Notes from Third Einstein-Cartan-Evans (ECE) Conference
Swansea and Aberystwyth, Wales
July 2013

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Dpt SLC 7:10 7/2/13, DL
Arr ATL 12:30 7/2/13
Dpt ATL 22:45 7/2/13 DL 10
Arr LHR 12:00 7/3/13
Dpt LHR 12:30 7/3/13 Heathrow Express
Arr Paddington 13:00 7/3/13
Dpt Paddington 13:30 7/13/13 Tube
Arr Euston 14:00 7/1/13
Dpt Euston 14:43 7/3/13 Virgin Trains
Arr BHI 16:00 7/3/13
Dpt BHI 16:08 7/3/13 Arriva
Arr Aberystwyth 19:15 7/3/13
Arr B&B 20:30 7/3/13

Met:

- Kerry Pendergrast
- Simon Clifford (EE)
- Robert Cheshire (Producer)
- Horst Eckhardt (Siemens)
- Bernhard
- Nachaat (med researcher?)
- Victor Ricansky
- Dave
- Richard

Evening:
Beer
Pool Hall, Pier
Food
dBeer

Impressions:

Kerry pretty down to earth, critical of Myron on everything except science

Simon. Very interesting. EE smart, nice. Has met with Alex Hill. Knows the story of Aurelio Hortung. Claims he is the brains, Hill is being pressured to keep quiet by security services. Confirmed Myron consulting with USN on how such a device coudl work.

Kerry background

Nachaat – Human Heart Project, modelling human heart for Dx purposes

My preso very well received – personally and professionally

Simon is an important guy has met with Alex Hill, thinks Hortung is the important one

Doug Lindstrom also has met Alex Hill

Cold current papers

travelled with Victor, Robert
Myron is an utterly nice, grounded, brilliant man, “better than Einstein.”
Hiked through the tips trails
Met with him alone
He offered to help on my dissertation
I invited him to my committee; accepted
He said was interested in economics, maybe as much as I am interested in his physics
Offered to help me with anything including tensor calc!!!!
I felt I was in the presence of a great man

Swansea – Paddington 17:28 – 22:50 7/6/13
Paddington – Heathrow 23:00 –23:15 7/6/13
Heathrow – Sheraton 7/6/13
Sheraton – Heathrow 7/7/13

Agenda

- Economics – what is it, what are our challenges?
- Intersection of physics and economics
  - Methodologies
  - Thermodynamics
  - Shared people
- South Wales industrial history
- My interests
- Importance of energy in economic systems; hence, the importance of ECE theory in future economic systems
- The role of AIAS in the next great positive supply shock

What do economists do?

- Attempt to model complex social systems – Macroeconomics – equilibrium-based models
- Attempt to explain individual (consumer/firm) behaviour – Microeconomics – constrained optimization
- Attempt to link them – microfoundations of macroeconomics, network systems with emergent behaviours, stochastic agent-based models.
  N.B. the “Fallacy of Composition” makes the emergent properties of network systems (graph theory) a very compelling methodology, at least in economics

Challenges of economics

- Macro models do not forecast well
- Macro models (DSGE) tend to have many adjustable parameters, are very complex
- Empirical (statistical) models offer some relief, but . . .
- Few repeatable experiments

Similarities/dissimilarities with physics

- Use maths in several ways (physics envy?)
  - Theory – so use mostly the same algebras you do (especially linear), although so far no tensor calculus
  - Applied – since difficult to repeat experiments, have evolved a wide set of statistical methods
  - Simulation
- Use scientific methods, processes (publish, etc.)
- Have models with many adjustable parameters – Myron's admonitions apply equally well to economics
- Share people – Fredrick Soddy, Wall Streen "quants"

Similarities/**dissimilarities** with physics

- Narrow vein of thermodynamicists (Sergei Podolinski, Georgescu-Roegen, Timothy Garrett) to whom economics is a thermodynamic system
- Must incorporate institutions and history
- Again, very little repeatability – difficult to “rewind” a macroeconomy since people are involved

