CHAPTER 9

CAPITAL FORMATION

9.0 GROSS DOMESTIC FIXED CAPITAL FORMATION AT CURRENT AND CONSTANT PRICES, 1856–1965

DEFINITION OF THE SERIES[1]

Investment in physical assets and stocks is described as capital formation, to distinguish it from investment in financial assets. Domestic investment in fixed assets is covered in this chapter and investment in stocks and work in progress in Chapter 9.3. An estimate of net investment abroad is given in Chapter 6 (Table 15), but that covers both physical and financial assets.

Fixed capital formation represents additions to physical productive assets that yield a continuous service beyond the year in which they are acquired. In principle, improvements to fixed assets, e.g. extensions and structural alterations to buildings, should be included; and expenditure on maintenance and repairs to keep the assets in running order should be regarded as an operating expense, except in so far as it involves an element of improvement.[2] In practice it is often not possible to obtain data with precisely this demarcation of capital and current expenditure and the estimates depend in large measure on the accounting conventions adopted by businesses.

The estimates relate primarily to fixed assets used for productive purposes by trading enterprises owned by persons, corporate bodies and public authorities. Other categories of fixed assets, in particular, private houses, and schools, roads and other non-trading assets of public authorities or private non-profit-making bodies are included by a conventional extension of the term 'productive purposes'. Changes in the value of livestock and growing crops are included in Chapter 9.3 with stocks and work in progress. There are two important types of asset which are not included: household durable goods and cars (treated as consumers' current expenditure in Chapter 2.4) and assets acquired for military purposes (treated as Central Government current expenditure in Chapter 4.4).

The estimates are described as *gross* fixed capital formation to indicate that no deduction is made for wear and tear, obsolescence and accidental damage. (For *net* capital formation see Chapter 9.2). It thus covers replacements of assets scrapped (retired) and new additions to the stock of assets. The flow is measured by the cost of acquisition of the assets (including costs of transport and installation, and professional and legal fees, but not costs of obtaining finance) less any amounts received from the sale of fixed assets, including assets sold for scrap. For certain assets, which take a long time to construct, progress payments are made to the contractor during the course of construction, and these payments will generally be included in the estimates of fixed capital formation, even though the assets in question will not yet be in use.

Transactions in land and second-hand assets are included in the estimates for individual sectors, but for the economy as a whole these transactions cancel out except for a positive item arising from costs of transfer (such as the legal costs incurred in the purchase of land or the margins earned by second-hand dealers, including their charge for any reconditioning work); and a negative item arising from sales of assets abroad, notably second-hand ships, or to final consumers, as when a used car is sold by a business to a private individual.

Finally, the word *domestic* is included in the title because the fixed assets covered are limited to those located in the United Kingdom (irrespective of whether or not they are owned by residents of the country). The one qualification to this is that all ships and aircraft owned by United Kingdom residents are included whatever their physical location, and all those owned by non-residents are excluded.

Broadly the same definition is followed for the whole of the period covered.

Estimates of total gross domestic fixed capital formation are given for 1870–1965 at current prices in Table 2 and at constant prices in Table 5 (or as an index number in Table 7). The totals at current prices for 1856–1965 are classified by type of asset and by sector in Table 39, at constant prices by type of asset in Table 40; and for

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[1] Based on C.S.O. [73], pp. 360–3, and Feinstein [162], ch. 1.
[2] For an extended discussion of certain rather complex cases see Feinstein [162], pp. 7–10.

1882–1965 at current and constant prices by industry[1] in Tables 41 and 42. In Table 16 the current price estimates for 1920–38 and 1946–65 are brought together with the two other categories of additions to reproducible wealth: investment in stocks and work in progress (from Table 2) and net investment abroad (from Table 15) and related to estimates of savings by the various sectors.

SOURCES AND METHODS OF ESTIMATION

(i) At current prices

1946–1965

The estimates prepared by the C.S.O. for the Blue Book are based predominantly on the 'expenditure method', i.e. on accounting data of businesses and public authorities recording the expenditure allocated by them to capital account. For most private enterprises in manufacturing, distribution and other services the information is collected by the Board of Trade in annual enquiries, with a comprehensive census at intervals of about five years and sample enquiries for intervening years. For public corporations and public authorities annual information is provided by the published accounts, and certain additional information is collected by special enquiries.

The two categories for which the 'expenditure method' is not used are agriculture and private dwellings. For the former estimates of supplies of tractors and machinery are made from statistics of imports and deliveries to the home market, estimates for cars and lorries from regular censuses of equipment in use on farms, and estimates for new buildings and works (including farm ditching, drainage etc.) from government grants for such capital improvements and on periodic surveys of expenditure by farmers. For private dwellings the estimate is based on a series compiled from returns from a sample of builders, with an addition for professional and other charges.

1939–1945

For manufacturing, construction, distribution and other services the estimates used for buildings and for plant and machinery are those given by Dean [154, p. 334]. These were derived from three sources: Ministry of Works figures for the value of work done on industrial facilities [77, p. 56];[2] estimates by P. Redfern[3] for privately-financed investment in plant and machinery – this series is based on depreciation allowances for income tax; and amounts derived from Ashworth[4] and other volumes in the Civil Series of the *History of the Second World War* for government-financed investment in plant and machinery, excluding £250 m. for specialised armaments capacity estimated to have been scrapped after the war.[5] It may be noted that all the

government-financed and almost all the privately financed investment was in manufacturing.

For all other sectors the estimates are based mainly on series prepared by Redfern [235, pp. 173–81] or by Dean [154, pp. 342–4] for items not covered by Redfern. (These unpublished estimates for the war years were provided by Mr Dean). The main sources used for these sectors are published accounts for local authorities, railways and public utilities; and estimates of average costs and physical units: tonnage launched, vehicles (buses, goods vehicles and a proportion of new cars) newly registered, and houses built.

1920–1938

All the estimates for this period are taken unchanged from a previous volume in this series [162]. These estimates were derived from a variety of different sources including samples of company accounts for manufacturing and certain services; published accounts for local authorities, railways, Post Office, and gas, electricity and water; Census of Production-based estimates of new building work allocated by type of building for shops, hotels etc. and farm buildings; average costs and numbers built or newly registered for dwellings, ships and vehicles; and Inland Revenue wear and tear allowances for plant and machinery in distribution and certain services.

The decision to use the previous estimates without adjustment reflects the lack of data on which to base any

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[1] Details regarding the classification by industry are given in the notes to Table 41. From 1956 onwards the classification is on the basis of the business unit and not the establishment; for 1948–55 and 1920–38 (see [162], p. 26) the figures are on an establishment basis. Since the classification on either basis is based on *ownership*, it will not provide a precise analysis by industry of *use* in those cases where assets owned by one industry (e.g. buildings owned by banks and property companies) are leased to another. Ownership of dwellings is, however, treated as a separate industry. For years before 1920 the classification is not sufficiently detailed for these distinctions to be relevant.

[2] This series is far from ideal. It covers the value of work done (both new work and repairs and maintenance) by firms registered in the twelve main trades of the building and civil engineering industries, but excludes firms consisting solely of working principals and also excludes certain specialist trades; see [77, p. 213] for details. There is no way of knowing whether the value of repairs and maintenance included is greater or less than the value of new work excluded.

[3] P. Redfern, 'Net Investment in Fixed Assets, 1938–53', *J. R. Statist. Soc.*, A, 118, 1955 [235], p. 179.

[4] W. Ashworth, *Contracts and Finance*, 1953 [111], Appendix Tables A, B and C.

[5] The cost of this equipment is treated in the same way as other military expenditure and included in Chapter 4.4.

TABLE 9.1 COMPARISON OF ESTIMATES OF DOMESTIC FIXED CAPITAL
FORMATION IN 1907   (£M.)

	Total work done			Repairs and maintenance			Domestic fixed capital formation		
	Buildings and works	Engineering etc.	Total	Buildings and works	Engineering etc.	Total	Buildings and works	Engineering etc.	Total
1. Flux	..	..	342	..	..	132	..	..	210
2. Clark	149	102	251	62	41	103	87	61	148
3. Cairncross	150	125	275	72	53	125	78	72	150
4. Mercer	160	139	299	60	38	98	99	101	200

SOURCES: 1. *General Report on the 1907 Census* [42(a)], pp. 30–1. £13 m. for naval shipbuilding and ordnance is excluded and the figures represent the mid-point of the range given by Flux.
2. Colin Clark, *Investment in Fixed Capital in Great Britain*, London and Cambridge Economic Service, Special Memorandum No. 38, 1934 [147] as amended in [149], pp. 177–8. To obtain consistency with the other estimates I have transferred £23 m. for work done on railways, telephones etc. from engineering to buildings and works [147, p. 5] and have added back the £2 m. which Clark deducted to exclude Southern Ireland.
3. Cairncross [143], pp. 120–3.
4. Mercer, *Gross Capital Formation, 1907*, mimeographed, 1964 [210], p. 26. The figures represent the mid-point of the range given by Miss Mercer.

significant changes rather than a belief that improvement is unnecessary.

The classification by industry and by type of asset is taken directly from [162]. I have, however, added a classification by sector (Table 39) which was not given previously.[1] It is based on the estimates for the Central Government[2] (including the Post Office) and local authorities plus the capital outlays of the three main pre-1938 public corporations: the Central Electricity Generating Board, the London Passenger Transport Board and the British Broadcasting Corporation.[3] These estimates for the public sector are then subtracted from the total to obtain the private sector as a residual. It is thus not possible to distinguish personal and company fixed capital formation. The estimate used for local authorities is not precisely the same as the corresponding estimate made for [162] but the differences are not significant. The estimate in Chapter 5.6 includes purchases of land and as this was excluded in the previous study the effect is – as required – to show the capital formation by the private sector net of receipts from the sales of land.

1856–1920

Estimates for this period are a revised version of the series which I published in 1961 [160]. The basic method is to derive a benchmark estimate for the one census year (1907), to allocate this to various components, and to extrapolate each component back to 1855 and forward to 1919.

The starting point for the estimates is the 1907 Census of Production[4] and this is the only year for which a reasonably comprehensive figure is available. Unfortunately, there is ample scope for disagreement in the derivation of a benchmark estimate from the Census. Differences arise partly from the absence of data on the extent of duplication in the returns by different trades; partly from the usual difficulties of demarcation between capital and consumer goods and between new assets and replacements, parts etc.; and partly from uncertainty as to the amount to include for items not covered by the census such as distributive margins and transport or installation costs.

Three estimates of the value of work done in 1907 on the production of capital goods (less net exports) have been published, and there is also an unpublished estimate prepared at the Department of Applied Economics by Miss B. Mercer. The four estimates are compared in Table 9.1 and range from a low of £148 m. to a high of £210 m. Of the four, the most detailed is that made by

[1] In the earlier study a series was given for the 'public and semi-public' sector which included those parts of the private sector which were nationalised after 1946. See [162], pp. 46–8.
[2] The data were obtained from the classification of expenditure made in Chapter 4.
[3] See R. F. Bretherton, F. A. Burchardt and R. S. G. Rutherford, *Public Investment and the Trade Cycle in Great Britain*, 1941 [136], pp. 290, 439 and 441.
[4] *Final Report on the First Census of Production of the United Kingdom (1907)*, Cd. 6320, 1912 [42(a)].

Cairncross in 1953, and in my view, it is both the most reliable and the closest conceptually to the estimate required for this chapter. The comparison with other estimates, particularly Miss Mercer's, suggests that it may be somewhat low, perhaps by some £10 m. However, rather than set yet another estimate marching round the world I have accepted Cairncross' figure of £150 m. as the benchmark for 1907.

The estimate published with the *Census Report* by A. W. Flux was discussed by Cairncross [143, pp. 103–6 and 120–2]. Part of the discrepancy arises because Flux allowed £30–£35 m. for costs of transport, merchants' profits etc., whereas Cairncross argues persuasively that about £5 m. would be adequate. With regard to the remaining discrepancy Cairncross observed: 'It would obviously be possible to accumulate the remaining £35 m. from the census schedules. But the real difficulty is to know whether this would not be mere duplication' [143, p. 121]. Since Flux provided no details of his estimate it is impossible to make any further investigation.

