A COMPARISON OF NATIONAL OUTPUT AND PRODUCTIVITY

OF THE UNITED KINGDOM AND THE UNITED STATES

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Chapter VI

Chapter VII

Chapter VIII

* * *

APPENDICES ON TECHNICAL METHODS AND SOURCES

* * *

LIST OF TABLES AND CHARTS

TABLES

CHARTS

I

INTRODUCTION

The object of this study is to provide statistical comparisons of the national products and productivity per worker of the United Kingdom and the United States, not only for the two economies in the aggregate, but for the various industries that contribute to total output. The aim, therefore, is to measure the various industries so that they can be aggregated and yield estimates that will show the comparative industrial structure of the two countries and show how overall productivity is a result of that industrial structure as well as of the productivity in the individual industries. We hope that the results will be found interesting and also that the investigation of the statistical and theoretical problems of approaching international comparisons by means of industry of origin data will be stimulating. In view of its experimental character, the study was confined to the United Kingdom and the United States, as the basic data required were most readily available for those two countries.

Several lines of research that have been done since the war provide the scientific background for this study. International comparisons of national products were made in two previous O.E.E.C. studies[1] by attacking the problem through measurement of the various components of final expenditures. The same basic concept of the gross national product is used in the present study and detailed discussion of conceptual matters that are common to both is not repeated here.[2] However, the statistical measures overlap only in part, so that the two types of estimates are, in fact, different methods of comparing the same aggregates. We may say that part of our interest in this study was to see how similar the results of the two approaches would be ; we believe that the differences in the results are reasonable, given the broad character of the estimates, and also instructive from the standpoint of techniques.

The work done in the Department of Applied Economics on measuring the real national product over time by the industry of origin approach

1. Milton Gilbert and Irving B. Kravis, "An International Comparison of National Products and the Purchasing Power of Currencies" (O.E.E.C., Paris, 1954) and Milton Gilbert and Associates, "Comparative National Products and Price Levels" (O.E.E.C., Paris, 1958).
2. Gilbert and Kravis, op. cit., Chapter VI.

is also part of the scientific background.[1] As inter-temporal comparisons are both conceptually and technically similar to international comparisons, the present study benefited from that experience, although international measures raise their own problems.

Finally, there is the work on international productivity measures initiated by Rostas[2] and continued more recently by Frankel.[3] The productivity aspects of the present study build on these works and extend them by constructing complete and consistent measures of the aggregate national product.

While the conceptual problems involved in the study as well as the statistical methods and procedure used are described in detail in the volume, a brief introduction may be useful to those interested primarily in the results. Basically, the procedure is to construct an index number of production showing the relation of total output between the two countries. In the usual indices of production over time, some year is chosen as a base and the prices of that year are used to weight together the outputs of the various industries. For the purposes of this study there are two possible bases for the price weights that are equally relevant —those of the United Kingdom and those of the United States. Consequently, both are used and, hence, two indices of production are given in the results.

In constructing these indices, the component element to be measured for each industry is the economic activity that it contributes to the aggregate gross national product. This is obtained by taking the gross output of the industry for each country, in the sense of sales plus inventory change, and deducting from it the inputs or purchases that have been obtained from other industries. This leaves as a residual the value-added for each industry, which is called net output for short in this volume, although it is net of current account inputs but not net of depreciation or other capital consumption. As two price-weight bases are being used, four value series of net output are obtained, one for each country on its own price weights and one for each on the other country's price weights. From each pair of series, a production index can then be calculated. Similarly, the quantity and unit value data obtained by this process can be used to calculate net cost indices for the two countries at each country's weights.

As the production indices obtained in this way are based on the net outputs of domestic establishments, they are measures of the gross *domestic* product. Indices of the gross *national* product are obtained by adding the real contribution of current transactions with the outside world that result from net factor income from abroad and foreign trade, also calculated at both countries' prices. These measures of gross

1. See W. B. Reddaway, "Some Problems in the Measurement of the Real Geographical Product", *Income and Wealth*, Series I, 1951, and also articles by W.B. Reddaway, C. F. Carter and A. A. Adams in the London and Cambridge Bulletin. Similar annual indices are now included in *National Income and Expenditure*, H.M.S.O. and described in "National Income Statistics : Sources and Methods", H.M.S.O., 1956.

2. Rostas, "Comparative Productivity in British and American Industry", Cambridge University Press, 1948.

3. M. Frankel, "British and American Manufacturing Productivity", University of Illinois, 1957.

national product are the same conceptually as those presented in our other studies by the expenditure approach.

