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LABOR PRODUCTIVITY IN THE UNITED STATES AND THE UNITED KINGDOM DURING THE NINETEENTH CENTURY

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ABSTRACT

A number of writers have recently questioned whether labor productivity or per capita incomes were ever higher in the United Kingdom than in the United States. We show that although the United States already had a substantial labor productivity lead in industry as early as 1840, especially in manufacturing, labor productivity was broadly equal in the two countries in agriculture, while the United Kingdom was ahead in services. Hence aggregate labor productivity was higher in the United Kingdom, particularly since the United States had a larger share of the labor force in low value-added agriculture. U.S. overtaking occurred decisively only during the 1890s, as labor productivity pulled ahead in services and the share of agricultural employment declined substantially. Labor force participation was lower in the United States, so that the United Kingdom's labor productivity advantage in the mid-nineteenth century translated into a larger per capita income lead.

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I. INTRODUCTION

A number of writers have recently questioned whether labor productivity and per capita incomes were ever higher in the United Kingdom than in the United States (Prados de la Escosura, 2000; Ward and Devereux, 2003). Although previous work by Broadberry (1998) calculated sectoral differences in output per worker in the United Kingdom and the United States from 1870 to 1990, and confirmed that US overtaking occurred during the 1890s, this work was based on time series projections from a 1937 benchmark. That study was able to check the time series projections against a sectoral benchmark for 1910, but no attempt was made to provide any additional checks for the nineteenth century.

This paper addresses more directly the issue of comparative productivity levels in the United Kingdom and the United States during the nineteenth century, by using time series projection from a 1910 benchmark, and using an 1850 benchmark as an additional cross-check. We provide results for the period from 1910 back to 1840 for the overall economy together with a full three-sector breakdown for the period 1840-1910, based on agriculture, industry, and services, as well as a more detailed breakdown of industry into manufacturing, mining and construction. However, due to limitations in the pre-1870 data, we have provided a more detailed breakdown of comparative productivity in the service sector into transport and public utilities, distribution, other private services and government, only for the period 1870-1910.

We show that although the United States already had a substantial labor productivity lead in industry as early as 1840, especially in manufacturing, labor productivity was broadly equal in the two countries in agriculture, while the United

Kingdom was ahead in services. Hence aggregate labor productivity was higher in the United Kingdom, particularly since the United States had a larger share of the labor force in low value-added agriculture. U.S. overtaking occurred decisively only during the 1890s, as labor productivity pulled ahead in services and the share of agricultural employment declined substantially.

In addition, the proportion of the population in the labor force was higher in the United Kingdom than in the United States, reinforcing the U.K.'s per capita income lead that resulted from its labor productivity advantage in the mid-nineteenth century. The rise in the share of the population in the U.S. labor force after 1880, as well as the improvement in overall labor productivity, enabled the United States to attain per capita income leadership early in the twentieth century.

II. COMPARATIVE LABOR PRODUCTIVITY, 1840-1910: DATA SOURCES AND OVERVIEW

In this section we utilize time-series data on output and employment in the United Kingdom and the United States to establish comparative productivity levels back to circa 1840 by extrapolation from a circa 1910 benchmark. The sectors are agriculture (farming, fishing, forestry), industry (mining, manufacturing and construction) and services (including transportation and public utilities, distribution, finance and other private services and government). The data are provided in Appendix 1, together with detailed sources.

1. U.S. Time Series of Output and Employment

Time series back to 1839 are readily available for the United States at a 10-year frequency from Census and other sources. For the period 1869-1909, the standard source is Kendrick (1961) for both output and employment. For the period 1839-1869, Gallman (1960) drew on Census data to calculate real value added in agriculture and industry, while Gallman and Weiss (1969) present data on service sector value added. Following Johnston (2001), the sectoral labor force data prior to 1869 are taken largely from Lebergott (1966), but incorporating a number of widely accepted corrections suggested by Weiss (1975; 1986; 1992). These figures refer to "gainful workers", a broader definition than Kendrick's (1961) concept of "persons engaged". Since gainful workers includes all persons who usually followed an occupation, whether or not they were employed at the time of the Census, Lebergott's total for employment exceeds Kendrick's at the splice point in 1869, although the sectoral distribution is similar in both sources.

When possible, we have cross checked the data with other sources. For example, Davis's (2004) new annual index of U.S. industrial production (starting in 1790) accords well with that of Frickey (1947) and the path of real output in manufacturing suggested by Gallman (1960). We have also recalculated total output as a weighted average of the sectoral outputs and total employment as the sum of sectoral employments, to ensure that our use of additional information does not take us too far from the original totals for output and employment presented in the standard sources.

2. U.K. Time Series of Output and Employment

For the United Kingdom, time series for output and the labor force by sector are readily available at a 10-year frequency for the period 1861-1911 from Feinstein (1972), and can be extended back to 1851 using Lewis (1978). The labor force data are on broadly the same basis as those of Lebergott (1966) rather than Kendrick (1961) for the United States. For the period 1841-1851, it is not possible to obtain sectoral estimates for the United Kingdom, and attention has been confined to Great Britain, excluding Ireland. This is potentially an important issue, since Ireland accounted for 30.2 per cent of the United Kingdom's population in 1841, falling to 23.8 per cent by 1851, after the Great Famine (Mitchell, 1988: 13). However, although trends in output and employment were thus very different in Ireland and Great Britain over this decade, it is likely that trends in productivity were far more similar. Although the disarray arising from the famine may be expected to have had an adverse effect on Irish productivity, there are also offsetting factors to consider. First, the decline in agricultural employment resulted in much of the most marginal land being taken out of production, hence boosting agricultural productivity in Ireland (Boyer et al., 1994). Second, Geary (1998) points out that although there was a sharp decline in the share of the Irish labor force employed in textiles between 1841 and 1851, this was offset to a large extent by an increase in the share employed in other high-value-added manufacturing industries.

