

UNIT 2. The Industrial Revolution.

(2478) Economic History.



Suggested citation

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- CONVOCATORIA PARA EL IMPULSO Y LA CONSOLIDACIÓN DE PROYECTOS DE DOCENCIA BILINGÜE DURANTE EL CURSO 2021/2022 (Resolución R-1000/2021)

- 2. The Industrial Revolution (IR).
- 2.1. Introduction.
- 2.2. Basic Determinants of the Industrial Revolution.
- **2.3. The Industrial Revolution and its Patterns of Development.**
- **2.4. Industrialization in Spain.**
- **2.5. Conclusions.**



Textbook:

- ALLEN, Robert. 2011. Global Economic History: A Very Short Introduction (Very Short Introductions), Oxford University Press, 27-30.
- **Other references:**
- ALLEN, Robert. 2009. Why was the Industrial Revolution British? [<http://www.voxeu.org/article/why-was-industrial-revolution-british>].
- **Other References: please check the presentation**



- **2.3.1. Explaining the Industrial Revolution.**
- The explanation of why the IR was British is based on:
 - The British structure of wages and prices.
- The economy of high wages & cheap energy made it profitable for British firms:
 - To invent.
 - To use the breakthrough technologies of the IR.



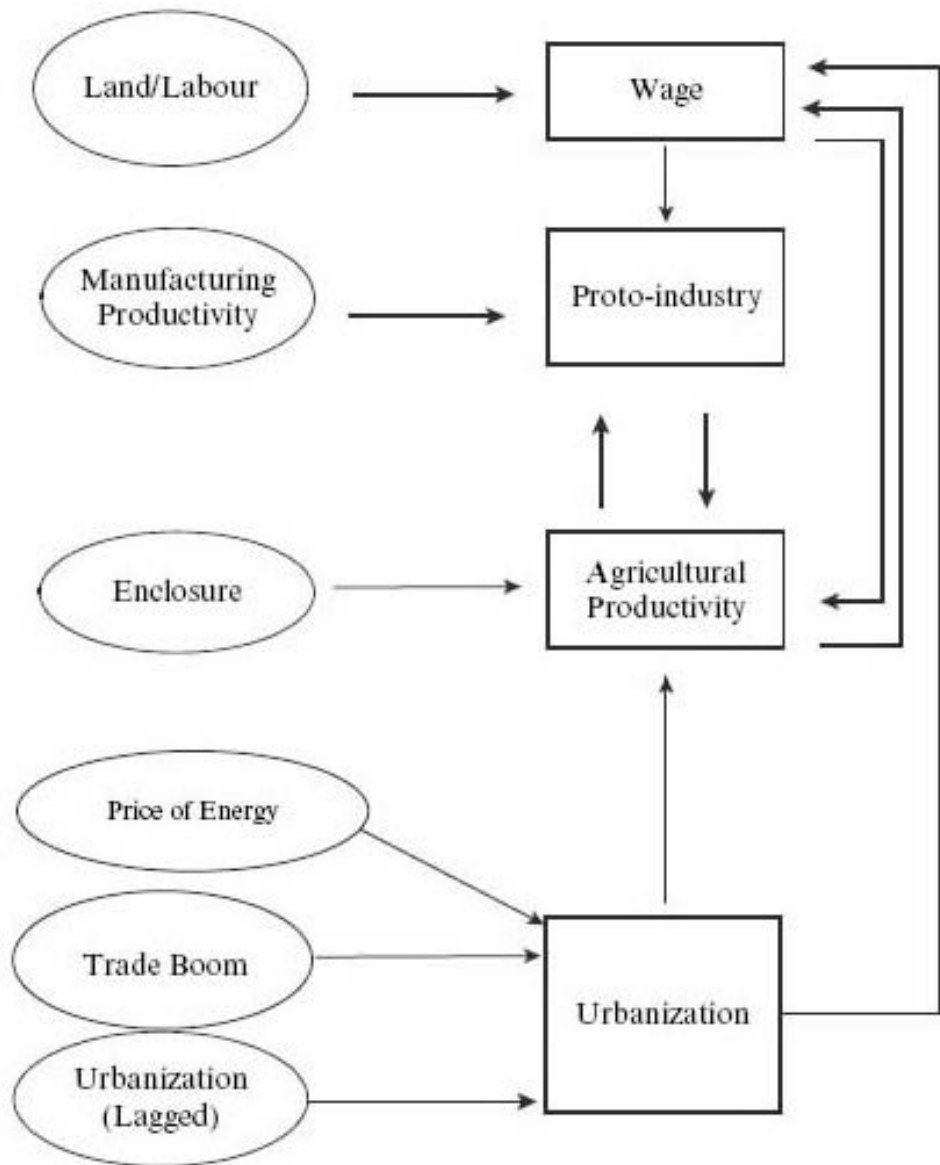


Figure 5.1 Flowchart (one period) of the model

Allen advocates that England in the 18th century possessed a “high wage economy”.

English labor costs relative to continental Europe and Asia were unusually high.

