Two Views of the British Industrial Revolution

PETER TEMIN

There are two views of the British Industrial Revolution in the literature today. The more traditional description sees the Industrial Revolution as a broad change in the British economy and society. This broad view of the Industrial Revolution has been challenged by Crafts and Harley who see the Industrial Revolution as the result of technical change in only a few industries. This article presents a test of these views using the Ricardian model of international trade with many goods. British trade data are used to implement the test and discriminate between the two views of the Industrial Revolution.

There are two views of the British Industrial Revolution in the literature today. The more traditional description is represented by the views of T. S. Ashton and David S. Landes. It sees the Industrial Revolution as a broad change in the British economy and society. In Ashton's memorable phrase, "A wave of gadgets swept over England."[2] This broad view of the Industrial Revolution has been challenged recently by N. F. R. Crafts and C. Knick Harley. This new school of thought sees the Industrial Revolution as a much narrower phenomenon, as the result of technical change in a few industries. The new industries, obviously, were cotton and iron. All others were mired in premodern backwardness.[3]

It may seem as if the choice between these two views is a matter of taste, since the literature is almost exclusively about the two modern industries singled out by the narrow view of the Industrial Revolution. That appears to be how this choice is treated in the literature. In fact, the looseness of our current conception has encouraged a few people to take the views of Crafts and Harley to the extreme. Rondo Cameron argues that the change noted by these authors was so small relative to the whole economy that it no longer deserves the title of Industrial Revolution.[4]

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Peter Temin is Professor, Department of Economics, Massachusetts Institute of Technology, Cambridge, MA, 02139.

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[2]Ashton, *Industrial Revolution*, p. 42.

[3]Mokyr, "Editor's Introduction," pp. 6–7, distinguishes four views of the Industrial Revolution. My division corresponds roughly to his macroeconomic and technological schools.

[4]Cameron, *Concise Economic History*, pp. 165–67.

But it is seldom that an empirical question cannot be tested. True, productivity indexes are hard to calculate for obscure industries. It is necessary to search for other data that will let the historian discriminate between these two views. Trade data provide the information needed to discriminate between these two views.

I will use a Ricardian model of international trade to formulate a testable hypothesis about the nature of the Industrial Revolution. In this model, the traditional view of the Industrial Revolution implies that Britain should have been exporting other manufactures—that is, manufactured products other than cotton textiles and iron bars. In the more modern view, by contrast, Britain should have been importing these same goods in the early nineteenth century. Trade data allow us to see which is the case.

The plan of this article is as follows. The first section argues that there are two distinct views of the Industrial Revolution in the literature. The second section will describe the Ricardian model of international trade with many goods and formulate the hypothesis to be tested. The third section will describe the British trade data and implement the test of the previous section. A final section concludes.

TWO VIEWS OF THE INDUSTRIAL REVOLUTION

The traditional view of the British Industrial Revolution can be found in countless texts. T. S. Ashton's classic exposition clearly described a general change in British economy and society. He was very expansive in his descriptions of technical change: "Inventors, contrivers, industrialists, and entrepreneurs—it is not easy to distinguish one from another at a period of rapid change—came from every social class and from all parts of the country." Expanding the statement quoted above about "a wave of gadgets," Ashton said, "It was not only gadgets, however, but innovations of various kinds—in agriculture, transport, manufacture, trade, and finance—that surged up with a suddenness for which it is difficult to find a parallel at any other time or place."[5]

This view was widespread during the 1950s and 1960s. David Landes expressed it well in an authoritative book.[6] The well-known growth estimates of Phyllis Deane and W. A. Cole confirmed the view of widespread change and appeared to provide a firm basis for the qualitative expositions.[7] More current work by Joel Mokyr supports the pervasiveness of technological change in Britain at this time.[8] But in a recent survey of the

[5]Ashton, *Industrial Revolution*, pp. 13, 42.
[6]Landes, *Prometheus Unbound*, pp. 41, 105.
[7]Hartwell, *Industrial Revolution*; Matthias, *First Industrial Nation*; Deane, *First Industrial Revolution*; and Deane and Cole, *British Economic Growth*.
[8]Mokyr, *Lever*, chap. 10.

TABLE 1
CONTRIBUTIONS TO NATIONAL PRODUCTIVITY GROWTH, 1780–1860
(percentage per annum)

Sector	McCloskey	Crafts	Harley
Cotton	0.18	0.18	0.13
Worsteds	0.06	0.06	0.05
Woolens	0.03	0.03	0.02
Iron	0.02	0.02	0.02
Canals and railroads	0.09	0.09	0.09
Shipping	0.14	0.14	0.03
Sum of modernized	0.52	0.52	0.34
Agriculture	0.12	0.12	0.19
All others	0.55	0.07	0.02
Total	1.19	0.71	0.55

Sources: McCloskey, "Industrial Revolution," p. 114; Crafts, *British Economic Growth*, p. 86; and Harley, "Reassessing the Industrial Revolution," p. 200.