Detailed sources for the United Kingdom are also given in Appendix 1. As with the United States, we have recalculated total output for the United Kingdom as a weighted average of the sectoral outputs and total employment as the sum of sectoral employments, to ensure that our use of additional information does not take us too far from the original totals for output and employment presented in the standard sources.

3. A benchmark for circa 1910

The starting point for the time series projection, which forms the basis of our central results, is a benchmark estimate of comparative labor productivity by sector circa 1910. This has been published previously with a slightly different sectoral breakdown in Broadberry (1997). For most sectors, the comparative labor productivity level is as in the earlier study, but with the utilities (gas, electricity and water) now combined with transport and communications to make up the transport & utilities sector.[1] However, for the aggregate economy, a new estimate has been provided using the geometric mean of comparative U.S./U.K. labor productivity using value added weights for both countries and adjusting for (1) the different basis of the U.S. and U.K. employment data and (2) the ownership of dwellings.

4. Comparative productivity levels by sector: an overview

Table 1 presents the main productivity comparisons. Strictly speaking, the dates of comparison are 1839/41, 1849/51, etc., but we shall refer in the text to the central dates of 1840, 1850, etc. The first three columns are the main sectors – agriculture, industry, and services – followed by the economy-wide overall comparative labor productivity. Not surprisingly, the story from 1870 to 1910 is essentially the same as that in Broadberry (1998) and Broadberry and Ghosal (2002), with roughly equal productivity in agriculture, much higher U.S. labor productivity in industry, and a rapid catch-up in U.S. service sector productivity. The data again indicate that the United States had caught up to the U.K. economy in aggregate labor productivity around 1890 and exceeded it in the decades thereafter.

[1] The U.S. data do not permit separate estimates for the utilities before 1870.

What is new in Table 1 is the stability of the 1870 comparative productivity levels in the three decades prior to that year. In the economy as a whole, comparative labor productivity was about the same in 1840 as it was in 1870; i.e., the United States had about 95 percent of the U.K. level of G.D.P. per person engaged. There was no marked catch-up during the mid-nineteenth century; rather, the productivity gap appears to have been small and stable. The overall pattern of sectoral productivity performance seen in 1840 and 1850 was also roughly the same as it was in 1870, with roughly equal productivity in agriculture, a large U.S. productivity advantage in industry, and a large U.K. productivity advantage in services.

Thus, in terms of overall labor productivity, the United States was about as far behind the United Kingdom in 1840 as it had been in 1870, which is to say, not much. The story that emerges is one in which the United States was close behind the United Kingdom for much of the mid-century, only to catch up later largely as a result of a convergence of productivity in services and a shift of the labor force away from agriculture. The process of overall catch-up was not uniform throughout the century as there is little evidence of such catch-up between about 1840 and 1880.

Table 2 sets out the sectoral composition of the labor force in the two countries, which sheds some light on how the comparative productivity levels in the individual sectors aggregate to the overall comparative productivity levels in the final column of Table 1. Clearly, agriculture was much more important in the United States than in the United Kingdom. Since value added per worker was substantially lower in agriculture than in industry or services in the United States, the concentration of such

a large share of the labor force in agriculture helps to explain how G.D.P. per worker was higher in the United Kingdom despite the substantial U.S. productivity lead in industry.[2] The proportional shift of labor out of agriculture in both countries also helps to explain how the United States was able to catch-up with and eventually overtake the United Kingdom. The falling share of labor in agriculture in the United Kingdom was matched largely by a rising share of labor in services. In the United States, however, there was also a substantial increase in the share of labor in industry.

III. SECTORAL ASPECTS OF COMPARATIVE PRODUCTIVITY, 1840-1910

1. Comparative productivity in agriculture

In agriculture, the stability of the relative productivity measure is a striking feature of these figures. This implies that the timing of productivity improvements in agriculture was broadly comparable in the two countries. In the United States, both our figures and those of Weiss (1993) indicate that output per worker grew slightly but was relatively unchanged before 1850, in line with the earlier estimates of Towne and Rasmussen (1960). The slowness of agricultural productivity to increase can be explained largely in terms of the westward movement of the frontier, expanding the land area under cultivation without many capital investments taking place. However, as Olmstead and Rhode (2002) point out, avoiding a decline in productivity should be regarded as an achievement, since without substantial biological changes such as the introduction of new varieties of wheat, yields would have fallen with the increasing severity of insects, diseases and weeds.

[2] For example, U.S. G.D.P. per employee in 1849 was $285.5 for the whole economy but $168.3 in agriculture (Gallman, 1960; Johnston, 2001).

After 1850, labor productivity began to increase more rapidly as mechanization combined with further biological improvements (Parker and Klein, 1966; Olmstead and Rhode, 2002). However, developments in the South acted to offset the gains in the North, with the emancipation of slaves reducing the intensity of work and the breakdown of the plantation system leading to the loss of economies of scale (Ransom and Sutch, 1977: 45; 74-75; Fogel and Engerman, 1974: 204).