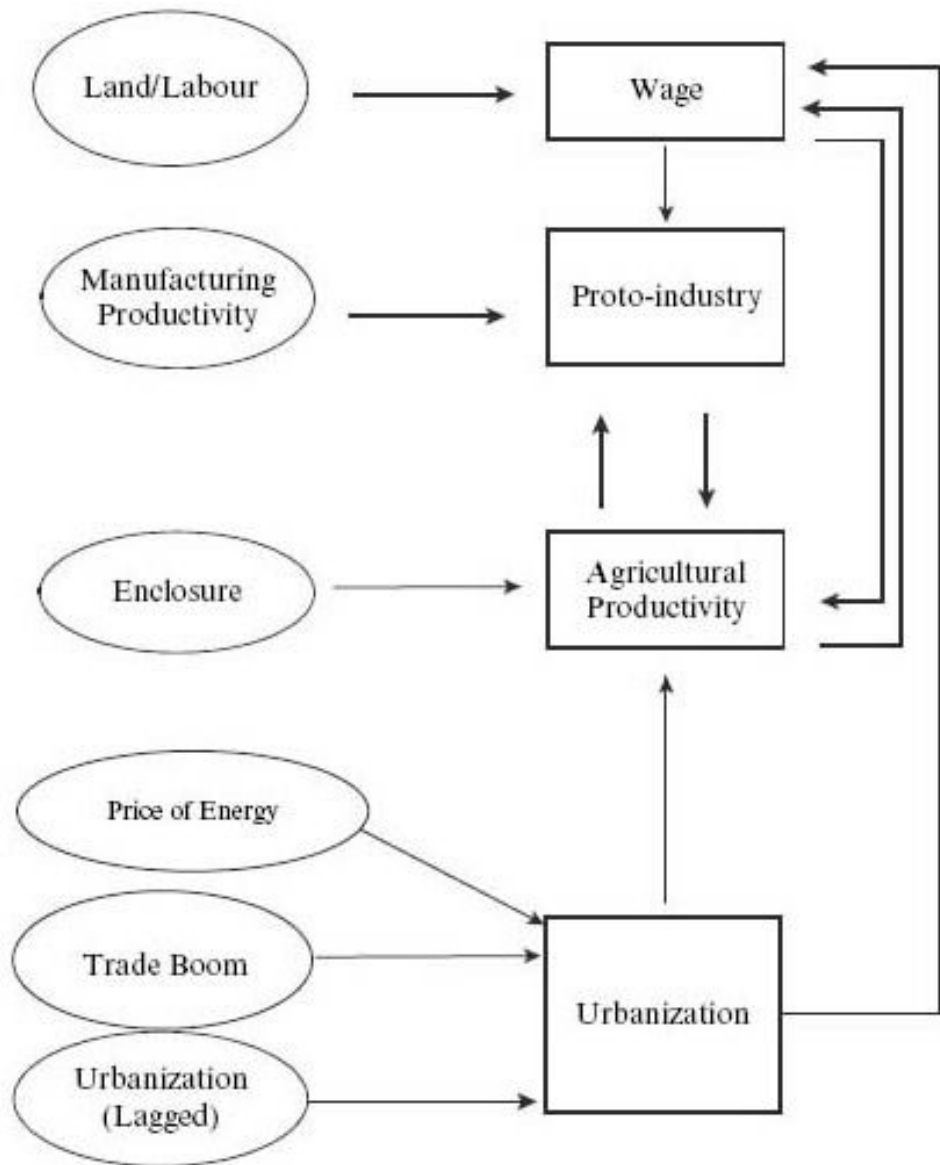


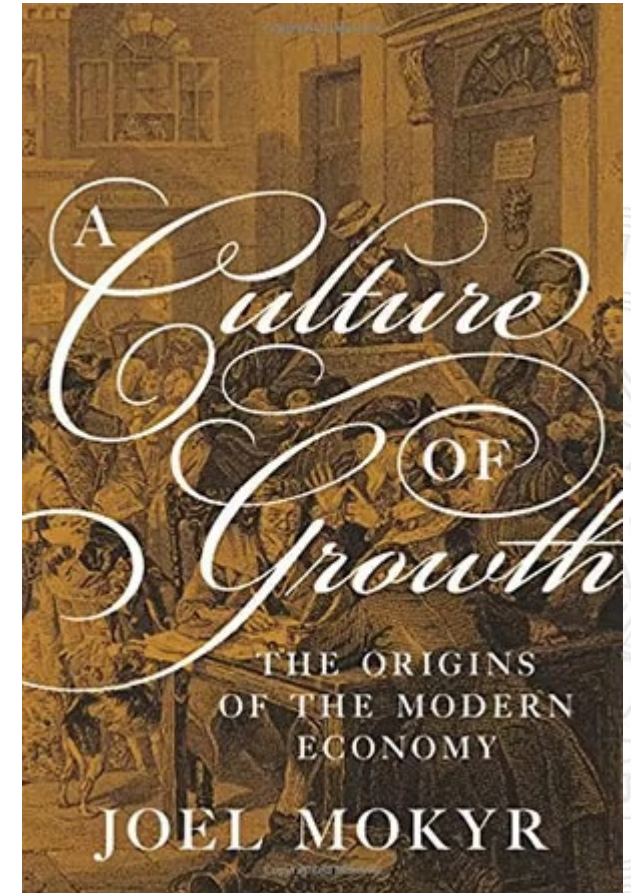
Figure 5.1 Flowchart (one period) of the model

England's high wages relative to its cheap energy and low capital costs biased technical innovation in favor of labor-saving equipment, and that is why it was cost-effective to industrialize in England first, before the rest of Europe.

Source: Random thoughts on critiques of Allen's theory of the Industrial Revolution. 2016

[<https://pseudoerasmus.com/2016/12/01/allen/>] (September, 2022)

- **2.3.1. Explaining the Industrial Revolution.**
- **[ALSO]** The explanation of why the IR was British is based on:
 - The relative importance to Cultural Developments and Scientific discoveries.
 - Cultural development and Scientific discoveries were known across Europe.



- Mokyr's book seeks to identify the conditions that turned the inventions of the late 18th and early 19th centuries into sustained, modern economic growth.
- There had been earlier significant waves of invention in China and the Islamic world, but none snowballed into a world-changing industrial revolution.
- Mokyr argues that in western Europe at the time of the Enlightenment, a set of conditions appeared: a ferment of public debate and innovation we might now label as "open science".

- **Knowledge**, from elaborated scientific insight to more practical technological know-how, became a common resource.
- Leading scientists and thinkers corresponded with counterparts around the continents. A great example: Benjamin Franklin



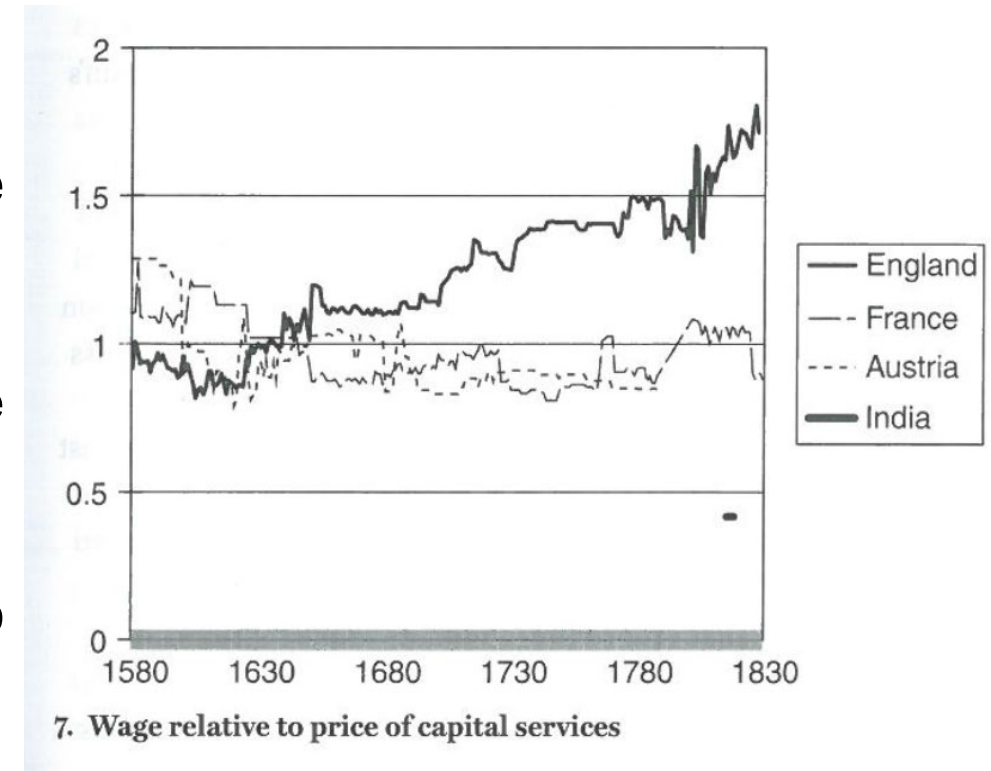


The geomap shows Franklin's network of correspondents (top) and Voltaire's (bottom). Many of Franklin's letters crossed the Atlantic; only a few of Voltaire's did.

Source: Claire Rydell and Caroline Winterer, "Benjamin Franklin's Correspondence Network, 1757-1763," Mapping the Republic of Letters Project, Stanford University, October 2012

UNIT 2.3. The Industrial Revolution and its Patterns of Development.

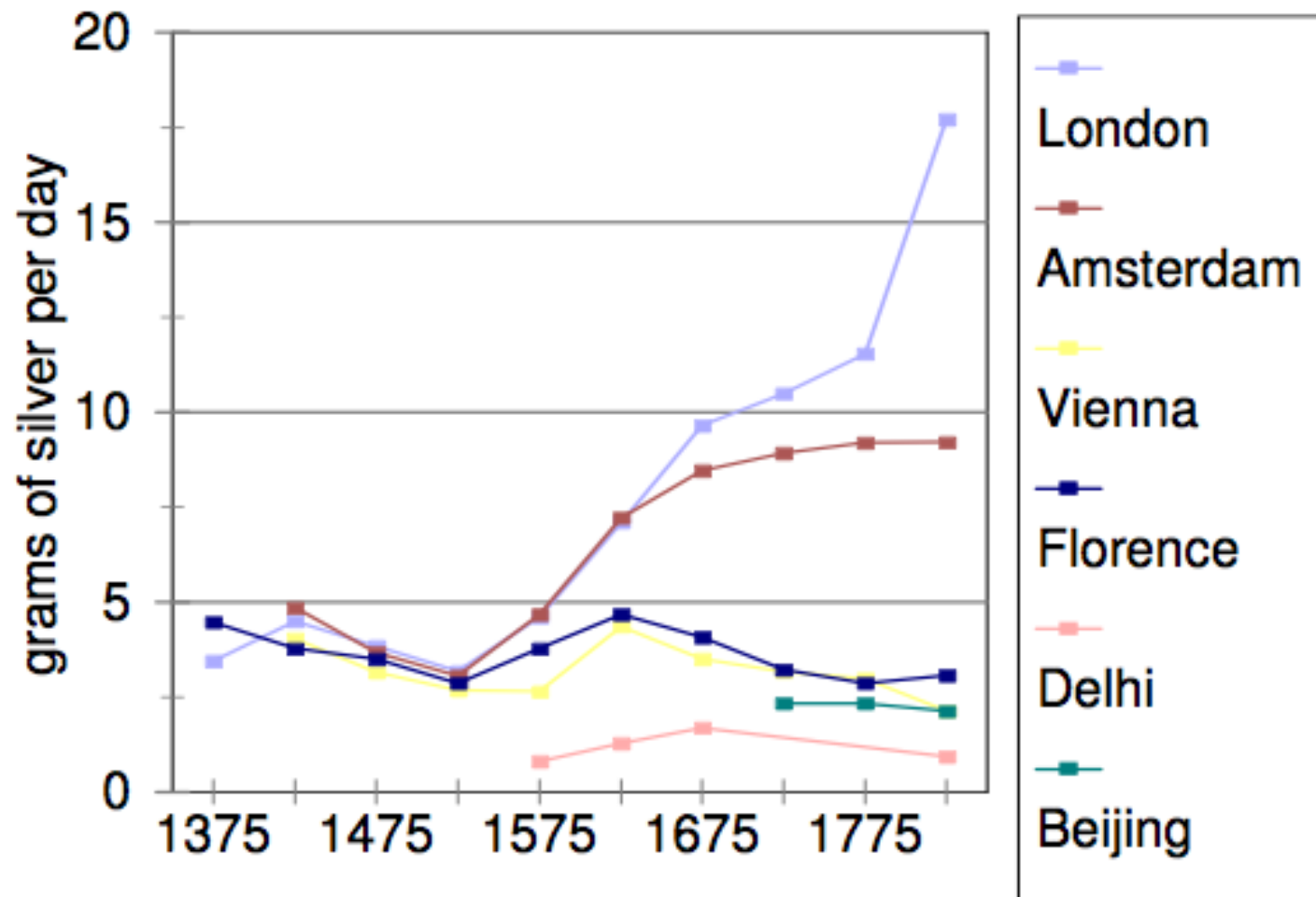
- **2.3.1. Explaining the Industrial Revolution: back to Allen.**
- The wages in Britain were high enough to enable most people to vary their diet:
 - 3 B (beer, bread and beef) vs. bare bones subsistence wages (diet based on grain).
- In the late 1500s English wages were similar to those in France and Austria.
- Mid 18th- 19th centuries: labor related to capital was at least 60% more expensive in England than on the continent.



