BRITAIN'S TWENTIETH CENTURY PRODUCTIVITY PEFORMANCE IN INTERNATIONAL PERSPECTIVE

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I. INTRODUCTION

This chapter provides an overview of Britain's labour productivity performance during the twentieth century, incorporating the catching-up and convergence perspective. By taking account of levels of labour productivity, as well as growth rates, we will see that it is possible to arrive at a more sanguine evaluation of Britain's twentieth century performance than is common in much of the literature. Until recently, the literature was dominated by a "declinist" perspective, emphasising the slower rate of productivity growth in Britain compared with other countries (Wiener, 1981; Kirby, 1981, Dintenfass, 1982; Pollard, 1984; Elbaum and Lazonick, 1986; Barnett, 1986; Alford, 1988). However, following important papers by Abramovitz (1986) and Baumol (1986) on the convergence of productivity and living standards, a more balanced view has become possible.

The central idea in the convergence literature is that there is a negative correlation between the productivity growth rate and the initial level of productivity. This can be explained most intuitively by the fact that it is easier for a lagging economy to imitate via adoption of technology or organisation from abroad than to innovate at the frontier. However, it also follows in a simple neoclassical growth model, since in a world of diminishing returns to capital, a country with a low level of capital per worker and hence a low level of labour productivity will have high returns to capital and hence attract investment. Since Britain had a relatively high level of productivity in the late nineteenth century, the finding of slower productivity growth in Britain is only to be expected within this framework. Furthermore, it should not be overlooked that per capita income in 2000 was around four-and-half times higher than

it had been in 1900, representing a considerable increase in living standards over the century.

However, there is a danger of taking the revisionism of the convergence framework too far and taking too optimistic a view of Britain's twentieth century productivity performance (Booth, 2001; Rubinstein, 1993). Crafts and Toniolo (1996) continue to see British performance as disappointing, even allowing for differences in catch-up potential, since Britain was not just caught-up by many countries, but also fell behind. Furthermore, Britain has been slow to close the productivity gap that has opened up with North America and much of Western Europe (Broadberry and O'Mahony, 2004).

One way of guarding against an excessively optimistic interpretation of Britain's productivity performance is to delve beneath the aggregates to look at sectoral variations in comparative productivity performance. We present results for the US/UK and Germany/UK comparisons, so as to provide coverage of both North America and Western Europe. In addition to highlighting areas of weakness as well as strengths, this helps to shed light on the long term development of the British economy. We show that the high levels of overall labour productivity achieved in late nineteenth century Britain were underpinned by high levels of labour productivity in agriculture and services rather than in industry, together with a highly favourable structure. In particular, Britain's high level of development at this time shows up in a relatively small share of the labour force in agriculture, a sector with relatively low value added. One strand of the literature has drawn attention to the substantially higher levels of labour productivity in American industry compared with British

industry during the nineteenth century as a result of land abundance and labour scarcity (Habakkuk, 1962). Nevertheless, if there has been a long-standing British labour productivity gap in industry, it has not trended upwards (Broadberry, 1997a; 1997b). This means that over the long run, the overall deterioration in Britain's comparative labour productivity performance must be concentrated in agriculture and services, together with the effects of structural change. Structural change matters because of the later movement of labour out of agriculture, a relatively low value-added sector, in other countries. However, the long run stationarity of comparative labour productivity in industry is quite consistent with shorter periods of disappointing performance, which were later reversed. This pattern occurred during the period 1950-79, for example, with Britain much slower than Germany to close the large productivity gap that had opened up with the United States across World War II, so that Germany overtook Britain. However, Britain then closed the gap with Germany during the 1980s (Broadberry and Crafts, 2003).

The chapter also offers a quantitative overview of explanations of Britain's productivity performance. Before WWII, Britain, in common with the rest of Europe, had a productivity gap with the United States, particularly in industry. Since the 1970s, there has also been a productivity gap with Europe. This section draws on growth accounting and levels accounting to quantify the factors behind Britain's productivity performance during the twentieth century, focusing on the roles of physical capital, human capital and innovation.

II. BRITAIN'S AGGREGATE PRODUCTIVITY PERFORMANCE

The rate of labour productivity growth in Britain has tended to be slower than in most other major economies which have been perceived as Britain's main competitors, throughout most subperiods since 1870. This is shown in panel A of Table 1, with Britain having the slowest labour productivity growth during the periods 1870-1913, 1913-29, 1929-38, and 1973-90. Furthermore, although the United States grew more slowly during 1950-73, this was the period when the growth rate gap between Britain and most continental European economies and Japan was at its peak. A similar pattern of a lagging British growth rate appears in data on GDP per capita and GDP per employee. This pattern of relatively slow growth in Britain has tended to generate a rather pessimistic and critical tone to much of the literature on British economic history during the twentieth century.

This view has been tempered in more recent years by a consideration of comparative levels of labour productivity, shown here in panel B of Table 1. Consideration of these data tends to lead to a more optimistic view, showing Britain starting out in 1870 with the highest level of labour productivity. The faster growth of other countries can thus be explained as part of the process of catching-up. However, whilst this can be seen as applying to Japan throughout the twentieth century, and to France and Germany into the early post-World War II period, it cannot be used to explain the forging ahead of the United States between 1913 and 1950, nor the continued growth of the French and German productivity lead until 1990. Why were other countries able to forge ahead, and why was the British economy so slow to catch-up once it had fallen behind?

III. SECTORAL PRODUCTIVITY PERFORMANCE

1. Overview

The data in Table 1 refer to GDP per hour worked. To provide a sectoral breakdown of Britain's comparative labour productivity performance, however, requires working in terms of output per person engaged. The figures in Table 2 for the US/UK and Germany/UK comparisons show levels and trends that are very similar to Maddison's (1995; 2001) well-known comparative data on GDP per hour worked until about 1973, when hours worked per person engaged began to diverge between Europe and America.

Around 1870, aggregate GDP per person engaged in the United States was about 90 per cent of the British level, but US overtaking occurred in the 1890s. The United States then forged ahead, reaching a peak labour productivity lead around 1950, after which Britain slowly narrowed the gap. In 1871, aggregate GDP per person engaged in Germany was less than 60 per cent of the British level. Although this had risen above 75 per cent before 1914, World War I provided a significant setback to Germany. By the late 1930s, German labour productivity had reached about 80 per cent of the British level, but World War II provided another setback. Thereafter, Germany returned to the catching-up path and overtook Britain during the 1960s. Germany continued to forge ahead until 1979, and during the 1980s comparative aggregate labour productivity fluctuated without trend until German reunification.