One point worth stressing is that the concept of labor productivity being considered here is output per worker rather than output per hour. This is important because as David (1996) notes, both the ratio of persons engaged to gainful workers and the number of hours worked per person engaged were much lower in agriculture than in the rest of the economy. Indeed, David (1996) calculates that the number of full-time equivalent manhours per gainful worker in agriculture was little more than half the level in the rest of the economy. This helps to explain the co-existence of separate literatures emphasizing on the one hand how agriculture was a backward sector from which surplus labor needed to be extracted to effect development and on the other hand how land abundance in the United States led to labor shortages in industry by creating a high opportunity cost for labor outside agriculture (Kuznets, 1966; Habakkuk, 1962). In the literature inspired by Kuznets (1966), U.S. agriculture has low output per gainful worker, and the redeployment of labor away from agriculture into industry helps to raise aggregate output per worker (Broadberry, 1998). However, in the literature inspired by Habbakuk, this is consistent with agriculture having high output per hour worked, in line with the assumption of land abundance (David, 1996).

In the United Kingdom, agricultural labor productivity kept pace with developments in the United States. After the repeal of the Corn Laws in 1846, agricultural output stagnated in the United Kingdom and the growing population was fed increasingly through imports from abroad (Afton and Turner, 2000). As the agricultural labor force declined, however, labor productivity continued to grow in line with U.S. agriculture. The high and growing level of labor productivity in U.K. agriculture throughout the nineteenth century can be understood in terms of (1) the already low share of the labor force in agriculture during the Industrial Revolution (Crafts, 1985) (2) increasing capital intensity during the "high farming" period or the "golden age" between the 1840s and the 1870s (Beckett, 2000: 734-741) (3) the shift of the product mix away from grain towards higher value added pastoral products during the period of falling grain prices caused by the "grain invasion" from the United States from the early 1870s (Ojala, 1952; Drescher, 1955; Turner, 2000).[3]

2. Comparative productivity in industry

Turning to industry, we build on the earlier findings of Broadberry (1994), who examined U.S./U.K. comparative labor productivity levels in manufacturing in the nineteenth century. The definition of industry in Table 1 includes mining and construction, and is therefore broader than just manufacturing. However, a similar pattern emerges, with a substantial U.S. labor productivity lead already established in industry by the mid-nineteenth century.

Table 3 presents a sectoral breakdown of the comparative productivity position within industry, while Table 4 shows how the labor force was distributed

[3] In the U.K. literature, this period of falling prices from the mid-1870s to the mid-1890s is often

across the main industrial sectors. The largest industrial sector in both countries was clearly manufacturing, and comparative labor productivity in this sector follows the pattern analyzed in more detail in Broadberry (1994). Even as early as 1840, the United States had a substantial labor productivity advantage over the United Kingdom. Labor productivity in U.S. manufacturing was more than twice that in British manufacturing in the 1840-1860 period, even higher than it was later in the century. From 1870 through the end of the century, the U.S. productivity advantage was nearly two-to-one.[4]

This large U.S. labor productivity advantage in manufacturing during the nineteenth century has attracted a great deal of attention since it was linked by Habakkuk (1962) to the abundance of land and natural resources in the United States. Habbakuk's argument was that resource abundance led to labor scarcity and hence (1) substitution of capital for labor in manufacturing and (2) labor saving technical progress.[5] The first result, of resource abundance leading to greater capital intensity in manufacturing, goes through so long as there is a complementarity between capital and resources, and this has been widely accepted in the recent literature (Ames and Rosenberg, 1968). The second result of resource abundance leading to labor saving technical progress has been demonstrated by David (1975), drawing on a model of

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confusingly called the Great Depression (Orwin and Whetham, 1964: 240-288).

[4] The pre-1870 pattern of comparative labor productivity in manufacturing differs somewhat from that reported in Broadberry (1994) largely on account of changes in the employment data for both countries. For the United States, Lebergott's (1966) data have been amended in line with Johnston (2001), while for the United Kingdom the estimates of Lewis (1978) and Deane and Cole (1967) have been preferred here to those of Mitchell (1988).

[5] Temin (1966; 1971) pointed out that these results are far from obvious in a standard neoclassical model. In a standard model with two goods (agricultural and manufactured) and three factors (resources, labor and capital), it is not obvious that resource abundance leads to greater capital intensity in manufacturing, since both capital and labor are scarce. However, Krueger's (1977) variation on this model (allowing for an agricultural good and two or more manufactured goods) demonstrates that a country with little capital may nonetheless produce quite capital-intensive manufactured goods if it is also well endowed with land.

endogenous localized technical change from Atkinson and Stiglitz (1968). These effects are often seen as being reinforced by the greater homogeneity of demand in the United States, allowing a greater degree of standardization and mechanization in the production process.

However, one difficulty remains the observation by Field (1985) that capital intensity was not higher in the United States during the nineteenth century, even in manufacturing. One possibility, suggested by Field, is to distinguish between overall capital intensity and machine intensity, since most capital was in the form of buildings. Another possibility, suggested by James and Skinner (1985), is to make a distinction between skilled and unskilled manufacturing, with greater U.S. capital (or machine) intensity only in the former. The distinction is based on the skill of the workers; only in the skilled manufacturing sector were there sufficient incentives to substitute capital (and resources) for labor.