The next estimate – row 2 of Table 9.1 – was made by Colin Clark in 1934 and shows almost exactly the same result as Cairncross for the final total of new work, but there are important differences in the components. In particular, Clark's estimate for total work done on engineering, shipbuilding etc. contains no allowance either for the tools, brass goods, office equipment and miscellaneous minor items included by Cairncross, or for the costs of transport, installation etc. Part of this omission is repair work, but the balance is reflected in a 15 % lower estimate of new work done on engineering etc. However, this is largely offset by Clark's higher estimate for buildings and works: he arrived at the same estimate for total work done but classified a smaller amount as repairs and maintenance.

The substantially higher estimate – row 4 of Table 9.1 – obtained by Miss Mercer after a very thorough exploration of the Census data is due partly to the inclusion of a number of minor items (e.g. casks, pit props, tanks, ropes and cable) which Cairncross either did not treat as capital goods or assumed to be duplicated in the returns of other trades installing or working with these. However, the principal discrepancy is in the treatment of new work and repairs. Miss Mercer considered firstly that a large proportion of the construction work returned as 'alterations and repairs' should be classified for national accounting purposes as new work, and secondly that: 'acceptance of the "accounting" definitions of repairs and new work for railways, highways, public utilities and shipbuilding...resulted in the assignment of what appears to be quite unreasonable proportions of total work to the repairs category'

[210, p. 1]. I would not endorse this conclusion, mainly because the use of the 'accounting conventions' is, in my view, both acceptable and consistent with the estimates for the later periods (see, e.g. C.S.O. [73], p. 362). Moreover, even if one wanted to adjust the figures there is no objective basis on which to do so, and Miss Mercer's alternative estimates are, as she acknowledges, based on essentially arbitrary corrections and assumptions.

We therefore accept Cairncross' figure of £150 m., with the reservation that it may be slightly on the low side. The next step is to allocate the total in such a way that the components can be related to the indicators for which annual series can be constructed. In the first instance a classification was used which related essentially to the type of asset. The annual series obtained on this basis was accepted as the basic estimate. Alternative estimates were then made (see pp. 189–90, below) to provide a classification of this total by sector and, from 1882 onwards, by industry.

Cairncross provided a table showing the detailed breakdown of his estimate of new work [143, p. 123] and the present reclassification of this into 13 categories is shown in Table 9.2. In some cases the 1907 value of the indicator was adjusted to equal the Census data; for others the Census estimate was adjusted to agree with the value shown by the annual series. In most cases, including all the major items such as ships or dwellings, there is a reasonably clear basis for this allocation of the Census data, but for some items the procedure is not entirely satisfactory.[1] However, the items involved are not large and any error introduced at this point (by the use of the 'wrong' indicator to extrapolate the base year value) is unlikely to be significant.

For two of the items shown in Table 9.2 – dwellings and ships – the 1907 data distinguishes between completed units and the change in work in progress over the course of the year. The annual indicators relate only to the completed units although, in principle, the change in work in progress on fixed assets should be treated as part of fixed capital formation. Since no appropriate indicator is available for this I have assumed that it was zero in all years other than 1907. This means that the aggregate series for fixed capital formation is, to this extent, slightly overstated in years (other than 1907) when there was a fall in work in progress, and slightly understated in years when work in progress was rising.

The following paragraphs describe the methods used to obtain annual series for each of the 13 categories.

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[1] In particular, there are problems in reconciling the Census returns with the accounting data for expenditure out of loans by local authorities and capital expenditure by railway companies.

Dwellings

The 1907 benchmark for completed dwellings is extra-polated by the product of three series. The first is an index of the number of houses built in each year.[1] This is based on housebuilding in a wide sample of towns and conurbations but does not cover rural areas[2] or Ireland.

TABLE 9.2 COMPOSITION OF GROSS DOMESTIC FIXED CAPITAL FORMATION IN 1907 (£M.)

Dwellings:		
1a. Completed dwellings	30.0	
b. Change in work in progress	−2.0	
c. Total work done		28.0
Other new buildings and works:		
2. Shops, warehouses, offices, factories etc.	13.0	
3. Local authorities' capital expenditure[a]	19.8	
4. Railway way and works	7.3	
5. Docks, harbours etc.	3.5	
6. Telegraph and telephone lines and works	2.8	
7. Other building and construction work	4.7	51.1
Ships:		
8a. Completed ships	21.0	
b. Change in work in progress	−2.5	
c. Total work done		18.5
Vehicles:		
9. Railway rolling stock	5.1	
10. Motor vehicles	2.5	7.6
Plant, machinery etc.:		
11. General engineering	24.4	
12. Electrical engineering	6.7	
13. Other items, fittings, installation etc.	13.7	44.8
		150.0

SOURCE: See text and Cairncross [143], p. 123.

[a] Excluding docks, harbours etc.; equipment for electricity supply undertakings and housing. See also p. 187. This item includes some expenditure on plant etc. (e.g. plant used by gas undertakings) but is predominantly buildings (schools, hospitals etc.) and works (sewerage, roads etc.).

The second is an 'index of size and complexity' designed to allow for the increase over time in the size and standard of houses built. It rises by 1 % p.a. from 1855 to 1889; and then – in order to allow, very roughly, for the effect of the new building regulations introduced in 1890 – by 5 % in 1890 and by 2 % p.a. from there until the end of the building boom at the turn of the century. The rate of increase then drops to $1\frac{1}{2}$% p.a. until 1913, and is zero during the war years. The third element is the index of the costs of house-building (labour and materials), compiled by Dr Maywald [208, p. 192]; the index is reproduced in Table 63, column (1).

A partial and rather uncertain check on the resulting estimates can be made by converting the Parry Lewis index to an estimate of the number of houses built[3] and calculating the average cost per house implicit in the estimates.

There is a brief discussion of the outcome of such a test in a later section (p. 195, below).

Shops, warehouses, offices, factories, etc.

A very approximate indication of the value of non-residential building can be derived from the inhabited house duty statistics published in the *Annual Reports of the Commissioners of Inland Revenue* [30]. The significant relevant categories are residential shops, and premises not used as dwellings. Both numbers and gross annual values are given, and the latter were used because of the wide disparity between the individual units. The annual increase in the gross annual value was roughly corrected for the effect of the periodic reassessments (working separately with the figures for the metropolis, the rest of England and Wales, and Scotland), for certain changes in the operation of the Act and for known irregularities in the official statistics. A very rough correction for the fact that the series was obtained from annual values was then made by deflating the adjusted increments by an index of rents given by Cairncross [143], p. 213. The resulting estimate of the annual volume of non-residential building was multiplied by Maywald's index of building costs and used to extrapolate the 1907 base-year value of £13.0 m.[4]

The necessary inhabited house duty statistics only begin in 1874/5. For 1856–74 non-residential building was assumed to be the same proportion of residential building as it was, on average, from 1875 to 1884.

[1] J. Parry Lewis, 'Indices of House-Building in the Manchester Conurbation, South Wales and Great Britain, 1851–1913', *Scottish Journal of Political Economy*, VIII, 1961 [201], pp. 151–2. The index is reproduced by Parry Lewis in *Building Cycles and Britain's Growth*, 1965, pp. 316–17.

[2] See B. Weber, 'A New Index of Residential Construction, 1838–1950', *Scottish Journal of Political Economy*, II, 1955 [259], pp. 119–22.

[3] For this purpose Weber's estimate of the number of houses erected in Great Britain in the decade 1901–10 [259, p. 132] was used as a base for the Lewis index.

[4] This includes a rough allocation of £5 m. for structural work undertaken by iron and steel and engineering firms.

Local authority capital expenditure

As a reasonable proxy for actual capital expenditure we follow Cairncross in using the local authority expenditure out of loans or, for years before that is available in the *Annual Local Taxation Returns*, receipts from loans. Cairncross' figures are not adjusted to calendar years and cover the period 1870–1914 [**143**, pp. 142–3]. The series is easily extended to 1919 by reference to the *Statistical Abstracts*, but it is more difficult to obtain estimates for the period 1856–69. For 1867/8 there is an estimate of receipts from loans of £6.0 m. made for Goschen's *Report on Local Taxation* [**88**, Appendix, Table III, p. 227]. For other years most of the components of this total cannot be traced, and the estimate for this period is extremely rough. It is based on such returns as are available, scaled up roughly in proportion to the amounts shown in 1867/8.

This total was then reduced by the estimated loan expenditure on housing, docks, harbour and canals, and on equipment etc. for electricity supply undertakings.[1] These items are already covered by rows 1, 5 and 12 of Table 9.2.

Railway way and works

This series is based on Mitchell's[2] compilation of capital expenditure as shown by the accounts of a large sample of railway companies grossed-up on the basis of data on paid-up capital available for all companies in the *Railway Returns*.

Docks, harbours etc.

I am grateful to Dr. Mitchell for making available his unpublished series for this item. It covers capital (or loan) expenditure as shown in the accounts of the railway companies, local authorities and other port and harbour authorities.

Telegraph and telephone lines and works

Annual estimates for telegraphs and telephones (excluding buildings) were built up from data on public and private capital expenditure. For the Central Government the annual expenditure on extension of telegraphs and telephones and on erection of buildings from 1875/6, and the separate expenditure on telephones under the Telegraph Acts 1892–1907 from 1892/3, is assembled up to 1905/6 in an official return,[3] and from 1906/7 the expenditure on construction of telephones (trunk lines and exchanges) and telegraphs is available annually in the *Post Office Accounts*.[4] For the private sector the estimate covers the capital expenditure of the National Telephone Company prior to its take-over by the Post Office in January 1912. From 1885 to 1904 this

was taken as equal to the annual increase in the capital of the company;[5] and for 1905–11 an estimate of expenditure on exchanges and lines was derived from the summarised accounts in *Garcke's Manual of Electrical Undertakings* [**272**].

The cumulated total of the final series for the period 1880–1919 is £49 m. and this agrees reasonably well with the £47 m. for the value of plant at prime cost as shown in the *Post Office Accounts* [**25**(a), H.C.7, 1922, pp. 14–17] at 31 March 1920.

Other building and construction work

This series covers several items, including churches, Central Government building by the civil and revenue services (including the Post Office) and building and construction work for private tramway, gas, electricity and water supply companies.[6] In the absence of a suitable indicator it was assumed to be a constant proportion of total work done other than on this item and the corresponding item for plant etc.

Merchant ships

This series is calculated separately for steam and sailing vessels and relates to completed units only. Naval vessels are not included. For the steamers the estimate is the product of the net tonnage built in the United Kingdom for home owners,[7] and Dr Maywald's[8] estimates of the

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1 This was assumed to represent 80 % of total expenditure: see the paragraph on electrical engineering on p. 188, below.

2 B. R. Mitchell, 'The Coming of the Railways and United Kingdom Economic Growth', *Journal of Economic History*, XXIV, 1964 [**212**], pp. 334–6. In order to reconcile Mitchell's series with the Census data I have excluded the amount which he added in for renewals to the permanent way.

3 Post Office Telegraphs and Telephones, *Account Showing the Gross Amount Received and Expended*, H.C. 378, 1913 [**25**(b)], pp. 4–5 and 8.

4 For 1906/7 see Departmental Committee on Telegraph and Telephone Accounts, *Reports and Appendices*, Cd. 4520, 1909 [**49**], p. 23. From 1907/8 onwards see [**25**(a)], e.g. H.C. 378, 1913, p. 12; H.C. 218, 1920, pp. 11 and 16.

5 *Report from the Select Committee on the Post Office (Telephone Agreement)* 1905, [**92**], Appendix No. 2, p. 413, and No. 9, p. 425.

6 Plant and equipment for electricity supply companies is included in electrical engineering, and for gas and water supply companies in general engineering. Estimates for total capital formation in gas, electricity and water, including local authority undertakings, are described below, p. 190.