The natural starting point for the sectoral analysis of Britain's comparative productivity performance is the widely acknowledged fact that comparative productivity trends in manufacturing have differed from trends in the aggregate

economy (Broadberry, 1993). The US/UK and Germany/UK comparative labour productivity trends in manufacturing are shown here in Figure 1. In contrast to the situation at the aggregate level, in manufacturing there is no long run trend in comparative labour productivity. In 1870, US labour productivity in manufacturing was roughly twice the UK level, and this was also the case in the late twentieth century. Although there have been periods of sustained deviation from this two-to-one US labour productivity advantage, particularly following major wars, in the long run there has always been a return to this ratio. The sharp increase in the US/UK comparative labour productivity ratio in manufacturing between 1938 and 1950, and the subsequent downward trend between 1950 and 1979 should be interpreted in this light. Similarly, there has been no long run change in the Germany/UK comparative labour productivity ratio, with Germany roughly on a par with Britain in both 1870 and 1990.

This large US labour productivity advantage in manufacturing since at least the mid-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. Habakkuk's argument was that resource abundance led to labour scarcity and hence (1) substitution of capital for labour in manufacturing and (2) labour saving technical progress. 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 (Ames and Rosenberg, 1968). The second result, of resource abundance leading to labour saving technical progress has been demonstrated by David (1975), drawing on a model of endogenous localised technical change from Atkinson and Stiglitz (1969).

Broadberry (1997a) extends the argument into the twentieth century with the incorporation of human capital. The resource-using machinery was substituted for skilled labour in the United States, making good use of US natural resource abundance and skilled labour scarcity. However, US mass production methods were not well suited to European conditions of natural resource scarcity and skilled labour abundance. The large, homogeneous US market reinforced these technological differences, since mass production technology produced standardised products. US mass production technology can be seen as co-existing with European flexible production technology, with a process of innovation on one side of the Atlantic mirrored by imitation on the other side of the Atlantic, and with technical progress adapted to local circumstances on both continents.

To make these ideas more concrete, it is helpful to focus on a particular industry, motor vehicles. Already by the end of the nineteenth century, substantial differences had emerged between the European and American industries, with US firms building long runs of standard cars, assembled by semi-skilled labour from bought-in components, while European firms tended to use skilled craft workers to produce parts in-house, and to assemble them on a more customised basis (Lewchuk, 1987). Production census data for the period 1907-1909 capture these differences very well, with output per worker substantially higher in the United States than in Britain or Germany (Broadberry, 1997a). The process of standardisation and the substitution away from skilled labour received a further boost with developments at Ford during World War I, with the introduction of a moving assembly line, high wages in return

for hard driving of the labour force and the extreme pursuit of volume by the removal of all variation in the product (any colour you want so long as it's black!).

Although there was clearly technological cross-fertilisation between the European and American car industries, with Ford and General Motors producing in Europe as well as America, differences in demand patterns (more varied in Europe), relative factor prices (cheaper skilled labour and more expensive energy in Europe) meant that in Europe there was much greater model variety than in America, the labour force relied more heavily on skilled craft workers, and machinery remained more general purpose and less specialised (Lewchuk, 1987; Foreman-Peck, 1982; Bardou et al, 1982). Whilst American car producers remained technological leaders for much of the twentieth century, with European producers having to adapt American technology to European conditions, the tables were turned from the 1970s, with the revival of flexible production on the basis of numerically controlled machine tools and computer aided design (Broadberry, 1994; Milgrom and Roberts, 1990; Juergens et al., 1993). Having a skilled labour force with experience of building to custom became once again an asset (Edquist and Jacobssen, 1988). Again, however, given differences in factor proportions and demand patterns between countries, differences in production strategies and productivity outcomes have persisted (McKinsey Global Institute, 1993).

Since manufacturing was the biggest industrial sector, and since agriculture had shrunk in importance to around two or three per cent of the labour force in all three countries by the late 1980s, reconciling the trends and levels of comparative

productivity performance in manufacturing and the whole economy seemed to require a loss of British productivity leadership in services. This was first established by Broadberry (1997b; 1997c, 1998) using a nine-sector breakdown. However, to bring out the crucial importance of services for understanding Britain's comparative productivity performance since 1870, it is sufficient to consider the results on the basis of a three-sector breakdown, covering agriculture, industry and services.

Britain's loss of productivity leadership in services coincided with the "industrialisation"of market services in the United States, which involved the transition from a customised, low-volume, high-margin approach to business organised on the basis of networks to a more standardised, high-volume, low-margin business with hierarchical management. As with the related introduction of mass production in manufacturing, the industrialisation of services led to sustained growth of labour productivity. However, the gains from the introduction of the technology and organisation of industrialised services provision varied by sector over time (Broadberry and Ghosal, 2002).

Again, to make the idea of the industrialisation of services more concrete, it is helpful to focus on a particular example. Here, we consider shipping. As Boyce (1995) notes, shipping ventures in the nineteenth century were usually conducted by networks. A group of agents would each make an initial investment, which would allow the purchase of a ship and other necessary items. The aim of the venture might be to take a cargo between two cities (say London and Buenos Aires), find a cargo for the return voyage and then sell the ship or undertake another venture. Agents would bring different skills and commercial contacts as well as initial capital. However,

there was much scope for opportunistic behaviour, since it was difficult to monitor the actions of agents over long distances. Suppose, for example, that there were difficulties in finding a return cargo in Buenos Aires, which reduced the profitability of the venture. How could the other partners in the venture find out whether or not this was the fault of the agent in Buenos Aires? In these circumstances, group reputation and the associated persistence of group membership, could be used to provide a solution to the incentive problem and deter opportunistic behaviour. You only trade with people you can trust, and that trust can take a long time to build up. The economic mechanisms underpinning these networks of trust have been analysed formally by Greif (1989; 2000).

During the late nineteenth century, however, a number of developments permitted the development of a more anonymous, high-volume "industrial" approach to shipping. First, the scale of business increased as world population, incomes and trade grew. Second, communications improved with the spread of the telegraph and then the telephone. And third, the transition from sail to steamships improved the predictability of sailing times. These developments all made it more feasible to establish a regular scheduled service between two ports, requiring investment in a fleet of ships, the establishment of a bureaucracy to run the regular service and a marketing organisation to secure sufficient demand to fill the capacity. This led to the establishment of shipping lines, which required Chandler's (1977) three-pronged investment in production, management and marketing. This led to a dramatic increase of concentration in shipping, with the 8-firm concentration ratio in the British fleet reaching 42.5% by 1918/19, and 100% in the liner section (Boyce, 1995: 128-129).

