

From the Counting House to the Modern Office: Explaining Anglo-American Productivity Differences in Services, 1870–1990

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The United States overtook Britain in comparative aggregate productivity levels primarily as a result of trends in services rather than trends in industry. This occurred during the transition from customized, low-volume, high-margin business organized on the basis of networks to standardized, high-volume, low-margin business with hierarchical management from the 1870s. This transformation from the counting house to the modern office was dependent on technologies that improved communications and information processing. The technologies were slower to diffuse in Britain as a result of lower levels of education and stronger labor-force resistance to intensification.

It has been known for some time that services have made a substantial contribution to economic growth in the modern period. For both Britain and the United States, historical national accounts are available on a sectoral basis, and a number of writers have demonstrated that since the late nineteenth century, services have accounted for as large a share of output growth and productivity growth as has industry.¹ However, most economic-history textbooks of the modern period have continued to focus on industry and to provide, at best, patchy coverage of services.² When examining one country in isolation, this position could be defended as covering about half of aggregate productivity growth. However, when we seek to explain differential productivity performance and to understand how, say, the United States overtook Britain, the neglect of services becomes more difficult to under-

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¹ Matthews et al., *British Economic Growth*; Lee, *British Economy*; Gemmell and Wardley, "Contribution of Services"; Kendrick, *Productivity Trends*; and Field, "Relative Productivity."

² Atack and Passell, *New Economic View*; Engerman and Gallman, *Cambridge Economic History*; Floud and McCloskey, *Economic History*; and Booth, *British Economy*.

stand. For, as Stephen Broadberry has shown, long-run trends in comparative productivity levels for the whole economy have been driven primarily by trends in services rather than by trends in industry.³ If we are really to understand changes in comparative economic performance, then we will need to understand productivity developments in services.

One obstacle in the way of a wider appreciation of the role of services in comparative productivity performance has been the absence of a framework providing a link from technology and organization to productivity performance in services. In this article, we provide that link, building on the transition from customized, low-volume, high-margin business organized on a network basis to modern business enterprise, characterized by standardized, high-volume, low-margin business and multiple operating units managed by a hierarchy of salaried executives. Although Alfred Chandler Jr. notes that modern business enterprise began on the railways and also affected distribution, he fails to note the implications for productivity in market services, and treats these developments primarily as preconditions for the emergence of mass production in manufacturing.⁴ Indeed, Chandler's book comparing Britain, the United States, and Germany focuses exclusively on manufacturing.⁵ In this article, we characterize the shift to high-volume business in market services as a transformation from the counting house to the modern office, beginning in transport and communications and spreading more slowly, but still surely, to distribution and finance. Developments were slower in distribution where consumers continued to value the personal service offered by high-margin, low-turnover businesses, and restraints on trade such as resale price maintenance supported small, single-unit businesses.⁶ Asymmetric information and the need for trust hindered the application of an anonymous, industrial-scale approach to finance, while regulations prevented the growth of interstate banking.⁷

The growth of modern business enterprise in market services was dependent on technologies that improved communications and information processing, such as the telegraph and the telephone, the typewriter, the duplicator, the vertical filing system, and the calculating machine.⁸ These technologies were in turn dependent on the existence of appropriate social capabilities: a labor force that was both well educated and willing to accept an intensification of the labor process, with high levels of standardization and monitoring. These modern office technologies were relatively slow to diffuse in

³ Broadberry, "How did the United States?" Bernard and Jones, "Comparing Apples", similarly demonstrate the overriding importance of services for changing comparative productivity levels among OECD countries in the period since 1970.

⁴ Chandler, *Visible Hand*, pp. 81–121.

⁵ Chandler, *Scale and Scope*.

⁶ Field, "Relative Productivity," pp. 16–19.

⁷ White, *Banking and Finance*, p. 749.

⁸ Yates, *Control through Communication*; and Campbell-Kelly, "Large-scale Data Processing."

Britain as a result of differences in social capabilities: lower levels of education and stronger labor-force resistance to intensification. The role of education emphasizes the importance of nonmarket services for the productivity performance of market services, because education has been one of the most significant outputs of the nonmarket service sector.

COMPARATIVE PRODUCTIVITY LEVELS IN SERVICES, 1870–1990

Services and the Aggregate Economy

The importance of services to Britain's loss of overall productivity leadership can be demonstrated with Table 1. The concept of labor productivity used here is output per person engaged, and the estimates are based on time-series extrapolations from benchmarks in the 1930s, although they have also been checked against additional benchmarks for a number of earlier and later years. Although an earlier paper by Broadberry 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.⁹ Industry includes mineral extraction, manufacturing, construction, and the utilities, whereas services include transport and communications, distribution, 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 in 1870 aggregate labor productivity in the United States was lower than in Britain, with the U.S. overtaking occurring in the 1890s. The U.S. labor-productivity lead peaked in the 1950s, after which Britain narrowed the gap slowly.

Turning to the sectoral estimates, note first that the long-run trends in comparative labor-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 circa 1890 and 1990, the U.S. labor-productivity lead in industry declined slightly while the United States went from a position of lower aggregate labor productivity to a 33 percent lead. Note, second, that comparative productivity trends in services broadly mirror comparative productivity trends for the economy as a whole. That is not to say that industry and agriculture did not matter, particularly in shorter-run fluctuations of comparative productivity. Indeed, Broadberry notes that the U.S. productivity lead in manufacturing increased across World War I and again across World War II, but in each case the increase was not sustained.¹⁰ Also, Broadberry notes that the shift out of agriculture, a low value-added activity, occurred later in the United States,

⁹ Broadberry, "How did the United States?"

¹⁰ Broadberry, *Productivity Race*.

TABLE 1
COMPARATIVE U.S.–U.K. LABOR-PRODUCTIVITY LEVELS BY SECTOR,
1869–1871 TO 1990
(U.K. = 100)

	Agriculture	Industry	Services	Aggregate Economy
1869–1871	86.9	153.6	85.8	89.8
1889–1891	102.1	164.5	84.2	94.1
1909–1911	103.2	193.5	107.3	117.7
1919/20	128.0	198.2	119.0	133.3
1929	109.7	222.9	121.2	139.4
1937	103.3	190.6	120.0	132.6
1950	126.0	243.9	140.8	166.9
1973	131.2	215.1	137.3	152.3
1990	151.1	163.0	129.6	133.0

Notes: Benchmark estimates of comparative productivity levels for 1937 are projected to other years using time series for output and employment from historical national accounting sources.

Sources: Derived from Broadberry, “Forging Ahead.”

contributing to the U.S. catching up.¹¹ But again, even in shorter-run fluctuations, services dominate; the correlation coefficient R between the comparative productivity in the aggregate economy and in services in Table 1 is 0.98, compared with 0.85 between the aggregate economy and industry and 0.65 between the aggregate economy and agriculture.

To put the long-term trends in perspective, in about 1870 the service sector was highly developed in Britain and relatively underdeveloped in the United States. The subsequent development of the U.S. service sector undoubtedly had substantial effects on productivity in industry and agriculture, as Chandler notes, but it is important to recognize that the primary impact was on productivity in services.¹² Whereas in 1870 the United States already had a productivity lead in industry, Britain was ahead in services. In 1990 the United States was also ahead in services.

Market Services

Although it is acknowledged that there are difficulties of interpretation in the case of nonmarket services, where it is hard to measure output independently of inputs, these difficulties are much less severe in market services such as transport and communications, distribution, and finance. The guide to the U.K. national accounts lists the primary indicators used in tracking real output, which runs to seven pages on market services.¹³ In transport, the key indicators are ton-miles and passenger miles for freight and passengers, respectively, whereas for communications we have data on indicators such

¹¹ Broadberry, “How did the United States?”

¹² Chandler, *Visible Hand*.

¹³ U.K., *National Income Statistics*, pp. 359–65.

TABLE 2
COMPARATIVE U.S.–U.K. LABOR-PRODUCTIVITY LEVELS IN MARKET SERVICES,
1869–1871 TO 1990
(U.K. = 100)

	Transport and Communications	Distribution	Finance, Professional, and Personal Services
1869–1871	110.0	66.9	64.1
1889–1891	167.1	97.0	53.2
1909–1911	217.4	120.0	77.9
1919/20	250.6	109.0	103.6
1929	231.5	121.9	101.5
1937	283.4	119.8	96.1
1950	348.4	135.2	111.5
1973	303.3	149.6	118.0
1979	302.7	153.8	118.3
1990	270.5	166.0	101.0

Notes: Benchmark estimates of comparative productivity levels for 1937 are projected to other years using time series for output and employment from historical national accounting sources.

Sources: Broadberry, “Forging Ahead.”

as items of mail, telephone calls, and telegraph messages. For distribution, we can track the volume of goods produced and consumed in all the main branches, whereas in finance we can measure the number of key transactions such as check clearings and stock-exchange transactions, the number and real value of loans, and the number and real value of insurance policies. Many of these indicators are available on a comparative basis, and have been used to derive the estimates of comparative U.S.–U.K. labor-productivity levels by sector in Table 2. We would not suggest that these measures of output and productivity in market services are perfect, but we do think they are good enough to establish the basic trends in comparative productivity performance.¹⁴ At the very least, we think it is important that these trends should be set out explicitly and investigated, because most economic historians and economists appear to accept the trends in comparative productivity performance at the whole economy level and in the commodity-producing sectors of the economy. Given the shortage of data on potential explanatory variables, the analysis of the role of services in growth cannot hope to be as sophisticated or as complete as the analysis of the role of industry, but this should not be a reason for continuing to ignore services.