The corresponding net cost ratios for the individual industries measure their relative unit costs, including capital and labour costs and profits, but excluding that of materials and other purchased inputs. The weighted sum of the net cost ratios then gives a price ratio for final output identical with that obtained in an expenditure comparison, if the latter is made at factor cost, with indirect taxes and subsidies excluded.

By relating the net quantity indices to employment in each industry, relative productivity or output per worker is obtained excluding differences in output resulting from input variations. The productivity relatives do not, of course, take account of variations in amounts of capital and other factors of production applied within the industry, nor of differences in natural resources or technology since these are all reflected in net output. The aggregate productivity indices obtained give the relative real product per head of the employed labour force, and reflect differences due to the distribution of employment among the industries as well as to differences in productivity levels in individual industries.

In many sectors the measurement of net output as a residual, as described above, presents serious statistical problems. Separate estimates of gross output and inputs could be made only for agriculture, and part of the transport sector, and a simplified form of the method was used for the fuel sector. In the manufacturing industries, and the remaining sectors, the closest approximations possible were made to the net indices described above, but the method used was broadly that of an inter-temporal production index with indicators of output only, selected to measure the activity of the industry, and combined with net output weights. Distortions due to important differences in relative inputs of fuel and transport were corrected by global adjustments, to secure as accurate as possible an estimate of the real final product.

One of the major tasks involved in the study was the reclassification of the two countries' national accounts and employment data to a comparable basis for the large number of separate industries that were identified in the study. Consequently a major difficulty in extrapolating the results to 1954 and 1957 was that this detailed reclassification could not be repeated for the later years. The method used for the extrapolations was to calculate 1954 and 1957 quantity indices from those for 1950 by estimating the relative volume movement in the two countries by means of internal production indices. Separate quantity indices were obtained in this way for each of the main sectors and manufacturing major groups, and sector indices were combined with approximate 1954 and 1957 price weights (based on a rough reclassification of the national accounts) to obtain total real product indices for these years.

II

NATIONAL PRODUCT AND ITS COMPOSITION

Total National Product and Relative Costs

The global results of the present comparison are presented together with those obtained in the expenditure study, in the following table :

Table 1. INDICES OF GROSS NATIONAL PRODUCT OF THE UNITED KINGDOM AND THE UNITED STATES IN 1950 TOTAL AND PER CAPITA

United Kingdom = 100.

	TOTAL		PER CAPITA	
	AT U.K. PRICES	AT U.S. PRICES	AT U.K. PRICES	AT U.S. PRICES
Industry Method	535	452	178	151
Expenditure Method	613	478	204	159

The industry study, in both sets of weights, gives results that are somewhat more favourable to the United Kingdom than those obtained in the earlier expenditure study. It indicates that the United States has a total real product about 540 per cent of that of the United Kingdom when valued at British prices, and about 450 per cent when American price weights are used. The corresponding *per capita*[1] figures are about 180 per cent and 150 per cent.

The purchasing power equivalent, or price ratio[2] shows a corresponding deviation and the industry study implies a greater divergence from the official exchange rate ($2.80 = £ 1) than that found by the expenditure method. Rates of $4.9 = £ 1 are given in the calculation weighted by British quantities, and $4.2 = £ 1 using American weights. The comparison of the two series is as follows :

1. *Per capita* is used here and subsequently to mean "per head of total population", and when references are made to relationships between output and employment these are stated specifically.

2. The term "price ratio" rather than "purchasing power equivalent" is normally used throughout this report, since, although it is less precise, it has the advantage of brevity and is more appropriate in discussion of costs and net output. (See Chapter III.)

TABLE 2. RELATIVE COSTS AND PRICES IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950
(PRICE RATIOS AT FACTOR COST)

$ *per* £.

	U.K. QUANTITY WEIGHTS	U.S. QUANTITY WEIGHTS
Industry Method	4.9	4.2
Expenditure Method	4.7	3.7

The industry study yields comparisons of total output per worker in industrial sectors of the economy. In the aggregate, American output per worker is found to be 215 per cent of that of the United Kingdom when output is measured at British price weights, and 172 per cent at American weights. This is an average for the whole economy which depends upon the distribution of workers among industries as well as upon the relative productivity in the individual industries.[1]

The fundamental differences in the techniques employed and the sources of much of the data used make it impossible to assess which approach gives more accurate estimates. Discussion of the relative merits of each requires a detailed study of techniques and is, therefore, deferred to a later chapter. At this stage it is sufficient to consider briefly the results of the two investigations under three heads :

a) The results are more favourable to the United Kingdom in the present investigation than in the expenditure one, whichever set of prices is used.

b) The discrepancy between the results obtained in the two studies is about 14 per cent in the comparisons made at British prices, but is only a little over 5 per cent when American price weights are used.

c) The "index number spread", i.e. the difference between the British and American weighted indices, is smaller in the industry comparison than in the expenditure one.

