The two graphics clearly show the increase in wood consumption in both absolute and relative terms (IOU). Both also 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 times 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)[8]. We have also included an index of building (IB) trying to capture the possible effects of building cycles on timber consumption[9]. The model is limited to the period from 1871 to 1936, since data on iron prices for the prior period are not available. The variables of the model are in logarithms, so the estimations of the parameters of position are interpreted as elasticities. Following the results of previous works (Iriarte y Ayuda, 2008), our hypothesis is that wood consumption had a positive elasticity with regard to GDP. Regarding prices, we expected a negative sign for wood prices (an increase in its prices would halt the increase in consumption) and a positive sign for iron prices (an increase in the prices of this substitute material would contribute to more wood consumption), although we believe that the behavior of prices do not explain everything and have to be combined with others variables for an accurate explanation of consumption.

To avoid the problem of spurious regressions, we first analyzed the order of integration of the data series. To this end, we examined the graphics of the series, their correlograms[10], as well as the augmented Dickey-Fuller test (Dickey-Fuller, 1981). As all the series in this paper are series with a breaking trend function, we use the generalized least squares detrending method and we allow for three changes in both the level and slope of the trend function. So, to test the order of integration of the series we use the DF-GLS that tests the null hypothesis of a unit root, allowing breaks under both the null and the alternative hypotheses. To obtain the DF-GLS we use the programming algorithm described in Carrión-i-Silvestre et al. (2009). Because the DF test is generally known to have little power, we present also the results of the KPSS test of Kwiatkowski et al. (2001), that tests the null hypothesis of stationarity against the alternative of a unit root. Table 1 presents the results of the tests. We conclude that four of the series are stationary or trend stationary according to the DF-GLS test, at the 5 % level of significance, and that the index of building, IB, and the iron price, IP, are integrated of order one, I(1), while all are stationary or trend stationary according to the KPSS test[11].

[8] 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).

[9] The index of building has been taken from Mitchell (1980).

[10] Graphs and correlograms are not shown here for reasons of space, but can be requested from the authors.

[11] For the results of the tests we have used the GAUSS program. For the KPSS test we have introduced the modification of the test proposed by Sul et al. (2005) that is known to improve the behaviour of the test in terms of size.

TABLE 5: DF-GLS and KPSS tests

Variables	DF-GLS	C.V.		KPSS	C.V.	
WC	-3.90	-3.51	I(0)	0.11	0.15	I(0)
GDP	-3.82	-3.46	I(0)	0.04	0.15	I(0)
WP	-3.65	-3.59	I(0)	0.03	0.15	I(0)
IP	-3.06	-3.87	I(1)	0.04	0.15	I(0)
IB	-3.08	-3.78	I(1)	0.03	0.15	I(0)

C.V.: Critical values at 5% significance level.

After that, given that the variables can be considered to be stationary (with the exception of IB and IP, that, following the DF-GLS test, are not stationary, but they are following the results of the KPSS) we have estimated the following model, taking into account two dummy variables in order to test whether there is some structural change that we can appreciate from the graphs and in previous analysis of integration; F1, that takes value 1 in the years 1914-1922 and 0 in the rest, with the aim of measuring the effects of the First World War, and F2, that takes value 1 in the years 1923-1936 and 0 in the rest with the aim of measuring the changes after the First World War. In order to ensure the specification is correct, we test whether the residuals of the proposed model are also stationary. The most adequate model, according to Akaike's information criterion (AIC) and the Schwarz's Bayesian information criterion (SBIC), as well as the adjusted coefficient of determination, is the following[12]:

TABLE 6: OLS estimation of the consumption function

$$WC_t = \underset{(-5.96)}{-1.66} \underset{(-3.44)}{-18.89} F1_t + \underset{(26.64)}{1.22}\, GDP_t + \underset{(2.70)}{0.14}\, IP_t + \underset{(3.91)}{5.01}\, GDP_t F1_t +$$
$$\underset{(-5.26)}{-1.45}\, WP_t F1_t + \underset{(2.48)}{0.48}\, IP_t F1_t - \underset{(-5.14)}{0.49}\, WP_t F2_t + \underset{(4.96)}{0.39}\, IP_t F2_t - \underset{(-5.54)}{0.26}\, F1918$$

$R^2 = 0.96$

$\overline{R}^2 = 0.95$

$LM(1) = 0.14[0.70]$
$LM(2) = 1.51[0.47]$
$LM(3) = 1.52[0.68]$
$LM(4) = 3.17[0.52]$
} *Autocorrelation tests*

$W - H = -0.41[0.65]$

$White(Het.) = 22.62[0.12]$

$J - B = 2.14[0.34]$

$AIC = -2.18$

$SBIC = -1.85$

$DF(res.) = -7.30[0.00]$

* t-ratios are in brackets and p-values in square brackets.

