CHAPTER 10

REAL PRODUCT

10.0 GROSS DOMESTIC PRODUCT AT CONSTANT FACTOR COST, 1855–1965

DEFINITION OF THE SERIES

This chapter provides an estimate of the gross domestic product at constant factor cost, sub-divided by industry of origin and measured (in principle) by means of production data. The production approach covers all domestic industries and services, irrespective of whether they produce raw materials, finished or semi-finished products for use by other sectors, or goods for final use in consumption and investment; but in each case only the *value added* (net output)[1] at base year prices of each industry is measured, i.e. it is an aggregation of each industry's net contribution to the gross domestic product, valued at base year prices. By contrast, the constant price expenditure estimates (e.g. for consumers' expenditure in Chapter 2.4 or for capital formation in Chapter 9) cover only *final* purchases of goods and services but measure their full value at base year prices, i.e. they include the value of all raw materials and intermediate products incorporated in the final goods.[2]

The estimate obtained by the production approach can be regarded as a weighted quantity index, where the weights represent the base year contribution to the gross domestic product by each constituent industry or service; and the year to year changes in output are represented (in principle) by a direct measure of the changes in gross output less inputs. This means, in effect, that we have quantity indices weighted by base year *prices*, as can be seen if we note that for any industry or section of an industry:

$$q_0 p_0 \cdot \frac{q_n}{q_0} = q_n p_0, \qquad (1)$$

where $q_0 p_0$ = value added in the base year and

$\frac{q_n}{q_0}$ = an index of the output of the industry in year n relative to the output in year 0.

There is, in general, not too much difficulty in obtaining the appropriate weights: essentially what is required is the allocation to the individual industries of income data (income from employment, profits and rent, before providing for depreciation but after providing for stock appreciation), and/or census of production data (gross output minus inputs), for the base year. Practical problems arise only where the data does not permit a degree of sub-division fine enough to apply to the individual industries for which separate indices are desired. The actual classification of industries follows the 1958 version of the *Standard Industrial Classification* [**76**] for 1948–65 and the 1948 version for 1920–46.[3] For earlier years there was no formal classification but the industrial sub-divisions correspond broadly to those for later periods.

In accordance with the principles discussed in Chapter 1.1 different base year prices have been used in various sub-periods. The actual base years are summarised in Table 10.1. Where two or more dates are given the index is a geometric mean of indices with the stated base years, and for agriculture the 'date' is in several cases an average of three crop-years.

These particular base years were determined by those responsible for the existing indices which (with the exception of non-industrial production for 1913–48) were not specially constructed for the present study. However, with the possible exception of the inter-war industrial production series,[4] they should correspond reasonably well in terms of the structure of relative prices to the base years used for the expenditure estimates.

The other aspect of the calculation – the measure of year to year changes in output – is a far more complex issue and raises numerous problems, both conceptual and practical. The subject has been extensively discussed in

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[1] Net output is used here, and elsewhere in this chapter, to refer to gross output less inputs. It is *not* net of depreciation.

[2] If all statisticians and their data were perfect the two methods would yield identical results. For a comparison of the actual results obtained with imperfect statistics and statisticians see Chapter 1.4.

[3] For an indication of the effect of the change in classification see Table 59 where estimates are given for the employed labour force in 1948 classified according to both the 1948 and the 1958 S.I.C. See also the sources quoted on p. 33, n. 4, above.

[4] See also p. 209 below.

TABLE 10.1 BASE YEARS USED FOR THE INDICES OF REAL OUTPUT, 1855–1965

	Agriculture	Industrial production	Services	Gross domestic product
1958–64	1954/5–1956/7	1958	1958	1958
1954–58		1954	1954	1954
1948–54	1948/9			
1946–48		1948	1948	1948
1938–48	1945/6	1935, 1948	1948	1938, 1948
1920–38[b]	1936/7–1938/9	1924, 1930, 1935	1938[a]	1938
1913–20	1911–13	1907, 1924	1924	1924
1855–1913	1911–13	1907	1907	1907

[a] See also p. 210, below.

