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Stephen Broadberry, Kyoji Fukao & Nick Zammit

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HOW DID JAPAN CATCH-UP ON THE WEST? A SECTORAL ANALYSIS OF ANGLO-JAPANESE PRODUCTIVITY DIFFERENCES, 1885-2000

Stephen Broadberry, London School of Economics, S.N.Broadberry@lse.ac.uk
Kyoji Fukao, Hitotsubashi University, k.fukao@srv.cc.hit-u.ac.jp
Nick Zammit, University of Warwick, N.Zammit@warwick.ac.uk

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Abstract: Although Japanese economic growth after the Meiji Restoration is often characterised as a gradual process of trend acceleration, comparison with the United States suggests that catching-up only really started after 1950, due to the unusually dynamic performance of the US economy before 1950. A comparison with the United Kingdom, still the world productivity leader in 1868, reveals an earlier period of Japanese catching up between the 1890s and the 1920s, with a pause between the 1920s and the 1940s. Furthermore, this earlier process of catching up was driven by the dynamic productivity performance of Japanese manufacturing, which is also obscured by a comparison with the United States. Japan overtook the UK as a major exporter of manufactured goods not simply by catching-up in labour productivity terms, but by holding the growth of real wages below the growth of labour productivity so as to enjoy a unit labour cost advantage. Accounting for levels differences in labour productivity between Japan and the United Kingdom reveals an important role for capital in the catching-up process, casting doubt on the characterisation of Japan as following a distinctive Asian path of labour intensive industrialisation.

JEL classification: N10, N30, O47, O57

Key words: Labour productivity, sectoral disaggregation, international comparison,

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I. INTRODUCTION

Much of the literature on Japanese economic growth treats the Meiji restoration of 1868 as a key institutional change, ushering in a period of modern economic growth which has lasted to the present. The story of Japan's economic success in the post-World War II period is thus traced back to foundations laid in earlier periods, with Ohkawa and Rosovsky (1973) identifying a gradual process of "trend acceleration in the twentieth century". However, taking an international comparative perspective, there is much less evidence of continuity between the pre-World War II and post-World War II periods, particularly if attention is focused on Japan's position vis à vis the United States. Maddison's (2009) estimates of GDP per capita in Japan as a percentage of the US level for the period 1871-2007 are provided in Table 1. Pilat (1994: 17-18) notes that Japan failed to catch up on the United States between 1870 and 1929, and although the Great Depression had a more adverse effect on the United States than on Japan, the catastrophic effects of World War II on Japan meant that by 1950, the latter was further behind than in 1870. If the international comparative framework is centred on the United States, then, the process of Japanese catching-up only really began in the post-World War II period.

This apparent disjuncture between the Japan-centred and international comparative frameworks largely disappears, however, if the international comparison is centred on the United Kingdom rather than the United States, as can be seen in Table 1. The pattern of US economic growth between 1870 and 1950 was wholly exceptional, with the United States at first catching-up on the United Kingdom during the late nineteenth century, then forging ahead during the first half of the twentieth century, but with a major interruption to the process during the Great Depression of

the 1930s, when the UK briefly regained per capita income leadership. Compared with the United Kingdom, the per capita income leader during the late nineteenth century, we see that the process of Japanese catching-up began in the late nineteenth century and continued until after World War I. There was then a period between 1920 and 1950 when the process of catching-up first stalled and then went into reverse. Catching-up growth resumed between 1950 and 1990, followed by another period of reversal which has lasted to the present.

The comparison with the United Kingdom brings out a number of important features of Japanese economic growth which are obscured in the comparison centred on the United States. First, the process of Japanese catching-up began in the late nineteenth century rather than the second half of the twentieth century. But second, a short-lived period of Japanese catching up with the United States during the 1930s is seen to have resulted from the adverse effects of the Great Depression on the latter, since Japan did not catch-up with the United Kingdom during this period. Third, a sectoral analysis of comparative productivity performance clearly highlights industry as the key sector in Japanese catching-up, something which is again obscured in a comparison with the United States, particularly during the pre-World War II period. Fourth, an analysis of comparative unit labour costs reveals that Japan overtook the United Kingdom as an exporter of manufactured goods not simply through catching-up in labour productivity, but through holding down real wage growth so as to enjoy a unit labour cost advantage. Fifth, a levels accounting exercise reveals an important role for capital in Japan's catching-up, which casts doubt on the idea of Japan following a distinctive Asian path of labour-intensive industrialisation.

The paper proceeds as follows. Section II sets out the basic data sources and methods, analysing the time series evidence on growth rates in Japan and the United Kingdom and showing how to combine this with the cross-sectional evidence on comparative levels of income and productivity calculated at purchasing power parity (PPP). The results of the sectoral productivity comparison and the differences in the sectoral distribution of the labour force are then presented in section III, while section IV considers ways of cross-checking the results. Section V relates Japan's success in exporting manufactured goods to holding down the growth of real wages below the growth of labour productivity in manufacturing so as to maintain a unit labour cost advantage. Section VI considers the role of capital in Japanese catching-up, while section VII concludes.

II. DATA AND METHODS FOR ANGLO-JAPANESE PRODUCTIVITY COMPARISONS

1. Japanese time series

Many of the historical data series underlying our estimates of output and employment in Japan have been conveniently pulled together in the multi-volume *Estimates of Long-Term Economic Statistics of Japan Since 1868*, edited by Kazushi Ohkawa, Miyohei Shinohara and Mataji Umemura. In particular, we have drawn heavily on the volumes on national income and manpower (Ohkawa *et al*., 1974; Umemura *et al*., 1988), supplemented with additional information from Ohkawa and Rosovsky (1973), Pilat (1994), and the *Historical Statistics of Japan* produced by the Japanese Statistics Bureau. Data for recent years are taken from the *Annual Report on National Accounts*. In the case of employment data for the period of 1885-1940, we used new estimates of Fukao et al. (2014). Using results of Saito and Settsu (2007), they revised by-

employment data of the LTES. Table A1 in the Appendix presents the output, employment and labour productivity data for the whole economy and for the five main sectors, agriculture, mining and manufacturing, construction, facilitating industry and commerce-services, together with a detailed listing of sources. It should be noted that agriculture includes forestry and fishing as well as farming, facilitating industry combines transport and communications with gas, electricity and water, and commerce-services includes distribution, finance, government and other services. Japan's boundaries have remained almost hanged throughout the period.

The output and employment data from the Appendix can be used to calculate indices of labour productivity by major sector. From these indices it is possible to calculate the average annual growth rates of labour productivity by sector, which are presented here in Table 2. From the late nineteenth century until the end of World War I, a fairly rapid overall labour productivity growth rate was driven by mining/manufacturing and facilitating industry as Japan embarked on a process of modernisation following the Meiji restoration. The period between the end of World War I and the end of World War II was characterised by much slower labour productivity growth in all sectors apart from construction. Japan returned to rapid labour productivity growth between 1950 and 1990, this time with truly spectacular performance in mining/manufacturing and facilitating industry during the 1950s and 1960s. The fading miracle of the 1970s and 1980s was followed by a period of much slower labour productivity growth after 1990, but with mining/manufacturing continuing to record the fastest labour productivity growth.