Broadberry shows that there was a wide spread of comparative productivity levels across different industries within manufacturing for the U.S.–U.K. case.¹⁵ Similarly, there was a spread of comparative productivity levels

¹⁴ Indeed, the approach is widely used today in preference to some of the more experimental methods explored in Griliches, *Output Measurement*. See, for example, Baily and Solow, “International Productivity Comparisons”; O’Mahony, *Britain’s Productivity Performance*; and McKinsey Global Institute, *Service Sector Productivity*.

¹⁵ Broadberry, *Productivity Race*.

TABLE 3
BENCHMARK ESTIMATES OF U.S.–U.K. COMPARATIVE LABOR-PRODUCTIVITY
LEVELS IN MARKET SERVICES, 1870–1993 (U.K.=100)

	1870	1890	1910	1924	1930	1937
Railways	76.2	158.2	215.5	342.2	447.9	390.6
Communications			143.5	136.1	166.5	270.0
Distribution			118.7			119.8
Finance	43.3	68.9	119.9	155.8	103.0	86.4
	1950	1968	1993			
Railways	620.7	395.0	370.3			
Road transport		167.2				
Shipping		170.0				
Air transport		152.0				
Communications	144.6	302.0	152.9			
Distribution	148.4		143.6			
Finance	138.7		117.7			

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

Sources: Broadberry, "Forging Ahead." Railway estimates for 1870 and 1890 are derived from Fishlow, "Productivity"; Mitchell, *British Historical Statistics*; Cain, "Private Enterprise"; and Hawke, *Railways*. Additional figures for 1968 are from Pryke, *Public Enterprise*; for 1973 from Smith et al., *International Industrial Productivity*; for 1993 from O'Mahony et al., "Market Services."

within market services, as can be seen in Table 2. For selected benchmark years, it is also possible to obtain estimates of comparative labor-productivity levels at a more disaggregated level, and these are presented in Table 3. 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.

The United States had already built up a substantial lead in transport and communications before World War I, as can be seen in Table 2. The U.S. lead in this sector remained large during the interwar period, and despite a reduction in the scale of this lead since World War II, Britain remained a long way behind in transport and communications in 1990. These trends can also be seen in Table 3 on the railways, which accounted for nearly a quarter of employment in Britain's transport and communications sector at the peak of their importance before World War I, and still close to 20 percent at the end of World War II.¹⁶ Note that a substantial productivity gap had also opened up in communications before World War I and in road transport, shipping, and air transport after World War II.¹⁷

Returning to the time-series projections in Table 2, although the United States had overtaken Britain by World War I in distribution, the lead was relatively small and remained so between the wars. This is confirmed by the

¹⁶ Mitchell, *British Historical Statistics*, pp. 104–05.

¹⁷ Smith et al., *International Industrial Productivity*.

benchmark estimates in Table 3. Only since World War II has the U.S. lead in distribution been decisive.

Returning again to the time-series projections in Table 2, we see that in finance and professional and personal services, although the United States pulled ahead across World War I, the British lead was restored during the financial crisis of the 1930s, and the U.S. productivity lead in this sector has remained relatively small since World War II. However, because these figures include professional and personal services as well as finance, it is necessary to examine the benchmark estimates in Table 3 to build up a picture for finance more narrowly defined.¹⁸ The comparative productivity trend is similar over the long run, but with some important differences in the short run. First, the United States had pulled slightly ahead of Britain in finance before rather than during World War I, and built up a bigger lead during the 1920s. Second, the U.S. financial collapse of the 1930s restored the British lead in finance as well as in professional and personal services. And third, the U.S. lead in finance narrowly defined has been substantially higher than in the broader finance and professional and personal services sector since World War II.

THE GROWTH OF MODERN BUSINESS ENTERPRISE IN SERVICES

Modern Business Enterprise and Market Services in the United States

In services, the emergence of the U.S. productivity lead is associated with the appearance of modern business enterprise, beginning in transport and communications and spreading later to distribution and finance. As noted by Chandler, the modern hierarchical corporation began on the U.S. railroads during the late nineteenth century.¹⁹ Unlike turnpikes or canals, railways required centralized operation because steam locomotives moved much faster than horse-drawn carriages or barges and operated on a single track. As the length of the track that a railroad operated extended beyond what could be managed personally by a single superintendent, the railroad was divided into geographic divisions, and each division was further subdivided by function, and managerial hierarchies appeared.²⁰ By the beginning of the

¹⁸ It is not possible to provide time series projections for finance more narrowly defined because of the absence of separate series for the United States before 1929. See Broadberry, "Forging Ahead," for a more detailed discussion of the data series.

¹⁹ Chandler, *Visible Hand*, pp. 81–121.

²⁰ Chandler, "United States," p. 16. Geography is sometimes seen as playing a role in explaining the U.S. productivity lead on the railways, since the terminal handling element is proportionately larger on the short haul routes that dominate British rail business. However, it would be difficult to account for the large swings in comparative productivity without reference to changes in organization. Although Channon, *Railways in Britain*, does not accept all of Chandler's arguments concerning organizational differences on the British and American railways, he does nevertheless use the Chandlerian framework

twentieth century, the modern corporate form had spread to other parts of the transport and communications sector, including steamship lines, urban traction systems, and the telegraph and telephone systems.²¹

These changes in transport and communications were accompanied by the emergence of modern business enterprise in distribution, with commodity dealers who bought directly from farmers and sold directly to processors replacing commission merchants in the distribution of agricultural produce and with full-line wholesalers replacing commission merchants in the marketing of manufactures.²² Also, from the 1880s wholesalers were beginning to lose ground to direct links between manufacturers and the new mass retailers such as department stores, chain stores, and mail-order houses.²³ Nevertheless, modern business enterprise did not diffuse as widely in distribution as in transport and communications. For one thing, there were limits to the degree of centralization and standardization that consumers found acceptable in retailing, particularly given the relatively low levels of population density in the United States.²⁴ And second, as Alexander Field notes, there were restraints on competition which acted to support small retail outlets.²⁵ In particular, resale price maintenance retained an ambiguous legal status until 1975 and limited price competition, making it easier for small independent retailers to survive.²⁶ In addition, state legislation aimed at supporting the independent retailers applied escalating tax rates to businesses with two or more retail outlets.²⁷

The modern business enterprise was relatively slow to develop in American finance, partly because of the nature of the business, but also partly because of the regulatory environment. Dealing first with the nature of the business, there are obvious dangers in adopting a high-volume, impersonal, standardized approach to banking and finance, because asymmetric information and trust are very important in this sector.²⁸ Although simple routines have been developed for assessing risks on relatively small transactions, reputation and personal contact have often remained important on large transactions. Hence we should not be surprised to see that low-volume, high-margin business has continued to be important in financial services, particularly in international finance, where networks of personal contacts

as the basis of his comparison. Note that the technological developments emphasized by Fishlow, "Productivity and Technological Change", such as more powerful locomotives pulling longer and heavier trains, were only possible within a system organized on a high-volume basis.

²¹ Chandler, *Visible Hand*, pp. 189–203.

²² Chandler, "United States," pp. 19–20.

²³ *Ibid.* p. 20.

²⁴ Hall et al., *Distribution*, pp. 131–38; and Field, "Relative Productivity," p. 27.

²⁵ *Ibid.*, pp. 25–27.

²⁶ McCraw, "Competition."

²⁷ Tedlow, *New and Improved*, pp. 214–26; and Perkins, *Wall Street*, pp. 119–20.

²⁸ Stiglitz and Weiss, "Credit Rationing"; and Lamoreaux, *Insider Lending*.

can be more important than modern business enterprise in generating high value added.²⁹ Nevertheless, it seems clear that the emergence of modern business enterprise in banking and finance in the United States has also been limited by regulation. In particular, regulations prevented the growth of interstate banking, keeping concentration in U.S. banking relatively low.³⁰ Charles Calomiris also cites the Glass-Steagall Act and Regulation Q as helping to keep American banks small by keeping apart commercial and investment banking and by setting a ceiling on interest rates that could be paid on bank deposits.³¹

The Link to Productivity in Market Services

The growth of modern business enterprise in services can be characterized as a shift to high-volume, low-margin business, which required enormous technological and organizational change. As a result of these changes, the counting house of the nineteenth century, which had been common in a range of trades covering the transport and communications, distribution and financial sectors, including banking, insurance, shipping, broking and merchant wholesaling, was transformed into the modern office of the twentieth century.³²

The transition from the counting house to the modern office was permitted by developments in information and communications technologies, which allowed a high-volume approach to business.³³ It is useful to consider developments in three main areas: telecommunications technologies, including the telegraph and the telephone; written communications technologies, including the typewriter, the duplicator, and the vertical filing system; and data processing technologies, including the adding machine and the calculator. Rather more attention has been paid to the telegraph and the telephone than to the technologies of written communications and data processing, at least in the context of economic growth.

The telegraph and telephone opened up new possibilities for rapid exchanges of information across large distances, and hence had their biggest impact on businesses spread over large geographical distances, such as shipping companies, railways, merchant wholesalers, and international banks. In terms of office management and the switch to productivity-enhancing high-volume business, however, the impact was rather limited, because the telegraph was most often used for *ad hoc* communications and the telephone for informal communications.³⁴

²⁹ Jones, *British Multinational Banking*.

³⁰ White, "Banking and Finance," p. 749.

³¹ Calomiris, "Costs of Rejecting."

³² Anderson, *Victorian Clerks*, p. 4; and Lockwood, *Blackcoated Worker*, pp. 23–24.

³³ Yates, *Control through Communication*; and Campbell-Kelly, "Large-scale Data Processing."

³⁴ Yates, *Control through Communication*; pp. 21–22.

