The rise and fall (?) of industrial capitalism

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Energy and GDP – one “data generating process”

Period	Pearson Correlation Coefficient: energy and GDP
England 1300-1873	0.998
World 1980-2008	0.993

Table: Energy/GDP correlations – the case for energy revolutions as the historic driving force in economic history

Energy consumption matters

Year	England	China	Netherlands	India
1650[a]			0.63	
1820	0.61			
1840[a]			0.33	
1870	2.21			
1970[a]			8.07	0.33
1973		0.48		
1998[b]	6.56	1.18		
2008[b]	5.99	2.56	9.86	

Table: Per-Capita Primary Energy Consumption, annual Tonnes of Oil Equivalent. *Source:* Angus Maddison, [a]de Zeeuw, [b]US DOE EIA

Towards a theory of organic industrial revolutions

Two first energy revolutions: China 900 – 1200 (Northern Sung); England 1590 – 1700:[1]

$$\frac{\text{Marginal Product}_{\text{wood Joule}}}{\text{Price}_{\text{wood Joule}}} \ll \frac{\text{Marginal Product}_{\text{coal Joule}}}{\text{Price}_{\text{coal Joule}}} \quad (1)$$

Causal event – deforestation with increasing population leading to increased wood prices.

[1] This is intended to be didactic, not ideological, i.e. not supporting marginalism in general. Note that replacing neo-classical marginal pricing with more general average prices or prices of production will not affect this theory.

Towards a theory of organic industrial revolutions

Second energy revolution: England 1700 – 1873, but not in China:[2]

$$\frac{\text{Marginal Product}_{\text{labor Joule}}}{\text{Price}_{\text{labor Joule}}} \ll \frac{\text{Marginal Product}_{\text{steam Joule}}}{\text{Price}_{\text{steam Joule}}} \qquad (2)$$

In early-modern England the RHS of (2) was so large because of high wages and low coal prices, that it induced a major positive aggregate supply shock and large positive income effects.

China had low wages and, relatively, high energy prices, so failed to complete its natural industrial revolution.

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Whence rising aggregate demand?