We would emphasise the following three points from this preliminary analysis of labour productivity growth in Japan. First, the fastest growth occurred in mining/manufacturing and facilitating industry. Second, labour productivity grew more slowly in agriculture than in the economy as a whole throughout the period 1891-1973. Since agriculture still accounted for almost half of Japanese employment as late as 1950, this sector can be seen as acting as a major drag on the economy until very recently. Third, labour productivity growth in Japan can best be characterised as following a U-shaped pattern, with an initial growth spurt before 1920 followed by slower growth between 1920 and 1950, before the dramatic postwar episode of catching up. Ohkawa and Rosovsky's (1973) attempt to describe Japanese growth as a process of continuous trend acceleration, based on an analysis of output rather than per capita income or productivity, and dependent on a careful choice of benchmark years, seems to us to obscure as much as it illuminates.

2. UK time series

The UK time series are taken largely from the historical national accounts of Feinstein (1972), updates with output estimates from the *UK National Accounts* and employment data from O'Mahony (1999) and the EU KLEMS database (O'Mahony and Timmer, 2009). Again, the series are presented in the Appendix, together with full details of the data sources. The territory covered refers to the United Kingdom of Great Britain and the whole of Ireland before 1920, but Great Britain and Northern Ireland after 1920. In contrast to Broadberry (1998), where the output and employment data were both spliced at 1920, following the procedures of Maddison (1995) to provide continuous series within the current boundaries of the United Kingdom, in this study both the output and employment series change with the

secession of Southern Ireland. This is more in keeping with the approach to boundary changes adopted by Maddison (2003) for his later work on non-European countries such as India, and by Broadberry and Klein (2012) for Europe, although it does not make a lot of difference for the UK case. As in the Japanese case, the output and employment series can be combined to derive indices of labour productivity, from which the labour productivity growth rates shown in Table 2 are calculated. A stronger case could be made for trend acceleration of labour productivity growth in the period to 1973 for the United Kingdom than for Japan.

UK labour productivity growth before 1920 was fastest in facilitating industry and slowest in agriculture and construction. The period 1920-1950 saw an increase in the labour productivity growth rate in all sectors apart from commerce-services, which exhibited a decline in productivity. After World War II, rapid labour productivity growth continued in agriculture, mining/manufacturing and facilitating industry.

Having examined labour productivity growth in each country in isolation, we can now put the two together to shed light on the patterns of differential labour productivity growth performance in part C of Table 2. A positive number here indicates that Japan was catching-up, while a negative number indicates falling behind. The first conclusion, which can be gleaned from the final column, is thus that Japan was catching up on the United Kingdom before 1920 and again between 1950 and 1990, but the process stalled between 1920 and 1950 and went decisively into reverse after 1990. The second conclusion is that the periods of rapid Japanese catching-up were driven largely by developments in mining/manufacturing and

facilitating industry, although commerce-services played an important role during the period 1973-1990. By and large, then, Japan fits the stereotypical Asian pattern of manufacturing-led catching-up, in contrast to the exceptional case of service-led development in India (Broadberry and Gupta, 2010).

3. A benchmark for 1997

The labour productivity data for Japan and the United Kingdom from the Appendix can be combined to provide trends in comparative labour productivity for each sector in index number form. To pin down the comparative labour productivity level, we use a benchmark for 1997, presented in Table 3 and derived from the EU KLEMS database (O'Mahony and Timmer, 2009). The benchmark is estimated from data on nominal value added per person engaged in each country, compared at sector-specific price ratios, adjusted for purchasing power parity (PPP). This is necessary because the exchange rate cannot be assumed to be a perfect guide to difference in prices between two countries, especially at the level of individual goods and services, or particular sectors. For example, a country with a comparative advantage in agriculture may expect to have relatively cheap food, while a country with a comparative advantage in manufacturing may expect to have relatively cheap industrial goods, although we may expect the effects of trade to moderate such tendencies.

Note that the overall PPP in 1997 was £1 = 326.3 yen, at a time when the exchange rate was £1=198.1 yen, suggesting a significantly overvalued Japanese yen. Note also that the scale of the deviation from PPP was dramatically higher in agriculture and correspondingly lower in mining and manufacturing, consistent with most assessments of Japan's comparative advantage, with manufactured goods

relatively cheap and foodstuffs relatively expensive. Labour productivity was particularly low in Japanese agriculture, consistent with the findings of other international comparative studies (Pilat, 1994; O'Mahony, 1999)

III. SECTORAL ASPECTS OF PRODUCTIVITY PERFORMANCE

1. Comparative labour productivity levels by sector

Table 4 provides a breakdown of Japan/UK comparative labour productivity levels by sector. The first point to note is that the sector which most closely mirrors the comparative labour productivity performance of the economy as a whole is mining and manufacturing. Second, comparative labour productivity performance in construction and in facilitating industry exhibits a pattern of long cycles with high amplitude, suggestive of inverse swings in infrastructure investment in the two countries. Third, Japanese agriculture has moved from an above average comparative labour productivity performance before World War I to a dramatically worse than average performance since World War II. Fourth, although Japanese commerce-services failed to improve their comparative labour productivity performance before World War II, their position has improved more or less in line with the economy as a whole since 1950.

It is worth contrasting these findings with those of Pilat's (1994) Japan/US comparative study. Although Pilat (1994: 130) found that manufacturing played an important role in Japanese catching-up on the United States after World War II, his findings for the pre-World War II period suggested a much less important role for manufacturing. Indeed, any prewar catching-up in mining and manufacturing was largely confined to the 1930s, when the Great Depression hit the United States much

harder than Japan. Agriculture also showed no catching up compared with the United States before World War II, so to the extent that catching up occurred between the 1880s and the 1930s, it was largely confined to other sectors, comprising construction, facilitating industry and commerce-services. However, care must be taken in interpreting these findings, because of the unusual experience of the United States, which was itself catching-up on the United Kingdom in the late nineteenth century and forging ahead during the first half of the twentieth. Measured against Britain and other European economies, Japan experienced a strong phase of catching up between the 1880s and the early 1920s, driven by developments in manufacturing. This helped to lay the foundations of the post-1950 catching-up growth. The interlude between the 1920s and 1950, when Japanese catching-up stalled, is also obscured by the comparison with the United States, due to the uniquely severe effects of the Great Depression on the latter country.

The important role played by industry in Japanese catching-up can be seen most clearly in Figure 1, which shows how Japan/UK comparative labour productivity at the whole economy level moved broadly in line with comparative productivity in manufacturing and mining.

2. The structure of economic activity

To fully understand the contributions of the five main sectors to comparative productivity performance, it is necessary to track their shares in economic activity as well as their comparative productivity levels. Table 5 shows the percentage distribution of employment by major sectors for selected years. The sectoral composition of economic activity was clearly very different in the two countries for

much of the period. Compared even with other developed economies, Britain already by the late nineteenth century devoted a very small share of the labour force to agriculture. Thus, for example, while both Germany and the United States had approximately 43 per cent of the labour force tied up in agriculture in 1891, the figure was under 16 per cent in the United Kingdom (Lebergott, 1966: 119; Hoffmann, 1965: 205; Feinstein, 1972: T131). For Japan, the agricultural share of the labour force was almost 65 per cent in 1891, and was still nearly 50 per cent as late as 1950. Although these figures are somewhat lower than those suggested by Ohkawa (1957: 245), who made no allowance for the by-employment of agricultural workers in the industrial sector, this still represents a very high commitment of resources to an inherently low value added sector, a point recently emphasised by Hayashi and Prescott (2008). Combined with the slower productivity growth in agriculture compared with the whole economy before the 1990s, this meant that agriculture held back Japanese economic growth for much of the period since the Meiji Restoration.