By contrast, the introduction of the typewriter, the duplicating machine, and the vertical filing system radically changed the way that a business could produce, reproduce, and store documents, which crucially affected the way that the whole business was organized.³⁵ In the counting house, written records were slowly entered into large ledger books using quill pen and ink. Copies had to be hand-written or made at the time of writing using a rudimentary letter press, and storage of records was necessarily chronological. The typewriter speeded up the production of documents, and together with shorthand and dictation, freed up time for managers to concentrate on executive decisions. The development of carbon paper and the duplicating machine made possible multiple copies at the time of writing, while the later introduction of photocopying separated reproduction from the production of written records. The replacement of the ledger book by the vertical filing system meant that records no longer had to be stored chronologically, and allowed incoming correspondence, outgoing correspondence and internal memoranda to be combined in a system indexed in a way that suited the record keeper.

The 1880s and 1890s saw a wave of invention of new office machinery in the United States, much of it concerned with data processing. It is not difficult to see a path from these primitive adding and calculating machines to the modern computer.³⁶ Adding machines had been built before, but the addition of a keyboard for data entry, following the development of the typewriter, made an enormous difference to the possibilities of wide diffusion.³⁷ The punched card tabulator and the cash register were further important developments in the late nineteenth century which aided the shift to high-volume business.³⁸

These developments all contributed to a transformation in the U.S. office environment. Elyce Rotella lists the following machines as commonly available in American offices by 1919: typewriters, dictating machines, stencotypes, copypresses, automatic typewriters, stencil or gelatin duplicators, typesetting machines, printing presses, photographing machines, telephones, TelAutographs, Dictographs, mechanical messenger boys (pneumatic tubes and overhead carriers), adding machines, calculating machines, billing machines, cash registers, statistical machines (card punchers and readers), mailing machines, addressing machines, letter openers, letter folders, envelope feeders, time clocks, paper cutters, padding machines, binding machines, and bailing machines.³⁹

The modern office was a more intensive working environment than the counting house, with work organized on a more systematic basis and with

³⁵ Ibid., pp. 21–64.

³⁶ Cortada, *Before the Computer*, p. 25.

³⁷ Ibid., pp. 29–30.

³⁸ Ibid., pp. 44–78.

³⁹ Rotella, *Home to Office*, pp. 69–70.

closer supervision and monitoring. These aspects of the transformation of office work are noted by David Lockwood, who argues that: the modern office typically employed more clerks than the counting house; there was a much higher degree of specialization of tasks with reduced autonomy for individual clerks; recruitment became more impersonal, less dependent on the personal networks of the counting-house era; hence there were reduced prospects of promotion to partnership within the firm as a narrower range of tasks was undertaken; and the material status advantages that clerks enjoyed over the mass of manual workers were eroded in the modern office, particularly from the 1930s.⁴⁰

It should be noted, however, that the intensification occurred for managers as well as for workers because the former had to monitor the latter closely. We may therefore expect resistance to the adoption of modern office technology where workers have power in the labor market, particularly where trade-union density is high. However, we may also expect managers and workers to perceive a common interest in slowing the adoption of modern office technology where product market power is strong and there are rents to be shared. This bargaining approach has been applied by Broadberry and Nicholas Crafts to Anglo-American productivity differences in manufacturing during the interwar period, and it is natural to extend the approach to market services, where regulation meant that restrictions on competition were much more systematic and persistent than in manufacturing.⁴¹

Although previous writers have discussed these developments in office technology and organization, it is striking how they have been seen mainly as preconditions for the emergence of mass production in manufacturing, rather than as service-sector developments in their own right. We have already noted this in the case of Chandler, but it applies also to the work of Joanna Yates, who writes explicitly within the Chandlerian framework.⁴² Here, we argue that the biggest impact of the office-technology revolution was in the market-service sector.

Modern Business Enterprise and Market Services in Britain

One defining feature of the modern business enterprise is large scale. A popular myth for a long time was that British industrial firms were smaller than their U.S. counterparts. In fact, in sectors where mass production became the norm in the United States, British firms also consolidated, but performed relatively badly.⁴³ Similarly, in those market services where high-volume, low-margin business became the norm, British firms consolidated.

⁴⁰ Lockwood, *Blackcoated Worker*, pp. 41–96.

⁴¹ Broadberry and Crafts, “Britain’s productivity Gap.”

⁴² Chandler, *Scale and Scope*; and Yates, *Control through Communication*.

⁴³ Prais, *Productivity*; Kinghorn and Nye, “Scale of Production”; and Broadberry, *Productivity Race*.

Hence, the sectoral pattern of the emergence of large-scale business in British services looks very similar to the pattern in the United States. Large firms became important first in transport and communications and spread later to distribution and finance. However, by lagging in the adoption of modern office technology, these large British service-sector firms failed to achieve the improved productivity performance of their U.S. counterparts.

Table 4 presents data on the growth of large firms in Britain, based on lists of the hundred largest employers provided by David Jeremy, with corrections by Peter Wardley.⁴⁴ It is clear from Table 4 that in Britain, large firms accounted for a high share of employment in transport and communications already before World War I, and a much lower share in distribution and finance. Equally, it is clear from Table 4 that the numbers employed in large firms increased over time in all service sectors, although in the case of distribution, this did not lead to an increase in the proportion employed in large firms between 1907 and 1935 because of a larger increase of employment in small firms during the depressed conditions between the wars.⁴⁵ Only after World War II did the share of large-scale retailers (chain stores, department stores, and co-operatives) in retail sales rise decisively above one-third.⁴⁶ Chandler has focused on rankings of U.S. firms by market capitalization, and much less is known about employment.⁴⁷ Jeremy and Douglas Farnie note that this is odd, given the emphasis on managerial hierarchies in the Chandler paradigm.⁴⁸ Nevertheless, Wardley's data on employment in 40 large U.S. firms do suggest that Britain's large service-sector firms were of a similar size to their U.S. counterparts.⁴⁹

The message of Table 4 is that the transformation from the counting house to the modern office was embarked upon in Britain with much the same sectoral pattern as in the United States, beginning in transport and communications and spreading later to distribution and finance. However, the message of Table 2 is that the productivity outcomes were much less successful in Britain. Clearly, there was more to the modern business enterprise than simply scale. Indeed, large scale may simply confer on firms greater market power, which can be utilized to resist painful reorganization. Before we consider the adoption of modern office technology in Britain, then, we need to examine the competitive environment.

⁴⁴ Jeremy, "Hundred Largest Employers"; Wardley, "Emergence of Big Business" and "Ranking of Firms." In fact, the corrections make little difference to the basic findings reported here on the proportions of employment in each sector accounted for by large firms.

⁴⁵ Foreman-Peck, "Seed-Corn or Chaff?"

⁴⁶ U.K. Board of Trade, *Report of the Census of Distribution*. Large supermarkets with self-service appeared in Britain for the first time only after World War II (Turner, *Business in Britain*, pp. 252–53).

⁴⁷ Chandler, *Visible Hand*, and *Scale and Scope*; See also Wardley, "Emergence of Big Business," p. 94.

⁴⁸ Jeremy and Farnie, "Ranking of Firms," p. 105.

⁴⁹ Wardley, "Emergence of Big Business," p.107.

TABLE 4
EMPLOYMENT IN THE LARGEST 100 EMPLOYERS IN BRITAIN, 1907–1955

	Employees in Large Firms	Large-Firm Employment as Percentage of All Employment	Number of Firms
A. 1907			
Industry	660,038	7.3	66
Services:			
Transport and communications	819,249	51.9	26
Distribution	48,560	19.7	6
Finance	28,625	12.4	2
Total services	896,434	10.0	34
Total economy	1,556,472	7.6	100
B. 1935			
Industry	1,148,749	13.3	76
Services:			
Transport and communications	894,488	56.6	9
Distribution	157,254	5.3	9
Finance	73,358	16.2	6
Total services	1,125,100	11.2	24
Total economy	2,273,849	11.3	100
C. 1955			
Industry	2,878,627	24.9	68
Services:			
Transport and communications	1,281,233	72.8	8
Distribution	395,926	12.7	16
Finance	98,442	19.9	6
Other services	38,500	0.6	2
Total services	1,814,101	15.5	32
Total economy	4,692,728	19.3	100

Sources: Derived from Jeremy, "Hundred Largest Employers," with corrections for 1907 and 1935 from Wardley, "Emergence of Big Business" and "Ranking of Firms." Sectoral employment data are from Feinstein, *National Income*.

Competition and Productivity Performance in Services

We have argued that Britain was overtaken in comparative productivity levels for the whole economy by the United States primarily as a result of trends in services rather than by trends in industry. Important permissive factors here were the sheltered nature of many services and the regulatory environment, which severely limited competition. Although there were periods when protection and regulatory policies acted to slow down the exit of inefficient firms, in the long run competitive forces have operated more effectively in industry than in services. In much of the service sector, competition from providers located abroad is impossible, while in other parts, firms typically require licenses to operate and are required to submit to a high degree of regulation. In these

heavily regulated sectors, collusion between providers has been common, as we document below. Whereas British manufacturers that failed to keep up with productivity growth abroad were ultimately replaced by imports, there was no such possibility of replacing the bulk of Britain's service providers. The survival of inefficient firms, then, is dependent on product market power. Without market power, it is not possible for the inefficient to remain in business in the long run.

