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Explaining Anglo-German productivity differences in services since 1870

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Germany overtook Britain in comparative productivity levels for the whole economy primarily as a result of trends in services rather than trends in industry. Britain's productivity lead in services before World War II reflected external economies of scale in a highly urbanised economy with an international orientation. Low productivity in Germany reflected the underdevelopment of services in an economy that was slow to move out of agriculture. As German agricultural employment contracted sharply from the 1950s, catching-up occurred in services. This was aided by a sharp increase in human and physical capital accumulation, underpinned by the institutional framework of the postwar settlement.

1. Introduction

Germany overtook Britain in comparative productivity levels for the whole economy primarily as a result of trends in services rather than trends in industry (Broadberry 1997c, 1998). Before World War II, although labour productivity in German industry was on a par with British industry, German labour productivity in services was substantially lower than in British services. Furthermore, services have accounted for a much smaller share of employment in Germany throughout the period since 1870, largely as a result of a larger agricultural sector before World War II, and a larger industrial sector since. And yet, most studies of comparative productivity performance continue to focus on industry and to ignore services.

This article provides an overview of Anglo-German comparative productivity performance in services since 1870, building on Broadberry and Ghosal's (2002) Anglo-American study. Although Britain began to fall behind the United States in parts of the service sector from the late nineteenth century as a result of the adoption of high volume methods

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using modern office technology, British productivity in most parts of the service sector remained higher than in Germany until after World War II (Broadberry and Ghosal 2002, Broadberry 1998). In sectors where Germany was able to adopt US methods (particularly in transport and communications), productivity was relatively high, but large parts of the German service sector remained too spread out in a predominantly rural society with a large agricultural sector. Britain's high level of urbanisation, together with an international orientation in much of the commercial service sector, generated external economies of scale which underpinned high levels of productivity.

German catching-up in most parts of the service sector occurred only after World War II, with the shrinking of the agricultural sector. The shift of labour from agriculture into services was accompanied by high levels of physical and human capital accumulation in Germany, associated with the institutional framework of the postwar settlement (Carlin 1996, Eichengreen 1996). This underpinned the spread of vocational training from industry into services after World War II, coupled with high rates of investment in physical capital. As a result, Germany has achieved higher levels of productivity than Britain in most parts of the service sector since the 1970s.

2. Comparative productivity levels in services, 1870–1990

2.1. Services and the aggregate economy

The basic approach to establishing Anglo-German comparative labour productivity levels for the period 1870–1990 is to assemble time series of output and employment for Britain and Germany and to project the implied trend in comparative labour productivity both forwards and backwards from a 1935 benchmark (Broadberry 1997c). The 1935 benchmark was established on a sectoral basis, using either physical indicators of output per employee or value added per worker converted to a common currency using unit value ratios, and the reader is referred to Broadberry (1997c, pp. 263–6) and Broadberry and Fremdling (1990) for further details. For the time series, conventional national accounts sources for the post-World War II period have been supplemented with historical national accounts data taken from Feinstein (1972) for Britain and from Hoffmann (1965) for Germany for the pre-World War II period. After setting out the basic trends, we will consider the implications of some recent challenges to the Hoffmann data.

The importance of services to the German overtaking of Britain can be demonstrated with Tables 1 and 2. The concept of labour productivity used here is output per person engaged, since hours worked are not available on a consistent sectoral basis before World War II. As noted above, the estimates are based on time series projections from a benchmark for 1935, although they have also been checked against additional benchmarks for a number of

Table 1. *Comparative Germany/UK labour productivity levels by sector, 1871-1990 (UK = 100).*

	Agriculture	Industry	Services	Aggregate economy
1871	55.7	91.7	62.8	59.5
1881	54.7	93.7	61.3	57.3
1891	53.7	99.3	64.4	60.5
1901	67.2	105.0	71.9	68.4
1911	67.3	127.7	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
1937	59.0	96.9	89.4	79.2
1950	41.2	91.8	83.2	74.4
1960	47.8	117.9	102.6	94.5
1968	48.6	121.9	115.9	107.1
1973	50.8	121.1	120.1	114.0
1979	65.5	132.8	131.8	126.5
1985	62.1	114.8	131.6	120.9
1990	75.4	111.0	134.9	125.4

Notes: Benchmark estimates of comparative productivity levels for 1935 are projected to other years using time series for output and employment from historical national accounting sources.

Sources: Derived from Broadberry (1997c).

later years. Although Broadberry (1998) presented figures for comparative productivity levels in ten sectors, it is helpful to begin the analysis here with a three-sector breakdown between agriculture, industry and services. Industry includes mineral extraction, manufacturing, construction and the utilities, while services includes transport and communications, distribution and finance, professional and personal services, and government. Agriculture includes forestry and fishing as well as agriculture more narrowly defined.

In Table 1, we see that aggregate labour productivity in Germany was about 60 per cent of the British level in 1871, rising to about three-quarters of the British level by 1911. After a setback across World War I, aggregate labour productivity in Germany regained three-quarters of the British level by the mid-1930s, but there was another German setback across World War II. There was rapid labour productivity growth in the Federal German Republic during the 1950s and 1960s, but German overtaking of Britain occurred only during the mid-1960s. Germany then forged ahead until 1979, and during the 1980s comparative aggregate labour productivity fluctuated without trend until reunification.

Turning to the sectoral estimates, note first that the long-run trends in comparative labour productivity levels for the aggregate economy owe rather less to trends in industry than is usually assumed in accounts of comparative productivity performance. Thus, for example, between 1911

Table 2. *Sectoral shares of employment in the United Kingdom and Germany, 1870–1990 (%)*.

	Agriculture	Industry	Services
A. United Kingdom			
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
B. Germany			
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

Sources: United Kingdom: derived from Feinstein (1972); CSO, *Annual Abstract of Statistics* and OECD, *Labour Force Statistics*. Germany: derived from Hoffmann (1965) and Statistisches Bundesamt, *Völkswirtschaftliche Gesamtrechnungen*.

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.¹ Note, second, that comparative productivity trends in services broadly mirror comparative productivity trends for the economy as a whole. And note, third, from Table 2, that the shift out of agricultural employment occurred much later in Germany than in Britain. As many writers have recognised, this is important for overall productivity performance because agriculture is a low value-added activity (Kaldor 1966, Kindleberger 1967, Temin 2002). However, we shall also argue that the late movement out of agriculture further penalised Germany's overall productivity performance because of the under-development of the service sector.

¹ Over shorter periods, however, there have been substantial movements in comparative Germany/UK productivity levels in industry. Broadberry (1997a) emphasises the German forging ahead in manufacturing during the 1970s, with Germany attaining close to a 50 per cent 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. See also Broadberry and Crafts (2003).

Table 3. *Comparative Germany/UK labour productivity levels in market services, 1871–1990 (UK = 100).*

	Transport/ communications	Distribution/ finance	Professional/ personal services
1871	74.4	70.7	89.7
1881	97.4	38.6	83.4
1891	113.5	45.9	77.0
1901	150.0	49.7	76.6
1911	166.8	52.5	76.3
1925	140.0	47.1	86.7
1929	151.2	50.3	99.8
1935	132.4	54.3	105.6
1937	136.3	56.8	113.0
1950	122.0	50.7	94.2
1960	117.0	64.2	85.7
1968	130.0	75.4	101.3
1973	119.5	88.0	98.4
1979	135.0	106.4	103.1
1985	132.7	109.2	105.3
1990	125.7	111.2	120.5

Notes: Benchmark estimates of comparative productivity levels for 1935 are projected to other years using time series for output and employment from historical national accounting sources.

Source: Derived from Broadberry (1997c).

2.2. Market services

Although productivity in non-market services is difficult to interpret because of problems in measuring output independently of inputs, these difficulties are much less severe in market services such as transport and communications, distribution and finance. The United Kingdom Central Statistical Office (1956, pp. 538–70) lists the primary indicators used in tracking real output in the British national accounts, which runs to seven pages on market services. Many of these indicators are available on a comparative basis, and have been used to derive the estimates of comparative Germany/UK labour productivity levels by sector in Table 3.

Broadberry (1997a) shows that there was a wide spread of comparative Anglo-German productivity levels across different industries within manufacturing. Similarly, there was a spread of comparative productivity levels within market services, as can be seen here in Table 3. For selected benchmark years, it is also possible to obtain estimates of comparative labour productivity levels at a more disaggregated level, and these are presented in Table 4. The cross-sectional variation in comparative productivity levels, together with the time-series variation within each sector, helps to identify the key factors explaining comparative productivity performance.

Table 4. *Benchmark estimates of comparative Germany/UK labour productivity levels in market services, 1935–1993 (UK = 100).*

	1935	1968	1973	1993
Railways	178.9	108.2		107.2
Road transport		129.8		
Shipping		190.0		
Air transport		113.0		
Communications	34.5	106.4		67.7
Distribution			127.0	112.1
Finance				109.9
		54.3		

Notes: Benchmark estimates based on direct observation for the years stated.

Sources: Broadberry (1997c). Additional figures for 1968 from Pryke (1971), for 1973 from Smith *et al.* (1982), for 1993 from O'Mahony *et al.* (1998).

We see in Table 3 that Germany had already overtaken Britain before World War I in transport and communications. However, the scale of the German lead in this sector at this time owed much to the relative importance of the railways and was subsequently reduced as other forms of transport and communications accounted for a growing share of economic activity.² In distribution and finance, German productivity levels remained a long way behind British productivity levels before World War II. This part of the service sector remained relatively underdeveloped in Germany at this time, and German overtaking occurred only during the 1970s.