Further steps in the industrialisation of shipping came after World War I with the replacement of steam ships by motorships, and the associated development of large oil tankers to replace the declining oil trade (Sturmey, 1962). These developments led to a further squeeze on tramp shipping. After World War II, the growth of the oil tanker business accelerated, and the dry cargo business moved towards containerisation, with dramatic changes in operating methods, leading to much higher labour productivity (Channon, 1978).

2. Sectoral analysis of the US/UK case, 1870-1990

The importance of services to the changing US/UK comparative labour productivity level in the aggregate economy over the period 1870-1990 can be seen in the sectoral breakdown of comparative productivity levels in panel A of Table 2. To get the full picture, however, requires adding to this the sectoral breakdown of employment in the two countries, shown in Table 3. Panel A of Table 2 illustrates the point raised in the previous section that the long run trends in comparative labour productivity for the aggregate economy owe rather less to trends in industry than is usually assumed in accounts of comparative productivity performance. Hence, for example, between circa 1890 and 1990, the US labour productivity lead in industry declined slightly, while the United States went from a position of lower labour productivity to a 33 per cent lead in the aggregate economy. That is not to say that industry did not matter, particularly in shorter run fluctuations of comparative labour productivity. Indeed, Broadberry (1997a) notes that the US labour productivity lead in manufacturing increased significantly across World War I and again across World War II, but in each case, the increase was not sustained.

Note, second, that although the trend of comparative labour productivity in agriculture moved in the same direction as in the aggregate economy, with the United States overtaking Britain, this was not the really significant contribution of agriculture to changing comparative productivity performance at the aggregate level. The greater significance of agriculture was in its declining share of the labour force, which can be seen for both countries in Table 3. The decline in agriculture's share of employment had a significant impact on aggregate labour productivity because agriculture is a relatively low value-added activity. Hence countries which have retained a large share of the labour force in agriculture have also remained poor.[1] Shifting labour from agriculture into higher value added industrial and service sectors hence acted to boost aggregate labour productivity. Note, however, that this shift out of agriculture occurred rather later in the United States than in Britain, thus contributing to the US catching-up. Whereas in about 1870, agriculture accounted for just 22.2 per cent of employment in Britain, it still accounted for a full half of the US labour force. By 1990, however, agriculture accounted for less than three per cent of employment in both countries.

An important point to note in panel A of Table 2 is that comparative labour productivity trends in services broadly mirror comparative labour productivity trends for the economy as a whole. The US overtook Britain in services during the 1890s, and forged ahead to the 1950s. Furthermore, since services grew in importance throughout the period in both countries, it is this loss of British productivity leadership in services that largely explains Britain's loss of overall productivity

[1] Note that rich New World countries such as Australia and Canada conform to this pattern, with labour force shares of agriculture well under 5 per cent by the end of the twentieth century.

leadership (Broadberry and Ghosal, 2002). Services also played an important role in shorter run fluctuations, frequently mirroring the patterns in the aggregate economy.

3. Sectoral analysis of the Germany/UK case, 1870-1990

The importance of services to the changing Germany/UK comparative labour productivity level in the aggregate economy over the period 1870-1990 can be seen in the sectoral breakdown of comparative productivity levels in panel B of Table 2, together with the sectoral employment data in Table 3. Again, the first point to note is that the long run trends in comparative productivity levels for the aggregate economy are less affected by trends in industry than is commonly thought. Thus, for example, between 1911 and 1990, the German labour productivity lead in industry declined while for the aggregate economy Germany went from three-quarters of the British level to a lead of more than 25 per cent. However, over shorter periods, there have been substantial movements in comparative Germany/UK levels in industry. Broadberry (1997a) emphasises the German forging ahead in manufacturing during the 1970s, with Germany attaining close to a 50 per cent labour productivity lead by the end of the decade. This was not sustained, however, and by the end of the 1980s, most of the German lead had been eliminated (Broadberry and Crafts, 2003).

Second, although Germany's comparative productivity position in agriculture has improved since the late nineteenth century, agricultural labour productivity remained much lower in Germany than in Britain in 1990. Again the declining importance of agriculture as a share of the labour force requires emphasis. Since the shift of labour out of low-value-added agriculture occurred much later in Germany than in Britain, and even substantially later than in the United States, this had

important implications for the lateness of German catching-up at the aggregate economy level. With such a large share of the German labour force tied up in low productivity agriculture before World War II, the overall labour productivity level was bound to be much lower in Germany than in Britain. On the other hand, once Germany shifted decisively out of agriculture after World War II, overall catching-up was rapid.

For the Germany/UK case in panel B of Table 2, comparative labour productivity trends in services broadly mirror comparative labour productivity trends for the economy as a whole, as for the US/UK case in panel A. Again, the key to understanding Germany's overtaking of Britain at the aggregate level was the loss of British productivity leadership in services (Broadberry, 2004b). Services also played an important role in the shorter run fluctuations, frequently mirroring the patterns in the aggregate economy.

4. Developments since 1990

The period from the mid 1990s is seen as a watershed in comparative productivity analysis since it represents the first time in decades that US productivity levels gained ground on major EU countries for a sustained period of time. It is also a period when Britain narrowed the gap with large European countries. Table 4 shows comparative levels of output per hour worked for the sector division shown in previous tables, but also shows figures for the market economy and market services. This confirms that aggregate trends are not being driven by trends in non-market services (health, education and public administration), where outputs are frequently measured by inputs.

Table 4 confirms the previous findings that Britain has a significant productivity shortfall relative to the United States, Germany and France, in all sectors other than agriculture. However it also shows that whereas Britain lost some ground relative to the United States since 1995 in the market economy, Britain gained on France and Germany, in particular in market service sectors. Again as in the previous sections, developments in service sectors dominate the trends, with the United States forging ahead in market services, in particular relative to France and Germany. The dramatic turnaround in the fortunes of US service industries has been increasingly noted in the literature and is now acknowledged to be highly influenced by the adoption and diffusion of information technology (Triplett and Bosworth, 2003; O'Mahony and van Ark, 2003). The information technology age appears also to have coincided with a turnaround in British productivity performance relative to large EU countries. However, despite the faster growth rate of labour productivity, Britain has not yet caught up with the other large EU countries in terms of labour productivity levels. This reflects the fact that Britain had fallen substantially behind during the 1970s and 1980s.