A similar point has been made previously by D. McCloskey and Lars Sandberg in the context of British manufacturing during the period 1870–1914.⁵⁰ But whereas there was a high degree of competition in most British manufacturing industries before 1914, cartelization and restrictive practices had already begun to spread in a number of market services. The conference system in shipping and agreements on interest-rate setting in banking are notorious pre-1914 examples of restrictions on competition.⁵¹ These practices spread more widely during the interwar period, as protectionist regulations limited international competition and governments encouraged domestic collusion. Policies of imperial integration were adopted as a response to the autarkic environment of the interwar period, while collusion and price fixing were tolerated as a means to stabilize falling prices and to prevent real wages from rising.⁵² During the post-World War II period, an anticompetitive environment persisted in many parts of the service sector, shored up by regulation and restrictive practices. Much of the transport and communications sector was nationalized, the financial-service sector was highly regulated and resale price maintenance and other restrictive practices were prevalent in distribution.⁵³

However, we have already noted that the sheltered nature of services and restrictions on competition also limited the spread of modern business enterprise in the United States. Lack of competition, then, can really only be seen as a permissive factor in the differential productivity performance between nations, allowing inefficiency to persist. The really interesting question is why the transformation from the counting house to the modern office was more difficult in Britain than in the United States, given that services were more sheltered than industry in both countries. We have seen that the problem did not lie in the persistence of small-scale enterprise in Britain. We now show that the problem lay rather in the slow adoption of modern office technology and the social capabilities needed to reorganize.

⁵⁰ McCloskey and Sandberg, "From Damnation."

⁵¹ Deakin, *Shipping Conferences*; and Griffiths, "Development of Restrictive Practices."

⁵² Drummond, *Imperial Economic Policy*; and Broadberry and Crafts, "Implications."

⁵³ Hannah, "Economic Consequences"; Griffiths, "Development of Restrictive Practices"; and Yamey, "United Kingdom."

TABLE 5
TELEPHONES PER 100 POPULATION, 1900–1980

	Total Telephones		Business Telephones	
	United Kingdom	United States	United Kingdom	United States
1900	0.005	1.8		
1905	0.08	4.9		
1910	0.2	8.3		
1915	1.7	10.5		
1920	2.0	12.5		4.0
1925	2.9	14.6	2.1	4.8
1930	4.1	16.3	2.9	5.6
1935	5.1	13.7	3.4	5.0
1940	6.9	16.6	4.1	6.4
1950	10.2	28.4	6.2	8.5
1960	15.0	41.3	8.4	11.6
1970	25.1	59.0	12.3	16.2
1980	47.5	79.6	17.4	21.1

Sources: United Kingdom: Total and business telephones: Mitchell, *British Historical Statistics*; U.K. Post Office, *Telecommunications Statistics*; Population: Mitchell, *British Historical Statistics*. United States: Total and business telephones and population: U.S. Department of Commerce, *Historical Statistics and Statistical Abstract*.

OFFICE TECHNOLOGY AND ORGANIZATION

International Differences in the Diffusion of Office Technology

Our next task is to quantify international differences in the adoption of productivity-enhancing office technology. We begin with the diffusion of the telephone, as measured by the number of connections and extensions per 100 population, shown here in Table 5. It is only possible to distinguish between business and residential telephones from the 1920s, but it is clear that before 1920 the scale of telephone ownership was so much higher in the United States than in Britain that it must have affected business usage.⁵⁴ After 1920, although the absolute scale of the gap between the two countries continued to increase, the proportional gap narrowed. Furthermore, the gap was considerably smaller for business telephones than for total telephones. Nevertheless, it is clear that the United States retained an advantage even in business telephones, which must have affected business-to-business communications. This U.S. advantage must also have been reinforced in business-to-consumer communications, which require high overall levels of telephone ownership. One problem here, however, is that the slow development of telephone usage in Britain may reflect simply the supply policies of the Post

⁵⁴ See Hannah, "Managerial Innovation," p. 257 for a discussion of the growth of business telephone use in Britain.

TABLE 6
OFFICE MACHINE SALES PER 1000 POPULATION, 1908–1968

	1908	1924	1930	1935	1948	1958	1968
A. Typewriters (units)							
United Kingdom	0.50	1.29	1.32	1.78	1.74	3.65	5.70
United States	1.13	3.68	4.34	6.08	7.76	8.91	18.62
B. Cash Registers, Calculating Machines, and Other Office Machinery (£ at constant 1929 prices)							
United Kingdom			28.3	33.3	106.0	289.5	509.2
United States			128.9	187.8	252.1	757.6	2,352.6

Notes: Sales obtained as production minus exports plus imports. U.S. values were converted to sterling at unit-value price ratios for manufacturing; current prices in sterling were converted to constant prices using the U.K. deflator for GDP at factor cost. Dates for the United States: 1900, 1925, 1929, 1937, 1947, 1958, 1967.

Sources: Production: U.S. Department of Commerce, *Census of Manufactures*; U.K. Board of Trade, *Census of Production*; Exports and imports: U.S. Department of Commerce: *Foreign Commerce*; U.K. Customs and Excise, *Annual Statement*; Population: U.S. Department of Commerce, *Statistical Abstract*; U.K. Central Statistical Office, *Annual Abstract*; and Feinstein, *National Income*; Manufacturing unit value price ratios: Broadberry, *Productivity Race*; Deflator for GDP at factor cost: U.K. Central Statistical Office, *Economic Trends Annual Supplement*; and Feinstein, *National Income*.

Office, which had a monopoly of the telephone service for much of the period under consideration.⁵⁵

However, we can show that Britain was also slow to adopt data processing machinery and other office machinery such as the typewriter. Martin Campbell-Kelly notes that in contrast to the vast literature on the slow adoption of mass-production technology in British manufacturing, the slow adoption of office machinery in Britain has received almost no attention, and he provides a number of intriguing case studies.⁵⁶ In Table 6 we present some flow data on sales of office machinery in Britain and the United States 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, and the end date reflects the growing importance of the electronic computer. Sales have been calculated by subtracting exports from the sum of production and retained imports. In the case of typewriters, the volume of units is available, and this has been used in the comparison of sales between the countries. However, for Britain, because data for preceding years are not available, we have estimated production in the early years using the 1930 ratio of production to exports. The results are not very sensitive to this assumption because the sales figures were dominated by imports at this time. We have also been able to compare unit values to check that quality differences are not too large. In the case of cash registers, calculating machines, and other office machinery, the lack of adequate volume data means that the

⁵⁵ Foreman-Peck and Millward, *Public and Private Ownership*, p. 252.

⁵⁶ Campbell-Kelly, "Large-Scale Data Processing," p. 126.

value of sales must be used in the comparison between countries. Sales values are converted to a common currency using a unit-value price ratio, reflecting deviations from purchasing power parity. Finally, current prices in sterling are converted to constant 1929 prices using the U.K. deflator for GDP at constant factor cost.

For typewriters, the U.S.–U.K. comparative sales per 1,000 population ratio fluctuates around a level of about three-to-one, giving the United States a considerable lead. For cash registers, calculating machines, and other office machinery, the ratio fluctuates rather more, but around a higher level of the order of five-to-one. The flow data on office machine sales, then, point clearly in the same direction as the stock data on telephone ownership, with a large U.S. advantage.

Perspectives on the Case-Study Literature

Although nobody has previously assembled data on the diffusion of modern office equipment, there have been a number of case studies, which it is helpful to reconsider in the light of our findings on comparative productivity performance. Studies by Campbell-Kelly for the pre-1914 period and by Wardley for the interwar period cover the financial-services sector in the period before a sustained U.S. labor-productivity lead had emerged.⁵⁷ By contrast, the study by Campbell-Kelly of the Railway Clearing House covers a sector where a large productivity gap had opened up before World War I.⁵⁸

For the Prudential Assurance Company, Campbell-Kelly starts from the observation that it took from the 1870s to the 1930s to make the transition from manual data processing methods to the fully mechanized office.⁵⁹ There were, nevertheless, large productivity gains, with the expense ratio (the fraction of premium income consumed by administration, collection, and actuarial expenses) declining from 40.5 percent in 1920 to 22.46 percent in 1939.⁶⁰ Campbell-Kelly explains the slow adoption of modern office technology at Prudential by the longevity of life-assurance policies, which made it necessary to continue updating policies based on the old technology alongside processing new policies on any new system.⁶¹ This necessarily imparted a bias towards technological conservatism, so that it took about 60 years for Prudential to make the transition from the manual data-processing methods of the 1870s to the fully mechanized office of the 1930s. The na-

⁵⁷ Campbell-Kelly, “Large-Scale Data Processing” and “Data Processing and Technological Change”; and Wardley, “Commercial Banking Industry.”

⁵⁸ Campbell-Kelly, “Railway Clearing House.”

⁵⁹ Campbell-Kelly, “Large-Scale Data Processing.”

⁶⁰ *Ibid.*, p. 132.

⁶¹ *Ibid.*, pp. 126, 133.

ture of the business thus set limits to the process of mechanization, which therefore occurred slowly but efficiently.

Similarly, Campbell-Kelly goes on to explain how conservative attitudes towards new technology in the Post Office Savings Bank (POSB) were consistent with economic efficiency.⁶² Thus the POSB resisted the introduction of the typewriter before 1914 on the grounds that given the scale of operations, preprinted standard responses were cheaper, with more than 550 standard replies in use by 1885, rising to 1,000 by 1914.⁶³ Similarly, calculating machines were of little value to the POSB because the bank had developed an accounting system that required balances to be calculated only at the end of the year when interest calculations were made. Furthermore, interest computations could easily be made manually because the interest rate of 2.5 percent corresponded to an exact halfpenny per pound per month and interest was paid only on whole pounds for whole months. The objection to loose-leaf filing depended on a perceived threat to security, because it was almost impossible to lose an account or to create a phantom account by inserting a fresh page in a bound ledger book. In this latter case, the nature of the business set limits to the diffusion of modern office technology. In all three cases, conservative attitudes to new technology were consistent with economic efficiency. Again, it is important to note that in financial services, the United States had only just pulled ahead of Britain in productivity terms by World War I. Wardley's study of the "Big Five" British clearing banks, which comments favorably on the extent of their mechanization between the wars, also applies to the period before a sustained Anglo-American productivity gap had opened up in financial services.⁶⁴

In transport and communications, however, and particularly on the railways, a large Anglo-American productivity gap had opened up by the inter-war period. Campbell-Kelly's study of the Railway Clearing House is thus able to uncover examples of persistent inefficiency that remained sheltered from competitive pressures.⁶⁵ Thus, for example, the Office Appliances Committee established by the Railway Clearing House in 1920 recommended mechanizing the calculation of local ton-mile statistics by buying six Comptometers at £100 16s 0d each.⁶⁶ Because this would allow the replacement of 70 male clerks by six female clerks, it would yield an annual saving of over £18,000 for a one-time outlay of a little over £600! Campbell-Kelly notes that there were many similar examples, none of which elicited any critical comment from the Office Appliances Committee. It is important that the Railway Clearing House was effectively a monopoly, free

⁶² Campbell-Kelly, "Data Processing and Technological Change."

