Econ 210a: Industrial Revolutions (February 12, 2020a)

J. Bradford DeLong

Spring 2019
Evans 648
W 1:10-3:00 pm

<https://bcourses.berkeley.edu/courses/1487686/>

<https://github.com/braddelong/public-files/blob/master/econ-210a-lecture-4a.pptx>

Industrial Revolutions: Readings for February 12…

Robert C. Allen (2011): Why the Industrial Revolution Was British: Commerce, Induced Invention and the Scientific Revolution <http://onlinelibrary.wiley.com/doi/10.1111/j.1468-0289.2010.00532.x/pdf>

Peter Temin (1997): Two Views of the British Industrial Revolution <http://www.jstor.org/stable/pdfplus/2951107.pdf>

Stephen Nicholas and Richard H. Steckel (1991): Heights and Living Standards of English Workers during the Early Years of Industrialization, 1770–1815 <http://www.jstor.org/stable/pdfplus/2123399.pdf>

Allen's Assertions

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
-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%
2100	13474.9	$485,096	$53,900	9000	?	0.211%	1.894%	2.000%
2200	99566.8	$3,584,405	$398,267	9000	?	0.000%	2.000%	2.000%
2500	40168118.9	$1,446,052,279	$160,672,475	9000	?	0.000%	2.000%	2.000%

Global Growth: The Industrializing West (2019)

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

- For 'the west' the largest multiplicative jump up comes with the Industrial Revolution
  - And Allen wants to argue that the further upward jump to MEG is then baked in the cake
  - Steam & iron & machine tools ⇒ inevitable development of the technologies of the "Second Industrial Revolution": electricity, organic chemicals, internal combustion engines, advanced materials, &c….
- First generation industrial-revolution technologies profitable to deploy only at the center
- Second generation industrial-revolution technologies profitable to deploy in "the west"
- Third generation industrial-revolution technologies profitable to deploy everywhere
- But—according to Allen—no first generation profitability, no first generation industrial-revolution technologies…

Reading Allen

Robert C. Allen (2011): Why the Industrial Revolution Was British: Commerce, Induced Invention and the Scientific Revolution <http://onlinelibrary.wiley.com/doi/10.1111/j.1468-0289.2010.00532.x/pdf>:

- Britain had a unique wage and price structure in the eighteenth century, and that structure is a key to explaining the inventions of the industrial revolution:
  - British wages were very high by international standards, and energy was very cheap.
  - This configuration led British firms to invent technologies that substituted capital and energy for labour.
  - And when technology was first invented, it was only profitable to use it in Britain.
  - High wages also increased the supply of technology by enabling British people to acquire education and training.
- Britain's wage and price structure was the result of the country's success in international trade, and that owed much to mercantilism and imperialism.
- Eventually it was improved enough that it became cost-effective abroad.
- When the 'tipping point' occurred, foreign countries adopted the technology in its most advanced form…"

“Subsistence Basket” Wages

- But this is an input rather than an output to the process of generating modern economic growth…