That the industry results are more favourable to the United Kingdom and the expenditure results to the United States, is not wholly unexpected ; there are factors in the methods used in the industry study which seem likely to favour the relatively lower-income, lower-productivity country, and factors in the expenditure study which may favour the United States both as the higher income country, and as the country with more comprehensive price and quantity data on the consumption side. It is not, however, possible to assess whether these factors (which are discussed in Chapter VIII) are in fact likely to account for the actual discrepancy shown.

The fact that the divergences are greater when the comparisons are made using British weights may partly be due to the fact that these indices are affected by the difficulties of handling unique,[2] or almost

1. See Chapter V for full discussion.

2. Unique products are products which are produced (or used) by only one of the two countries being compared. See Gilbert and Kravis *op. cit.* (par. 118 ff.) for a discussion of the problems involved and methods of treating them.

unique, product industries, whereas at American weights these problems are of no practical significance. Although this factor results in a lower degree of certainty for the estimates at British weights of both studies, it is not obvious why it should have acted in opposite directions in each study. In any event, the differences between the two studies do not seem to us to be large, considering the wide scope of the estimates and their experimental character.

The narrower "spread" in the industry indices is more difficult to explain. It may be, however, that this occurs merely as the result of the operation of the other two factors, or is due to purely statistical causes.[1]

THE COMPOSITION OF THE GROSS DOMESTIC PRODUCT BY SECTORS IN 1950

As we have seen, the industry study enables an alternative estimate to be made of the total real product comparisons produced from the expenditure side. Of far greater importance, however, is the new information made available by the study on the relative position of the individual sectors and industries contributing to the gross national product. Previously, the only kind of analysis possible, apart from productivity and output studies of particular industries and sectors, was based on the percentage distribution of value added in different countries, each in their own national currencies. With the present data, however, we are able to study the contribution of the various sectors in real terms.

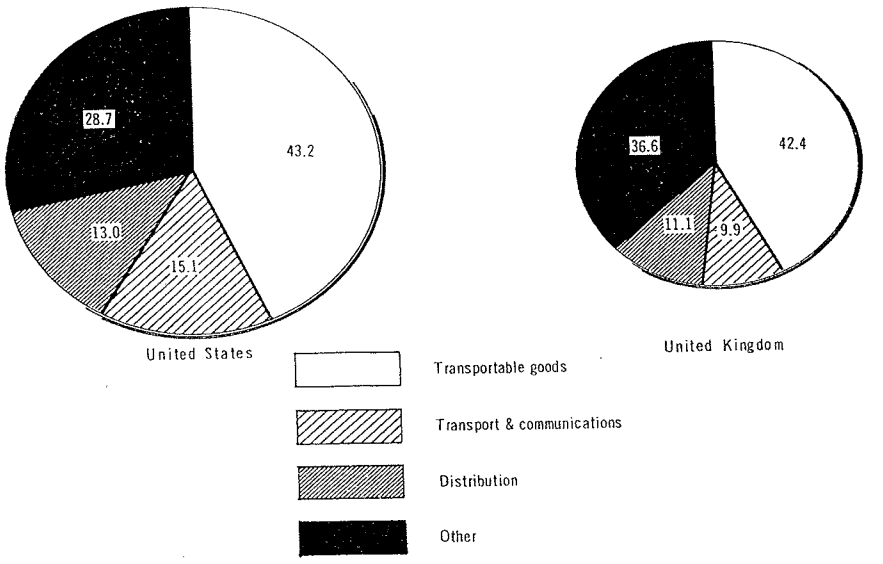
Details of the comparison by sectors are given in Tables 3, 4 and 5 and they are shown graphically in *per capita* terms in Figure 1. In the following paragraphs we shall examine the results for the main economic sectors contributing to the gross *domestic* product. Consideration of the effects of foreign trade and other external transactions, i. e. of the other items in the gross *national* product, is deferred until the next section.

