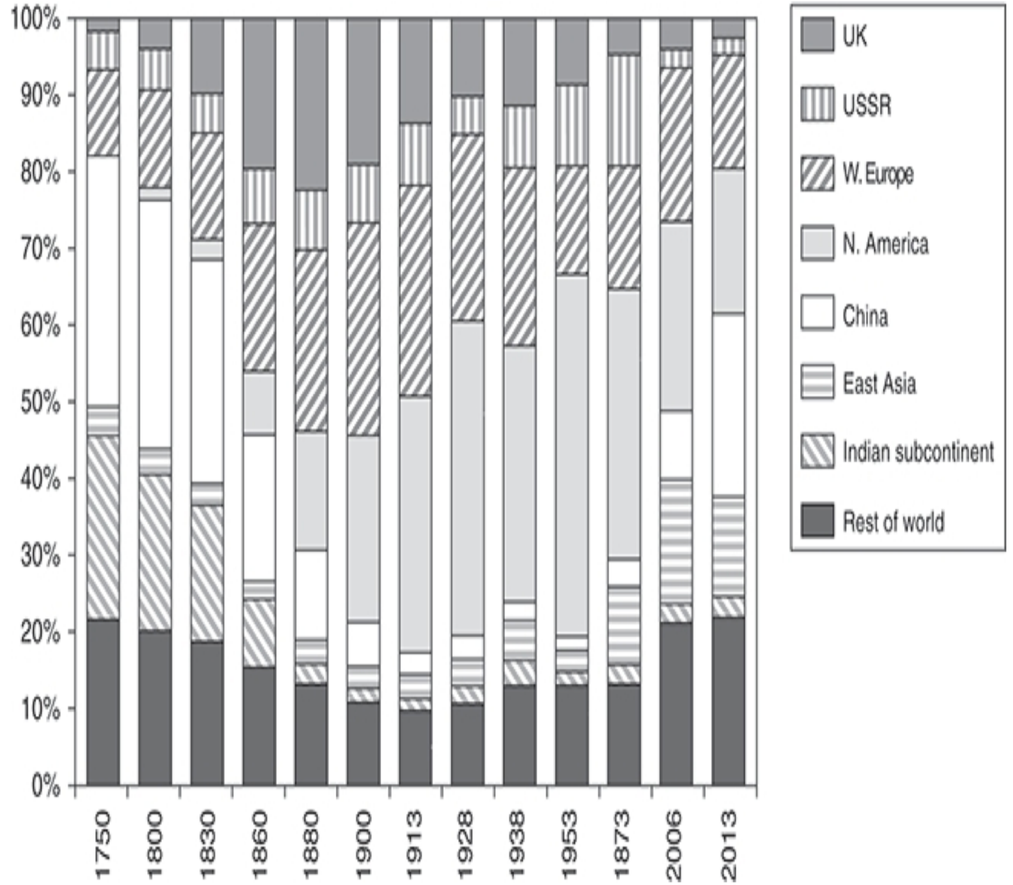
	1700-9	1860-9
Population (millions)	5.16	19.97
English Farm net output (£ m.)	63.1	111.7
Net Food Imports (£ m.)	2.2	75.2
Net Raw Material Imports (£ m.)	-1.3	62.7
Domestic Coal Consumption (£ m.)	1.7	50.3
Total Food, Energy and Raw Material Consumption (£ m.)	65.7	309.9
Consumption per Person (£)	12.7	15.5
Predicted Consumption (£)	12.7	15.8

Notes: Cotton, wool, flax, and silk retained for home consumption are estimated by subtracting the raw material content of textile exports estimated using figures given in Deane and Cole (1962).

Allen: Spread & Concentration of Industrialization

Robert Allen (2017): *The Industrial Revolution: A Very Short Introduction* <https://delong.typepad.com/files/allen-industrial.pdf>, chs. 3, 5-6:

- Western Europe: 12% in the 18th century to 28% in 1913
- North America: Less than 1% in the 18th century to 47% in 1953
- The Pacific Rim share dropped from 4 per cent to 2 per cent in the early 19th century, but then increased to 5 percent in the first half of the 20th century. By 2006, these countries were producing 17 per cent of the world's manufactures
- China in 1953 at 2% of manufacturing was at its all time low. 9 per cent in 2006. 25 per cent in 2013
- The Indian subcontinent: 2% of the world's manufactures in 1973 and only 3% in 2013



16. Percentage shares of world manufacturing output, 1750–2013.

Many, Many Theories About the Industrial Revolution: We Follow Allen

Melissa Dell takes the "institutional" approach…

Theories About the Industrial Revolution

There are many (and many more citations could be provided)...

- Religion (Weber, 1905)
- Exploitation of oversees colonies (Williams, 1944)
- Demography (Hajnal 1965) - cultural checks on fertility
- Institutions (North 1973) - property rights, patent laws, etc.
- Interstate rivalries (Jones 2003, Diamond 1997) - war makes states
- Scientific Revolution (Mokyr, 1992) - i.e. the Scientific Method, Republic of Letters
- Labor costs (Allen, 2014) - the English invent machines because labor is expensive
- Coal (Pomeranz, 1992)
- Agricultural productivity

Our focus:

- Religion (Weber, 1905)
- **Exploitation of oversees colonies (Williams, 1944)**
- **Demography (Hajnal 1965) - cultural checks on fertility**
- **Institutions (North 1973) - property rights, patent laws, etc.**
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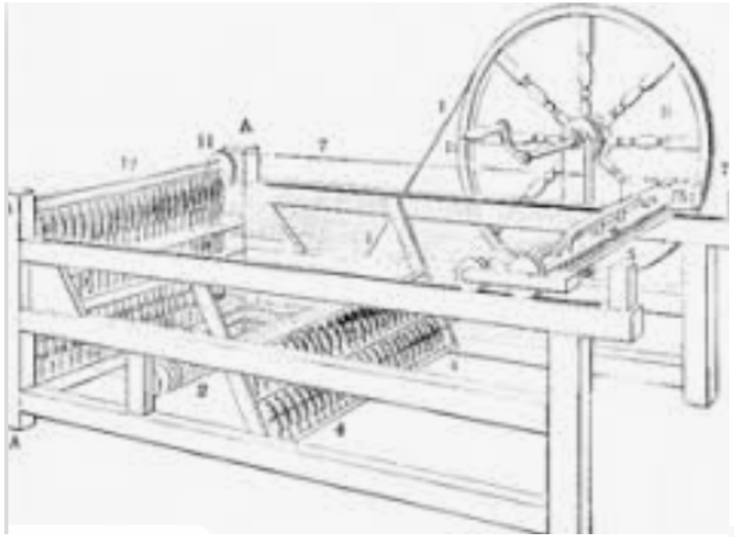
- Coal (Pomeranz, 1992)
- Agricultural productivity (Matsuyama, 1992)

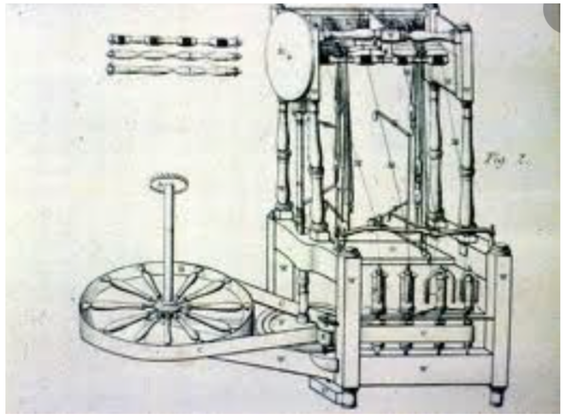
Factor Prices & Empire: Robert Allen (2017): *The Industrial Revolution: A Very Short Introduction* <https://delong.typepad.com/files/allen-industrial.pdf>, chs. 3, 5-6:

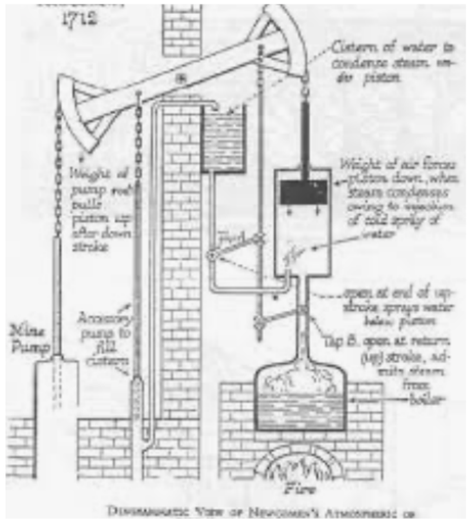
- Technological change is the motor that powers economic growth:
- A *technological revolution* was at the heart of the Industrial Revolution
  - Abraham Darby's successful smelting of pig iron with coke rather than charcoal in 1709…
  - Huntsman revolutionized the production of steel with the crucible process in the 1740s
  - Henry Cort did the same for wrought iron manufacture with the puddling and rolling processes in the 1780s.
  - James Hargreaves invented the spinning jenny in the 1760s
  - Richard Arkwright invented the water frame in the 1770s
  - Samuel Crompton invented the self-acting mule in the 1780s
  - Power weaving by Edmund Cartwright around 1785
  - The steam engine by Thomas Newcomen in the early 1700s
  - Steam engine improvement by James Watt in the 1760s

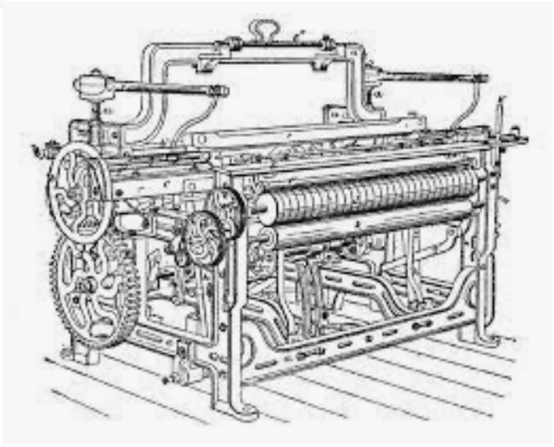
What Do These Look Like?

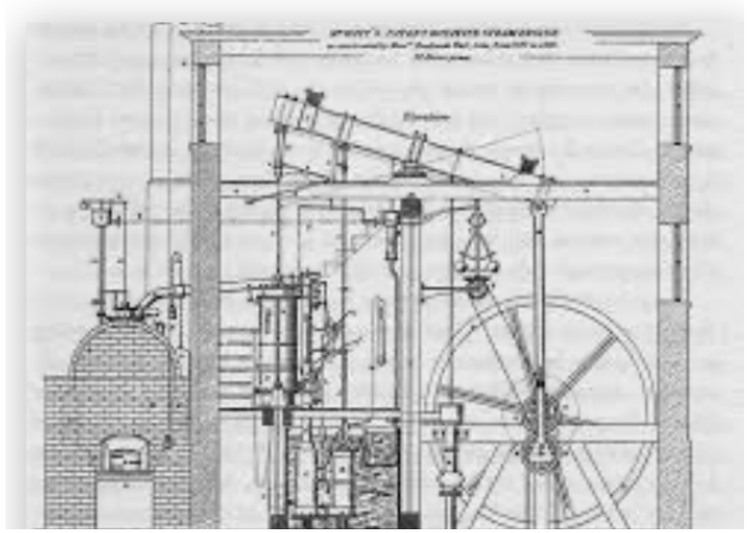
Spinning jenny, water frame, self-acting mule, Cartwright's power loom, Newcomen & Watt.







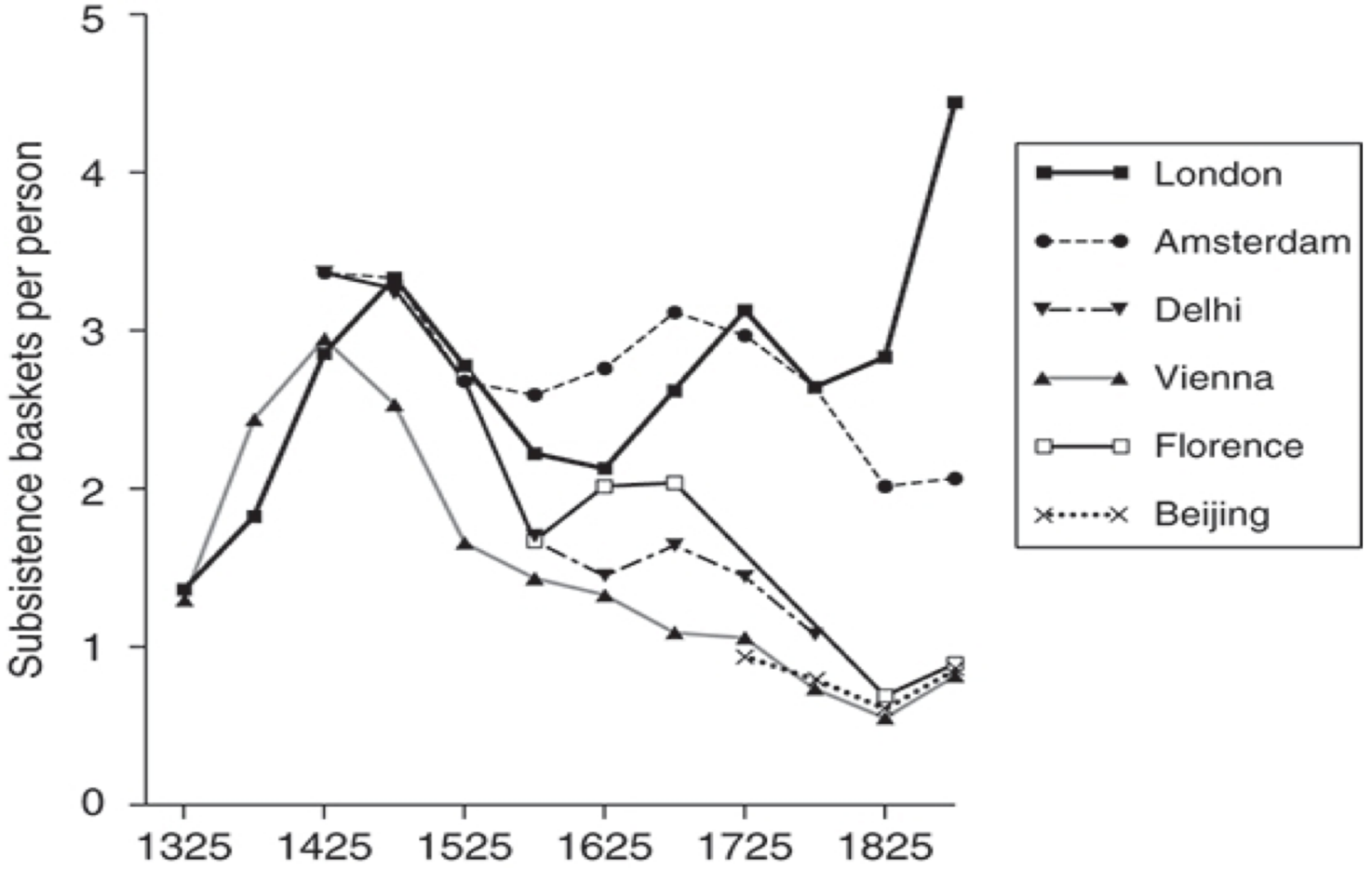




Background Factors

Allen (2017): "Institutions, practices, and culture that supported technological innovation and business investment, they were not sufficient on their own to explain the Industrial Revolution. Other parts of the world were equally blessed, but they did not have industrial revolutions…":