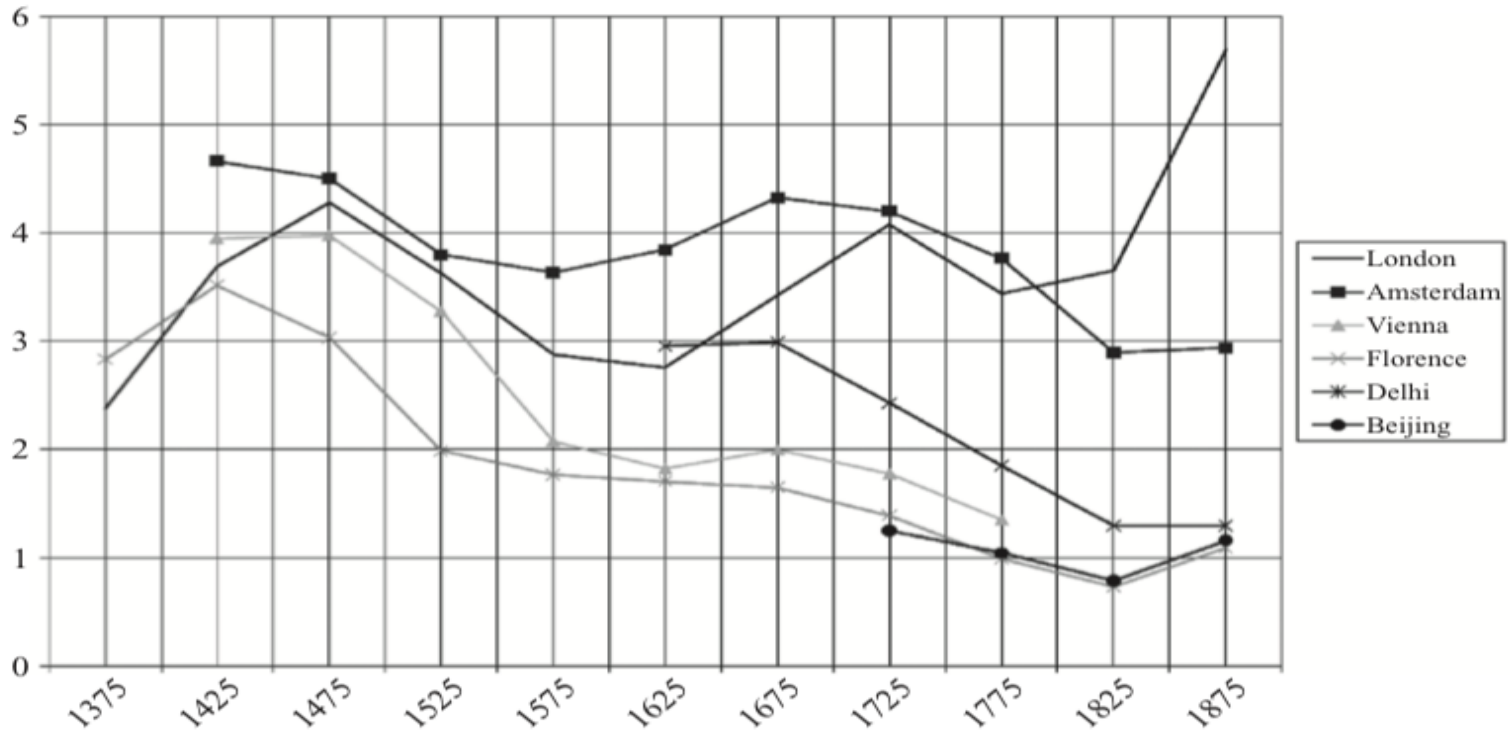


Figure 2. *Subsistence ratio for labourers: income relative to cost of subsistence basket*

Robert Allen: Rule, Brittania!

- Britain had uniquely high real wages
  - Why? Northwest European marriage pattern?
  - Why? Yeoman smallholder legacy of the Bubonic Plague?
  - Why? The British navy and the British empire and the fiscal-military state?

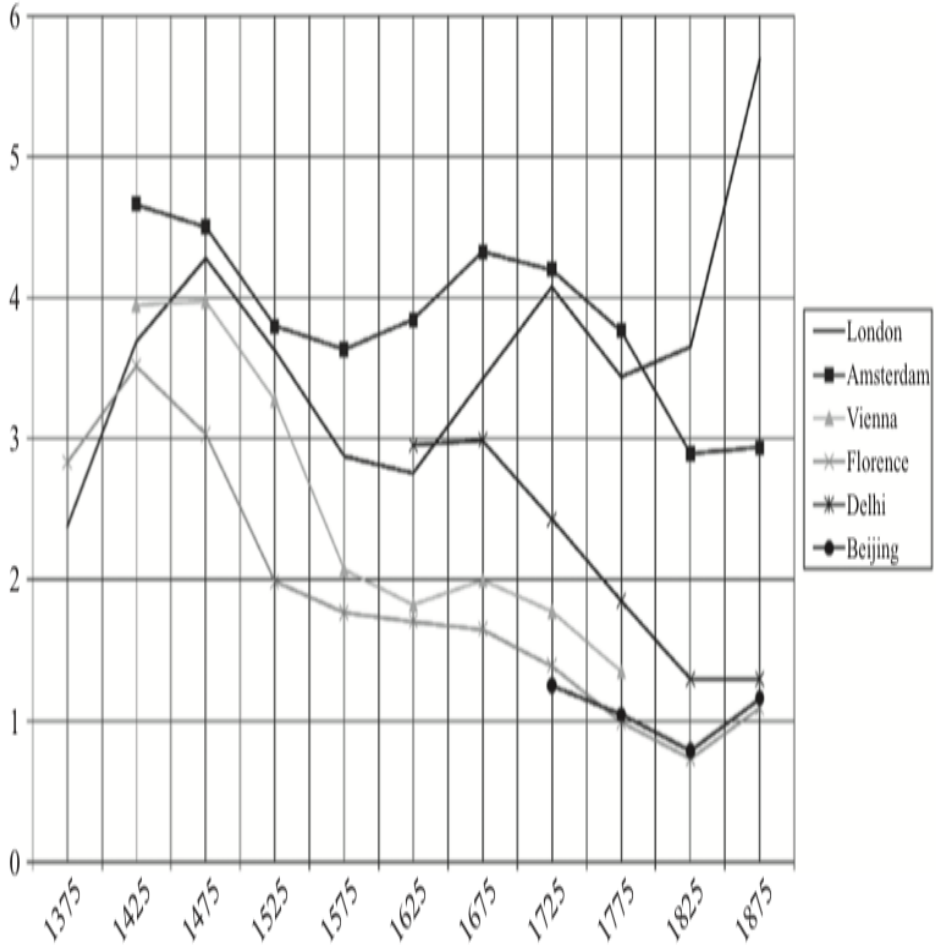


Figure 2. *Subsistence ratio for labourers: income relative to cost of subsistence basket*