[b] For 1920–4 the industrial production index is a mean of indices calculated respectively with 1907, 1924 weights and with 1924, 1930, 1935 weights.

the literature[1] and it is only necessary to mention briefly some of the main points of which users of the series should be aware. First, it is generally not possible to obtain separate annual indicators for gross output and total inputs (agriculture is the one sector where both output and inputs can be measured each year) and the change in value added has, therefore, to be represented by a series for gross output. This means that any change in the ratio of net to gross output (e.g. through increased efficiency in the use of materials) will cause a corresponding error in the estimates. Some evidence regarding the extent of this source of error is considered below (p. 211). Moreover, in some cases even a series for gross output is not available. This applies to certain services, such as education or defence, where no obvious and homogeneous units of output are produced which could be directly measured in physical terms; and also to some industries where there is no inherent conceptual problem but simply a lack of appropriate data. In such cases output has instead to be measured by the numbers employed or the input of the principal raw material i.e. it is assumed that there is a constant relationship between output and one particular input.

Secondly, there is in almost every case the practical problem of fitting the indicators available to the industry weights – the object being to maximise the coverage of the industry while minimising the element of imputation, i.e. reducing as far as possible the number of instances in which it has to be assumed that the output of that part of an industry for which one has no indicator, even of an imperfect character, changed at the same rate as the other part(s) of the industry for which data are available.

Finally, it is difficult to make accurate allowance for improvements in the quality of the goods or services produced, and the estimates may tend to understate any growth of output in the form of better quality or design. More generally, there is the intractable problem of changes in the composition of output as new goods are introduced and old ones go out of production. The longer the period covered, the greater will be the proportion of such goods and thus the more approximate will be the index.

The indices available, or specially constructed, for the various sub-periods have been linked to form a continuous index with 1913 = 100. The gross domestic product index is given in Table 6 and again, together with the indices for the main industrial orders in Table 8. The individual industries comprising the index of industrial production are shown in Tables 51 and 52 and the indices for the main services are given separately in Table 53. All the above indices follow the general rule in that they cover Great Britain and Ireland for 1855–1920 (first estimate) and then exclude Southern Ireland from 1920 (second estimate) onwards. Table 54 provides an additional estimate covering only Great Britain for the period 1855–1920 and for many purposes it is this alternative index which is most nearly comparable, in terms of geographic coverage, with the series for 1920 onwards.

SOURCES AND METHODS OF ESTIMATION

The indices span the period from 1855 to 1965 omitting the war years 1914–19 and 1939–45.[2] The value added

[1] See, for example, W. B. Reddaway, 'Movements in the Real Product of the United Kingdom, 1946–1949', *J. R. Statist. Soc.* CXIII, 1950 [**233**], and 'Some Problems in the Measurement of Changes in the Real Geographical Product', *Income and Wealth*, I, 1951 [**234**], pp. 267–92; and also C.S.O. [**73**], pp. 77–87.

[2] Provisional results for the period 1920–48 were published earlier in C. H. Feinstein, 'Production and Productivity,

TABLE 10.2 WEIGHTS USED IN ESTIMATING GROSS DOMESTIC PRODUCT AT CONSTANT FACTOR COST FROM OUTPUT DATA

	1907	1924	1938	1948	1958
1. Agriculture, forestry and fishing	71.6	48.9	35.9	61.4	44.4
2. Industrial production					
(*a*) Mining and quarrying	66.3	61.4	36.1	36.7	35.1
(*b*) Manufacturing	263.2	310.0	312.4	355.7	365.9
(*c*) Construction	38.3	42.0	48.9	62.4	61.6
(*d*) Gas, electricity and water	14.1	21.8	27.0	20.3	26.4
Total	381.9	435.2	424.4	475.1	489.0
3. Transport and communication[a]	100.2	103.3	91.4	95.7	88.4
4. Distributive trades	159.0	132.8	146.2	123.6	116.2
5. Other services					
(*a*) Insurance, banking and finance[b]	16.9	51.0	63.1	25.3	60.4
(*b*) Ownership of dwellings	81.8	48.1	54.9	28.3	34.6
(*c*) Public administration and defence	42.4	51.3	52.5	72.7	62.8
(*d*) Professional and scientific services	55.7	68.6	68.5	55.5	70.4
(*e*) Miscellaneous services	90.5	70.9	73.2	72.4	64.8
Total	287.3	289.9	312.2	254.2	293.0
6. *Less* Adjustment for net interest[c]	—	10.1	10.1	10.0	31.0
7. Gross domestic product	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0

[a] Covers all road goods vehicles including those owned by other industries.