Finally in this section, it is worth noting some differences in the structure of the service sector in the two countries, drawing on Table 5. First, transport and communications accounted for a much smaller share of employment in Germany than in Britain until the 1970s. Although Germany constructed a productive railway system in the nineteenth century and built up an efficient liner fleet on the North Atlantic route before World War I, the rest of the German transport and communications sector was relatively small and unproductive. For the entire period, distribution and finance have accounted for a smaller share of employment in Germany than in Britain. Other services have also remained substantially smaller in Germany, which has had a correspondingly large agricultural sector before the 1970s, and a large industrial sector since the 1970s.

² The scale of the German lead in transport and communications before World War I is lower here than suggested in Broadberry (1997c), due to a correction for prewar employment on the German railways. Hoffmann (1965, pp. 191, 201) allocated all technical personnel to industry before World War I, and a correction can be made for this using the later proportional breakdown between industry and the railways.

Table 5. Sectoral shares of employment in selected services (% of total employment).

	Transport/ communications	Distribution/ finance	Professional/ personal services
A. United Kingdom			
1871	5.4	7.8	19.2
1911	7.7	13.2	19.1
1925	8.4	14.5	17.5
1930	8.3	16.4	18.8
1935	7.9	17.1	19.8
1950	7.9	14.1	17.6
1973	6.4	24.0	17.1
1990	5.5	31.4	25.6
B. Germany			
1875	2.4	6.0	10.0
1913	4.9	11.2	8.3
1925	4.8	12.5	7.9
1930	5.0	14.7	8.4
1935	4.8	13.5	8.8
1950	5.6	13.2	7.9
1973	5.5	15.3	12.2
1990	5.6	16.3	19.9

Sources: United Kingdom: derived from Feinstein (1972); OECD, *Labour Force Statistics*; and CSO, *Annual Abstract of Statistics*. Germany: derived from Hoffmann (1965) and Statistisches Bundesamt, *Völkswirtschaftliche Gesamtrechnungen*.

2.3. The implications of alternative German data series

The above estimates rely largely on Hoffmann (1965) for German time series of output and employment. We now consider briefly the implications of some alternative German data sources, particularly for output. Ritschl (2004a, 2004b) argues that Hoffmann's (1965) series for real output are flawed, particularly for industry and agriculture. It is interesting to note, however, that his use of alternative output series from Wagenführ (1933) and von der Decken and Wagenführ (1935) does not lead to a major change in the path of aggregate output. Rather, it leads to offsetting changes in the paths of agricultural and industrial production. The key finding of Ritschl (2004a) is that Wagenführ's (1933) index of industrial production grew more slowly than Hoffmann's (1965) index before World War II, while Ritschl (2004b) argues that von der Decken and Wagenführ's (1935) measure of agricultural output grew more rapidly than Hoffmann's. Hence, projecting backwards from 1935, Ritschl (2004b) finds for the pre-World War I period a larger German labour productivity lead in industry and an even more backward German agricultural sector. This has the effect, then, of confirming the basic sectoral patterns of Anglo-German comparative labour productivity

levels established by Broadberry (1997c), but in a more exaggerated fashion.

Hence, for example, whereas Broadberry (1997c, p. 251) reports a figure of 67.3 for the comparative Germany/UK labour productivity level in agriculture in 1911, Ritschl (2004b) reports a value of 53.7. Offsetting this, however, in manufacturing, whereas Broadberry (1997c, p. 251) reports a comparative Germany/UK labour productivity level of 119.3, Ritschl (2004b) finds a value of 137.3. The problem with this is that the exaggerated German labour productivity lead in manufacturing during the pre-World War I period would be very hard to square with what is known about nominal incomes in industry. For example, Fremdling (1991) found industrial value added per employee in Germany to be lower than in Britain just before World War I when converted to a common currency using a purchasing power parity adjusted price ratio. It is likely that Hoffmann's (1965) estimates of capital income, used by Fremdling (1991), are too low.³ However, whereas it is possible to see how this could be consistent with a small German labour productivity advantage in manufacturing before World War I, it is difficult to see how it could possibly be consistent with a German productivity lead of the order of magnitude suggested by Ritschl (2004b). Note further, that this work has no implications for comparative productivity in services, which is the focus of attention in this article.

3. Key aspects of Britain's productivity performance in services

3.1. External economies of scale in Britain

Britain was highly successful in commercial services during the nineteenth century, playing a key international role in shipping, distribution and finance. For most of the nineteenth century, Britain had a labour productivity lead over the United States as well as over Germany in services as a whole (Broadberry 1997b, 1998; Broadberry and Irwin, 2004). Similarly, British success in commercial services shows up in the balance of payments, with Imlah's (1958) figures on the net contribution of business services to the current account surplus amounting to £86.8 m in 1870, or about 8 per cent of national income.

This British success was based on external rather than internal economies of scale. The City of London provided the largest agglomeration of commercial activity in the world, yet it consisted of a large number of small firms rather than a small number of giant firms. The large scale of the overall activity facilitated specialisation, and each firm could

³ Indeed, Fremdling (1988, pp. 348–9) himself suggests this.

benefit from proximity to other specialised firms in classic Marshallian fashion (Marshall 1920). Since asymmetric information was endemic in this type of activity, it was important to be able to deter opportunistic behaviour.⁴ As a result, trade often took place within networks of agents, who could be trusted. Although there is a large historical literature on merchant networks from medieval times, it is only recently that economic historians and economists have begun to analyse the economic mechanisms underpinning them. The pioneering work in this field by Greif (1989) used the *geniza* documents to show the importance of a reputation mechanism in sustaining trade among Maghribi traders during the eleventh century. Subsequent work, summarised in Greif (2000), puts this example of an early merchant network into a general framework, where for individuals to enter into mutually beneficial exchange relationships, they have to be able to commit to fulfil their contractual obligations. The merchant network can be seen, then, as one way of mitigating this 'fundamental problem of exchange'.

Britain's commercial networks in the modern period can now be understood in the light of this framework. In shipping, Boyce's (1995) detailed study of share purchases in ninety-nine steamship ventures registered in West Hartlepool over the five-year period 1878–1883 captures information asymmetries by distinguishing occupational categories of shareholders, and captures the building up of reputation and trust over time by examining patterns of repeat purchase. Other studies by Ville (1987, 1989) and Cottrell (1981) document the role of networks in other ports, including London, Newcastle-upon-Tyne and Liverpool. In finance, Cassis (1994) uses information on bankers and bank directors from ten private banks, 20 merchant banks, seven discount houses, 13 joint stock banks, 14 overseas (colonial) banks and the Bank of England to provide an equally detailed study of networks in the City of London, but focusing on social as well as economic aspects. He builds up a picture of small family firms, public school and Oxbridge education, marriage into the aristocracy and Empire links. But whereas this is sometimes used to suggest a culture of industrial decline, it is seen here to be associated with commercial success. In distribution, the study by Broadberry and Marrison (2002) emphasises the key role of merchants in the generation of external economies of scale in the Lancashire cotton industry.

⁴ In a principal-agent problem with imperfect monitoring, an agent may try to pass off a business loss for the principal as due to bad luck when it is due to inadequate effort or downright fraud. The agent may, for example, claim that a cargo was lost in rough weather or stolen in port when it was lost due to the negligence of the agent in leaving it unattended or even sold for the agent's profit to an unscrupulous merchant.

3.2. American developments

In 1870, although Britain still had a labour productivity lead over the United States in services as a whole, the United States had already caught up in transport and communications (Broadberry and Ghosal 2002). By World War I, furthermore, the United States had a substantial labour productivity lead over Britain in this sector. In distribution, the United States had just overtaken Britain by World War I, but Britain remained ahead in other services until the interwar period. In services as a whole, therefore, the United States was already ahead by World War I and continued to forge ahead until the 1950s. Britain only narrowed the productivity gap with the United States in services (and the economy as a whole) substantially from the 1970s.

Broadberry and Ghosal (2002) attribute this growing US superiority in services during the first three-quarters of the twentieth century to the spread of a standardised, high-volume, low-margin approach based on hierarchical management and utilising technologies that improved communications and information processing. These technologies were slower to diffuse in Britain as a result of lower levels of education and strong labour force resistance to the intensification of the labour process that their efficient use required. This explanation is consistent with the observed pattern of comparative US/UK labour productivity levels, since these high-volume methods diffused rapidly in some sectors, but more slowly in others. These methods were first developed on the railways, then spread quickly to other parts of the transport and communications sector, including steamship lines, urban traction systems and the telegraph and telephone systems (Chandler 1977, pp. 189–203). However, in distribution, there were limits to the degree of centralisation and standardisation that consumers found acceptable, and there were also restraints on competition which acted to support small retail outlets (Hall *et al.* 1961, pp. 131–8; Field 1996, p. 27; McCraw 1996). In banking and finance, there were obvious dangers in adopting a high-volume, impersonal, standardised approach, since asymmetric information and trust are very important in this sector, while regulations prevented the growth of interstate banking (White 2000, p. 749).

Although this article focuses on transport and communications, distribution and finance, Bakker's (2001) study of the entertainment sector is suggestive of how the approach can also be applied to other personal services, where output is often less well measured in the national accounts. His use of the term 'industrialisation of services' captures broadly the same phenomena as the shift to a standardised, high-volume, low-margin approach based on hierarchical management that is emphasised here.⁵

⁵ A fuller treatment of the theoretical issues raised by the coexistence of high-volume and low-volume methods, including a formal model, is available in Broadberry and Ghosal (2004).