The variable IB is not in the model because it was not significant. All the parameters that appear in the model are significantly different from zero and display the expected

[12] We also estimated a model with the relative price of timber with respect to iron, as an exogenous variable, but the model presented heteroskedasticity.

sign. A dummy variable for the year 1918, F1918, has been introduced in the model because was detected as an outlier. As exogeneity is usually violated in these demand functions, we used the Wu-Haussman statistic, W-H, in order to test the exogeneity of the WP. Different lags of the Wood Price have been used as instrumental variables and in all the cases the exogeneity hypothesis has not been rejected even at high significance levels. The results of the W-H test in the model corresponds to the case where the instrumental variable for WP was the first lag of the variable. The Breusch-Godfrey tests were applied in search of potential autocorrelation problems, LM(p), and the White test for possible heteroskedasticity. We conclude that the consumption function does not display autocorrelation and is homoskedastic at a significance level of 5 per cent. The estimated model is not a spurious relation, since the test to detect possible non-stationarity of the residual DF (res.) confirms the stationarity of the residuals.

TABLE 7: ESTIMATED ELASTICITIES OF WOOD CONSUMPTION

	1871-1913	1914-1922	1923-1936
GDP	1.22	6.23	1.22
WP	-	-1.50	-0.49
IP	0.14	0.59	0.53

As we expected, wood consumption shows a positive elasticity with regard to GDP both before and after the war[13]. The new aspect, regarding the case of Spain previously studied, is that that elasticity is superior to the unit, highlighting the fact that wood consumption from the middle of the 19th century was especially linked to industrial development and, consequently, the growth in GDP in a heavily industrialized country like Great Britain, had a stronger pull on wood consumption than in the case of Spain. It is also worth noting that the IOU of wood consumption did not fail in Britain between 1871 and 1938[14]. Prices of timber, as well as of iron, show the expected sign, although the relevance varies considerably according to the period. Before the First World War, the evolution of wood prices is not significant, not even rising to a 10% significance level. Iron prices, on their part, show a reduced elasticity (0.14%). That situation changed considerably during the war, when prices of raw materials skyrocketed and had a much more visible effect on consumption. During the 1920s and 1930s, the situation that obtained during the War remained, although at more moderate levels.

4. Discussion

The results presented in the previous sections allow us to establish some significant discussion points concerning economic growth, the use of natural resources, the substitution of materials, and technological change.

a) First, the observed growth of timber consumption, as well as positive and superior elasticity to the unit of consumption, with regard to GDP, allows us to take a fresh look at the process of energy transition and its results regarding the use of organic raw

[13] The strong increase in elasticity with respect to GDP in the period between1914-1922 is due as much to the drop in GDP from 1919 as to the strong increase in imports that occurred in the years immediately after the war.

[14] In Spain the energetic transition was followed of a drop in the total IOU of Wood (firewood plus wood as a raw material. Nevertheless, the IOU of Wood as a raw material tended to growth (Iriarte and Ayuda, 2008).

materials. Undoubtedly, as Wrigley (1988 and 2010) pointed out the energy jump from firewood to coal was, at its base, a new form of economic growth that allowed the surpassing of limits on economies with an organic base. However, even in Great Britain, the country that first and most completely underwent that transition, the use of an organic raw material like wood continued to grow in the long run, along with the growth in GDP. It is possible that the collapse in the use o firewood for energetic purposes during the second half of the 18th century and the first half of the 19th were associated with a temporary drop in total wood consumption. In fact, Warde (2010) report a minimum total wood consumption of around 9 million cubic meters in 1720, including 4.4 million of cubic meters of tar & pitch and ash, that is, a figure higher than those that we have calculated for 1850. Thus a more detailed research for that period is needed. But once the new industrial growth was consolidated in the middle of the 19th century, wood consumption grew again, went beyond any figures reached in pre industrial era and got the highest level in history. It can be said, therefore, that in the long run the new growth based on fossil fuels stopped being dependent on wood for its energy uses, but continued to need that raw material as a complement to its own industrial growth. From this perspective, at least in the period between the middle of the 19th century and the Second World War, it makes no sense to identify fossil-based economic growth with a process of dematerialization of the use of timber, since the latter did not occur in either absolute or relative terms.