⁶³ *Ibid.*, p. 22.

⁶⁴ Wardley, "Commercial Banking Industry."

⁶⁵ Campbell-Kelly, "Railway Clearing House."

⁶⁶ *Ibid.*, p. 70.

from the competitive pressures that would have forced the adoption of the efficient technology.

SOCIAL CAPABILITIES

Education

Developing a concept first introduced by Kazushi Ohkawa and Henry Rosovsky, Moses Abramovitz argued that a society's ability to absorb new technology is limited by its social capability.⁶⁷ The key quantifiable factor affecting social capability is the level of education. In the past, attempts to attribute an important role to education in the rise of U.S. productivity leadership have foundered upon erroneous data indicating relatively low levels of education in the United States; and a focus on industry, where the link between the tasks that most workers actually perform on the shop floor and the skills learned in school seems rather tenuous. In services, by contrast, the link between education and the tasks performed by most office workers is rather closer.

On the issue of data, Angus Maddison's suggestion that the British labor force in 1913 had more years of schooling than the U.S. labor force has recently been corrected by Claudia Goldin, who shows that the data on enrolments point overwhelmingly to the opposite conclusion.⁶⁸ However, the claim of Goldin and Lawrence Katz that the early development of mass secondary schooling in the United States was important in the development of batch and continuous-process methods in industry during the early twentieth century, goes against the grain of an earlier view which sees the development of mass production in the United States as substituting away from skilled labor.⁶⁹ Furthermore, Goldin's own evidence on the cross-state variation in the level of schooling shows a negative relationship between high school graduation and the share of the labor force in manufacturing.⁷⁰ As Paul David and Gavin Wright note, a long period of time undoubtedly elapsed before industrial employers learned to make effective use of the supply of high school graduates.⁷¹ However, the move to mass secondary schooling surely makes more sense when seen in the context of the organizational and technological changes occurring in the rapidly expanding service sector during the first half of the twentieth century.⁷²

⁶⁷ Ohkawa and Rosovsky, *Japanese Economic Growth*; and Abramovitz, "Catching Up."

⁶⁸ Maddison, *Dynamic Forces*, p. 64; and Goldin, "America's Graduation."

⁶⁹ Goldin and Katz, "Origins"; and Habakkuk, *American and British Technology*.

⁷⁰ Goldin, "America's Graduation."

⁷¹ David and Wright, "Early Twentieth Century."

⁷² Indeed, Goldin "Human-Capital Century," p. 273, now cites the growth of large-scale retailing and the growth of office machinery alongside technological change in industry as factors behind the growing demand for an educated labor force in the twentieth century.

TABLE 7
EDUCATIONAL ENROLMENT RATES PER 1,000 POPULATION UNDER AGE 20,
1870–1990

	Primary	Secondary	Higher
A. Britain			
1871	118.6		
1881	238.4		
1891	285.8		
1901	344.7		1.6
1911	374.1	11.1	
1921	371.8	24.1	3.8
1931	380.6	31.7	
1938	357.1	37.1	4.8
1951	323.1	164.4	8.7
1961	299.8	233.2	13.9
1971	337.4	258.0	26.0
1981	327.4	327.4	30.5
1991	333.1	279.1	46.8
B. United States			
1870	390.6	4.2	
1880	404.5	4.6	
1890	492.5	10.3	
1900	478.9	18.7	
1910	475.6	26.8	
1920	472.9	56.1	15.8
1930	479.2	99.6	23.1
1938	472.2	147.1	29.8
1950	409.6	125.2	52.0
1960	436.6	138.6	62.5
1970	443.0	187.4	111.5
1980	389.0	248.7	167.0
1990	434.1	213.3	191.1

Sources: Britain: Primary and secondary school enrolments: Mitchell, *British Historical Statistics*; U.K. Department of Education and Science, *Education Statistics*; Higher enrolments: Halsey, *Trends*; U.K. Department of Education and Science, *Education Statistics*; Population: Mitchell, *British Historical Statistics*; U.K. Central Statistical Office, *Annual Abstract*.

United States: Primary and secondary school enrolments: U.S. Department of Commerce, *Historical Statistics* and *Statistical Abstract*; Higher enrolments: Tyack, *Turning Points*; Population: U.S. Department of Commerce, *Historical Statistics* and *Statistical Abstract*.

Table 7 provides data on formal schooling in Britain and the United States. Although there are obvious difficulties in comparing enrolment data across countries, these issues have been worked over by a number of scholars, and it is now possible to draw fairly firm conclusions in several areas.⁷³ First, although it is widely accepted that the official data on primary enrolments in England and Wales overstate the British shortfall due to under-recording, it is clear that Britain lagged behind the United States in the provision of mass primary education until about 1900, as has been widely noted

⁷³ Mitch, *Rise of Literacy*; Goldin, "America's Graduation"; and Lindert, "Democracy."

in the history of education literature. Second, Britain lagged behind the United States in the development of mass secondary education between the two World Wars. This has been noted by historians of education such as Fritz Ringer, and has also been emphasized recently in the work of Goldin.⁷⁴ Third, Britain lagged behind the United States in the provision of mass higher education after World War II. By 1990 tertiary enrolment ratios in Britain were still a long way behind U.S. levels.

Three points should be borne in mind when interpreting these trends. First, the transfer from primary to secondary education has generally occurred at a later age in the United States than in Britain, affecting the breakdown between primary and secondary education. Second, however, it is not possible to give enrolment ratios for narrower age bands, as the difference between primary and secondary education was a matter of class as well as age before World War II. Third, some of the educational deficiency in Britain may have been made up by part-time commercial education, particularly with the growth of shorthand courses at the end of the nineteenth century.⁷⁵ However, the limited evidence on enrolments in such courses in Glasgow, Lancashire, and Cheshire suggests that this could not have overturned the substantial U.S. educational advantage.⁷⁶ The higher enrolment rates in the United States clearly reflect a greater investment in human capital per person than in Britain.

Factor Prices

One factor that we might expect to influence the introduction of new technology in commerce is the price of clerical labor compared to the price of office machinery. Indeed, the standard treatment of British and American technology since the nineteenth century places a great deal of emphasis on similar factor price differences in manufacturing.⁷⁷ However, there are a number of reasons to reject factor prices as a key determinant of the differential adoption of modern office technology. First, low wages should be seen as a result of low levels of education and training, not as an indication of cheap labor. Second, the dynamic pattern of relative factor prices suggests that relative wages could not have been very important in explaining the origins of technological divergence in commerce. In fact, we can show that clerical wages were relatively high in Britain before 1914, while there was little transatlantic divergence in the price of office machinery.

The trade data underlying Table 6 suggest that typewriters sold at roughly the same price in Britain and the United States, with detailed data available

⁷⁴ Ringer, *Education*, pp. 252–53; and Goldin, “America’s Graduation.”

⁷⁵ Anderson, *Victorian Clerks*, pp. 101–04; and Guerriero Wilson, *Disillusionment*, pp. 60–62.

⁷⁶ *Ibid.*, p. 134; and Anderson, *Victorian Clerks*, pp. 92, 97.

⁷⁷ Habakkuk, *American and British Technology*; and Melman, *Dynamic Factors*.

on different specifications. Guy Routh's figures suggest that a male clerk earned an average of £99 a year in Britain in 1913/14, equivalent to the wage of a skilled worker in industry.⁷⁸ Although Paul Douglas presents data on clerical and salaried earnings in U.S. manufacturing in 1909, which point to an average of about £244 (using the exchange rate of £1 = \$4.86), this applies to all white-collar workers, including supervisors, and not just clerks.⁷⁹ On the railways, the figure is £148, and this drops to £129 in the retail and wholesale trade and £123 in the service trades in Ohio.⁸⁰ Furthermore, this comes after the wave of office machinery innovations of the 1880s and 1890s. Given the British labor-productivity lead in services in 1870 and the higher per capita incomes in Britain until the 1890s, there can be no presumption that the incentive to substitute office machinery for labor in commerce was greater in the United States than in Britain before the office revolution occurred. Clearly, once the adoption of office machinery had raised productivity, wages also increased, justifying further investment in office machinery. But wages must then be treated as an endogenous variable, and cannot be taken as an exogenous variable to explain the investment in office machinery. One further issue concerns the scale of the divergence, because it is clear that clerical wages were not so much higher in the United States as to justify a five-to-one U.S.–U.K. ratio of investment in office machinery.

Intensification, Monitoring, and Labor Resistance

The intensification of work and the intrusiveness of monitoring in the modern office are well illustrated by the data on clerical standards recommended by the Systems and Procedures Association of America in 1960, reproduced here in Table 8. In addition to these extraordinarily precise allowances for “open and close” and “chair activity,” there are detailed timings for many other activities, including “cut with scissors,” which gives different timings for the first snip and for each additional snip.⁸¹ The example is extreme, but there can be no doubt about the loss of autonomy with the general trend towards intensification and monitoring in the modern office.