4. German services before World War II in comparative perspective

4.1. The effects of tariff protection

Tariff protection in late nineteenth century Germany was designed to slow down the decline of agriculture and accelerate the development of heavy industry. The alliance of 'rye and iron' in the newly formed German Reich meant that proportionally, at least, services had to be the loser. This effective bias against services strengthened considerably after World War I with the growing scale of protection.

German agricultural tariffs can be seen as an attempt to stave off a 'grain invasion' from the United States. On the eve of World War I, agriculture still accounted for 34.5 per cent of employment in Germany, compared with just 11.8 per cent in Britain (Table 2). Even in the United States, a land-abundant grain exporter, agriculture accounted for a smaller share of employment. One effect of Britain's policy of free trade in agriculture following the repeal of the Corn Laws in 1846, then, was undoubtedly a further transfer of labour from agriculture into industry and services. The agriculture that remained in Britain was highly productive, and able to compete internationally. This was achieved partly by increasing capital intensity in what remained of arable farming, and partly by shifting the product mix away from grain towards higher-value-added pastoral products (Brown 1987, pp. 25–6, 33; Ó Gráda 1994, pp. 149–56). The high levels of agricultural labour productivity that already characterised British agriculture during the Industrial Revolution were raised still further, and the relatively small British agricultural sector continued to achieve labour productivity levels on a par with the United States before World War I.

Webb (1980) argues that industrial tariffs in Wilhelmine Germany, often in combination with cartels, should be seen as an attempt to reduce the riskiness of investment in capital intensive technologies by restricting competition. He thus sees tariffs as successfully stimulating heavy industry in Germany. To the extent that tariffs slowed down the shift of labour out of agriculture and accelerated the expansion of industrial employment, then services must have been squeezed. Nevertheless, the scale of the retreat from free trade in Germany before World War I must be kept in proportion. The figures in Table 6 suggest that customs revenue as a share of import values was not dramatically higher in Germany than in Britain before World War I, although the scale of the difference is increased if the British figures are adjusted to allow for revenue-raising duties on tobacco and petrol, which were not produced domestically. Compared with the retreat into autarky during the 1930s, however, Germany remained integrated into the world economy before 1914. Table 7 shows multilateral tariff rates on a number of key commodities on the eve of World War I. They show Britain to be a free trade country and Germany moderately protectionist. However, it should

Table 6. *Customs revenue as a share of import values in the United Kingdom and Germany, 1870–1989 (%)*.

	United Kingdom		Germany Total
	Total	Excl. tobacco & petrol	
1870	7.1	5.0	
1880	4.7	2.7	5.8
1890	4.8	2.7	8.8
1900	4.6	2.6	8.1
1910	4.5	2.2	7.4
1913	4.4	2.1	6.3
1920	7.7	4.7	
1929	9.7	4.4	8.2
1935	24.5	10.2	30.1
1938	24.1	10.4	33.4
1940	22.7		
1945	38.2		
1950	31.2	2.9	5.4
1960	30.2	3.9	6.5
1970		3.1	2.6
1980		2.0	1.3
1989		1.4	1.3

Sources: United Kingdom: Total customs revenue from Mitchell (1988, pp. 581–6); Total import values from Mitchell (1988, pp. 451–4); Customs revenue from tobacco and petrol from CSO, *Statistical Abstract of the United Kingdom, Annual Abstract of Statistics*, and *National Income and Expenditure*. Imports of tobacco and petrol from Mitchell (1988, pp. 474–80). Germany: Customs duties and imports from Mitchell (1980) to 1975, updated from Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*.

be noted that Germany had a high tariff on wheat, the key agricultural product.

The consequences of these protectionist policies for German productivity performance have often been misunderstood. Contemporaries and historians have consistently overestimated the strength of the German economy before World War II by focusing on the modern sectors which policy was designed to promote. However, it is important to remember that these Gerschenkronian policies had adverse consequences for the less favoured sectors. The underdevelopment of these other sectors shows up in low productivity, but can also be seen in their low shares of economic activity. Olson (1963, pp. 138–40) highlights the importance of these factors for the outcome of the two world wars, noting that it was Germany rather than Britain that collapsed under the pressure of blockade. Olson (1963, pp. 138–9) points to the ability of the British agricultural sector to expand output on the stored-up fertility of grasslands brought back into arable use, compared with the inability of German agriculture to maintain output at full stretch in the face of wartime disruption. However, Olson (1963, p. 146) also argues that

Table 7. *Multilateral tariffs in 1913, selected commodities (German marks per 100 kg).*

	Wheat	Cotton yarn	Cotton fabric unbleached	Cotton fabric printed	Laces	Bar iron	Sheet iron	Sewing needles
Russia	free	108.13	1,161.00	1,404.0	2,539.0	9.89	13.85	641.20
Spain	6.50	140.00	352.35	299.70	1,093.5	5.18	6.48	243.00
United States	3.95	67.20	51.87	103.74	45%	2.78	5.56	25%
Austria-Hungary	5.35	28.05	—	121.55	561.00	4.25	8.50	144.50
France	5.66	14.99	86.67	152.28	405.00	6.07	10.93	205.50
Italy	6.08	26.73	63.18	129.68	405.00	4.86	9.72	64.80
Germany	5.50	18.00	70.00	120.00	350.00	1.00	4.50	100.00
Sweden	4.16	22.50	56.25	123.75	450.00	free	4.50	45.00
Denmark	free	7.04	56.80	151.68	227.50	1.17	1.17	75.00
Belgium	free	12.15	64.80	81.00	15%	0.81	0.81	13%
Norway	4.86	13.50	28.13	123.75	674.50	free	free	84.38
Japan	2.68	22.28	62.70	87.14	69.60	2.09	2.61	175.89
Switzerland	0.24	16.20	8.10	48.60	81.00	0.24	0.49	40.50
Netherlands	free	free	5%	5%	5%	5%	5%	5%
Great Britain	free	free	free	free	free	free	free	free

Notes: Percentage values refer to *ad valorem* rates.

Source: Grunzel (1916, pp. 155–8).

the decisive factor was the flexibility of the British service sector, which was able to draw on a wealth of experience in general administration as well as skills directly related to distribution and finance.

4.2. The Gerschenkronian perspective reconsidered

The widespread overestimation of the performance of the German economy before World War II is dependent on a view of economic activity which privileges industry, and particularly heavy industry. In the widely accepted Gerschenkronian analysis of Germany's industrialisation, the success of German heavy industry receives a great deal of attention (Tilly 1991). However, there is much less acknowledgement of the costs arising from the protection of agriculture in the face of competition from the New World, and even less recognition of the underdevelopment of services in Germany. Indeed, since the Gerschenkronian analysis emphasises the role of the railways in creating a national market and the role of the universal banks in mobilising finance for heavy industry, there is even a danger that economic historians may draw the seriously misleading conclusion that Germany had a dynamic and highly productive service sector. But in fact, although the German railway system was relatively productive, the German banking system was distinctly underdeveloped compared with its British counterpart (Collins 1988, p. 18). Furthermore, productivity remained relatively low in most of the German service sector, with its low level of specialisation.

The lack of specialisation in the German service sector can be linked to the slow contraction of agriculture behind tariff barriers, combined with the direction of resources into industry. With such a large share of the labour force tied up in low productivity agriculture and receiving low incomes, the extent of the domestic market for services was necessarily limited. Furthermore, the German service sector was much less geared towards overseas markets than the British service sector, which had developed a global outlook with the expansion of the British empire during the eighteenth and nineteenth centuries (Cain and Hopkins 1993, Rubinstein 1993). With specialisation limited by the extent of the market, the German tendencies towards autarky and a large domestic agricultural sector before World War II resulted in relatively low productivity in services, as well as in agriculture (Stigler 1951, Smolensky 1972).

4.3. Railways

The German railways have received a great deal of attention because of their perceived role in creating a unified national market (Fremdling 1975). This is traditionally seen as important for industrial development, and hence for industrial productivity. From the perspective of this article, however, the

most remarkable feature of the German railways is their role in generating high levels of productivity in the transport and communications sector. The key question is how did Germany manage to achieve such high levels of productivity on the railways when productivity in the rest of the service sector was so low? To understand this, it is helpful to return to the origins of modern business enterprise in the United States during the nineteenth century.

Modern business enterprise, characterised by standardised, high-volume, low-margin business and multiple operating units managed by a hierarchy of salaried executives, began on the US railroads during the late nineteenth century (Chandler 1977, pp. 81–121). This hierarchical form of organisation did not fit well with British social capabilities, and British productivity performance lagged behind most strongly in sectors where this form of organisation diffused most fully (Broadberry and Ghosal 2002). The railway system that emerged in Germany was also organised on the basis of modern business enterprise, with a high-volume, low-margin approach and hierarchical management, since there was no room on the railways for niche producers organised on a network basis, generating external economies of scale. German social capabilities must in this respect be regarded as closer to American than British capabilities.⁶ However, the promotion of heavy industry, centred on iron and steel and coal, which needed to be transported in bulk, was important in generating the internal economies of scale that underpinned Germany's high productivity on the railways (Fremdling 1975). Note that the railways were, in turn, very important users of these products, generating important backward linkages (Fremdling 1977). It must be emphasised, however, that the high productivity of the railways was very atypical of German services.