A second striking finding from Table 5 is that despite the fact that Japan currently has a much larger share of its labour force employed in mining and manufacturing than Britain, at its industrial peak between the wars Britain had a much larger share of its labour force in mining and manufacturing. A third point to note from Table 5 is that the commerce-services sector has seen the fastest growth of employment in both countries, but the growth has been much more dramatic in Japan than in Britain.

IV. CROSS-CHECKING THE RESULTS

A number of recent studies have questioned the use of time series projections from a single benchmark over long periods of time, the methodology used here in Table 4. Ward and Devereux (2003) suggest that the further one projects from the original benchmark, the bigger the discrepancy between time series projections using GDP per head in constant prices and cross-sectional benchmarks based on nominal GDP per head converted at PPPs, because of index number problems. The issue is the subject of debate between Broadberry (2003) and Ward and Devereux (2004). In fact, however, Broadberry (1993) had already suggested the use of additional benchmarks to provide cross-checks in a study of comparative productivity in manufacturing, while Broadberry (1997a; 1997b; 1998; 2006) applied the method to full sectoral productivity comparisons over the period 1870-1990 for the United Kingdom with the United States and Germany, and found broad agreement between the benchmarks and time series evidence for those countries. Broadberry and Irwin (2006; 2007) find similar agreement between time series projections and benchmarks for the United Kingdom compared with the United States in the nineteenth century and the United Kingdom compared with Australia over the period 1861-1948. More recently, Broadberry and Gupta (2010) have applied the same methodology to an Anglo-Indian comparison between 1870 and 2000.

To provide a cross-check on our time series projections from 1997, we would ideally like to estimate a second benchmark for a pre-war year such as 1935. To do this, we need to estimate a set of sectoral PPPs. Table 6 provides a PPP for manufacturing industry in 1935, based on factory gate prices derived from production

census sources.[1] The overall PPP for manufacturing in 1935 was £1 = 12.46 yen, at a time when the market exchange rate was £1 = 17.14 yen (Kinyu Kenkyukai, 1937). The industrial price level was thus substantially cheaper in Japan than in the United Kingdom. However, it has not been possible to apply this methodology to agriculture because of the extremely different structures of the agricultural sector in the two countries, with Japanese agriculture dominated by rice, which was not grown in the UK at all, and with UK farming dominated by the production of livestock products such as meat and dairy produce, which were much less widely produced or consumed in Japan. We have therefore chosen to construct a PPP for the whole economy based on consumer prices and expenditure weights, as in Fukao *et al.* (2007). The results suggest an expenditure PPP of £1 = 7.23 yen, consistent with a substantially lower Japanese price level overall than in industry. The low overall price level in Japan can be explained partly by the low prices for the basic foodstuffs consumed by the Japanese, including rice, fish and vegetables, but also by the low cost of many labour-intensive services as a result of low wages in Japan.

Table 8 then uses these PPPs to calculate comparative Japan/UK GDP per employee levels for the whole economy and for manufacturing and mining in 1935, as a cross-check on the time series projections in Table 4. Nominal GDP and employment data are obtained from the standard historical national accounting sources for the two countries (Feinstein, 1972; Ohkawa, 1957; Ohkawa *et al.*, 1971). These are then compared using the PPPs from Tables 6 and 7. For the economy as a

[1] Value added weights are available for the six main manufacturing sectors, but within each sector it is necessary to aggregate using gross output weights. This procedure has been used widely since the work of Paige and Bombach (1959), although value added weights are normally available at a lower level of aggregation. Although Fremdling et al. (2007) compared British and German manufacturing productivity in the mid-1930s using double deflated value added, it made almost no difference at the level of total manufacturing.

whole, the comparative benchmark obtained in this way in Table 8 suggests Japanese labour productivity at 35.7 per cent of the UK level, which is very close to the time series projection in Table 4 of 34.8 per cent. For industry, the comparative benchmark suggests that Japanese labour productivity was 41.4 per cent of the UK level, which is a bit further away from the 33.5 per cent suggested by the time series projection in Table 4. However, the time series projection is much closer to Broadberry's (1997c: 57) benchmark for manufacturing alone of 35.4 per cent. Given the enormously rapid growth and the dramatic structural change exhibited by the Japanese economy between 1935 and 1997, it would be unrealistic to expect a closer degree of agreement between the benchmarks and time series projections.

V. COMPETITIVE ADVANTAGE IN INDUSTRY

Industrial labour productivity was substantially lower in Japan than in Britain before the 1970s. However, Japan managed to achieve success in export markets despite this productivity gap because the gap in own product real wages was even larger. Here, we follow Broadberry and Burhop (2010) in calculating comparative unit labour costs in industry. Table 9 provides data on industrial wages and producer prices for both countries, indexed on 1935 for the pre-World War II period and 1997 for the post-World War II period, since the extent of inflation in Japan across World War II makes it difficult to use a single index. The own product real wage clearly grew more rapidly in Japan than in the United Kingdom both before and after World War II.

Part A of Table 10 combines the prewar industrial real wage data from Table 9 with the productivity data for manufacturing and mining from Table 4 to estimate comparative unit labour costs. The comparative own product real wage in index

number form in the third column, based on 1935=100, is converted to a UK=100 basis using a benchmark estimate of comparative own product real wages for 1935. The average Japanese industrial wage of 375 yen is 22.34 per cent of the average UK industrial wage of £134.71 when converted at the PPP of £1 = 12.46 yen from Table 6. Projecting back to 1901, Japan's real wage was just 14.4 per cent of the UK level. At this stage, Japan was still not competitive because labour productivity was just 13.0 per cent of the UK level. However, by the 1920s, Japan had slightly lower unit labour costs than Britain because labour productivity was growing faster in Japan than in Britain, while real wages were growing more slowly. Japan's unit labour costs became substantially lower during the 1930s, when the Japanese cotton textile industry, in particular, posed a major threat in Britain's main export markets (Broadberry and Marrison, 2002).

Part B of Table 10 takes the story into the postwar period. The indices of comparative real wages based on 1997=100 in the third column is converted to a UK=100 basis using a benchmark estimate of comparative own product real wages for 1997. The average Japanese industrial wage of 5,298,942 yen is 85.2 per cent of the average UK industrial wage of £23,922.26 when converted at the PPP of £1 = 259.9 yen from Table 3. Although labour productivity was substantially lower in Japan than in the UK in the early postwar period, wages were lower by a greater margin, so that Japan had substantially lower unit labour costs. By the 1970s, however, the growth of real wages in Japan was outpacing the growth of labour productivity, so that Japan lost its unit labour cost advantage. Faster real wage growth in the UK during the 1990s and 2000s has allowed Japan to regain a unit labour cost advantage.