b) Once we have a general view of wood consumption, the next step is to discuss what forces, and what uses of wood, were behind that growth and why wood was not substituted for other materials arising from industrial and technological development. The habitually accepted approach to explain the substitution of wood as an energy source and as raw material is based on scarcity, and price differentials of raw materials As Nathan Rosenberg (1973) put it "The Industrial Revolution in Britain essentially substituted cheap coal for wood as a source of fuel and power, and cheap and abundant iron for vanishing timber resources". In the case of the substitution of firewood for coal, the difference of prices is confirmed (Allen, 2009) and is accepted as a cause even by those authors who cast doubt on the existence of an authentic timber shortage in physical terms. Nevertheless, the data contributed by this work indicate that the substitution of wood as raw material was not as great as has been hitherto supposed

The evolution of the price of wood throughout the 19th century could be one of the elements that contributed to maintaining a high level of wood consumption. In fact, the available data suggests that the prices of wood imports to Britain were falling from the end of the Napoleonic Wars until the 1870s (Rackham, 1990), to become stabilized at a slight rise from that moment until the WWI (Stebbing, 1919), when wood, like other raw materials, strongly increased their prices (Forestry Commission, 1921). From there, prices of wood imports fell again during the inter-War years to levels lower than those recorded before the Great War. Thus, except for specific circumstances, reduction was the predominant tendency. That fall in price was due, as previously indicated, not only to the decrease in transport costs, but also to the fact that the international supply of wood was growing since new exporting countries had come into the market, and forest areas were exploited that had previously been untouched. From this perspective, it could be said that if, during the early modern period, the increase in timber prices had driven its substitution by coal as an energy source, their later reduction could contribute to its continued use as a raw material. Despite that, the elasticities shown in Table 7 suggest that prices of wood as well as a basic substitute such as iron, despite having

influence, were not the determinant elements in the evolution of consumption. It seems necessary, therefore, to examine in detail the specific uses for which wood was substituted as raw material by other materials, as well as those other uses for which it continued to be used, in an attempt to find complementary explanations.

In the first case, the most obvious example is that of shipbuilding, a sector in which wood lost its prominence in the middle decades of the 19th Century. According to Evans (1982), in 1850, less than one-tenth of the British tonnage built was iron, but by 1875, it was nine-tenths. That change had mainly to do with technical questions that gave the clear advantage to iron. For example, iron allowed the construction of boats with hulls that weighed less and, consequently could be increased in size and carrying capacity (Dyos and Aldcroft, 1969). Iron also gave greater integrity to the ships, due to the increased ease in joining the pieces, iron's greater strength, and to the advantages in incorporating modern machinery. In addition, given that many British ships spent a lot of time in tropical zones, iron also guaranteed there would be less deterioration of the hull due to environmental factors. (Evans, 1982). Wood was also replaced in many large structures, especially bridges; although wooden bridges on many railroad lines were built of wood until the middle of the 19th Century, as the size of these structures increased, iron was shown to be better adjusted to the new conditions of necessary resistance (Evans, 1982). Something similar occurred with machinery, due to the highly heterogeneous character of wood. As Haines (1990) states, not only is each species of tree unique, producing timber with a combination of qualities and properties unlike any other, every tree within a species can have different characteristics, depending on its conditions of growth. That heterogeneity and variability made wood difficult to use in a standard way for precision machinery and it was routinely avoided by mechanical engineers for their new projects and works.