4.4. Banks

The Gerschenkronian literature alleges that the German universal banks mobilised capital for domestic industry, while the British clearing banks failed to provide long-term support to British industry (Gerschenkron 1962, pp. 13–16; Kennedy 1987, pp. 121–2). There are a number of problems with this view, however. First, it is clear that in Germany, as well as in Britain, most industrial investment was financed from internal rather than external funds (Edwards and Ogilvie 1996, Fohlin 1999). Second, it is important to

⁶ Social capabilities are obviously a macro concept. Nevertheless, certain social capabilities are more useful for some sectors than for others. A society that is good at hierarchical management is more likely to be successful in sectors where hierarchical management is essential (such as the railways) than in sectors where personal contact within networks of trust is important (such as international finance). The theoretical underpinnings of this view are discussed in Broadberry and Ghosal (2004).

recognise that the British clearing banks were part of a specialised system, with merchant banks responsible for the mobilisation of long-term capital. Third, even if defined widely to include the private banks as well as the joint stock credit banks, the universal banks never accounted for more than about half of the German credit market (Guinnane 2002, p. 81). The public savings banks (*Sparkassen*), credit co-operatives, mortgage banks and other small institutions that made up the banking sector were often oriented more towards agriculture than industry. They pulled down the average productivity performance of the German banking sector, with municipal control often leading to the sacrifice of profits for social objectives and the ambitions of local politicians. Fourth, in terms of short-term lending to industry, on which it is fair to judge the British clearing banks, recent archival research has revealed that they were just as supportive as their continental counterparts (Capie and Collins 1996, Baker and Collins 1999). But even if the clearing banks supported British industry with short-term funds, it is still possible that the merchant banks, with their primary responsibility for long-term funds, were biased against British industry. But if that were the case, it should show up in relative rates of return on domestic and overseas issues. Edelstein (1971), however, has shown that rates of return on domestic and overseas assets of the same risk (measured by the variance of returns) were not significantly different.

In general, it seems almost perverse to criticise the highly specialised British system in comparison with the German universal system, since even in Gerschenkron's (1962) view, universal banking was seen as a result of economic backwardness. Finance was provided on a much greater overall scale in Britain than in Germany before World War I, permitting greater specialisation and sophistication. It makes little sense, then, to criticise English banks for failing to develop along German lines as if the German system were the final stage on a development path (Collins 1998, p. 18). This is important once we take the view that it is the overall level of GDP rather than just industrial output that matters, since the British financial system with its global outlook clearly generated high levels of GDP per person employed. Furthermore, even if attention is limited to industrial output, it is important to bear in mind that to the extent that German banks were successful at directing funds into heavy industry, this meant that light industry was starved of funds (Neuburger and Stokes 1974, Tilly 1986). This matters because any productivity advantage that Germany enjoyed over Britain in heavy industry was offset by lower productivity in light industry (Broadberry and Fremdling 1990, Broadberry 1997a).

Arguments concerning the alleged superiority of the German universal banking system over the British specialised system rarely consider the interwar period. And yet, it is precisely during such volatile times that the disadvantages of banks tying up their assets in long-term loans to industry become most obvious. Had Britain's clearing banks become more heavily

involved in industrial rationalisation as Best and Humphries (1986), Tolliday (1987) and others have urged, it is likely that the stability of the financial system would have been threatened. As it was, the liquidity of the British clearing banks helped Britain to avoid the devastating collapse of the banking system that occurred in Germany, the United States and other countries, and there were no important bank failures in Britain during the 1930s (Collins 1998, pp. 19–20). Indeed, the experience of the financial crisis after 1929 led the United States to insist on a clear separation between commercial and investment banking in the Glass-Steagall Act of 1933 (Carosso 1970, p. 371).

4.5. *Other services*

The rest of the German market service sector appears decidedly underdeveloped in the pre-World War II period, and has attracted little attention in the modern literature.⁷ The most important other sector to consider is distribution, which Hoffmann (1965) grouped together with finance in a general trade or commerce sector (*Handel*). As with finance, one contrast between Britain and Germany is the greater importance of international business for the former, with British merchant wholesalers at the hub of a global trading system. A recent study by Jones (2000) documents the growth of the British overseas trading companies and their continued success during the pre-World War II period on the basis of the network form of organisation.

However, the quantitatively most important part of the distribution sector was domestic retailing, and here again there were important contrasts between Britain and Germany. An important trend in Britain, as in the United States, was the emergence of large-scale enterprise in retailing, in the form of multiple shops (chain stores), department stores and Co-operative Societies (Clapham 1938, pp. 238–51). Jefferys (1954, pp. 29–30, 73–4) shows that the share of large-scale retailers in the total UK retail trade increased from 13.5 per cent in 1900 to 36.5 per cent by 1939. Jefferys (1954, p. 34) sees this development as dependent on the existence of a large, steady and consistent demand from a relatively homogeneous urban working class. This provides a strong contrast with Germany, which remained a far more agricultural and rural society until well after World War II, serviced by a large number of small general shops (Mataja 1910, pp. 246–7). Although the United States was also more rural than Britain, most writers have stressed the homogeneity of US demand, even among the rural population. Whereas the mail-order store provided cheap homogeneous goods to rural consumers in the United States, this occurred on a much more limited scale in Germany

⁷ The organisational details can nevertheless be readily obtained from studies carried out by the German historical school of economics (Conrad *et al.* 1910, Aubin and Zorn 1976, Henning 1996).

(Chandler 1990, pp. 59, 420). It must also be remembered that *per capita* incomes were always higher in the United States than in Germany.

When large-scale department stores, chain stores and consumer co-operatives threatened for the first time to take significant market share from Germany's small-scale *Mittelstand* retailers in the interwar period, the latter organised buyer co-operatives and pressed for legislation to limit the growth of large retailers (Kopper 2002, pp. 15–19). Persuading the National Socialists that department stores and chain stores were part of a Jewish world conspiracy, the *Mittelstand* retailer-activists were successful in securing legislation to tax large-scale retailers more heavily, to ban the founding or expansion of such businesses, and to limit price discounts (Kopper 2002, pp. 35–8). However, a voluntary 'Aryanisation' of boards saved the department stores from extinction (Homburg 2000, pp. 175–6). Many of the restrictions on German retailing survived well into the post-World War II period (Kopper 2002, pp. 75–81).⁸

It is not simply that there were more large British firms in distribution and other services, however. It is just as important that the overall size of these service sector activities was greater in Britain, so that the many small firms were able to benefit from external economies of scale. This followed partly from the greater international orientation of the British economy, but it also resulted simply from the smaller share of economic activity accounted for by agriculture in Britain. In Germany, with such a large fraction of the total labour force engaged in agriculture and such a large share of the non-agricultural labour force engaged in industry, there was simply not the labour available to provide services on the same level as in Britain. There is thus a strong contrast between the small but specialised service sector firms in Britain, reaping external economies of scale, and the small, general service sector firms in Germany, operating at lower levels of productivity.⁹

4.6. *Large firms in British and German services*

The above analysis has suggested that German services have to be treated carefully in any international comparison, because of the way that the process of modernisation occurred in Germany. Given the importance of the railways in creating a unified market and the role of the universal banks in mobilising

⁸ Indeed, the *Rabattgesetz* of 1933, which limited discounts to 3 per cent, lasted until 2001 (Kopper 2002, p. 75).

⁹ Mataja (1910: 246) finds little more than three-quarters of the businesses in Germany's *Handel* sector in 1907 to be specialised in trade. Figures from the *Statistisches Jahrbuch für das Deutsche Reich* for 1937 show the average firm size in retailing in 1935 to vary between 2 and 4 persons in all branches apart from electrical goods and office supplies. In wholesaling, average employment was less than 8 in all branches apart from electrical goods and office supplies.

Table 8. *Largest 125 employers in the United Kingdom and Germany, circa 1907.*

	Employees in large firms	Large firm employment as % of all employment	Number of firms
A. United Kingdom			
Industry	824,093	9.2	93
Services:			
Transport & Communications	771,909	48.9	24
Distribution	48,560	19.7	6
Finance	28,625	12.4	2
Total services	849,094	9.4	32
Total economy	1,673,187	8.2	125
B. Germany (largest 125 employers)			
Industry	1,186,795	11.3	112
Services:			
Transport & Communications	994,198	76.3	11
Distribution	0	} 0.3	0
Finance	7,523		2
Total services	1,001,721	13.4	13
Total economy	2,188,516	7.7	125

Note: Gas, electricity and water are included in industry; German employment figures are available only for distribution and finance together; German employment data in transport and communications includes an allowance for technical personnel.

Source: Derived from Wardley (1999). Employment by sector from Feinstein (1972) and Hoffmann (1965).

capital for heavy industry, we should expect to see the early emergence of a number of large firms in these sectors, achieving relatively high labour productivity.¹⁰ In the rest of the service sector, however, we should expect to see relatively few large firms. The data on the 125 largest employers in Britain and Germany around the year 1907 in Table 8 allow us to compare the scale of employment in large firms with a breakdown between industry and services, and between the main service sectors.

Of the 125 largest employers in the two countries, just 13 were in services in Germany, compared with 32 in Britain. In absolute terms, the distribution of firm size was quite similar in the two countries, although a few German firms at the top end of the distribution were larger than their British counterparts, while the British firms at the lower end of the distribution were a little larger than their German counterparts (Wardley 1999). Because these giant

¹⁰ That is not to say that large scale is always good, since it can lead to the abuse of monopoly power. However, without large scale it is difficult to see how firms could have borne the fixed costs of investing in the machinery and organisational change underpinning the high volume methods needed to achieve high productivity.