Figure 2 shows the levels of comparative unit labour costs from Table 10 on a continuous basis. Note that it makes little difference whether comparative unit labour costs are projected backwards from the 1997 benchmark or forwards from the 1935 benchmark. The trends and levels can be related to the shares of world exports in manufacturing shown in Table 11. The high share of the UK in the 1880s reflects the fact that the first industrial revolution occurred in Britain, and this share was bound to shrink as other countries industrialised. The low share of Japan in the nineteenth century reflects both the low level of development and the lack of openness to trade before the Meiji Restoration. Britain lost out not just to Japan during the pre-World War II period, but also to the United States and Germany (Broadberry and Burhop, 2010). Between the early 1950s and 1973, Japan continued to gain world market share while UK market share declined, as unit labour costs remained lower in Japan. However, between 1973 and 1979 unit labour costs became higher in Japan and the process of gaining world market share stalled. Although unit labour costs in Japan have again fallen below those in the UK, this has not prevented a decline in Japanese world market share, as lower wage economies such as China have dramatically improved their competitive position in world markets.

VI. THE ROLE OF CAPITAL

In this section, we investigate the role of capital in Japan's catching-up. This is of particular interest because of suggestions in the literature that Japan followed a distinctive Asian path of labour intensive industrialisation. The idea can be traced back to the work of Hayami (1967) who coined the phrase "industrious revolution" to describe Japanese growth before the Meiji Restoration. Hayami and Tsubouchi(1989)

generalised the idea to an East Asian industrious revolution, based on rice cultivation, which was seen as the basis of an alternative to western capital-intensive industrialisation. This idea has been emphasised recently in the work of Sugihara (2007). However, the phrase "industrious revolution" has also been applied by de Vries (1994) to growth in Europe before the "industrial revolution", which suggests that rather than being a distinctive Asian path of labour intensive industrialisation, it may simply reflect appropriate factor proportions given relative factor prices at low levels of per capita GDP. This latter interpretation would be strengthened to the extent that Japan's post-1868 catching-up on the West was accompanied by convergence in levels of capital intensity.

The data for the gross capital stock (excluding dwellings) at constant prices and the share of capital in income at current prices are presented in Appendix Table A3. Over the whole period, they are not available broken down by sector, and are therefore presented at the level of the aggregate economy. Table 12 shows how Japan caught up with the UK in terms of capital intensity as well as labour productivity. During the late nineteenth century, Japan's capital per employee was around 15 per cent of the UK level, but had reached about one-third of the UK level by the mid-twentieth century. By 1979, capital per employee was higher in Japan than in the United Kingdom. Table 12 also shows the implications of this for comparative total factor productivity (TFP). Because capital intensity was so much lower in Japan than in the UK in 1891, this explains some of the labour productivity gap between the two nations, so that comparative TFP was higher than comparative labour productivity. By 1979, when Japan had caught up in terms of capital intensity, comparative TFP was about the same as comparative labour productivity.

Table 13 examines the role of capital intensity in Japanese catching-up in another way by utilising the growth accounting identity:

$$g_{Y/L} = \alpha g_{K/L} + g_{TFP} \quad (1)$$

where $g_{Y/L}$ is the growth rate of output per employee, $g_{K/L}$ is the growth rate of capital per employee, g_{TFP} is the growth rate of total factor productivity and α is the share of capital in income. Labour productivity growth can be decomposed into the parts due to capital deepening ($\alpha g_{K/L}$) and improving efficiency (g_{TFP}). Capital deepening played an important role in explaining labour productivity growth in both countries, but in Japan, the contribution of capital deepening exceeded the contribution of improving efficiency in three of the five periods. Part C of Table 13 analyses the catching-up process by subtracting UK growth rates from Japanese growth rates. The second and third columns therefore reveal the contributions of differential rates of capital deepening and TFP growth to Japanese catching–up. Capital deepening made a larger contribution than TFP growth in two out of the three periods when Japan was catching up on the UK. Furthermore, in the two periods when Japan was falling behind, capital deepening continued to favour Japanese catching-up. The stalling of Japan's catching-up process has thus been due to problems of efficiency rather than failure to accumulate capital.

These are relatively crude calculations of TFP which do not take account of the quality of the capital stock or the labour force, but such adjustments would be likely to decrease rather than increase the contribution of TFP. The conclusion that the adoption of increasingly capital-intensive production methods helped Japan to catch-up is therefore secure. This is not to suggest that Japan caught-up merely by slavishly

copying the West. Indeed, there is a large literature that emphasises differences in factor proportions amongst western countries, the need to adopt appropriate technology for given factor prices, and the impact on subsequent technical progress (Habakkuk, 1962; David, 1975; Broadberry, 1997; Acemoglu, 2002). Within this framework, Japan can be seen as playing a leading role in the development of modern flexible production technology (Broadberry, 1994; Freeman, 1987; Oliver and Wilkinson, 1988). Nevertheless, it is important to recognise that there are limits to the variation in capital intensity consistent with high living standards, and that Japan would not have caught up without increasing capital intensity to western levels (Allen, 2012).

VII. CONCLUSIONS

Previous quantitative analysis of Japanese catching-up on the West has relied on a comparison with the United States, which tends to underplay the importance of both pre-1950 developments and the exceptional contribution of manufacturing (Pilat, 1994). This paper's focus on the comparison with the United Kingdom brings out a number of important features of Japanese economic growth which are obscured in the comparison centred on the United States. First, the process of Japanese catching-up began in the late nineteenth century, following the institutional changes of the Meiji restoration, rather than in the second half of the twentieth century. This is more in line with the spirit of Ohkawa and Rosovsky's (1973) idea of trend acceleration in Japanese economic growth, emphasising the continuity between the prewar and postwar experience.

Second, a short-lived period of Japanese catching up with the United States during the 1930s is seen to have resulted from the adverse effects of the Great Depression on the latter, since Japan did not catch-up with the United Kingdom during this period. What is widely seen as an unfortunate period in Japanese political history was thus also relatively unsuccessful in economic terms. This is rather less in tune with Ohkawa and Rosovsky's (1973) notion of continuity and trend acceleration, and is perhaps more suggestive of a sustained wrong turning that lasted a generation.

Third, a sectoral analysis of comparative labour productivity performance highlights industry as the key sector in Japanese catching-up, something which is again obscured in a comparison with the United States, particularly during the pre-World War II period. Manufacturing was the driving force behind Japanese catching-up, achieving export success in world markets, with success in cotton textiles during the interwar period prefiguring postwar success in shipbuilding, motor vehicles and consumer electronics. Fourth, an analysis of comparative unit labour costs reveals that Japan overtook the United Kingdom as an exporter of manufactured goods not simply through catching-up in labour productivity, but through holding down real wage growth so as to achieve lower unit labour costs. Fifth, it is shown that capital played an important role in Japanese catching-up, casting doubt on the idea that Japan followed a distinctive Asian path of labour-intensive industrialisation.

TABLE 1: GDP per capita in Japan as a percentage of the United Kingdom and the United States

	Japan/UK	Japan/US
1871	22.3	29.6
1881	23.2	25.8
1891	24.1	27.6
1901	27.1	27.0
1911	28.8	26.9
1920	37.3	30.5
1929	36.8	29.4
1935	36.6	38.8
1950	27.7	20.1
1960	46.1	35.2
1973	95.1	68.5
1979	100.0	70.1
1990	114.4	81.0
1997	112.9	80.3
2007	97.1	73.2

Source: Derived from Maddison (2010).