7 Board of Trade, *Annual Statement of the Navigation and Shipping of the United Kingdom* [**15**].

8 K. Maywald, 'The Construction Costs and the Value of the British Merchant Fleet, 1850–1938', *Scottish Journal of Political Economy*, III, 1956 [**209**], p. 50.

cost (in pounds) per gross registered ton (multiplied by a factor of 1.64 to convert to cost per net ton).[1] For sailing vessels the annual net tonnage built is valued at Maywald's estimate of the average cost per gross registered ton of 'hulls only'.[2] Unlike the cost indices used for dwellings and machinery Maywald's estimates of shipbuilding costs incorporate an ingenious allowance for the effect of improvements in shipbuilding design and construction, including changes in the materials used to build a unit of registered tonnage [209, pp. 46–52]. No deduction is made to allow for the proceeds from ships scrapped or sold abroad, and thus, strictly speaking, the estimates relate not to gross capital formation but to what in the inter-war series, was called 'the year's purchases'. [162, p. 11].

General engineering

This is basically the same as the series which Cairncross devised, and of which he said: '. . . I had to manufacture an index of output without any figures of machinery produced and an index of machinery prices without any price quotations' [143, p. 158]. Given the importance of this item it is undoubtedly the weakest link in the pre-1914 estimates of capital formation, but it does not seem possible to obtain a more reliable annual series.

I have followed essentially the same procedure as Cairncross, but have extended the series to cover the period 1856–1919 and have made some minor adjustments, notable the exclusion of iron and steel used by the railway companies (based on information kindly supplied by Dr Mitchell).[3] The first stage of the procedure is the calculation of the iron and steel available for the production of machinery:

     United Kingdom production of pig iron
Less   Net exports of pig iron
     Change in stocks
Equals Home consumption of pig iron
Less   Consumption of pig in steel
Add   Output of steel ingots
Equals Home consumption of iron and steel
Less   Net exports of iron and steel[a]
     Iron and steel used for shipbuilding and railways[a]
Equals Iron and steel available for machinery[a]

       [a] In ingot equivalent.

This series is then multiplied firstly by a 'price index' and secondly by a notional index designed to allow for the increasing complexity and value of a 'ton of machinery'. The price index is constructed by taking a five-year moving average of indices of iron and steel prices (average value per ton of iron and steel exports)

and of wages in engineering and shipbuilding[4] combined with equal weights; it is reproduced in Table 63, column (4). The 'index of complexity' is arbitrarily assumed to have risen by one percentage point p.a. The product of the three series is then used to extrapolate Cairncross' 1907 figure for the value of machinery produced in the United Kingdom (£50 m.). Finally, the net exports of machinery (reduced by 6% to exclude costs of transport and handling) are deducted and the residual is taken as the estimate of the ex-works value of 'machinery' retained for home consumption. Further comment on this series is given in the subsequent section, p. 195, below.

Electrical engineering

This series covers electrical plant and equipment (including transmission cables) purchased by public electricity supply undertakings and also by railways and private concerns generating their own electricity. It is derived by a rather indirect procedure. Firstly, an estimate was made of the accumulated capital expenditure on plant and equipment by public supply undertakings at the end of each year from 1891 to 1919.[5] Next, the accumulated expenditures on plant and equipment (distinguishing between generation and distribution) were calculated on the assumption that they were a constant proportion of the total (36% and 44% respectively), equal to the ratios shown by the breakdown of the accumulated expenditures at March 1922, given by the Electricity Commissioners; see [162], p. 92.

Accumulated expenditure on the private supply of electricity was then estimated as a proportion of the

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[1] This is the average ratio of gross to net tonnage calculated from the data for steamers built from 1886–1913 when both measures are available.

[2] In compiling his estimates Maywald assumed that the cost of hulls per gross ton for steamers corresponded to the cost of hulls per net ton for sailing vessels [209, p. 46]. In the case of sailing ships it is, therefore, not necessary to correct for the fact that the series for ships built is in net tons.

[3] For 1915–18 a deduction is also made for iron and steel used for munitions and other military purposes. See, e.g. F. H. Hatch, *The Iron and Steel Industry of the United Kingdom under War Conditions*, 1919 [175], p. 11.

[4] A. L. Bowley and G. H. Wood, 'Statistics of Wages in the United Kingdom during the Nineteenth Century, Part XIV, Engineering and Shipbuilding', *J. R. Statist. Soc.* LXIX, 1906 [135], p. 185.

[5] Based mainly on data in British Electrical and Allied Manufacturers' Association, *The Electrical Industry of Great Britain*, 1929 [264], p. 9, for 1903–19, *The Returns relating to Electricity Supply Undertakings in the United Kingdom for the years 1899 and 1900*, H.C. 1901, 1902 [70], and Garcke's *Manual of Electrical Undertakings* [272] for 1890–8.

expenditure on plant and equipment for generation by the public undertakings. The proportion used was based on the ratio of the generating capacity of industries and other private suppliers to that owned by the public supply undertakings in 1907, 1912 and 1920–4.[1] The ratio was assumed to have been the same as in 1907 (71 %) from 1899 to 1906 and to have risen to this proportion from a conjectural 50 % in 1891–5. The rise to 88 % in 1912 was spread evenly over the year 1908–12; and the ratio was then assumed to be broadly stable to 1920. (Thereafter it fell rapidly with the expansion of the public supply system, dropping to 57 % by 1924.)

The accumulated capital expenditure on the public, private and railway electricity supply were then aggregated and the required estimates were obtained from the first difference in this series. The estimate obtained by this procedure for 1907 was £6.7 m. and this was substituted for the £6.5 m. suggested by Cairncross on the basis of the Census data [see 143, p. 114].

Railway rolling stock

The estimates for this item were compiled from the accounts of the railway companies by Mitchell [212, pp. 335–6]. They include expenditure on renewals.

Motor vehicles

Cairncross suggests that the output of commercial motor vehicles was probably negligible in 1907 and that the motor trade was 'engaged almost exclusively in the production of consumers' durable goods' [143, pp. 118–19]. However, analysis of the Census data for 1907 and 1912 [42, *Final Report, First*, pp. 141 and 709; and *Third, Part Three*, pp. 311–12] on production and net imports of cars and motor bodies, together with Prest's estimates for consumers expenditure on cars [232, pp. 141–2] indicates that some £2.5 m. should be allowed in 1907 and £3.0 m. in 1912 for capital expenditure on motor vehicles. Rough estimates for other years from 1900 to 1919 were made by interpolating on the basis of a series obtained by taking the estimated production of cars and commercial vehicles,[2] adding net imports of complete cars and chassis and deducting consumers' expenditure [232, p. 142]. For 1914–18 a further amount was deducted to cover military purchases of vehicles.

Other items, fittings, installation etc.

This is a final rag-bag. It covers certain miscellaneous items (tools and implements, colliery wagons, office equipment, brass goods etc.); the plant installed by gas and water company undertakings; the allowance for costs of distribution, transport and installation of machinery and equipment, and new work undertaken by manufacturers on their own plant. In the nature of

the series no suitable annual estimate is available for most of these components but it seems not unreasonable to assume that it is a constant proportion of all other capital expenditure.

Classification by type of asset

The estimates are classified by type of asset in Table 39. The 13 series are aggregated as shown in Table 9.2 except that for 1900–19 an estimate for tramway cars is included with vehicles and deducted from general engineering.[3] As noted in the footnote to Table 9.2 a small amount of the local authority expenditure classified as buildings and works should be plant etc. but no adjustment was made for this.

Classification by sector

Capital expenditure by local authorities is represented by their aggregate loan expenditure (in earlier years loan receipts), i.e. it is the sum of the series corresponding to row 3 of Table 9.2 plus the expenditure included in rows 1, 5 and 12. For the Central Government it is not possible to obtain a precise estimate since the *Appropriation Accounts* do not always distinguish between new work and repairs but a rough allowance has been made on the basis of an examination of the *Accounts* for selected years. It covers the buildings for the post office, public departments, diplomatic service, police, museums etc. From the 1880s expenditure on telegraph and telephone plant is also included (row 6 of Table 9.2 less the expenditure of the National Telephone Co.); and from 1911 the outlays by the Road Fund. The private sector capital formation is then obtained as a residual.

Classification by industry

From 1882/3 the *Annual Local Taxation Returns* [10] provide a classification of local authority loan expenditure in England and Wales and it becomes possible to go a reasonable way towards a classification by industry, although not to distinguish separately the major private sectors (agriculture, mining, manufacturing, distribu-

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[1] 1924 Census of Production, *Part V General, Statistical Tables* [42 (b)], p. 454, and also B.E.A.M.A. [264], pp. 118–21.

[2] For 1908–13 the estimated output is given by the Society of Motor Manufacturers and Trader, *The Motor Industry of Great Britain*, 1947 [276], p. 6. The series was extrapolated to 1919 on the basis of Hoffman's index, which is supposed to represent the annual output of motor vehicles [179, p. 249]; and the annual production was then valued at the prices per vehicle used by Prest [232, p. 142] for cars.

[3] The estimate is based on the classification of capital expenditure in the *Annual Return of Tramway and Light Railway (Street and Road) Undertakings*, H.C. [33].

tion etc.). A broad classification on this basis is given in Table 41.

It is easiest to take first the estimate for transport and communication. This is based on six series, shown separately in the table. For four of these: railways, ships, docks, harbours etc. and the Post Office the estimates are those previously described. For roads the estimate is the local authority loan expenditure on highways and bridges and private street works plus the outlays by the Road Fund from 1911. For road passenger transport the previous estimate for motor vehicles is added to local authority loan expenditure on transport services and an estimate for capital expenditure by private tramway and light railway companies.[1]

The estimate for electricity combines the 20% of local authority loan expenditure allowed for buildings (p. 187, n. 1, above) plus the estimate for electrical engineering. The series thus covers local authority and company supply undertakings and also the electrical equipment of industries generating their own electricity.

For gas and water supply undertakings the local authority loan expenditure on these services was combined wth special estimates made for company undertakings. In the case of gas companies the estimate was based on the increase in the paid-up share and loan capital of the companies[2] (adjusted for obvious instances of nominal additions to the capital in 1896 and 1899). For the water companies the annual capital expenditure by the metropolitan companies prior to the formation of the Metropolitan Water Board is readily available in Parliamentary returns.[3] For 1907–14 the overall ratio of company to local authority water supplies was about 20%;[4] and capital outlays by the non-metropolitan companies were assumed to be 20% of local authority plus metropolitan company capital expenditure from 1882 to 1902 and 20% of local authority expenditure (including the M.W.B.) from 1903 to 1919.

The series for capital expenditure on social and public services is the local authority loan expenditure less the outlays on housing, roads and trading services, plus the Central Government estimate for buildings (other than the post office); and the series for dwellings is the one already described. The final industry group covers industrial and commercial capital, agriculture, mining etc. It is obtained by aggregating the original estimates for factories, shops etc., general engineering, 'other building and construction work' and 'other items, fittings, installations etc.', and deducting the estimates for the capital expenditure by companies on buildings and plant for tramways, gas and water and by the Central Government on buildings. It is unfortunate that it is not possible to sub-divide this large residual more finely and give, for example, a separate series for manufactur-

ing investment but with the data at present available there is no reliable basis for this.

(ii) At constant prices

For 1948–65 and 1920–38 the estimates at constant prices are from the same sources as the current price estimates: [75] and [162] respectively. The link between 1938 and 1948 prices is based on the 1957 Blue Book [75, pp. 48–9]. For 1939–47 the estimates at current prices are deflated by the price indices given by Redfern [235 pp. 170–71]. For 1856–1919 the current price series are deflated by the following indices: for buildings and other construction work the two indices compiled by Maywald [208, pp. 192–3]; for general and electrical engineering the index described on p. 188 above; for ships an unweighted average of indices of the cost of ship plates and of shipbuilding wages;[5] and for railway rolling stock an unpublished index constructed by Mitchell.[6] Finally, the two miscellaneous items are again moved proportionately to all other capital expenditure. The same indices were used in appropriate combinations for the classification by industry in Table 42.

The estimates are given for 1855–1913 at 1900 prices, 1913–48 at 1938 prices and 1946–65 at 1958 prices but the categories deflated are so broad that the base year used has little impact on the movement – as opposed to the level – of the series. The main price indices used are given in Table 63 and the implicit current weighted

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[1] The estimate is based on the data on accumulated capital expenditure given in the *Annual Return of Tramway and Light Railway (Street and Road) Undertakings* [33] with adjustments to allow for the effect of acquisition of undertakings by local authorities.