One problem with the James and Skinner (1985) formulation, however, is that there is a large literature which sees the development of mass production from the American system of manufactures during the second half of the nineteenth century as saving on the use of skilled labor (Hounshell, 1984; Braverman, 1974). Broadberry (1997a) uses the distinction between mass production and flexible production to identify parallel approaches to accumulation on the two sides of the Atlantic. In U.S. mass production, resource-using machinery was substituted for skilled craft labor to produce standardized goods. Production was therefore more machine intensive and more resource intensive, which suited U.S. factor supplies of abundant natural

resources but scarce skilled labor. In the United Kingdom flexible production retained a greater emphasis on customized production using skilled craft workers. This suited the U.K. environment of abundant skilled labor but scarce natural resources. The two technologies can be seen as developing in parallel, as in David's (1975) model, and this is consistent with a stationary comparative labor productivity ratio in manufacturing as a whole over long time periods, so long as in the technologically lagging country imitation is possible in some industries, and competition reduces the size of industries where imitation is not possible.

In mining, U.S. labor productivity was less than two-thirds of the U.K. level in 1840, but had caught up by 1870 and forged ahead after 1890. With labor productivity growing only very slowly in U.K. mining before 1870 and declining slightly thereafter, the overtaking resulted from rapid productivity growth in the United States. The stagnant productivity performance in U.K. mining resulted largely from diminishing returns in coal mining as the sector grew in response to a rapidly expanding demand for energy. Although capital intensity increased and technical progress occurred, they did little more than offset the tendency to diminishing returns as pits became deeper and more difficult seams were mined (Taylor, 1961; Walters, 1975; Church, 1986: 471-496). The timing of productivity growth in the United States was not uniform, however, with a large jump in the 1860s and another surge during the 1890s. The first productivity jump may be related to the effects of the California gold rush in 1849 and the subsequent expansion of gold, silver, and copper mining in the western United States. The second productivity advance is probably related to the opening of the vast Lake Superior iron ore ranges (near the Great Lakes) in the late 1880s and early 1890s (Herfindahl 1966).

These developments in mining were an important factor in shaping U.S. comparative advantage in international trade during this period. Wright (1990) demonstrates that U.S. net exports were natural resource intensive from the 1870s through the 1920s. Irwin (2003) argues that the opening of the Mesabi iron ore range led to a sharp decline in the relative price of U.S. exports of iron and steel products, thus propelling a rapid expansion of those exports. In his account, this helped shift the United States from a net importer to a net exporter of manufactured goods for the first time in its history.

In construction, U.S. labor productivity was little more than half that in the United Kingdom in 1840, but was slightly above the U.K. level in 1890. However, the U.S. trend improvement in construction was much more cyclical than in mining. Indeed, as noted in Broadberry (1997), there appears to be a long swing pattern to comparative productivity in construction, with periods of boom in the U.S. building industry coinciding with periods of slump in the U.K. building industry. This pattern was first identified by Thomas (1954), and although the indicators of building activity in the two countries have been improved substantially since this work, the inverse cyclical pattern is still visible in the revised data series. The small scale of the U.S. productivity advantage in construction on the eve of World War I, compared with the position in manufacturing, suggests that there were limitations to the possibility of adopting high throughput methods in this sector to offset the higher wages in America. Indeed, construction was the one industrial sector in the United States where the apprenticeship system for training skilled craft workers remained important into the twentieth century (Bolino, 1989).

However dramatic was the improvement in comparative U.S. productivity in mining and construction, these sectors were a relatively small part of the overall U.S. overtaking of the United Kingdom because the share of the labor force employed in mining and construction remained small in both countries, reaching a peak of 8.1 per cent in the United States and 11.4 per cent in the United Kingdom in 1909/11 (Table 4).

3. Comparative productivity in services

Table 5 examines comparative productivity in the service sector in more detail, while Table 6 presents data on the employment shares of. As noted earlier, data limitations prevent a reliable breakdown of comparative productivity levels within services for the period before 1870. However, we still believe that the data are adequate to establish the finding that labor productivity in the service sector as a whole was substantially higher in the United Kingdom than in the United States during the period 1840-1870. After the Civil War, however, U.S. productivity performance improved rapidly in services, catching-up to U.K. levels during the 1870s, and pulling ahead decisively during the 1890s.

Broadberry and Ghosal (2002) link the U.S. overtaking in services to the application of high-volume, low-margin methods to services, beginning on the railroads, and moving on rapidly to other parts of the transport and utilities sector, with the establishment of steamship lines, urban traction systems and the telegraph and telephone systems (Chandler, 1977: 189-203). This resulted in U.S. overtaking in

transport and the utilities by 1880, and the establishment by World War I of a productivity lead in this sector on a scale similar to that in manufacturing.

In the distribution sector, although there was a move in the direction of high volume business with the emergence of department stores, chain stores and mail-order houses, demand factors limited the diffusion of modern business enterprise. In particular, there were limits to the degree of centralization and standardization that consumers were prepared to accept, particularly given the relatively low levels of population density in the United States compared with the United Kingdom (Field, 1996: 25-27).

In other private services, such as banking and finance, there were obvious difficulties in adopting a high-volume, impersonal, standardized approach, given the importance of asymmetric information and trust (Stiglitz and Weiss, 1981; Lamoreaux, 1994). The United Kingdom retained a clear advantage in this sector until World War I. The scale of U.K. employment in this sector was relatively large, but to the extent that this generated economies of scale, they must be seen as external economies. For the late nineteenth century, Cassis (1994) paints a convincing picture of the City of London as a “Marshallian district”, reaping external economies of scale through a network of small financial institutions.