So, what did wood continue to be used for? Information regarding this for the second half of the 19th century is scant, but the production figures gathered from the beginning of the 20th century provide some interesting clues. We have information on industries related to wood classified in various groups, according to their specific activities for 1907, 1924 and 1930. The figures do not provide systematic data of the quantities of wood used in physical terms, and it must be borne in mind that only a part of the wood consumed went to British industry, since another portion arrived from abroad already prepared for use in specific activities. This data, therefore, can serve only as an approximation of those kinds of products that continued to be made with wood. In a broad outline, we can distinguish three main types of activities. The first has to do with the sawmill industry, making pieces destined for different uses. A considerable part of their production (which in the period between 1924 and 1930 could be placed around 15% of wood consumption) was engaged in making pit-props for the collieries; another part, (around 11- 14% of consumption for the same period) was sleepers for the railroads; a third part (around 55-60% of consumption) was set aside for the creation of a variety of products for the construction of buildings (planks, battens, boards) and for interiors (floorings, mouldings, etc.). The second activity was the furniture and upholstery trade, including the construction of a wide range of objects, from furniture and cabinetry, to bedding and cushions; from drawing office furniture to theatre and cinema seating. Finally, the third activity had to do with the manufacture of containers for the transportation of merchandise, including a wide range of products such as crates, cases and barrels, boxes, and trunks.

The production figures therefore give an idea of the main activities that sustained the growth in wood consumption, all of which were related in one way or another to modern economic growth. In fact, maintaining the new coal-based economy required wood for the support of such basic activities as the mines and the railway network. Both elements (mining and railways) were gaining in their production capacity and in the density of the network, which considerably increased wood consumption. On the other hand, some later innovations such as the telegraph, the telephone and electricity cable also depended on the timber poles to carry the wires. In all of these cases, it was necessary to renew the wood supports every so often, due to their deterioration, which brought new consumption over time.

The second element that sustained the growth in wood consumption over time had to do with the processes of urbanization, and, in general, with the building industry. It is known that modern economic growth was accompanied by considerable urban growth, which spurred a significant increase of the building trades. What has passed largely unnoticed, however, is the important part that wood continued to play in building construction. As Powel (1980) states for the 19th century "the applications of timber were very numerous and in many cases not susceptible of substitution with alternative materials". Roof structures, suspended floors, doors, cupboards and fittings, lintels, claddings, window frames and stairs, continued to be made from timber, as other temporary uses such as scaffolding, arch centering, and shoring. The light character of wood and the fact that it is relatively easy to work must have been fundamental reasons for its continued use. On the other hand, Rodger (1989) points out that there were few technological advances in the construction field during all of the 19th century, and that the dependence on traditional materials was very high. It must be said that something similar occurred during the inter-war period. According to Richardson and Aldcroft (1968), in the 1920s and 1930s a considerable portion of building costs were attributable to wood. That was also the main material in the making of furniture for public and private buildings. Although the economic history of the furniture industry has not been analyzed in detail, presumably the increase in per capita income was accompanied by an increase in the amount of furniture per household, which also contributed to the increase in wood consumption.

Finally, the transportation of merchandise related to the development of trade, associated at the same time to economic growth, was another sector in which wood was crucial. The re-usable character of wood containers makes it impossible to establish a direct relationship between the increase in trade and the production of wood containers, but it seems fairly evident that it must have been a positive relationship.

All this allows us to explain some of the forces that drove the growth in wood consumption. Before the First World War, there was a substitution of wood in uses for which other materials offered clear technical advantages, but not in many basic activities that continued to use wood, quite independently of prices. Nevertheless, following the Great War, other possibilities of substitution were opened up and thus prices of wood - and of alternative materials - played a more important role. Finally, it is worth noting that wood was used in a wide range of economic activities and that its consumption was not restricted to a single industry. This could explain, for instance, the absence of significance of the Index of Building (IB) used in our model.

c) A third element that is worth noting is that of technological change associated with the use of wood. This is a forgotten aspect since normally, technical improvements have been considered as forces promoting the substitution of traditional raw materials. However, significant technological transformations also existed that affected wood that by improving its acquisition and its qualities had the effect of boosting its consumption. It is evident that, from the 19th century on, a whole series of innovations came into being affecting different phases of the process of harvesting and treating timber. There were, first of all, changes associated with the planting and rotations of trees (that which some authors began to call new forestry) the basic objective of which was the creation of a type of forest specifically designed to be able to cover the growing demand for wood generated by industrial economies. Given the peculiar characteristics of the forestry sector (long turns of exploitation and minimal intervention by man in the tree-growing process), the application of the principals of that new forestry was probably the only possible way to increase forest productivity. In the second place, there were some improvements in the manner of exploitation of forests that basically had to do with the improvement in tools to cut the timber. The appearance, for example, of the circular saw - powered first by steam and then by electricity - meant a fundamental change in the preparation of the material on the forest floor. And, above all, there was a series of improvements in the treatment of wood for modern purposes that can be characterized as an authentic process of industrialization of wood (Haines, 1990).