[2] *Annual Return relating to all authorised Gas Undertakings in the United Kingdom other than those of Local Authorities*, H.C. 137, 1914 [34], pp. 102–3.

[3] For 1882–97 see Appendices P to W of the *Final Report of Her Majesty's Commissioners appointed to enquire into the subject of the Water Supply within the limits of the Metropolitan Water Companies*, Cd. 108, 1900 [44]. For other years see *Return of the Accounts of the Metropolitan Water Companies*, H.C. Paper, annual [32(a)].

[4] This is based on data for England and Wales quoted in Prest [232], p. 99.

[5] As noted above (p. 188) Maywald's estimates of ship construction costs combine an estimate of changes in labour and material costs per ton of hull weight and an allowance for the changes in composition and design of the ships reflected in the average weight of hulls per registered ton. The index prepared for the present estimates for purposes of deflation attempts to isolate the former element in Maywald's series by reconstructing his index of the change in costs of labour and materials [209, p. 52].

[6] The index was kindly provided by Dr Mitchell. It combines series for engineering wages and costs of iron and other materials.

(Paasche) price index for all capital goods is shown in column (3) of Table 61.

COMPARISON WITH OTHER ESTIMATES

For 1920–38 a detailed comparison with other estimates is given in [162], pp. 238–59. For the period prior to 1914 there are several estimates with which comparison

pletely by-passes the 1907 Census and instead builds up annual estimates for 1830–1914 from numerous series for separate categories of capital formation. The resulting estimate of total gross domestic fixed capital formation is compared with the present estimate in Table 9.3 and Figure 9.1 (at 1900 prices) for the common period 1856–1913, and two of the main components are graphed in Figure 9.2.
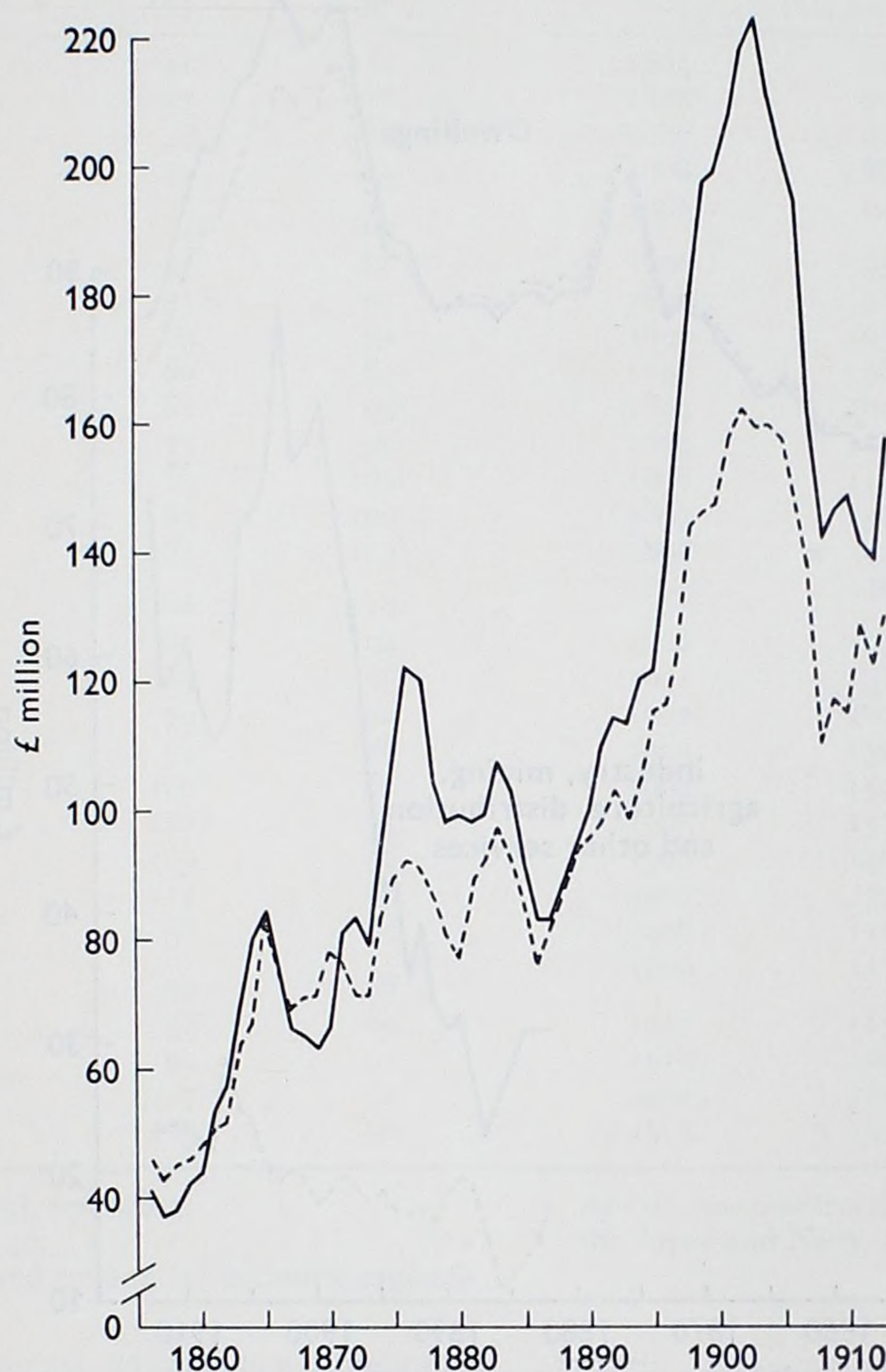

FIGURE 9.1   COMPARISON WITH DEANE'S ESTIMATES OF TOTAL GROSS DOMESTIC FIXED CAPITAL FORMATION AT 1900 PRICES, 1856–1913

——————— Present estimate   ———————— Deane

might be made. Two of these, by Cairncross [143, p. 203] and Jefferys and Walters [184, pp. 34–7] were made by broadly the same procedure but the present estimates make use of a more comprehensive range of annual series for extrapolation of the 1907 benchmark, and also have the advantage of improved information on such aspects as houses built, building prices and ship construction costs.[1]

A more recent, and rather different, estimate is given by Phyllis Deane [155, pp. 104–11]. This series com-

In the decade 1856–64 Deane's series is first above and then below the present estimate, but the difference is moderate in absolute terms and the two agree in the mid-sixties. They then move apart, with the present estimate showing a far more substantial boom in the 1870s, and at the common peak in 1876 the difference

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[1] See also the remarks made in connection with my earlier estimates [160], p. 373.

is £30 m. (25% of the higher estimate). Both series again agree on the timing of the next peak, in 1883, but differ over its scale. The present estimate puts this peak well below that of 1876, whereas Deane's estimate shows this boom as the stronger of the two.

The two series again come together briefly at the end of the eighties, but from there on the present estimate

as new naval construction of ships and dockyards [155, p. 111]. The present study follows the standard conventions and classifies these outlays as public authorities' current expenditure.[1] The main item involved is naval shipbuilding: the navy was spending some £2–3 m. p.a. on new ships in the 1870s and 1880s, and then expanded the building programme very rapidly in the 1890s to
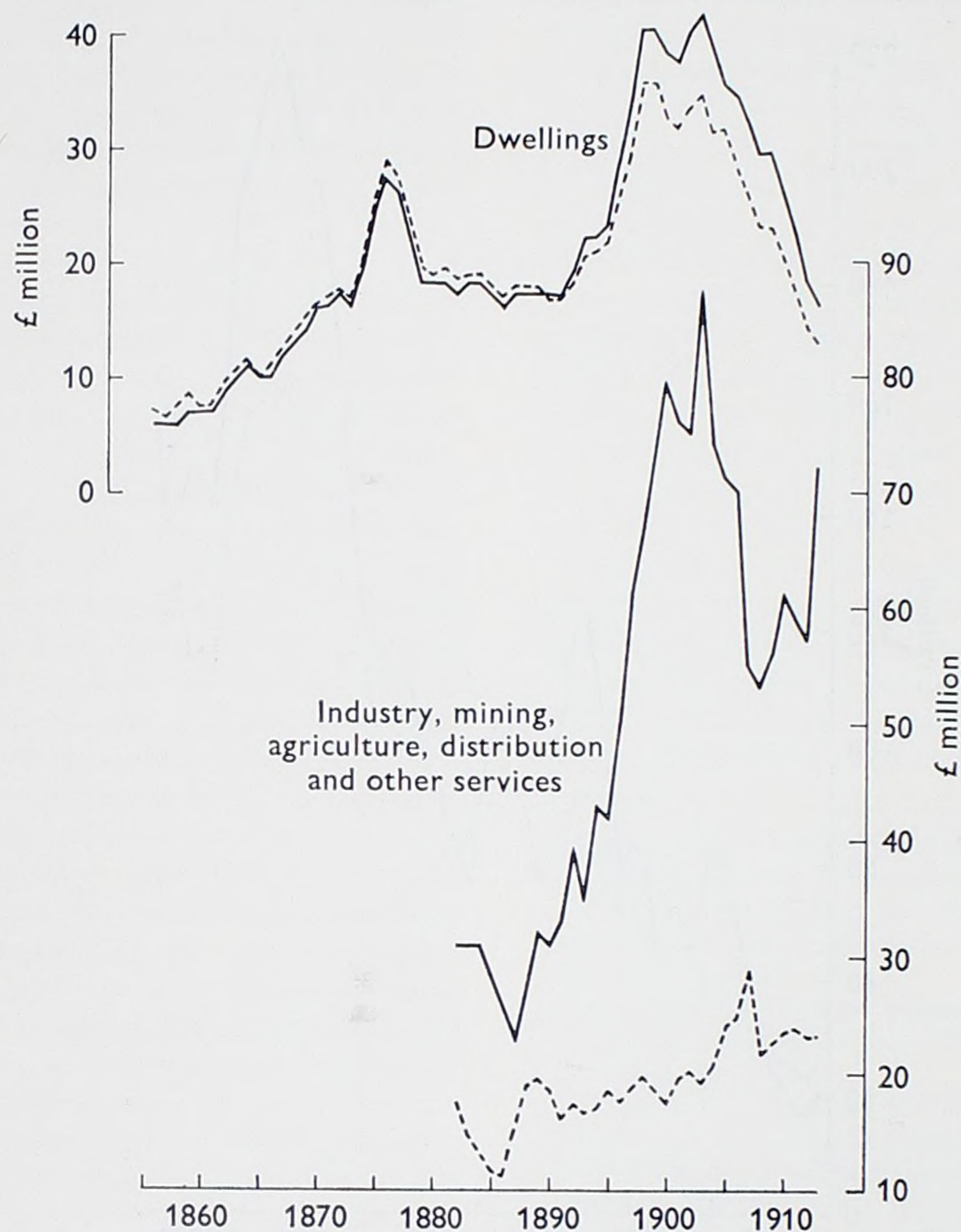

FIGURE 9.2   COMPARISON WITH DEANE'S ESTIMATES OF GROSS DOMESTIC FIXED CAPITAL FORMATION AT 1900 PRICES – SELECTED COMPONENTS, 1856–1913

———— Present estimate   ———— Deane

rises very much more strongly in the boom of the 1890s, and at the peak in 1902–3 is almost £60 m. (26%) higher. It remains at a markedly higher level until the end of the period, although the gap narrows slightly in 1911–12.

The discrepancy is actually larger than is suggested by Table 9.3 since Miss Deane includes in capital formation the expenditure on new works and buildings by the Navy, Army and ordnance departments as well

reach an average of about £9 m. p.a. after 1900, rising to £13 m. in the years immediately before World War I.

If we take the estimates (at current prices) for 1907

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[1] The series that Deane uses for public authorities' current expenditure also covers all defence spending, including naval shipbuilding. Consequently, there is an element of double-counting in her estimates of total expenditure generating gross national product.

TABLE 9.3   COMPARISON WITH DEANE'S ESTIMATES OF TOTAL
GROSS DOMESTIC FIXED CAPITAL FORMATION AT
1900 PRICES, 1856–1913   (£M.)