- Specific triggers…
  - Empire, commerce, and real wages…
  - Cotton—a fiber that could be worked by machine…
  - Factories…
  - Coal…
  - & steam engines…



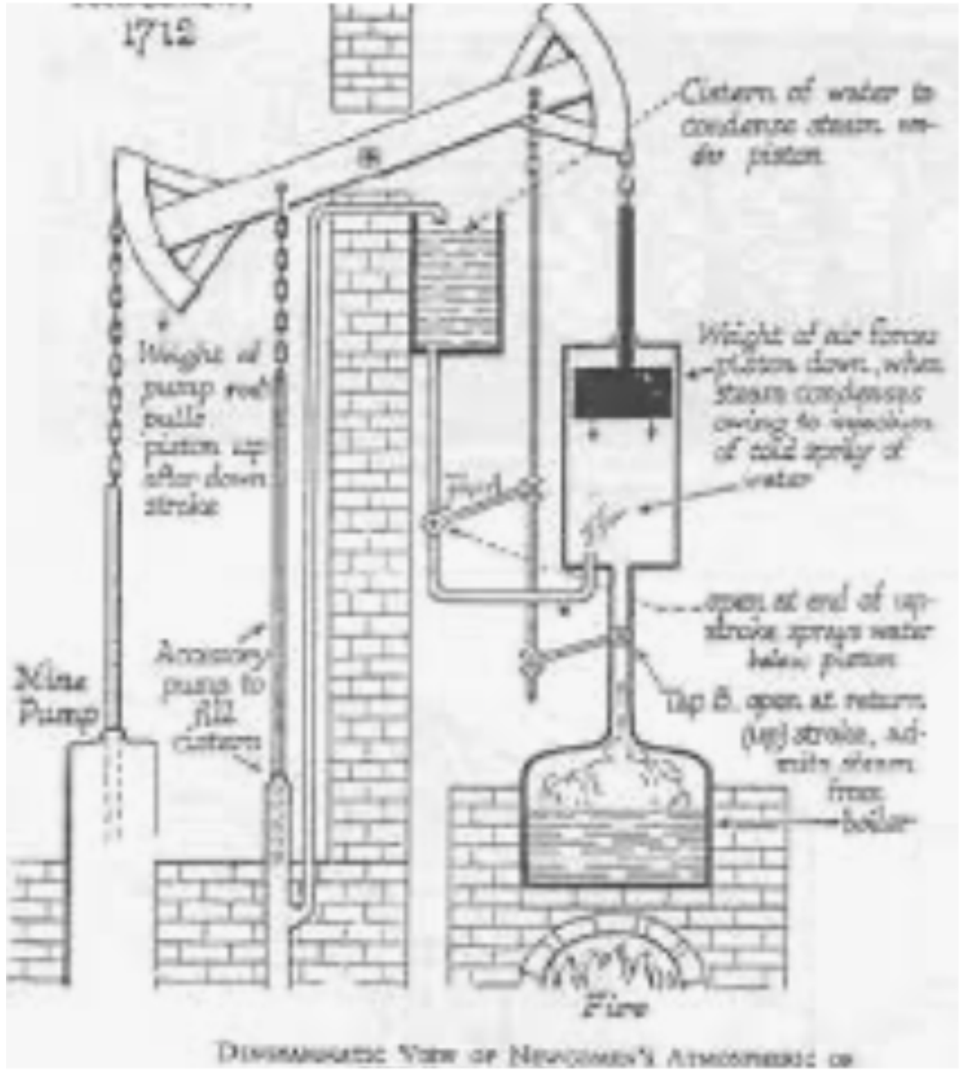
6. Wages relative to the cost of subsistence around the world.

Background Factors: Coal

Steam Engines

“The reason it was profitable to develop the Newcomen engine in Britain was because there were coal mines to be drained “:

- The science underlying the steam engine was pan-European
- The research and development (R&D) was carried out in Britain by an Englishman
- James Watt, FRS: The Industrial Enlightenment



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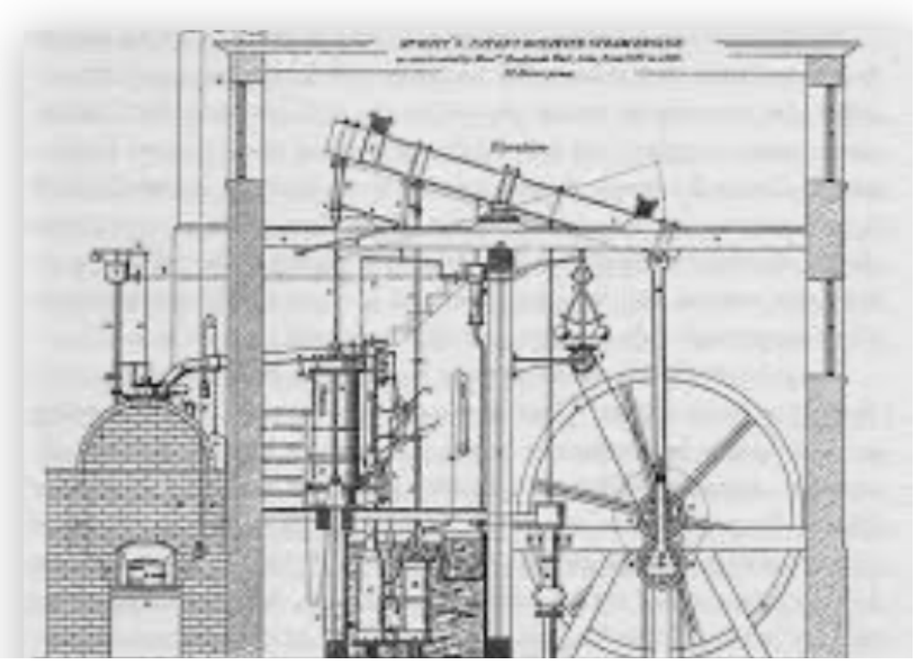
English vs. Chinese Pottery Kilns

Energy prices mattered—a lot:

- England developed methods that differed fundamentally from those used in China. In both countries, technology evolved in the direction of reducing the use of expensive inputs while increasing the use of cheap ones…
- English-style kilns had a coal fire in the bottom. The heat rose, enveloped the pots, and then vented out of the furnace through a hole in the top…
- Chinese kilns used lots of capital to preserve energy. They consisted of a series of chambers rising up a hillside. A fire burned at the entrance to the lower chamber where the heat was drawn in to bake the pots. The heat was not vented out of a hole in the top in the English manner. Instead, it was forced down through a hole at floor level and entered the next chamber up the hill…

Don’t Overestimate that Spread

Steam Engines: 165K HP in 1830, 2.1M HP in 1870:



- 1712: Newcomen: 5 HP
- 1733: 1K HP (100 engines)
- 1775: 9K HP (600 engines)
- 1800: 40K HP (500 Watt, 1500 Newcomen engines)
- 1830: 165K HP
- 1870: 2.1M HP