Allen (2011, 31): Figure 7

- Britain was a high wage economy in four senses: 1. At the exchange rate, British wages were higher than those of its competitors.

Figure 1
Labourers' wages around the world

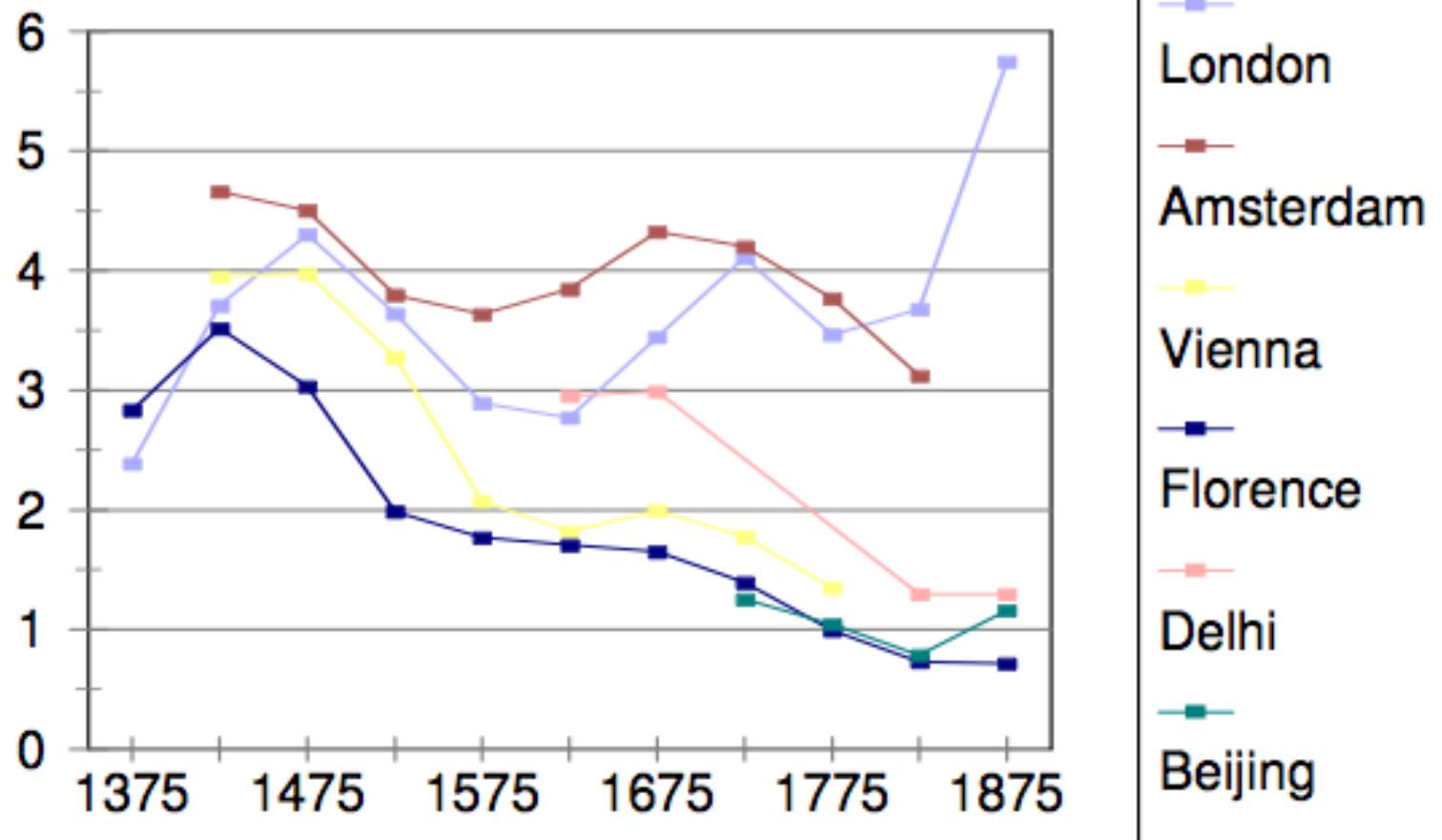


<https://www.bradford-delong.com/2012/02/robert-allen-the-british-industrial-revolution-in-global-perspective.html>

- Britain was a high wage economy in four senses: 2. High silver wages translated into higher living standards than elsewhere.

Figure 2

Subsistence Ratio for Labourers
income/cost of subsistence basket

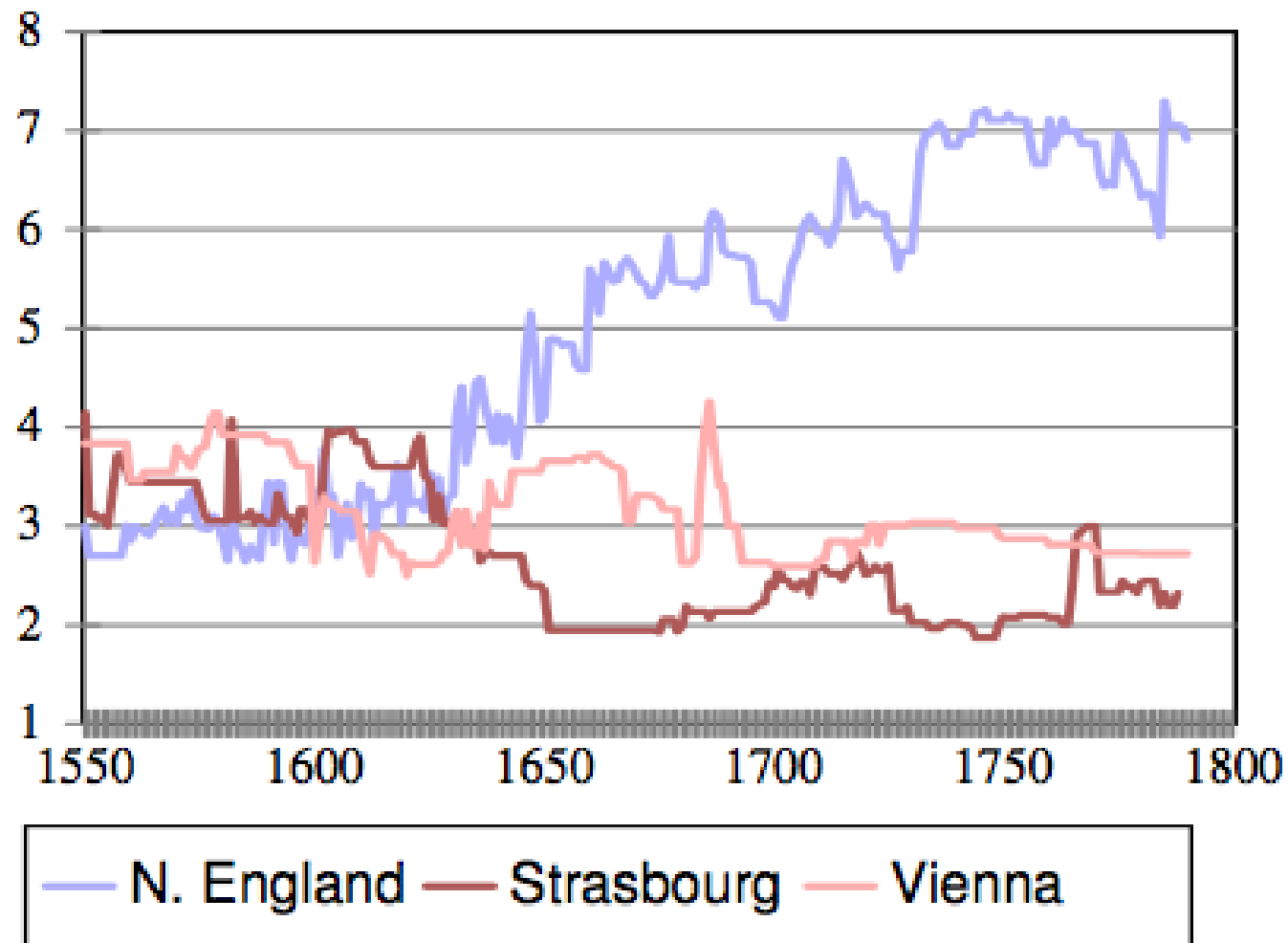


<https://www.bradford-delong.com/2012/02/robert-allen-the-british-industrial-revolution-in-global-perspective.html>

- Britain was a high wage economy in four senses: 3. British wages were high relative to capital prices.