Wood treatment to improve durability and conditions had been a constant, at least from the Early Modern Era, when timber became essential for the fleets of the various European countries in expansion. But according to Haines (1990), the 19th century would bring new treatments directly related to industrialization and associated with the new uses of wood. The best-known were the application of chemicals to wood to extend its useful life (especially creosote), and the steam bending system that consisted of treating wood with steam to make the material more malleable. If chemical treatments were predominant in wood used outdoors (sleepers and poles), steam bending was used more for the manufacture of furniture and pieces that required greater curvatures (especially furniture). However, with the technologies of the second industrial revolution, treatments related to wood reached a higher degree of sophistication. Among these, the possibility of making plywood must be highlighted. Plywood is made from thin layers of wood that, when combined with certain types of glue, resulted in a new product more easily standardized for diverse purposes. The second great innovation was related to the production of paper by a chemical treatment to obtain wood pulp.

Although no specific research has been found on these innovations referring to wood in Britain, the impression is that, once this raw material no longer formed an essential part of ship building, the British economy no longer took an interest in this sector of investigation. Countries such as the USA, Canada, Germany and Sweden that had greater timber resources became technological leaders (Cohen, 1984; Dick, 1982). In fact, if we focus on wood pulp, it is evident that Britain required more and more of that product for its own production of paper. Nevertheless, the British economy did not develop that line of production (Shorter, 1981), but instead merely imported the necessary wood pulp (see the evolution of pulpwood in table 1). Nevertheless, British wood consumption was stimulated by innovations produced outside the country, contributing, no doubt, to its growth by increasing the uses for wood.

We began this discussion by denying that British industrial development meant a "dematerialization" in wood consumption. Taking into account the technological innovations that we have mentioned, it can be said that the more suitable term for timber is trans-materialization, a word proposed by Labys (2004) for other materials. In fact, the use of wood in Britain throughout the 19th century, and during the inter-war period, passed through different stages, according to its uses. In some, as firewood, it had already lost its essential economic function as an energy source. In others, as in shipbuilding or construction of bridges, it was in a "declining stage"; and in others, (building, pit-props, sleepers and furniture) it reached a mature stage that provided wood with a long run of growing consumption. Finally, from the end of the 19th century, technological change applied to wood opened new possibilities for its use (plywood and wood pulp), positioning those new forms in an "initial introduction stage" which would not reach absolute maturity until after the Second World War.

d) Finally, the growth in British wood consumption showed also allows us to complement the idea developed by Krausmann, Schandl and Sieferle (2008) that considers "industrialization as a stepwise process of decoupling the supply of energy from land-related biomass" (p. 188). For those authors, the decoupling process was, at first, only partial since, despite coal substituting for firewood as an energy source, real economic growth - and the population growth it entailed - also meant an increase in the demand for food and feed that continued pressure on the land. What we can add, having measured the evolution of wood consumption, is that the growing demand for this raw material for uses related to industrial growth also had an effect in the same direction, and contributed to the increased pressure that economic growth exercised over land use. The British economy of the 19th century did not have the capacity to increase food production or yields of wood to cover the growing demand, and thus had to resort in ever greater measure to imports. It is in this context of metabolic transition, in which we understand that the Corn Laws were also accompanied by the disappearance of timber duties in the middle of the 19th Century. In this sense, the decoupling of the new energy system from land use was only relative, that is, it was true only for domestic land, but not for land used abroad. It was in foreign countries where the linkages between growth and land continued to be evident, as far as food and feed were concerned, but also wood needed for economic growth was obtained from there. From this perspective, industrialization was not only a question of subterranean forests, in the sense used by Sieferele (2001); but also of foreign forests. It is notable that, to achieve the more than 35 million cubic meters of wood imported at the peak, in 1936, and given the yields obtained in wood, Britain had to devote more than 13 million hectares to wood production, an area almost ten-fold its actual woodlands, or 40% of the total area of the country.