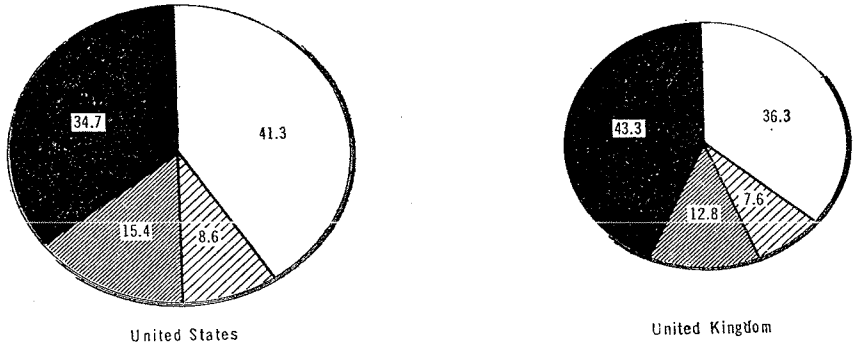
A number of sectors, including manufacturing, have a rather similar share in the total product in both countries (see Table 4), but in certain groups there are striking differences which are only revealed when output is measured in real terms, i. e. using a common set of prices. Thus we would expect the extractive industries (agriculture and fuel production), where natural resource factors are of particular importance, to make a substantially larger contribution to the total in the United States. Yet when both are measured in national currencies (Table 4, columns 2 and 3), these sectors only account for 13 per cent of the American national product compared with 11 per cent in the United Kingdom. In real terms, however, the relative contribution of these sectors in the United States is about twice the British figure, 22 per cent

1. Provided both countries' weights are used we generally expect a wider index number spread when final expenditures are broken down in greater detail. There are some grounds for believing that the detailed industry comparisons made in this study may imply a finer breakdown of the final product (see Chapter VI) but this may be offset by the fact that it was frequently impossible to use both countries' weights within individual industries.

Figure 1. RELATIVE SIZE AND PERCENTAGE DISTRIBUTION OF PER CAPITA REAL PRODUCT IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950

At U.K. prices





At U.S. prices

NOTE. As the areas of the circles are proportionate to the levels of per capita G.N.P. measured at the appropriate price weights, the area of each segment indicates the contribution of the corresponding sector to per capita G.N.P.

Source : Tables 3 and 4.

compared with 11 per cent, when both are measured in British prices, and 13 per cent to 6 per cent in American prices.

In the service industries, and in government and housing the real contribution is greater in the United Kingdom, and yet, when the share

TABLE 3. REAL PRODUCT AND EMPLOYMENT OF THE UNITED KINGDOM AND THE UNITED STATES BY MAIN ECONOMIC SECTORS IN 1950

	GROSS NATIONAL PRODUCT				EMPLOYMENT ('000)	
	AT U.K. PRICES £M		AT U.S. PRICES $M			
	U.S.	U.K.	U.S.	U.K.	U.S.	U.K.
1. Agriculture	7,808	660	21,940	2,134	7,043	1,324
2. Fuels	(6,083)	(646)	(11,169)	(1,489)	1,449	1,183
of which :						
3. Solid and liquid	2,844	308	5,674	641	—	—
4. Gas, water and electricity	3,239	338	5,495	848	—	—
5. Manufacturing	21,832	3,916	78,975	16,210	15,041	7,889
6. Sub-total : transportable goods (1)+(3)+(5)	(32,484)	(4,884)	(106,589)	(18,985)	—	—
7. -do.- adjusted for transport input	27,116	4,884	106,589	21,124	—	—
8. Construction	2,790	560	14,997	3,010	4,112	1,238
9. Transport and communications	9,457	1,153	22,399	4,449	4,576	2,298
10. Distribution	8,147	1,293	40,182	7,473	9,339	2,856
11. Ownership of dwellings	1,298	368	11,050	3,133	—	—
12. Services (including health and education)	8,678	1,949	44,827	10,609	13,442	4,004
13. Government	1,567	754	13,667	6,679	4,278	2,074
14. Gross Domestic Product (4)+(7 to 13)	62,290	11,299	259,206	57,325	59,280	22,866
15. Net factor income from abroad	452	337	1,266	944	—	—
16. Gross National Product (based on output of domestic establishments)	62,743	11,636	260,472	58,269	—	—
17. Net adjustment for foreign trade	—477	0	0	— 674	—	—
18. Gross National Product (= Gross National Expenditure)	62,266	11,636	260,472	57,595	—	—

NOTE. Detail may not add to total because of rounding.

of these three sectors is measured in national currencies, it is actually slightly less in the United Kingdom than in the United States. Measured in British prices, 17 per cent of the total British product originates in this group, compared with 10 per cent of the American. Using American price weights the ratios are 26 per cent and 16 per cent.