TABLE 2: Average annual growth rates of output per employee (% per year)

A. Japan

	Agric	Mining/ manuf	Constr.	Facilitating industry	Commerce-Services	GDP
1891-1920	1.85	4.76	2.44	6.97	1.21	2.59
1920-1950	-0.46	1.93	2.68	0.74	0.25	0.91
1950-1973	5.20	9.30	4.73	7.38	3.16	6.65
1973-1990	2.79	3.89	1.21	2.79	2.15	2.79
1990-2007	2.05	3.28	-1.63	1.37	0.76	1.29

B. United Kingdom

	Agric	Mining/ manuf	Constr.	Facilitating industry	Commerce-Services	GDP
1891-1920	0.05	0.39	0.23	0.62	0.36	0.46
1920-1950	2.68	2.11	1.34	2.09	-0.12	1.14
1950-1973	5.34	2.87	1.28	3.89	1.21	2.27
1973-1990	3.40	3.43	0.86	2.60	0.46	1.73
1990-2007	2.22	3.31	1.32	4.46	1.48	2.08

C. Japan – United Kingdom

	Agric	Mining/ manuf	Constr.	Facilitating industry	Commerce-Services	GDP
1891-1920	1.79	4.37	2.21	6.35	0.85	2.13
1920-1950	-3.14	-0.18	1.33	-1.35	0.36	-0.23
1950-1973	-0.14	6.44	3.45	3.49	1.95	4.38
1973-1990	-0.62	0.46	0.35	0.19	1.69	1.06
1990-2007	-0.16	-0.03	-2.96	-3.08	-0.71	-0.79

Source: Derived from Appendix Tables A1, A2.

TABLE 3: Comparative Japan/UK GDP per employee by sector, 1997

	Agric	Mining/ Manuf	Constr.	Facilitating industry	Commerce-services	GDP
Japan (000 yen)	1992.0	8575.5	5812.8	10920.6	7825.7	7580.6
UK (£ 000)	18.7	37.0	22.2	42.4	23.6	26.8
PPP (yen per £)	723.0	259.9	282.6	320.6	347.5	326.2
Japan/UK (UK=100)	14.7	89.3	92.7	80.4	95.5	86.7

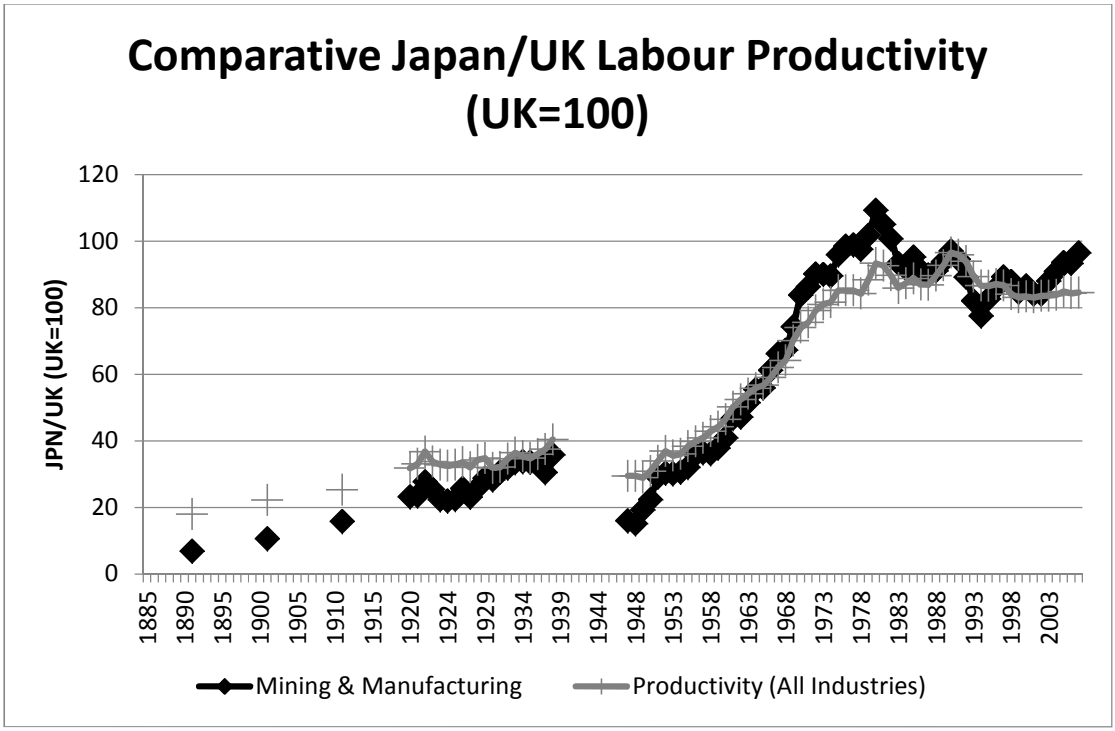
Sources and notes: Derived from EU KLEMS database (O'Mahony and Timmer, 2009). The market exchange rate for 1997 was £1 = 198.1 yen.

TABLE 4: Comparative Japan/UK labour productivity by sector (UK=100)

	Agriculture, forestry & fisheries	Mining & manuf	Construction	Facilitating industry	Commerce-Services	GDP
1891	24.6	6.8	24.4	12.7	34.1	18.0
1901	29.6	10.6	27.4	31.2	39.8	22.2
1911	31.6	15.7	44.0	59.1	39.3	25.3
1920	41.2	23.5	45.9	74.7	43.5	33.1
1929	29.6	28.8	34.6	104.3	43.0	34.8
1935	26.2	33.5	57.2	109.5	35.3	34.8
1950	16.3	22.3	68.0	50.2	48.5	30.9
1960	19.8	40.9	98.9	82.2	47.5	46.5
1973	15.8	90.0	146.9	107.3	75.2	81.0
1979	13.7	101.7	155.9	105.9	82.3	88.4
1990	14.3	97.1	155.9	110.7	99.8	96.5
1997	14.7	89.3	92.7	80.4	95.5	86.7
2007	13.9	96.5	94.2	66.5	88.6	84.6

Source: Derived from the benchmark in Table 3 and the time series in Appendix Tables A1 and A2.

FIGURE 1: Comparative Japan/UK labour productivity (UK=100)



Sources: See Table 4.

TABLE 5: Labour force by sector (%)

A. Japan

	Agric	Mining/ manuf	Constr.	Facilitating industry	Commerce-Services	GDP
1891	63.8	15.2	2.7	2.4	16.0	100.0
1920	53.0	18.1	2.9	4.5	21.5	100.0
1950	47.1	16.8	4.4	5.6	26.1	100.0
1973	15.1	24.7	8.8	7.6	43.9	100.0
1990	8.1	21.7	9.1	7.2	53.9	100.0
2007	4.7	15.9	7.8	7.4	64.2	100.0

B. United Kingdom

	Agric	Mining/ manuf	Constr.	Facilitating industry	Commerce-Services	GDP
1891	15.8	38.2	5.0	7.0	34.0	100.0
1920	8.6	42.0	4.6	9.0	35.8	100.0
1950	5.1	38.6	6.3	9.4	40.5	100.0
1973	2.5	34.6	7.7	7.8	47.4	100.0
1990	2.0	21.6	8.4	7.2	60.8	100.0
2007	1.4	12.4	7.5	6.9	71.9	100.0

Sources: See Appendix Tables A1 and A2.