Although government was a small part of the economy, and poses particularly severe measurement problems, it is included here for the sake of completeness. Feinstein (1972) and Lewis (1978) measure real output in this sector by assuming an increase in labor productivity of 0.5 per cent per annum in civil administration, but

not the military. This is justified on the grounds of the growing introduction of office machinery (Lewis, 1978: 264). Since in both countries output moves in line with employment, the equivalent assumption in a cross-country comparison, that comparative output varies in line with comparative employment, yields equal labor productivity in the two countries by construction. The small deviations from 100 in Table 5 reflect the relative importance of the military, particularly around the Boer War.

IV. SOME CROSS CHECKS

1. A benchmark check for 1850

Since our estimates of comparative productivity involve projection with time series from a benchmark for 1910, it will be useful to construct an independent benchmark estimate for 1850, to act as a cross check. For the United States and Great Britain, it is relatively straightforward to compile the estimates of nominal G.D.P per employee from the sources used to construct our time series of real output and employment by sector, and these are provided for the whole economy, together with the three-sector breakdown in Table 7. The most difficult part is to obtain a price ratio to compare the U.S. estimates in dollars with the British estimates in pounds sterling. Our simple procedure here is to construct a P.P.P. for the whole economy on the basis of the wholesale prices of five commodities, covering wheat, raw cotton, cotton cloth, raw wool and coal. Using this P.P.P., we obtain an estimate of the U.S./G.B. comparative productivity ratio of 95.7, which is reassuringly close to the figure of 89.9 obtained by time series projection in Table 1.

However, as noted earlier, it is important to take account of the difference between Great Britain and the United Kingdom. Accordingly, in part B of Table 7 we also provide an estimate of the U.S./U.K. comparative G.N.P. per head ratio in 1850 using the P.P.P of £1 = $5.33. This yields a lower U.S./U.K ratio of 78.4, largely on account of the much lower labor force participation rate in the United States, an issue which we investigate further below.

The P.P.P used in the above calculations is clearly far from ideal, and we would agree with the appeals of Ward and Devereux (2003) and Prados de la Escosura (2000) for more work on international comparisons of price levels in history. However, it is also important to avoid the inconsistent use of new price evidence by these authors, as highlighted by Broadberry (2003). To a large extent, the value of nominal G.D.P in historical national accounts is obtained by reflating volume indicators using limited price information. If the price information set is expanded, it is appropriate to calculate new estimates of nominal G.D.P. It is incorrect to leave the nominal value of G.D.P unchanged and to use the new price information to derive different estimates of real G.D.P.

What we are able to show in Table 8 is that the P.P.P.s calculated every decade between 1840 and 1913 from the basic price information on these five commodities tracks quite closely the implied P.P.P from time series projections for the entire period. This means that the price information being used in our circa 1850 benchmark is at least consistent with the price indices that have been used to reconstruct the nominal values of G.D.P. in the historical national accounts for these two countries.

2. Population, labor and comparative per capita incomes

Our estimates have been concerned primarily with output per worker. However, the claims in the recent literature of U.S. superiority in the mid-nineteenth century have typically been couched in terms of higher levels of G.D.P. per capita. Thus Ward and Devereux (2003) suggest higher per capita income in the United States in 1872, while Prados de la Escosura (2000) shows the United States ahead as early as 1820. In fact, given the substantially higher share of the population in the labor force in the United Kingdom, shown here in Table 9, a small U.S. per capita income lead would imply that the United States maintained a very large lead in labor productivity. These authors do not provide evidence of such a lead.

Indeed, since our estimates show a very small U.K. labor productivity lead between 1840 and 1880, the higher proportion of the population in the labor force in the United Kingdom translates into a rather more substantial lead in per capita income terms, as can be seen in the fourth column of Table 9. Thus, the United States overtook the Untied Kingdom in overall labor productivity by 1890, but did not overtake in per capita income until 1910.[6]

The lower share of the population in the labor force in the United States during the nineteenth century can be explained at least in part by demographic factors. The median age of the population was substantially lower in the United States than in he United Kingdom, where an earlier fall in fertility led to an earlier fall in the child dependency rate (Easterlin, 1972: 141). Whilst U.S. fertility also declined in the later

nineteenth century, the child dependency rate remained markedly higher and the proportion of the population in the labor force correspondingly lower in the United States than in the United Kingdom on the eve of World War I.[7]

V. CONCLUSIONS

This paper has revisited the issue of comparative labor productivity between the United Kingdom and the United States in the late nineteenth century, and linked it to relative per capita incomes in the two countries. Building on the earlier work of Broadberry (1998), we push back the sectoral productivity estimates from 1870 to 1840 and provide another cross check on the results by using an 1850 benchmark in addition to the 1910 benchmark. We find that U.S. labor productivity was about 95 percent of that of the United Kingdom in 1840, about the same as it was in 1870. The United States already had a substantial labor productivity advantage in industry, particularly manufacturing, roughly comparable productivity in agriculture, and lower productivity in services. The United States overtook the United Kingdom in per capita income after the turn of the century as a result of shifting labor out of agriculture, raising its productivity in the service sector, and increasing the share of the population in the labor force.