Only a comparison made in real terms can reveal these striking differences because in the separate national series each country has low prices in those sectors where output is high, producing a strong inverse

correlation between the price and quantity indices. The same effect is seen in the expenditure comparison but is even more marked in an industry breakdown because many of the most striking variations are in intermediate goods, whose use can be varied by substitution, and in

TABLE 4. PERCENTAGE DISTRIBUTION OF REAL PRODUCT AND EMPLOYMENT IN THE UNITED KINGDOM AND THE UNITED STATES BY MAIN ECONOMIC SECTORS IN 1950

	DISTRIBUTION OF REAL PRODUCT				DISTRIBUTION OF EMPLOYMENT	
	AT U.K. PRICES		AT U.S. PRICES			
	U.S.	U.K.	U.S.	U.K.	U.S.	U.K.
1. Agriculture	12.4	5.7	8.4	3.7	11.9	5.8
2. Fuels	(9.7)	(5.6)	(4.3)	(2.6)	2.4	5.2
of which :						
3. Solid and liquid	4.5	3.0	2.2	1.1	—	—
4. Gas, water and electricity	5.2	2.6	2.1	1.5	—	—
5. Manufacturing	34.8	33.6	30.3	27.8	25.4	34.5
6. Sub-total transportable goods (1)+(3)+(5)	(51.8)	(42.4)	(40.9)	(32.6)	—	—
7. -do.- adjusted for transport input	43.2	42.4	40.9	36.3	—	—
8. Construction	4.4	4.8	5.8	5.2	6.9	5.4
9. Transport and communications	15.1	9.9	8.6	7.6	7.7	10.0
10. Distribution	13.0	11.1	15.4	12.8	15.8	12.5
11. Ownership of dwellings	2.1	3.2	4.2	5.4	—	—
12. Services (including health and education)	13.8	16.7	17.2	18.2	22.7	17.5
13. Government	2.5	6.5	5.3	11.5	7.2	9.1
14. Gross Domestic Product (4)+(7) to (13)	99.3	97.1	99.5	98.4	100.0	100.0
15. Net factor income from abroad	0.7	2.9	0.5	1.6	0	0
16. Gross National Product (based on output of domestic establishments)	100.0	100.0	100.0	100.0	100.0	100.0

export goods. Thus, the prices as well as the quantities of goods entering final demand are less diverse than those of the goods making up production.

The quantity indices for the individual sectors (Table 5) also reveal the strong effect of natural resource differences. In agriculture, American total output is 10-12 times that of Britain (about 4 times as high per head of population). In the fuel industries per capita production is more than 2 ½ times that of the United Kingdom, and the figure is almost as large in communications, although in the latter case other causes than the greater distances to be covered in the United States are clearly in operation. In the transport industries the situation is more complex, and the aggregate result is largely dependent on the prices used. The effect of the greater distances in the United States is clearly

revealed in freight transport requirements, but in passenger traffic it is more than offset by the substitution in the United States of private motoring (which is not included in the transport industries) for public transport services. Consequently prices and volume are highly favour-

TABLE 5. INDICES OF REAL PRODUCT, OUTPUT PER WORKER AND NET COSTS, BY MAIN ECONOMIC SECTORS FOR THE UNITED KINGDOM AND THE UNITED STATES IN 1950

	QUANTITY INDICES U.K. = 100				OUTPUT PER WORKER U.K. = 100 BASED ON		NET COST RATIO $ PER £	
	TOTAL		PER CAPITA					
	U.K. PRICES	U.S. PRICES	U.K. PRICES	U.S. PRICES	U.K. PRICES	U.S. PRICES	U.K. PRICES	U.S. PRICES
1. Agriculture	1,183	1,028	395	343	222	193	3.2	2.8
2. Fuels	942	750	313	249	769	612	2.3	1.8
3. Manufacturing	558	487	185	162	292	256	4.1	3.6
4. Sub-total transportable goods	(665)	(561)	221	186	—	—	(3.9)	(3.3)
5. -do.- adjusted for transport input	555	505	184	168	—	—	4.3	3.9
6. Construction	498		165		150		5.4	
7. Transport and communications	820	504	274	168	412	253	3.9	2.4
8. Distribution	630	538	210	179	193	164	5.8	4.9
9. Ownership of dwellings	353		117		—		8.5	
10. Services (including health and education)	445	423	148	140	—		5.4	5.2
11. Government	208	205	68	67	—		8.9	8.7
12. Gross Domestic Product	551	452	183	150	213	175	5.07	4.16
13. Net factor income from abroad	134		43		—		2.8	
14. Gross National Product (based on output of domestic establishments)	539	447	179	148	—	—	5.00	4.15
15. Gross National Product (= Gross National Expenditure)	535	452	178	150	216	183	4.95	4.18

able to the United States in freight transport and to the United Kingdom in passenger transport.