[b] Including real estate other than dwellings and agricultural land and buildings.

[c] For 1924, 1938 and 1948 this is a deduction for the input of banking services into all other industries and services; for 1958 the deduction also covers insurance and other financial services [**73**, p. 83]. The deduction is made in this form since it is not possible to estimate separately the financial services used by each industry. (See also Chapter 7.1, pp. 141–2, above).

SOURCE: 1907: W. Arthur Lewis [**202**], p. 122.
1924 and 1938: See text, p. 210.
1948: C.S.O. [**74**], pp. 358–70.
1958: C.S.O. [**73**], p. 83.

weights used to combine the main industrial orders at different periods are shown in Table 10.2.

1946–1964

Indices for this period were compiled by the C.S.O. and are taken from the Blue Book [**75**, 1967, p. 18, and – for 1946–8 – 1957, p. 7]. For some details of the weights used see Tables 10.1 and 10.2.[1]

1938–1948

Estimates of the change in real output between 1938 and 1948 (omitting all intervening years) were made separately for each sector.

For agriculture the link is based on the Ministry of Agriculture estimates of net output at 1945/6 prices,[2] adjusted for inputs of fertilisers, expenditure on maintenance of machinery, and other expenses not deducted in the then current official definition of net output.[3]

For mining, manufacturing and gas, electricity and water the trans-war link is based on the Census of Production data for 1935 and 1948, with the former extrapolated to 1938 by the indices used below for the

1920–1962', *London and Cambridge Economic Bulletin*, New Series, 48, 1963 [**161**], p. xii. A few minor revisions have been made in the final version.

[1] For details of the weights and indicators used in the index of industrial production see C.S.O., *The Index of Industrial Production*, *Studies in Official Statistics* No. 2, 1952 [**78**] and No. 7, 1959 [**78**], and *Economic Trends* [**267**], March 1962. For other sectors see C.S.O. [**73**], pp. 81–98, and for earlier years *Economic Trends* [**267**], August 1960, February 1966 and, for agriculture, March 1960.

[2] Ministry of Agriculture, *Output and Utilization of Farm Produce in the United Kingdom 1946–47 to 1955–56*, 1958 [**86**], p. 6.

[3] Expenditure on these additional inputs (at current prices) was taken from the *Annual Abstract of Statistics* [**9**], No. 93, 1956, Table 209, and converted to constant prices by means of the appropriate price indices for fertilisers and other items.

inter-war period. The original calculation was made by B. C. Brown [**138**, p. vi] and we have taken a geometric mean of his results with 1935 weights and 1948 weights. For construction the link is based on a C.S.O. estimate.[1] These four sectors are also combined to give the index for total industrial production.

For forestry and fishing, transport, distribution and other services the indicators used to measure the change in real output between 1938 and 1948 are, in general, the same as those used by the C.S.O. in the early post-war period (see [**74**], pp. 358–70, for the complete list).[2] However, there are a few cases where discontinuities in the available data made it necessary to have recourse to alternative indicators. This applied, for example, to road and railway passenger transport, and to medical services. Within each of these sectors only 1948 weights were used, except in the case of transport, for which estimates of 1938 weights were also made for the main sub-groups, and a geometric mean taken of the two results.

In order to combine the indices calculated for the main components of G.D.P. (i.e. for agriculture, industrial production, and the seven service sectors for which separate weights are listed in Table 10.2) one estimate was made using 1938 weights and another using 1948 weights, and a mean of the result was then adopted. For the 1948 weights the published C.S.O. estimates [**74**, pp. 358–70] were used; for the 1938 weights see p. 210, below.