IV. EXPLAINING BRITAIN'S PRODUCTIVITY PERFORMANCE

Before WWII, Britain, in common with the rest of Europe, had a productivity gap with the United States, particularly in industry. Since the 1970s, there has also been a productivity gap with Europe. This section draws on growth accounting and levels accounting studies of productivity performance to identify the proximate causes, with particular emphasis on physical capital and human capital.

1. Physical capital to 1990

Much of the literature on international comparisons suggests that labour productivity growth rates differ at least in part because of differences in capital stock growth (Denison, 1967; Maddison, 1987). Hence it is of some interest to consider the role of capital in explaining international differences in labour productivity levels. For the US/UK case at the aggregate level, trends in comparative total factor productivity (TFP) in panel A of Table 5 and labour productivity in panel A of Table 2 are similar, but with TFP differences generally smaller than labour productivity differences. This means that capital has a role to play in explaining labour productivity differences, but not enough to eliminate TFP differences altogether. One point worth noting here is that whereas the United States overtook Britain before World War I in terms of labour productivity, it was only between the wars that the United States gained a TFP advantage. This would be consistent with the emphasis of Abramovitz and David (1973; 1996) on the importance of capital rather than TFP in American economic growth during the nineteenth century. It is also consistent with McCloskey's (1970) claim that Victorian Britain did not fail, at least in the sense that the United States was still catching-up in terms of aggregate TFP levels. In services, too, note that US overtaking of Britain also occurred later in terms of TFP than in terms of labour productivity.

For the Germany/UK case, comparing panel B of Tables 5 and 2 we see that trends are very similar for comparative TFP and labour productivity at the aggregate level, with differences in TFP generally smaller than differences in labour productivity. Again, as in the US/UK case, this means that capital has a role to play in explaining labour productivity differences, but not enough to eliminate TFP

differences altogether. Note that in industry, Germany had caught up with Britain in terms of TFP as well as labour productivity before World War I. In services, higher capital intensity in Britain throughout the period means that until 1950 the British TFP lead was smaller than the British labour productivity lead, but that from 1973 the German TFP lead was greater than the German labour productivity lead.

When considering the more recent periods, the increasing importance of information and communications technology (ICT) equipment in the past two decades has led to significant changes in the method employed to measure capital input, with capital services increasingly replacing capital stocks as the main measure being employed in national accounts. Essentially the difference between the two measures relates to methods employed to aggregate across asset types, which in turn requires detailed investment series not available in the historical data. Hence comparisons across countries based on this new measure are confined to the period from 1990 and discussed in the section on growth accounting below.

2. Formal education and human capital

The most basic indicator of human capital is the level of education of the labour force. Table 6 provides data on formal schooling in Britain, the United States and Germany. The data are presented in the form of enrolment rates per 1000 population under the age of 20, to facilitate international comparisons (Mitchell, 1975; Flora, 1983; Mitch, 1992; Goldin, 1998; Lindert, 2001).

First, it is clear that Britain lagged behind both Germany and the United States in the provision of mass primary education until about 1900, as has been widely noted

in the history of education literature and demonstrated quantitatively by Easterlin (1981). However, it is widely accepted that the official data on primary enrolments in England and Wales overstate the British shortfall due to under-recording. Lindert (2001) provides a corrected series using data on the number of child scholars from the 1871 Census of Occupations, which shows primary enrolments per 1000 population in England and Wales having already reached 137.5 by 1871. This suggests that the British lag in primary education may not have been as great as suggested by the official data in Table 7, but it does not eliminate the lag.

Second, both Britain and Germany lagged behind the United States in the development of mass secondary education between the two World Wars. This has been noted by historians of education such as Ringer (1979: 252-253), and has also been emphasised recently in the work of Goldin (1998). Third, both Britain and Germany lagged behind the United States in the provision of mass higher education after World War II. By 1990, tertiary enrolment ratios in Britain and Germany were still a long way behind U.S. levels.

Two points should be borne in mind when interpreting these trends. First, the transfer from primary to secondary education has generally occurred at a later age in the United States and Germany than in Britain, affecting the breakdown between primary and secondary education. Second, however, it is not possible to give enrolment ratios for narrower age bands, as the difference between primary and secondary education was a matter of class as well as age before World War II.

Previous attempts to provide a link between education and productivity have focused on industry, where the link between the tasks that most workers actually perform on the shopfloor and the skills learned in school seems rather tenuous. In services, by contrast, the link between education and the tasks performed by most office workers seems rather closer. Although Goldin and Katz (1996) claim that the early development of mass secondary schooling in the United States was important in the development of batch and continuous process methods in the early twentieth century, the argument goes against the grain of an earlier view which sees the development of mass production in the United States as substituting away from skilled labour (Habakkuk, 1962; Braverman, 1974). Furthermore, Goldin's (1998) own evidence on the cross-state variation in the level of schooling shows a negative relationship between high school graduation and the share of the labour force in manufacturing. As David and Wright (1999) note, a long period of time undoubtedly elapsed before industrial employers learned to make effective use of the supply of high school graduates. The move to mass secondary schooling surely makes more sense when seen in the context of the organisational and technological changes occurring in the rapidly expanding service sector during the first half of the twentieth century. High levels of formal education can thus be seen as one factor behind the early industrialisation of services in the United States.

3. Vocational training and human capital

Not all human capital is accumulated in schools, so it is important to supplement the data on formal education with data on vocational training. It is also important to draw a distinction between higher level and intermediate level vocational training. Higher level training is taken to cover vocational qualifications at the standard of a university

degree, including membership of professional institutions, while intermediate level training is taken to cover craft and technician qualifications above secondary level but below degree level, including non-examined time-served apprenticeships (Prais, 1995: 17). We begin with intermediate level skills, paying particular attention to developments in the service sector since World War II.

Table 7 provides apprentice-to employment ratios in Britain, Germany and the United States. As well as economy-wide ratios, estimates are also provided on a sectoral basis where available. Data are taken from official sources including occupational censuses for all three countries and various enquiries into apprenticeship training. Traditionally, apprenticeships have been concentrated in the industrial sector, and this is reflected in Table 7. The most striking finding is the much lower proportion of apprentices in US industry compared with both Britain and Germany throughout the period. The most important factor here is the different approaches to training in manufacturing on the two sides of the Atlantic, with US manufacturing oriented towards mass production with unskilled or semi-skilled labour and European manufacturing more oriented towards flexible production with skilled craft workers (Broadberry, 1997a).