Rule, Brittania! II

- Britain—not London so much as Newcastle, and Manchester—had a uniquely cheap real price of energy
- Why? Coal at the surface?
- Why? Coal on navigable water?
- Why? Wet coal mines?
- Only in Britain would the first generation of steam engines be both (a) useful and (b) profitable
- Eighteenth-century Lancashire the only escape from Malthusian agrarian poverty

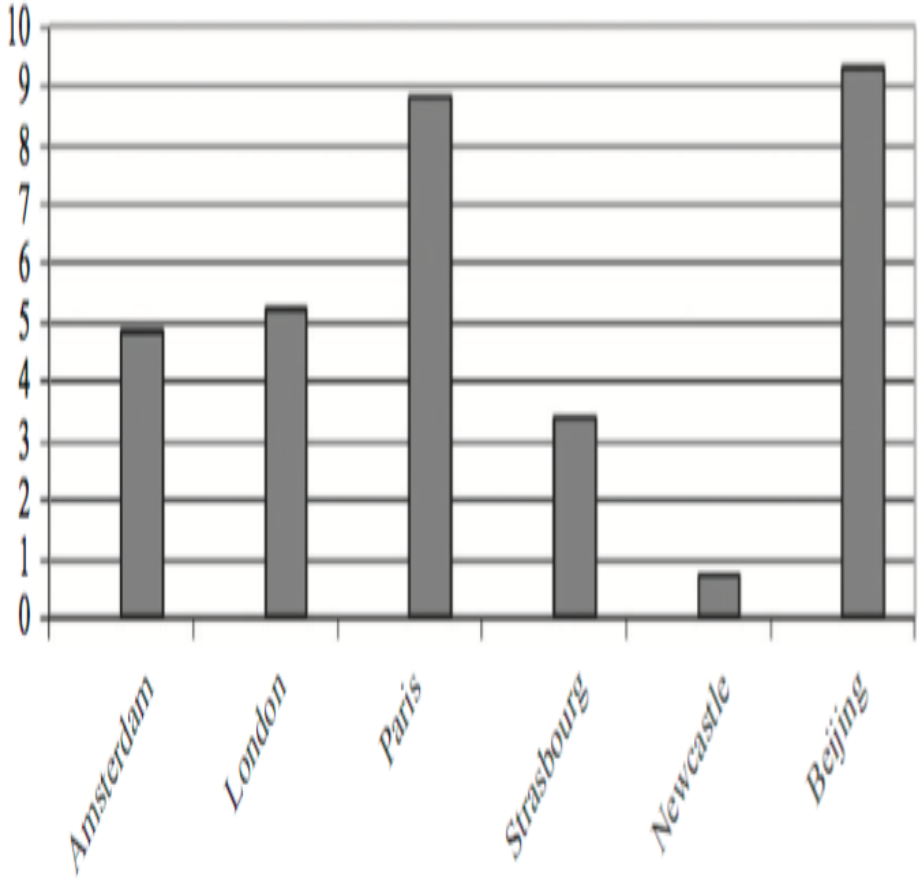
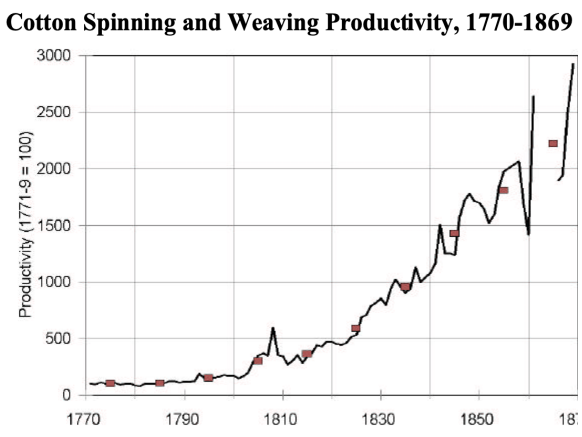
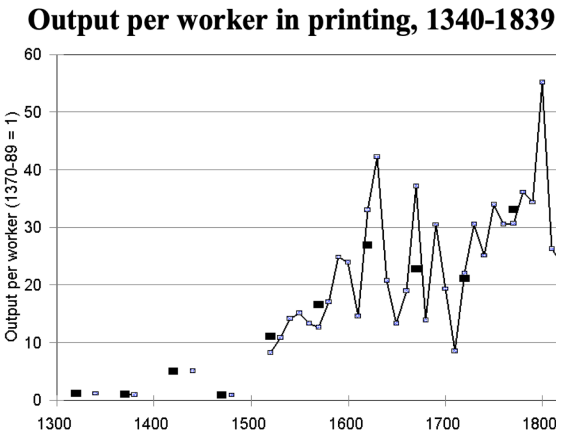