German firms were largely in transport and communications (including the railways and shipping), the share of employment in this sector accounted for by large firms was extremely high. Germany's other large service sector employers in 1907 were two banks. Although no banks appeared in the list of large British employers before the amalgamations at the end of World War I, two large insurers did (Wardley 1999, Jeremy 1991). Six large retailers also appeared in the list of Britain's largest employers. So although large firm employment as a share of all employment was actually larger in Germany than in Britain in services as well as in industry, this was entirely due to the transport and communications sector. The rest of the service economy in Germany was populated by small firms.

5. German services since World War II in comparative perspective

5.1. Retreat from agriculture

Returning to the data in Table 2, as much as 24.3 per cent of the West German labour force was still employed in agriculture in 1950, compared with just 5.1 per cent in Britain. By 1990, the German and British shares were 3.4 and 2.4 per cent, respectively. This shift out of agriculture played an important role in the German 'economic miracle' of the post-World War II period, as has been widely noted in the literature (Kindleberger 1967, Dumke 1990, Temin 2002). Less widely noted, however, is the fact that this was primarily a shift of labour from agriculture into services rather than industry. Compared with other countries, Germany already had an unusually large share of both employment and GDP in manufacturing before World War II, so further expansion in this direction would have been surprising, particularly given the limited scope for importing many services. Although some labour went into industry during the 1950s and 1960s, industry's share of employment declined from the 1970s, and was smaller in 1990 than in 1950. It is also worth noting from Table 1 that although Germany pulled substantially ahead of Britain in terms of industrial labour productivity between the 1950s and 1979, subsequent developments have more or less closed that gap. It is in services that the most substantial and persistent German productivity lead has emerged.

Conventional estimates of the contribution of the release of labour from agriculture use shift-share analysis. Broadberry (1997c, p. 258) points out that structural change accounted for 0.5 per cent of the 3.1 per cent annual growth rate of aggregate labour productivity in Germany between 1950 and 1990, while over the same period structural change contributed nothing to the 1.8 per cent aggregate labour productivity growth in Britain. This means that structural change accounted for 0.5 per cent of the 1.3 per cent aggregate German labour productivity growth advantage over Britain.

Furthermore, as Broadberry (1998, pp. 386–92) points out, this is almost certainly an underestimate of the contribution of the release of labour from agriculture, since much of the rapid labour productivity growth in German agriculture (which is counted as inter-sectoral growth in the standard shift-share analysis) should be regarded as the result of the redeployment of surplus rural labour. Temin's (2002) regression-based approach attributes a central role to the initial share of the labour force in agriculture in explaining differential productivity growth performance among European countries during the post-World War II period.

This substantial shift of labour out of agriculture took place despite the continued protection of agriculture in West Germany and other European countries. However, given developments in agricultural productivity in the rest of the world and dramatic reductions in relative transport costs, feasible levels of agricultural protection were no longer sufficient to support reasonable incomes in European agriculture without a substantial increase in agricultural labour productivity. The resulting exodus of labour from German agriculture led to a substantial expansion of the service sector.

5.2. Physical and human capital in services

The shift of labour from agriculture to services provided a boost to aggregate labour productivity in Germany. This was not simply a static reallocation effect arising from the shift between sectors with different levels of value added per worker, but arose also through the accumulation of physical and human capital in services. It must be emphasised that there are severe data problems in comparing both physical and human capital across countries, even at the aggregate level, let alone at the sectoral level (O'Mahony 1999). Nevertheless, it is possible to demonstrate that the labour transferred from agriculture to services in Germany after World War II, compared to Britain, benefited from (1) higher flows of investment per head in physical capital, leading to higher stocks of physical capital per head by 1973, and (2) higher flows of investment per head in human capital, building on an existing advantage of higher stocks of human capital per head at the intermediate level, and making good a shortfall of human capital per head at the higher level.

Data problems in comparing capital intensity across countries in services are very severe, and the data on comparative Germany/UK capital per hour worked in Table 9 are available only since 1973. O'Mahony's (1999) data refer to net capital stocks and have been calculated from sectoral investment data using the perpetual inventory method and assuming common asset lives and depreciation rates in both countries. They suggest a higher level of capital intensity in Germany for the market economy as a whole already by 1973, and higher levels of capital intensity in Germany in transport and

Table 9. *Comparative Germany/UK capital per hour worked in market services, 1973–1995 (UK = 100).*

	Transport & communications	Distribution	Financial & business services	Total market economy
1973	166	182	79	133
1979	173	166	82	136
1989	180	134	109	143
1995	156	141	119	140

Source: O'Mahony (1999, pp. 6, 21).

communications and distribution.¹¹ Only in financial and business services was capital intensity higher in Britain in 1973, and even here Germany had higher capital intensity by 1989. O'Mahony's (1999) data show a rapidly rising German capital intensity advantage from the 1970s, particularly on a per hour worked basis. There is a sense in which this flatters the German service sector, since the number of hours worked per person has fallen more rapidly in Germany than in Britain, leading to both higher capital per hour and output per hour. However, the capital intensity and labour productivity advantage also exists on a per worker basis.

The greater success of Germany than Britain in accumulating physical capital after World War II can be attributed to the nature of the postwar settlement in the two countries (Bean and Crafts 1996, Eichengreen 1996). The idea of the postwar settlement was to stimulate investment through a commitment mechanism: unions are prepared to moderate wage claims so long as firms invest, and firms are prepared to invest so long as unions are prepared to moderate wage claims.¹² Whilst this appears to have worked well in economies such as Germany, with sufficiently centralised unions and employers' organisations, it faced severe difficulties in a country like Britain, with decentralised industrial relations (Crouch 1993, Bean and Crafts 1996). Although industry was most directly affected by these postwar settlements, parts of the service sector were also highly unionised, and the wage moderation effects also filtered through to services through wage relativities. Hence Eichengreen (1996) formulated the model at the whole economy level.

The labour that was moving into services, then, was working with more rapidly increasing levels of capital intensity in Germany. Just as importantly, however, Germany's expanding service sector labour force was becoming increasingly well trained. It is helpful to distinguish between intermediate and higher levels of training. Intermediate level training covers craft and technician qualifications above secondary level but below degree level,

¹¹ The German capital intensity advantage was even larger in non-market services.

¹² The original formulation of the problem was by Lancaster (1973).

Table 10. *Apprentices as a percentage of persons engaged in Great Britain and Germany, 1900–1990.*

	Great Britain		Germany	
	Services	Total	Services	Total
1895			1.60	2.99
1907	0.65	2.48	1.60	2.87
1925	0.50	2.54	0.40	3.18
1933			0.48	2.28
1951	0.59	1.87	3.89	4.75
1961	2.69	3.56	5.65	4.62
1971	2.74	3.28	5.50	4.89
1981	1.98	2.58	5.29	6.34
1990			5.31	6.08

Sources: Britain: 1907: More (1980, pp. 98–103), based on data from Board of Trade (1909), *Report of an Enquiry by the Board of Trade into the Earnings and Hours of Labour of Workpeople of the United Kingdom*, supplemented with information from Board of Trade (1915) Report of an Enquiry by the Board of Trade into the Conditions of Apprenticeship and Industrial Training in Various Trades and Occupations of the United Kingdom; 1925: derived from Ministry of Labour (1928) *Report of an Enquiry into Apprenticeship and Training for the Skilled Occupations in Great Britain and Northern Ireland, 1925–26*; 1951–1981: Office of Population Census and Surveys, *Census of England and Wales, Census of Great Britain, Census of Scotland*.

Germany: Apprentices: 1895: Statistisches Reichsamt (1898), Berufs- und Gewerbezahlung vom 14. Juni 1895. Gewerbestatistik für das Reich im Ganzen, *Statistik des Deutschen Reichs*, Neue Folge, Band 113; 1907: Statistisches Reichsamt (1909), Berufs- und Gewerbezahlung vom 12. Juni 1907. Berufsstatistik, *Statistik des Deutschen Reichs*, Band 202; 1925: Statistisches Reichsamt (1929), Volks-, Berufs- und Betriebszahlung vom 16. Juni 1925, Gewerbliche Betriebszahlung. Die gewerblichen Betriebe und Unternehmungen im Deutschen Reich, *Statistik des Deutschen Reichs*, Band 413; 1933: Statistisches Reichsamt (1936), Volks-, Berufs- und Betriebszahlung vom 1933. Das Personal der gewerblichen Niederlassungen nach der Stellung im Betrieb und die Verwendung von Kraftmaschinen, *Statistik des Deutschen Reichs*, Band 462; 1951: Statistisches Bundesamt (1957), 'Die Lehrlinge und Anlernlinge 1950 bis 1957/58', Beilage zum Heft 11/57 der *Arbeits- und sozialstatistischen Mitteilungen*; 1961, 1971: Statistisches Bundesamt (1970), 'Auszubildende in Lehr- und Anlernberufen in der Bundesrepublik Deutschland', Beilage zum Heft 12/70 der *Arbeits- und sozialstatistischen Mitteilungen*; 1981, 1990: Statistisches Bundesamt (various years), *Statistisches Jahrbuch für die Bundesrepublik Deutschland* (Wiesbaden, 1990, Table 16.7); Employment: Hoffmann (1965), Tables 14, 15, 20; Kohler (1988), Table 5.2; Statistisches Bundesamt (various years), *Statistisches Jahrbuch für die Bundesrepublik Deutschland*.

including non-examined time-served apprenticeships, while higher level training covers qualifications at the standard of a university degree including membership of professional institutions (Prais 1995, p. 17). Germany has invested relatively heavily in intermediate level qualifications in services since World War II. This can be seen in Table 10, where it is clear that apprenticeship was originally much stronger in industry than in services, in both Britain and Germany. In Germany, however, apprenticeship spread

strongly into services after World War II. Although there was a similar development in Britain during the 1950s, it occurred at a much lower level than in Germany, where vocational training has been accorded a very high priority (Prais 1995). The way in which more highly qualified labour translated into higher labour productivity in Germany has been examined in detail in a number of studies of particular sectors. In services, Prais *et al.* (1989) studied the hotel sector in Britain and Germany, while more recent work by Mason *et al.* (2000) has examined banking.