These developments were clearly unwelcome to established office workers and led to a dramatic change in the composition of the British clerical labor force during the first half of the twentieth century. Routh's figures show the female share of clerical employment in Britain rising from 20.2

⁷⁸ Routh, *Occupation and Pay*, p. 104.

⁷⁹ Douglas, *Real Wages*, p. 361.

⁸⁰ *Ibid.*, pp. 361–71.

⁸¹ Braverman, *Labor*, p. 322.

TABLE 8
CLERICAL STANDARDS OF THE SYSTEMS AND PROCEDURES ASSOCIATION OF
AMERICA

Activity	Minutes
Open and close	
File drawer, open and close, no selection	0.04
Folder, open or close flaps	0.04
Desk drawer, open side drawer of standard desk	0.014
Open center drawer	0.026
Close side	0.015
Close center	0.027
Chair activity	
Get up from chair	0.033
Sit down in chair	0.033
Turn in swivel chair	0.009
Move in chair to adjoining desk or file (4 feet maximum)	0.050

Source: Braverman, *Labor*, p. 321.

percent in 1911 to 58.8 per cent in 1951.⁸² A similar feminization of the clerical labor force occurred a generation earlier in the United States, and is explained by Rotella as a response to the standardization of office work, which removed many of the firm-specific skills of the counting house.⁸³ These firm-specific skills had acted as a barrier to the employment of women, who were perceived as having shorter attachments to the labor force.

We would argue that it is useful to see these developments as parallel to the adoption of mass-production technology in manufacturing. It is well established in the literature that mass-production technology did not fit well with British social capabilities, and there are signs of similar difficulties with modern office technology in the British service sector. In manufacturing, craft workers opposed the introduction of mass-production technology that was seen as threatening workers' control over the production process.⁸⁴ Industrial relations were at their worst in large plants, where mass-production methods were most likely to be introduced.⁸⁵

As with mass-production technology in manufacturing, modern office technology in services reduced the autonomy of workers, creating an army of workers performing standardized tasks and subject to close monitoring. It is worth noting that, as in manufacturing, the pattern of British trade union densities in Table 9 tended to follow the pattern of big business growth in

⁸² Routh, *Occupation and Pay*, pp. 4–5.

⁸³ Rotella, *Home to Office*, pp. 168–69.

⁸⁴ Lewchuk, *American Technology*; and Zeitlin, "Between Flexibility."

⁸⁵ Prais, *Productivity*; and Broadberry, *Productivity Race*. It must be emphasized that the argument is not that British firms remained smaller than their U.S. counterparts in manufacturing, any more than in services (Kinghorn and Nye, "Scale of Production"). Rather, the argument is that the move to large-scale enterprise was not accompanied by the organizational and technological changes necessary to achieve high productivity.

TABLE 9
UNION DENSITY IN SERVICES, GREAT BRITAIN, 1892–1971
(percentage)

	1901	1911	1921	1931	1951	1961	1971
Railways	11.3	16.9	59.1	55.3	84.8	85.1	91.2
Road transport	14.6	33.3	59.2	48.8	93.0	91.8	85.4
Sea transport	10.6	83.3	73.4	55.7	80.4	84.0	89.8
Inland waterways	38.2	86.0	80.2	67.4	90.2	77.3	82.6
Air transport					56.1	49.3	68.9
Post and telecommunications	42.7	59.2	64.2	62.4	81.2	85.3	84.9
Distribution	2.7	5.4	9.0	7.2	15.0	12.3	11.6
Insurance, banking and finance	2.4	6.7	22.4	17.5	29.5	31.3	34.7

Source: Bain and Price, *Profiles*.

Table 4, with high union densities in the large-scale hierarchically organized transport and communications sector, and lower union densities in the distribution and financial-services sectors. George Bain explains these patterns largely in terms of the degree of employment concentration, the degree to which employers are prepared to recognize unions, and the extent of government action which promotes union recognition; and he is skeptical about the link between employment conditions and the growth of white-collar unionism.⁸⁶ However, it seems likely that the degree of employment concentration acts as a proxy for the amount of autonomy experienced by individual workers, with the working conditions of workers becoming increasingly standardized in larger organizations.⁸⁷ Also, it should be noted that transport and communications has been a particularly strike-prone sector during much of the twentieth century, in some years even accounting for more than half of all working days lost through strikes.⁸⁸

In fact, however, as in manufacturing, there is evidence that managers disliked the intensive monitoring as much as the workers who were being monitored. Thus, Campbell-Kelly finds managers in the Post Office Savings Bank as strongly opposed as the workers to the introduction of modern office technology.⁸⁹ The decision to retain bound ledgers, for example, was supported by management with the argument that a card-based system would be “most troublesome and distasteful to the clerks” and would “render their daily duties more irksome and difficult.” As Campbell-Kelly notes, the concern of the managers with the welfare of the workers rings rather hollow given their previous record, but there can be no doubt about their distaste for modern office technology.⁹⁰ This brings us back to the point

⁸⁶ Bain, *Growth*, p. 183.

⁸⁷ Lockwood, *Blackcoated Worker*, p. 141; and Anderson, *Victorian Clerks*, p. 110.

⁸⁸ Mitchell, *British Historical Statistics*, pp. 144–46.

⁸⁹ Campbell-Kelly, “Data Processing and Technological Change,” p. 24.

⁹⁰ *Ibid.*, p. 24.

made earlier about the need for product market power to enable firms to persistently use inefficient technology. It is not simply that unionized workers resisted the attempts of managers to introduce new technology. Rather, workers and managers shared rents arising from a sheltered competitive environment. This reluctance of British managers to adopt a system of tight monitoring is reflected in the emphasis on the decentralized network form of organization in large British service-sector firms, which is usually contrasted with the more hierarchical forms of organization in U.S. business during the twentieth century.⁹¹

To avoid misunderstanding, we note finally that the conservative approach of British managers and workers to modern office technology is consistent with rational behavior. We have already seen that McCloskey and Sandberg's reliance on competition to enforce optimal choice of technology in Victorian Britain's manufacturing sector is much less appropriate for the service sector, which was more sheltered than manufacturing.⁹² Furthermore, the simple static economic models that were used in this debate have increasingly come to be seen as inappropriate by economists working on dynamic issues. There are now formal models incorporating concepts such as path dependence and lock-in through economic culture, as well as endogenous growth through investment in education and other factors.⁹³ Indeed, even McCloskey has recently called for more emphasis on social factors, to complement her earlier emphasis on economic factors defined more narrowly.⁹⁴ We have also seen that parts of the service sector remained unsuitable for the type of standardized, high-volume, low-margin business that underpinned the U.S. productivity drive in services, and that Britain continued to do relatively well in services where customized, low-volume, high-margin business remained important, such as international finance. Indeed, the two approaches to business, with standardized, high-volume, low-margin business organized on the basis of hierarchies and customized, low-volume, high-margin business organized on the basis of networks, can both be shown to be supported as equilibria in an economic model.⁹⁵ This can be thought of as a service-sector analogue of the distinction between mass production and flexible production in manufacturing, which has been used widely by economic historians such as Charles Sabel and Jonathan Zeitlin and modeled formally by Paul Milgrom and John Roberts.⁹⁶ For a fuller discussion of

⁹¹ Jones, *British Multinational Banking, and Merchants to Multinationals*; Boyce, *Information*; and Broadberry and Ghosal, "Networks."

⁹² McCloskey and Sandberg, "From Damnation."

⁹³ David, "Clio"; Arthur, *Increasing Returns*; Greif, "Cultural Beliefs"; and Barro and Sala-i-Martin, *Economic Growth*.

⁹⁴ McCloskey, "Bourgeois Virtue."

⁹⁵ Broadberry and Ghosal, "Networks."

⁹⁶ Sabel and Zeitlin, *World of Possibilities*; and Milgrom and Roberts, "Economics of Modern Manufacturing."

these issues in the context of a formal economic model the reader is referred to Broadberry and Ghosal.⁹⁷

CONCLUDING COMMENTS

The United States overtook Britain in comparative-productivity levels for the whole economy primarily as a result of trends in services rather than trends in industry. Although a number of recent studies have recognized the importance of services in the process of economic growth, they have given a misleading impression about the role of services in British relative economic decline. If we confine our attention to productivity levels in late-nineteenth-century Britain, then writers such as William Rubinstein, Peter Cain and Antony Hopkins, and Clive Lee are correct to point out that the performance of services was rather better than that of industry.⁹⁸ However, they neglect to point out that Britain's productivity lead in services at that time was not sustained into the twentieth century. Hence, although we are in full agreement with these authors that the earlier "declinist" writers such as Martin Wiener, Michael Dintenfass, and Bernard Elbaum and William Lazonick exaggerated Britain's overall economic decline, we disagree over the source of the exaggeration.⁹⁹ In our view, the exaggeration of Britain's overall decline arose from the over-statement of industrial decline, not the under-estimation of Britain's service-sector performance.

The U.S. overtaking of Britain in market services occurred during the transformation from the counting house to the modern office with the growth of modern business enterprise from the 1870s. This transformation occurred first in transport and communications, before spreading to distribution and finance, and was dependent on technologies that improved communications and information processing. The pattern of diffusion across sectors in the United States was influenced by the nature of demand and the degree of shelter from competition. The overall diffusion of modern office technology was also dependent on the existence of appropriate social capabilities: a labor force that was both well-educated and willing to accept an intensification of the labor process, with high levels of standardization and monitoring. Although a process of consolidation occurred in Britain, giving rise to large-scale firms in market services, the modern office technologies were slower to diffuse as a result of lower levels of education and stronger labor-force resistance to intensification. The sheltered nature of much of the service sector limited external pressures for change that did not suit British social capabilities. The role of education emphasizes the importance of

⁹⁷ Broadberry and Ghosal, "Networks."