Industrial history of South Wales

Century	Company	Location	Product	Customer
16^{th}–17^{th}	Mineral and Battery Company	Tintern	brass, wire	woolcards
	Mines Royal	Cornwall Neath	copper mining copper smelting (coal)	
	various	Swansea,Tenby	coal mining	export
	various	Brecon, Monmouth	iron (charcoal)	
18^{th} (1^{st} half)	various	Pontypool	tinplate	
	Humphrey Mackworth	Melincryddan	lead,copper	
	John Lane	Landore	copper smelting	
	various	Swansea	copper smelting	
	various	Taibach	copper smelting	
	various (16)	various (small)	iron (charcoal)	
1750–1850	Powicke Forge	Hirwaun	iron (coal)	Seven Years' War
	Llanishen Merthyr Furnace	Merthyr Dowalis	mineral lease (iron) iron (coal)	Merthyr Furnace war
	Cyfarthfa Pennydarren Plymouth Works	Merthyr Merthyr Merthyr	mineral lease (iron) mineral lease (iron) mineral lease (iron)	war war war
	Cyfartha Works	Merthyr	cannon	US Revolution
	Cyfartha Works	Merthyr	puddlling process	wrought iron
	various (4)	various	tramroad canals	transport
	Pen-y-Darren Ironworks Richard Trevithick (1804)	Merthyr Tydfil	steam engine locomotive	hammer transport
1815-1850	various	various	iron,tinplate,copper,coal	
1727-	Robert Morris, others	Swansea	non-ferrous smelting	input story cheap coal near ores

Pen-y-darren engine replica, National Waterfront Museum, Swansea

Blast furnaces 1709 (coke), Blists Hill, Coalbrookdale, Shropshire

My interests

- Long time background physics interest, bemusement over great divide

[1] A note on the University of Utah: one of the most heterodox economic programs in the world; also the home of Fleischmann and Pons experiments

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- Last year I “came out of the heterodox closet” by writing Myron on cold fusion; I am humbled by the response and truly feel I am on the sidelines of a revolution
- So, onto the importance of energy in economic systems: [1]

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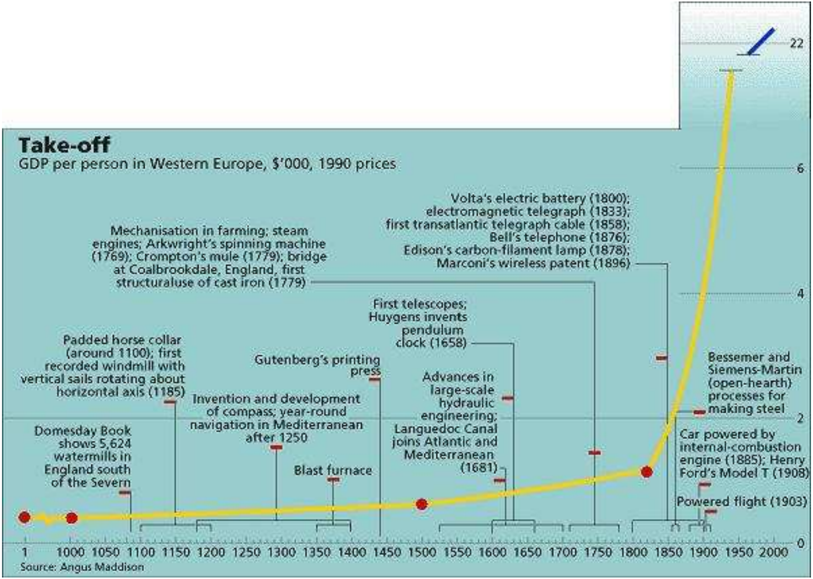
English Industrial Revolution, 1590 - 1876

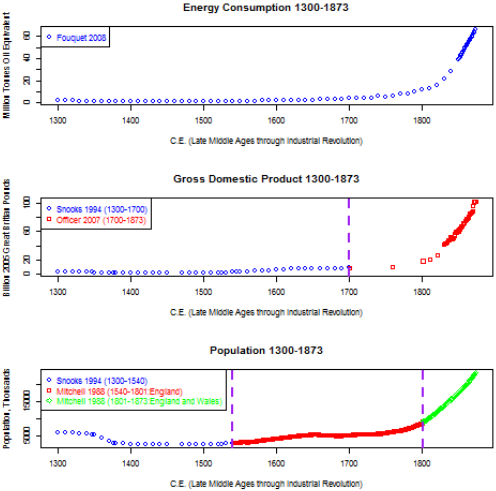
- Modern economic growth
- Unconstrained quantity of fossil carbon energy – an *energy* revolution (in fact two!) led by a demand revolution
- Little statistical space for institutional or cultural events – except to explain structural breaks