TABLE 6: A Japan/UK PPP for industry, 1935 (yen per £)

	PPP (yen per £)	Japanese weights (%)	UK weights (%)
Chemicals & allied	14.81	20.3	7.0
Metals & engineering	13.10	6.0	7.0
Engineering	9.70	18.6	27.3
Textiles & clothing	11.21	21.8	19.9
Food, drink & tobacco	16.52	15.1	17.7
Other industry	11.80	18.2	21.1
Total industry	12.46	100.0	100.0

Sources: Price and quantity information for PPPs from Statistics Bureau, Management and Coordination Agency (1988), Vol.2 and Board of Trade (1938). Value added weights from Ohkawa. (1957) and Business Statistics Office (1978). Within each of the six main manufacturing sectors, PPPs for individual matched products are aggregated using gross output weights. The market exchange rate in 1935 was £1 = 17.14 yen, from Kinyu Kenkyukai (1937).

TABLE 7: A Japan/UK PPP for the whole economy, 1935

	UK weights	Japanese weights	PPP at UK weights	PPP at Japanese weights	PPP geometric mean
Grain & bread	4.1	16.4	18.11	8.16	12.16
Meat	9.9	1.1	12.77	12.29	12.53
Fish	0.9	3.4	2.46	2.49	2.47
Milk & eggs	5.1	1.0	14.27	7.74	10.51
Sugar	1.9	3.5	17.90	17.90	17.90
Vegetables & fruit	4.6	3.8	5.68	6.66	6.15
Processed foods	1.7	7.9	3.02	3.02	3.02
Alcohol	7.1	2.0	10.41	410.41	10.41
Tea	1.3	0.5	8.61	8.61	8.61
Tobacco	3.8	1.6	7.17	7.17	7.17
Total food	40.4	41.3	11.22	7.55	9.21
Fuel & light	4.3	4.8	15.19	17.32	16.22
Clothing	11.9	10.6	12.80	12.88	12.84
Housing & furniture	17.3	10.2	1.61	1.79	1.70
Transport & communications	7.6	2.1	4.17	4.31	4.24
Health & hygiene	9.1	7.7	2.41	3.31	2.82
Education & entertainment	9.4	23.4	6.06	6.67	6.36
Total expenditure	100.0	100.0	8.09	6.47	7.23

Sources and notes: UK consumer prices and expenditure weights were taken largely from Stone (1954) and Stone and Rowe (1966), with additional data on service sector wages from Chapman (1953) and on newspaper prices from Kaldor and Silverman (1948). Japanese consumer prices and expenditure weights were taken from Fukao *et al.* (2007). The market exchange rate in 1935 was £1 = 17.14 yen, from Kinyu Kenkyukai (1937).

TABLE 8: Comparative Japan/UK GDP per employee benchmark, 1935

	Mining/ manufacturing	Whole economy
Japanese GDP per employee (yen)	921.26	539.72
UK GDP per employee (£)	178.72	209.31
PPP (yen per £)	12.46	7.23
Japan/UK GDP per employee (UK=100)	41.37	35.66

Sources and notes: GDP at current prices from Ohkawa et al. (1974) and Feinstein (1972). Employment from Ohkawa (1957) and Feinstein (1972). PPPs from Tables 6 and 7. The market exchange rate in 1935 was £1 = 17.14 yen, from Kinyu Kenkyukai (1937).

TABLE 9: Industrial wages and prices in Japan and the United Kingdom

A. Before World War II (1935=100)

	Japan			UK		
	Nominal wage	Producer price	Own product real wage	Nominal wage	Producer price	Own product real wage
1901	21.3	60.7	35.2	44.1	81.1	54.3
1911	32.8	79.1	41.4	46.3	92.7	49.9
1920	120.3	197.8	60.8	137.2	290.7	47.2
1929	128.3	121.2	105.8	101.0	133.2	75.9
1935	100.0	100.0	100.0	100.0	100.0	100.0

B. After World War II (1997=100)

	Japan			UK		
	Nominal wage	Producer price	Own product real wage	Nominal wage	Producer price	Own product real wage
1953	2.9	55.4	5.1	2.1	10.4	19.7
1960	4.7	51.4	9.2	3.1	10.7	29.1
1973	26.8	65.1	41.2	8.8	20.1	43.9
1979	54.1	95.7	56.5	24.7	57.8	42.7
1990	87.6	105.2	83.3	70.6	100.3	70.3
1997	100.0	100.0	100.0	100.0	100.0	100.0
2007	98.3	100.1	98.2	157.0	99.6	157.6

Sources: UK wages: Feinstein (1972; 1990); Chapman (1953); Department of Employment (1971); Department of Employment (various years), *British Labour Statistics*; EU KLEMS database (O'Mahony and Timmer, 2009). UK producer prices: Mitchell, (1988); National Statistics (various years) *Monthly Digest of Statistics*; EU KLEMS database. Japanese wages: Minami and Ono (1978); Statistics Bureau (various years), *Annual Report on National Accounts*; Japanese producer prices: Ohkawa *et al.* (1967); *Annual Report on National Accounts*.

TABLE 10: Comparative Japan/UK unit labour costs in industry

A. Before World War II

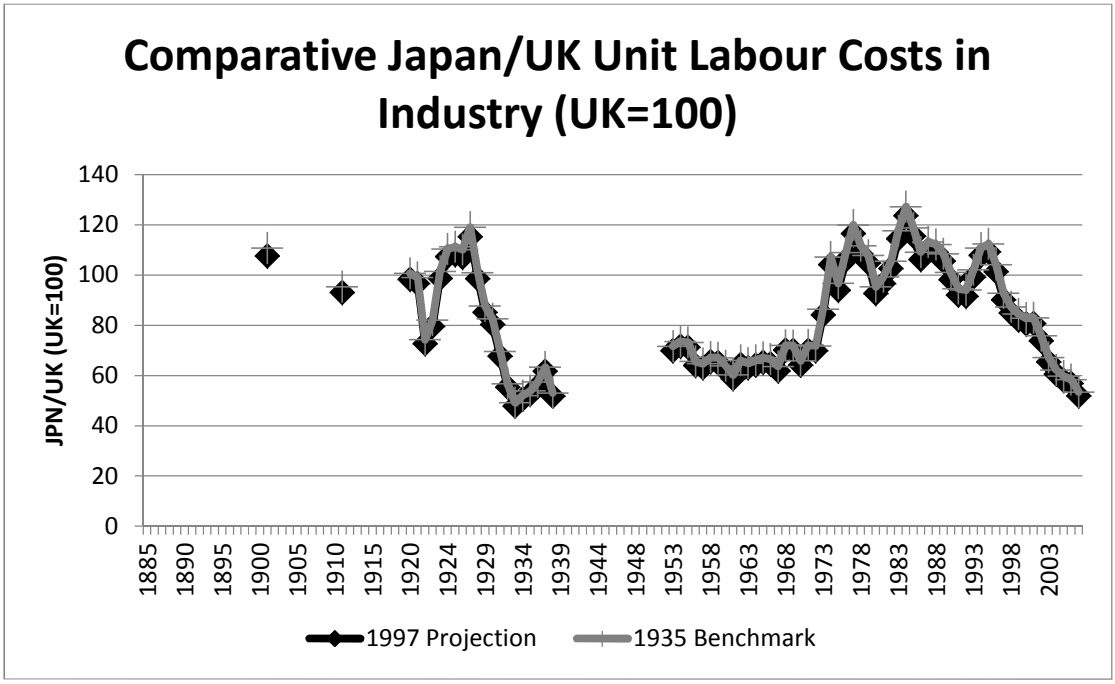
	(1935=100)			(UK=100)		
	Japanese real wage	UK real wage	Japan/UK real wage	Japan/UK real wage	Japan/UK labour productivity	Japan/UK unit labour costs
1901	35.2	54.3	64.7	14.4	13.0	111.0
1911	41.4	49.9	83.0	18.5	19.4	95.4
1920	60.8	47.2	128.9	28.7	29.0	99.1
1929	105.8	75.9	139.5	31.1	35.5	87.6
1935	100.0	100.0	100.0	22.3	41.4	53.9