1920–1938

For agriculture special estimates were made by valuing gross output for each year at the average prices of the crop years 1936/7–1938/9, and deducing inputs valued at these prices. Physical production data for crops are given in substantial detail in the annual *Agricultural Statistics* [**8**], and for each crop, *output* (i.e. that part of production which is sold off the national farm or consumed in farm households) was calculated as a proportion of production. The relevant proportions were obtained from data for 1925, 1930 and 1936–8.[3] Comprehensive data on output of livestock and livestock products (meat, milk, eggs, wool etc.) and of fruit, flowers and vegetables are also available [**8**]. The valuation at the average prices of 1936/7–1938/9 was based on the detailed price data [**86**, p. 33]. June to May crop year statistics were converted to calendar years in the proportion 7:5, e.g. 1929 is five-twelfths of 1928/9 plus seven-twelfths of 1929/30.

The data on inputs are taken partly from Ministry of Agriculture statistics [**8**], and partly from estimates by Bellerby [**120**, p. 342]. Series for expenditure at current prices were deflated by appropriate price indices.

For fishing an index was calculated by valuing the quantities of six different types of fish of British taking at the average 1938 prices per ton. The necessary statistics are given in the *Statistical Abstracts*.

For industrial production we have adopted the index constructed by Professor K. S. Lomax.[4] This is presented for 1924–38 in the form of a geometric mean of separate indices calculated respectively with 1924, 1930 and 1935 weights. It would have been more consistent with the weights used elsewhere in the present study to have taken only the index with 1935 weights but unfortunately Professor Lomax was unable to provide this. The effect of the incorporation of the earlier base years will presumably be to increase the measured rate of growth (see pp. 5–6, above); and there are also problems associated with the choice of a depression year like 1930 as one of the base years [see **203**, p. 214]. The original study should be consulted for details of the procedures followed in the construction of the index and for information about the quantity indicators used.

For transport, distribution and five other groups of services new indices of real output were constructed. These calculations were carried out in considerable detail, involving, for example, the use of 23 indicators for transport and communication, 49 for the distributive trades and 29 for professional and miscellaneous services. In very many cases it was possible to use indicators which are the same as, or very similar to, those used by the C.S.O. in the early 1950s and listed in [**74**], pp. 359–70. Among the main exceptions are road goods transport, where no data on ton-mileage (or even mileage) are available[5] and the indicator used was simply a weighted index of goods vehicles in use. For public administration and medical services the indicators used were simply numbers employed in a few broad categories, and this is consistent with the present C.S.O. practice [**73**,

[1] C.S.O., *The Interim Index of Industrial Production*, Studies in Official Statistics, No. 1, 1949 [**78**], p. 44.

[2] The C.S.O. very kindly provided a considerable number of unpublished series and these were of great value in the calculation of the trans-war link: in particular, more detailed components of consumers' expenditure in 1938 and 1948 at 1948 prices than are given in the Blue Books.

[3] For 1925 and 1930 see the *Census of Agricultural Output* data: [**85**, p. 20, **39**(*d*), p. 61, and **39**(*e*)]. For 1936–8 see [**86**], pp. 10–11. See also Ojala [**222**], pp. 191–200.

[4] K. S. Lomax, 'Production and Productivity Movements in the United Kingdom since 1900', *J. R. Statist. Soc.* **122**, 1959 [**203**].

[5] Some figures of tonnage carried are available for individual months for selected regions but it was not possible to turn these into a reliable annual series. See, e.g. Ministry of Transport, *Road Traffic Census, 1935*, 1936 [**89**] and Royal Commission on Transport, *Final Report*, Cmd. 3751, 1931 [**62**], p. 82.

p. 87]. For the most part the reasoning underlying the choice of indicator is fairly obvious: for example, quantity series for various components of consumers' expenditure, industrial production or overseas trade to represent the volume of turnover handled by the distributive trades. There are, however, a few series, notably insurance, where the logic is rather more subtle and if further explanation is required reference should be made to the sources quoted above, in particular C.S.O. [**74**] and Reddaway [**233**].