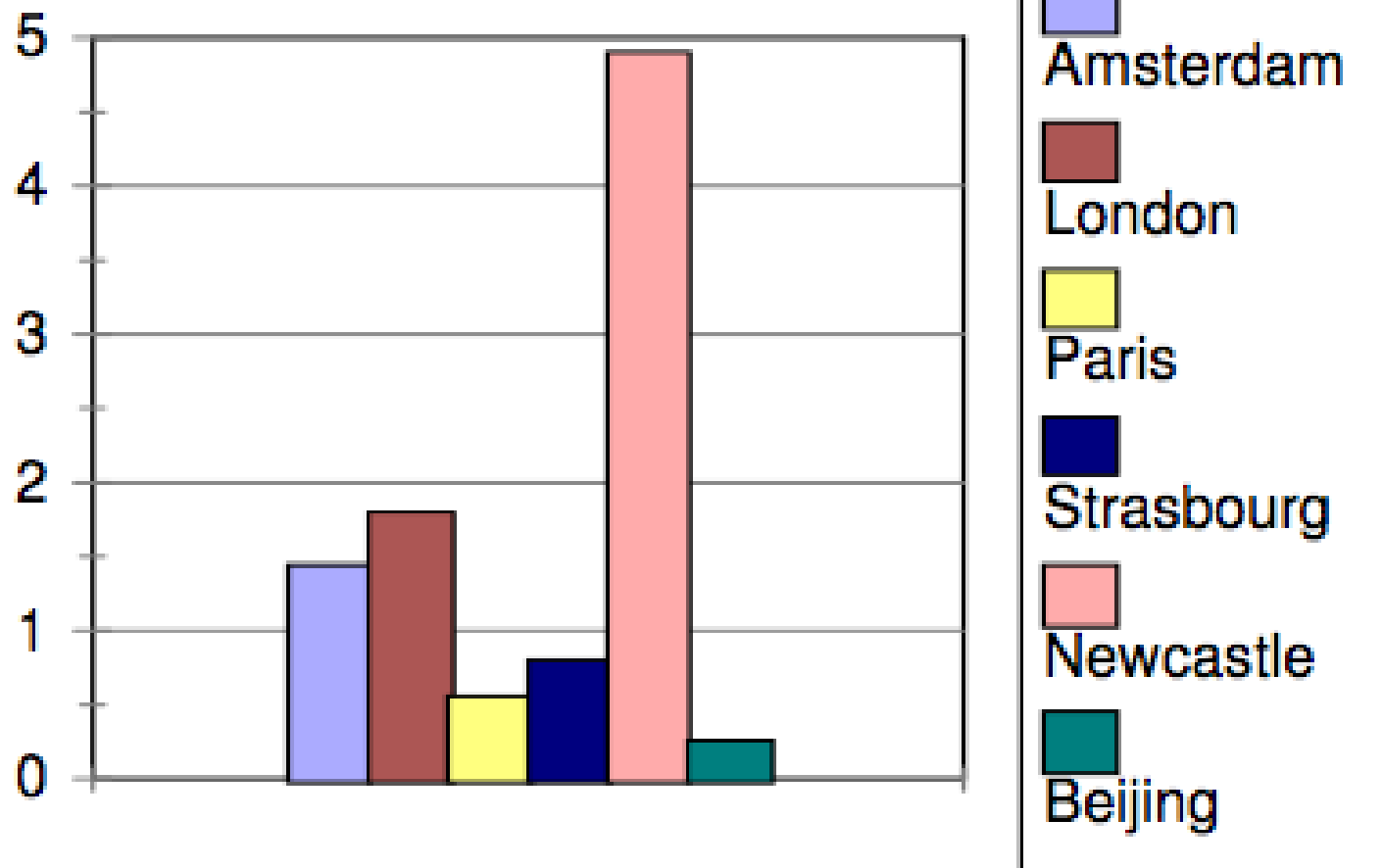
Figure 3

Wage Relative to Price of Capital



- Britain was a high wage economy in four senses: Wages in northern and western Britain were exceptionally high relative to energy prices

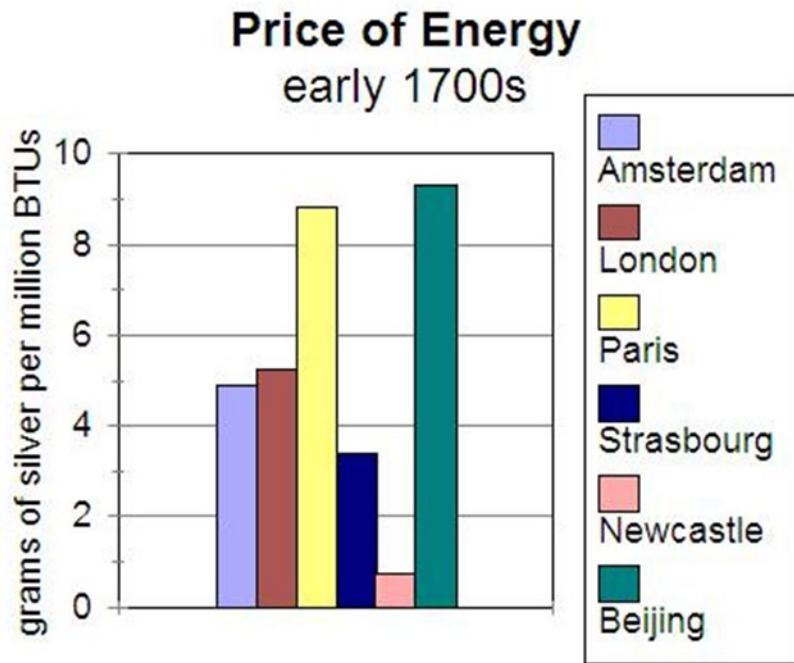
Figure 4
Price of Labour relative to Energy
early 1700s



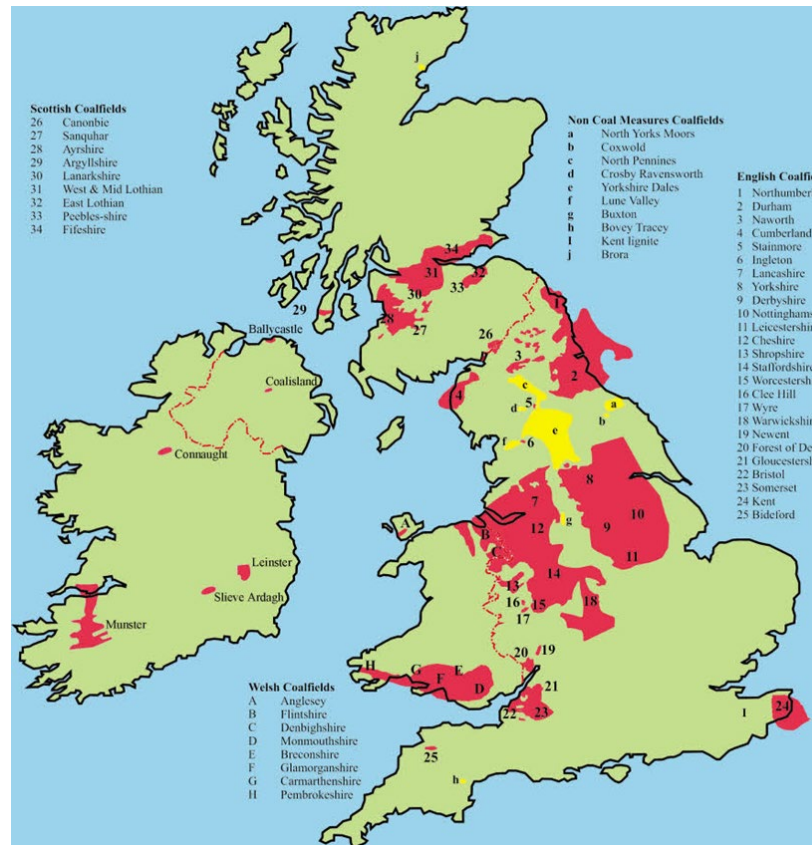
<https://www.bradford-delong.com/2012/02/robert-allen-the-british-industrial-revolution-in-global-perspective.html>

UNIT 2.3. The Industrial Revolution and its Patterns of Development.