B. After World War II (1997=100)

	(1997=100)			(UK=100)		
	Japanese real wage	UK real wage	Japan/UK real wage	Japan/UK real wage	Japan/UK labour productivity	Japan/UK unit labour costs
1953	5.1	19.7	26.1	21.0	30.1	69.8
1960	9.2	29.1	31.5	25.4	40.9	62.0
1973	41.2	43.9	94.1	75.8	90.1	84.1
1979	56.5	42.7	132.3	106.5	101.7	104.7
1990	83.3	70.3	118.4	95.3	97.1	98.2
1997	100.0	100.0	100.0	80.5	89.3	90.1
2007	98.2	157.6	62.3	50.2	96.5	52.0

Sources and notes: Real wages: Table 9, with benchmark levels in 1935 and 1997 discussed in the text. Labour productivity: Table 4. Comparative unit labour costs derived as the ratio of own product real wages to labour productivity.

FIGURE 2: Comparative Japan/UK unit labour costs in industry (UK=100)



Sources: See Table 10.

TABLE 11: Shares of world exports of manufacturing (%)

	UK	Japan	USA	Germany
1881-85	43.0	0.0	6.0	16.0
1899	34.5	1.6	12.1	16.6
1913	31.8	2.5	13.7	19.9
1929	23.8	4.1	21.7	15.5
1937	22.3	7.4	20.5	16.5
1950	24.6	3.4	26.6	7.0
1964	14.0	8.3	20.1	19.5
1973	9.1	13.1	15.1	22.3
1979	9.2	13.1	16.3	21.6
1999	6.9	12.2	17.8	14.2

Source: Broadberry (1994: 294; 2004: 64).

TABLE 12: Japan/UK comparative labour productivity (Y/L), capital intensity (K/L) and total factor productivity (TFP) (UK=100)

	Comparative Y/L	Comparative K/L	Comparative TFP
1891	18.0	13.1	43.8
1901	22.2	14.5	52.6
1911	25.3	16.4	58.3
1920	33.0	24.0	55.5
1929	34.7	27.6	57.8
1935	34.8	30.3	55.8
1950	30.9	36.0	42.7
1960	46.5	43.2	61.6
1973	81.0	91.0	83.4
1979	88.4	103.4	87.6
1990	96.5	135.1	88.1
1997	86.7	145.4	76.9
2007	84.5	122.1	79.2

Sources and notes: Derived from Appendix Table A1-A3. The level of comparative capital intensity is derived using the capital stock PPP for 1997 from the EU KLEMS data base. Comparative TFP is calculated using the geometric mean of Japanese and UK capital shares in income.

TABLE 13: Accounting for labour productivity growth (% per year)

A. Japan

		Contributions of:	
	Labour productivity growth	Capital deepening	TFP growth
1891-1920	2.59	1.51	1.08
1920-1950	0.92	0.80	0.12
1950-1973	6.65	2.29	4.36
1973-1990	2.79	1.32	1.47
1990-2007	1.29	0.88	0.41

B. United Kingdom

		Contributions of:	
	Labour productivity growth	Capital deepening	TFP growth
1891-1920	0.46	0.33	0.13
1920-1950	1.14	0.19	0.95
1950-1973	2.27	0.67	1.60
1973-1990	1.73	0.58	1.15
1990-2007	2.08	0.86	1.22

C. Japan – United Kingdom

		Contributions of:	
	Labour productivity growth	Capital deepening	TFP growth
1891-1920	2.13	1.18	0.95
1920-1950	-0.22	0.61	-0.83
1950-1973	4.38	1.62	2.76
1973-1990	1.06	0.74	0.32
1990-2007	-0.79	0.02	-0.81

Sources and noted: Derived from Appendix Table A1-A3. TFP growth is calculated using the geometric mean of the capital shares of income during each period.

APPENDIX: DATA AND SOURCES FOR TIME SERIES PROJECTIONS

TABLE A1: Time series for Japanese output, employment and labour productivity by sector (1935=100)

A. Japanese output

	Agriculture, forestry & fisheries	Mining & manuf	Construction	Facilitating industry	Commerce-Services	GDP
1891	59.3	7.6	13.6	2.8	37.0	26.3
1901	71.1	14.0	20.4	8.0	53.1	36.7
1911	80.0	23.8	30.1	20.9	61.7	46.3
1920	97.7	40.5	34.0	43.4	82.2	64.4
1929	97.7	69.9	65.0	86.3	101.5	87.2
1935	100.0	100.0	100.0	100.0	100.0	100.0
1950	100.7	88.4	151.4	90.3	142.8	112.5
1960	152.2	320.5	394.5	274.3	272.7	258.1
1973	158.9	1,550.7	1,342.9	971.1	754.6	760.3
1979	145.4	1,846.1	1,486.9	1,111.7	985.3	922.7
1990	157.8	3,008.7	1,982.3	1,709.4	1,539.7	1,404.3
1997	132.0	3,173.6	1,670.4	1,998.6	1,831.3	1,550.1
2007	130.4	3,862.2	1,295.6	2,230.6	2,104.6	1,760.9

B. Japanese employment

	Agriculture, forestry & fisheries	Mining & manuf	Construction	Facilitating industry	Commerce-Services	Total
1891	100.9	65.8	65.7	40.9	41.0	74.0
1901	101.5	72.2	72.0	48.3	48.6	78.1
1911	101.4	77.5	84.6	55.3	54.7	81.3
1920	97.7	91.4	81.7	89.1	64.3	86.1
1929	98.0	94.3	105.5	93.8	81.4	92.6
1935	100.0	100.0	100.0	100.0	100.0	100.0
1950	115.4	112.4	164.7	148.5	103.7	114.4
1960	97.2	179.4	253.8	200.9	180.4	144.5
1973	56.8	254.9	504.8	310.8	267.8	176.0
1979	50.1	230.7	564.2	322.6	310.4	183.4
1990	35.3	258.5	607.1	342.7	380.9	203.7
1997	27.7	232.8	673.4	372.9	430.1	213.3
2007	20.7	191.7	525.1	354.6	457.5	205.6

C. Japanese output per employee

	Agriculture, forestry & fisheries	Mining & manuf	Construction	Facilitating industry	Commerce-Services	GDP
1891	58.8	11.5	20.7	6.9	90.3	35.6
1901	70.1	19.4	28.3	16.6	109.2	47.0
1911	78.9	30.6	35.6	37.8	112.9	57.0
1920	100.0	44.3	41.6	48.7	127.9	74.8
1929	99.7	74.1	61.7	92.1	124.7	94.2
1935	100.0	100.0	100.0	100.0	100.0	100.0
1950	87.2	78.6	91.9	60.8	137.7	98.3
1960	156.7	178.7	155.4	136.6	151.1	178.7
1973	279.9	608.3	266.1	312.5	281.7	431.9
1979	290.2	800.2	263.5	344.6	317.4	503.1
1990	446.6	1163.8	326.5	498.8	404.2	689.3
1997	477.2	1363.1	248.1	536.0	425.8	726.8
2007	631.0	2014.2	246.8	629.1	460.0	856.6

Sources

Output by sector

1885-1940: Ohkawa *et al.* (1974: Table 25).
1940-1953: *Japan Statistical Yearbook* (1963, Table 256 A) and Pilat (1994: 276).
1953-1955: Ohkawa and Shinohara (1979: 282).
1955-1998: *Historical Statistics of Japan*, (Table 03-03-A).
(http://www.stat.go.jp/english/data/chouki/03.htm).
1998-2008: *Annual Report on National Accounts*, 2010, NA for 2008 (Table 23fcm3r_en)

Employment by sector

1885-1940: Fukao et al. (2014).
1941-1970: Ohkawa and Rosovsky (1973: 310.)
1970-1991: Pilat (1994: 280).
1991-2008: *Annual Report on National Accounts*, 2010, NA for 2008
(http://www.esri.cao.go.jp/en/sna/h20-).