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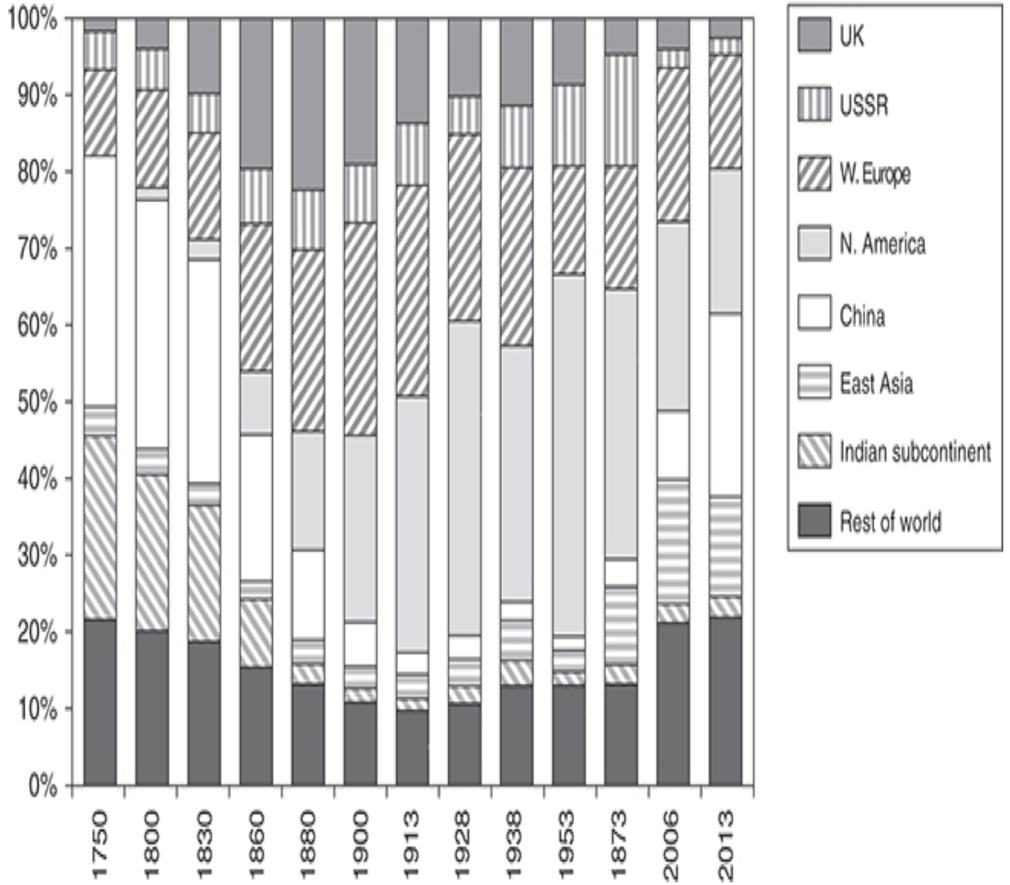
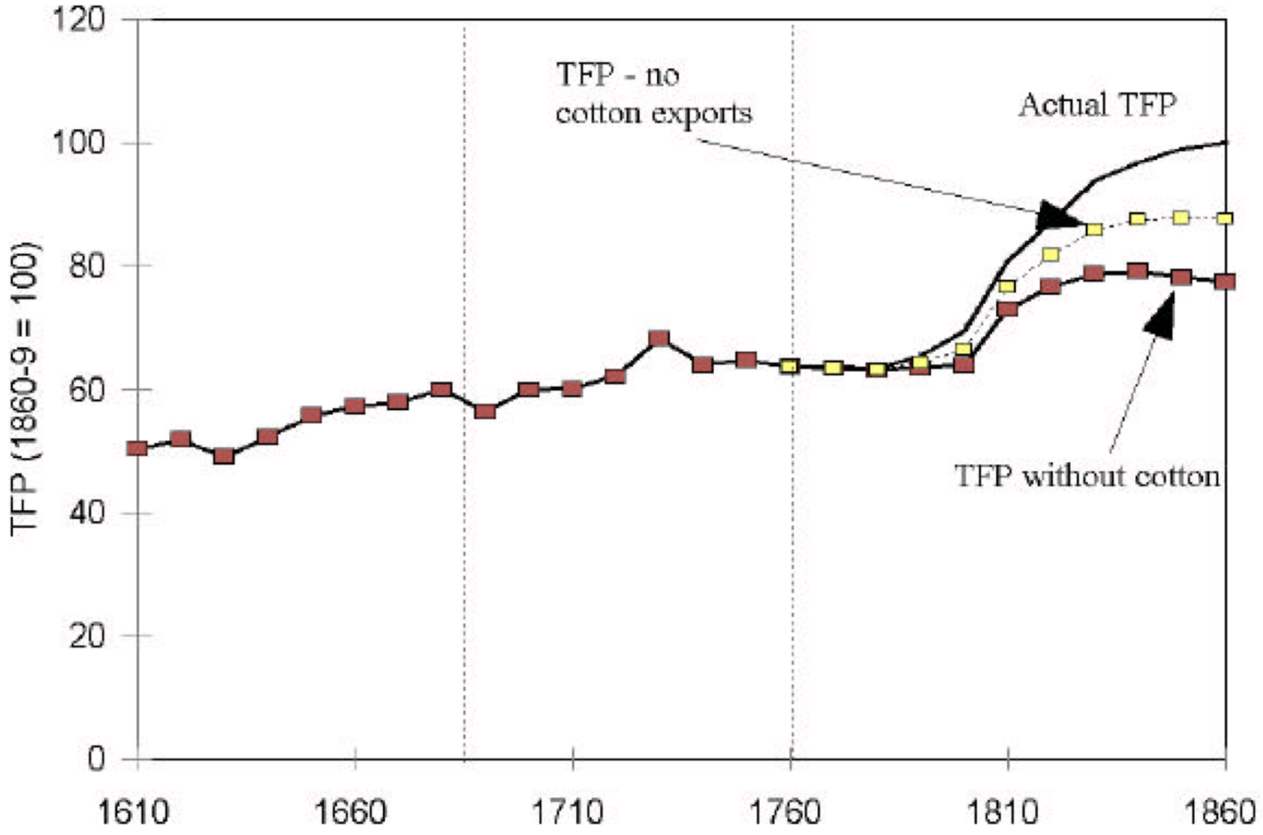


16. Percentage shares of world manufacturing output, 1750–2013.

Was the Industrial Revolution *That* Big a Deal?

- **Gregory Clark**. 2001. "The Secret History of the Industrial Revolution." Unpublished manuscript. <http://faculty.econ.ucdavis.edu/faculty/gclark/papers/secret2001.pdf>

Figure 12: Overall TFP in England, 1610-1860



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Notes: Cotton, wool, flax, and silk retained for home consumption are estimated by subtracting the raw material content of textile exports estimated using figures given in Deane and Cole (1962).

Sources: Coal production: Flynn (1984, p. 26) and Church (1986, pp. 19, 53, 85-97). Imports 1860-9: Mitchell (1988). Imports 1700-9: Schumpeter (1960, tables XV, XVII). Exports 1700-9: Schumpeter (1960, tables VII, IX, X, XII, XIII), Mitchell (1988), pp. 221-2).

Was the Industrial Revolution a Good Thing for Those Caught in It?

- **Stephen Nicholas & Richard H. Steckel**. 1991. "Heights and Living Standards of English Workers during the Early Years of Industrialization, 1770–1815." *Journal of Economic History* 51 (December): 937–957. <http://www.jstor.org/stable/pdfplus/2123399.pdf>

We employed data on the heights of English and Irish male convicts transported to Australia to assess the living standards of workers between 1770 and 1815. Falling heights of urban- and rural-born males after 1780 and a delayed growth spurt for 13- to 23-year-old boys revealed declining living standards among English workers during the Industrial Revolution. This conclusion was supported by the fall in English workers' heights relative to that of convicts transported from Ireland. Significant urban-rural and regional variations in English living standards were revealed by using regression techniques.

changes in English living standards between 1770 and 1815. The height of both rural and urban workers fell significantly after 1780; rural Englishmen born in 1813 were almost 1 inch shorter than cohorts born in 1780, and urban Englishmen were over 1.5 inches shorter in 1802 than cohorts born in the late 1770s. The evidence shows that the growth spurt of English workers was delayed, that their growth continued much longer (at least until the age of 23), and that their final attained height fell from centile 20 in the 1770s to centile 6 for urban-born and centile 12 for rural-born Englishmen near the end of our period.