	Deane (1)	Present estimate (2)	Discrepancy[a] (1) as percentage of (2) (3)		Deane (1)	Present estimate (2)	Discrepancy[a] (1) as percentage of (2) (3)
1856	46	41	112	1885	84	91	92
1857	43	37	116	1886	76	83	92
1858	45	38	118	1887	81	83	98
1859	46	42	110	1888	88	88	100
				1889	94	97	97
1860	48	44	109				
1861	51	53	96	1890	95	99	96
1862	52	57	91	1891	98	109	90
1863	63	69	91	1892	103	114	90
1864	67	80	84	1893	98	113	87
1865	83	84	99	1894	104	120	87
1866	74	75	99	1895	115	121	95
1867	69	66	105	1896	116	137	85
1868	71	65	109	1897	124	157	79
1869	71	63	113	1898	143	181	79
				1899	146	197	74
1870	78	66	118				
1871	76	81	94	1900	147	199	74
1872	71	83	86	1901	157	207	76
1873	71	79	90	1902	162	217	75
1874	83	94	88	1903	159	222	72
1875	89	109	82	1904	159	210	76
1876	92	122	75	1905	157	202	78
1877	91	120	76	1906	148	194	76
1878	87	114	76	1907	137	162	85
1879	80	98	82	1908	110	142	77
				1909	117	146	80
1880	77	99	78				
1881	87	98	89	1910	115	148	78
1882	92	99	93	1911	128	141	91
1883	97	107	91	1912	122	138	88
1884	93	103	90	1913	130	157	83

SOURCE: (1) Deane [155], pp. 106–7.
(2) See Table 40.
[a] Column (1) includes, and column (2) excludes, expendi-
ture on new construction of ships, buildings and works for
the Army and Navy. See p. 192.

we find that Deane's estimate, adjusted to a comparable basis, is some £27 m. (18%) below the present benchmark of £150 m.[1] In the light of the earlier finding (p. 185, above) that the present estimate for 1907 is, if anything, too low, there would seem to be little case for the substitution of an even lower figure.

In order to make a more complete assessment of the two estimates it is necessary to identify and compare their principal components. Because of the differences in methods of estimation it is not possible to group the components on a precisely comparable basis, but from 1882 onwards – where the present estimates can be classified by industry – it is possible to distinguish seven

broadly comparable categories.[2] The estimates are shown in this form in Table 9.4 and for the sake of brevity are given as annual averages for four or five-year periods, but the annual series for dwellings and for industrial and commercial capital etc. are shown in Figure 9.2.

[1] Deane's estimate for 1907 at current prices is £132 m. [155, p. 105], and we deduct £8 m. for new construction of ships and £1 m. for new buildings and works (mainly ports) for the Navy and Army.
[2] I am grateful to Miss Deane for providing the unpublished components of her series and thus making possible this more detailed comparison.

TABLE 9.4   COMPARISON WITH DEANE'S ESTIMATE OF GROSS
DOMESTIC FIXED CAPITAL FORMATION, AT
1900 PRICES, BY INDUSTRY, 1882–1913   (£M.; annual average)

	1882–85	1886–90	1891–95	1896–1900	1901–5	1906–10	1911–13
1. Transport and communication[a]							
Deane	41.5	33.0	39.2	46.6	57.8	42.6	47.0
Present estimate	40.2	33.2	37.8	45.8	60.6	45.0	43.3
Discrepancy	1.3	−0.2	1.4	0.8	−2.8	−2.4	3.7
2. Gas, electricity, water[c]							
Deane	3.8	3.6	6.2	10.6	14.4	7.2	7.7
Present estimate	4.3	5.0	6.8	12.8	18.6	11.8	8.0
Discrepancy	−0.5	−1.4	−0.6	−2.2	−4.2	−4.6	−0.3
3. Dwellings							
Deane	18.3	17.2	19.4	31.4	32.2	24.0	15.0
Present estimate	17.5	16.8	20.6	35.8	38.2	30.0	18.7
Discrepancy	0.8	0.4	−1.2	−4.4	−6.0	−6.0	−3.7
4. Other social capital							
Deane	6.0	5.8	8.4	10.8	12.6	10.2	9.3
Present estimate	7.2	6.4	11.2	13.0	16.8	12.6	11.7
Discrepancy	−1.2	−0.6	−2.8	−2.2	−4.2	−2.4	−2.4
5. Industrial and commercial capital etc.[b]							
Deane	14.0	16.8	17.2	18.4	20.6	24.2	23.3
Present estimate	30.2	28.0	38.4	66.2	76.6	59.0	62.7
Discrepancy	−16.2	−11.2	−21.2	−47.8	−56.0	−34.8	−39.4
6. Administration and defence[d]							
Deane	3.8	4.8	7.4	12.2	16.8	14.4	23.3
Present estimate	0.5	0.6	0.6	0.6	0.8	1.0	1.0
Discrepancy	3.3	4.2	6.8	11.6	16.0	13.4	22.3
of which							
Naval shipbuilding	2.4	3.5	4.6	7.1	9.9	9.4	13.3
7. Horse transport[e]							
Deane	4.5	5.8	5.6	5.6	4.6	3.2	1.3
8. Total							
Deane	91.9	87.0	103.4	135.6	159.0	125.8	127.0
Present estimate	100.0	90.0	115.4	174.2	211.6	158.4	145.3
Discrepancy	−8.1	−3.0	−12.0	−38.6	−52.6	−32.6	−18.3

[a] Covers railways, ships, docks, harbours and canals, roads and bridges, tramways, motor vehicles and Post Office telegraphs and telephones. Horse transport is not included.
[b] Covers industry, mining, agriculture, distribution and other services.
[c] The present estimate includes the equipment of industries generating a private supply of electricity.
[d] The present estimate does not include defence, see p. 192.
[e] Deane's estimate covers horses and carriages, wagons etc. Horses are omitted from the present estimate but a small allowance for horse-drawn vehicles is included in the estimate of industrial and commercial capital.

Of the seven categories, the estimates for four agree reasonably well, there is one item for which the present estimate is substantially higher and two for which it is much lower. Agreement is best in the case of the estimates grouped together under the heading of transport and communication: railways, roads, ships, docks and harbours, tramways, motor vehicles and Post Office. This largely reflects the fact that for these series both estimates use essentially the same sources and methods; though there are minor differences arising, for example, in the treatment of renewals of the permanent way (see p. 187, n. 2) or the estimates for roads and bridges.

For gas, electricity and water and for 'other social capital' there is a fair measure of agreement, though Deane's estimates are consistently lower. In the case of gas, electricity and water this is partly explained by the inclusion in the present estimate of capital expenditure on privately owned electrical generating equipment; if this were transferred to 'industrial capital etc.' it would reduce the discrepancy on gas, electricity and

water at the cost of an increased discrepancy on industrial and commercial capital. The disagreement on other social capital is almost entirely accounted for by the fact that Deane's estimate omits certain categories of local authority capital expenditure which are individually minor but which in total account for capital expenditure of several millions each year.[1]

The final item on which the two estimates agree moderately well is dwellings. The comparison can be taken back to 1856 and shows very close agreement (generally within £1 m.) until 1891. From there onwards the present estimate is consistently higher and the difference averages some £5 m. (16%) over the period 1890–1913. There are several factors which could account for this but it seems that the primary one is the lower average cost per house used by Deane: £215 circa 1900 [155, p. 110] compared with the figure of some £250 implicit in the present method of estimation.[2] It is easy to find widely varying statements about the cost of new houses and difficult to be certain about their precise content and the extent to which they are representative (cf. [162], pp. 214–15). The present estimate has its basis in the data collected for the 1907 Census of Production (see [143], pp. 107–9); and it is unlikely that the Census would yield an overestimate of new building work – the opposite is far more likely in a trade in which small firms predominate. For these reasons I am not disposed to alter the present estimates for dwellings but recognise the margin of uncertainty attaching to them.

Moreover, if the Census total is accepted, but the allocation between types of building altered in the direction of a lower figure for dwellings, this would mean a higher figure for other building work and so widen still further the discrepancy in the estimates for industrial and commercial capital.

As can be seen from row 5 of Table 9.4 and from the graph in Figure 9.2 the disagreement on this important sector, covering industry, commerce, mining and agriculture, is already very great: over the whole period 1882–1913 Deane's estimate averages only 37% of the level of the present estimate, with annual averages of £19 m. and £51 m. respectively; and over the boom years 1896–1905 it falls to as little as 27% (£20 m. and £71 m.). The present estimate is derived principally from the series for non-residential building, general engineering and 'other items, fittings, installations etc.' (see pp. 186, 188 and 189, above), all of which are very far from ideal. Nevertheless I would judge the aggregate to be substantially more reliable than the alternative estimates which, as Miss Deane notes, are 'somewhat impressionistic' and 'give only a very rough overall indication of the levels and trends in industrial

capital expenditure' [155, p. 111]. It seems clear that the errors of omission which Miss Deane anticipated are in fact very considerable; and the series loses almost all trace of the great upsurge in industrial capital formation in the 1890s, a boom well substantiated from other sources.[3]

On each of the components so far considered the present estimate is the higher of the two and the combined discrepancy is thus very large. It is, however, partly offset by the two remaining items. One of these, public administration and defence, involves the difference in treatment of defence expenditure already discussed above (p. 192). Deane's estimate also includes new works and buildings by the Post Office; in the present estimates these are included in transport and communication. The other is the estimate for horse-drawn transport. The present estimate omits the horses, and the coverage of carriages, wagons etc. is very poor;[4] whereas Miss Deane covers both horses and vehicles. The amount which she has provided for this – an average of some £5 m. per year until the last few years before the war – seems very high[5] but it is not an easy item to estimate accurately.

To sum up, the general conclusion which I would draw from this detailed examination of the two series is that the present set of estimates are defective in certain respects but almost certainly give a more accurate picture of the trends and cycles in gross domestic fixed capital formation, of its overall level, and of its composition by industry.

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1 The items of 'social capital' listed by Deane [155, p. 110] do not include the following components of the local authority expenditure out of loans: public libraries, markets, parks, police stations and the residual item 'other works and purposes'. This latter amounted to between £2 m. and £4 m. p.a. in the period 1900–14, and the other categories were together responsible for roughly a further £1 m. p.a. See *Statistical Abstract* [35], e.g. No. 58, pp. 56–9.

2 Before 1891 the effect of this difference must be offset by differences in the estimates of the number of houses built and of the rate of improvement in the standards of building.

3 See E. M. Sigsworth and J. Blackman, 'The Home Boom of the 1890s', *Yorkshire Bulletin of Economic and Social Research*, 17, 1965 [243], especially pp. 85–91.

4 New construction of horse-drawn vehicles is included in the 1907 benchmark but is not separately extrapolated and is likely to be underestimated in earlier years.

5 One indication of this is the estimate for 1907, where Deane estimates expenditure on carriages etc. at about £4 m. of which £2 m. is for vehicles. The Census of Production shows only £900,000 for construction of horse-drawn vehicles, and £400,000 of this is for private carriages already covered in the estimates of consumers' expenditure; see [42 (a))], p. 729, and [232], p. 142.

The series can be accepted as broadly consistent in coverage and definition over the whole period 1856–1965. There is an 11 % discrepancy between the present and the C.S.O. estimate for 1938 (cf. [**162**], pp. 243–5) but this can largely be neglected in terms of the trans-World War II figures, and the C.S.O.'s sources and methods of estimation for 1938 have little in common with the post-war period so there is no reason to regard this as indicative of a discontinuity between the inter-war and post-war estimates.

The reliability grades[1] for the aggregate series can be summarised as follows:

1856–90	C
1891–1919	B/C
1920–38	B
1939–45	C
1946–65[a]	B

[a] For further details see C.S.O. [**73**], pp. 381–2.

The 'guess' made with regard to the inter-war estimates was that for most years they would lie within a range of error of 7–15 % [**162**, p. 236] and the estimates for 1890–1913 are probably nearer the lower end of the C category, i.e. the error is likely to be nearer 10 % than 20%.