- 2.3.1. Explaining the Industrial Revolution.
- Energy: thanks to the coal fields in the North and the Midlands, Britain had the cheapest energy in the world.



Allen (2009)

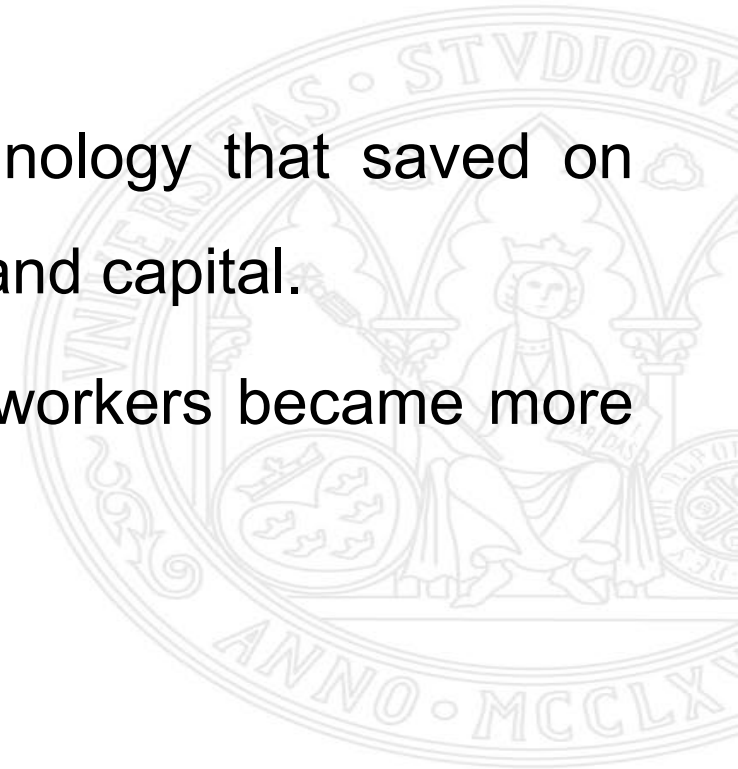


Coal Mining in the British Isles Source. <http://nmrs.org.uk/mine/s/coal/index.html>

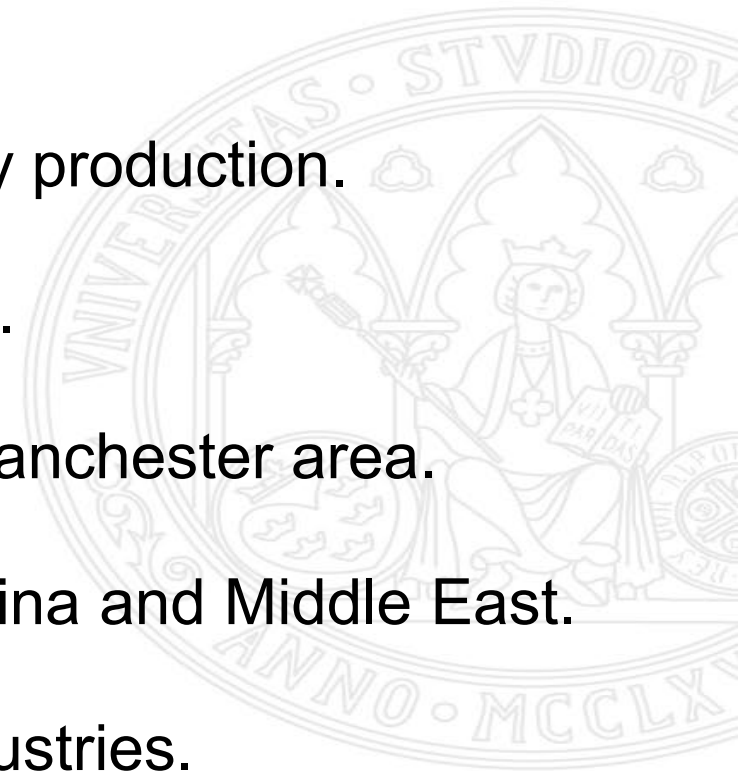
- **2.3.1. Explaining the Industrial Revolution.**

Corollary:

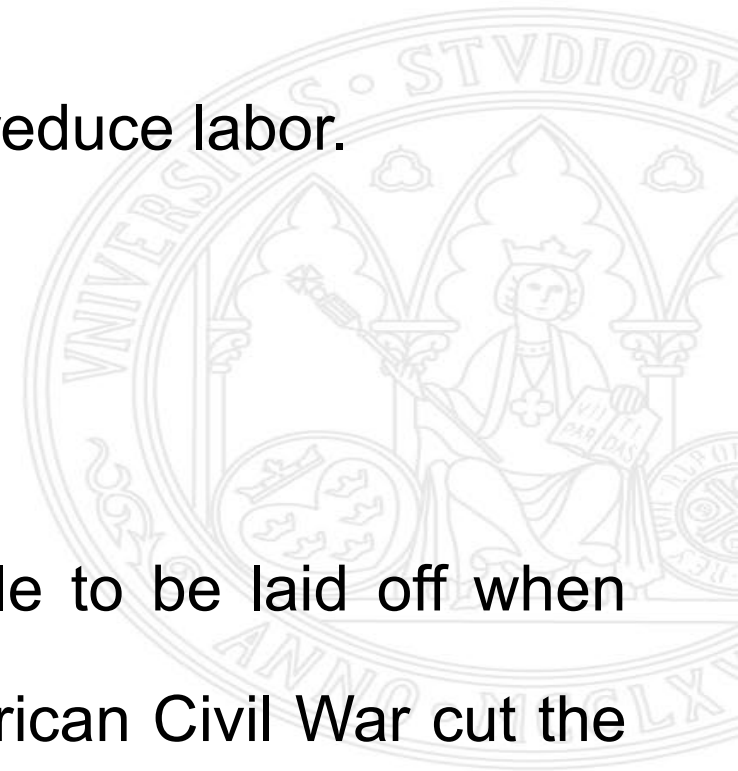
- Businesses in England found it profitable to use technology that saved on expensive labor by increasing the use of cheap energy and capital.
- With more capital and energy at their disposal, British workers became more productive.



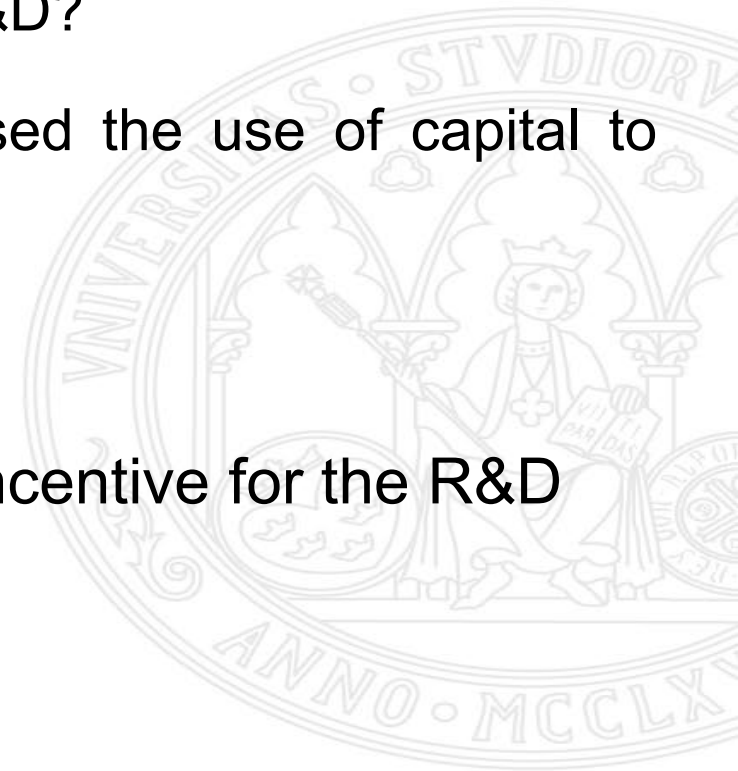
- **2.3.1. Explaining the Industrial Revolution.**
- **A. The Cotton Industry.**
- Cotton was the first industry to be transformed by factory production.
 - Mid 18th century: 8% GDP & 16% manufacturing jobs.
 - The cotton industry led the explosive growth of the Manchester area.
 - Britain's expansion came at the expense of India, China and Middle East.
 - China and India had the world's largest cotton industries.