5. Concluding remarks

At the end of the 17th century, John Evelyn, one of the first Englishmen concerned with English forestry, advised his compatriots: "We had better be without gold than without timber". It was a time when wood played a crucial role in energy supply, and when timber was also essential to maintain the "wooden walls" that English war ships were considered to be. Two hundred years later, things were very different. Wood had lost its importance as a source of power and most of the fleet was made of iron. On the other hand, exports coming from the English industrial revolution were providing Britain with enormous amounts of "gold", part of which was used to obtain timber from

all over the world. The timber age had gone, and the sources of power came from the subterranean forests represented by extensive coalfields. A new type of growth had begun and the economic role played by timber was beginning a process of change.

But that does not mean that that process were one of wood dematerialization. On the contrary - as we found in a previous work for the case of Spain - in Britain also, wood and timber consumption continued to grow, both in absolute and in relative terms, through industrialization. The difference was that, in Britain, the elasticity of wood consumption related to GDP was higher than in Spain and exceeded the unit, suggesting that the increase in wood consumption was closely related to the modern economic development, that is, the greater the industrial growth, the greater the elasticity of wood consumption. The three main drivers of that evolution were: 1) the decline of wood prices did not create the necessity to substitute wood in many industrial uses, at least before the First World War. After that, the evolution of the prices of wood and iron, and perhaps the increased opportunities to use other materials, meant that the elasticity of prices related to consumption was stronger. 2) The improvement in forestry at the international level, the introduction of new machinery for forest exploitation, and the industrialization of wood itself (changes in treatment, and development of new materials like plywood and wood pulp) opened new and broader possibilities for wood in new applications. 3) The fact that wood was crucial in a wide range of industrial uses (coal extraction, railroads, construction, furniture, transport, tools, paper making) was important for the increase in consumption, insofar as wood use could be partially substituted in some economic activities, but reinforced and extended in others, throughout a trans-materialization process.

Britain faced the increase in wood demand in a quite peculiar way. The yields of home- grown timber were stagnant before the First World War, while other countries were developing a new forestry through which they improved forest productivity for industrial purposes. On the contrary, British wood consumption relied almost totally on imports, especially after the repeal of timber duties. This situation began to change in the 1920s, when British governments tried to develop new plantation schemes in response to the great depletion of forests resulting from the exploitation of home- grown timber during the war. These changes did not advance very far before the onset of the Second World War. Moreover, it does not appear that the British economy invested in a significant amount of research on industrial wood innovations related to plywood or wood pulp. Thus, in the 1920s and 1930s, British dependence on wood and wood pulp coming from abroad actually grew. In other words, the decoupling of economic growth from land use, was true at the domestic level, but not on the global scene. Without doubt, British economic development was to a great extent focussed on the subterranean forest, but simultaneously supported large tracts of foreign forest.

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References

BOARD OF AGRICULTURE AND FISHERIES (1905) Agricultural Returns in Great Britain, Her Majesty's Stationary Office, London.

ALBION, R.G. (1926) Forests and Sea Power, Harvard.

ALLEN, R. C. (2009) The British industrial Revolution in Global Perspective, Cambridge University Press, Cambridge.

ÁSTRÖM, S.E. (1987) "Northeastern Europe's Timber Trade Between The Napoleonic and Crimean Wars: A Preliminary Survey", The Scandinavian Economic History Review, 35, p. 170-177.

BEST R. H. and COPPOCK, J.T. (1962) The changing use of land in Britain, Faber and Faber, London.

BIRCH, T. W. (1936) The afforestation of Britain, Economic Geography, 12-1, 2-27.

BROWN, J. (1861) The forester. A practical treatise on the planting, rearing, and general management of forest trees, William Blackwood and soons, Edinburgh census of production, 1924.

CARRIÓN-I-SILVESTRE, J.L., Kim, D. and Perron, P. (2009) GLS-Based unit root tests with multiple structural breaks under both the null and alternative hypotheses. *Econometric Theory*, 25, 1754-1792.

CHARTRES, J. (2000) "Rural industries and manufacturing", in COLLINS, E.J.T. The Agrarian History of England and Wales, VII, 1850-1914, CUP, Cambridge, pp. 1101-1149.