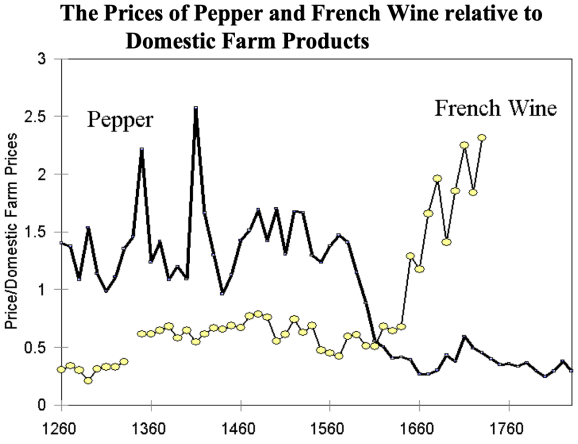
Figure 5. *Price of energy, early 1700s*

Questions About Allen

1. What supports are needed for the fact that a first-generation steam engine would be *profitable* to lead to the actual invention and then deployment of first-generation steam engines?
2. What supports are needed for "tinkerers" to turn first-generation into second- and third-generation steam engines?
3. How about textile machinery and the iron masters? Water power worked fine for them, right? How is it that they fit into this particular mix?
4. Could the Industrial Revolution have ground to a halt without the factor price configuration that supported steam?
5. What % of non-necessities consumption are pepper and wine, books, and textiles, anyway?







Reading Temin

Peter Temin (1997): Two Views of the British Industrial Revolution <http://www.jstor.org/stable/pdfplus/2951107.pdf>:

TABLE 1
CONTRIBUTIONS TO NATIONAL PRODUCTIVITY GROWTH, 1780–1860
(percentage per annum)

Sector	McCloskey	Crafts	Harley
Cotton	0.18	0.18	0.13
Worsteds	0.06	0.06	0.05
Woolens	0.03	0.03	0.02
Iron	0.02	0.02	0.02
Canals and railroads	0.09	0.09	0.09
Shipping	0.14	0.14	0.03
Sum of modernized	0.52	0.52	0.34
Agriculture	0.12	0.12	0.19
All others	0.55	0.07	0.02
Total	1.19	0.71	0.55

Sources: McCloskey, "Industrial Revolution," p. 114; Crafts, *British Economic Growth*, p. 86; and Harley, "Reassessing the Industrial Revolution," p. 200.

Two Views of the British Industrial Revolution

Peter Temin. 1997, "Two Views of the British Industrial Revolution," Journal of Economic History 57 (March), pp.63–82. www.jstor.org/stable/pdfplus/2951107.pdf

TABLE 2
SHARES OF TOTAL AND MANUFACTURING EXPORTS
(percentage)

Sector	1794–1796	1814–1816	1834–1836	1854–1856
Manufacturing/total	86	82	91	81
Cotton/manufacturing	18	49	53	42
Woolens/manufacturing	27	21	17	15
Iron/manufacturing	11	2	2	7
Other/manufacturing	44	28	28	36

Source: Davis, *Industrial Revolution*, pp. 95–101.

Two Views of the British Industrial Revolution

- “There was, as noted for exports in Table 4, little variation in the composition of British imports over the first half of the nineteenth century….
- “Britain maintained a clear comparative advantage in a wide variety of manufacturing industries throughout the first half of the nineteenth century. They held their own in the face of the spectacular growth of cotton-textile exports during those years. There is no hint that these other commodities were being pushed off the list of exports by the growth of cotton exports….
- “There is an exception that proves the rule… watches and clocks. As Landes noted in his book on that industry, the English clockmakers and watchmakers were falling behind their continental competitors in the nineteenth century. Productivity stagnated in this industry, and it had become an import industry by midcentury.
- “The export of most other manufactures, however, was continuing merrily along. The lesson of the constant rank order of these exports is that the various industries were keeping pace with each other…”

Two Views of the British Industrial Revolution

- Temin seeks to investigate whether the “narrow front“ coal and steam and textiles and iron interpretation of the British Industrial Revolution fits the historical facts better or worse than the “broad front“ innovative society and economy interpretation.
- Temin aims to use the Ricardian theory of trade and revealed comparative advantage To shed insights into changes in industry-level productivity over the course of the Industrial Revolution.
- He finds essentially no change in the set of commodities that Britain exports and imports across the Industrial Revolution.
- He claims that this decisively answers the question in favor of the “broad front” interpretation.

Two Views of the British Industrial Revolution

- Why might he be wrong?

Two Views of the British Industrial Revolution

- Why might he be wrong?
  - Capital outflows…
  - Improvements abroad in agriculture etc.
  - Changes in relative prices…
    - Especially cotton...

Two Views of the British Industrial Revolution

TABLE 3
EXPORTS OF OTHER MANUFACTURES, 1850–1852

Export	Value (pounds sterling)
Linens	4,694,567
Hardwares and cutlery	2,556,441
Brass and copper manufactures	1,830,793
Haberdashery and millinery	1,463,191
Silk manufactures	1,193,537
Earthenware of all sorts	975,855
Machinery and millwork	970,077
Tin and pewter wares and tin plates	904,275
Apparel, slops, and Negro clothing	892,105
Beer and ale	513,044
Arms and ammunition	505,096
Stationary/stationery of all sorts	373,987
Apothecary wares	354,962
Lead and shot	339,773
Glass/glass of all sorts	296,331
Plate, plated ware, jewelry, and watches	286,738
Soap and candles	275,200
Painters' colors and materials	237,880
Books, printed	234,190
Cabinet and upholstery wares	155,407
Cordage	155,127
Leather saddlery and harness	121,401
Hats of all other sorts	106,933
Musical instruments	85,006
Umbrellas and parasols	72,928
Carriages of all sorts	57,018
Spirits	52,843
Fishing tackles	41,607
Hats, beaver and felt	34,351
Mathematical and optical instruments	34,289
Spelter, wrought, and unwrought	22,097
Bread and biscuit	15,529
Tobacco (manufactured) and snuff	14,762

Source: U.K., *Parliamentary Papers*, 1852 (196), vol. 28, pt. 1.