Again, the difference between the two countries can be seen as an outcome of the postwar settlement, with Germany providing a more centralised solution to the externalities posed by the possibility of free riders poaching trained workers (Carlin 1996, Soskice 1994). By 1978/79, when data on the stock of qualified labour in both countries first became available, the proportion of the labour force with at least intermediate level qualifications was 65.5 per cent in Germany compared with just 28.6 per cent in Britain (O'Mahony 1999, p. 28). The difference was almost entirely due to intermediate level qualifications, since the proportion of the labour force with higher level qualifications was 7.0 per cent in Germany and 6.8 per cent in Britain.

Britain had traditionally enjoyed an advantage over Germany in terms of higher level qualifications in services as a result of the early development in Britain of professional associations, one function of which was to oversee the provision of training (Carr-Saunders and Wilson 1933, Reader 1966). However, this advantage was eroded over time with the spread of higher education as an alternative provider of higher level qualifications. Nevertheless, O'Mahony's (1999) data still suggest a substantial British advantage in the proportion of the labour force with higher level qualifications in financial and business services in 1978/79, with 16.7 per cent in Britain compared with 12.2 per cent in Germany.

5.3. Modern office technology

German services were generally even slower than British services to adopt the American high-volume, low-margin approach. Hence we should expect to see a similar lag in the adoption of modern office technology in Germany. Table II presents some flow data on sales of office machinery in Britain, the United States and Germany from the early 1900s to the late 1960s. The starting date reflects the fact that office machinery was not recorded separately in British trade statistics before 1908, while the end date reflects the growing importance of the electronic computer.

For typewriters, there is evidence of a rapid German investment drive during the 1950s, although this fell off again during the 1960s, suggesting a postwar reconstruction effect. For cash registers, calculating machines and

Table 11. *Office machine sales per 1000 population, 1908–1968.*

A. Typewriters (units)							
	1908	1924	1930	1935	1948	1958	1968
UK	0.50	1.29	1.32	1.78	1.74	3.65	5.70
US	1.13	3.68	4.34	6.08	7.76	8.91	18.62
Germany					3.51	10.28	9.34

B. Cash registers, calculating machines and other office machinery. (£ at constant 1929 prices)					
	1930	1935	1948	1958	1968
UK	28.3	33.3	106.0	289.5	509.2
US	128.9	187.8	252.1	757.6	2,352.6
Germany		79.4	67.5	229.0	1,016.1

Notes: Sales obtained as production minus exports plus imports. US and German values converted to sterling at unit value price ratios for manufacturing; current prices in sterling converted to constant prices using the UK deflator for GDP at factor cost. Dates for US: 1900, 1925, 1929, 1937, 1947, 1958, 1967; Dates for Germany: 1936, 1950, 1958, 1967. *Sources:* Production: US: Department of Commerce (various years), *Census of Manufactures*; UK: Board of Trade (various years), *Census of Production*; Germany: Statistisches Reichsamt (1939), *Die deutsche Industrie*; Statistisches Bundesamt (various years), *Die Industrie der Bundesrepublik Deutschland*; Exports and imports: US: Department of Commerce (various years), *Foreign Commerce and Navigation of the United States*; UK: Board of Trade (various years), *Annual Statement of the Trade of the United Kingdom*; Germany: Statistisches Reichsamt (various years), *Monatliche Nachweise über den auswärtigen Handel Deutschlands*; Statistisches Bundesamt (various years), *Der Aussenhandel der Bundesrepublik Deutschland*; Population: US: Department of Commerce, *Statistical Abstract of the United States*; UK: Feinstein (1972); CSO, *Annual Abstract of Statistics*; Germany: Statistisches Reichsamt, *Statistisches Jahrbuch für das Deutsche Reich*; Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*; Manufacturing unit value price ratios: Broadberry (1997a); Deflator for GDP at factor cost, UK: Feinstein (1972); CSO, *Economic Trends Annual Supplement*.

other office machinery, there is no evidence of a systematic German lead over Britain before the late 1960s, and both countries clearly lagged behind the United States.

5.4. *International trade in services*

Finally, it is worth noting that the large advantage that Britain once reaped from a much larger tradable services sector was already much diminished by the 1970s, when systematic data become available. In part A of Table 12, we see that during the first half of the 1970s Germany overtook Britain in terms of the share of total OECD service sector credits, and retained a slightly larger share throughout the rest of the 1970s and the 1980s. However, since Germany retained a much larger share of total OECD service sector

Table 12. *International trade in services.*

	UK	Germany	USA
A. Credits as a percentage of OECD total			
1970	12.1	10.7	20.0
1975	11.1	11.5	15.4
1980	11.3	11.8	13.8
1985	9.4	10.6	21.1
1990	8.1	10.4	19.9
B. Debits as a percentage of OECD total			
1970	10.7	13.5	23.0
1975	9.6	16.1	15.4
1980	9.2	16.0	14.0
1985	7.3	12.5	23.8
1990	7.2	13.2	17.7
C. Ratio of credits to debits			
1970	1.19	0.84	0.92
1975	1.24	0.77	1.08
1980	1.31	0.78	1.06
1985	1.36	0.90	0.94
1990	1.15	0.80	1.14

Source: Derived from OECD, *Services: Statistics on International Transactions*.

debits, shown here in part B of Table 12, Germany remained a substantial net importer of services, while Britain continued to be a major net exporter of services. Hence the ratio of credits to debits in part C of Table 12 is persistently above unity for Britain and below unity for Germany.

6. Conclusions

Germany overtook Britain in comparative productivity levels for the whole economy primarily as a result of trends in services rather than trends in industry. Although German economic success has conventionally been attributed to manufacturing, it is important to distinguish between levels and growth rates of productivity. Germany had already caught up with Britain in manufacturing by the late nineteenth century, but lagged considerably in services. This meant that there was much less scope for subsequent rapid productivity growth in Germany's already productive industry than in the relatively underdeveloped service sector.

Britain's productivity lead in services before World War II can be seen as reflecting external economies of scale in a highly urbanised economy with an international orientation, while low productivity in the bulk of the German service sector reflected the underdevelopment of services in an

economy that was slow to move out of agriculture. There are, however, two important exceptions to this characterisation of German services, which have both received a great deal of attention in the literature, and hence given a misleading impression. These are the railways and the universal banks, both of which can be understood within Germany's state-driven policy of modernisation based on heavy industry. High productivity on the railways gave a substantial boost to productivity in the German transport and communications sector, particularly before World War I. The impact of the universal banks on productivity is less visible, however, since they were but one part of the wider financial services sector. It must be emphasised that the railways and the universal banks were highly unrepresentative of the German service sector before World War II, and that the more typical German service sector provider was small-scale, less specialised than in Britain, and achieving a much lower level of productivity.

As German agricultural employment contracted sharply from the 1950s, catching-up occurred in services. This was aided by a sharp increase in human and physical capital accumulation, underpinned by the institutional framework of the postwar settlement and a greater participation in the international service economy. It was important that Germany's vocational training system, so widely appreciated for its contribution to manufacturing, spread also into services. And although Germany continued to run a deficit on service sector trade, by the 1970s Germany's contribution to service sector exports was on a par with Britain's.

References

A. Official sources

United Kingdom

- BOARD OF TRADE (1909). *Report of an Enquiry by the Board of Trade into the Earnings and Hours of Labour of Workpeople of the United Kingdom*. London: HMSO.
- BOARD OF TRADE (1915). *Report of an Enquiry by the Board of Trade into the Conditions of Apprenticeship and Industrial Training in Various Trades and Occupations of the United Kingdom*. Printed but not published by the Board of Trade.
- BOARD OF TRADE (various years). *Annual Statement of the Trade of the United Kingdom*. London: HMSO.
- BOARD OF TRADE (various years). *Census of Production*. London: HMSO.
- CENTRAL STATISTICAL OFFICE (1956). *National Income Statistics: Sources and Methods*. London: HMSO.
- CENTRAL STATISTICAL OFFICE (various years). *Annual Abstract of Statistics*. London: HMSO.
- CENTRAL STATISTICAL OFFICE (various years). *Economic Trends Annual Supplement*. London: HMSO.

- CENTRAL STATISTICAL OFFICE (various years). *National Income and Expenditure*. London: HMSO.
- CENTRAL STATISTICAL OFFICE (various years). *Statistical Abstract of the United Kingdom*. London: HMSO.
- MINISTRY OF LABOUR (1928). *Report of an Enquiry into Apprenticeship and Training for the Skilled Occupations in Great Britain and Northern Ireland, 1925–26*. London: HMSO.
- OFFICE OF POPULATION CENSUSES AND SURVEYS (various years). *Census of England and Wales*. London: HMSO.
- OFFICE OF POPULATION CENSUSES AND SURVEYS (various years). *Census of Great Britain*. London: HMSO.
- OFFICE OF POPULATION CENSUSES AND SURVEYS (various years). *Census of Scotland*. London: HMSO.