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[6] These estimates are close to those of Maddison (2003: Tables 1c and 2c) for adjacent years, despite the use of slightly different time series for our output based estimates.

[7] Figures from Feinstein (1972: Tables 55-56) and the U.S. Department of Commerce (1975: Series A119-134) show that in circa 1910, 30.6 per cent of the population was under the age of 15 in the United Kingdom, compared with 32.1 per cent in the United States. The corresponding figures for 1860 were 35.0 per cent in the United Kingdom and 40.6 per cent in the United States.

TABLE 1: U.S./U.K. comparative labor productivity by major sectors, circa 1840-1910 (U.K.=100)

	Agriculture	Industry	Services	Whole economy
1839/41	78.1	159.7	84.8	93.8
1849/51	98.9	162.7	65.2	89.9
1859/61	100.0	152.8	73.0	95.0
1869/71	92.4	145.1	77.4	94.0
1879/81	103.9	146.3	103.6	98.1
1889/91	96.7	167.8	104.1	100.3
1899/01	112.0	170.9	116.1	114.8
1909/11	108.5	186.5	119.3	124.7

Notes: U.S. dates are 1839, 1849, 1859,…. U.K. dates are 1841, 1851, 1861,…..
Time series projections based on 1909/11 benchmark.
Sources: See text.

TABLE 2: Sectoral distribution of labor in the United States and the United Kingdom, circa 1850-1910 (%)

A. United States

	Agriculture	Industry	Services
1849	60.0	17.1	22.9
1869	48.3	23.8	27.9
1889	41.6	25.5	32.9
1909	30.4	30.2	39.4

B. United Kingdom

	Agriculture	Industry	Services
1851	28.3	40.9	30.8
1871	22.2	42.2	35.6
1891	15.8	43.2	41.0
1911	11.8	43.5	44.7

Sources: U.S.: Johnston (2001: Table A-1); Kendrick (1961: Table A-VII); U.K.: Feinstein (1972: Table 60); Lewis (1978: Table A.4).

TABLE 3: U.S./U.K. comparative labor productivity in industry, circa 1840-1910 (U.K.=100)

	Mining	Manufacture	Construction	Total industry
1839/41	63.5	239.3	53.3	159.8
1849/51	68.3	224.9	53.6	162.7
1859/61	60.5	190.5	77.8	152.8
1869/71	102.5	182.6	64.1	145.1
1879/81	98.8	169.9	93.5	146.3
1889/91	108.5	193.6	110.3	167.8
1899/01	146.5	195.7	94.1	170.9
1909/11	161.3	201.9	133.6	186.5

Notes: U.S. dates are 1839, 1849, 1859,…. U.K. dates are 1841, 1851, 1861,…..
Time series projections based on 1909/11 benchmark.
Sources: See text.

TABLE 4: Sectoral distribution of industrial labor in the United States and the United Kingdom, circa 1850-1910 (% of total labor force)

A. United States

	Mining	Manufacture	Construction	Total industry
1849	1.2	10.9	5.0	17.1
1869	1.3	17.6	4.9	23.8
1889	2.3	18.7	4.5	25.5
1909	3.1	22.1	5.0	30.2

B. United Kingdom

	Mining	Manufacture	Construction	Total industry
1851	3.1	33.3	4.5	40.9
1871	4.0	33.5	4.7	42.2
1891	5.0	33.1	5.1	43.2
1911	6.3	32.1	5.1	43.5

Sources: U.S.: Johnston (2001: Table A-1); Kendrick (1961: Table A-VII); U.K.: Feinstein (1972: Table 60); Lewis (1978: Table A.4).

TABLE 5: U.S./U.K. comparative labor productivity in services, circa 1840-1910 (U.K.=100)

	Transport & utilities	Distribution	Other private services	Government	Total services
1839/41					84.8
1849/51					65.2
1859/61					73.0
1869/71	88.2	69.6	47.1	97.8	77.4
1879/81	113.4	107.0	63.9	97.5	103.6
1889/91	146.5	95.9	72.7	98.0	104.1
1899/01	198.3	106.1	76.4	110.3	116.1
1909/11	191.3	118.7	79.1	100.0	119.3

Notes: U.S. dates are 1839, 1849, 1859,…. U.K. dates are 1841, 1851, 1861,…..
Time series projections based on 1909/11 benchmark.
Sources: See text.

TABLE 6: Sectoral distribution of service labor in the United States and the United Kingdom, circa 1850-1910 (% of total labor force)

A. United States

	Transport & utilities	Distribution	Other private services	Government	Total services
1849	2.4	4.4	14.4	1.7	22.9
1869	5.1	7.7	11.9	3.2	27.9
1889	7.1	9.7	12.7	3.4	32.9
1909	8.8	11.7	14.9	4.0	39.4

B. United Kingdom

	Transport & utilities	Distribution	Other private services	Government	Total services
1851	3.0	6.2	18.4	3.2	30.8
1871	5.6	7.5	19.5	3.0	35.6
1891	7.0	9.9	20.8	3.3	41.0
1911	8.3	12.1	20.2	4.1	44.7

Sources: U.S.: Lebergott (1966: Table 1); Kendrick (1961: Table A-VII); Gallman and Weiss (1967: Table A-12); U.K.: Feinstein (1972: Table 60); Lewis (1978: Table A.4).

