



Analysis

Not only subterranean forests: Wood consumption and economic development in Britain (1850–1938)

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ABSTRACT

This paper analyzes wood consumption in Britain over the period 1850–1938. We calculate the apparent consumption of wood, taking into account both net imports of wood and the home harvest. We then develop some quantitative exercises that correlate wood consumption with GDP, with prices of wood and iron (as an alternative material to wood) and with other measures. The main conclusion is that, although wood had lost its economic centrality after the energy transition, wood consumption continued to grow in Britain both in absolute and relative terms, showing a positive elasticity to GDP superior to the unit. This result allows us to reach a more complete understanding of the socio-metabolic transition associated with the Industrial Revolution. Britain faced the increase in wood demand by relying almost entirely on imported wood, reinforcing the idea that the decoupling of economic growth from land use must be handled with care, and should be observed not at the national level but on a global scale. Although British economic development was to a great extent focussed on what has been called the “subterranean forests” of coal, it simultaneously supported large tracts of surface foreign forest.

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1. Introduction

Although, as is evident, the forest is much more than a storehouse of timber, wood has been – and to a significant extent continues to be – the main economic product obtained from forests. Therefore, the evolution of wood use throughout history can provide interesting keys to a better understanding of the criteria and the specific ways in which forests have been exploited. As is well known, the economic uses of wood changed radically as industrialization spread throughout the western world. In Early Modern Europe, wood was a key element in the economy, since it was the main source of energy for daily life and for the operation of many industries. It was also the essential raw material in the manufacture of many products. As Warde (2006) has pointed out, wood can be considered, at that moment, as an “avenue to understanding much of the needs, tensions, conflicts and attitudes of the day”. Furthermore, according to Moore (2010a), the access to wood reserves was one of the key elements in explaining the success – and the failure – of European Empires at the dawn of the Capitalist Era.

With industrialization, new materials and sources of energy, in the form of fossil fuels, entered the economic system, diminishing the importance of biomass-based energy systems (Wrigley, 1988; 2010).

This was one of the main elements of a process that has been described by some authors as a change in the social metabolism of economies (Fischer-Kowalski and Haberl, 1993; Krausmann, 2001; Krausmann and Haberl, 2002; Krausmann et al., 2003). From then on, energy came from what has been called the “subterranean forest” of coal (Sieferle, 2001), through which modern economies could be decoupled from the supply of energy coming from the surface of the land (Krausmann et al., 2008; Krausmann et al., 2009).

Nevertheless, do those changes mean that wood consumption declined with industrialization? Could we thus speak of a wood dematerialization associated with modern industrial growth? Was industrialization just a matter of the subterranean forest? In an earlier work (Iriarte-Goñi and Ayuda, 2008), we analyzed the evolution of wood consumption in Spain throughout the first and second industrial revolutions, discovering two salient facts. On the one hand, the importance of wood in relation to GDP tended to decrease (through the decline in firewood consumption); but on the other hand, the total consumption of wood continued to increase (via the increase of wood used as a raw material) and the elasticity of wood as a raw material (with respect to GDP) had a positive sign. Consequently, the economic pressure on forests also increased, as industrialization continued to develop in Spain.

The basic objective of this paper is to revisit that topic for the British case, to see whether or not the most developed economy in the world in the 19th century followed a trend similar to that of the Spanish case. Our basic hypothesis is that, far from producing a wood dematerialization

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process, British economic growth from 1850 to 1938 required increased quantities of imported wood. From this perspective, the British industrialization process was not only a question of subterranean forest, but also a question of forest exploitation abroad.

In *Section 2* of this paper, we calculate the apparent consumption of wood in Britain, taking into account both net imports of wood and an estimation of the home harvest. In *Section 3*, we develop some quantitative exercises correlating wood consumption with GDP, with prices of wood and iron (as an alternative material to wood) and with other measures. In *Section 4*, we discuss the effects of economic growth on the use of wood, the forces driving the substitution – or not – of this material, the effects of technological change applied to wood itself, and the effects of growing consumption on forest exploitation. The paper finishes with concluding remarks.

2. An Estimation of British Wood Consumption

Our interest lies in the account of wood, in physical terms, as part of the biomass material flow entering the economic system. British Statistics do not include annual data on wood until the 1940s. Before that date, one way to approximate that measure is to calculate “apparent consumption” following the formula: consumption = wood imports, minus wood exports, plus home grown wood. Our series of net imports include imports and exports of solid wood and imports of pulp wood (from 1885 on).² Imports of solid wood grew from 1850 until the First World War, during which period they were considerably restricted due to the embargo that Great Britain underwent, and also to the necessity of using available ships for the importation of other goods that were more crucial for the economy in time of war (*Forestry Commission, 1921*). After the war, the imports of solid wood grew again and, despite following a most irregular trend, on average they surpassed the level reached before the war.³ Additionally, from the decade of the 1880s, the use of wood pulp for paper significantly increased imports of that product (*Magee, 1997*). In fact, pulp imports grew at a more rapid rate than those of solid wood before the World War, declined less during wartime, and recovered more strongly during the 1920s and especially the 1930s. Given that exports represented a very low percentage of imports, and declined in importance over time (from 0.62% in 1850–54 to 0.03 in 1934–38), net imports of cubic meters of wood (in the form of solid wood or wood pulp), increased ten-fold from 1850 to 1938 (see *Appendix A* for details).