9.1 GROSS AND NET CAPITAL STOCK AT CURRENT AND CONSTANT PRICES, 1855–1965

DEFINITION OF THE SERIES

Two measures of the capital stock are given in this chapter; both relate to domestic tangible reproducible fixed capital, but one is an estimate of the gross stock, the other of the net (depreciated) stock. The coverage is the same as that of the gross investment series in Chapter 9.0, and the string of adjectives in the preceding sentence indicates that the estimates are confined to assets in the United Kingdom (irrespective of ownership)[2] and do not include land, standing timber, mineral wealth, livestock and inventories, military equipment, consumer durable goods or intangible assets such as patents and goodwill.[3]

The stock of reproducible fixed capital can be measured on three different price bases: (i) at historical (or original cost); (ii) at current replacement cost; and (iii) at constant replacement cost. The historical cost concept is of limited interest (except to accountants) but reveals most clearly the essential feature of the concept of capital adopted in this study: it represents the actual past cost of the creation of the stock of assets, and there is no reference to such factors as the expected future earnings of the assets or its technical capacity to produce a particular output. For the measurements at current and at constant replacement cost, which are the time series shown in the present tables, the estimates relate in principle to the cost of replacing this stock with identical assets at the prices ruling in the given year or in the year selected as base year for the estimates at constant prices.

The gross stock represents the accumulated estimates of *new* fixed capital formation, i.e. gross fixed capital formation net of assets scrapped (retired). Since direct estimation on this basis would require series stretching

back to the first date on which any particular type of asset was installed, we may think alternatively in terms of the flows of gross fixed capital formation in each type of asset cumulated over a period equal to the life of the assets. Assets are thus assumed to remain in the stock until the end of their lives, at which date they are scrapped and so removed from the stock. Until that date, however, there is no adjustment made for wear and tear, premature obsolescence, age or intensity of use.

We thus have the following relationships for each type of asset. :[4]

$$G_n = \sum_{t=0}^{n} [I_t - S_t]$$

$$= \sum_{t=0}^{n} [I_t - I_{t-L}]$$

$$= \sum_{n-L}^{n} [I_t] \tag{1}$$

and

$$G_n = G_{n-1} + I_n - S_n \tag{2}$$

$$= G_{n-1} + I_n - I_{n-L}. \tag{3}$$

G = Gross stock at end of year
I = Investment during the year
S = Scrapping during the year
L = Length of life of the asset

For the net stock of capital the accumulated gross investment is reduced by the accumulated amount of capital consumption (see Chapter 9.2) on assets still in the capital stock. The net stock thus represents the accu-

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[1] See Chapter 1.4 for further discussion of these grades.
[2] With the usual convention for ships and aircraft: see Chapter 9.0.
[3] Estimates of the book value of livestock, inventories etc. and of assets held abroad (net of liabilities) are given for selected years in Tables 49 and 50.
[4] The equations hold for estimates at constant or historical cost, but not for current costs.

mulated estimates of *net* fixed capital formation (gross capital formation net of capital consumption). At historical and constant prices we can thus write:

$$N_n = \sum_{t=0}^{n} [I_t - C_t] \quad (4)$$

and

$$N_n = N_{n-1} + I_n - C_n. \quad (5)$$

N = Net stock at end of year
C = Capital consumption during the year

In practice it is again generally not possible to accumulate estimates from year 0 – as required by formula (4) – and estimates are made by making appropriate assumptions regarding the ratio of the net to the gross stock in a particular year.[1] The net stock in earlier or later years can then be obtained by using formula (5).

The series are presented in four tables. Table 43 shows the gross and net stock at constant prices, classified by type of asset, from 1855 to 1965; and in Tables 44 and 45 the gross stock at constant prices is classified by industry for selected years from 1880. At current prices there is a classification by type of asset for the gross and net stock, from 1855 to 1965, in Table 46.

The classification by industry relates essentially to the ownership of the assets and will not correspond to the stock of assets *used* in those cases where assets are leased by one industry to another.

SOURCES AND METHODS OF ESTIMATION

(i) *At constant replacement cost*

Estimates are given for 1855–1913 at 1900 replacement cost, 1913, 1920–38 and 1948 at 1938 replacement cost, and 1938 and 1948–65 at 1958 replacement cost.

1938, 1948–1965

For 1938 and for the post-war years the gross stock estimates at 1958 replacement cost are unpublished series prepared by J. C. Odling-Smee. These in turn rest largely on the estimates by Dean [154] and the Central Statistical Office [75] but with amendments to certain series – particularly hospitals and agricultural buildings – for which the Blue Book estimates are thought to be inadequate.[2]

The estimates are based on the 'perpetual inventory method' outlined in the preceding section and it should be noted that in the absence of direct information on the actual life of assets the estimates rest on a set of assumptions regarding the normal working life of particular types of asset. This is unlikely to represent a serious weakness in most cases, but it may be very misleading where industries are subject to rapid changes as with the sweeping closure of collieries or railway branch lines.

Odling-Smee has also improved the Blue Book classification by industry. First, he has eliminated the residual item 'other industries' by allocating his revised estimates for its heterogenous components (textiles, hospitals, agricultural buildings and vehicles, private schools and universities) to their appropriate categories. Secondly, he has extended the classification within manufacturing (see Table 45), principally by splitting the Blue Book estimate for 'other metals, engineering and allied industries' into four separate industries. This was done by subdividing the 1955 stock on the basis of the more detailed estimates obtained by Barna[1] from fire insurance valuations, and carrying the results backward to 1948 and forward to 1965 on the basis of Blue Book estimates for gross fixed capital formation and rough assumptions about scrapping.

Revision of the official gross stock estimates logically requires corresponding revision to the estimates of capital consumption and hence of net fixed capital formation and of the net stock, though to the extent that the increase in the gross stock is attributable to accumulation over a longer life the effect on the capital consumption estimates will be small. However, I have not made any adjustment for this and the series for the net stock at 1958 prices is derived directly from the C.S.O.'s figure for the net stock at end-1958 at 1958 replacement cost, and their estimates for 1948–65 of net fixed capital formation at 1958 prices, i.e. by means of formula (5). The further extrapolation to 1938 is based on the estimates of net capital formation for 1939–47 described in Chapter 9.2.

1920–1938, 1948

The estimates were derived from the series in [162] at constant replacement cost with a change in the base year from 1930 to 1938. These estimates were in general not derived by the perpetual inventory method, but by starting from a benchmark for either the gross or the net stock for one or more inter-war years, making an estimate of the ratio of the gross to the net stock in order to obtain the measure not directly available, and then employing formulae (2) and (5) as a means of extrapolating the series to cover the remaining years. The

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[1] For further discussion see Feinstein [162], pp. 14–17, and also the more elaborate treatment in R. W. Goldsmith, *The National Wealth of the United States in the Postwar Period*, 1962 [171], pp. 11–28.

[2] The gross and net stock estimates are shown in the tables with two decimal places, i.e. to the nearest £10 m., but this does not imply that they can be regarded as accurate to the last digit.

[3] T. Barna, 'The Replacement Cost of Fixed Assets in British Manufacturing Industry in 1955', *J. R. Statist. Soc.*, 120, 1957 [115].

benchmark was obtained from a variety of sources including aggregate accounts published for public utilities; samples of accounts for companies in mining, manufacturing and distribution; statistics compiled for licensing and other purposes of the total number or tonnage of dwellings, ships, railway rolling stock, motor vehicles, cotton spindles and agricultural machinery; and tax assessments of the gross annual value of shops and hotels.

Where estimates were derived from accounts the basic information related to estimates at original cost and in some cases also to the net stock of assets; and heroic assumptions were required to convert the basic data to estimates of the gross stock at constant replacement cost. Where estimates were first available in physical units an appropriate average value was used to convert the physical quantities to a value series, and for these assets the initial series obtained would be the gross stock at constant replacement cost. The original study should be consulted for further details. Minor changes, noted in Tables 44 and 45, have been made in the classification by industry.

The 1938 figure was extended to 1948 by means of the gross capital formation series in Chapter 9.0 and a very rough allowance for scrapping.

1855–1920

Of all the series in the present book these almost certainly have the best claim for early revision. They were obtained by taking the end-1920 estimates from the inter-war study [162], making a small addition for Southern Ireland, and working backwards from there on the basis of formulae (3) and (5). Strict application of these formulae requires estimates of gross and net fixed capital formation and of scrapping, and while the former are available for the period back to 1855 by type of asset (see Tables 40 and 48), and back to 1882 by industry (Table 42), the latter are largely non-existent. The standard assumption that the assets scrapped in any year are those installed L years previously, where L equals the length of life of the asset, cannot be applied because with few exceptions the gross capital formation estimates do not reach sufficiently far back. As a poor substitute for this scrapping was estimated as a proportion of the gross stock. The proportions used were 0.25 % for dwellings and for industrial and commercial buildings, 0.20 % for other buildings and works and 1.00 % for plant and machinery. See also p. 201, n. 1 below.

The one exception to this whole procedure is the estimate for the stock of ships, where direct data are available for the registered tonnage. As part of his study of shipbuilding costs and the value of the British merchant fleet Dr Maywald prepared estimates of the gross and net stock of (a) steamers and (b) sailing vessels, measured in terms of net registered tonnage; and these were valued at 1900 replacement cost by means of the cost data given in his paper [209, p. 50].

Professor Pollard and others at Sheffield University are currently investigating the capital formation undertaken in the century before 1850 and when this project is completed it should be possible to build up more reliable estimates of the capital stock in the nineteenth century. Until then the present estimates may stand as a rough order of magnitude. They were made primarily in order to obtain the capital consumption estimates in Chapter 9.2, and since they are the only estimates of their type currently available,[1] they may be of sufficient interest to warrant publication, albeit with loud warnings as to their margins of error.

(ii) At current replacement cost

1938 and 1948–1965

The gross stock at constant replacement cost by type of asset was converted to current replacement cost by multiplying by the price indices implied by the Blue Book estimates of gross fixed capital formation at current and constant prices. The calculation was done separately for four separate categories of asset.

The net stock at current replacement cost is given in the Blue Book for 1955 onwards. Earlier years and additional detail for the classification by type of asset were obtained by applying appropriate price indices to the estimates at constant replacement cost.

1920–1938

Estimates for these years for the gross and net stock at current replacement cost by type of asset and by industry are taken from Feinstein [162].

1855–1920

The series for the gross stock at constant replacement cost for three categories of asset: dwellings, other buildings and works, and plant, vehicles etc. were revalued at current replacement cost by multiplying by the corresponding price indices described in Chapter 9.0 and given in Table 63, columns (1) to (4); and Maywald's series for the first cost value at current prices of the merchant fleet [209, p. 59] was added to this. The same procedure was followed for the net stock, with

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[1] Other estimates of the capital stock have been published (e.g. by Deane and Cole [156], p. 271, and Phelps Brown [228], pp. 300–7) but all these rest on the capitalisation of current income (the so-called Giffen method) and are not comparable with the present estimates. For a brief elaboration of this point see [162], pp. 257–8.

TABLE 9.5   COMPARISON WITH AN ALTERNATIVE ESTIMATE OF
THE GROSS STOCK OF REPRODUCIBLE FIXED CAPITAL IN 1938

(£M. at 1938 replacement cost)

	Alternative estimate (1)	Present estimate (2)	Discrepancy (1) as percentage of (2) (3)
Agriculture, forestry and fishing	749	756	99
Mining and quarrying	324	508	64
Gas, electricity and water	1,496	1,696	88
Manufacturing and construction	3,029	3,239	93
Transport and communication	3,057	3,308	92
Distribution and other services	1,711	2,737	62
Social and public services	1,751	1,143[a]	153
Roads	455	533	85
Dwellings	5,298	5,599	95
Total	17,870	19,519	92
of which:			
Vehicles, ships and aircraft	1,238	1,348	92
Plant and machinery	3,795	3,610	105
Other buildings and works	7,539	8,962	84

SOURCE: (1) Unpublished estimate by J. Odling-Smee based on estimates by Dean [154] adjusted to 1938 replacement cost and with additions for agricultural buildings, hospitals and other assets not given by Dean.

(2) Feinstein [162]. Municipal markets are included in social and public services; road haulage is included in distribution and other services; railway workshops are included in manufacturing.

