UNIT 2. The Industrial Revolution.

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UNIT 2. Syllabus

- 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.
- For other resources, please, check the presentation



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NEW APPROXIMENTS OF DECEMORIC AND SECONE MISSIONS.

THE BRITISH INDUSTRIAL REVOLUTION IN GLOBAL PERSPECTIVE

Robert C. Allen



GLOBAL ECONOMIC HISTORY

CONFIDENCE

Robert C. Allen THE INDUSTRIAL REVOLUTION A Very Short Introduction

UNIT 2.1. Introduction

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• 1.1 Introduction:

- In the following video R. Allen discusses why Britain became industrialized while other countries did not.
- This clip is part of *The <u>CORE</u> project*. CORE is an open-access, interactive ebookbased course for anyone interested in learning about the economy and economics.
- Here you can read the transcript of the previous video: <u>https://www.core-econ.org/the-economy/book/text/bob-allen_why-britain-industrialised-when-others-did-not-transcript.html?query=economic+history</u>



- Robert Allen: The Industrial Revolution
 - Why did it happen in England?
 - Why did it happen in the 18th Century?



"The industrial revolution was fundamentally a technological revolution, and progress in understanding it can be made by focusing on the sources of invention.... [T]he reason the industrial revolution happened in Britain, in the eighteenth and nineteenth centuries, was not because of luck (Crafts 1977) or British genius or culture or the rise of science. Rather it was Britain's success in the international economy that set in train economic developments that presented Britain's inventors with unique and highly remunerative possibilities. The industrial revolution was a response to the opportunity...'[Source: https://www.bradford-delong.com/2012/02/robert-allen-the-british-industrial-revolution-in-global-perspective.html (27.09.2022)]

Spinner: meaning female spinner Building labourer: meaning male building labourer.

The reason why a woman's earnings rose in spinning so much was because the textile industries expanded rapidly to supply Britain's growing commercial empire

Wages increasing made much more profitable to use capital intensive technology

Figure 3. Earnings of a spinner relative to a building labourer Sources: Spinners' wage from Muldrew, "Th'ancient distaff" ', pp. 504–11, 519. Labourers' wage from Woodward, Men at work, pp. 274–5; Gilboy, Wages, pp. 280–2.







[[Wooden model 16 inches high 11 inches wide, 20 inches long--it ha 12 spindles operated by hand crank. This is a model of the spinning jenny invented by James Hargreaves, June 22, 1770. This model was accessioned in 1906]]

The wages of women made the spinning jenny profitable in the 18th Century whereas would have not been in the 17th C.



Source:

https://americanhistory.si.edu/collections/search/object/ nmah_625460



 "So, the answer to the big question, the reason that machinery was invented in Britain at the end of the 18th century, is because Britain was a high wage economy then, and it was a high wage economy because of the economic expansion induced by her successful imperialism".



In 1760 the British Empire stretched around the world, from North America to India and points in between.

Source:

https://sageamericanhistory.net/revolution/topics/am rev1761-74.html

- 2.2. Basic Determinants of the Industrial Revolution.
- The Industrial Revolution (IR) was the result of the transformation of the early modern economy.
 - England: high wages and salaries, low energy prices.
- (Allen, 2009). Britain's creative response to the challenges and opportunities created by the global economy that emerged after 1500.
 - <u>1st step</u>: Britain took a commanding position in the extensive market that emerged.
 - 16th 17th C.: The British wool textile industry competed with the established producers in Italy and the Low Countries.

- 2.2. Basic Determinants of the Industrial Revolution.
- <u>1st step</u>: Britain took a commanding position in the extensive market that emerged.
 - 17th -18th C.: Britain extended her lead by expanding intercontinental trade:
 - Acquisition of colonies.
 - Mercantilism.
 - Trade promotion.
 - Naval power.
- <u>2nd step</u>: Britain's success in the expansion of rural manufacturing industries and rapid urbanization.

UNIT 2.2. Basic Determinants of the Industrial Revolution.

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https://studentmadehistory.wordpress.com/2015/05/20/whatimpacts-did-the-industrial-revolution-have-on-population-andurbanization-by-abdullahi-mohammed-jesus-alvares-and-fluffyhernandez/



- 2.2.1 Cultural and Political Context.
- The growth of British commerce had three important consequences (R. Allen, 2009):
 - 1. The growth of London created a shortage of firewood that was only relieved by the use of coal.
 - 2. The growth of cities and manufacturing increased the demand of labor
 - British wages and living standards were the highest in the world.
 - Beer, bread and beef.
 - 3. The growth of cities and wages stimulated agriculture.

UNIT 2.2. Basic Determinants of the Industrial Revolution.

- 2.2.1 Cultural and Political Context.
- The IR was a turning point in world history.
 - A new era of sustained economic growth (1760-1850).
- The IR was the result of the transformation of the early modern economy.
 - 1.5% growth per year (1760 [1776]).
 - It was not the abrupt discontinuity that its name suggests.
- Technological change was the driving force behind the IR.
 - Inventions, innovations, new products:
 - were responses to the high wages and cheap energy of the British economy.
 - meant labor was replaced with capital and energy.