Take-off
GDP per person in Western Europe, $'000, 1990 prices
Volta's electric battery (1800); electromagnetic telegraph (1833); first transatlantic telegraph cable (1858); Bell's telephone (1876); Edison's carbon-filament lamp (1878); Marconi's wireless patent (1896)
Mechanisation in farming; steam engines; Arkwright's spinning machine (1769); Crompton's mule (1779); bridge at Coalbrookdale, England, first structuraluse of cast iron (1779)
First telescopes; Huygens invents pendulum clock (1658)
Padded horse collar (around 1100); first recorded windmill with vertical sails rotating about horizontal axis (1185)
Gutenberg's printing press
Advances in large-scale hydraulic engineering; Languedoc Canal joins Atlantic and Mediterranean (1681)
Bessemer and Siemens-Martin (open-hearth) processes for making steel
Invention and development of compass; year-round navigation in Mediterranean after 1250
Domesday Book shows 5,624 watermills in England south of the Severn
Blast furnace
Car powered by internal-combustion engine (1885); Henry Ford's Model T (1908)
Powered flight (1903)
22
6
4
2
0
1 1000 1050 1100 1150 1200 1250 1300 1350 1400 1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000
Source: Angus Maddison

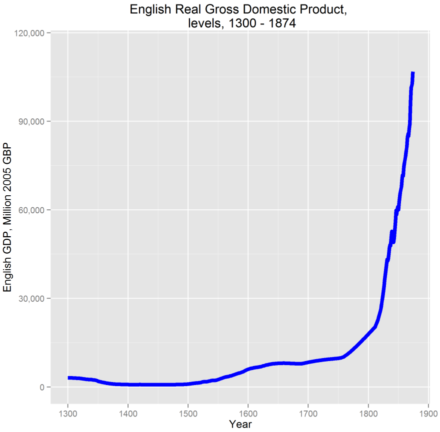
Taxonomy of EIR explanations

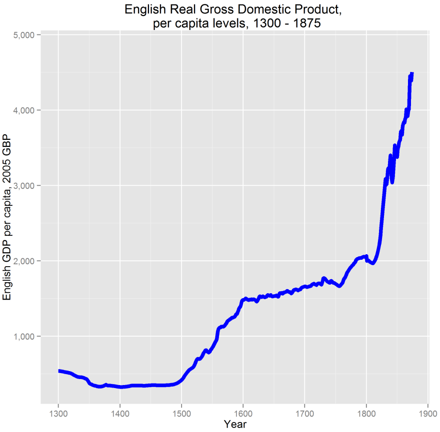
Label	Examples
English exceptionalists	Landes (1969), McCloskey (2010), Mokyr (1992,2010)
Partial culturalists	Cipolla (1966), Pomeranz (2001), Allen (2009)
Primarily energetic	Cottrell (1955), Wrigley (1988,2010), Malanima (2010), Nef (1932)
Thermodynamicists	Georgescu-Roegen (1975), Ayres (2003), Garrett (2009)

Author/time-span series of energy consumption, GDP, and population

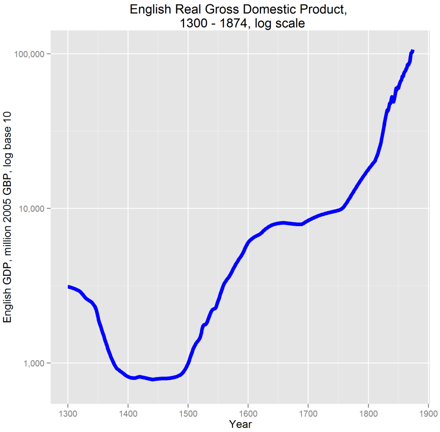


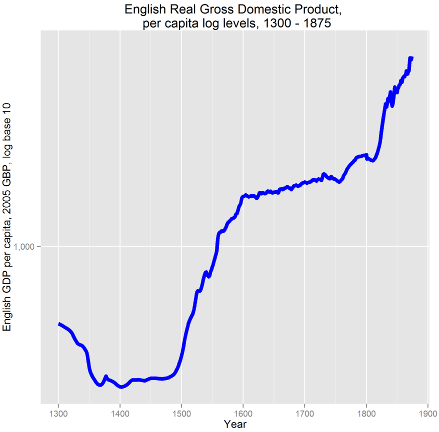
English real gross domestic product, levels and per–capita