[a] Excluding universities and private schools.

ships taken from Maywald's estimate for the depreciated value at current prices.

CONSISTENCY AND RELIABILITY

The capital stock estimates rest on broadly the same conceptual basis over the whole period covered, but there is a break in continuity between the series up to 1938 and those from 1938 onwards. The two sets of estimates are shown in Table 9.5. It will be seen that the present estimates are higher in every industry except social and public services. For this industry it was noted earlier that the present estimate was possibly too low [162, pp. 255–6] and the discrepancy has been widened as a result of the new estimates for hospitals, universities and private schools prepared by John Odling-Smee.

The principal source of the large overall discrepancy is in the estimates for non-residential buildings and works, most notably in distribution and other services. There is some comment on this by Dean [154, pp. 330–1] and also in Feinstein [162, p. 256]. The primary reason, applying particularly to commercial buildings but also to industrial buildings, mine workings and dwellings, is the treatment of 'historic assets'. The estimates made by Dean used the present gross stock estimates for the

1920–38 period [162] as a starting point, but specifically excluded that part of the end-1938 gross stock which was not accounted for by the gross capital formation during the assumed life-time of the assets; for example, for commercial buildings (shops, offices, hotels, inns etc.) Dean's end-1938 stock would exclude the substantial stock of buildings surviving from before 1859 [154, p. 331]. With assets such as these it is not a matter of choosing a slightly longer life, but rather of recognising that where a large number of buildings survive from earlier periods the perpetual inventory method breaks down.

For this reason, the procedure adopted in such cases for all the present estimates (except roads) involved an initial benchmark which covered all assets existing at that date, irrespective of their vintage. In the case of commercial buildings, for example, the benchmark was based principally on the gross annual value of shops, inns etc. assessed for inhabited house duty in 1913/14. There are obviously difficulties in the translation of this figure into an estimate of the gross stock at current replacement cost, but there is no reason to believe that it is errors at this point which are responsible for the large discrepancy. As Dean has observed [154, p. 342] the exclusion of 'historic buildings' is not due to dis-

agreement on grounds of principle, but to problems of estimation, and the omission of these buildings must be kept in mind in any comparison involving the inter-war and post-war estimates.

The method of estimation used for the pre-1920 series ensures that there is no break in continuity, but it also means that any error in the end-1920 figures is reproduced unchanged in each year back to 1855. An under or over-statement which may be small relative to the end-1920

stock could be large relative to the stock at earlier dates and so seriously affect the reliability of the estimates.

The C.S.O. has assessed the total post-war gross stock estimates as category C [73, p. 387] and the same grade could be applied to the estimates for 1920–38. Earlier years are probably in grade D.[1] The net stock estimates have not been graded by the C.S.O. but in the post-war and earlier periods are probably of the same order of reliability as the gross stock.

9.2 DEPRECIATION AND NET DOMESTIC FIXED CAPITAL FORMATION AT CURRENT AND CONSTANT PRICES, 1855–1965

DEFINITION OF THE SERIES

The estimates of *depreciation* (capital consumption) represent an allowance for the fact that capital is generally subject to gradual deterioration on account of wear and tear and obsolescence, and also to damage by fire and other causes. While it is quite obvious that capital is 'used up' in the course of production it is not a process which can be directly observed or measured, and the allowance for depreciation must, therefore, be made on the basis of some more or less arbitrary conventions about the life of assets and the way in which the services they yield are spread over this life.

An indication of the length of life assumed for the principal assets is given in Table 9.6 below. For the pre-1914 and post-1948 estimates depreciation is cal-culated by the 'straight line' method according to which assets are assumed to depreciate by a constant amount each year (i.e. $1/n$th of its cost is written off in each of its n years of life). For the inter-war estimates the 'reducing balance' method was also adopted for some types of plant and equipment (see [162], pp. 3 and 17–22). With this system depreciation is a constant proportion of the written-down value at the beginning of each year, with the result that the depreciation allowances get progressively smaller each year for any given asset. It will be seen that with both of these systems depreciation is calculated as a fraction of the cost of the assets and for the present study reference is to the current or constant replacement cost of the assets (as estimated in Chap-ter 9.1) and not to the original cost which provides the basis for most accounting concepts of depreciation.

The sole exception to the procedure indicated above is the treatment of roads, for which no depreciation allowance is made (see [73], p. 387).

Estimates of *net domestic fixed capital formation* are ob-tained by deducting depreciation from gross fixed capital formation and are thus defined by the two primary concepts.

Tables 47 and 48 give estimates of net capital forma-tion at current and constant prices classified by type of asset. The corresponding estimates of depreciation are not shown separately but the total is shown at current prices in Table 1 and at constant prices in Table 5.

SOURCES AND METHODS OF ESTIMATION

The estimates of depreciation and net domestic fixed capital formation at current and constant prices are available for 1948–65 in the Blue Book[2] and for 1920–38 in [162]. An adjustment was made to the inter-war series to bring the treatment of roads into line with the C.S.O. estimates. For 1939–47 rough estimates were made for the main types of asset by interpolating between the 1938 and 1948 estimates on the basis of the gross stock series. For 1856–1920 new estimates of depreciation were made for five categories of asset using the gross stock esti-mates described in Chapter 9.1.[3] These were then deducted from the gross series to obtain net fixed capital formation. The length of life assumed for the principal types of asset in the calculation of depreciation in each of the three main periods is indicated in Table 9.6. For the estimates of depreciation at current and constant prices the fractions indicated by the assumed lives were applied to the corresponding estimates of the gross stock at current or constant replacement cost. For 1856–1913

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[1] See Chapter 1.4 for further discussion of these reliability grades.

[2] For 1948–52 the detailed estimates by type of asset are not available on a basis consistent with the total in the 1968 Blue Book, but the required components were kindly provided by the C.S.O.

[3] The present estimates for depreciation in the years before 1914 differ substantially from those previously given [160, pp. 373–4]. The earlier estimates were obtained by extrapolation of a 1907 benchmark of £50 m. (the present estimate for 1907 is £108 m.) and are now realised to be based on a confusion of the relationship between deprecia-tion and scrapping. For further comment on this see the Appendix to Chapter 1, pp. 28–9.

TABLE 9.6 LENGTH OF LIFE ASSUMED FOR CALCULATIONS OF DEPRECIATION, 1856–1965 (Number of years)

	1948–65	1920–38	1856–1913
Buildings and works			
Dwellings	100	100	125
Railway way and works	100	100	125
Industrial and commercial buildings	80	73[a]	100
Other buildings and works	63[b]	67[a]	125
Plant, vehicles, ships etc.			
Plant and machinery	30[b]	28[a]	40
Ships	20 or 25	20	25 or 30
Road vehicles	10	8	—

[a] This is the weighted average (in 1938) of the lives used for a number of separate categories. For details of the components see Feinstein [162], pp. 18–21.
[b] This is the weighted average (in 1958) of the lives used for a number of separate categories. For details see C.S.O. [73], p. 386.

the assumed lives were constrained (in the event, increased) by the requirement that the series for the net stock of capital – which the depreciation estimates affect through formula (5), see p. 198 – should show a plausible ratio to the gross stock. For analysis of the net/gross ratio see Goldsmith [171], pp. 11–28.[1]

CONSISTENCY AND RELIABILITY

The depreciation estimates are conceptually consistent over the whole period,[2] but there are statistical discrepancies between the Blue Book estimates for 1938 and those given here, and it is necessary to consider how far these are relevant to the long-run continuity of the series.[3] For depreciation these reflect the differences in the corresponding capital stock estimates as well as in the length of life assumed for certain assets. For net fixed capital formation there is the further discrepancy created by the differences in the estimates of gross capital formation. These various differences were discussed in detail (by industry and type of asset) in Feinstein [162, pp. 243–6] and are summarised in Table 9.7 p. 202.

As suggested in the earlier study the 'best' estimates for fixed capital formation in 1938 might be:

	£ m.
Gross	610
Depreciation[a]	360
Net[a]	250

[a] Adjusted to exclude depreciation of roads.

An adjustment of the inter-war estimates on these lines would presumably improve the comparability with the post-war data, but I have not done this, partly because there is reason to believe that the corrections suggested for 1938 would not be appropriate for earlier years [162, p. 245].

In assessing the implications of these discrepancies in 1938 for the wider question of the comparability of the inter-war and post-war series it is essential to note that the Blue Book estimates for 1938 for depreciation and net capital formation are no longer consistent with the Blue Book estimates for 1948 onwards. These 1938 estimates have not been revised since they appeared in the 1957 Blue Book and so do not reflect either the change in treatment of roads or the revised estimates flowing from the new capital stock series prepared by Dean. In particular, Dean [154, p. 341] obtained an estimate for the stock of buildings in distribution and other services which was a third less than the former estimate. This entailed a downward revision of capital consumption and an upward revision of net capital formation. Since the other adjustments made by Dean also tended to lower capital consumption, a revised 'Blue Book' estimate for 1938 would show an even wider discrepancy in the estimates of net capital formation than is indicated by columns (5) and (6) of Table 9.7, and the disagreement would also be concentrated on non-industrial buildings and works. It is, therefore, necessary that caution should be exercised in making any direct comparison of net capital formation in the inter-war and post-war periods: the relatively low level of the earlier period (see e.g. Table 48) is partly the result of these discrepancies in estimation.

The C.S.O. give a C grade to their estimates of depreciation [73, p. 387] and those for 1920–38 could be put in the same category [162, p. 246]. Earlier periods would be grade D. Net capital formation estimates are not ranked by the C.S.O. and are probably grade D throughout.[4]

[1] The alternative possibility would have been shorter assumed lives yielding progressively higher net stock series moving back to 1856. This would then have required upward revision of the gross stock series by an increase in the estimates of scrapping. However, such independent checks as could be made of the gross stock and/or scrapping estimates (e.g. from data on the number of dwellings at Census dates) indicated that this would not be appropriate.
[2] A minor qualification is that in the Blue Book transfer costs of land and buildings are wholly written off in the year incurred, while in the estimates for 1920–38 they are written off over the life of the assets to which they relate.
[3] For comparison with other estimates available for 1924–38 see Feinstein [162], pp. 249–52.
[4] See Chapter 1.4 for further discussion of the reliability grades.

TABLE 9.7   COMPARISON WITH THE BLUE BOOK ESTIMATES OF
                 CAPITAL FORMATION AND DEPRECIATION IN 1938   (£M.)

	Gross domestic fixed capital formation		Depreciation		Net domestic fixed capital formation	
	Blue Book (1)	Present estimate (2)	Blue Book (3)	Present estimate (4)	Blue Book (5)	Present estimate (6)
Vehicles	50	44	43	40	7	4
Rolling stock, ships and aircraft	37	37	26	28	11	9
Plant and machinery	181	182	119	129	62	53
Dwellings	180	169	54	56	126	113
Industrial and commercial buildings	75	56	34	49	41	7
Other buildings and works	133	104	83	68	50	36
Total	656	592	359	370	297	222

SOURCE: (1), (3) and (5): 1957 Blue Book [75], Tables 48, 54 and 56, and additional detail from Redfern [135], Tables 2 and 9.
(2), (4) and (6): Feinstein [162], p. 246, adjusted by the deduction of £5 m. previously included for depreciation of roads.

Note: As explained in the text, p. 201, these Blue Book estimates for 1938 are no longer consistent with the Blue Book estimates for 1948 onwards.

9.3 STOCKS, STOCKBUILDING (AT CURRENT AND CONSTANT PRICES) AND STOCK APPRECIATION, 1870–1965

DEFINITION OF THE SERIES[1]

The stocks (inventories) covered in this chapter consist of (a) raw materials and (b) finished or partly finished products awaiting sale, together with (c) unpaid work in progress on assets which take a long time to produce.[2] The estimates cover all such stocks and work in progress (subsequently referred to for the sake of brevity simply as stocks) held by trading enterprises, as well as strategic stocks of food and raw materials held by the Central Government. Livestock and growing crops are included in work in progress.