⁹⁸ Rubinstein, *Capitalism*; Cain and Hopkins, *British Imperialism*; and Lee, *British Economy*, and "Service Industries".

⁹⁹ Wiener, *English Culture*; Dintenfass, *Decline*; and Elbaum and Lazonick, *Decline*.

nonmarket services for the productivity performance of market services, because education is one of the principal outputs of the nonmarket service sector.

REFERENCES

- Abramovitz, Moses. "Catching Up, Forging Ahead and Falling Behind." *This JOURNAL* 46, no. 2 (1986): 385–406.
- Anderson, Gregory. *Victorian Clerks*. Manchester: Manchester University Press, 1976.
- Arthur, W. Brian. *Increasing Returns and Path Dependence in the Economy*. Ann Arbor: University of Michigan Press, 1994.
- Atack, Jeremy, and Peter Passell. *A New Economic View of American History, Second Edition*. New York: Norton, 1994.
- Baily, Martin N., and Robert M. Solow. "International Productivity Comparisons Built from the Firm Level." *Journal of Economic Perspectives* 15, no. 3 (2001): 151–72.
- Bain, George S. *The Growth of White-Collar Unionism*. Oxford: Clarendon Press, 1970.
- Bain, George S., and Robert Price. *Profiles of Union Growth: A Comparative Statistical Portrait of Eight Countries*. Oxford: Blackwell, 1980.
- Barro, Robert J., and Xavier Sala-i-Martin. *Economic Growth*. New York: McGraw-Hill, 1995.
- Bernard, Andrew B., and Charles I. Jones. "Comparing Apples to Oranges: Productivity Convergence and Measurement Across Industries and Countries." *American Economic Review* 86, no. 5 (1996): 1216–38.
- Booth, Alan. *The British Economy in the Twentieth Century*. Basingstoke: Palgrave, 2001.
- Boyce, Gordon. *Information, Mediation and Institutional Development: The Rise of Large-Scale Enterprise in British Shipping, 1870–1919*. Manchester: Manchester University Press, 1995.
- Braverman, Harry. *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century*. New York: Monthly Review Press, 1974.
- Broadberry, Stephen N. *The Productivity Race: British Manufacturing in International Perspective, 1850–1990*. Cambridge: Cambridge University Press, 1997.
- _____. "Forging Ahead, Falling Behind and Catching-Up: A Sectoral Analysis of Anglo-American Productivity Differences, 1870–1990." *Research in Economic History* 17 (1997): 1–37.
- _____. "How did the United States and Germany Overtake Britain? A Sectoral Analysis of Comparative Productivity Levels, 1870–1990." *This JOURNAL* 58, no. 2 (1998): 375–407.
- Broadberry, Stephen N., and Nicholas F. R. Crafts. "The Implications of British Macroeconomic Policy in the 1930s for Long Run Growth Performance." *Rivista di Storia Economica* 7, no. 1 (1990): 1–19.
- _____. "Britain's Productivity Gap in the 1930s: Some Neglected Factors." *this JOURNAL* 52, no. 3 (1992): 531–58.
- Broadberry, Stephen N., and Sayantan Ghosal. "Networks, Hierarchies and Economic Performance." Unpublished Manuscript.
- Cain, Peter J. "Private Enterprise or Public Utility? Output, Pricing and Investment on English and Welsh Railways, 1870–1914." *Journal of Transport History* 1, no. 1 (1980): 9–28.
- Cain, Peter J., and Antony G. Hopkins. *British Imperialism: Innovation and Expansionism 1668–1914*. London: Longman, 1993.

- Calomiris, Charles W. "The Costs of Rejecting Universal Banking: American Finance in the German Mirror, 1870–1914." In *Coordination and Information: Historical Perspectives on the Organization of Enterprise*, edited by Naomi R. Lamoreaux and Daniel M.G. Raff, 257–315. Chicago: Chicago University Press, 1995.
- Campbell-Kelly, Martin. "Large-Scale Data Processing in the Prudential, 1850–1930." *Accounting, Business and Financial History* 2, no. 2 (1992): 117–39.
- _____. "The Railway Clearing House and Victorian Data Processing." In *Information and Acumen: The Understanding and Use of Knowledge in Modern Business*, edited by Lisa Bud-Frierman, 51–74. London: Routledge, 1994.
- _____. "Information Technology and Organizational Change in the British Census, 1801–1911." *Information Systems Research* 7, no. 1 (1996): 22–36.
- _____. "Data Processing and Technological Change: The Post Office Savings Bank, 1861–1930." *Technology and Culture* 39, no. 1 (1998): 1–32.
- Carson, Daniel. "Changes in the Industrial Composition of Manpower since the Civil War." *NBER Studies in Income and Wealth* 11 (1949): 46–134.
- Chandler, Alfred D., Jr. *The Visible Hand: The Managerial Revolution in American Business*. Cambridge, MA: Harvard University Press, 1977.
- _____. "The United States: Seedbed of Managerial Capitalism." In *Managerial Hierarchies: Comparative Perspectives on the Rise of the Modern Industrial Enterprise*, edited by Alfred D. Chandler, Jr. and Herman Daems, 9–40. Cambridge, MA: Harvard University Press, 1980.
- _____. *Scale and Scope: The Dynamics of Industrial Capitalism*. Cambridge, MA: Harvard University Press, 1990.
- Channon, Geoffrey. *Railways in Britain and the United States, 1830–1940: Studies in Economic and Business History*. Aldershot: Ashgate, 2001.
- Cortada, James W. *Before the Computer: IBM, NCR, Burroughs and Remington Rand and the Industry they Created, 1865–1956*. Princeton, NJ: Princeton University Press, 1993.
- David, Paul A. "Clio and the Economics of QWERTY." *American Economic Review, Papers and Proceedings* 75, no. 2 (1985): 332–37.
- David, Paul A., and Gavin Wright. "Early Twentieth Century Productivity Growth Dynamics: An Inquiry into the Economic History of 'Our Ignorance'." Unpublished Manuscript.
- Deakin, Brian M. *Shipping Conferences: A Study of their Origins, Development and Economic Practices*. Cambridge: Cambridge University Press, 1973.
- Dintenfass, Michael. *The Decline of Industrial Britain, 1870–1990*. London: Routledge, 1982.
- Douglas, Paul H. *Real Wages in the United States, 1890–1926*. Boston: Houghton Mifflin, 1930.
- Drummond, Ian M. *Imperial Economic Policy, 1917–1939: Studies in Expansion and Protection*. London: Allen & Unwin, 1974.
- Edwards, Alba M. *Comparative Occupation Statistics for the United States, 1870–1940*. Washington, DC: GPO, 1943.
- Elbaum, Bernard, and William Lazonick, eds. *The Decline of the British Economy*. Oxford: Clarendon, 1986.
- Engerman, Stanley, and Robert Gallman, eds. *The Cambridge Economic History of the United States, Volume III: The Twentieth Century*. Cambridge: Cambridge University Press, 2000.
- Feinstein, Charles H. *National Income, Expenditure and Output of the United Kingdom, 1855–1965*. Cambridge: Cambridge University Press, 1972.

- Field, Alexander J. "The Relative Productivity of American Distribution, 1869–1992." *Research in Economic History*, 16 (1996): 1–37.
- Fishlow, Albert. "Productivity and Technological Change in the Railroad Sector, 1840–1910." In *Output, Employment and Productivity in the United States After 1800*, edited by Dorothy S. Brady, 583–646. NBER Studies in Income and Wealth, vol. 30. New York: Columbia University Press, 1966.
- Floud, Roderick, and D. McCloskey, eds. *The Economic History of Britain Since 1700, Second Edition, Volumes 1–3*. Cambridge: Cambridge University Press, 1994.
- Foreman-Peck, James. "Seed-Corn or Chaff? New Firm Formation and the Performance of the Interwar Economy." *Economic History Review* 38, no. 3 (1985): 402–22.
- Foreman-Peck, James, and Robert Millward. *Public and Private Ownership of British Industry, 1820–1990*. Oxford: Clarendon Press, 1994.
- Gemmell, Norman, and Peter Wardley. "The Contribution of Services to British Economic Growth, 1856–1913." *Explorations in Economic History* 27, no. 3 (1990): 299–321.
- Goldin, Claudia. "America's Graduation from High School: The Evolution and Spread of Secondary Schooling in the Twentieth Century." *This JOURNAL* 58, no. 4 (1998): 345–74.
- _____. "The Human-Capital Century and American Leadership: Virtues of the Past." *This JOURNAL* 61, no. 2 (2001): 263–92.
- Goldin, Claudia, and Lawrence Katz. "The Origins of Technology-Skill Complementarity." *Quarterly Journal of Economics* 113, no. 3 (1998): 693–732.
- Greif, Avner. "Cultural Beliefs and the Organization of Society: A Historical and Theoretical Reflection on Collectivist and Individualist Societies." *Journal of Political Economy* 102, no. 5 (1994): 912–50.
- Griffiths, Brian. "The Development of Restrictive Practices in the UK Monetary System." *Manchester School* 41, no. 1 (1973): 3–18.
- Griliches, Zvi, ed. *Output Measurement in the Service Sectors*. Chicago: Chicago University Press, 1992.
- Guerrero Wilson, Robbie. *Disillusionment or New Opportunities? The Changing Nature of Work in Offices, Glasgow 1880–1914*. Aldershot: Ashgate, 1998.
- Habakkuk, H. John. *American and British Technology in the Nineteenth Century*. Cambridge: Cambridge University Press, 1962.
- Hall, Margaret, John Knapp, and Christopher Winsten. *Distribution in Great Britain and North America: A Study in Structure and Productivity*. Oxford: Oxford University Press, 1961.
- Halsey, Albert H., ed. *Trends in British Society Since 1900: A Guide to the Changing Social Structure of Britain, Second Edition*. London: Macmillan, 1988.
- Hannah, Leslie. "Managerial Innovation and the Rise of the Large-Scale Company in Interwar Britain." *Economic History Review* 27, no. 2 (1974): 252–70.
- _____. "The Economic Consequences of the State Ownership of Industry, 1945–1990." In *The Economic History of Britain Since 1700, Second Edition, Volume 3: 1939–1992*, edited by Roderick Floud and D. McCloskey, 168–94. Cambridge: Cambridge University Press, 1994.
- Hawke, Gary R. *Railways and Economic Growth in England and Wales, 1840–1870*. Oxford: Oxford University Press, 1970.
- Jeremy, David J. "The Hundred Largest Employers in the UK: 1907, 1935, 1955." *Business History* 33, no. 1 (1991): 93–111.
- Jeremy, David J., and Farnie, Douglas A. "The Ranking of Firms, the Counting of Employees, and the Classification of Data: A Cautionary Note." *Business History* 43, no. 3 (2001): 105–18.