literature, Patrick K. O'Brien labeled this view "old-hat" economic history that "is still being read and continues to be written by an unrepentant but elderly generation of Anglo-American economic historians."[9]

The growth rate of the British national product was adjusted downward in a gradual process. C. Knick Harley revised the growth rate of manufacturing downward in 1982. N. F. R. Crafts extended these estimates into a revision of Deane and Cole's estimates of the British national product in his 1985 book. Crafts and Harley presented their "final" version in 1992.[10]

The implications of the new estimates for the conceptualization of the Industrial Revolution can be seen in an exercise introduced by D. N. McCloskey.[11] He calculated the productivity gains of what he called the modernized sectors from industry sources. Then he weighted the gains by the share of the industries in gross production and added them. The productivity gain of all other sectors (except agriculture, which was estimated separately) was obtained by subtracting this total from the rate of growth of production in the economy as a whole. The calculations are shown in the first column of Table 1.

Crafts reproduced McCloskey's calculations in his book and noted that the bottom line, the estimated rate of growth of the economy as a whole, came from Deane and Cole. Since Crafts was revising these estimates, he substituted his new estimates as shown in the second column of Table 1. None of the industry estimates were changed; only the growth of the unidentified, residual sector. As can be seen, the contribution of "other

[9]O'Brien, "Introduction," p. 7. O'Brien's exposition focused on the growth rate during the British Industrial Revolution, but estimates of income growth cannot be separated from the underlying conception of the Industrial Revolution, as shown below.

[10]Harley, "British Industrialization"; Deane and Cole, *British Economic Growth*; Crafts, *British Economic Growth*; Crafts, and Harley, "Output Growth."

[11]McCloskey, "Industrial Revolution," p. 114.

sectors" to economic growth fell from 0.55 percent a year to 0.07 percent. In Crafts's words: "[T]he term 'Industrial Revolution'. . . should *not* be taken to imply a widespread, rapid growth of productivity in manufacturing."[12]

Quite the contrary. As Crafts repeated throughout his discussion, the Industrial Revolution in this view was a decidedly localized affair. The industries affected were textiles, iron, and transportation. All else—other manufactures and other services—were technologically stagnant for the first half of the nineteenth century. This conclusion contrasts strongly with the assertions of Ashton and Landes.

Crafts recognized that his new estimates created a paradox. If British manufacturing was in general so backward and British agriculture so progressive—as we know from other sources—then why did Britain not export agricultural goods and import manufactures in the early nineteenth century?[13]

It is important to understand the nature of this paradox. The traditional view implied that Britain had a comparative advantage in manufacturing. Crafts had denied the premise of this traditional view by asserting that most British manufacturing was backward and inefficient. Evidence that British agriculture was more productive than continental then implied that Britain had a comparative advantage in agriculture. It is no wonder that previous economic historians had not confronted this paradox; it does not exist in the traditional view of the Industrial Revolution.

The resolution of the paradox came in two propositions. First, Crafts confirmed the existence of paradox by reiterating that most British industry "experienced low levels of labor productivity and slow productivity growth—it is possible that there was virtually no advance during 1780–1860." Second, he resolved the problem by asserting that "rapid growth in key manufacturing sectors . . . gave Britain a substantial comparative advantage in those activities."[14] In other words, industrializing Britain had a comparative advantage in cotton and iron, not manufacturing as a whole.

The clear implication of Crafts's view is that other manufactures were not exported because Britain lacked a comparative advantage in manufacturing in general. In fact, the juxtaposition of evidence of a productive agriculture with that of backward manufacturing outside of textiles and iron provided evidence that Britain had a comparative disadvantage in these other manufactures. That is, Crafts's resolution of the paradox implies that Britain

[12]Crafts, *British Economic Growth*, p. 86, emphasis in the original. Crafts's estimates reduced the implied rate of productivity change in all other sectors from 0.65 percent per year to 0.08 percent per year. He added in a footnote that even this new, low estimate could be an overestimate.

[13]Crafts, "British Industrialization."

[14]Ibid., p. 425.

should have been importing other manufactures along with agricultural goods.

Crafts and Harley recently revised and restated their new views in light of the ensuing discussion. Their definitive views reduced the rate of economic growth during the Industrial Revolution even further than Crafts's initial estimates.[15] Harley incorporated these estimates into McCloskey's exercise, as shown in the third column of Table 1. Harley revised McCloskey's estimates of productivity growth in the modern sector as Crafts had not done, reducing their aggregate contribution to economic growth. But because the rate of growth of the total economy was estimated to be so low, the contribution of other sectors fell to the vanishing point, from 0.07 percent per year to 0.02 percent per year.[16]

Harley embedded the Crafts-Harley view into a computable general equilibrium model of the British economy in the early nineteenth century. He distinguished four producing sectors in Britain: modern manufacturing, agriculture, services, and other industry. (The latter two sectors are the "all other" sector of Table 1). Britain exports the products of modern manufacturing and imports agricultural goods in this model; services and other manufactures are not traded.[17]

Harley asserted that this model demonstrates the consistency of the Crafts-Harley view. But many products of other manufactures were easily traded, as will emerge below. Unless other manufacturing started out from a position of great comparative advantage—a presumption belied by the abundant historical evidence of the eighteenth century and explicitly denied by Crafts—the ability to export other manufacturing would have been rapidly eroded by technical progress in cotton, iron, and even agriculture. If agricultural goods were imported in the early nineteenth century, therefore, then other manufactures should have been as well.