In services, although apprentice-to-employment ratios were also substantially lower in the United States than in Britain and Germany throughout the period, the transatlantic gap was smaller than in industry before World War II. This reflected the fact that the absolute numbers involved in service sector apprenticeship were small, even in Germany. After World War II, however, the German lead in the provision of intermediate level vocational training in services became substantial, with the spread

of apprenticeship into services. Given the importance of developments within services for the German overtaking of Britain in terms of aggregate labour productivity during the post-World War II period, this German lead in the provision of intermediate level vocational skills in services is of major significance.

Turning to higher level vocational training, an important aspect of human capital accumulation was the early development in Britain of professional bodies, an important function of which was to oversee professional training (Carr-Saunders and Wilson, 1933; Reader, 1966). The majority of these qualified professionals worked in the service sector, where Britain had a labour productivity lead over Germany and the United States in the late nineteenth century. Table 8 presents data on the employment of professionals in the three countries since 1881. The British data allow a distinction between higher and lower professions, and data on the higher professions are shown in panel A. The definition is taken from Routh (1965), and corresponds broadly with the concept of higher level skills employed here, requiring a qualification at the standard of a university degree (Prais, 1995). Although the key higher professions in the nineteenth century were in the church, medicine and law, the twentieth century has seen the growing importance of engineering, science and accounting. Increasingly, these professions have come to be restricted to graduate entry, so that in recent times information on professional associations does not substantially alter the picture of human capital levels gleaned from data on higher education.

To measure the growth of the professions on a comparative basis, it is necessary to include the lower professions as well as the higher professions, in panel B of Table 8. Although Britain started the period with a higher share of the occupied

population in the professions, the United States had pulled ahead by the end of the nineteenth century. Although much of the existing literature on the professions concentrates on social aspects and eschews quantification, the idea of a leading role for Britain in the professionalisation of society during the nineteenth century and a leading role for the United States during the first half of the twentieth century does seem to be widely accepted (Perkin, 1996; Gilb, 1966). In Germany, the effects of the large agricultural sector with low value added, and the resulting low per capita incomes, can be seen in the restricted growth of the professions, in line with the stunted growth of the service sector. Figures for the interwar period suggest a substantially smaller professional sector in Germany through to 1950 (McClelland, 1991).

For some professional groups, it is possible to chart the growth of qualifications on a comparative basis. Broadberry (2003: 118) shows that the share of professional accountants in the British labour force has been unusually high compared with the United States, and especially compared with Germany, throughout the twentieth century. Although the high degree of reliance on professional accountants in Britain has been widely noted in the contemporary business literature, the long standing nature of this reliance has been less widely commented upon (Handy et al., 1988; Matthews et al., 1997). Matthews et al. (1997) explain it at least in part by the nature of the British capital market, with its emphasis on market transactions rather than German-style long-term internalised relationships, which generated an early and growing need for independent auditors.

Although British services almost certainly had a human capital advantage over the United States during the late nineteenth century in terms of the proportion of workers with higher level professional qualifications, this was increasingly offset by the rapid growth of higher education in the United States, particularly after World War II.

In the period since 1979, increased data availability from labour force surveys means that it is possible to present comparisons of the stocks of skilled workers, combining qualifications attained both through formal education and vocational training. Table 10 presents the percentage of the workforce with qualifications at three levels, namely Higher (degree or equivalent), Intermediate (secondary school qualification at age 18 and certified vocational qualifications deemed above the level achieved by pupils leaving school at age 16) and Low skills (no certified qualifications). This illustrates the well known finding that Britain has a skills gap relative to the United States at the higher level but performs better than the European countries in this respect. However, Britain has a large gap in intermediate skills relative to the European countries.

Compared with Germany and France, Britain has shown a greater narrowing of the higher skills gap with the US, in particular during the 1990s. This has resulted from a more rapid expansion of higher education in Britain than in Germany or France, so that by the beginning of the twenty-first century, Britain was sending roughly the same share of its young people to university as in the United States. To the extent that degree and equivalent qualifications are those most in demand in adopting and using information technology, it could be argued that Britain has

upgraded its skill base more successfully than the other European economies. However, the intermediate skills gap remains very large, with Britain still in a position where a large section of the working population have no more than basic skills. Note that the categorisation by skill group for the United States does not include high school graduates in the intermediate group since this is an attainment rather than a qualification measure – all pupils in the US who finish high school graduate - and so it is difficult to compare with the European economies. If high school graduates were included, then the US intermediate proportions would be about 57 percent in both 1979 and 2000, comparable to proportions in France and Germany.

4. Growth accounting

Growth accounting estimates, showing the contributions of labour quality, physical capital and TFP to UK labour productivity growth are shown in Table 10. These estimates are derived by weighting inputs by their shares of value added, assuming constant returns to scale and perfect markets. Traditionally, growth accounting is used to break down the growth of output into the parts attributable to the growth of factor inputs and residual TFP growth:

$$g_Y = \alpha\, g_K + \beta\, g_H + \gamma\, g_L + g_{TFP} \qquad (1)$$

where g_Y, g_K, g_H and g_L are the growth rates of output, physical capital, human capital and raw labour, respectively, and α, β and γ are the shares of each factor in national income. Here we are interested in accounting for labour productivity growth, so subtracting the growth of raw labour from both sides under the assumption of constant returns to scale ($\alpha + \beta + \gamma = 1$) yields the accounting identity used in Table 10:

$$g_Y - g_L = \alpha\,(g_K - g_L) + \beta\,(g_H - g_L) + g_{TFP} \qquad (2)$$

The left-hand side is now the growth of output per hour worked, and this can be accounted for by capital deepening, an improvement in the quality of the labour force and residual TFP growth.

For the period 1873-1973, the data in Table 10 are taken from the study by Matthews et al. (1982). The growth of output per hour worked shows a U-shaped pattern, with relatively slow growth during the peak-to-peak interwar period 1924-37. However, note that the high labour productivity growth across World War I was largely the result of the sharp reduction in the length of the working week from 54 to 47 hours in 1919-20 (Dowie, 1975; Broadberry, 1990). Note also that the number of hours worked ceased to grow substantially after the end of the 1930s as population growth slowed down and annual hours worked per person continued to decline. Before World War II, labour productivity growth was largely explained by capital deepening and improvements in the quality of the labour force. However, after World War II, TFP growth became more important.

For the period since 1973, data are taken from O'Mahony and van Ark (2003) and O'Mahony (1999).[2] These estimates suggest a decline in output growth and labour productivity growth in the period after 1973, which fits in with the widely accepted view of slower growth in the western world at this time (Matthews, 1982). These figures also suggest that the period since 1989 has seen a return to the labour productivity growth of the Golden Age of the 1950s and 1960s. Again, as during the

[2] Physical capital input is based on a finer division of asset types. In particular ICT assets are distinguished from other equipment and given a relatively high weight due mainly to their rapid depreciation and hence high marginal productivities. The labour quality adjustment is also based on a finer division by type of labour, so care must be taken in making comparisons with the pre-1973 period.