Germany

- STATISTISCHES BUNDESAMT (1957). 'Die Lehrlinge und Anlernlinge 1950 bis 1957/58'. Beilage zum Heft 11/57 der *Arbeits- und sozialstatistischen Mitteilungen*.
- STATISTISCHES BUNDESAMT (1970). 'Auszubildende in Lehr- und Anlernberufen in der Bundesrepublik Deutschland'. Beilage zum Heft 12/70 der *Arbeits- und sozialstatistischen Mitteilungen*.
- STATISTISCHES BUNDESAMT (various years). *Der Aussenhandel der Bundesrepublik Deutschland*. Wiesbaden.
- STATISTISCHES BUNDESAMT (various years). *Die Industrie der Bundesrepublik Deutschland*. Wiesbaden.
- STATISTISCHES BUNDESAMT (various years). *Statistisches Jahrbuch für die Bundesrepublik Deutschland*. Wiesbaden.
- STATISTISCHES BUNDESAMT (various years). *Volkswirtschaftliche Gesamtrechnungen*. Wiesbaden.
- STATISTISCHES REICHSAMT (1898). Berufs- und Gewerbezahlungen vom 14. Juni 1895. Gewerbestatistik für das Reich im Ganzen. *Statistik des Deutschen Reichs*, Neue Folge, Band 113.
- STATISTISCHES REICHSAMT (1909). Berufs- und Gewerbezahlungen vom 12. Juni 1907. Berufsstatistik. *Statistik des Deutschen Reichs*, Band 202.
- STATISTISCHES REICHSAMT (1929). Volks-, Berufs- und Betriebszählung vom 16. Juni 1925, Gewerbliche Betriebszählung. Die gewerblichen Betriebe und Unternehmungen im Deutschen Reich. *Statistik des Deutschen Reichs*, Band 413.
- STATISTISCHES REICHSAMT (1936). Volks-, Berufs- und Betriebszählung vom 1933. Das Personal der gewerblichen Niederlassungen nach der Stellung im Betrieb und die Verwendung von Kraftmaschinen, *Statistik des Deutschen Reichs*, Band 462.
- STATISTISCHES REICHSAMT (1939). *Die deutsche Industrie*. Berlin.
- STATISTISCHES REICHSAMT (various years). *Monatliche Nachweise über den auswärtigen Handel Deutschlands*. Berlin.
- STATISTISCHES REICHSAMT (various years). *Statistisches Jahrbuch für das Deutsche Reich*. Berlin.

International

- ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (various years). *Labour Force Statistics*. Paris: OECD.
- ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (various years). *Services: Statistics on International Transactions*. Paris: OECD.
- UNITED STATES DEPARTMENT OF COMMERCE (various years). *Census of Manufactures*. Washington: GPO.
- UNITED STATES DEPARTMENT OF COMMERCE (various years). *Foreign Commerce and Navigation of the United States*. Washington: GPO.
- UNITED STATES DEPARTMENT OF COMMERCE (various years). *Statistical Abstract of the United States*. Washington: GPO.

B. Books and articles

- AUBIN, H. and ZORN, W. (eds.) (1976). *Handbuch der Deutschen Wirtschafts- und Sozialgeschichte*. Stuttgart: Klett-Cotta.
- BAKER, M. and COLLINS, M. (1999). English industrial distress before 1914 and the response of the banks. *European Review of Economic History* 3, pp. 1–24.
- BAKKER, G. (2001). Entertainment industrialised: emergence of the international film industry, 1890–1940. Unpublished Ph.D thesis, European University Institute, Florence.
- BEAN, C. and CRAFTS, N. F. R. (1996). British economic growth since 1945: relative economic decline ... and renaissance? In N. Crafts and G. Toniolo (eds), *Economic Growth in Europe Since 1945*. Cambridge: Cambridge University Press.
- BEST, M. H. and HUMPHRIES, J. (1986). The City and industrial decline. In B. Elbaum and W. Lazonick (eds), *The Decline of the British Economy*. Oxford: Clarendon Press.
- BOYCE, G. (1995). *Information, Mediation and Institutional Development: The Rise of Large-Scale Enterprise in British Shipping, 1870–1919*. Manchester: Manchester University Press.
- BROADBERRY, S. N. (1997a). *The Productivity Race: British Manufacturing in International Perspective, 1850–1990*. Cambridge: Cambridge University Press.
- BROADBERRY, S. N. (1997b). Forging ahead, falling behind and catching-up: a sectoral analysis of Anglo-American productivity differences, 1870–1990. *Research in Economic History* 17, pp. 1–37.
- BROADBERRY, S. N. (1997c). Anglo-German productivity differences 1870–1990: a sectoral analysis. *European Review of Economic History* 1, pp. 247–67.
- BROADBERRY, S. N. (1998). How did the United States and Germany overtake Britain? A sectoral analysis of comparative productivity levels, 1870–1990. *Journal of Economic History* 58, pp. 375–407.
- BROADBERRY, S. and CRAFTS, N. (2003). UK productivity performance from 1950 to 1979: a restatement of the Broadberry-Crafts view. *Economic History Review* 56, pp. 718–35.
- BROADBERRY, S. N. and FREMDLING, R. (1990). Comparative productivity in British and German industry, 1907–37. *Oxford Bulletin of Economics and Statistics* 52, pp. 403–21.

- BROADBERRY, S. and GHOSAL, S. (2002). From the counting house to the modern office: explaining comparative productivity trends in Britain and the United States since 1870. *Journal of Economic History* **62**, pp. 967–98.
- BROADBERRY, S. and GHOSAL, S. (2004). Technology, organisation and productivity performance in services: lessons from Britain and the United States since 1870. University of Warwick <<http://www2.warwick.ac.uk/fac/soc/economics/staff/faculty/broadberry/wp/>>.
- BROADBERRY, S. and IRWIN, D. (2004). Labor productivity in the United States and the United Kingdom during the nineteenth century. NBER working paper 10364, <<http://dsl.nber.org/papers/w10364.pdf>>.
- BROADBERRY, S. and MARRISON, A. (2002). External economies of scale in the Lancashire cotton industry, 1900–1939. *Economic History Review* **55**, pp. 51–77.
- BROWN, J. (1987). *Agriculture in England: A Survey of Farming, 1870–1947*. Manchester: Manchester University Press.
- CAIN, P. J. and HOPKINS, A. G. (1993). *British Imperialism: Innovation and Expansionism, 1668–1914*. London: Longman.
- CAPIE, F. and COLLINS, M. (1996). Industrial Lending by Commercial Banks, 1860s–1914: why did banks refuse loans? *Business History* **38**, pp. 26–44.
- CARLIN, W. (1996). West German growth and institutions, 1945–90. In N. Crafts and G. Toniolo (eds), *Economic Growth in Europe Since 1945*. Cambridge: Cambridge University Press.
- CAROSSO, V. P. (1970). *Investment Banking in America: A History*. Cambridge, MA: Harvard University Press.
- CARR-SAUNDERS, A. M. and WILSON, P. A. (1933). *The Professions*. Oxford: Oxford University Press.
- CASSIS, Y. (1994). *City Bankers, 1890–1914*. Cambridge: Cambridge University Press.
- CHANDLER, A. D., Jr. (1977). *The Visible Hand: The Managerial Revolution in American Business*. Cambridge, MA: Harvard University Press.
- CHANDLER, A. D., Jr. (1990). *Scale and Scope: The Dynamics of Industrial Capitalism*. Cambridge, MA: Harvard University Press.
- CLAPHAM, J. H. (1938). *An Economic History of Modern Britain: Machines and National Rivalries (1887–1914), with an Epilogue (1914–1929)*. Cambridge: Cambridge University Press.
- COLLINS, M. (1988). *Money and Banking in the UK: A History*. London: Croom Helm.
- COLLINS, M. (1998). English bank development within a European context, 1870–1939. *Economic History Review* **51**, pp. 1–24.
- CONRAD, J., ELSTER, L., LEXIS, W. and LOENING, E. (eds.) (1910). *Handwörterbuch der Staatswissenschaften*. Jena: Verlag von Gustav Fischer.
- COTTRELL, P. L. (1981). The steamship on the Mersey, 1815–80: investment and ownership. In P. L. Cottrell and D. H. Aldcroft (eds), *Shipping, Trade and Commerce: Essays in Memory of Ralph Davis*. Leicester: Leicester University Press.
- CROUCH, C. (1993). *Industrial Relations and European State Traditions*. Oxford: Clarendon Press.
- DUMKE, R. H. (1990). Reassessing the Wirtschaftswunder: reconstruction and postwar growth in West Germany in an international context. *Oxford Bulletin of Economics and Statistics* **52**, pp. 451–91.