In the literature survey noted above, O'Brien seemed to conclude that the gap between "old-hat" and new-fangled economic history can never be bridged. The problem is that the data needed to construct national income aggregates do not exist for many parts of British industry in the early nineteenth century. Microeconomic and macroeconomic studies, O'Brien appeared to assert, will just have to go their own ways.

[15]Crafts and Harley, "Output Growth."

[16]Crafts recently revised downward even further his estimate of productivity change by taking account of the growth of human capital. If Harley estimated the rate of productivity change of individual industries in Table 1 from prices (as McCloskey did), these estimates would not be affected by the consideration of human capital in the overall total. This would turn the residual category of other activities *negative*. This change makes the test proposed below even sharper than with the estimated rates in Table 1. Crafts, "Exogenous or Endogenous Growth?"

[17]Harley, "Reassessing the Industrial Revolution."

Instead of banging our head against the stone wall of unavailable data, I propose to shift the terms of debate to a different kind of data.[18] Crafts and Harley have suggested some implications of the new view for Britain's international trade. Trade data are available in great detail; can they help us to disentangle the nature of the Industrial Revolution?

A RICARDIAN MODEL OF INTERNATIONAL TRADE

The implications of the Crafts-Harley view for Britain's international trade can be used to formulate a test of these views. A model is needed to derive a test, more formal than Crafts's verbal exposition and more transparent than Harley's computable general equilibrium model. The Ricardian model of international trade with many goods poses the issues clearly.

A Ricardian model with many goods was analyzed by Dornbusch, Fischer, and Samuelson in 1977, and I follow their exposition here.[19] They argued that the many goods can be seen as spread out along a continuum of comparative advantage and dealt with by their location along this continuum. The historical application of this model will be to identify the location of specific goods in this continuum.

Imagine two "countries": Britain and everywhere else. For ease of exposition, I will refer to the rest of the world as if it were a single foreign country. Since this is a Ricardian model, there is only one factor of production: labor. This factor can be seen as a Hicksian good by assuming that the relative price of different factors of production does not change. The model therefore does not say that there were no other factors of production but only that changes in the relative price of these factors can be ignored.[20] This would not be suitable for consideration of, say, the repeal of the Corn Laws, but it provides a good way to focus on the effects of productivity changes over almost a century.[21]

Each country both produces and consumes a large variety of goods made from this single factor of production. These goods can be numbered from 1 to N. The technology of each country can be described by the labor needed to produce each good. The labor requirement to produce the nth good in

[18]Berg and Hudson, "Rehabilitating the Industrial Revolution," also recommend shifting the terms of debate about the Industrial Revolution, albeit in a different direction than developed here.

[19]Dornbusch, Fischer and Samuelson, "Comparative Advantage."

[20]It is worth noting that Britain was not pressing against land scarcity at this time. Acres of arable rose almost by half in the first half of the nineteenth century while the agricultural labor force stayed constant. Allen, "Agriculture," pp. 104–07.

[21]More formally, the assumption of a single factor of production and changing technology is more appropriate to the question at hand than a model with several factors and stable technology. A model with many factors and changing technology would have so many degrees of freedom that no useable test could be derived from it.

Britain is a_n, where a_n is the number of hours of British labor needed to produce a single unit of the nth good. Following the convention of international trade, a^*_n represents the hours of foreign labor needed to produce the nth good in the foreign country.

The ratio of the labor needed to produce the good in the foreign country and in Britain is a^*_n/a_n. The goods can be re-indexed by this ratio, starting with the good for which the relative quantity of foreign labor needed for production is the highest (so the ratio, a^*_n/a_n, is the highest).

$$a_1^*/a_1 > a_2^*/a_2 > a_3^*/a_3 > \cdots > a_N^*/a_N \qquad (1)$$

The pattern of trade is determined by the relative costs of producing goods in the two countries. And in this Ricardian model costs are simply the wages of the sole factor of production: labor. Let w be the British wage; w^*, the foreign wage. Then the cost of producing good i in Britain is wa_i; the cost in the foreign country, $w^*a^*_i$. Any good for which $w^*a^*_i > wa_i$ will be produced in Britain because its production costs are cheaper in Britain.

This inequality can be rewritten as $a^*_i/a_i > w/w^*$. Production costs for this good are lower in Britain; the good will be produced in Britain and exported to the foreign country. Conversely, any good, j, for which $a^*_j/a_j < w/w^*$ will be produced in the foreign country and imported into Britain. The numbering scheme for goods ensures that there is a point in the ordered list of goods such that all goods to the left with lower numbers are produced in Britain. All the goods with higher numbers are produced abroad. This is illustrated in Figure 1, where the downward–sloping curve, A, shows a^*/a for each good. It also shows the index of the last British export at any w/w^*.