Golden Age, this rapid labour productivity growth is only partly explained by the rapid growth of physical capital and skills, leaving an important role for TFP growth.

5. Accounting for comparative productivity levels

A more complete picture can be obtained by breaking down Britain's productivity gap with the United States, Germany and France. To do this requires adapting the growth accounting identity (2), which compares labour productivity in a single country at different points in time and assesses the contributions of changing factor inputs and TFP. We now need to compare labour productivity between different countries at a single point in time, and assess the contributions of differences in labour quality, capital intensity and TFP:

$$\ln Y/L^{US} - \ln Y/L^{UK} = (\ln A^{US} - \ln A^{UK}) + \alpha (\ln K/L^{US} - \ln K/L^{UK}) + \beta (\ln H/L^{US} - \ln H/L^{UK}) \quad (3)$$

The term on the left hand side of (3) is the proportional labour productivity difference between two countries, superscripted by US and UK. This is explained by differences in TFP, differences in capital intensity and differences in the quality of the labour force.

For the period to 1973, data are taken from Broadberry (2003), and work in terms of accounting for the differences in output per person engaged. For the US/UK comparison, labour quality made little contribution to explaining the total labour productivity gap, which rose from 17.7 percentage points in 1910 to 66.9 percentage points by 1950, before narrowing to 52.3 percentage points in 1973. Capital intensity made the biggest contribution to explaining the US/UK labour productivity gap before 1950, after which TFP became more important. This echoes the growing importance

of TFP in explaining the growth of British labour productivity after World War II, noted in the earlier discussion of Table 10. For the Germany/UK case, by contrast, TFP was the most important factor behind the labour productivity gap until 1950. However, it must be stressed that this was a negative labour productivity gap, with Britain achieving higher levels of labour productivity as a result of higher TFP levels. By 1973, however, we see the growing importance of labour force quality in explaining the emergence of a German labour productivity advantage over Britain, with capital intensity playing a secondary role, and any remaining British TFP advantage being of minor importance.

Table 12 brings the story up to the beginning of the 21st century, but working in terms of differences in output per hour worked. The key finding is that in 2000, as in 1973, TFP plays a much bigger role in explaining Britain's labour productivity gap with the United States than it does in explaining Britain's labour productivity gap with Continental Europe. In 2000, whereas TFP explains around half of Britain's labour productivity gap with the United States, it explains only a very small part of Britain's labour productivity gap with Germany. Furthermore, in the comparison with France, TFP is higher in Britain despite labour productivity being higher in France. Tables 11 and 12 taken together are thus consistent with the view that accumulation of physical and human capital largely explains the overtaking of Britain by Continental European economies such as Germany and France in the postwar period. Accumulation appears also to have played an important role in US forging ahead in the first half of the twentieth century. However, during the postwar period, US labour productivity leadership has rested largely on innovation leading to higher levels of TFP.

V. CONCLUDING COMMENTS

The catching-up and convergence perspective recognises a negative relationship between the starting level of productivity and subsequent productivity growth, which helps to avoid too pessimistic an evaluation of Britain's productivity performance during the twentieth century. For Britain in 1900 had a relatively high level of productivity, and subsequently grew more slowly than other countries which were catching up. However, this framework cannot provide a complete explanation, since Britain had already been overtaken by the United States in 1900, and continued to fall further behind until the 1950s. Furthermore, Britain was not only caught up by most West European countries by the end of the 1960s, but also continued to fall behind during the 1970s. Although the relative decline was stemmed during the 1980s, it was not decisively reversed, and by the end of the twentieth century Britain continued to have a substantial labour productivity gap with both the United States and Continental Europe.

The sectoral breakdown of Britain's comparative productivity performance sheds light on the factors behind British relative decline. We see that Britain's position in the late nineteenth century was quite fragile because overall productivity leadership rested on a precocious release of labour from low value added agriculture, combined with a large, labour-intensive industrial sector, that did not achieve particularly high levels of labour productivity. As other countries industrialised, Britain's overall productivity leadership was threatened, and a loss of labour productivity leadership in services exacerbated the problem. The low point of Britain's comparative productivity performance was reached during the post-World

War II period, with the widespread adoption of Fordist mass production methods in industry and an acceleration in the "industrialisation" of services. Difficulties of adjustment to these new forms of technology and organisation led to substantial relative economic decline in Britain during this period. However, with a return to more flexible forms of production based on ICT from the 1980s, in both industry and services, Britain's relative economic decline has been stemmed, and has recently shown signs of being reversed.

Physical capital and human capital have both played an important part in Britain's productivity performance, accounting for large portions of British labour productivity growth and Britain's labour productivity gaps with the United States and Continental Europe. However, the importance of technology and organisation also show up in the contribution of TFP.

TABLE 1: Rates of growth and comparative levels of GDP per hour worked

A. Growth rates (% per annum)

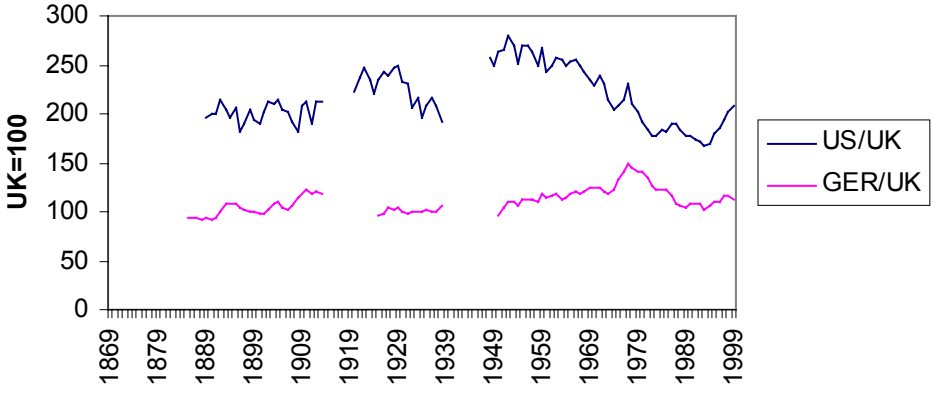
	1870-1913	1913-29	1929-38	1938-50	1950-73	1973-90	1990-98
UK	1.2	1.5	0.9	2.3	3.1	1.7	3.1
USA	1.9	2.4	1.5	3.2	2.7	1.4	1.7
Germany*	1.8	1.4	1.1	-0.8	6.0	2.4	2.4
France	1.7	2.4	2.9	0.5	5.1	2.9	1.7
Japan	1.9	3.5	2.3	-0.6	7.7	3.0	2.1

B. Comparative levels (UK=100)

	1870	1913	1929	1938	1950	1973	1990	1998
UK	100	100	100	100	100	100	100	100
USA	87	116	136	144	161	148	141	126
Germany*	61	80	79	81	56	105	116	111
France	52	65	75	89	72	113	138	123
Japan	18	23	32	37	26	72	89	82

Notes: * Former West Germany for the period after 1950.
Sources: Derived from Maddison (1995: Table J-5; 2001: Table E-7).