- EDELSTEIN, M. (1971). Rigidity and bias in the British capital market, 1870–1913. In D. N. McCloskey (ed.), *Essays on a Mature Economy: Britain After 1840*. London: Methuen.
- EDWARDS, J. and OGILVIE, S. (1996). Universal banks and German industrialization: a reappraisal. *Economic History Review* 49, pp. 427–46.
- EICHENGREEN, B. (1996). Institutions and economic growth: Europe after World War II. In N. Crafts and G. Toniolo (eds), *Economic Growth in Europe since 1945*, Cambridge: Cambridge University Press.
- FEINSTEIN, C. H. (1972). *National Income, Expenditure and Output of the United Kingdom, 1855–1965*. Cambridge: Cambridge University Press.
- FIELD, A. J. (1996). The relative productivity of American distribution, 1869–1992. *Research in Economic History* 16, pp. 1–37.
- FOHLIN, C. (1999). Universal banking in pre-World War I Germany: model or myth? *Explorations in Economic History* 36, pp. 305–43.
- FREMDLING, R. (1975). *Eisenbahnen und deutsches Wirtschaftswachstum, 1840–1879: Ein Beitrag zur Entwicklungstheorie und zur Theorie der Infrastruktur*. Dortmund: Gesellschaft für Westfälische Wirtschaftsgeschichte.
- FREMDLING, R. (1977). Railroads and German economic growth: a leading sector analysis with a comparison to the United States and Great Britain. *Journal of Economic History* 37, pp. 583–604.
- FREMDLING, R. (1988). German National Accounts for the 19th and early 20th century: a critical assessment. *Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte* 75, pp. 339–55.
- FREMDLING, R. (1991). Productivity comparison between Great Britain and Germany, 1855–1913. *Scandinavian Economic History Review* 39, pp. 28–42.
- GERSCHENKRON, A. (1962). *Economic Backwardness in Historical Perspective*. Cambridge, MA: Harvard University Press.
- GREIF, A. (1989). Reputation and coalitions in medieval trade: Maghribi traders. *Journal of Economic History* 49, pp. 857–82.
- GREIF, A. (2000). The fundamental problem of exchange: a research agenda in historical institutional analysis. *European Review of Economic History* 4, pp. 251–84.
- GRUNZEL, J. (1916). *Economic Protectionism*. Oxford: Carnegie Endowment for International Peace and Clarendon Press.
- GUINNANE, T. W. (2002). Delegated monitors, large and small: Germany's banking system, 1800–1914. *Journal of Economic Literature* 40, pp. 73–124.
- HALL, M., KNAPP, J. and WINSTEN, C. (1961). *Distribution in Great Britain and North America: A Study in Structure and Productivity*. Oxford: Oxford University Press.
- HENNING, F.-W. (1996). *Handbuch der Wirtschafts- und Sozialgeschichte Deutschlands*. Paderborn: Ferdinand Schöningh.
- HOFFMANN, W. G. (1965). *Das Wachstum der deutschen Wirtschaft seit der Mitte des 19. Jahrhunderts*. Berlin: Springer.
- HOMBURG, H. (2000). The first large firms in German retailing – the chains of department stores from the 1920s to the 1970/80s: structures, strategies, management. *Jahrbuch für Wirtschaftsgeschichte* 1, pp. 171–98.
- IMLAH, A. H. (1958). *Economic Elements in the Pax Britannica: Studies in British Foreign Trade in the Nineteenth Century*. New York: Russell & Russell.

- JEFFERYS, J. B. (1954). *Retail Trading in Britain, 1850–1950*. Cambridge: Cambridge University Press.
- JEREMY, D. J. (1991). The hundred largest employers in the UK: 1907, 1935, 1955. *Business History* **33**, pp. 93–111.
- JONES, G. (2000). *Merchants to Multinationals: British Trading Companies in the Nineteenth and Twentieth Centuries*. Oxford: Oxford University Press.
- KALDOR, N. (1966). *Causes of the Slow Rate of Growth of the United Kingdom*. Cambridge: Cambridge University Press.
- KENNEDY, W. P. (1987). *Industrial Structure, Capital Markets and the Origins of British Economic Decline*. Cambridge: Cambridge University Press.
- KINDLEBERGER, C. P. (1967). *Europe's Postwar Growth: The Role of Labor Supply*. Cambridge, MA: Harvard University Press.
- KOHLER, H. (1988). *Arbeitszeit und Arbeitsvolumen in der Bundesrepublik Deutschland, 1960–1986: Datenlage-Struktur-Entwicklung*. Nürnberg: Institut für Arbeitsmarkt und Berufsforschung der Bundesanstalt für Arbeit.
- KOPPER, C. (2002). *Handel und Verkehr im 20. Jahrhundert*. München: Oldenbourg.
- LANCASTER, K. (1973). The dynamic inefficiency of capitalism. *Journal of Political Economy* **81**, pp. 1092–1110.
- MCCRAW, T. (1996). Competition and 'fair trade': history and theory. *Research in Economic History* **16**, pp. 185–239.
- MARSHALL, A. (1977) [1920]. *Principles of Economics*, 8th edn. London: Macmillan.
- MASON, G., KELTNER, B. and WAGNER, K. (2000). Productivity and Service Quality in Banking: Commercial Lending in Britain, the United States and Germany. In R. Barrell, G. Mason and M. O'Mahony (eds), *Productivity, Innovation and Economic Performance*, Cambridge: Cambridge University Press.
- MATAJA, V. (1910). Handel. In J. Conrad, L. Elster, W. Lexis and E. Loening (eds), *Handwörterbuch der Staatswissenschaften*. Jena: Verlag von Gustav Fischer.
- MITCHELL, B. R. (1980). *European Historical Statistics*, 2nd edn. London: Macmillan.
- MITCHELL, B. R. (1988). *British Historical Statistics*. Cambridge: Cambridge University Press.
- MORE, C. (1980). *Skill and the English Working Class, 1870–1914*. London: Croom Helm.
- NEUBURGER, H. M. and STOKES, H. H. (1974). German banks and German growth, 1883–1913: an empirical view. *Journal of Economic History* **34**, pp. 710–31.
- Ó GRÁDA, C. (1994). British agriculture, 1860–1914. In R. Floud and D. McCloskey (eds), *The Economic History of Britain Since 1700*, 2nd edn, vol. 2: 1860–1939, Cambridge: Cambridge University Press.
- O'MAHONY, M. (1999). *Britain's Productivity Performance 1950–1996: An International Perspective*. London: National Institute of Economic and Social Research.
- O'MAHONY, M., OULTON, N. and VASS, J. (1998). Market services: productivity benchmarks for the UK. *Oxford Bulletin of Economics and Statistics* **60**, pp. 529–51.

- OLSON, M. (1963). *The Economics of the Wartime Shortage: A History of British Food Supplies in the Napoleonic War and in World Wars I and II*. Durham, NC: Duke University Press.
- PRAIS, S. J. (1995). *Productivity, Education and Training: An International Perspective*. Cambridge: Cambridge University Press.
- PRAIS, S. J., JARVIS, V. and WAGNER, K. (1989). Productivity and vocational skills in services in Britain and Germany: hotels. *National Institute Economic Review*, November, pp. 52–74.
- PRYKE, R. (1971). *Public Enterprise in Practice: The British Experience of Nationalisation over Two Decades*. London: MacGibbon & Kee.
- READER, W. J. (1966). *Professional Men: The Rise of the Professional Classes in Nineteenth-Century England*. London: Weidenfeld & Nicolson.
- RITSCHL, A. (2004a). Spurious growth in German output data, 1913–1938. *European Review of Economic History* 8, pp. 201–23.
- RITSCHL, A. (2004b). How and when did Germany catch up to Great Britain and the US? Results from the official statistics, 1901–1960. Paper presented to Economic History Society Conference, Royal Holloway, University of London.
- RUBINSTEIN, W. D. (1993). *Capitalism, Culture and Decline in Britain, 1750–1990*. London: Routledge.
- SMITH, A. D., HITCHENS, D. M. W. N. and DAVIES, S. W. (1982). *International Industrial Productivity: A Comparison of Britain, America and Germany*. Cambridge: Cambridge University Press.
- SMOLENSKY, E. (1972). Industrial location and urban growth. In L. Davis, R. A. Easterlin and W. N. Parker (eds), *American Economic Growth: An Economist's History of the United States*. New York: Harper & Row.
- SOSKICE, D. W. (1994). Reconciling markets and institutions: the German apprenticeship system. In L. M. Lynch (ed.), *Training and the Private Sector: International Comparisons*. Chicago, IL: University of Chicago Press.
- STIGLER, G. J. (1951). The division of labor is limited by the extent of the market. *Journal of Political Economy* 59, pp. 185–93.
- TEMIN, P. (2002). The Golden Age of European growth reconsidered. *European Review of Economic History* 6, pp. 3–22.
- TILLY, R. (1986). German banking, 1850–1914: development assistance for the strong. *Journal of European Economic History* 15, pp. 113–52.
- TILLY, R. (1991). Germany. In R. Sylla and G. Toniolo (eds), *Patterns of European Industrialization: The Nineteenth Century*. London: Routledge.
- TOLLIDAY, S. (1987). *Business, Banking and Politics: The Case of British Steel, 1918–1939*. Cambridge, MA: Harvard University Press.
- VILLE, S. P. (1987). *English Shipowning during the Industrial Revolution*. Manchester: Manchester University Press.
- VILLE, S. P. (1989). Patterns of shipping investment in the port of Newcastle upon Tyne, 1750–1850. *Northern History* 25, pp. 205–21.
- VON DER DECKEN, H. and WAGENFÜHR, R. (1935). Entwicklung und Wandlung der Sachgüterproduktion. Vierteljahrshefte zur Konjunkturforschung N.F. 11, pp. 145–63.
- WAGENFÜHR, R. (1933). Die Industriewirtschaft. Entwicklungstendenzen der deutschen und internationalen Industrieproduktion 1860 bis 1932. *Vierteljahrshefte zur Konjunkturforschung Sonderheft* 31, pp. 3–70.

- WARDLEY, P. (1999). The emergence of big business: the largest corporate employers of labour in the United Kingdom, Germany and the United States c. 1907. *Business History* **41**, pp. 88–116.
- WEBB, S. B. (1980). Tariffs, cartels, technology, and growth in the German steel industry, 1879 to 1914. *Journal of Economic History* **40**, pp. 309–29.
- WHITE, E. N. (2000). Banking and finance in the twentieth century. In S. L. Engerman and R. E. Gallman (eds), *The Cambridge Economic History of the United States*, vol. III: *The Twentieth Century*. Cambridge: Cambridge University Press.