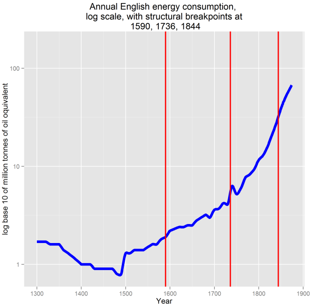


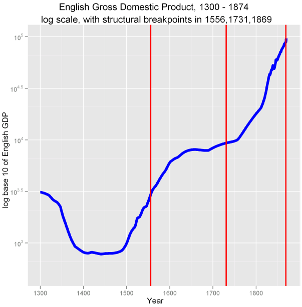
English real gross domestic product, log levels and log per–capita

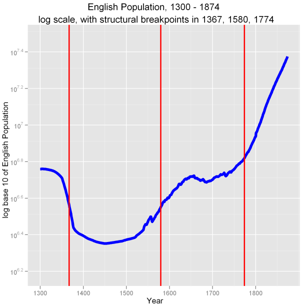




Structural break comparison



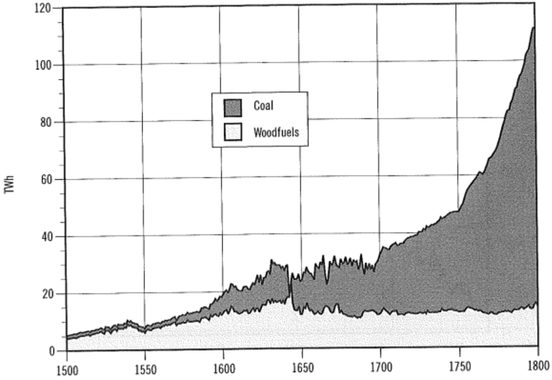




Coal and wood energy sources

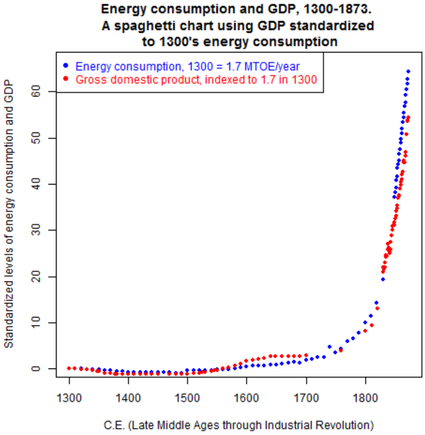
Source: Pearson & Fouquet

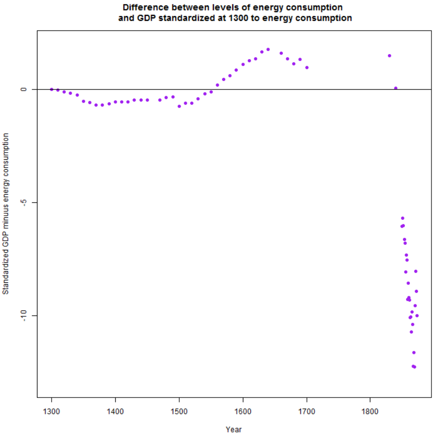
Figure 4: Energy consumption by final users (terawatt hours (TWh)), 1500–1800



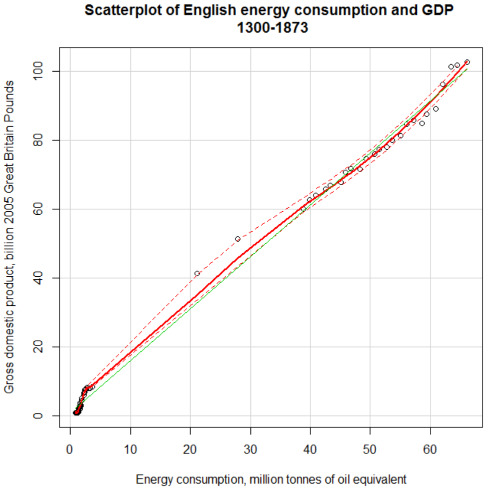
Note: The consumption of candles is not visible in this graph: even by 1800, it was only equivalent to 0.5TWh, while in 1500 it was only 0.1TWh. As a percentage share, it is just visible between 1500 and 1700, with its maximum value being around 4% of energy used (see Figure 10).