FIGURE 1: Comparative labour productivity in manufacturing



Source: Broadberry (2004a).

TABLE 2: Comparative labour productivity levels by sector, 1869/71 to 1990: GDP per person engaged (UK=100)

A. US/UK

	Agriculture	Industry	Services	Aggregate economy
1869/71	86.9	153.6	85.9	89.8
1889/91	102.1	164.1	84.2	94.1
1909/11	103.2	193.2	107.4	117.7
1919/20	128.0	198.0	118.9	133.3
1929	109.7	222.7	121.2	139.4
1937	103.3	190.6	120.0	132.6
1950	126.0	243.5	140.8	166.9
1973	131.2	214.8	137.4	152.3
1990	151.1	163.0	129.6	133.0

B. Germany*/UK

	Agriculture	Industry	Services	Aggregate economy
1871	55.7	91.7	62.8	59.5
1891	53.7	99.3	64.4	60.5
1911	67.3	127.3	73.4	75.5
1925	53.8	92.3	76.5	69.0
1929	56.9	97.1	82.3	74.1
1935	57.2	99.1	85.7	75.7
1950	41.2	91.8	83.2	74.4
1973	50.8	121.1	120.1	114.0
1990	75.4	111.0	134.9	125.4

Notes: * Former West Germany for the period after 1950.
Sources: Derived from Broadberry (1997b; 1997c).

TABLE 3: Sectoral shares of employment in the United States, the United Kingdom and Germany, 1870-1990 (%)

A. United States

	Agriculture	Industry	Services
1870	50.0	24.8	25.2
1910	32.0	31.8	36.2
1920	26.2	33.2	40.6
1930	20.9	30.2	48.9
1940	17.9	31.6	50.5
1950	11.0	32.9	56.1
1973	3.7	28.9	67.4
1990	2.5	21.8	75.7

B. United Kingdom

	Agriculture	Industry	Services
1871	22.2	42.4	35.4
1911	11.8	44.1	44.1
1924	8.6	46.5	44.9
1930	7.6	43.7	48.7
1937	6.2	44.5	49.3
1950	5.1	46.5	48.4
1973	2.9	41.8	55.3
1990	2.0	28.5	69.5

C. Germany*

	Agriculture	Industry	Services
1871	49.5	29.1	21.4
1913	34.5	37.9	27.6
1925	31.5	40.1	28.4
1930	30.5	37.4	32.1
1935	29.9	38.2	31.9
1950	24.3	42.1	33.6
1973	7.2	47.3	45.5
1990	3.4	39.7	56.9

Notes: * Former West Germany for the period after 1950.
Sources: Derived from Broadberry (1997b; 1997c; 1998).

TABLE 4: Comparative labour productivity levels by sector: output per hour worked (UK=100)

	1990	1995	2001
United States			
Total Economy	***138.4***	***124.4***	***123.9***
Agriculture	162.3	137.8	187.4
Industry	151.9	133.2	130.3
Services	133.1	121.4	120.6
Market services[2]	*149.9*	*136.3*	*139.0*
Market Economy[3]	*148.8*	*134.0*	*136.9*
Germany[1]			
Total Economy	***123.5***	***118.7***	***117.0***
Agriculture	37.4	39.6	46.9
Industry	126.1	105.0	103.8
Services	126.9	127.7	122.7
Market services[2]	*145.5*	*141.1*	*131.1*
Market Economy[3]	*134.8*	*124.8*	*121.2*
France			
Total Economy	***139.1***	***128.0***	***122.3***
Agriculture	61.0	71.5	78.0
Industry	133.9	120.1	119.9
Services	152.2	137.7	127.2
Market services[2]	*169.8*	*145.8*	*126.2*
Market Economy[3]	*142.6*	*129.3*	*120.7*

Source: Updated estimates from O'Mahony and de Boer (2002).
Notes: 1. Unified Germany; 2: transport, communications, distribution, hotels & catering, financial & business services and personal services. 3. Total economy excluding, health, education, public administration and real estate.

TABLE 5: Comparative total factor productivity levels by sector, 1869/71 to 1990 (UK=100)

A. US/UK

	Agriculture	Industry	Services	Aggregate economy
1869/71	99.5	154.2	86.5	95.2
1889/91	123.0	139.6	64.3	83.3
1909/11	118.7	150.9	71.6	90.5
1919/20	133.1	158.3	92.1	108.2
1929	118.0	187.8	92.0	112.7
1937	119.2	161.2	89.1	105.9
1950	132.6	217.6	110.2	138.1
1973	125.9	202.2	120.6	137.4
1990	138.8	157.3	119.8	125.3

B. Germany*/UK

	Agriculture	Industry	Services	Aggregate economy
1871	58.4	90.5	67.2	61.6
1891	59.8	91.6	65.5	63.2
1911	71.6	106.1	76.4	75.4
1925	57.0	92.9	83.6	74.3
1929	59.3	96.0	90.0	78.5
1935	59.6	97.1	88.8	78.2
1950	44.7	89.4	89.3	76.2
1973	48.1	105.7	127.6	108.6
1990	65.4	98.5	139.0	116.5

Notes: * Former West Germany for the period after 1950.
Sources: Derived from Broadberry (1997b; 1997c; 1998).