- **2.3.1. Explaining the Industrial Revolution.**
- **A. The Cotton Industry.**
- England could only compete if machines were invented to reduce labor.
- There were numerous attempts to mechanize production.
 - Years of experiments: innovation.
 - None involved great conceptual leaps.
- Workers benefited from continuous growth, but were liable to be laid off when there was a drop in demand or supply, like when the American Civil War cut the supply of cotton from the American Southern States.

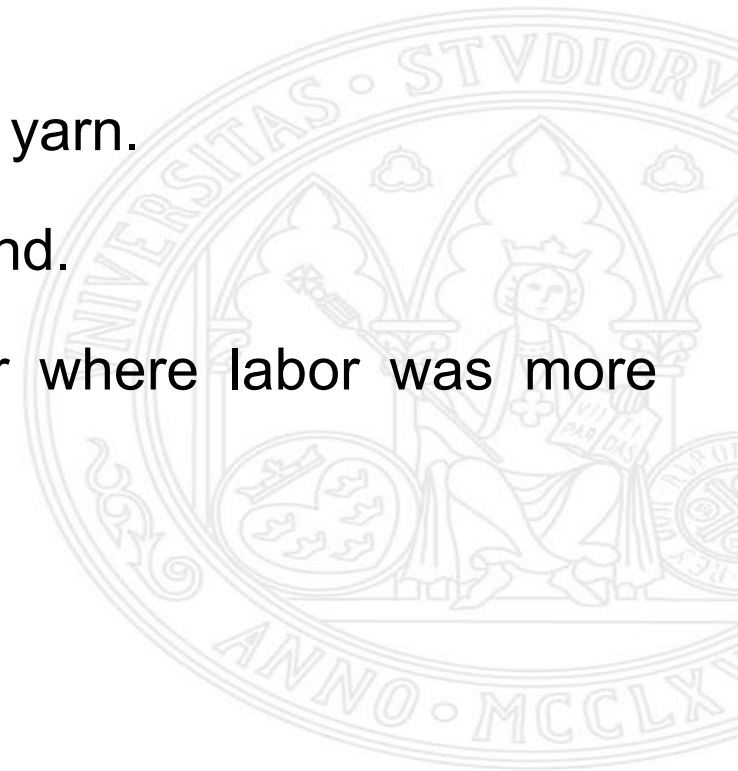


- **2.3.1. Explaining the Industrial Revolution.**
- **A. The Cotton Industry.**
- Why did British inventors spend so much time and money on R&D?
 - The machines/devices that were invented/patented increased the use of capital to save on labor.
 - Labor was expensive and capital was cheap.
- The bottlenecks in the production of cloth or yarn was an incentive for the R&D

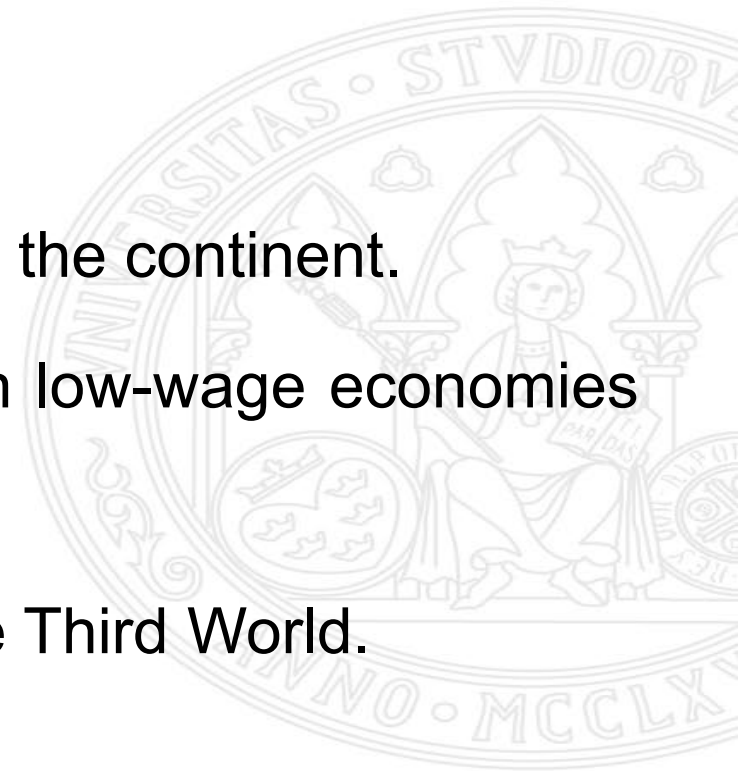


UNIT 2.3. The Industrial Revolution and its Patterns of Development.

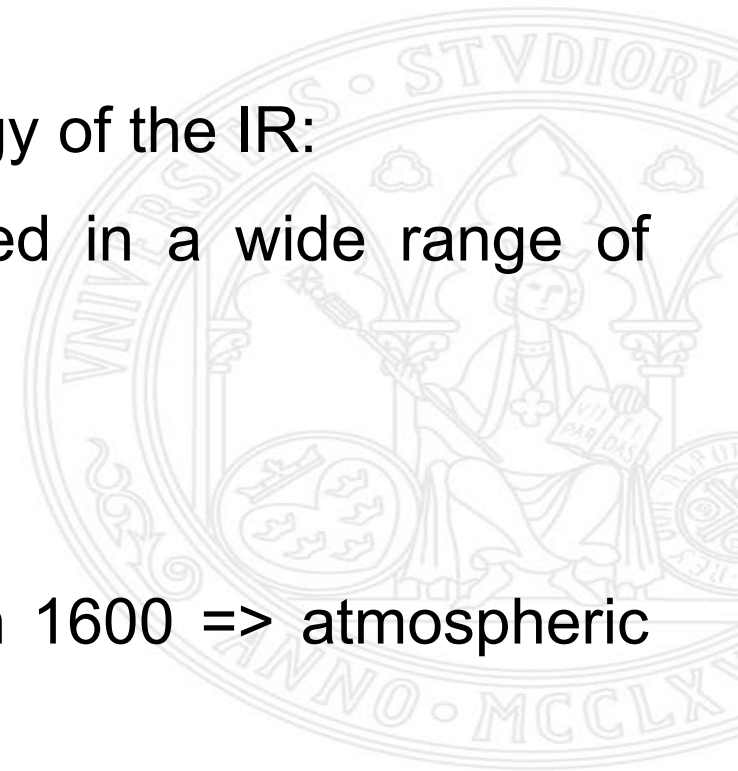
- **2.3.1. Explaining the Industrial Revolution.**
- **A. The Cotton Industry.**
- Cotton machines:
 - Reduced the hours of labor needed to produce one pound of yarn.
 - At the same time they increased the capital required per pound.
 - The savings made with mechanical spinning were greater where labor was more expensive.



- **2.3.1. Explaining the Industrial Revolution.**
- **A. The Cotton Industry.**
- The machines were not profitable anywhere else.
 - 1820s: cotton machinery proved profitable to install on the continent.
 - 1850s: cotton machinery proved profitable to install in low-wage economies such Mexico and India.
 - 1870s: factory cotton production began to shift into the Third World.