As far as possible, 1938 weights were calculated for the services from the detailed estimates of wages, profits and other factor incomes, prepared for this study;[1] and for some series within the distributive trades gross margins were calculated by applying to 1938 consumers' expenditure the percentage margins found for the relevant trades in the 1950 *Census of Distribution* [**40**]. For the finer sub-divisions 1938 value added could not be directly estimated and a rough approximation was made by extrapolating the C.S.O.'s 1948 weights by means of the quantity indicators linking 1938 and 1948.[2]

To obtain the index of real G.D.P. the component indices were combined with 1938 weights (given in Table 10.2). These represent the factor incomes originating in each sector and are derived from the present study; in particular, Tables 12, 22, 23, 26, 28, 30 and 8.1. Rough estimates were made to allocate certain items (e.g. director's fees and stock appreciation) not otherwise allocated by industrial order.

1913–1920

A new estimate of the level of real output in 1920 relative to that in 1913 was made in order to link the pre-1913 and post-1920 indices in a continuous series. This calculation was made for Great Britain and Ireland, but since the indices available from 1920 onwards cover only Britain and Northern Ireland, a rough adjustment to exclude Southern Ireland from the 1920 estimates was made separately for each sector.[3] It is this lower estimate which is then linked on to the indices for later years.

For agriculture the estimate is based on Ojala [**222**, p. 66], with the annual averages for 1911–13 and 1920–2 given by him spread over the constituent years on the basis of gross output data. The substantial deduction (23 %) to exclude Southern Ireland was then made on the basis of the agricultural census data for net output in 1925.[4] For industrial production we again use the Lomax index. For this period it was calculated as a geometric mean of indices with 1907 and 1924 weights [**203**, p. 191]. Census of Production data was then used to make a second estimate for 1920 excluding Southern Ireland.

For transport, distribution and other services indices were constructed, conforming as closely as possible to the procedures used for the inter-war period. For broad categories within these series 1924 weights were calculated from the present data on factor incomes, but for finer subdivisions it was again necessary to call in aid the 1948 data in the form indicated in n. 2 below. An adjustment was then made to each sector to obtain an estimate for 1920 excluding Southern Ireland, working in as much detail as possible with the individual quantity indicators.

Finally, the estimates for all sectors were combined to get the real G.D.P. index. The 1924 weights given in Table 10.2 were used for this purpose. They are derived from the present estimates of wages, profits and other factor incomes.[5]

1855–1913

For this period we are fortunate in having a newly constructed index by W. Arthur Lewis [**202**, pp. 116–25]. The index is based on 1907 weights. The index for agriculture is derived from Ojala [**222**]; and the index for mining and manufacturing is based partly on earlier series compiled by Hoffmann [**179**] and partly on revised and additional series constructed by Lewis. The remaining components, including construction, transport, distribution and other services are all new series prepared by Lewis. His study should be consulted for further information on the sources and methods.

The Hoffman and Lewis industrial series are given for products rather than industries; and I have aggregated these, using the weights given by Lewis [**202**, p. 122], to produce the indices for the industrial groups shown in Table 51 for 1855–1913. From 1913 onwards the series required for the table are available in the published sources used for total industrial production.

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[1] See, in particular, Tables 12, 22, 26 and 28.

[2] In terms of equation (1) above (p. 206), the estimate for an individual series is:

$$p_{48} \cdot q_{48} \cdot \frac{q_{38}}{q_{48}} = p_{48} \cdot q_{38} \cdot \qquad (2)$$

It may just be worth emphasising that the assumption implicit in this procedure is that *within* the various subgroups (e.g. railway transport or education) there was no significant change in relative *prices* between 1938 and 1948. It does not require any assumption regarding relative contribution to the gross domestic product.

[3] The adjustment was based mainly on the census data available for Eire in the mid-1920s. See [**98**, **99** and **100**].

[4] This is the same adjustment as was made for the income estimate in Chapter 2.2. For the sources used see p. 40, n. 7.

[5] See also the account of the corresponding estimates for 1938, p. 210, above.

CONSISTENCY AND RELIABILITY

The indices for real G.D.P. and for the component industries and services are consistent in the sense that there is no change in the conceptual basis of the series over the entire period 1855–1965, and there is also no break in continuity at any point (other than the treatment of Southern Ireland in 1920). On the other hand, long-term comparisons of the sort suggested by these indices inevitably raise the standard index number problem already referred to on p. 207 above and also in Chapter 1.4, pp. 9–10.