The model needs a demand side to determine wages. Assume that consumers spend a constant share of their income on each good and that tastes are the same in both countries. The wage in each country is determined by the demand for labor, which is determined in turn by the range of goods produced in that country. If the range of domestic goods increases at any relative wage, then the demand for domestic labor rises. This raises the ratio of domestic to foreign wages, leading to a positive relation between w/w^* and the range of goods produced domestically. This is shown as B, the upward sloping curve in Figure 1. Curve A shows the interaction between the number of exports and relative wages in the goods market; curve B, in the labor market. The division between exported and imported goods is where curves A and B cross, at x_0.[22]

[22]Capital movements do not affect the allocation of production in this model. Transport costs and uniform tariffs do not affect the argument; they only introduce a band of nontraded goods between exports and imports. The pattern of trade did not vary much at a time that tariffs were falling rapidly, suggesting that individual tariffs had little effect on the overall pattern of trade. Exports of services are ignored, following Harley.

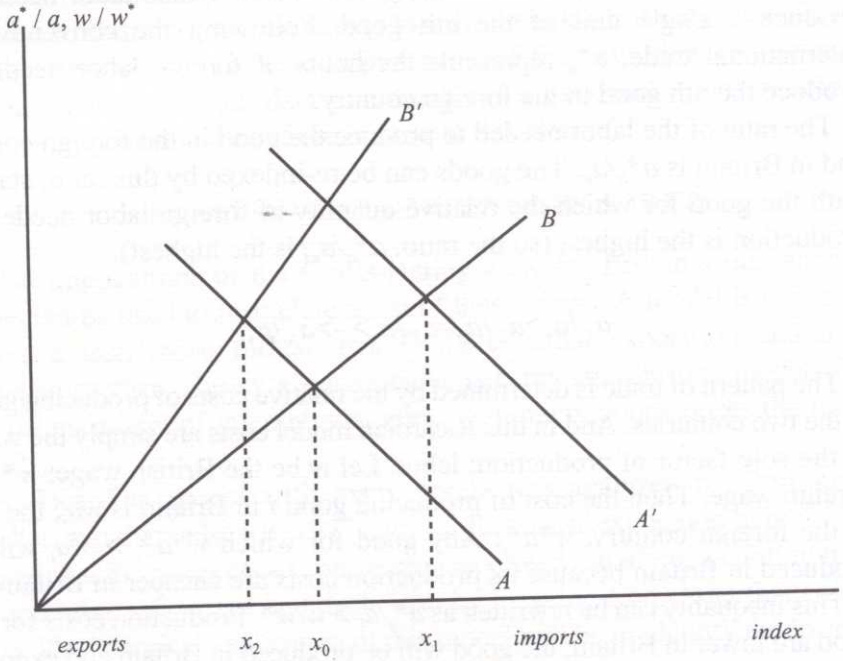

FIGURE 1

Consider now the effect of technical change in Britain. I assume that there is no technical change outside of Britain, that is, no change in labor productivity in the foreign country. Alternatively, one could say that the Industrial Revolution did not spread outside Britain in the first half of the nineteenth century. This is roughly correct—at least for continental Europe—and it connects the model to the estimates of productivity change reported in Table 1.[23]

There are two cases. If the technical change is general, that is, it reduces a_i for all i, then it increases a^*_i/a_i for all i. Curve A in Figure 1 shifts upward, increasing the range of goods exported by Britain at the same relative wage. This is shown as A' in Figure 1. The point dividing imports and exports on curve A, now A', moves to the right. This increase in the range of goods produced in Britain increases the demand for labor in Britain and reduces the demand for labor in the foreign country. British wages consequently rise relative to wages in the foreign country. A new equilibrium is reached where

[23]If productivity was growing uniformly in other countries, then this rate of change needs to be deducted from the rates derived from the final column of Table 1 to get relative rates. This does not change the order of change in the various sectors of the British economy. Like Crafts's recent reduction in the overall rate of productivity change in Britain, it only strengthens the argument here. Since there is only one factor of production, total factor productivity and labor productivity are the same. As noted above, I am assuming that labor stands for a Hicksian good and that the relative prices of different factors of production did not change substantially. See note 20.

curve B intersects the new A' curve, at x_1. At the new equilibrium, Britain is exporting goods that had previously been nontraded or imported.

If, by contrast, technical change is restricted to a few goods, the picture is more complicated. The simplest case is when productivity change is confined to a good already exported by Britain. Assume, for example, that advances in the British cotton textile industries caused people to shift demand from other goods to British textiles.[24] Then the B curve shifts up and to the left because trade balance at any w/w^* is achieved with the export of fewer British goods. The new curve is shown as B' in Figure 1; the new equilibrium is to the left of the original point on curve A, at x_2.