CHERRY, G.E. and SHEAIL, J. (2000) "Woodlands", in COLLINS, E.J.T. The Agrarian History of England and Wales, VII, 1850-1914, CUP, Cambridge, pp. 1101-1149.

COHEN, A. (1987) Factor substitution and induced innovation in north American kraft pulping: 1914–1940, Explorations in Economic History, 24, PP. 197-217

COLLINS, E.J.T. (1989) "The coppice and underwood trades", in MINGAY, G.E. (1989) The agrarian history of England and Wales, Vol VI, 1750-1850, CUP, Cambridge, pp. 484-501.

COLLINS, E.J.T. (2000) "Rural and agricultural change" in COLLINS, E.J.T. The Agrarian History of England and Wales, VII, 1850-1914, CUP, Cambridge, p. 72-223.

DEPARTAMENT OF EDUCATION AND SCIENCE (1966) Report of the Land use Study Group. Forestry, agriculture and the multiple use of rural land, Her´s Majesty Stationery Office, London.

DICK, T.J.O. (1982) Canadian Newsprint, 1913-1930: National Policies and the North American Economy, The Journal of Economic History, 42, 659-687

DICKEY, D.A., FULLER, W.A. (1981) Likelihood ratio tests for autoregressive time series with a unit root, Econometrica 49, 1057–1072.

DYOS, H. J. and ALDCROFT, D.H. (1969) British transport. An economic survey from the seventeenth century to the twentieth, Leicester University Press, Surrey.

EVANS, F. T. (1982), Wood Since the Industrial Revolution: a Strategic Retreat?, History of the Technology 7, pp. 37-55.

FISCHER-KOWALSKI, M. HABERL, H. (1993) Metabolism and colonization modes of production and the physical exchange between societies and nature. Innovation in Social Sciences Research 6, 415–442.

FITZGERALD, R. AND GRENIER, J. (1992) Timber. A centenary history of the Timber Trade Federation, 1892-1992, Batsford Ltd., London.
FORBES, A.C. (1910) The development of British Forestry, Arnold, London
FORESTRY BILL (1919), Parliamentary Papers, 156.
FORESTRY COMMISSION (1921) First annual report of the Forestry Commissioners, Parliamentary Papers, 128, 1921.
FORESTRY COMMISSION (1942) Post-war forest policy report by H.M. Forestry Commissioners, Parliamentary Papers, Cmd. 6447, 1942-43.
GAUNITZ, S. (1969) Forest resource and forest industry in Northern Sweden 1900-1939, Economy and History, XII, p. 43.
HAINES, Ch. M. (1990) The industrialization of wood: The transformation of a material, PhD Dissertation, University of Delawere.
IRIARTE-GOÑI, I. and AYUDA, M. I. (2008) Wood and industrialization Evidence and hypotheses from the case of Spain, 1860–1935, Ecological Economics, 65, 177-186.
JAMES N.G.D. (1981) A History of English Forestry, Basil Blackwel, Oxford.
JEFFERIES, Richard (1945) The wood from the trees, The pilot press, London.
KRAUSMANN, F SCHANDL H., SIEFERLE R. P. (2008), Socio-ecological regime transitions in Austria and the United Kingdom, Ecological Economics, 65, 187-201.
KRAUSMANN, F. SCHANDL, H. and SCHULZ, N.B. (2003): Long-term industrial transformation. A Comparative Study on the Development of Social Metabolism and Land Use in Austria and the United Kingdom 1830–2000. Social Ecology Working Paper, vol. 70. Krausmann, Schandl, and Schulz, 2003.
KWIATKOWSKI D, PHILLPS P.C.B., SCHMIDT P., and SHIN Y (1992) Testing the null hypothesis of stationarity against the alternative of a unit root, Journal of Econometrics, 54, 159-178.
LABYS, W.C. (2004) Dematerialization and transmaterialization: what have we learned? 1. Research Paper Series, WVU Regional Research Institute.
LATHAM, b. (1957) Timber, Its development and distribution. A historical Survey, George G. Harrap, London.
LOWER, A.L.M. (1973) Great Britain's wood yard. British America and the timber trade, 1763-1867, McGill-Queen´s University Press, London.
MADDISON, A. (2001) The World Economy: A Millennial Perspective, OECD Development Centre, Paris.
MINISTRY OF RECONSTRUCTION (1917), Forestry Sub-Committee. Final report, Parliamentary papers, Cd. 8881, 1917-18.
MITCHELL, B. R. (1980) British historical Statistics, CUP, Cambridge, 186-187.
MULHALL, Michael G. (1903) The dictionary of Statistics, Routledge, London.
MUSEL, A. (2009) Human appropriation of net primary production in the United Kingdom, 1800–2000 Changes in society's impact on ecological energy flows during the agrarian–industrial transition, Ecological Economics, 69, 270–281.
ROSENBERG, N. (1973) Innovative Responses to Materials Shortages, The American Economic Review, Vol. 63, No. 2, pp. 111-118.
POTTER, J. (1955) The British Timber duties 1815-1860, Economica, New Series, 22, 86, 122-136.
POWEL, C.G. (1980) An economic history of the British building industry, 1815-1979, The Architectural Press, London.
RACKHAM, O (1990) Trees and woodland in the British landscape, Dent and sons, London.

