# Towards understanding the origins of Industrial Capitalism: a tale of two historical economies

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# 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 counts

| 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

# A theory of natural industrial revolutions

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

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

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.

# A theory of natural 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.

[2]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.

# A theory of industrial capitalism

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

First energy revolutions – wood to coal – were necessary, 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 first hints

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.

# Karl Marx – Historical Materialism

"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." [3]

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

# Ruttan, Hayami – the micro case

Perhaps at the complete extreme away from Marx, 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.

# John Hartwell – 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) [5]

[5] 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 – 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.

# The journey from feudalism to capitalism

Marx, Dobb, Sweezy, Braudel, Wallerstein, Brenner . . .

I am not tackling this debate in this current work, but think I will have contributions.

# A story of the Industrial Revolution and industrial capitalism – demand begets supply – endogenous technology and institutions

Rising population causes rising effective aggregate demand.

Merchants become wealthy as producing for market and urbanization rise. Their capital needs are low, so they accumulate.

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 capital investment. The demand for steam arises from high English wages and low English energy prices.

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