TABLE 6: Educational enrolment rates per 1000 population under age 20, 1870-1990

A. Britain

	Primary	Secondary	Higher
1871	118.6		
1881	238.4		
1891	285.8		
1901	344.7		1.6
1911	374.1	11.1	
1921	371.8	24.1	3.8
1931	380.6	31.7	
1938	357.1	37.1	4.8
1951	323.1	164.4	8.7
1961	299.8	233.2	13.9
1971	337.4	258.0	26.0
1981	327.4	327.4	30.5
1991	333.1	279.1	46.8

B. United States

	Primary	Secondary	Higher
1870	390.6	4.2	
1880	404.5	4.6	
1890	492.5	10.3	
1900	478.9	18.7	
1910	475.6	26.8	
1920	472.9	56.1	15.8
1930	479.2	99.6	23.1
1938	472.2	147.1	29.8
1950	409.6	125.2	52.0
1960	436.6	138.6	62.5
1970	443.0	187.4	111.5
1980	389.0	248.7	167.0
1990	434.1	213.3	191.1

C. Germany*

	Primary	Secondary	Higher
1871	364.7	9.5	0.8
1880	362.4	9.6	1.0
1890	365.5	10.1	1.3
1900	372.1	10.6	1.8
1911	372.4	10.9	2.3
1925	291.2	35.4	4.0
1933	383.2	38.3	6.4
1939	345.6	34.5	2.6
1950	410.6	52.3	6.9
1960	332.9	73.9	12.5
1970	368.2	123.1	19.7
1980	332.0	226.9	60.7
1990	286.6	191.4	99.8

Notes: * Former West Germany for the period after 1950.
Sources: Broadberry (2003; 2004a).

TABLE 7: Apprentices as a % of persons engaged in Great Britain, Germany and the United States, 1895-1991

A. Great Britain

	Agriculture	Industry	Services	Whole economy
1906		4.19	0.65	2.48
1925		5.02	0.50	2.54
1951	0.17	3.22	0.59	1.87
1961	1.41	4.61	2.69	3.56
1966	1.34	5.08	3.18	4.01
1971	1.11	4.05	2.74	3.28
1981	0.56	3.67	1.98	2.58

B. Germany*

	Agriculture	Industry	Services	Whole economy
1895		7.67	1.60	2.99
1907		6.38	1.60	2.87
1925		7.64	0.40	3.18
1933		6.48	0.48	2.28
1950	0.50	7.87	3.89	4.75
1957	0.73	6.95	6.33	5.70
1962	0.77	4.78	5.65	4.62
1969	1.60	4.99	5.50	4.89
1980	3.47	7.94	5.29	6.34
1988	3.89	7.39	5.31	6.08

C. United States

	Agriculture	Industry	Services	Whole economy
1880		0.95	0.07	0.25
1900		0.87	0.06	0.28
1920		0.91	0.06	0.34
1930		0.56	0.03	0.19
1940		0.47	0.02	0.16
1952		0.74	0.03	0.26
1960		0.72		0.24
1970		0.98		0.31
1975		1.00		0.29
1991		0.84		0.20

Notes: * Former west Germany for the period after 1950.
Source: Broadberry (2003: 112).

TABLE 8: Professionals in Britain, the United States and Germany, 1880-1991

A. Higher professionals in Great Britain, 1881-1991 (thousands)

	1881	1911	1931	1951	1971	1991
Church	38	44	48	49	41	34
Medicine	21	35	46	62	80	115
Law	20	26	23	27	39	82
Engineering	24	24	51	138	343	542
Writing	7	15	21	26	51	79
Armed Forces	8	14	16	46	40	34
Accounting	13	11	16	37	127	171
Science	1	7	20	49	95	114
Total	132	176	240	434	816	1,173

B: Higher and lower professions as a % of total employment in Great Britain, the United States and Germany, circa 1880 to 1950 (%)

	1880	1890	1900	1910	1920	1930	1950
Great Britain	3.6	3.7	4.0	4.1	4.3	4.4	6.1
United States	3.1	3.7	4.0	4.4	5.0	6.1	7.5
Germany			2.6	2.8	2.6	3.0	3.5

Sources: Broadberry (2003: 116).

Table 9: Skill proportions of the workforce, aggregate economy, 1979-2000 (%)

	US	UK	France	Germany
1979				
Higher	18.7	8.3	5.6	4.2
Intermediate	17.4	28.2	54.9	61.2
Low	63.9	63.5	39.5	34.6
1989				
Higher	23.7	10.8	8.2	6.0
Intermediate	21.4	35.3	61.1	67.0
Low	54.9	53.9	30.7	27.0
2000				
Higher	27.6	18.6	11.7	8.2
Intermediate	25.3	37.0	67.3	71.7
Low	47.1	44.4	21.0	20.1

Source: O'Mahony et al. (2004).

TABLE 10: Growth of output and labour productivity in Britain and the contributions of labour quality, capital deepening and TFP, 1873-1973 (percentage points per annum)

	1873-1913	1913-1924	1924-1937	1937-1951	1951-1973	1973-1989	1989-2000
Output	1.8	-0.1	2.2	1.8	2.8	1.8	2.8
Hours worked	0.9	-2.3	1.5	0.1	-0.5	0.1	-0.5
Output per hour	**0.9**	**2.2**	**0.7**	**1.7**	**3.3**	**1.7**	**3.3**
Contributions of:							
Labour quality	0.5	1.2	0.4	0.7	0.5	0.7	0.5
Capital per hour	0.4	1.2	0.1	0.3	1.0	0.3	1.0
TFP	0.0	-0.2	0.2	0.7	1.8	0.7	1.8

Sources and notes: 1873-1973: Derived from Matthews et al. (1982: 208, 501); 1973-2000: Derived from the data in O'Mahony and van Ark (2003), backdated to 1973 using data in O'Mahony (1999).

TABLE 11: Contributions of labour quality, capital intensity and TFP to Britain's labour productivity gap, 1910-1973 (percentage points)

A. US/UK

	Labour quality	Capital intensity	TFP	Total labour productivity gap
1910	-1.9	30.1	10.5	17.7
1929	0.6	23.6	15.2	39.4
1950	0.3	20.9	45.7	66.9
1973	1.9	10.8	39.6	52.3

B. Germany/UK

	Labour quality	Capital intensity	TFP	Total labour productivity gap
1910	-0.1	0.2	-24.6	-24.5
1929	-0.6	-5.6	-19.7	-25.9
1950	-0.6	-2.6	-22.6	-25.6
1973	9.5	5.4	-0.9	14.0

Source: Broadberry (2003: 125-126).

TABLE 12: Decomposition of comparative labour productivity levels, 2000

	US/UK	Germany/UK	France/UK
Total Economy			
Total Labour Productivity gap	24.3	16.8	20.7
Percentage contribution to comparative labour productivity:			
Labour quality	0.4	3.7	3.6
Physical capital	12.6	11.7	17.1
TFP	11.3	1.4	-0.2

Source: Own calculations employing data underlying O'Mahony and de Boer (2002) and O'Mahony and van Ark (2003).

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