TABLE 7: Benchmark estimates of comparative labor productivity and per capita income, circa 1850

A. U.S./G.B.

	U.S. G.D.P. per employee ($)	G.B. G.D.P. per employee (£)	P.P.P ($ per £)	U.S./G.B. comparative labor productivity (G.B.=100)
Agriculture	168.3	50.7		
Industry	409.7	43.8		
Services	500.3	67.8		
Whole economy	285.5	53.9	5.53	95.7

B. U.S./U.K.

	U.S.	U.K.	U.S./U.K. (U.K.=100)
G.N.P.	$2,320m	£633m	66.3
Population (1000s)	23,261	27,524	84.5
G.N.P. per head	$99.74	£23.0	78.4

Sources: Part A: U.S. G.D.P. by sector: Gallman (1960: Table A-1; Gallman and Weiss (1967: Table A-1); U.S. labor force: Johnston (2001: Table A-1); G.B. G.D.P.: Deane and Cole (1967: Table 37); Mitchell (1988: 831); G.B. labor force: Deane and Cole (1967: Table 31); P.P.P. derived as unweighted average of 5 commodities from U.S. Department of Commerce (1975) and Mitchell (1988).
Part B: U.S. G.N.P.: Gallman (1966: Table A-1); U.S. population: U.S. Department of Commerce (1975: Series A-7); U.K. G.N.P.: Mitchell (1988: 831); U.K. population: Mitchell (1988: 11-12).

TABLE 8: U.S./U.K. P.P.P. estimates, 1840-1913 ($ per £)

	Direct estimates	Time series projections
1840	4.36	4.92
1850	5.53	5.48
1860	4.79	5.32
1870	6.11	6.48
1880	5.88	5.33
1890	5.52	5.11
1900	5.54	5.35
1913	5.26	5.27

Sources: Direct estimates: unweighted average of 5 commodities from U.S. Department of Commerce (1975) and Mitchell (1988); Time series projections: benchmark P.P.P. for 1970 from Kravis et al. (1978) projected using G.D.P. deflators from U.K. Central Statistical Office (various issues), Feinstein (1972) and Mitchell (1988) for the U.K. and U.S. Department of Commerce (1992), Balke and Gordon (1985) and Gallman (1966; 2000) for the U.S.

TABLE 9: Labor force participation and comparative per capita incomes, circa 1840-1910

	(%)		(U.K.=100)	
	Labor force participation rate		U.S./U.K. comparative labor productivity	U.S./.U.K comparative per capita income
	U.S.	U.K.		
1839/41	33.8	45.3	93.8	70.0
1849/51	35.2	46.5	89.9	68.1
1859/61	35.8	45.2	95.0	75.2
1869/71	32.4	44.5	94.0	68.4
1879/81	34.6	43.1	98.1	78.8
1889/91	37.0	44.1	100.3	84.2
1899/01	38.2	45.0	114.8	97.5
1909/11	40.6	45.0	124.7	112.5

Sources: U.S.: Lebergott (1966: Table 1); U.S. Department of Commerce (1975: Series A-7); U.K.: Feinstein (1972: Tables 55, 57); Deane and Cole (1967: Table 31); Mitchell (1988: 11-12).

APPENDIX 1: DATA FOR TIME SERIES PROJECTIONS, 1840-1910

1. United States

General sources for output by sector

1869-1909: Kendrick (1961: Table A-IV).
1839-1869: Gallman (1960: Table A-1).

General sources for employment by sector

1869-1909: Kendrick (1961: Table A-VII).
1839-1869: Johnston (2001: Table A-1). The basic data from Lebergott (1966: Table 1) have been adjusted in line with the later estimates of Weiss (1967; 1986; 1992).

Additional sources and notes for specific sectors

Agriculture: Output 1839-1869 is for narrowly defined output, excluding land improvements and home manufactures, for reasons of comparability with the U.K. Output 1869-1909 is gross output, farm segment, from Kendrick (1961: Table B-II).
Manufacturing: Output 1859-1869 from Frickey (1947: 54) and Davis (2004: Table 3).
Transport & utilities: Output 1839-1869 is value added in current prices from Gallman and Weiss (1967: Table A-1), deflated using a weighted average of shipping freight rates from North (1960) and Simon (1960), and railway freight rates and passenger rates from Fishlow (1966).
Distribution: Output 1839-1869 is value added in current prices from Gallman and Weiss (1967: Table A-1) deflated using a price deflator for distribution from Gallman and Weiss (1967: Table 3).
Other private services: Output 1839-1869 is value added in current prices from Gallman and Weiss (1967: Table A-1), deflated using a price deflator for services (variant 1) from Gallman and Weiss (1967: Table 3). Hand trades and shelter excluded.
Government: Output 1839-1909 derived from employment with assumption of labor productivity growth at 0.5 per cent per annum.

2. United Kingdom

General sources for output by sector

1861-1911: Feinstein (1972: Table 8).
1851-1861: Lewis (1978: Table A.3).
1841-1851: Hoffman (1965: Table 54B).

General sources for employment by sector

1861-1911: Feinstein (1972: Table 60).
1851-1861: Lewis (1978: Table A.4).
1841-1851: Deane and Cole (1967: Table 31).

Additional sources for specific sectors

Agriculture: Output 1841-1851 derived from volume indicators from John (1989), with arable and animal husbandry weights for 1846 from p.1046.
Construction: Output 1861-1911 is an unpublished revised index kindly made available by Charles Feinstein and Andrew Hilditch.
Transport & utilities: Output 1841-1851 is an extension of the Lewis (1978) method using railways and shipping data from Hawke (1970) and Mitchell (1988).