A more complex case is when the change in productivity changes the order of goods along curve A, moving a good from, say, the imported range to the exported. This change forces us to renumber all the other goods, giving them all higher numbers. For those goods close to the intersection of A and B, this change in the order could move them out of the range of exports into the range of imports (or nontraded goods). In terms of the goods themselves, the equilibrium has moved to the left as in Figure 1.

Conversely, if a British sector has negative technical change—that is, if it stagnates while the rest of the economy progresses—then it will move to the right in the array. Depending on its starting point and the extent of its technical lag, it could cross the dividing line in Figure 1 and change from export to nontraded or import. This case describes the Crafts and Harley conclusion shown in the last column of Table 1. The rate of productivity change in other manufacturing was not only slower than in modern industries but also than in agriculture. If we assume that productivity was rising in other countries, then the absence of productivity change for 80 years shown in the final column of Table 1 surely would have eroded whatever comparative advantage Britain might have had in these goods.

All of the subcases of restricted technical change move in the same direction. Britain exports fewer nontextile goods than before, although the representation in Figure 1 is too simple to describe all of the subcases. It follows that if there were more than one of these developments under way, the effects would cumulate. Rapid advances in British textiles and no productivity change in other manufacturing then are two separate causes for the number of British exported goods to fall.

Summarizing, uniform and restricted technical change have opposite implications for the movement of dividing points in equation 1. General technical change moves the dividing line between exports and nontraded goods to the right; restricted technical change, to the left. General technical

[24]Since the model has assumed constant shares of income spent on each good, this is equivalent to saying that the demand for British textiles was elastic.

change causes the list of exports to rise, while restricted technical change causes it to fall. This difference provides a test of historical views.

The test is which goods are exported and imported, not how much of each good is traded. The conclusions just reached refer to changes in the location of equilibria along this continuum of goods. The empirical evidence needed to discriminate between the two kinds of productivity change consists of listing exported and imported goods, not calculations of their magnitudes. To discover changes in the lists of exports and imports, lists need to be compiled for different dates during Britain's industrialization.

To create this test we need to identify goods in the array of equation 1. There are three categories of British goods: exports, nontraded goods, and imports. Following Harley, we identify exports with modern British industry, nontraded goods with services not related to trade, and imports with agriculture. But Harley has a fourth good in his model that is the one of most interest here. The question is where to put Harley's fourth category, other manufactures.

The discussion of the preceding section implies that there are two different answers. In the broad view of the Industrial Revolution, other manufactures were similar to modern manufactures; technical change was widespread. Exports of many manufactured goods should have been expanding. In the narrow view, by contrast, other manufactures were doing far worse than agriculture. Harley assumed they were not traded in his computable general equilibrium model, but as noted above, this is implausible. Other manufactures should have been imports in the Crafts-Harley view of the economy.

There are several reasons why the Crafts-Harley view implies other manufactures were imports. As cotton changed from an import to an export in the eighteenth century, the range of other manufactures exported should have fallen.[25] Further technical progress in cotton textiles that greatly increased the consumption of their products in the nineteenth century even after cotton textiles had moved to be first in the index of British goods magnified this effect. And as the residual sectors stagnated relative to agriculture in the nineteenth century, their costs of production in Britain must have risen sharply relative to the cost of growing food in Britain. Since agricultural goods were imported, the products of these other sectors—to the extent that they were traded at all—should have been imported as well. Even if other manufactures were not imported at the start of the nineteenth century, the rates of productivity change shown in the last column of Table 1 surely would have made them imports by midcentury.

The Ricardian model consequently generates a simple test to discriminate between the two views of the British Industrial Revolution. Were other

[25]Ashton, *Economic History of Britain*, p. 154; and Cameron, *Concise Economic History*, p. 160.

manufactures exported or imported? If exported, then the view that technical change was widespread among British industries in the early nineteenth century is confirmed. But if the other manufactures were imported, then the conclusion that technical change was restricted to a very few modern industries while other industries stayed mired in premodern production techniques is confirmed.

The path of trade in other manufactures also gives information. In the Crafts-Harley view shown in the last column of Table 1, these activities were not experiencing technical change in the first half of the nineteenth century. The productivity gap between other manufactures and agriculture—not to mention modern industry—was growing rapidly. Other manufactures, even if exported early in the Industrial Revolution, should have found their relative costs rising and their exports falling. They should have gone from exports to imports. This is not a statement about the relative rate of growth of these exports; it rather is whether individual goods changed from being exported to being imported.

The two views of the Industrial Revolution, therefore, can be tested by looking at marginal British exports. I do not claim that the pattern of trade in these goods describes the Industrial Revolution, only that it provides a test between two views of this event. Was Britain losing its comparative advantage in other manufacturing exports at the margin or maintaining it? After industrialization had progressed for a while, were other manufactures exported as the Ashton and Landes view implies or imported as the Crafts-Harley view implies?