Two Views of the British Industrial Revolution

TABLE 5
VALUE OF IMPORTS, 1850–1852

Import	Value (pounds sterling
Wool, cotton	23,670,472
Sugar	10,762,045
Corn, meal, and flour	9,167,600
Tea	5,796,086
Silk	5,163,865
Coffee	3,480,594
Flax, and tow or codilla of hemp and flax	3,123,329
Wool, sheep's	2,049,348
Hides, raw or tanned	1,999,233
Cochineal, granilla, and dust	1,909,848
Oil	1,793,320
Madder, madder root, and garancine	1,687,568
Guano	1,476,940
Tallow	1,333,889
Indigo	1,191,495
Wood and timber	1,153,477
Dye and hardwoods	1,104,308
Hemp, dressed or undressed	990,917
Spelter	957,540
Wines	927,721
Spirits	902,351
Seeds	719,017
Woollen manufactures	710,414
Rice, cleaned or in the husk	668,585
Bacon	653,214
Potatoes	562,595
Currants	559,919
Cotton manufactures	548,065
Cheese	537,322
Copper, unwrought and part wrought	477,778
Butter	466,357
Brimstone	383,691
Tobacco and snuff	367,685
Skins and Furs	367,269
Saltpetre and cubic nitre	355,564
Iron in bars, unwrought	336,706
Gum	298,147
Oil seed cakes	296,993

Two Views of the British Industrial Revolution

CONCLUSIONS

This test confirms the traditional view that the Industrial Revolution saw changes in more than a few industries. Technical change was hardly uniform—a point conceded by every historian—but it was widespread. Britain became the workshop of the world, not just the cotton factory of the world.

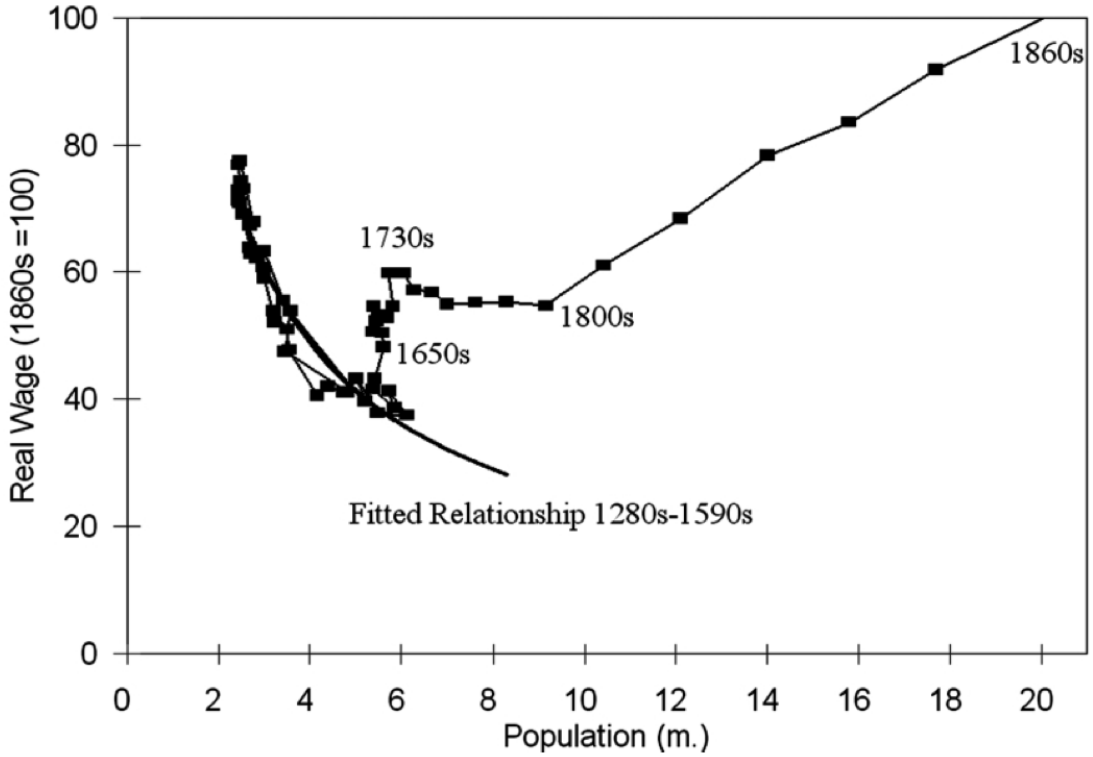
Scattered descriptions suggest the existence of a pattern in other manufactures.[36] With few exceptions, there were no factories like the famous cotton factories. Instead there were new organizations of work along the lines identified by Charles Sabel and Jonathan Zeitlin.[37] "Flexible specialization" has been thought of as a description of French industrialization.[38] Perhaps it also describes a significant part of the Industrial Revolution in Britain.