The reliability of the index has to be considered in the context of measurement of the *changes* in real output over time, and not of the actual level at any point in time. It is also important to consider the time period involved: the indices will be more reliable over periods of moderate length (roughly 10 to 50 years) than over periods which are very short or very long. In general the indices for industrial production are likely to be most accurate, followed by agriculture, transport and distribution. The remaining services are probably least reliable and it is important to bear in mind the extent to which use of these estimates depends on the acceptance of certain conventions. A further aspect of some importance is the use of numbers employed (or deflated wages and salaries) as the measure of output change for certain services. This applies, in particular to public administration and defence, to professional and scientific services and to certain miscellaneous services, notably private domestic service. In all these cases there is assumed to be no increase in output per head.[1]

A more specific evaluation of the real output index is given in Chapter 1.4 on the basis of a comparison with the other measures available of the changes in real G.P.D. Users of the indices should also refer to the discussion when Lomax's index of industrial production was presented to the Royal Statistical Society [**203**, pp. 213–20]; and to an article by S. Gupta.[2] This examines the possible extent of error arising from use of gross output indicators in place of separate indicators for outputs and inputs. For manufacturing as a whole Gupta finds relatively little change in the input content of output over the admittedly short period 1948–54: the input/output ratio was 2.1 % higher in 1954 than in 1948. For individual industries or industry groups, however, the variations are somewhat greater.

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[1] This is not true for 1855–1913, where Lewis assumes an increase of 0.5 % p.a. in output per head [**202**, p. 125].

[2] S. Gupta, 'Input and Output Trends in British Manufacturing Industry', *J. R. Statist. Soc.* **126**, 1963 [**172**].

APPENDIX 10.1

GROSS DOMESTIC PRODUCT AT CONSTANT FACTOR COST, GREAT BRITAIN, 1855–1920

The purpose of this appendix is to estimate what the indices of real output would have been if estimated for Great Britain (England, Scotland and Wales) alone instead of for the United Kingdom. It is thus, in a sense, a response to Professor Butlin's 'plea for the separation of Ireland'.[1] To do this the indices of net output at constant factor cost described in Chapter 10 were recalculated with the exclusion of all items in the weights and indicators which, either implicitly or explicitly, were incorporated in the United Kingdom estimates to cover Ireland. It will be appreciated that this is not the same as an attempt to estimate directly the real output of Ireland, and that the items which are excluded for the present estimate will not necessarily be the most accurate measures available for the Irish components.

The present procedure thus yields estimates for Great Britain (see Table 54) which are consistent with those for the United Kingdom in Table 8. It is then possible to derive as a by-product an index of the real output of Ireland (see Table 10.4) but this must be used with extreme caution. Ireland accounts for such a small proportion of the gross domestic product of the United Kingdom that an error in the recalculation which is small relative to the estimate for Great Britain would be very large relative to the Irish component: e.g. an understatement of only 1 % in the share of output allocated to Great Britain in the bare year (1907) would mean that the output of Ireland was overstated by about 20 %. If, moreover, the share attributable to Ireland is overstated in one period and understated in another, the margin of error in the estimated *trend* in Irish real output could be very large indeed.

No attempt has been made to produce a corresponding series for Great Britain for the period after 1920. However, from 1920 onwards the Irish component of the main estimates is limited to Northern Ireland, with a population less than 3 % of that in Great Britain (and an even smaller share in gross domestic product), and it is unlikely that an index of real output for Great Britain alone would differ significantly from the index in Table 8.