It may seem odd to test major views of the Industrial Revolution by looking at marginal activities. Not only should major historical events have large causes, but the tests about them, it seems, should involve the principal activities as well. Unhappily, this is not the case. Different stories have been presented to explain the same events. To be plausible, they all have to explain the major aspects of these events. It is only in the details that they differ, although, as described above, these differences may imply other, more important disagreements. The devil, as they say, is in the details.[26]

USING THE MODEL TO DISCRIMINATE BETWEEN TWO VIEWS

Some dimensions of British trade as summarized by Ralph Davis appear in Table 2.[27] The dominant place of manufactures in British exports is easily apparent from the first row. The important and initially growing share of

[26]This is the same argument I used in a very different context in *Did Monetary Forces Cause the Great Depression?*

[27]Davis, *Industrial Revolution*. Davis also surveyed intermediate decades, with results close to those shown in Table 2.

TABLE 2
SHARES OF TOTAL AND MANUFACTURING EXPORTS
(percentage)

Sector	1794–1796	1814–1816	1834–1836	1854–1856
Manufacturing/total	86	82	91	81
Cotton/manufacturing	18	49	53	42
Woolens/manufacturing	27	21	17	15
Iron/manufacturing	11	2	2	7
Other/manufacturing	44	28	28	36

Source: Davis, *Industrial Revolution*, pp. 95–101.

cotton manufactures in total manufactures is clear from the next row. Iron manufactures, for all their importance in the narratives of the Industrial Revolution, were never a major part of British manufacturing exports.

The question here is what was happening outside of these dominant industries. Manufacturing exports other than cotton, woolens, and iron are shown in the last row of Table 2. They were quite substantial, and they show no evidence of being pushed aside by cotton exports—as woolens were.

I went to the Parliamentary Papers to find data on exports of individual commodities. Not every year contained trade information in detail. I consequently had to chose years for which I found detailed data, which did not always correspond to the years Davis had surveyed. The trends shown in Table 2 were very clear in my data as well, and I do not think any information was lost in the change of dates. I used data for three-year periods around 1810, 1830, and 1850, and a few other years between the first two to investigate changes in the early stages of industrialization and during the Napoleonic Wars.

Table 3 shows exports of other manufactures for three years centered on 1850, close to the end of the period of the calculations shown in Table 1. The table lists all manufacturing exports other than those identified in Table 2. They are sorted by the magnitude of exports. The quantities exported are shown for information only. They were used to check my data against Davis's but they are not relevant to the test performed here. The evidence to be cited in Table 3 is the list of different products.

Linen was a major export. Silk manufactures also were steadily exported. Turning to metals, we find hardware and cutlery, brass and copper manufactures, and tin and pewter continuing to be exported. Other exports include earthenware, haberdashery, apparel, soap, and hats. The interest of this list is the absence of an organizing principle. There were exports of many different sorts.

Table 4 shows the correlation between the exports of individual goods for categories that existed in both years for several different years. There is a suspicion that the composition of other exports changed more in the two

TABLE 3
EXPORTS OF OTHER MANUFACTURES, 1850–1852

Export	Value (pounds sterling)
Linens	4,694,567
Hardwares and cutlery	2,556,441
Brass and copper manufactures	1,830,793
Haberdashery and millinery	1,463,191
Silk manufactures	1,193,537
Earthenware of all sorts	975,855
Machinery and millwork	970,077
Tin and pewter wares and tin plates	904,275
Apparel, slops, and Negro clothing	892,105
Beer and ale	513,044
Arms and ammunition	505,096
Stationary/stationery of all sorts	373,987
Apothecary wares	354,962
Lead and shot	339,773
Glass/glass of all sorts	296,331
Plate, plated ware, jewelry, and watches	286,738
Soap and candles	275,200
Painters' colors and materials	237,880
Books, printed	234,190
Cabinet and upholstery wares	155,407
Cordage	155,127
Leather saddlery and harness	121,401
Hats of all other sorts	106,933
Musical instruments	85,006
Umbrellas and parasols	72,928
Carriages of all sorts	57,018
Spirits	52,843
Fishing tackles	41,607
Hats, beaver and felt	34,351
Mathematical and optical instruments	34,289
Spelter, wrought, and unwrought	22,097
Bread and biscuit	15,529
Tobacco (manufactured) and snuff	14,762

Source: U.K., *Parliamentary Papers*, 1852 (196), vol. 28, pt. 1.

decades before 1831 than after. The evidence does not confirm this view.[28] Breaking up the earlier period—critical years in both the Industrial Revolution and the conversion to a peacetime economy—into subperiods gives the results shown in the lower part of Table 4. With the possible exception of the initial years of peace, there is no evidence of much change in the structure of other exports. This is true despite the inclusion of Irish exports in the totals after 1826.

Before concluding that much of other British industry was not backward, we need to look at British imports. For if it turns out that these same articles were being imported, and especially if they were being imported in greater quantities than they were exported, the conclusion would not follow.

[28]The data from 1811 to 1813 are in official values, whereas the later data are in real values. This does not seem to have affected the correlation, but it is hard to know. There also are fewer observations in the data from 1811 to 1813 because fewer individual exports were identified.