There are four related concepts associated with this class of assets. The first is the book value of the stocks at, say, the end of the calendar year; where this is derived from commercial accounting data it will typically represent the physical stocks held valued at the lower of cost or market value. The second measure is the change in the book value between the end of one period and the end of the following period. This can then be separated to show the two further concepts: the value of the physical increase in stocks and work in progress (stockbuilding) and stock appreciation. Stockbuilding at current prices measures the change in the quantity of stocks valued at the average prices of the year in question, and corresponding estimates can be made at constant prices, i.e. with the change in stocks valued

at the average prices of the base year. Stock appreciation is the difference between the change in the book value of the stocks and the estimate of stockbuilding. It thus reflects the change in the prices at which a particular quantity of stocks are valued.

For 1921–38 the estimates correspond broadly to the above definition, but there is a large element of approximation in the series for stockbuilding and stock appreciation. For 1870–1920 it is not possible to make a direct estimate of stockbuilding but the series given is intended to approximate the definition followed for later years. No estimate has been made for stock appreciation for the period before 1914.

Estimates of stockbuilding at current and constant prices are given in Tables 2 and 5 respectively and an estimate of stock appreciation is given from 1914 onwards in Table 1. Estimates of the total value of stocks are given for selected years in Table 49.

[1] For a more general discussion see C.S.O. [73], pp. 390–406.
[2] Progress payments for such work (e.g. on ships or buildings) are included in Chapter 9.0 as fixed capital formation.

1922–1938 and 1946–1965

For the years from 1948 onwards estimates of stock-building at current and constant prices, and of stock appreciation, are taken from the Blue Book [73, 1968 Tables 1 and 14]. For 1922–38 estimates are available in Feinstein [162, p. 54], and the series for stockbuilding at 1930 prices was converted to 1938 prices by means of the appropriate price indices. In both periods the basic source for the estimates for industry and trade is information on the book values of stocks held, and in order to obtain the required series a number of crucial assumptions have to be made regarding the methods of valuation underlying this data and also the period over which the stocks have been built up; see [73], pp. 400–6, and [162], pp. 31–3, for further details. For the inter-war years this was derived from samples of accounts and for the modern period the required data are collected in regular enquiries.

For agriculture, data on livestock and growing crops are obtained from the annual agricultural census; for inter-war years the figures relate to 4 June of each year for livestock and to the end of the calendar year for crops and the change in the former was taken without adjustment for the calendar year. In the post-war period changes in the value of stocks for farm years are converted to calendar years by taking five-twelfths and seven-twelfths of the changes in the appropriate farm years. The estimates for forestry represent the net cost of growing timber.

1939–1945

For the years of World War II official data are available for stocks of certain raw materials and selected foods and textiles[1] but the information is far from complete and not easily transformed into the form required for the national accounts. However it suggests that stocks were being run down in 1942, 1944 and 1945 and rising in the other years. I have therefore made essentially arbitrary estimates of stockbuilding at current prices (given to the nearest £100 m.) with changes of the approximate magnitude and sign indicated by this evidence. The Board of Trade wholesale price index was used to obtain the corresponding series at 1938 prices.

To obtain estimates of stock appreciation the procedure used was basically the same as that followed for 1922–38 [162, pp. 25 and 31–3]. The result is inevitably very crude, but it may help the evaluation of the results to point out that the estimate of stock appreciation is basically determined by the book value of the stocks,

and is not greatly affected by errors in the estimate of stockbuilding. This can be shown as follows:

Let

Volume of stocks at end of year	$= Q_t$
Price of stocks at end of year	$= P_t$
Price of stocks at date of acquisition	$= P_{t-m}$
Average price of stocks during year	$= P_a$

The required series for stockbuilding during the year can then be defined as:

$$(Q_t - Q_{t-1}) \, P_a \qquad (1)$$

The book value of stocks will depend on whether prices were rising or falling. If we take the case where prices were falling at both the beginning and end of the year (so that the formula 'lower of cost or market value' leads to stocks being valued at end-year prices) we have the increase in book values equal:

$$Q_t . P_t - Q_{t-1} . P_{t-1} \qquad (2)$$

Stock appreciation is, therefore:

$$[Q_t . P_t - Q_{t-1} . P_{t-1}] - [(Q_t - Q_{t-1}) \, P_a]$$
$$= Q_t \, (P_t - P_a) - Q_{t-1} \, (P_{t-1} - P_a) \qquad (3)$$

Since the second term of (3) is:

$$Q_t \, (P_{t-1} - P_a) - \Delta Q \, (P_{t-1} - P_a)$$

we can therefore rewrite (3) as:

$$Q_t \, (P_t - P_{t-1}) + \Delta Q \, (P_{t-1} - P_a). \qquad (4)$$

If prices were rising at the beginning and/or the end of the period it would simply be necessary to substitute:

$$P_{t-1-m} \quad \text{for} \quad P_{t-1} \quad \text{and/or} \quad P_{t-m} \quad \text{for} \quad P_t.$$

It can thus be seen that the first term of (4) will dominate the estimate of stock appreciation, primarily because the end-year stock (Q_t) will be many times larger than the physical increase in stocks (ΔQ), and also because the change in prices over the year ($P_t - P_{t-1}$) will usually be greater than the difference between the average price and the price at the beginning of the year ($P_{t-1} - P_a$).

For the present calculation the benchmark used for the book value was the value of stocks held at end-1948: this was derived from the Blue Book figures for the book value of stocks held at the end of 1967 and the annual increase in the book value of stocks from 1949 to 1967.[2]

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[1] See, in particular, J. Hurstfield, *The Control of Raw Materials*, 1953 [180], p. 468, and R. J. Hammond, *Food. I. The Growth of Policy*, 1951 [173], p. 397. Both volumes are part of the *History of the Second World War, Civil Series*. Other statistics are given by the C.S.O. [77], pp. 73–110.

[2] The estimate obtained for end-1938 by working back from this figure for end-1948 on the basis of the present estimates for 1939–48 is some £420 m. (24%) larger than the estimate of £1,710 m. given in [162] pp. 25, 71 and 77. This is regrettable, but not too surprising given

The various prices required were calculated on the basis of the wholesale price index.

1870–1921

The previous study of stockbuilding showed a large rise in stocks held by industry and trade in 1921 [**162**, p. 25] but this appears to be wrong, primarily because the calculation adopted too high a figure for balance sheet prices in 1920. The revised figure shows a fall in stocks in 1921 and this is more consistent with the economic character of the period.

For 1914–20 the stockbuilding estimates are almost entirely arbitrary and it might perhaps have been wiser to acknowledge ignorance and show no figure for this period. The estimate for stock appreciation was obtained by the procedure outlined above, using the *Economist* wholesale price index and a book value derived from the inter-war estimates.

For 1870–1913 an estimate was obtained for stockbuilding on the simple assumption that it represented 40 % of the change in total final expenditure at constant prices. This represents a small variation on a procedure proposed in 1952 by Phelps Brown,[1] in which stockbuilding was assumed to equal 40 % of the change in net national income at current prices. The variation proposed here seems more in line with the underlying logic: that there is a constant stock: output ratio in real terms. The procedure is obviously extremely crude and the figures are given rounded to the nearest £5 m. However, a check on the post-war data shows that estimates obtained on this basis may not be hopelessly unreliable. The import price index was used to convert the estimates to current prices and again rounded to the nearest £5 m. as a reminder of their margin of error.

No estimate was made for stock appreciation for the years before 1914. In view of the relative stability of prices in this period this may not be too serious an omission.[2]

CONSISTENCY AND RELIABILITY

The C.S.O. class the estimates of the change in the book value of stocks as grade C and say that the estimates of stockbuilding and stock appreciation 'should be regarded as subject to a wide margin of error' [**73**, p. 407], i.e. presumably grade D. For years before 1948 the series are equally poor, with the possibility being quite high, especially before 1913, that not only the size of the stock change but also the sign could be incorrect. See also Chapter 1.4 where a study of cyclical turning points leads to the conclusion that the stockbuilding estimates are particularly poor in certain specified years.

9.4 OVERSEAS ASSETS, NET OF LIABILITIES, 1856–1965

DEFINITION OF THE SERIES

This is an estimate of the stock of overseas assets, net of liabilities, obtained by accumulating the annual estimates of net investment abroad (i.e. of the balance on current account plus capital grants from overseas governments). It thus represents the holdings by United Kingdom residents of all external assets, net of non-residents' holdings of United Kingdom assets. The items covered include gold and convertible currencies, short-term financial claims, government and private lending, trade credit and direct investment. In each case the assets and liabilities are taken at their face value or at original cost.

The estimates are given for selected years in Table 50.

SOURCES AND METHODS OF ESTIMATION

For 1816–69 Imlah's estimates [**181**, pp. 70–2] of the balance on current account, plus the net export of gold and silver bullion and specie, were cumulated together with his estimate of the net figure at the end of 1815. From 1870 onwards the series was continued by cumulating the estimates given in Table 15 (adjusted for capital grants received in 1947–51).

COMPARISON WITH OTHER ESTIMATES

An alternative estimate can be made by compiling what is, in effect, a census of all external assets and liabilities at various dates, using data from official returns, company balance sheets, returns by banks and other financial institutions etc.

There are a number of reasons why the two methods cannot be expected to yield closely comparable results. Firstly, there is a substantial problem of valuation. The accumulated surplus on current account will represent

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the nature of the inter-war and post-war stock estimates and the highly unreliable estimates of war-time stock changes.

[1] E. H. Phelps Brown and S. J. Handfield-Jones 'The Climacteric of the 1890's', *Oxford Economic Papers*, 1952 [**228**], p. 304.

[2] From 1870 to 1913 the average rate of change (ignoring sign) in the import price index was 3 % p.a. For 1922–38 the corresponding rate of change for the price index used for stocks was 5½ % p.a.

the value at original cost. The 'census' estimate will represent a mixture of valuations, including, as a rule:

(a) Short-term assets and liabilities, including gold: at face value

(b) Long-term official assets and liabilities, including subscriptions to international financial organisations: at face or nominal value

(c) Portfolio investments: at market value

(d) Direct investments: at book value (i.e. fixed assets at original cost less depreciation, plus current assets less current liabilities)

Items (a) and (b) will thus be matched by corresponding figures in the balance of payments estimate, but changes in market values of portfolio investments will not be reflected in the accumulated surplus. For direct investments the book values will exceed the balance of payments data to the extent that no allowance is made for local long-term borrowing and fall below it to the extent that depreciation is written off fixed assets.

Secondly, the census, but not the balance of payments, estimate will be affected by changes in exchange rates; and by the writing down (in whole or in part) of debts, either by agreement or because of default or repudiation by the borrower.

Thirdly, there are likely to be substantial errors and omissions in both sets of data.

Given these reservations the comparison in Table 9.8 may be thought to present a reasonably consistent picture.

TABLE 9.8 COMPARISON WITH ALTERNATIVE ESTIMATES OF THE STOCK OF OVERSEAS ASSETS NET OF LIABILITIES, SELECTED YEARS, 1854–1966

(£ thousand million)

End of year	Accumulated net investment abroad (1)	Alternative estimates (2)
1854	0.26	0.23
1913	4.18	4.30
1939	4.91	4.00
1949	0.13	−0.50
1959	1.45	3.00
1962	1.29	1.35
1966	1.07	1.40

SOURCE: (1) Imlah [181], pp. 70–2, and Table 15, column (16).

(2) 1854 and 1913: Estimates by L. H. Jenks and Sir George Paish for publicly issued securities, adjusted by Imlah for capital privately placed abroad and foreign investment in Britain [181, pp. 68 and 79]. These estimates exclude short-term assets and liabilities and for 1913 Imlah's figure of £4.02 b. was raised to £4.30 b. on the basis of Morgan [214], pp. 331–4 and 342–3.

1939, 1948 and 1959: A. R. Conan, 'The United Kingdom as a Creditor Country', Westminster Bank Review, August 1960 [150], p. 21. Comparison of Conan's very rough estimates for 1959 and the detailed Bank of England figures for 1962 suggests that Conan underestimated the extent of (a) private foreign investment in the U.K., (b) overseas holdings of British government stocks, local authority mortgages etc., and (c) the net short-term liabilities. As a result his final estimate of the net creditor position was unduly favourable.

1962 and 1966: Bank of England, Quarterly Bulletin, VII, September 1967 [263], pp. 266–7.