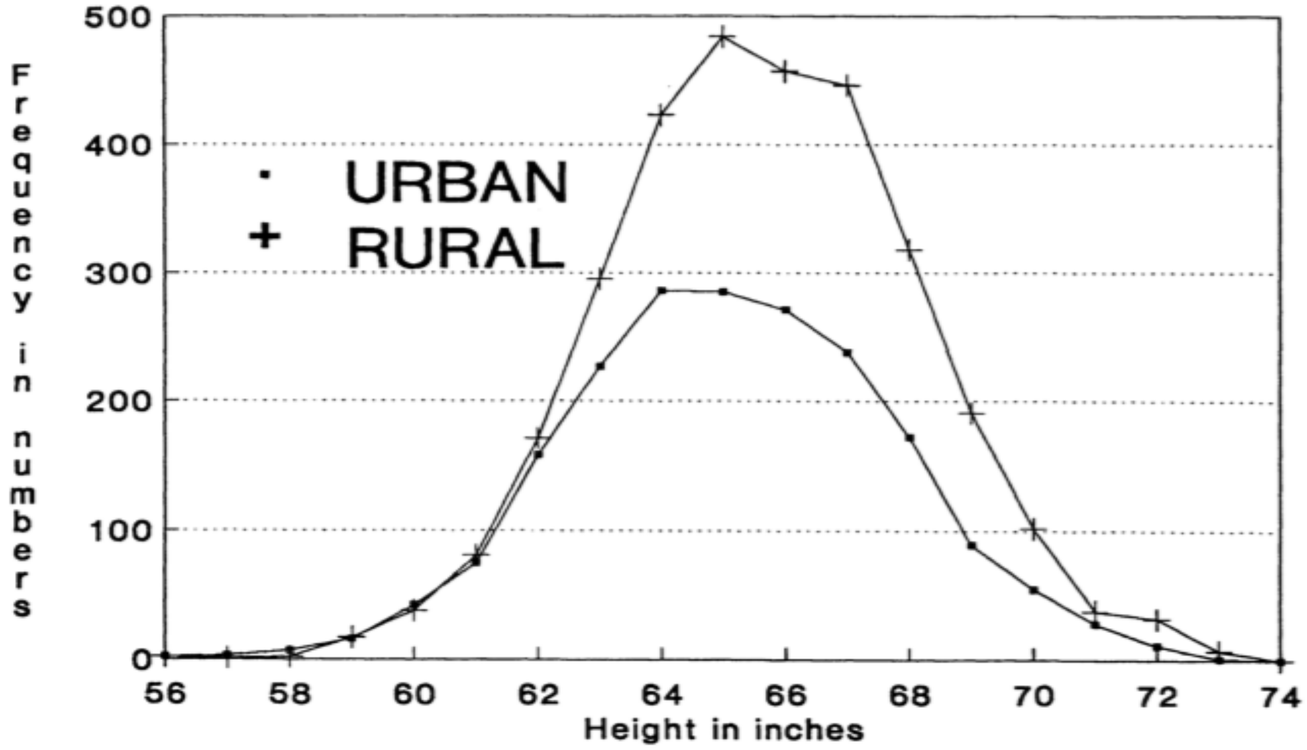


FIGURE 1

HEIGHT FREQUENCY FOR URBAN AND RURAL MALE ENGLISH WORKERS (23 TO 49 YEARS)