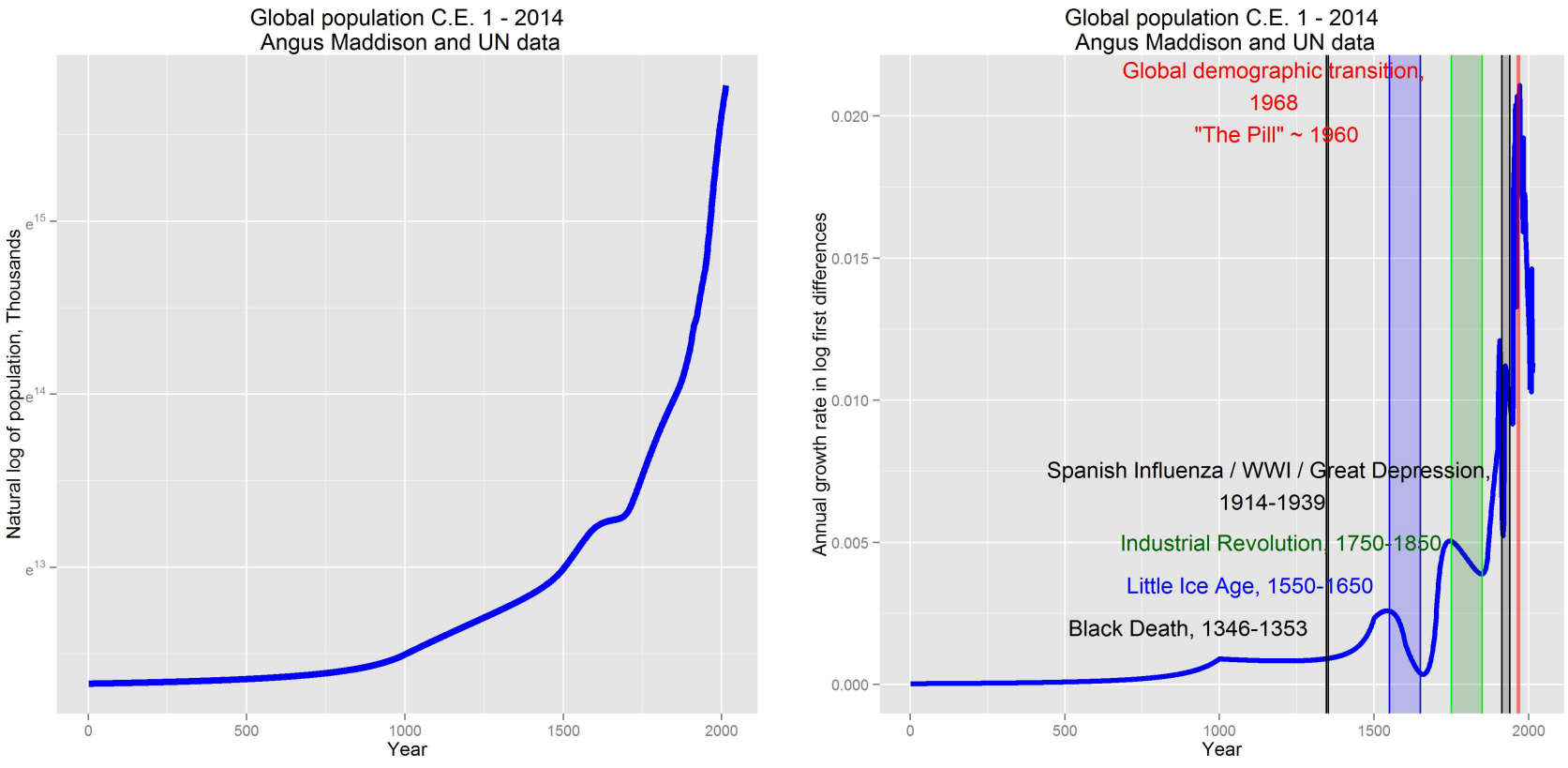

Figure: Angus Maddison and UN: log and log differences of global population levels

Towards a theory of industrial capitalism

All energy revolutions arose in a context of sufficient, ever increasing, effective aggregate demand.

First energy revolutions – wood to coal – were necessary for industrial capitalism, but not sufficient.

First energy revolutions generated large demand for capital – and supply appeared.

Second energy revolutions – muscle to steam – were sufficient.

The second energy revolution magnified the demand for, and supply of, capital. This was the economic change that spawned industrial capitalism.

John Nef – the coal question

Nef, in “The Rise of the British Coal Industry” (v1, p.380) clearly claims that it was the high capital demand for extraction, production, and transportation infrastructure for using coal from deep (often flooded), distant, and centralized locations that was the root of industrial capitalism. Nef dates the start to the sixteenth century, and it accelerates from there.

Capital supply was from wealthy merchants and landowners, and does not seem to have been a constraint.

Paul Mantoux – the steam question

Mantoux, in “The Industrial Revolution in the Eighteenth Century” details with rich anecdotes the rise of machine industry – the replacement of muscle with steam power in highly centralized factories – and the demand for tangible capital investments that resulted.

As in Nef’s story, capital supply was from wealthy merchants and landowners, and does not seem to have been a constraint.

John Hartwell – The “natural experiment” of Sung China

“From about 750 to 1100, China experienced a series of economic changes roughly comparable to the subsequent patterns of European growth from the Crusades to the eve of the French Revolution . . . and the achievements of late sixteenth- and early seventeenth-century England, which John Nef terms an ‘early industrial revolution,’ were in many respects even exceeded by the impressive expansion of mining and manufacturing in eleventh-century China.” (1966, p.29) [3]

[3] Hartwell, Robert. “Markets, Technology, and the Structure of Enterprise in the Development of the Eleventh-Century Chinese Iron and Steel Industry.” The Journal of Economic History 26, no. 1 (March 1, 1966): 29-58.

John Hartwell – The “natural experiment” of Sung China

Demand for capital – the rise of the coal industry and iron and steel making.

Supply of capital – thirty six “wealthy families,” with merchant capitalism being at least a possible source for their accumulated capital.

Ruttan, Hayami – endogenous technology

Modern work arising from agricultural economics offers theories of technological and institutional change induced by changes in relative resource endowments and technology. This work is founded in microeconomics. Ruttan and Hayami have a good exposition. [4]

[4] Ruttan, Vernon W., and Yujiro Hayami. "Toward a Theory of Induced Institutional Innovation." Journal of Development Studies 20, no. 4 (1984): 203-223. doi:10.1080/00220388408421914.

Karl Marx – endogenous institutions

"The changes in the economic foundation lead sooner or later to the transformation of the whole immense superstructure. In studying such transformations it is always necessary to distinguish between the material transformation of the economic conditions of production, which can be determined with the precision of natural science, and the legal, political, religious, artistic or philosophic – in short, ideological forms in which men become conscious of this conflict and fight it out." [5]

[5] Marx, Karl. A Contribution to the Critique of Political Economy. Charles H. Kerr, 1904.

A story of the Industrial Revolution and industrial capitalism

Rising population causes rising effective aggregate demand.

Merchants become wealthy as production for markets and urbanization rise. Their direct capital needs are low, so they accumulate and invest elsewhere.

More people cause deforestation, raising wood prices, eventually causing a transition to coal.

Coal production, being often deep, distant, and centralized, requires extraction, production, and transportation infrastructure and therefore high capital demand.

In England, this coal infrastructure investment feeds the second half of the revolution, the steam revolution, demanding ever more tangible investment. The demand for steam power arises from high English wages and low English energy prices.

Capital supply arises from wealthy merchant capitalists, wealthy land holders, and eventually a banking system.

Summarizing

Rising population causes rising effective aggregate demand.

Demand begets supply,
elicits endogenous technology (and institutions),
causes a rise in demand for, and supply of, tangible capital,
and leads to, as capital accumulates, industrial capitalism.

The Big Question for political economists: If population-driven rising aggregate demand "caused" the Industrial Revolution and elicited industrial capitalism, will population-driven falling aggregate demand cause the demise of industrial capitalism?