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The

IOURNAL of ECONOMIC

- "The spinning jenny helps explain why the Industrial Revolution occurred in Britain rather than in France or India. Wages were exceptionally high relative to capital prices in Britain, so the jenny was profitable to use in Britain but not elsewhere. Since it was only profitable to use the jenny in Britain, that was the only country where it as worth incurring the costs of developing it. Irrespective of the quality of their institutions or the progressiveness of their cultures, neither the French nor the Indians would have found it profitable to mechanize cotton production in the eighteenth century" (Allen, 2009*.
- (*) The Journal of Economic History, Volume 69, Issue 4, December 2009, pp. 901 927 DOI: https://doi.org/10.1017/S0022050709001326

- 2.2.1 Cultural and Political Context. England:
- A. Scientific Revolution (17th C.).
- B. English Constitution and Parliament.
- C. England collected twice as much taxes per capita as the French state:
 - i.e.: the Navy Act.
- D. Power to take people's property:
 - i.e.: the Enclosure Act.
- E. Public Utilities: infrastructure such as canals and roads.

UNIT 2.2. Basic Determinants of the Industrial Revolution.

- 2.2.1 Cultural and Political Context. England.
- A. Scientific Revolution 17th C.
- New vision of the world: methodological and mechanical.
- Science spread rapidly through education in universities (Oxford, Cambridge), academies and scientific societies.
- The Royal Society of England: the first permanent organization dedicated to scientific activity.



- 2.2.1 Cultural and Political Context. England.
- B. English Constitution and Parliament.
 - The Revolution of 1688.
 - When James II was overthrown, modern English parliamentary democracy began.
 - Bill of Rights of 1689: the monarch held absolute power.
 - Changes following the Glorious Revolution:
 - The king was no longer above the law.
 - The Crown could not call or disband parliament.
 - Parliament gained a direct role in financial matters.

UNIT 2.2. Basic Determinants of the Industrial Revolution.

- 2.2.1 Cultural and Political Context. England.
- B. English Constitution and Parliament.
 - Parliament introduced a land tax in 1693.
 - The French nobility was exempt from taxation.
 - But: most revenue was raised from consumer goods.
 - Beer.
 - Tobacco (colonies).
 - Sugar (colonies).
 - (NOTE: Wages higher than bare-bones subsistence wages).



- 2.2.1 Cultural and Political Context. England.
- C. English collected twice as much per capita as the French state.
 - Navy→ to promote commerce (Navy Act).
 - Monopoly with the colonies.
 - To promote trade & economic growth.



UNIT 2.2. Basic Determinants of the Industrial Revolution.

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The map of the Enclosure Award of the East Field shows the roads and boundaries drawn by the commissioners in 1846 across the strips marked in the 1775 survey. The contrast between the size of the new fields and the old strips is very marked

Source:

https://www.wilcuma.org .uk/the-history-of-dorsetafter-1066/dorsetenclosures/

UNIT 2.2. Basic Determinants of the Industrial Revolution.

- Enclosure Act:
- The standard explanation emphasizes enclosures and capitalist farming.



UNIT 2.2. Basic Determinants of the Industrial Revolution.

- Initiatives to enclose came from:
 - Landowners hoping to maximize rent from their estates.
 - Tenant farmers hoping to improve their farms.
- Parliament supported enclosure: bills.









- 2.2.1 Cultural and Political Context. England.
- E. Public Utilities: infrastructure such as canals and roads.
- Industrial Revolution created huge amounts of heavy produce which had to be moved.
 - Roads could not handle such weights and the vehicles needed to move this produce did not exist.
 - Canals were the answer to moving heavy objects large distances.

- 2.2.1 Cultural and Political Context. England.
- E. Public Utilities: infrastructure such as canals, turnpikes.
- "Although the turnpike trusts became outmoded in the Victorian era, it must not be forgotten that this most ubiquitous institution, an important feature of the landscape for over 150 years, had been one of the central pillars on which the industrial revolution was based."

Transport in the Industrial Revolution, D. H. Aldcroft (1983).



 Turnpike trusts were authorized by Acts of Parliament to build, maintain and operate toll roads in Britain.



- 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.



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)

Figure 5.1 Flowchart (one period) of the model

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

- 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.



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Britain was a high ulletwage 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





ullet

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





ullet

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





ullet

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



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





Coal Mining in the Brithish 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.

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

- 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.

UNIT 2.3. The Industrial Revolution and its Patterns of Development

- 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



A.D. 1769 Nº 913.

Steam Engines, &c.

WATT'S SPECIFICATION.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, JAME 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 5 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 priviledge and authority, that I, the said James Watt, my exors, aditions, and assigns, should and lawfully might, during the term of years therein expressed, use, exercise, and vend, throughout that part of His Majesty's 10 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 15 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. 20 NOW KNOW YE, that in compliance with the said provisoe, and in pur-

suance of the said Statute, I, the said James Watt, do hereby declare that 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.

Source: James Watt Patent 1769, n. 913 https://commons.wikimedia.org/wiki/File:James_Watt_Pat ent 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."

Source: The Second Industrial Revolution (September 2022) [https://www.uh.edu/engines/epi2694.htm]

- 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.

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

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





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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.

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 It took another half century for steam to fully replace sail as steam engines reduced coal requirements.

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• 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

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• 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.

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- 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?





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	price		nutrie	nts/day	
	per person	g. silver	spending	(grams of	
	per year	per unit	share	calories	protein	
bread	234 kg	.693	36.0%	1571	64	
beans/peas	s 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 1	7.545	4.3			
fuel	5.0 M BTU	J 4.164	4.6			
total		450.956	100.0%	2500	112	



	Week	ly income	2
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/da per adult male	ау 64	106	119	147
index of food cost/calorie	1.00	.92	1.23	1.41

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