Five-Year Moving Averages

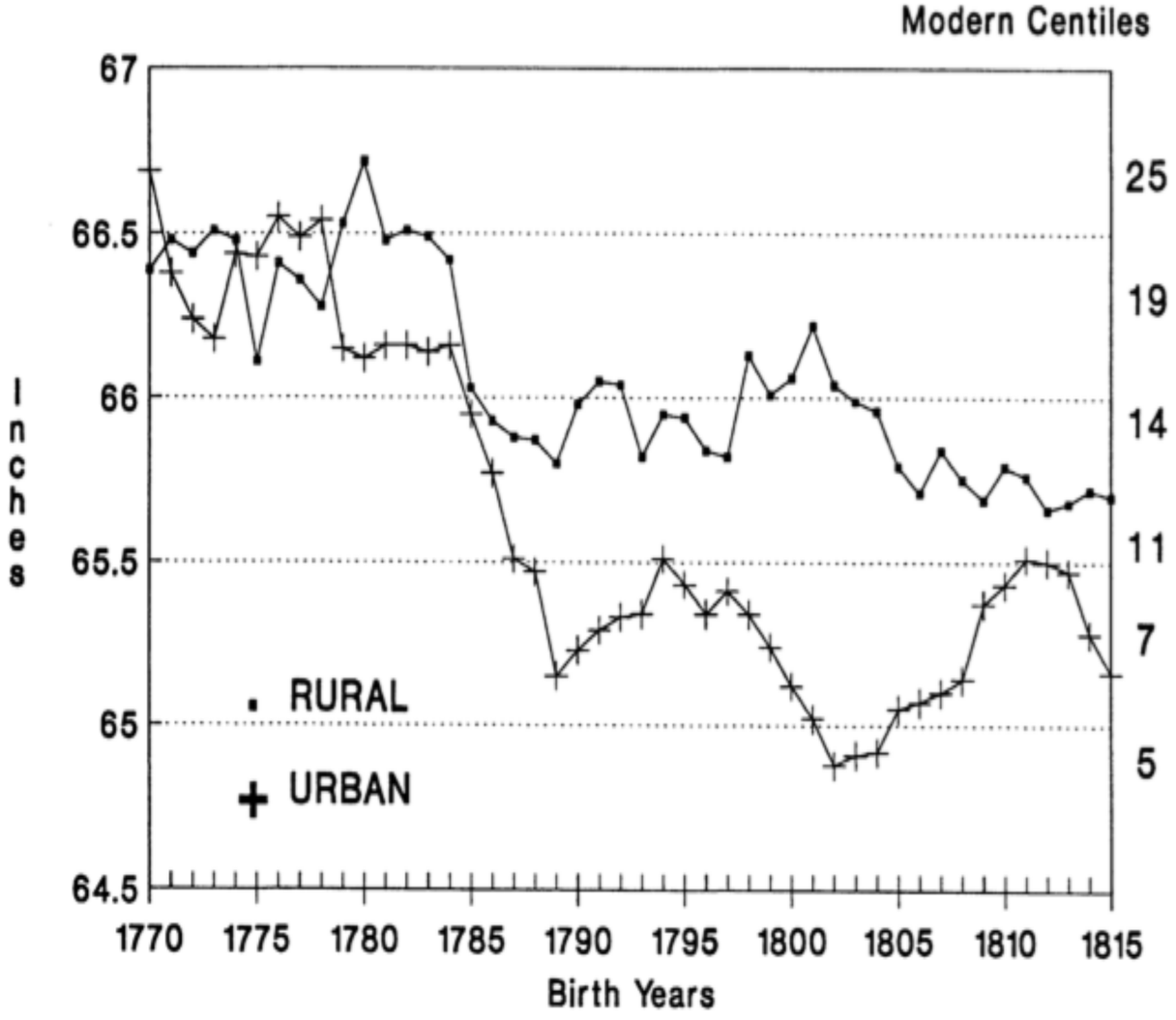


FIGURE 3

HEIGHT PROFILE OF ENGLISH WORKERS 23 TO 49: 5-YEAR MOVING AVERAGE

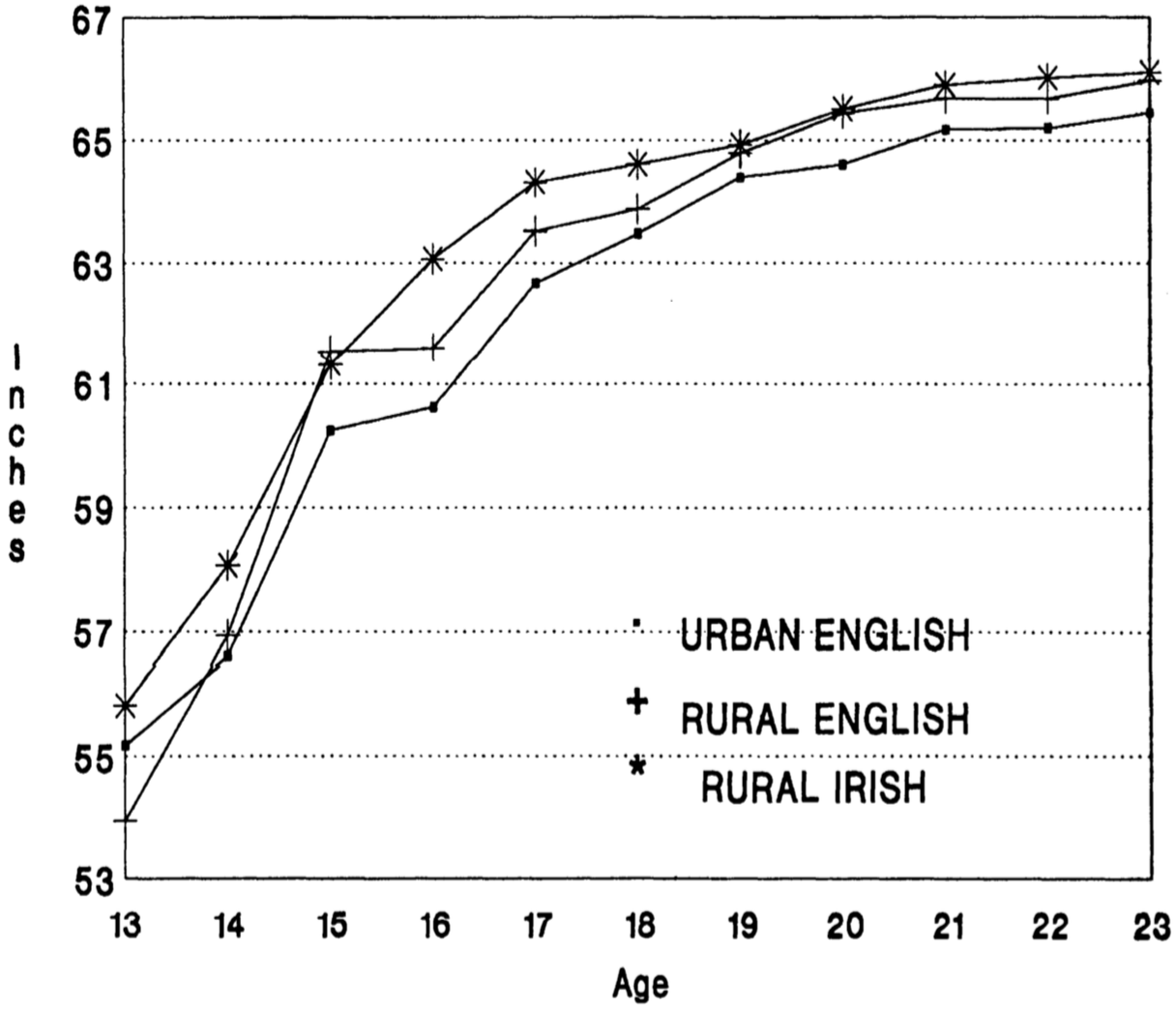


FIGURE 2

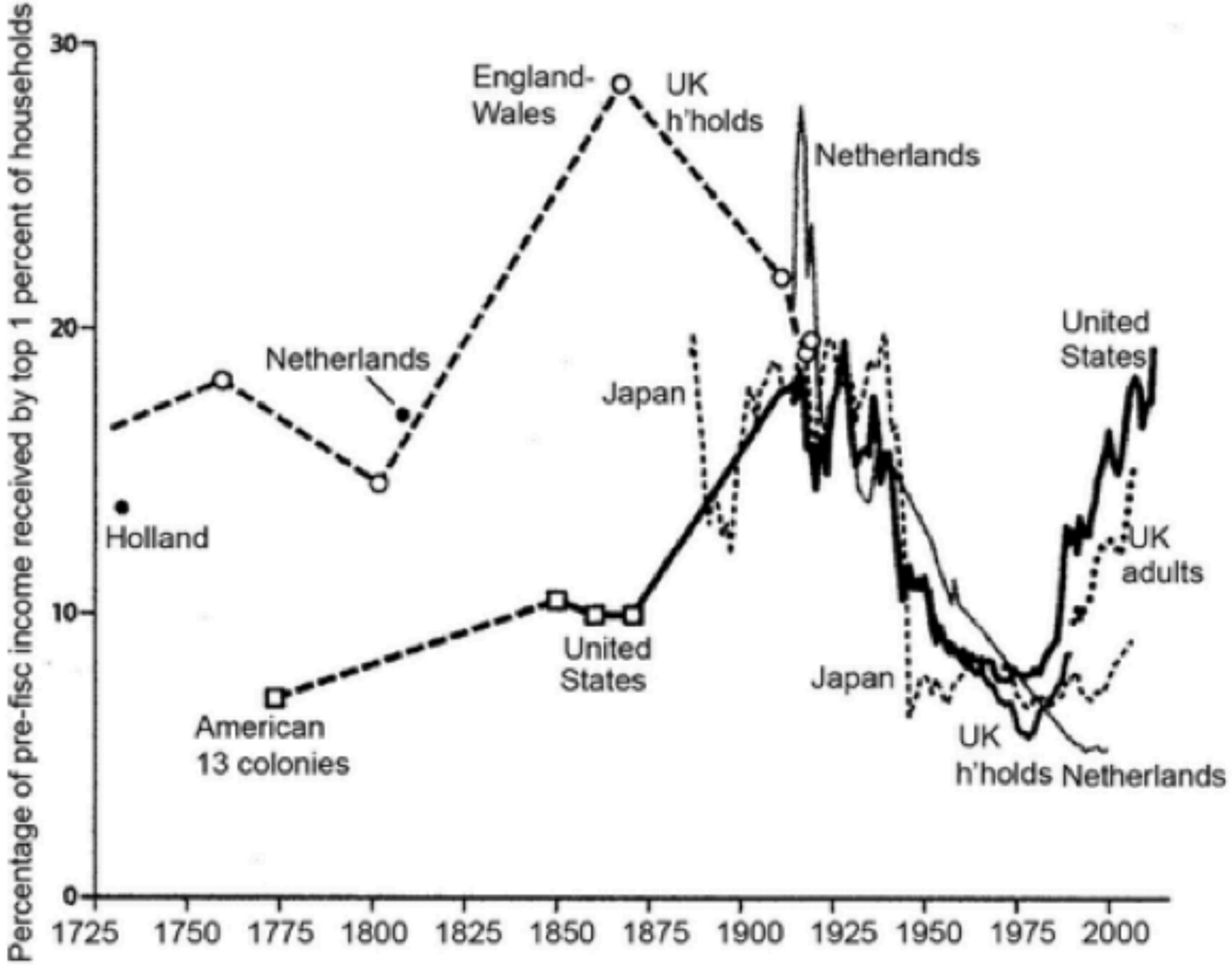
AVERAGE HEIGHT BY AGE OF ENGLISH AND IRISH WORKERS

Conclusions

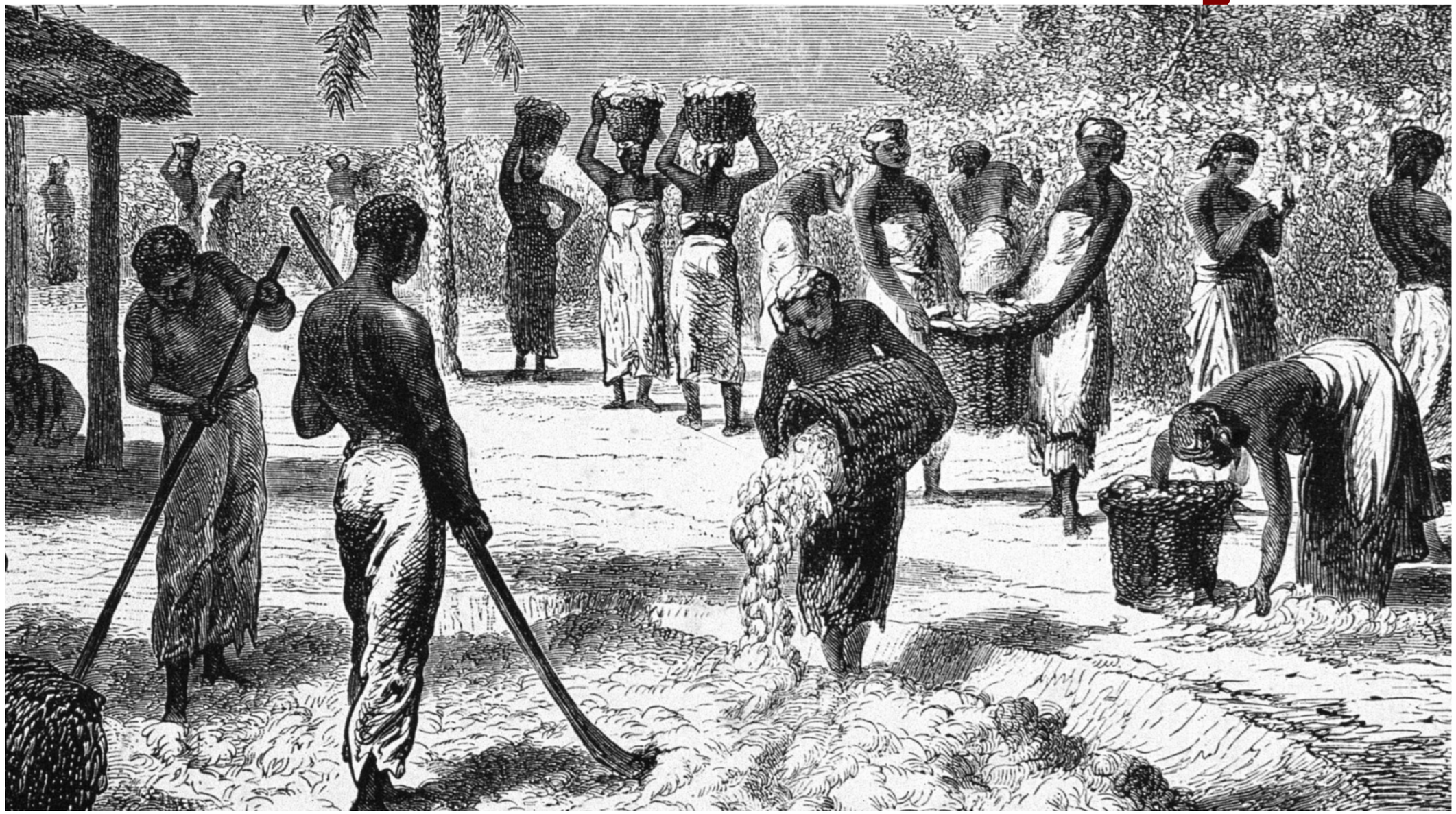
changes in English living standards between 1770 and 1815. The height of both rural and urban workers fell significantly after 1780; rural Englishmen born in 1813 were almost 1 inch shorter than cohorts born in 1780, and urban Englishmen were over 1.5 inches shorter in 1802 than cohorts born in the late 1770s. The evidence shows that the growth spurt of English workers was delayed, that their growth continued much longer (at least until the age of 23), and that their final attained height fell from centile 20 in the 1770s to centile 6 for urban-born and centile 12 for rural-born Englishmen near the end of our period.

Imperial-Commercial & Industrial-Revolution Age Inequality

Figure 3 Income share received by the top 1%, four countries over two centuries



Plantation Slavery



African Retardation & Slave Trade Legacy

In 1953 Africa was not "behind" the rest of the global south:

- Today it is—by far
- In 1950 1/7 of the world's extreme poor were in Africa
- Today ⅗ of the world's extreme poor are in Africa
- In the late colonial era Africa was doing good at exports: coffee, chocolate, palm oil, ground nuts, cotton
- In 1950 Zambia was more industrialized than and almost as rich as Portugal
- The same for Ghana

Abysmal Growth After Autonomy & then Independence

North Africa grows along with the rest of the global south—an average of 2%/year or so:

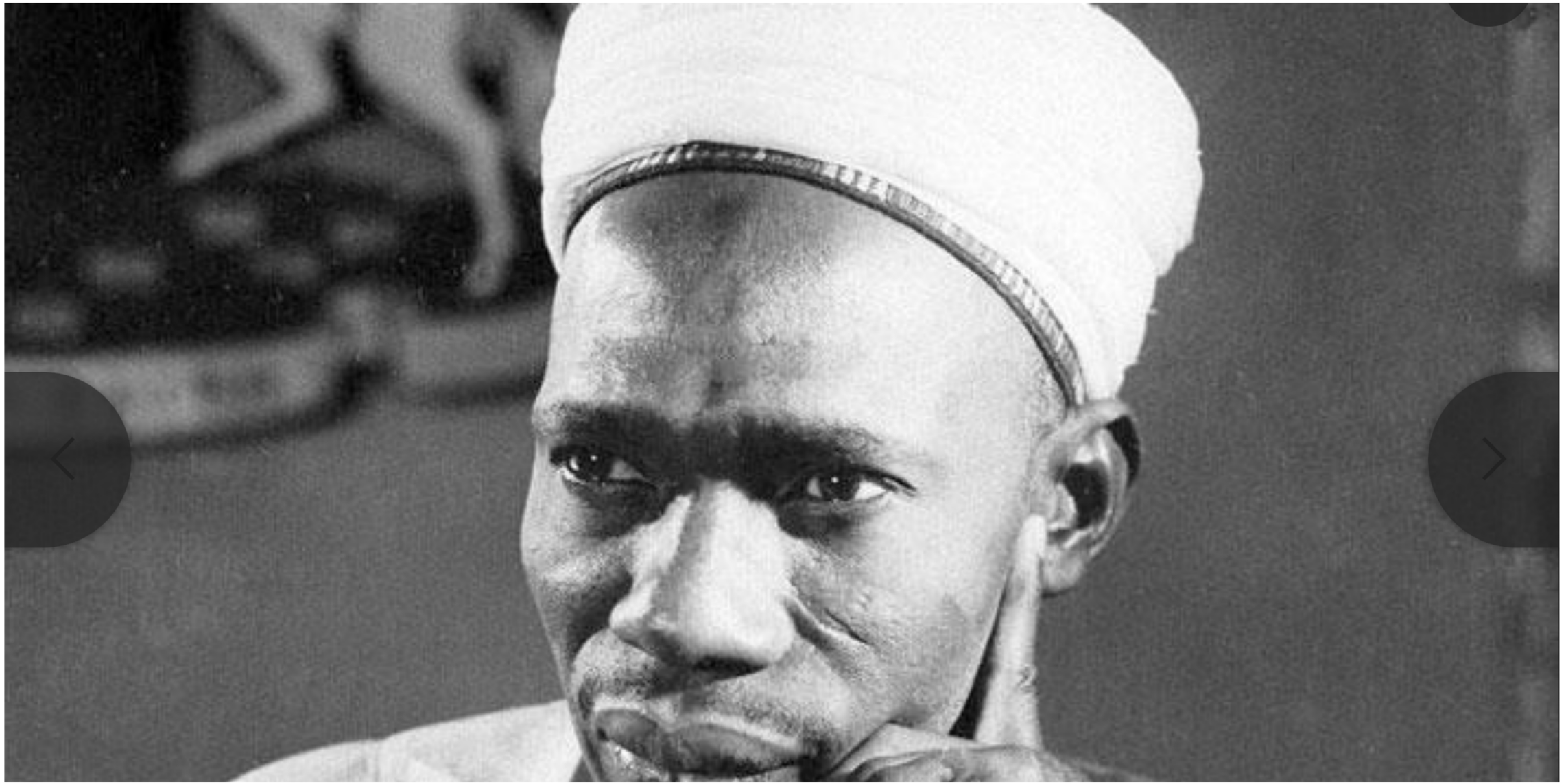
- But south of the Sahara things are different
- Ethiopia, Ghana, Zambia grow at 0.3%/year
- Three very different countries: an industrial, a primary-product exporter, an independent non-colonized
- What could apply to Africa south of but not north of the Sahara?
- And what could apply to pretty much all of Africa south of Sahara?
- The answer: the slave trade—primarily the early-modern imperial-commercial age Atlantic slave trade
- But also Indian Ocean and trans-Sahara

Slave Trades

Over history:

- Classical Greek and Roman powers: 30 million
- Vikings: 1 million
- Mediterranean: 1.5 million
- Black Sea: 3 million
- African trans-Atlantic: 13 million over 1600-1850
- African Indian: 5 million over 1000-1900
- African Sahara: 3 million 1200-1900,
- Internal African: ????
- Population of Africa in 1700: 60 million
- Born in Africa and surviving to 5 over 1500-1800: 360 million

Abubakar Tafawa Balewa



A Hypothesis

Why does African retardation vis-a-vis the rest of the global south start only with independence?

- Adam Smith: “it is not from the benevolence of the butcher or the baker that we expect our meat or bread, but from their self-interest”
- But is the self-interest of the butcher to sell you meat for money?
- Or is it the self-interest of the butcher to threaten you with his knife, take your money, tie you up, and sell you as a slave?
- Reciprocity and gift-exchange are powerful patterns of human interaction…
- But what if history leads you not to expect them?
- Not disastrous as long as colonial patterns of property and exchange dominate, but…

Nunn: Consequences of Rum, Guns, and Slaves

- From 8 to 6.5 in the natural log…
- exp(1.5) = 4.5
- Do we need controls?
- Or, rather, what controls do we need?
  - What else might be going on here?

- Nathan Nunn (2008): The Long-Term Effects of Africa's Slave Trades, *Quarterly Journal of Economics* 123 (February): 139–176. http://www.jstor.org/stable/pdfplus/25098896.pdf

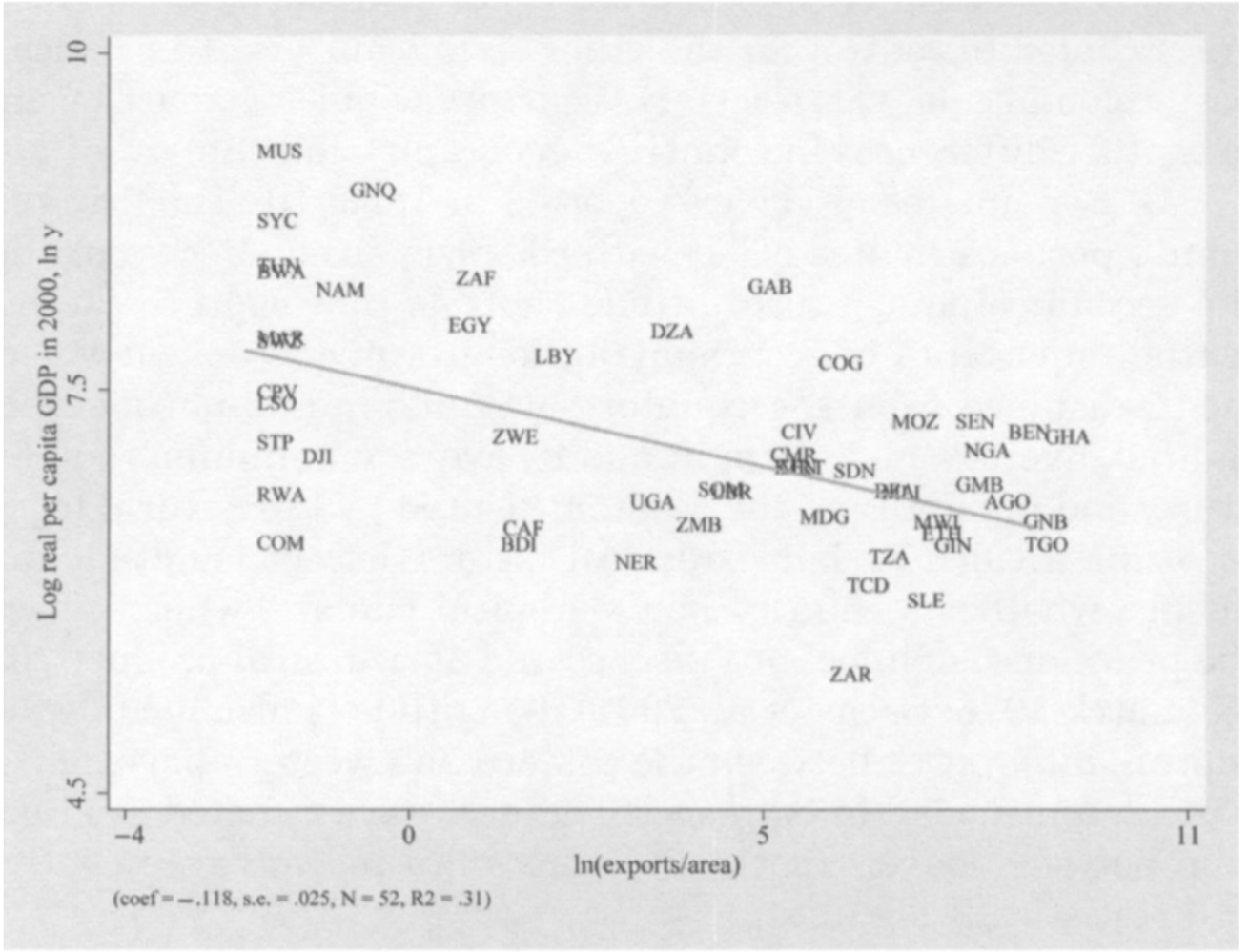


FIGURE III
Relationship between Log Slave Exports Normalized by Land Area, ln(exports/area), and Log Real Per Capita GDP in 2000, ln *y*