The basic method in all sectors except agriculture was to construct annual estimates of the percentage of the output of a particular industry or service accounted for by Great Britain, to apply this series to the corresponding indicators of real output for the United Kingdom and then express the resulting indicator for Great Britain as an index with 1907 = 100. For agriculture a more detailed procedure – described below – was adopted. The resulting indices were then combined by means of 1907 net output weights for Great Britain. These were obtained from the corresponding United Kingdom weights (see Table 10.2) and the present estimates of the proportion of this net output produced in 1907 in Great Britain.[2] The final series were then expressed as indices with 1913 = 100 and are shown on this basis in Table 54 for total GDP and for the main industries and services. The main source of error in this procedure is likely to be inaccurate allowance for differences in output per worker in the many sectors where the proportions of output produced in Great Britain and Ireland were based on employment data. However, this will only have a significant effect on the trend in the index numbers (as distinct from estimates of the levels of output in Great Britain or Ireland) if there were marked changes in relative labour productivity over time; and, in general, this is not likely to have occurred.

The real output series for agriculture was given the most detailed attention because it was the sector in which Ireland's relative contribution was most important: some 27 % of United Kingdom output in 1907 as compared with an average of under 5 % for the other industries and services.[3] For this section we give separate

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[1] N. G. Butlin, 'A New Plea for the Separation of Ireland', *Journal of Economic History* XXVIII, 1968 [**142**].

[2] The overall proportion in 1907 works out at about 94 %, i.e. the share of Ireland in the gross domestic product of the United Kingdom is estimated to be approximately 6 %.

[3] Furthermore, agriculture accounts for about one-third

TABLE 10.3 GROSS AND NET AGRICULTURE OUTPUT, GREAT BRITAIN AND IRELAND, AVERAGES OF YEARS, 1867–1913 (£M. at 1911–13 prices)

	Great Britain		Ireland	
	Gross output (1)	Net output (2)	Gross output (3)	Net output (4)
1867–69	152	115	49	39
1870–76	156	114	53	41
1877–85	154	106	52	38
1886–93	159	111	54	40
1894–03	161	104	56	39
1904–10	167	108	58	40
1911–13	170	108	57	39

SOURCE: See Ojala [**222**] and text, p. 213.

estimates for Great Britain and Ireland (see Table 10.3). The required estimates were built up by reconstructing the detailed calculations by Ojala [**222**, pp. 191–217] which form the basis for the series used by Lewis [**202**] and adopted in Chapter 10.

As a first step estimates were made of gross output for the groups of years used by Ojala. For each of the main crops separate production data are available for Great Britain and Ireland (here and elsewhere in this paragraph the sources are those used by Ojala) and the ratio of output (i.e. production less seed and feed used on farms) to production was assumed to be the same in the two areas. Output was then valued at 1911–13 prices as given by Ojala. Corresponding methods were used for fruit and vegetables. For beef and veal, mutton and lamb, and pigmeat estimates of output in 1905–9 at 1911–13 prices were made for Great Britain and Ireland and the six benchmarks were extrapolated to other years in proportion to the annual numbers of cattle, sheep and pigs respectively enumerated in the two areas. For milk Ojala [**222**, p. 204] had assumed that in 1907 the average United Kingdom yield was 10 gallons below the average yield for Great Britain. His estimates for each period were accordingly raised by a constant 10 gallons per head and applied to the annual numbers of cows and heifers in milk or in calf in Great Britain. The Irish series was then obtained as the difference between this series and Ojala's estimates for the United Kingdom milk output. Estimates were also made for horses, wool, eggs and poultry by means of appropriate adjustments to Ojala's data.

As the second stage of the process of estimation Ojala's figures for total off-farm inputs (feed, fertilizer etc.) at constant prices were allocated to the two areas in proportion to their respective shares in the relevant gross outputs. An addition to Irish output and to Great Britain's inputs was made to cover the store cattle exported from Ireland for fattening in Great Britain. Finally, the averages for periods of years at 1911–13 prices were converted to annual figures at 1907 prices in the same way that Ojala's averages were allocated and adjusted to individual years to give Lewis' United Kingdom estimates, but with the additional constraint that for each year the separate series for Great Britain and Ireland should sum to the aggregate given by Lewis. The series for Great Britain was then carried back to 1855 on the same basis as for the United Kingdom series, i.e. an estimate by Lewis that output grew at 0.4 % p.a.

The gross and net output series for the two areas at 1911–13 prices are summarised for periods of years in Table 10.3.