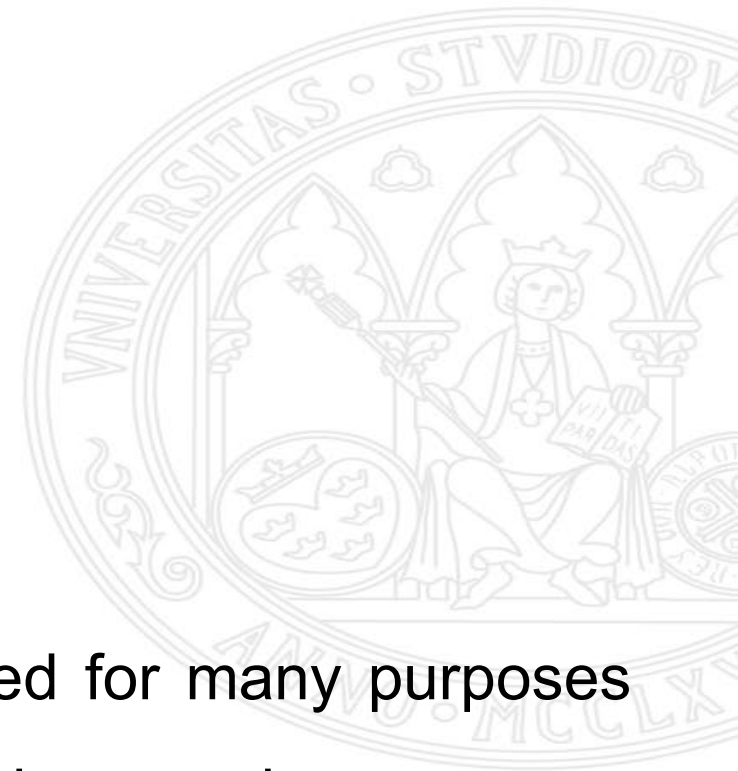


- **2.3.1. Explaining the Industrial Revolution.**
- **B. The Steam Engine.**
- The steam engine was the most transformative technology of the IR:
 - Steam engine allowed mechanical power to be used in a wide range of industries.
 - Railways.
 - Ocean-going ships.
- Steam power was a spin-off of the Scientific Revolution 1600 => atmospheric pressure (Newcomen, 1712).



UNIT 2.3. The Industrial Revolution and its Patterns of Development.

- **2.3.1. Explaining the Industrial Revolution.**
- **B. The Steam Engine.**
- R&D on the steam engine was conducted in England.
- Coal fields meant it paid to use the steam engine:
 - Original goal: to drain mines.
 - Early machines required vast quantities of coal.
- Steam power became a technology that could be applied for many purposes and used around the world, but only after the engine was improved.



James Watt created a commercially successful steam engine by observing where others had failed.

His patent prevented any rival manufacture and the development of any further improvements to the Newcomen engine he had based his invention on so that the 'Boulton & Watt' company he had formed with his backer had a monopoly on production.



A.D. 1769 N° 913.

Steam Engines, &c.

WATT'S SPECIFICATION.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, JAMES WATT, of Glasgow, in Scotland, Merchant, send greeting.

WHEREAS His most Excellent Majesty King George the Third, by His Letters Patent under the Great Seal of Great Britain, bearing date the Fifth day of January, in the ninth year of His said Majesty's reign, did give and grant unto me, the said James Watt, His special licence, full power, sole privilege and authority, that I, the said James Watt, my exors, admors, and assignes, should and lawfully might, during the term of years therein expressed, use, exercise, and vend, throughout that part of His Majesty's Kingdom of Great Britain called England, the Dominion of Wales, and Town of Berwick upon Tweed, and also in His Majesty's Colonies and Plantations abroad, my "NEW INVENTED METHOD OF LESSENING THE CONSUMPTION OF STEAM AND FUEL IN FIRE ENGINES;" in which said recited Letters Patent is contained a proviso obliging me, the said James Watt, by writing under my hand and seal, to cause a particular description of the nature of the said Invention to be inrolled in His Majesties High Court of Chancery within four calendar months after the date of the said recited Letters Patent, as in and by the said Letters Patent, and the Statute in that behalf made, relation being thereunto respectively had, may more at large appear.

NOW KNOW YE, that in compliance with the said proviso, and in pursuance of the said Statute, I, the said James Watt, do hereby declare that the

Source: James Watt Patent 1769,n. 913
https://commons.wikimedia.org/wiki/File:James_Watt_Patent_1769_No_913.pdf

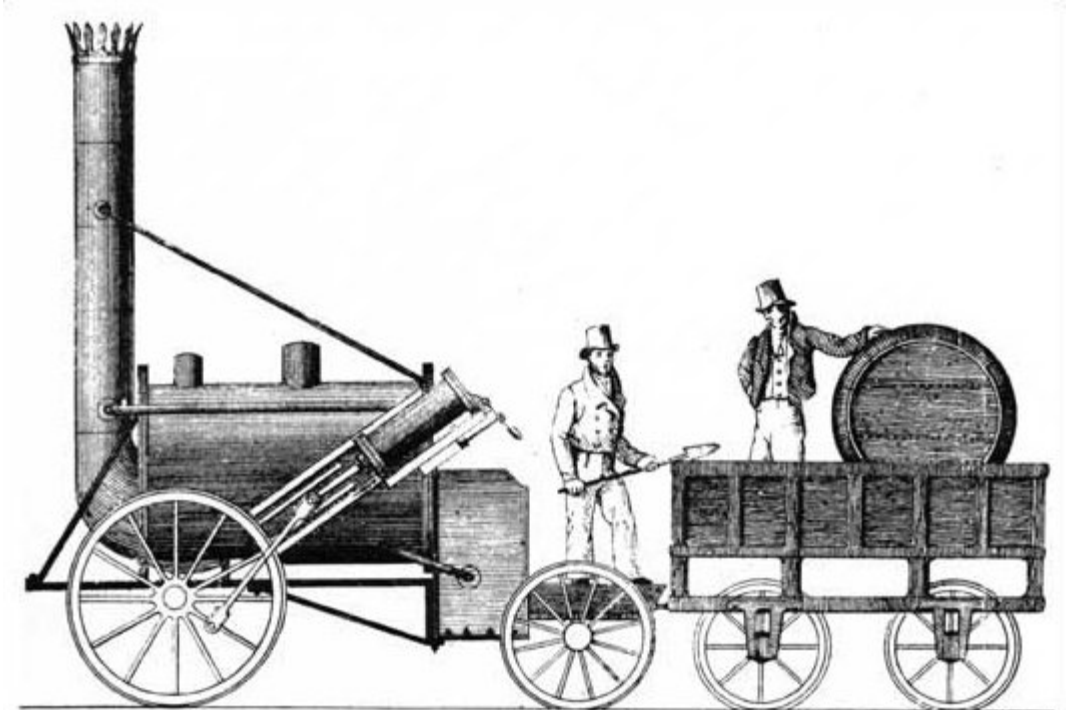
(*Mokyr is careful to point out that science wasn't entirely absent during the first industrial revolution, and that the second industrial revolution had its share of trial and error.

Mokyr also points out that, “the persistence and acceleration of technological progress [during what we now call the second industrial revolution] was due increasingly to science [and] experience and information.”

- **2.3.1. Explaining the Industrial Revolution.**
- **B. The Steam Engine.**
- Most factories were powered by water until the 1840s.
- 1850s: the fuel consumption of steam engines had dropped enough to make them a cheaper source of power.
- Steam power revolutionized transportation.
 - Land vehicle: iron rails replaced wooden ones.
 - The lines were extended.



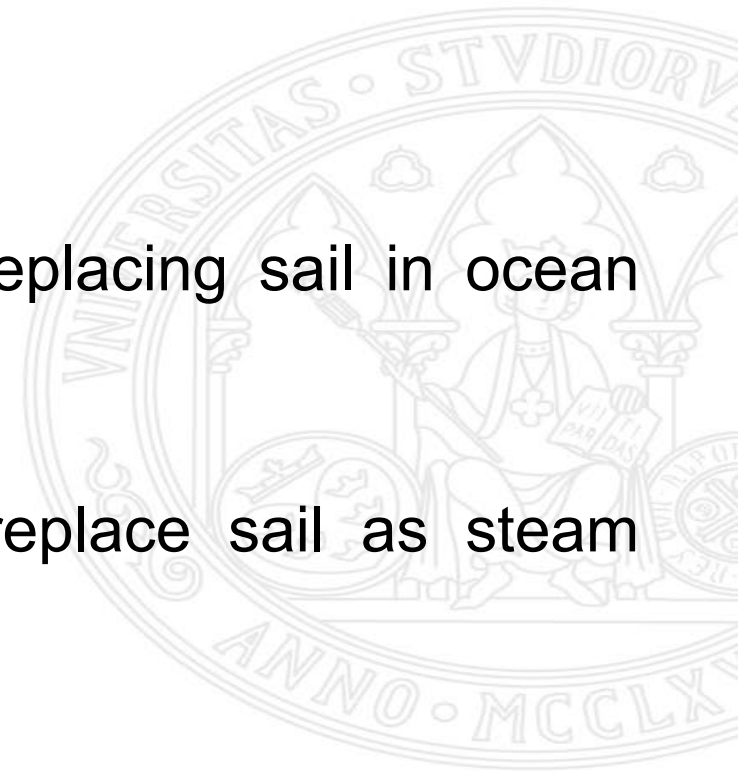
- **2.3.1. Explaining the Industrial Revolution.**
- **B. The Steam Engine.**
- Robert Stephenson designed the Rocket in 1829.
 - The Rocket was not the first steam locomotive.