To estimate annual home wood harvested is a more problematic question that forces us to make certain risky assumptions. Our estimates follow the general criteria proposed by authors who have tackled this problem (*Krausmann et al., 2008; Musel, 2009; Schandl and Schulz, 2002*): first, we assume wooded area for several benchmark years, based on available data⁴; Second, we assume typical values of productivity for different kinds of forest, provided by *Schlich (1904), Collins (1989), and Sieferle (2001)*; then, combining forest surfaces with productivity allows us to estimate wood harvest for benchmark years (see *Chart 1*).

The results have been tested by making cross-checks with irregular reports on timber supply (*Birch, 1936; Brown, 1861; Collins, 1989, 2000; Forbes, 1910; Forestry Commission, 1921, 1942; James, 1981;*

Ministry of Reconstruction, 1917; Robinson, 1927; Tsouvalis, 2000) and fit in with the median yields of British forests estimated by *Warde (2007)* and *Krausmann et al. (2008)*. We then interpolate data for the remaining years according to the median annual growth from date to date (see *Appendix A* for details).

Given the small amount of woodland as a proportion of the total country surface, and the low forest yield accounted in Britain, the home wood harvest was stagnant from 1850 to 1914; the decline of imports during the First World War led to a substantial exploitation of domestic woodlands and brought on the devastation of a considerable area of forest (*Birch, 1936*). This devastation brought the harvest of 1924 back to the level of 1854. So, most of the 1920s were years of recovery to the pre-war level and only in the 1930s was there growth driven by the reforestation schemes developed by the State through the works of the Forestry Commission.

To sum up, the resulting series show a strong growth of wood consumption, guided by imports. This result fits in with the early integration of Britain in international wood markets (*Åström, 1987; Williams, 2007*) and with the broadening of the area from which wood was sourced (*Gaunitz, 1969; Latham, 1957; Lower, 1973; Söderlund, 1953; Williams, 2003*), in what *Moore (2010a, 2010b)* has called the expansion of the “commodity frontier”. The result also matches the development of a network of well-connected British importers in international wood markets (*Fitzgerald and Grenier, 1992*), and the fall in freight rates that encouraged the growth of trade in bulky raw materials (*Dyos and Aldcroft, 1969*). The increase in wood imports coexisted with the problems of Britain in developing a new forestry policy through which to expand forest yields (*Forbes, 1910; Simpson, 1909; Stebbing, 1919*) and with the consequent decline in the percentage of home-grown wood over consumption, as pointed out by several authors (e.g. *Forestry Commission, 1921; Jefferies, 1945; Stebbing, 1919*).

3. Some Quantitative Exercises

Chart 2 offers our estimation of British wood consumption in the long run, taking into account both net imports and home wood harvested. *Chart 3* combines that data with British population and British GDP.

In absolute terms, wood consumption in Britain increased 6-fold between 1850 and 1913. The use of wood in physical terms related to GDP (IOU) remained almost constant in spite of the evident growth in GDP during the period.⁵ Regarding population, wood consumption per head rose from 0.2 to 0.7m³ during the period. All these variables show two differentiated behaviors over time. While in the period between 1850 and 1913 absolute growth, as well as relative growth, had a relatively stable evolution, from wartime on we are faced with much more noticeable fluctuations, strong growth followed by periods of decline. In any case, after the war, absolute as well as relative consumption was somewhat higher on average.

In order to analyze this evolution in more detail, we calculate a function of consumption that allows us to calibrate the elasticities of wood consumption (WC) with regard to GDP and also with regard to wood prices (WP) and those of a substitute material such as iron (IP).⁶ We have also included an index of building (IB) in an attempt to capture the possible effects of building cycles on timber consumption.⁷ The model is limited to the period from 1871 to 1936, since

² Data on imports and exports of solid wood have been extracted from the British Statistical Abstracts of the years 1850–1938. Imports of pulp wood began before 1885, but statistics only report systematic annual data from that date on. The United Kingdom did not export pulp wood during this period. The conversion of original measures of wood and pulp wood from the source to cubic meters, has been done following ratios provided by *Zapata (2001)*.

³ From 1900 to 1913 the annual average of net imports of solid wood was 13.3 million m³. From 1920 to 1938 was 14.8 million m³.

⁴ The benchmark years are: 1854, 1905, 1913, 1924 and 1938. For sources and methods see *Appendix A*. See also DT-AEHE, 1107 (<http://www.aehe.net/publicaciones/documentos-trabajo.html>).

⁵ The IOU (intensity of use) proposed by *Labys (2004)* is used here in the same way that *Krausmann et al. (2009)* used the term “resource intensity” and is defined as cubic meters of wood per unit of GDP. It should not be confused with energy intensity. In monetary terms, the value of wood related to GDP ranged from 1.8% in the period 1871–1875 to 1.2% in the period 1934–1938.

⁶ GDP data came from *Maddison (2001)*. Prices of wood are import prices (cubic meter/price of total wood imports). Prices of iron came from *Mitchell (1980)*.

⁷ The index of building construction has been taken from *Mitchell (1980)*.

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