Energy consumption vs. standarized GDP





Scatterplot of energy consumption vs. GDP



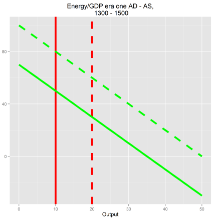
No “Solow” residual

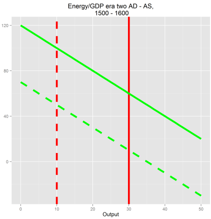
Granger tests of energy/GDP dynamics

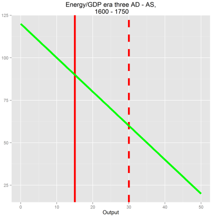
Era	Energy ~ GDP Pr(>F)	GDP ~ Energy Pr(>F)	AS/AD regime
1300 – 1500	0.0106	0.0003	EMP [2], Black Death: increasing wages, family income
1500 – 1600	0.1939	0.6126	Positive demand shock
1600 – 1750	0.3529	0.5185	Energy supply constraint
1750 – 1873	0.0024	0.1100	Positive supply shock: “virtuous” macro feedback cycle
1300 – 1873	0.0002	0.0361	Total study period

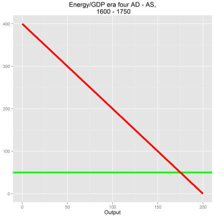
[2] European marriage pattern (Hajnal)

Aggregate Supply - Aggregate Demand
Four energy/GDP regimes









Desaguliers manuscript

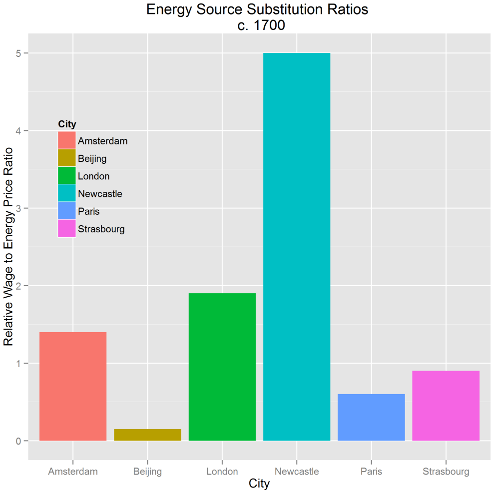
rection P *p*, and a Quantity of Water proportionate
be lifted up, and run out at P. This may be done 15 or 16 times in a
Minute, becauſe each Man would pull down but 30 Pounds at a time,
after the manner that People ring Bells. But as no Time is to be loſt, leſt
the Mine be overflow'd by the Springs below, there muſt be 100 more
Men to relieve theſe when they are weary. Now as it muſt be a rich
Mine indeed whoſe Profit can afford to keep 200 Men at this Work; that

Ooo 2

Lect. XII. Plate 36.

that Thought muſt be laid aſide. We'll conſider therefore what can be
done by Horſes. As an Horſe is equal to five Men, we muſt work 20
Horſes at a time to raiſe the Water requir'd; and as Horſes muſt be re-
liev'd even more than Men, about 50 Horſes muſt be kept to carry on
this Work conſtantly, and bring down the End of the Beam *b*, 16 times
in a Minute, and make the number of Strokes requir'd in the Pump,
the Weight of whoſe Rod after every Stroke will bring down the End
b 2, by drawing along the Tangent *i* H. It is plain to any body, that
tho' the Horſes may be had cheaper than Men, yet that will be a very
expenſive way. For the next Contrivance, we'll ſuppoſe a Philoſopher
to come, and find a means to bring down the End of the Beam, with-
out Men or Horſes, in this manner. To the Chain H L he fixes a

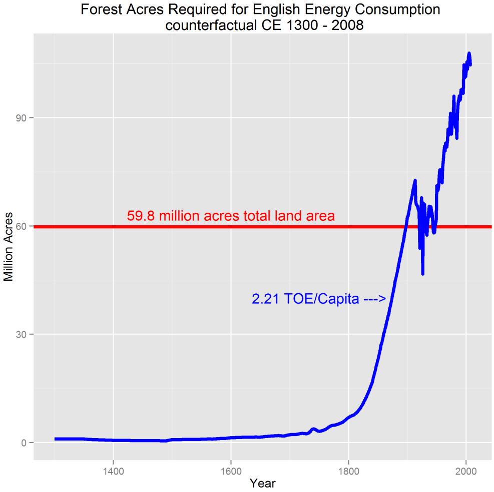
Real wage to energy ratios
Source: Robert Allen (2009)



Microeconomic theory

$$\frac{\text{Marginal Revenue Product}_{\text{organic energy joule}}}{\text{Price}_{\text{organic energy joule}}} = \frac{\text{Marginal Revenue Product}_{\text{fossil energy joule}}}{\text{Price}_{\text{fossil energy joule}}} \tag{1}$$

English wood energy supply constraint



The role of AIAS in future economic systems

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- What can I do to help?