Among the sectors where the United Kingdom has a higher relative real output, government is the only group for which Britain has a greater *per capita* product, and in this case, as will be seen later, the result may be biased in Britain's favour by the method of comparison used. Consumer services and housing show indices below the average for all industries, but American output is still 3.3 to 3.5 times that of the United Kingdom, giving a *per capita* relationship of 110 to 120 per cent. The other final service sectors, health and education, show quantity ratios only slightly below the general average.

The remaining sectors include manufacturing, construction, distribution and business services, but the latter two items are highly depen-

dent upon the results obtained for the manufacturing sector. The volume index for the manufacturing sector is extremely close to the general average. More than half of the total weight in the comparison is attributable to this sector. In both countries, manufacturing net output accounts directly for about one-third of the total real product and indirectly for somewhat more[1] and in addition the volume of production of manufactured goods largely determines the volume of distributive services.

With a few notable exceptions, natural resource differences are of less direct importance in manufacturing than in the extractive industries. Nevertheless, the sector is a highly heterogeneous one ; results for the various industries vary over a wide range, and the average for the whole sector reflects a large number of different contributory factors. These factors will be considered in the next chapter where the results for the 19 major manufacturing groups are reviewed.

Before passing to this more detailed discussion it will be useful to consider relative output per worker, and the levels of costs and prices for the main sectors (see Table 5). The output per worker indices shown relate to net output, allowing, as far as possible, for differences in purchased inputs.

For the economy as a whole, costs (defined to include profits) are necessarily equal to final prices, but for individual sectors we are only concerned with net costs, excluding the cost of purchased materials and services. They are thus equal to the sum of labour and capital costs and profits per unit of output, and measure only a part of the final price. In general, basic raw materials are relatively cheap in the United States and so we frequently find that because of low material costs, industries for which the United States shows relative processing costs above the official exchange rate include, nevertheless, many for which American exports are highly competitive. The United Kingdom export industries, on the other hand, usually require net cost (i.e. processing) ratios more favourable than the official rate to offset higher material costs.

Since labour costs are the largest item in net costs, a rather close inverse correlation between costs and output per worker is to be expected, and it will be more convenient to consider them together. In the fuel sector and in transport (when measured in British prices) the large American production is associated with extremely low relative unit costs and extremely high relative output per worker, e. g. 6 to 8 times that of the United Kingdom in the fuel industries. In manufacturing, communications, construction and agriculture, American output per worker is 2 to 3 times that of the United Kingdom, and the net cost ratios are relatively low, although for all except agriculture they are still 10 to 20 per cent higher than the official exchange rate.

In agriculture an output per worker index about 25 per cent less advantageous to the United States than that of manufacturing is associated with a net cost ratio nearly 25 per cent more favourable. This difference is the more striking in view of the fact that American agriculture employs a far larger area of land per worker. The low price ratio appears to be due largely to farm incomes being further below urban incomes in America than in Britain. It is, however, extremely difficult to obtain comparable data on agricultural employment, because of the importance of seasonal, part-time and family workers, and statistical differences may well account for part of the result.

1. A large part of the output of fuels, transport and business services are intermediate products which have been deducted as inputs. By the methods used for these deductions, their net output is, in effect, transferred to the user industries of which manufacturing is the most important.

In the service sectors, the comparisons made show net cost ratios highly favourable to the United Kingdom, reflecting the high proportion of direct labour service in this group. This result is, however, partly implicit in the methods used for the comparison, and no independent estimate of relative output per worker can be given for these groups. For government, in particular, employment indicators were used for the comparison with no adjustment for productivity variations, and in the other service groups employment, in one form or another, was extensively used. The difficulty here is partly statistical and partly conceptual. It is by no means clear on what basis differences in output per worker could be assessed for professional services and the armed forces, which together account for some 40 per cent of the total. In some routine government functions, and final services, adjustment might be possible, but there are no data from which differences in output per worker can be assessed. This output is almost certainly higher in the United States than in Britain, if only because higher wage rates encourage mechanisation and economy in the use of labour, but the advantage is clearly smaller than in the commodity producing industries and will be partly offset by shorter working hours. If we were to assume that output per worker in civil government and consumer services were at the same level as in distribution (160-190 per cent), which is probably the maximum, this would increase the total real product index in favour of the United States by some 5 or 6 per cent.[1]

Transactions with the Rest of the World

To complete the comparison of the gross national product, the domestic product comparison described above must be amended to take account of external transactions. This requires, firstly, the addition of net factor income from abroad, which was made by converting the original value series with the official exchange rate,[2] and secondly, adjustment for the effects of foreign trade.