Distribution: Output 1841-1851 is an extension of the Lewis (1978) method using data on agriculture, mining and manufacturing output plus imports and re-exports.
Other private services: Output 1841-1851 is nominal value added from Deane and Cole (1967) deflated by the Rousseaux price index for all items from Mitchell (1988: 722-723).
Government: Output 1841-1861 is derived from employment with an assumption of labor productivity growth at 0.5 per cent per annum.

TABLE A1: U.S. OUTPUT DATA (1909=100)

	Agric	Mining	Manuf	Constr	Total industry	Transprt	Distn	Other priv serv	Gov	Total services	G.D.P.
1839	16.8	0.92	2.28	4.26	2.44	0.643	3.79	3.04	8.0	3.30	5.69
1849	21.1	2.23	5.85	6.31	5.47	0.972	7.58	3.93	12.7	5.41	8.54
1859	31.8	4.34	10.3	11.69	9.78	3.46	14.2	6.79	16.4	9.50	14.4
1869	36.7	9.2	16.4	15.6	15.4	6.7	14.8	10.39	22.2	12.3	18.9
1879	57.4	17.7	23.5	24.3	22.9	13.2	29.5	18.9	33.4	22.7	28.7
1889	72.6	33.8	42.2	44.1	41.5	32.9	44.3	39.3	47.0	40.4	43.9
1899	92.0	56.6	63.4	57.5	61.6	58.8	67.2	60.0	67.6	62.9	66.8
1909	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE A2: U.S. EMPLOYMENT DATA (000)

1. 1839-1869

	Agric	Mining	Manuf	Constr	Total industry	Transprt	Distn	Other priv serv	Gov	Total services	Whole economy
1839	3,906	32	371	290	693	86	232	778	83	1,179	5,778
1849	4,919	102	889	410	1,401	193	360	1,177	142	1,872	8,192
1859	6,330	176	1,463	520	2,159	304	614	1,691	192	2,801	11,290
1869	6,818	180	1,927	780	2,887	506	781	1,647	291	3,225	12,930

2. 1869-1909

	Agric	Mining	Manuf	Constr	Total industry	Transprt	Distn	Other priv serv	Gov	Total services	Whole economy
1869	5,758	151	2,100	580	2831	604	926	1,412	379	3321	11,910
1879	7,640	281	2,810	645	3736	816	1,232	1,674	541	4263	15,639
1889	8,996	507	4,049	964	5520	1,531	2,104	2,744	725	7104	21,620
1899	9,912	659	5,365	1,315	7339	2,075	2,892	3,650	993	9610	26,861
1909	10,562	1,079	7,679	1,744	10502	3,059	4,089	5,177	1,396	13721	34,785

TABLE A3: U.K. OUTPUT DATA (1911=100)

	Agric	Mining	Manuf	Constr	Total industry	Transprt	Distn	Other priv serv	Gov	Total services	G.D.P.
1841	110.9	15.1	18.8	31.2	19.4	8.6	18.9	21.3	19.2	17.3	25.8
1851	96.5	21.4	25.4	40.7	26.3	19.6	27.8	28.9	27.9	26.2	32.9
1861	100.0	32.1	34.6	48.3	35.6	26.6	35.2	34.1	41.9	33.4	40.6
1871	102.8	45.7	47.7	62.6	48.9	37.0	47.7	42.5	41.9	42.9	50.5
1881	98.5	58.6	57.3	75.6	59.4	46.9	57.4	54.8	48.4	53.2	59.9
1891	104.8	69.6	70.4	78.8	71.1	62.1	71.0	67.9	60.5	66.7	71.7
1901	95.8	80.7	85.6	114.6	87.7	78.7	86.0	80.0	90.3	82.6	86.1
1911	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE A4: U.K. EMPLOYMENT DATA (000)

1. 1841-1851

	Agric	Mining	Manuf	Constr	Total industry	Transprt	Distn	Other priv serv	Gov	Total services	Whole economy
1841	1,900	200	2,700	400	3,300	300	900	1,906	94	3,200	8,400
1851	2,100	400	3,200	500	4,100	500	1,000	1,870	130	3,500	9,700

2. 1851-1861

	Agric	Mining	Manuf	Constr	Total industry	Transprt	Distn	Other priv serv	Gov	Total services	Whole economy
1851	3,530	390	4,160	560	5,110	375	770	2,295	400	3,840	12,480
1861	3,160	460	4,480	660	5,600	525	900	2,535	570	4,530	13,290

3. 1861-1911

	Agric	Mining	Manuf	Constr	Total industry	Transprt	Distn	Other priv serv	Gov	Total services	Whole economy
1861	3,520	490	4,300	550	5,340	615	850	2,315	450	4,230	13,090
1871	3,120	570	4,700	660	5,930	790	1,050	2,740	420	5,000	14,050
1881	2,850	680	4,920	830	6,430	900	1,300	3,120	460	5,780	15,060
1891	2,630	840	5,520	840	7,200	1,170	1,640	3,470	550	6,830	16,660
1901	2,420	1,020	5,990	1,090	8,100	1,550	1,990	3,740	880	8,160	18,680
1911	2,400	1,290	6,550	1,030	8,870	1,700	2,460	4,120	840	9,120	20,390

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