Figure: Standardized English energy intensity of GDP

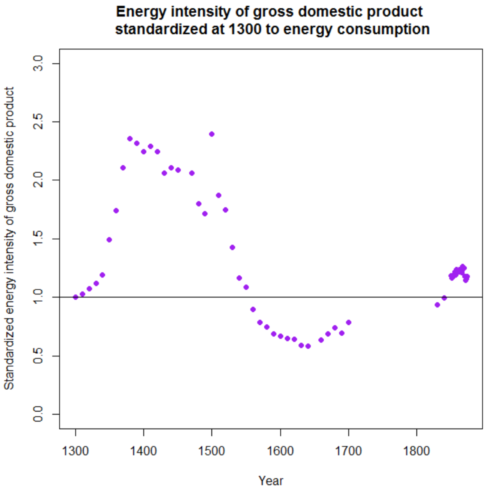


Figure: Log of GDP, with structural breaks

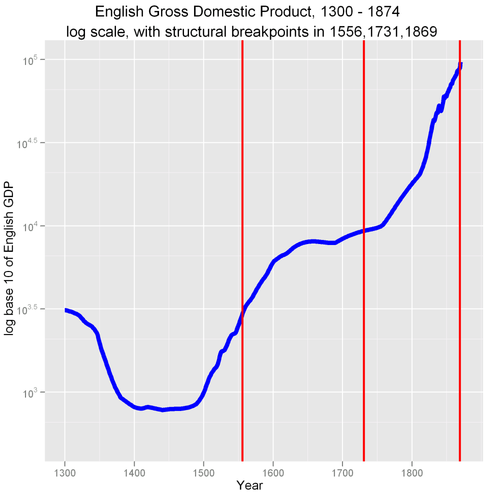
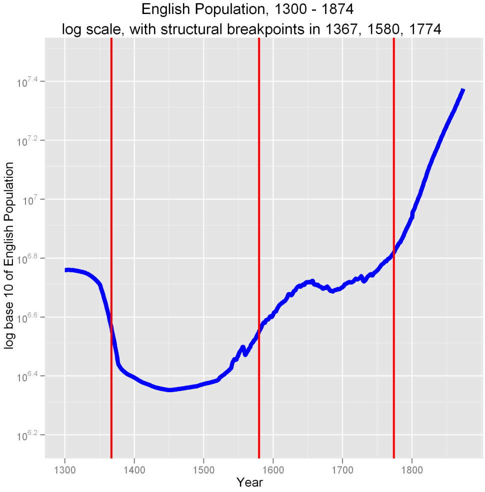


Figure: Log of population, with structural breaks



Data Sources

Data series	Year range	Geography	Source
Energy consumption	1300 – 1873	England/Wales	Roger Fouquet (2008)
Gross domestic product	1300 – 1700	England	Graeme Snooks (1994)
	1741 – 1873	England/Wales	Lawrence Officer (2009)
Population	1300 – 1540	England	Graeme Snooks (1994)
	1541 – 1800	England	B. R. Mitchell (1988)
	1801 – 1873	England/Wales	B. R. Mitchell (1988)

Table: growth rates by century

Year	1300	1400	1500	1600	1700	1801	1873	Total
GDP Million 2005 GBP	3114.7541	815.1288	994.4571	6031.953	8361.5911	18110	102811	
Century-over-century rate of growth		-0.738	0.220	5.066	0.386	1.166	4.677	32.008
Compounded annual rate of growth		-0.013	0.002	0.018	0.003	0.008	0.024	0.006
Energy consumption	1.7	1	1.3	2.2	3.6	11.6	66.1	
Century-over-century rate of growth		-0.412	0.300	0.692	0.636	2.222	4.698	37.882
Compounded annual rate of growth		-0.005	0.0026	0.005	0.005	0.012	0.024	0.006
Per-capita GDP 2005 GBP	542	329	421	1,484	1,663	1,999	4,392	
Century-over-century rate of growth		-0.393	0.282	2.521	0.121	0.202	1.198	7.108
Compounded annual rate of growth		-0.005	0.002	0.013	0.001	0.002	0.011	0.004

Table: Energy and GDP fit tests

Test	Statistic	p-value
Pearson's correlation	0.998	
Paired t-test	5.592	4.991e-07
Chi-square	2864	0.0004998