The expenditure comparison includes imports as part of each expenditure category, but omits exports (except for the balancing item of net exports, or net investment abroad). The basic production comparison, on the other hand, covers the total production of each industry, including its exports, but excludes imports. The adjustment required, therefore, must take full account of the effect of substituting imports

1. Differences in this item do not account for the discrepancy between the expenditure and the industry results, as the assumptions used here were the same in both studies.

2. This follows the convention used for net exports in the expenditure study, and appears to be the only way of handling purely monetary international transactions.

for exports[1] in the bill of goods on which the comparison is based. In the United Kingdom where imports and exports each totalled about 28 per cent of the gross national product in 1950, the change in the list of items compared is quite substantial. In the United States the effect is, of course, very much smaller.

Details of the foreign trade adjustment are discussed in a later chapter.[2] Its net effect, which is shown in Tables 3 and 5, is to somewhat reduce the index number spread between the results at British and those at American weights. This reflects, of course, the fact that production shows greater international specialisation and wider dispersions of prices and quantities than consumption, part of the divergences being evened out by the process of international trade.

Output per Capita and Output per Worker

The proportion of the total population in the employed labour force is higher in the United Kingdom than in the United States, and consequently the American advantage in output per worker is somewhat greater than that in the real product per head of total population. Thus for the economy as a whole, United States output per worker was found to be 215 per cent of that of the United Kingdom in British prices, and 172 per cent in American prices, whereas the corresponding *per capita* real product indices are 178 per cent and 151 per cent. The difference of some 16 per cent is due to the lower ratio of employed population to total population.

About one-third of this difference may be attributed to the proportion of the labour force which is unemployed, the level of which was about 5 per cent in the United States in 1950 compared with 1.2 per cent in Britain. The remaining difference is due to the fact that the labour force comprises a smaller proportion of total population in the United States : 41.3 per cent compared with 46.1 per cent in Britain. This reflects the fact that part of the higher overall standard of living in the United States is taken in the form of additional education and leisure. It is of interest that there are only minor differences in the age/sex structure and in the proportion of unoccupied adults, the main factor being the later age at which young people start work in the United States. This in itself has a small direct influence on average productivity, since the British labour force includes 6.3 per cent of juveniles under 18 and the American only 2.3 per cent. The additional years of general education available to the American worker may have a further indirect effect on productivity but this is more intangible.

Estimates for 1954 and 1957

At the time this investigation was undertaken, 1950 was selected as the base-year, partly to facilitate comparison with the expenditure study, but also because the detailed production data could not then be obtained for a more recent period. The quantity ratios for the sectors

1. Or more precisely the substitution of imports for exports for that part of foreign trade which is in balance.
2. See Chapter VI, and also Appendix D.

shown in Table 6 below have been projected to 1954 and 1957 by applying the volume changes in the sectors concerned in both countries. Thus, for example, the quantity ratio shown for agriculture in 1954 reflects the original quantity ratio for 1950 adjusted by the volume changes in agriculture between 1950 and 1954 in the two countries studied. These volume projections were based on 1950 prices within each sector and also, except in the case of manufacturing, assume that the distribution of output between industries within each sector remains broadly similar