TABLE 4
CORRELATIONS AMONG OTHER MANUFACTURING EXPORTS

Years	Number of Observations	Correlation
1811–1813 and 1830–1832	18	0.95
1830–1832 and 1850–1852	28	0.93
1811–8113 and 1816–1818	15	0.78
1816–1818 and 1821–1823	21	0.90
1821–1823 and 1826–1828	21	0.97
1826–1828 and 1830–1832	28	0.98

Source: U.K., *Parliamentary Papers*, 1812–13 (100), vol. 11, pt. 1; ibid., 1818 (147), vol. 12, pt. 1.; ibid., 1823 (220), vol. 12, pt. 1; ibid.,1828 (130), vol. 16, pt. 1; ibid., 1831–32 (310), vol. 26, pt. 1; ibid., 1852 (196), vol. 28, pt. 1.

Table 5 shows the composition of British imports in the same years as Table 3. The effect of stagnating productivity outside the modern sector and agriculture should have been most evident by 1850. But there was, as noted for exports in Table 4, little variation in the composition of British imports over the first half of the nineteenth century.

It can be seen easily that the imports are not of the same goods that were being exported, with a few exceptions. Silk was imported in greater quantities than it was exported. This was not an activity in which Britain maintained a comparative advantage. Linen was imported in the years 1811 to 1813, but Irish linens were no longer counted as imports by 1830, and there were few other linen imports. Most of the flax shown as imports must have gone to Ireland.

There is no mystery why Britain imported sugar, tea, or indigo. They, and the many other tropical products consumed in Britain, would not have been exported under any reasonable set of prices or changes in productivity. The important agricultural imports for the test performed here are corn, hides, and wool (sheep's). They were imported from western Europe and could have been exported from Britain.[29] These products are the products that Britain should have exported before other manufactures in the nineteenth century according to the Crafts-Harley view.[30]

None of the myriad other British manufacturing exports were imported at all. Britain maintained a clear comparative advantage in a wide variety of manufacturing industries throughout the first half of the nineteenth century. They held their own in the face of the spectacular growth of cotton-textile exports during those years. There is no hint that these other commodities were being pushed off the list of exports by the growth of cotton exports. Except for the Napoleonic War period, they kept pace with cotton exports.

[29]Davis, *Industrial Revolution*, pp. 114–24.

[30]Not, however, according to Harley's CGE model since other manufactures do not trade in that model.

TABLE 5
VALUE OF IMPORTS, 1850–1852

Import	Value (pounds sterling)
Wool, cotton	23,670,472
Sugar	10,762,045
Corn, meal, and flour	9,167,600
Tea	5,796,086
Silk	5,163,865
Coffee	3,480,594
Flax, and tow or codilla of hemp and flax	3,123,329
Wool, sheep's	2,049,348
Hides, raw or tanned	1,999,233
Cochineal, granilla, and dust	1,909,848
Oil	1,793,320
Madder, madder root, and garancine	1,687,568
Guano	1,476,940
Tallow	1,333,889
Indigo	1,191,495
Wood and timber	1,153,477
Dye and hardwoods	1,104,308
Hemp, dressed or undressed	990,917
Spelter	957,540
Wines	927,721
Spirits	902,351
Seeds	719,017
Woollen manufactures	710,414
Rice, cleaned or in the husk	668,585
Bacon	653,214
Potatoes	562,595
Currants	559,919
Cotton manufactures	548,065
Cheese	537,322
Copper, unwrought and part wrought	477,778
Butter	466,357
Brimstone	383,691
Tobacco and snuff	367,685
Skins and Furs	367,269
Saltpetre and cubic nitre	355,564
Iron in bars, unwrought	336,706
Gum	298,147
Oil seed cakes	296,993
Glass	270,110
Lard	258,790
Ashes, pearl and pot	238,077
Bark	213,708
Turpentine	213,561
Pork, salted or fresh	210,692
Quicksilver	201,669
Tin	200,801
Sago	178,329
Raisins	170,443
Lead, pig and sheet	169,024
Borax	164,565
Terra japonica and cutch	150,035
Hair or goats' wool, manufactures of	148,473
Cocoa, cocoa-nut husks and shells, and chocolate	145,973
Tar	142,819
Bones of animals and fish (except whalefins)	140,049
Cinnamon	132,648
Beef, salted or fresh	122,855
Embroidery and needlework	114,999
Copper ore and regulus	113,166