- Jones, Geoffrey. *British Multinational Banking, 1830–1990*. Oxford: Clarendon Press, 1993.
- _____. *Merchants to Multinationals: British Trading Companies in the Nineteenth and Twentieth Centuries*. Oxford: Oxford University Press, 2000.
- Kendrick, John W. *Productivity Trends in the United States*. Princeton, NJ: Princeton University Press, 1961.
- Kinghorn, Janice R., and Nye, John V. “The Scale of Production in Western Economic Development: A Comparison of Official Industry Statistics in the United States, Britain, France, and Germany, 1905–1913.” *This JOURNAL* 56, no. 1 (1996): 90–112.
- Lamoreaux, Naomi. *Insider Lending: Banks, Personal Connections, and Economic Development in Industrial New England*. Cambridge: Cambridge University Press, 1994.
- Lebergott, Stanley. “Labor Force and Employment, 1800–1960.” In *Output, Employment and Productivity in the United States after 1800*, edited by Dorothy S. Brady, 117–204. NBER Studies in Income and Wealth, vol. 30. New York: Columbia University Press, 1966.
- Lee, Clive H. *The British Economy Since 1700: A Macroeconomic Perspective*. Cambridge: Cambridge University Press, 1986.
- _____. “The Service Industries.” In *The Economic History of Britain Since 1700, Second Edition, Volume 2: 1860–1939*, edited by Roderick Floud and D. McCloskey, 117–44. Cambridge: Cambridge University Press, 1994.
- Lewchuk, Wayne. *American Technology and the British Vehicle Industry*. Cambridge: Cambridge University Press, 1987.
- Lindert, Peter H. “Democracy, Decentralization, and Mass Schooling Before 1914: Appendices.” Working Paper No. 105, Agricultural History Center, University of California, Davis, 2001.
- Lockwood, David. *The Blackcoated Worker: A Study in Class Consciousness*. London: Allen and Unwin, 1958.
- McCloskey, Deirdre N. “Bourgeois Virtue and the History of P and S.” *This JOURNAL* 58, no. 2 (1998): 297–317.
- McCloskey, D. N., and Lars G. Sandberg. “From Damnation to Redemption: Judgments on the Late Victorian Entrepreneur.” *Explorations in Economic History* 9, no. 1 (1971): 89–108.
- McCraw, Thomas K. “Competition and ‘Fair Trade’: History and Theory.” *Research in Economic History* 16 (1996): 185–239.
- McKinsey Global Institute. *Service Sector Productivity*. Washington, DC: McKinsey Global Institute, 1992.
- Maddison, Angus. *Dynamic Forces in Capitalist Development*. Oxford: Oxford University Press, 1991.
- Matthews, Robin C.O., Charles H. Feinstein, and John C. Odling-Smee. *British Economic Growth, 1856–1973*. Oxford: Oxford University Press, 1982.
- Melman, Seymour. *Dynamic Factors in Industrial Productivity*. Oxford: Blackwell, 1967.
- Milgrom, Paul, and John Roberts. “The Economics of Modern Manufacturing: Technology, Strategy and Organization.” *American Economic Review* 80, no. 3 (1990): 511–28.
- Mitch, David F. *The Rise of Literacy in Victorian England: The Influence of Private Choice and Public Policy*. Philadelphia, PA: University of Pennsylvania Press, 1992.
- Mitchell, Brian R. *British Historical Statistics*. Cambridge: Cambridge University Press, 1988.
- O’Mahony, Mary. *Britain’s Productivity Performance 1950–1996: An International Perspective*. London: National Institute of Economic and Social Research, 1999.

- O'Mahony, Mary, Nicholas Oulton, and Jennet Vass. "Market Services: Productivity Benchmarks for the UK." *Oxford Bulletin of Economics and Statistics* 60, no. 4 (1998): 529–51.
- Ohkawa, Kazushi, and Henry Rosovsky. *Japanese Economic Growth: Trend Acceleration in the Twentieth Century*. Stanford, CA: Stanford University Press, 1973.
- Perkins, Edwin J. *Wall Street to Main Street: Charles Merrill and Middle-Class Investors*. Cambridge: Cambridge University Press, 1999.
- Prais, Sigbert J. *Productivity and Industrial Structure: A Statistical Study of Manufacturing Industry in Britain, 1909–70*. Cambridge: Cambridge University Press, 1981.
- Pryke, Richard. *Public Enterprise in Practice: The British Experience of Nationalization over Two Decades*. London: MacGibbon & Kee, 1971.
- Ringer, Fritz K. *Education and Society in Modern Europe*. Bloomington, IN: Indiana University Press, 1979.
- Routh, Guy. *Occupation and Pay in Great Britain, 1906–60*. Cambridge: Cambridge University Press, 1965.
- Rotella, Elyce J. *From Home to Office: U.S. Women at Work, 1870–1930*. Ann Arbor, MI: UMI Research Press, 1981.
- Rubinstein, William D. *Capitalism, Culture and Decline in Britain, 1750–1990*. London: Routledge, 1993.
- Sabel, Charles F., and Jonathan Zeitlin, eds. *World of Possibilities: Flexibility and Mass Production in Western Industrialization*. Cambridge: Cambridge University Press, 1997.
- Smith, Anthony D., David M. W. N. Hitchens, and Stephen W. Davies. *International Industrial Productivity: A Comparison of Britain, America and Germany*. Cambridge: Cambridge University Press, 1982.
- Stiglitz, Joseph and Andrew Weiss. (1981) "Credit Rationing in Markets with Imperfect Information." *American Economic Review* 71, no. 3 (1981): 393–410.
- Tedlow, Richard S. *New and Improved: The Story of Mass Marketing in America*. Boston MA: Harvard Business School Press, 1996.
- Turner, Graham. *Business in Britain*. London: Eyre and Spottiswoode, 1969.
- Tyack, David, ed. *Turning Points in American Educational History*. Lexington, MA: Xerox, 1967.
- U.K. Board of Trade. *Census of Production: Final Report*. London: HMSO.
- U.K. Board of Trade. *Report on the Census of Distribution and Other Services*. London: HMSO.
- U.K. Central Statistical Office. *Annual Abstract of Statistics*. London: HMSO.
- U.K. Central Statistical Office. *Economic Trends Annual Supplement*. London: HMSO.
- U.K. Central Statistical Office. *National Income Statistics: Sources and Methods*. London: HMSO, 1956.
- U.K. Customs and Excise. *Annual Statement of the Trade of the United Kingdom*. London: HMSO.
- U.K. Department of Education and Science, *Education Statistics for the United Kingdom*, London: HMSO.
- U.K. Office of Population Censuses and Surveys. *Census of England and Wales*. London: HMSO.
- U.K. Office of Population Censuses and Surveys. *Census of Scotland*. London: HMSO.
- U.K. Post Office. *Telecommunications Statistics*, London: HMSO.
- U.S. Department of Commerce. *Census of Manufactures*, Washington, DC: GPO.
- U.S. Department of Commerce. *Foreign Commerce and Navigation of the United States*, Washington, DC: GPO.

- U.S. Department of Commerce. *Historical Statistics of the United States: Colonial Times to 1970*, Washington, DC: GPO, 1975.
- U.S. Department of Commerce. *Statistical Abstract of the United States*, Washington, DC: GPO.
- Wardley, Peter. "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, no. 4 (1999): 88–116.
- _____. "The Commercial Banking Industry and its Part in the Emergence and Consolidation of the Corporate Economy in Britain before 1940." *Journal of Industrial History* 3, no. 2 (2000): 71–97.
- _____. "On the Ranking of Firms: A Response to Jeremy and Farnie." *Business History* 43, no. 3 (2001): 119–34.
- White, Eugene N. (2000) "Banking and Finance in the Twentieth Century." In *The Cambridge Economic History of the United States, Volume III: The Twentieth Century*, edited by Stanley L. Engerman and Robert E. Gallman, 743–802. Cambridge: Cambridge University Press, 2000.
- Wiener, Martin J. *English Culture and the Decline of the Industrial Spirit, 1850–1980*. Cambridge: Cambridge University Press, 1981.
- Yamey, Basil S. "The United Kingdom." In *Resale Price Maintenance*, edited by Basil S. Yamey, 249–98. London: Weidenfeld & Nicolson, 1966.
- Yates, Joanna. *Control through Communication: The Rise of System in American Management*. Baltimore, MD: Johns Hopkins University Press, 1989.
- Zeitlin, Jonathan. "Between Flexibility and Mass Production: Strategic Ambiguity and Selective Adaptation in the British Engineering Industry, 1830–1914." In *World of Possibilities: Flexibility and Mass Production in Western Industrialization*, edited by Charles F. Sabel, and Jonathan Zeitlin, 241–72. Cambridge: Cambridge University Press, 1997.

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