RICHARDSON, H.W. and ALDCROFT, D.H. (1968) Building in the British economy between the wars, Allen & Unwin, London.
ROBINSON, R.L. (1927) British Forestry, Forestry, 1-5.
RODGER, R. (1989) Housing in urban Britain, 1870-1914: Class, capitalism and construction, MacMillan, London.
SCHANDL, H. and SCHULZ, N. (2002) Changes in the United Kingdom's natural relations in terms of society's metabolism and land-use from 1850 to the present day, Ecological Economics 41, 203–221.
SCHLICH, W. (1904) Forestry in the United Kingdom, Bradbury, Agnew & Co, London.
SHORTER, A.H. (1971) Paper making in the British isles. A historical and geographical study, David and Charles, Newton.
SIEFERLE, R.P. (2001) The Subterranean Forest: Energy systems and the industrial revolution. The White Horse Press, Cambridge.
SIMPSON, J. (1903) The new forestry or the continental system adapted to British woodlands and game preservation, Pawson and Brailsford, Sheffield.
SIMPSON, J. (1909) British woods and their owners, Paulson & Brailsford, Sheffield Simpson.
SÖDERLUND, E.F. (1953) Swedish Timber Exports 1859-1950. A History of the Swedish Timber Trade, Stokholm, The Swedish Wood Exporters association.
STATISTICAL ABSTRACT (1871), Her Majesty's Stationary Office, London
STATISTICAL ABSTRACT (1913), Her Majesty's Stationary Office, London
STEBBING, E.P. (1919) Commercial forestry in Britain: its decline and revival, London : J. Murray.
SUL, D, PHILLIPS, P.C.B. and CHOI, C.-Y. (2005) Prewhitening Bias in HAC Estimation, Oxford Bulletin of Economics and Statistics, 67, 517-546.
TSOUVALIS, J. (2000) A Critical Geography of Britain's State Forests, Oxford University Press, Oxford.
TSOUVALIS, J. and WATKINS, Ch. (2000) Imagining and creating forest in Britain, in AGNOLETTI, M. and ANDERSON, Forest History, IUFRO research series, 2, Cabi, Oxon, pp. 371-387.
WARDE, P. (2006a) Ecology, Economy and State Formation in Early Modern Germany, Cambridge University Press, Cambridge.
WARDE, P. (2006b) Fears of wood shortage and the reality of the woodlands in Europe, c. 1450-1850, History Workshop Journal, 62, 1, 29-57.
WARDE (2010) Wood and wood products in the English economy, c. 1550-1750, Manuscript.
WARDE, P. (2007) Energy consumption in England and Wales, 1560-2000, Consiglio Nazionale delle Ricerche, Napoli.
WRIGLEY, E. A. (1988) Continuity, chance and change. The Characte of the Industrial Revolution in England. Cambridge University Press, Cambridge.
WRIGLEY, E. A. (2010) Energy and the English Industrial Revolution, Cambridge University Press, Cambridge.
ZAPATA, S. (2001) La madera en España, c.1850–c.1950. Un primer esbozo, Revista de Historia Económica XIX (2), 287–343.
ZON R. and SPARHAWK, W.N. (1923) Forest resources of the world, McGaw Hill, London.