More research will be needed to confirm or refute suggestions like this. The test performed here shows that increases in British productivity were not confined to cotton and iron in the first half of the nineteenth century. The "old-hat" view of the Industrial Revolution cannot be banished by calling it names. It lives among us, and it deserves more attention to fill in its all too evident gaps.

[36]For example, Berg, *Age*.
[37]Sabel and Zeitlin, "Historical Alternatives."
[38]Piore and Sabel, *Second Industrial Divide*.

Questions About Temin

1. Does this paper survive the “price of textiles” critique?
2. Does this paper cause big problems for Allen?
3. What was going on before 1800 if Allen is right?
4. Why the timing of the acceleration if Allen is wrong?



Reading Nicholas and Steckel

Stephen Nicholas and Richard H. Steckel (1991): Heights and Living Standards of English Workers during the Early Years of Industrialization, 1770–1815 <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.

Heights and Living Standards of English Workers during the Early Years of Industrialization, 1770–1815

Stephen Nicholas and 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), pp.937–957. www.jstor.org/stable/pdfplus/2123399.pdf

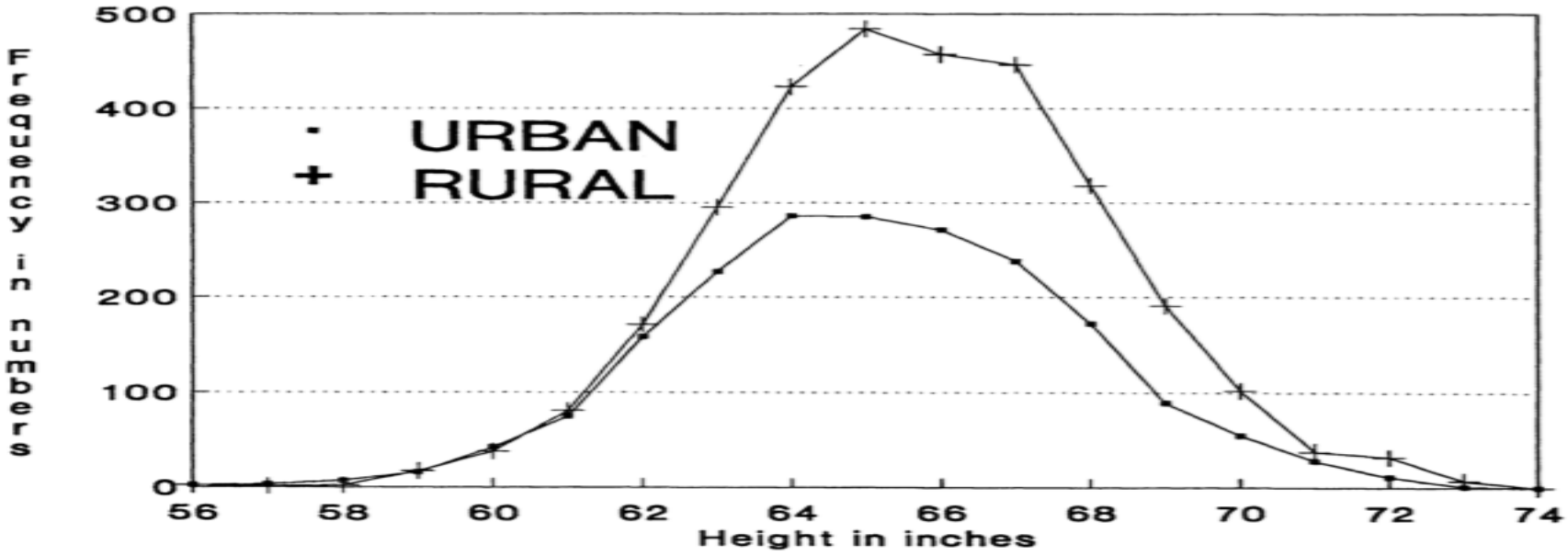


FIGURE 1

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

Five-Year Moving Averages

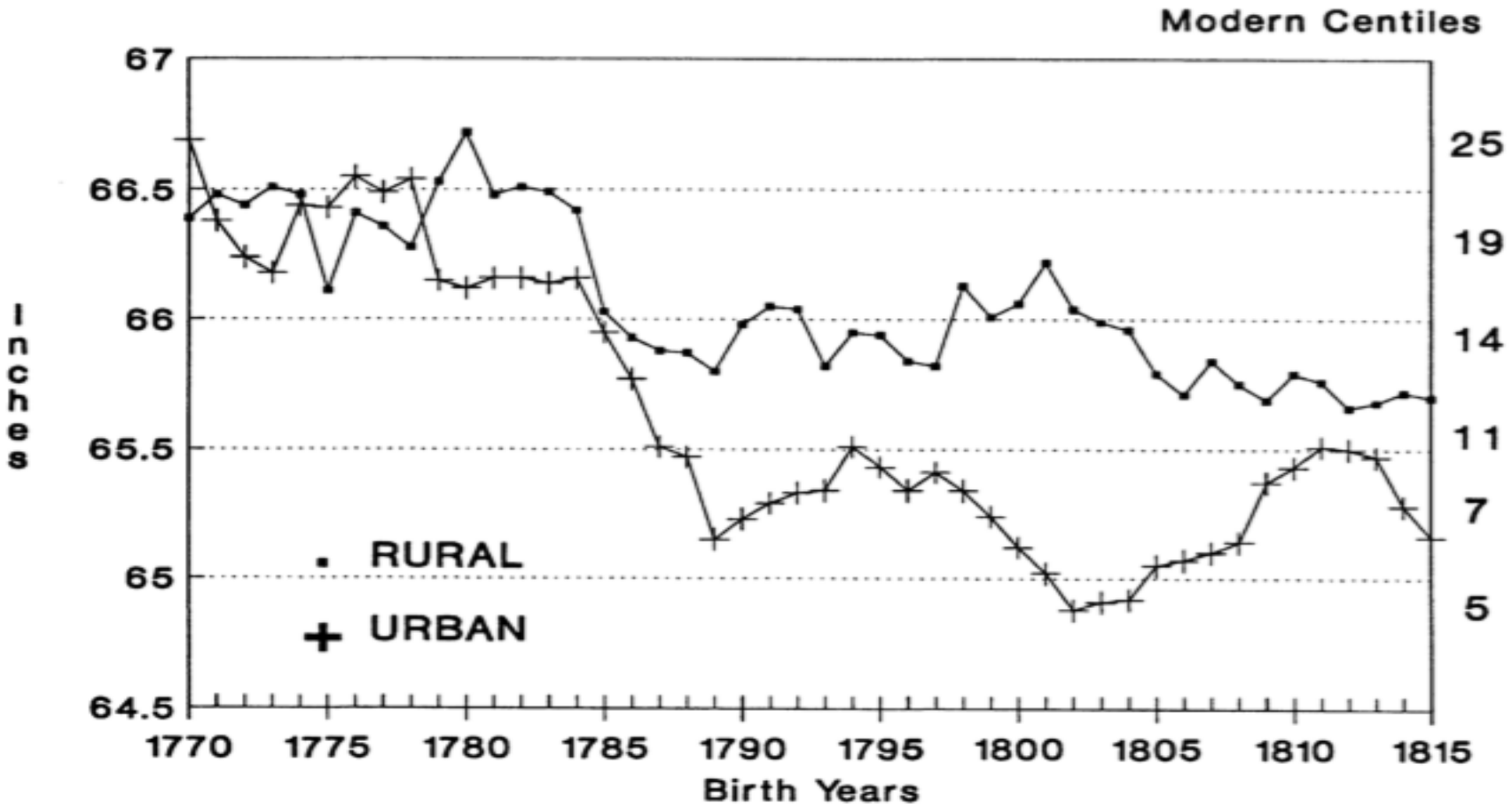


FIGURE 3

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

Growth Curves

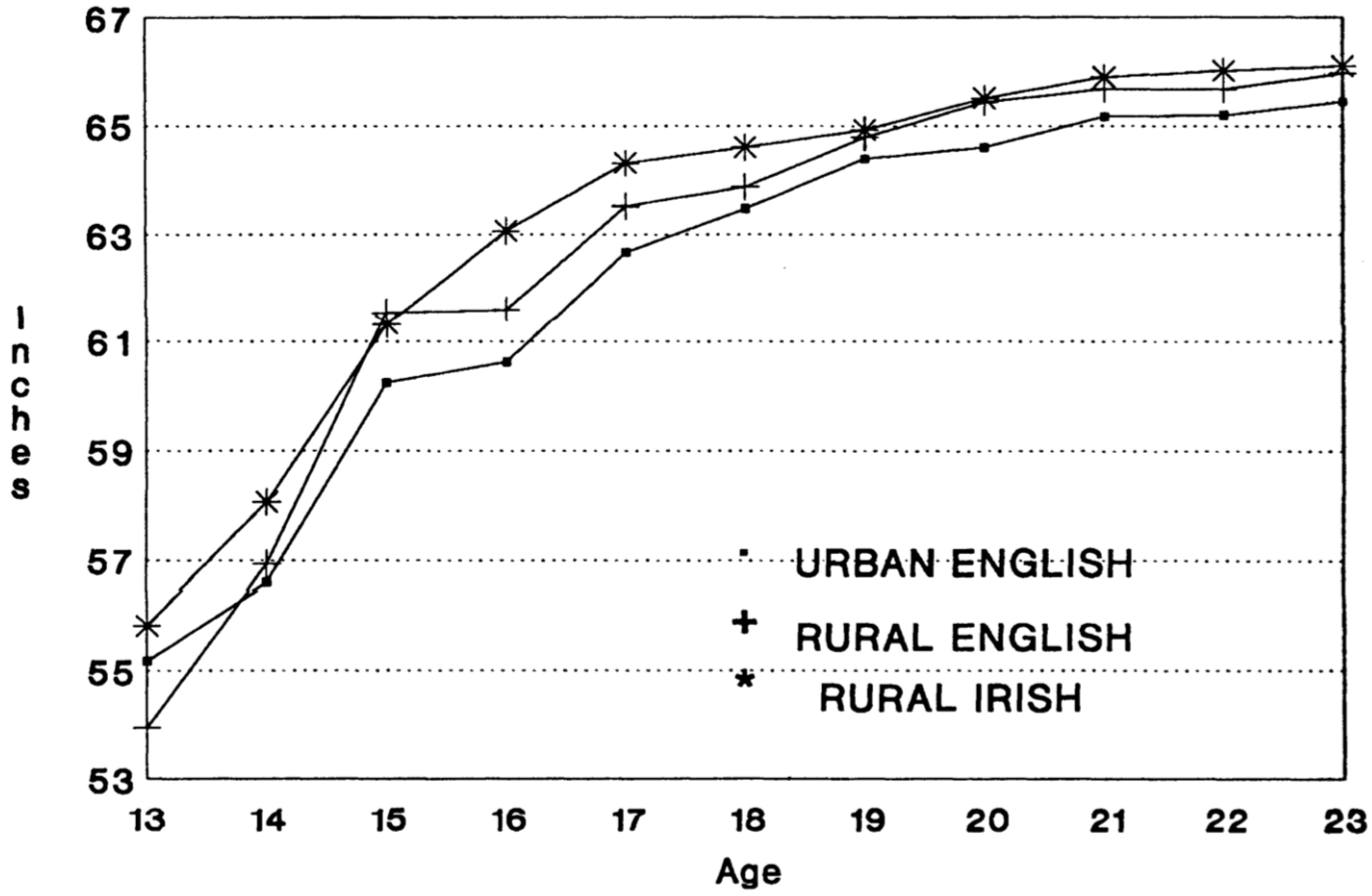


FIGURE 2

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.

Questions About Nicholas and Steckel

1. Transportees. What could go wrong with using transportees?
2. The urban/rural divide. Is this properly assessed as *standard of living* or *utility*?
3. When does the height decline take place?
4. Why isn't there a height *rise*? Things are happening in this period to real wages…
5. Why is the urban-rural correlation not smaller? Not bigger?
6. What freaky thing is going on in urban heights for those born between 1784 and 1789?

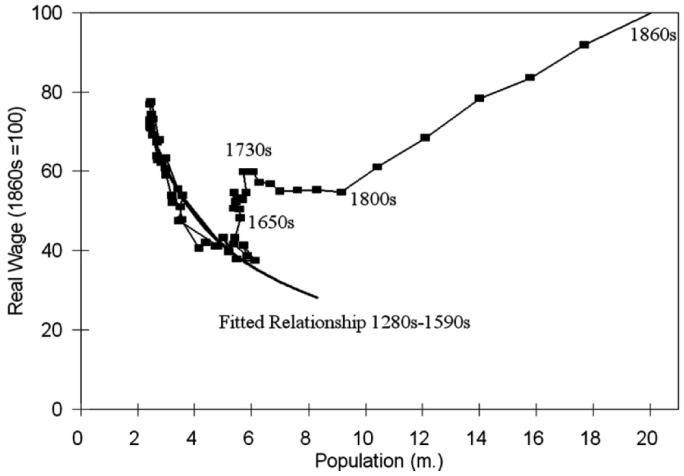