Source: Public Domain,
<https://commons.wikimedia.org/w/index.php?curid=216014>

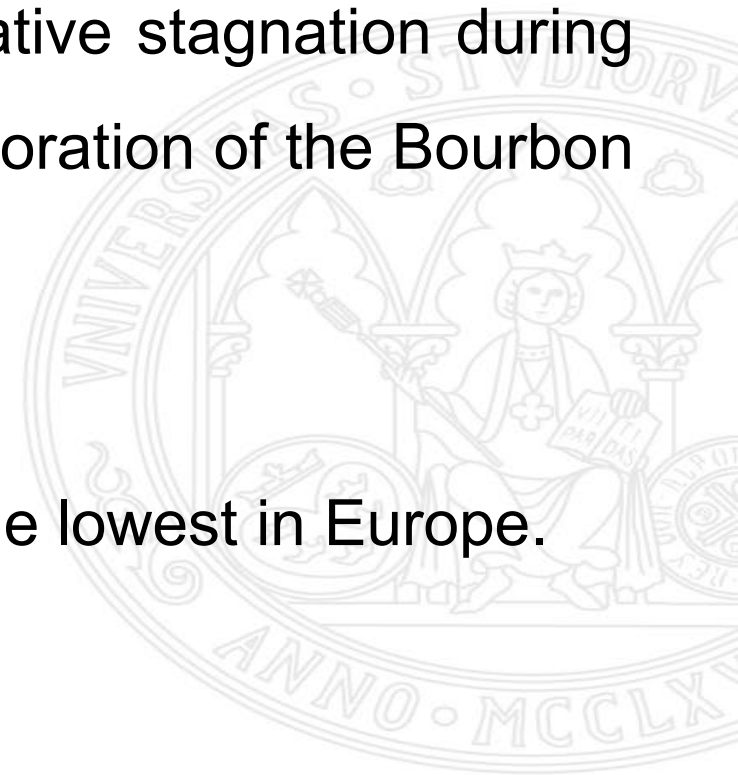
UNIT 2.3. The Industrial Revolution and its Patterns of Development.

- **2.3.1. Explaining the Industrial Revolution.**
- **B. The Steam Engine.**
- Steam power revolutionized transportation.
 - Water locomotion: By the mid-19th C, steam was replacing sail in ocean transportation.
 - It took another half century for steam to fully replace sail as steam engines reduced coal requirements.



UNIT 2.4. Industrialization in Spain.

- **2.4. Industrialization in Spain.**
- The Spanish economy experienced a period of the relative stagnation during the second half of the 19th C., especially during the Restoration of the Bourbon monarchy.
 - After a promising early start: Catalonia exception.
- By 1910, Spain's level of industrialization was among the lowest in Europe.
 - Prados (1988, 169): Table 4.10



UNIT 2.4. Industrialization in Spain.

- **2.4. Industrialization in Spain.**
- Prados (1988, 169) Table 4.10. Industrialization per capita in various European countries, 1800-1910 (in \$US, at parity purchasing power).

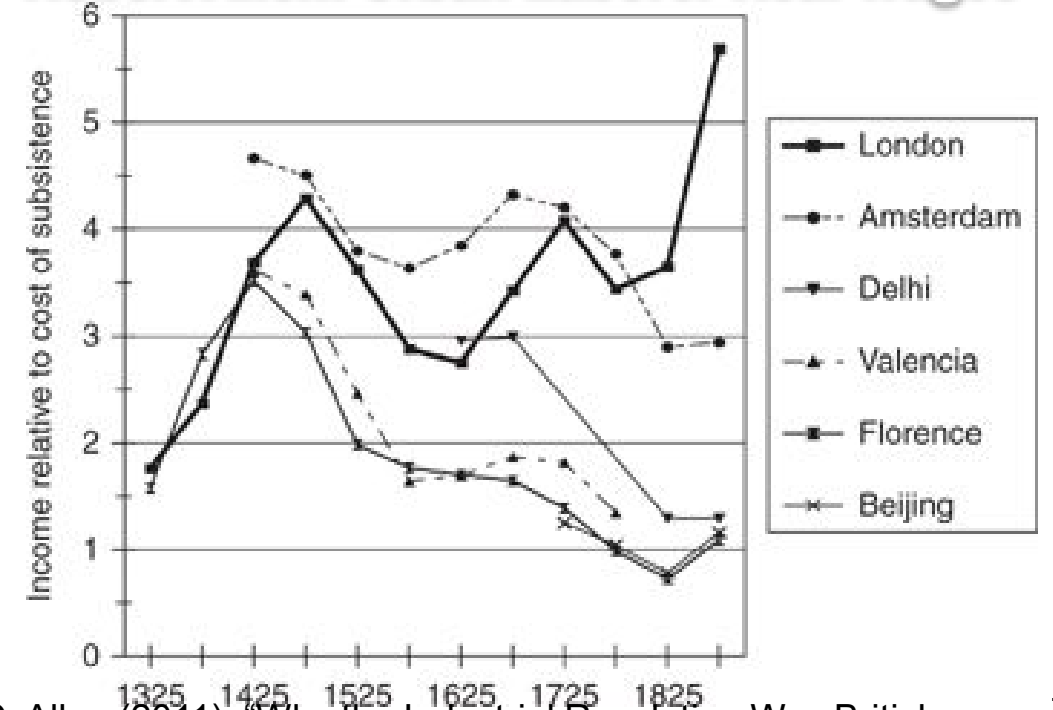
Country	1800	1830	1860	1890	1910
Great Britain	89	139	257	391	458
France	59	92	164	250	356
Germany	--	--	102	134	391
Sweden	--	--	46	97	198
Italy	--	--	35	63	145
Hungary	--	--	--	--	157
Spain	34	29	50	93	122

UNIT 2.5. Conclusions.

- 1. Comment on the following expression.
"The Industrial Revolution was Britain's creative response to the challenges and opportunities created by the global economy that emerged after 1500."
- 2. What were the main consequences of the growth of British commerce?



Robert Allen: Urban Laborer Real Wages



Robert C. Allen (2011): "Why the Industrial Revolution Was British: Commerce, Induced Invention and the Scientific Revolution," *Economic History Review* 64, pp. 357-384.
<http://onlinelibrary.wiley.com/doi/10.1111/j.1468-0289.2010.00532.x/pdf>

UNIT 2.3. The Industrial Revolution and its Patterns of Development.

- 3. R. Allen (2009) emphasizes that changes in diet are relevant to higher wages. Can you explain why?
- 4. Why does R. Allen say that the growth of cities stimulated agriculture?
- 5. Regarding technological change, please explain why patents were relevant for the economic growth.

	quantity per person per year	price g. silver per unit	spending share	nutrients/day grams of calories protein	
bread	234 kg	.693	36.0%	1571	64
beans/peas	52 l	.477	5.5	370	28
meat	26 kg	2.213	12.8	178	14
butter	5.2 kg	3.470	4.0	104	0
cheese	5.2 kg	2.843	3.3	54	3
eggs	52 each	.010	1.1	11	1
beer	182 l	.470	20.0	212	2
soap	2.6 kg	2.880	1.7		
linen	5 m	4.369	4.8		
candles	2.6 kg	4.980	2.9		
lamp oil	2.6 l	7.545	4.3		
fuel	5.0 M BTU	4.164	4.6		
total		450.956	100.0%	2500	112



Robert Allen. 2006: The High Wage Economy of Pre-industrial Britain
https://www.researchgate.net/publication/228899202_The_High_Wage_Economy_of_Pre-industrial_Britain

	Weekly income			
	66 d	120 d	180 d	318 d
pounds of food and pints of milk consumed per week				
flour	8.54	12.20	17.08	19.53
oatmeal	7.50	13.75	11.25	15.00
potatoes	17.39	34.78	36.52	34.78
milk	7.33	4.00	6.00	6.67
butter	0.00	0.00	0.80	1.28
meat	0.00	0.00	1.09	2.55
beacon	0.29	1.14	0.57	0.43
cheese	0.00	0.00	0.56	0.80
sugar	0.00	0.57	1.26	2.40
tea	0.00	0.00	0.12	0.23
% of income spent on food	85%	76	74	61
calories/day per adult male	1605	2806	3219	3937
grams protein/day per adult male	64	106	119	147
index of food cost/calorie	1.00	.92	1.23	1.41

Robert Allen. 2006: The High Wage Economy of Pre-industrial Britain

https://www.researchgate.net/publication/228899202_The_High_Wage_Economy_of_Pre-industrial_Britain

Notes:

1) The income class of 318 d is also shown consuming 6d per week of beer. I have ignored this.