TABLE A2: UK time series for output, employment and labour productivity by sector (1935=100)

A. UK output

	Agriculture, forestry & fisheries	Mining & manuf	Construction	Facilitating industry	Commerce-Services	GDP
1891	120.2	49.4	35.7	37.9	62.9	57.2
1901	109.7	59.5	56.4	49.1	76.0	68.7
1911	114.7	70.4	41.8	64.7	89.5	79.8
1920	80.8	74.3	42.1	70.8	89.6	79.7
1929	96.7	90.2	90.5	95.8	91.9	91.6
1935	100.0	100.0	100.0	100.0	100.0	100.0
1950	121.7	146.6	100.0	158.5	112.4	128.8
1960	153.4	197.5	128.9	207.7	137.3	165.6
1973	219.2	278.1	179.3	347.8	191.3	238.0
1979	226.5	293.4	160.3	383.3	213.1	253.7
1990	318.8	314.0	230.9	509.3	271.1	325.5
1997	311.1	346.1	224.2	691.0	317.3	375.2
2007	334.1	338.6	279.7	1,101.6	444.7	499.4

B. UK employment

	Agriculture, forestry & fisheries	Mining & manuf	Construction	Facilitating industry	Commerce-Services	Total
1891	192.0	87.6	73.6	63.5	67.2	83.1
1901	176.6	96.6	95.5	84.1	78.4	93.2
1911	175.2	108.0	90.3	92.3	88.1	101.8
1920	127.1	117.6	81.2	99.1	86.3	101.3
1929	109.6	104.4	88.6	99.1	89.8	97.2
1935	100.0	100.0	100.0	100.0	100.0	100.0
1950	86.6	123.9	129.4	119.4	112.1	116.3
1960	74.1	134.7	143.4	114.1	122.1	123.9
1973	47.2	122.7	173.1	109.1	144.5	128.3
1979	40.8	111.2	165.8	107.5	156.4	128.1
1990	38.8	78.1	192.7	103.2	189.4	131.1
1997	36.6	67.6	146.5	94.6	201.3	128.7
2007	28.0	48.4	186.7	106.4	242.2	141.7

C. UK output per employee

	Agriculture, forestry & fisheries	Mining & manuf	Construction	Facilitating industry	Commerce-Services	GDP
1891	62.6	56.4	48.5	59.7	93.7	68.8
1901	62.1	61.6	59.0	58.3	96.9	73.7
1911	65.5	65.2	46.3	70.1	101.6	78.4
1920	63.6	63.2	51.8	71.4	103.9	78.7
1929	88.2	86.4	102.1	96.7	102.4	94.2
1935	100.0	100.0	100.0	100.0	100.0	100.0
1950	140.6	118.3	77.3	132.7	100.3	110.7
1960	207.1	146.6	89.9	182.1	112.4	133.7
1973	464.9	226.6	103.6	318.9	132.4	185.5
1979	555.1	263.9	96.7	356.6	136.3	198.0
1990	821.0	402.2	119.8	493.5	143.1	248.4
1997	850.7	512.0	153.1	730.3	157.6	291.6
2007	1191.9	700.1	149.8	1035.8	183.6	352.4

Sources

Output by sector

1891-1965: Feinstein (1972: Table 8). Weights for component parts of sectors from Feinstein (1972: 208).

1965-2007: UK National Statistics (various years), *UK National Accounts*.

Employment by sector

1871-1965: Feinstein (1972: Tables 59, 60).

1965-1970: O'Mahony (1999).

1970-2007: EU KLEMS database (O'Mahony and Timmer, 2009).

Territory

Boundaries of the United Kingdom of Great Britain and Ireland before 1920, Great Britain and Northern Ireland after 1920.

TABLE A3: Aggregate time series for capital stock and capital share of income

	Capital stock (1997=100)		Capital share of income (%)	
	Japan	UK	Japan	UK
1891	0.7	13.5	45.5	42.0
1901	0.9	16.5	47.8	42.0
1911	1.2	20.4	49.5	43.3
1920	1.9	22.4	41.7	31.8
1929	2.7	24.7	43.6	35.9
1935	3.3	26.2	46.0	34.2
1950	4.5	30.6	34.0	29.6
1960	7.9	37.8	38.3	29.4
1973	29.7	57.3	33.2	29.1
1979	41.4	67.4	26.9	28.2
1990	73.0	83.7	35.9	25.2
1997	100.0	100.0	34.0	30.3
2007	111.8	152.1	37.7	28.4

Sources

Gross fixed capital stock excluding dwellings

Japan:
1891-1950: Ohkawa et al. (1966: Table 1, Reference Table 3)
1950-1960: Ohkawa et al. (1966: Reference Table 3) and Economic Planning Agency (1962, 1964)
1960-1970: Nomura (2004)
1970-2007: JIP Database 2013 (www.rieti.go.jp/en/database/JIP2013)

United Kingdom:
1891-1920: Feinstein (1988: Table XI).
1920-1955: Feinstein (1972: Appendix Table 43).
1955-1970: UK Central Statistical Office (various years), *National Income and Expenditure*; UK Central Statistical Office (various years), *Capital Stocks, Capital Consumption and Non-Financial Balance Sheets*.
1970-2007: Volume indices from EU KLEMS database (O'Mahony and Timmer, 2009).

Capital share of income

Japan:
1891-1940: Ohkawa et al. (1974: Table 8, Table 8A, Table 9, Table 9A).
1950-1955: Economic Council Agency (1954), Economic Planning Agency (1970), Ministry of Health, Labour and Welfare (various years), *Monthly Labour Survey*, and Statistics Bureau (various years), *Labour Force Survey*.
1955-1970: Economic and Social Research Institute, Cabinet Office (n.d.), *Annual Report on National Accounts*, Ministry of Health, Labour and Welfare (various years), *Monthly Labour Survey*, and Statistics Bureau (various years), *Labour Force Survey*.
1970-2007: Economic and Social Research Institute, Cabinet Office (n.d.), *Annual Report on National Accounts* and JIP Database 2013
(www.rieti.go.jp/en/database/JIP2013)

United Kingdom:
1891-1970: Feinstein (1972: Appendix Table 1) and Matthews, et al. (1982: Table 6.1 and 6.3).
1970-2007: EU KLEMS database (O'Mahony and Timmer, 2009).

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