FIG. 5.—Real wages vs. population on the new series, 1280s–1860s. The line summarizing the trade-off between population and real wages for the preindustrial era is fitted using the data from 1260–69 to 1590–99. Sources: population, same as for fig. 3; real wage, table A2.

Lecture Next Time: Modern Economic Growth

The three key numbers in this course are: 0.15, 0.44, 2.06—the annual percentage growth rates *h* of the useful-ideas stock in the Commercial Revolution, Industrial Revolution, and Modern Economic Growth periods. (Or perhaps 0.2, 0.9, 2.3—the numbers for "the West".) But is it really best thought of as 2.06 (or 2.3)? And why is it so much bigger than 0.44 (or 0.9)?:

Readings:

- William D. Nordhaus (1997): *Do Real-Output and Real-Wage Measures Capture Reality? The History of Lighting Suggests Not* <http://www.nber.org/chapters/c6064>
- Robert Gordon (2000): *Interpreting the "One Big Wave" in Long-Term Productivity Growth* <https://www.nber.org/papers/w7752.pdf>
- Peter Thompson (2001): *How Much Did the Liberty Shipbuilders Learn? New Evidence for an Old Case Study* <http://www.jstor.org/stable/pdfplus/10.1086/318605.pdf>

Catch Our Breath…

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

Notes…