The above estimates for Ireland show gross output increasing by 16 % between 1867–69 and 1911–13, and net output roughly stationary. There are a variety of alternative estimates with which this might be compared but they are all too uncertain to throw much light on the reliability of the present estimate. They range from Staehle's calculation that total gross production increased by 28 % from 1861 to 1909,[1] to Crotty's judgement that between the Famine and the First World War 'the volume of total agricultural production changed little if anything'.[2] Given the almost complete lack of data on such key items as average milk yields it is probably not now possible to make a really reliable estimate of Irish farm output.

For manufacturing production seven separate indices (six industries chosen because of the relative importance of Irish production, and a residual) were compiled and combined with 1907 net output weights derived from the Census of Production [**42**(*a*)]. For beer and for spirits the annual share of total output produced in Great Britain was calculated on the basis of the excise duties collected in Britain and Ireland. For clothing, boots and shoes, linen, other textiles and a final series covering all other manufacturing the annual share was obtained by linear interpolation between the ratios obtained from the census data on numbers employed

of the estimated gross domestic product of Ireland in 1907.

1 H. Staehle, 'Statistical Notes on the Economic History of Irish Agriculture, 1847–1913', *Journal of the Statistical and Social Inquiry Society of Ireland* XVIII, 1950–51 [**246**], p. 459. The revised calculation given by Staehle (p. 470) to measure gross *output* of crops would still show an overall growth of some 27 %.

2 R. D. Crotty, *Irish Agricultural Production, its Volume and Structure*, 1966 [**153**], pp. 68–83. See also Butlin [**142**], p. 287.

TABLE 10.4 INDEX NUMBERS OF REAL OUTPUT PER HEAD AT CONSTANT FACTOR COST, GREAT BRITAIN, IRELAND AND UNITED KINGDOM, AVERAGES OF YEARS 1857 TO 1913 (1913 = 100)

	Real output			Real output per head		
	United Kingdom (1)	Great Britain (2)	Ireland (3)	United Kingdom (4)	Great Britain (5)	Ireland (6)
1857–1866	38.5	35.3	95	60.3	62.3	72
1867–1873	45.2	42.3	96	66.0	67.6	77
1874–1882	52.5	50.0	97	70.7	72.0	80
1883–1890	60.6	58.6	97	75.9	76.6	86
1891–1900	71.8	70.3	98	83.1	83.3	93
1901–1907	84.1	83.2	100	90.1	89.9	98
1908–1913	92.5	92.1	99	93.9	93.7	98

SOURCE: Tables 8, 54 and 55.

in the respective industries. For linen and other textiles the ratios derived from the census figures of employment were checked against the information on employment, numbers of spinning spindles etc. given in the Parliamentary returns under the Factory and Workshops Acts. The annual ratios were then applied to the original indicators to get adjusted indicators for Great Britain.

For mining the United Kingdom series was used for Great Britain; for shipping a series for tonnage on the register in Great Britain was manipulated in the same way as Lewis' index; and for rent of dwellings Lewis' series, which is based on the number of houses in existence at Census of Population dates, was reduced to cover Great Britain only by means of a series based on the relative number of houses in Britain and Ireland, with a small adjustment to allow for an assumed lower average rental in Ireland. For construction, transport other than shipping, distribution and each of the seven other services for which a separate series is given by Lewis the proportion of the output attributable to Great Britain was based on the Census figures of the occupied population in Britain and Ireland, with a small adjustment for lower output per head in Ireland.

The final series for output and output per head are summarised in Table 10.4 in the form of index numbers with 1913 = 100, averaged over periods of years (the cyclical periods identified in Chapter 1).

The effect of the exclusion of Ireland, where aggregate real output was almost stagnant over the period 1857 to 1913, is to raise the rate of growth of real gross domestic product from about 1.8 % p.a. for the United Kingdom to 2.0 % p.a. for Great Britain. The rate of increase of real output per head of the population is, by contrast, slightly reduced, from 0.9 % p.a. with Ireland included, to 0.8 % p.a. for Great Britain alone. The differences are small – and well within the margins of error of the series – but the results are plausible.[1]

[1] See e.g. Butlin [**142**].