TABLE 5—continued

Import	Value (pounds sterling)
Cloves	106,630
Animals, living; viz. oxen, bulls, cows, and calves	103,463
Watches	95,928
Safflower	94,911
Boots, shoes and calashes, and boot fronts	94,779
Pepper	93,744
Lace, thread, and cushion or pillow lace	82,816
Leather gloves	81,441
Shumac	80,320
Oranges and lemons	74,845
Yarn, worsted or silk and worsted	73,690
Clocks	73,661
Rhubarb	70,912
Whalefins	69,277
Valonia	66,799
Hair, horse	63,159
Fish, of British taking	60,405
Nutmegs	60,144
Almonds of all sorts	59,705
Linens	57,562
Pimento	57,222
Liquorice juice and paste	54,153
Senna	53,452
Cork	53,196
Rags, &c. for paper	49,140
Wax, bees'	46,160
Teeth, elephants'	44,661
Bristles	44,048
Cassia lignea	43,735
Mace	41,082
Ginger	40,639
Animals, living; viz. sheep and lambs	35,144
Books, bound or unbound	33,865
Hams	28,935
Annatto	25,468
Isinglass	24,685
Figs	22,812
Barilla and alkali	2,122

Source: U.K., *Parliamentary Papers*, 1852 (196), vol. 28, pt. 1.

It is not surprising that Britain sold a wide variety of manufactures to tropical countries. Their comparative advantage in tropical exports was so large that they specialized completely. There is little surprise, therefore, that Britain exported hats to Australia in exchange for wool. It is important, however, that Britain did the same for western Europe.[31]

The shaping of hats was still done by hand at midcentury, but this handicraft had been surrounded by mechanization well before then. A hat-maker in London employed 1,500 people in 1840. The preparation of the fur and wool to make the felt for hats was thoroughly mechanized, using steam-powered machinery. And the dyeing of the finished hat was done on

[31]Davis, *Industrial Revolution*, pp. 101, 125. Davis's category is Hats, haberdashery, garments, and so forth, so it is not absolutely certain that hats were exported to Western Europe. I use it as my example, although other items of Davis's list could be cited as well.

machinery that allowed over 100 hats to be dyed at once. Labor productivity consequently was high.[32]

There is an exception that proves the rule. Table 5 shows that there were small imports of manufactured woolens and cotton. But they were approximately one-tenth the amounts of the exports of those commodities shown in Table 2.[33] They are hardly the exception. Further down the list in Table 5 come watches and clocks. As Landes noted in his book on that industry, the English clockmakers and watchmakers were falling behind their continental competitors in the nineteenth century.[34] Productivity stagnated in this industry, and it had become an import industry by midcentury.[35]

The export of most other manufactures, however, was continuing merrily along. The lesson of the constant rank order of these exports is that the various industries were keeping pace with each other. The share of cotton textiles in total manufacturing exports peaked in the 1830s as shown in Table 2. There was a slight fall in the share from the period 1814 to 1816 to the period 1854 to 1856. Other manufacturing exports as a whole kept pace with cotton exports during these 40 years, and exports of individual industries did so as well.

Although the empirical evidence in this test is the identity of exports and imports as shown in Tables 3 and 5, the productivity advance in British manufacturing should have lowered their prices relative to imports. They did. Albert Imlah correctly recognized this "severe deterioration" in the net barter terms of trade as a signal of British success, not distress. It is no surprise that the price of cotton manufactures fell rapidly in response to productivity growth. But even the price of woolen manufactures, which were declining as a share of British exports (Table 2), fell almost as rapidly as the price of exports as a whole.[36]

It follows, therefore, that the traditional "old-hat" view of the Industrial Revolution is more accurate than the new, restricted image. Other British manufactures were not inefficient and stagnant, or at least, they were not all so backward. The spirit that motivated cotton manufactures extended also to activities as varied as hardware and haberdashery, arms, and apparel.

It follows also that the calculations shown in the last column of Table 1 cannot be accepted as authoritative. The low rate of productivity change shown for other activities is too low. There must have been more technical progress outside the listed sectors in Table 1 to produce the results shown here.

[32]Dodd, *Days*.
[33]Davis, *Industrial Revolution*, p. 101.
[34]Landes, *Revolution*.
[35]Data for earlier years than in Table 5 show that clocks and watches were not imported earlier in the nineteenth century.
[36]Imlah, *Economic Elements*, pp. 93–102, 211–12.

CONCLUSIONS

This test confirms the traditional view that the Industrial Revolution saw changes in more than a few industries. Technical change was hardly uniform—a point conceded by every historian—but it was widespread. Britain became the workshop of the world, not just the cotton factory of the world.

Scattered descriptions suggest the existence of a pattern in other manufactures.[36] With few exceptions, there were no factories like the famous cotton factories. Instead there were new organizations of work along the lines identified by Charles Sabel and Jonathan Zeitlin.[37] "Flexible specialization" has been thought of as a description of French industrialization.[38] Perhaps it also describes a significant part of the Industrial Revolution in Britain.

More research will be needed to confirm or refute suggestions like this. The test performed here shows that increases in British productivity were not confined to cotton and iron in the first half of the nineteenth century. The "old-hat" view of the Industrial Revolution cannot be banished by calling it names. It lives among us, and it deserves more attention to fill in its all too evident gaps.

[36]For example, Berg, *Age*.
[37]Sabel and Zeitlin, "Historical Alternatives."
[38]Piore and Sabel, *Second Industrial Divide*.

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