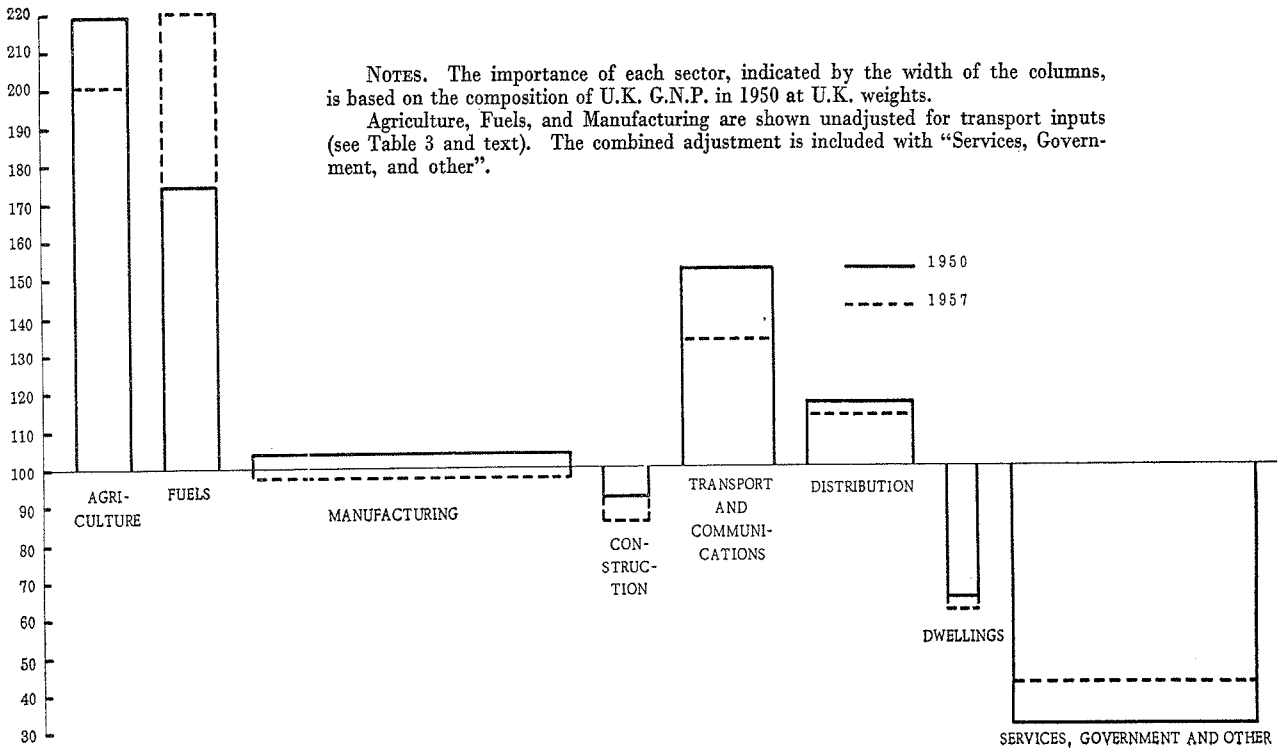
Table 6. INDICES OF REAL PRODUCT BY MAIN ECONOMIC SECTORS FOR THE UNITED STATES IN 1950, 1954 AND 1957 (U.K. = 100)

Sector	At U.K. prices			At U.S. prices		
	1950	1954	1957	1950	1954	1957
Agriculture	1,183	1,220	1,170	1,028	1,060	1,020
Fuels	942	1,040	1,280	750	840	1,020
Manufacturing (net of fuel input)	558	540	570	487	480	500
Construction	498	490	500	498	490	500
Transport and communication	820	740	770	504	450	480
Distribution	630	630	660	538	530	570
Service of dwellings	353	360	360	353	360	360
Service industries	445	470	510	423	440	490
Government	208	270	280	205	270	280
Net income from abroad	134	250	350	134	250	250
Gross National Product (based on domestic output)	539	570	581	447	450	472
Output per Worker	208	220	218	172	174	177
G.N.P. Price Ratio ($ per £)	5.0	4.5	4.4	4.2	3.6	3.5

over time. An aggregation of total real product ratios in 1954 and 1957 on the basis of an extrapolation by sector in terms of volume developments alone, however, would also be at 1950 prices. Consequently, an attempt has been made to allow for the effect on the total real product comparison of changes in the price structure at least as between the major sectors. The resulting comparisons of aggregate national products and price ratios in 1954 and 1957 are shown in the bottom two rows of the table. However, in view of classification difficulties and the fact that no account is taken of price changes within sectors, the aggregate indices do not correspond to those that might have been obtained by a repetition of the whole study on the basis of 1954 or 1957 information. It should also be noted that the projected indices are limited to the national product based on domestic output, i.e. no foreign trade adjustment has been made.

Over the seven-year period, the American real product increased by about 28 per cent, and the British by 20 per cent, so that the United States rate of growth was, on the average, about one per cent per annum greater than that of the United Kingdom. The relative gain of the

Figure 2 a. CONTRIBUTION OF INDICES OF OUTPUT IN COMPONENT SECTORS TO THE UNITED STATES INDEX OF GROSS NATIONAL PRODUCT (U.K. = 100) IN 1950 AND 1957[1]
(U.K. WEIGHTS)



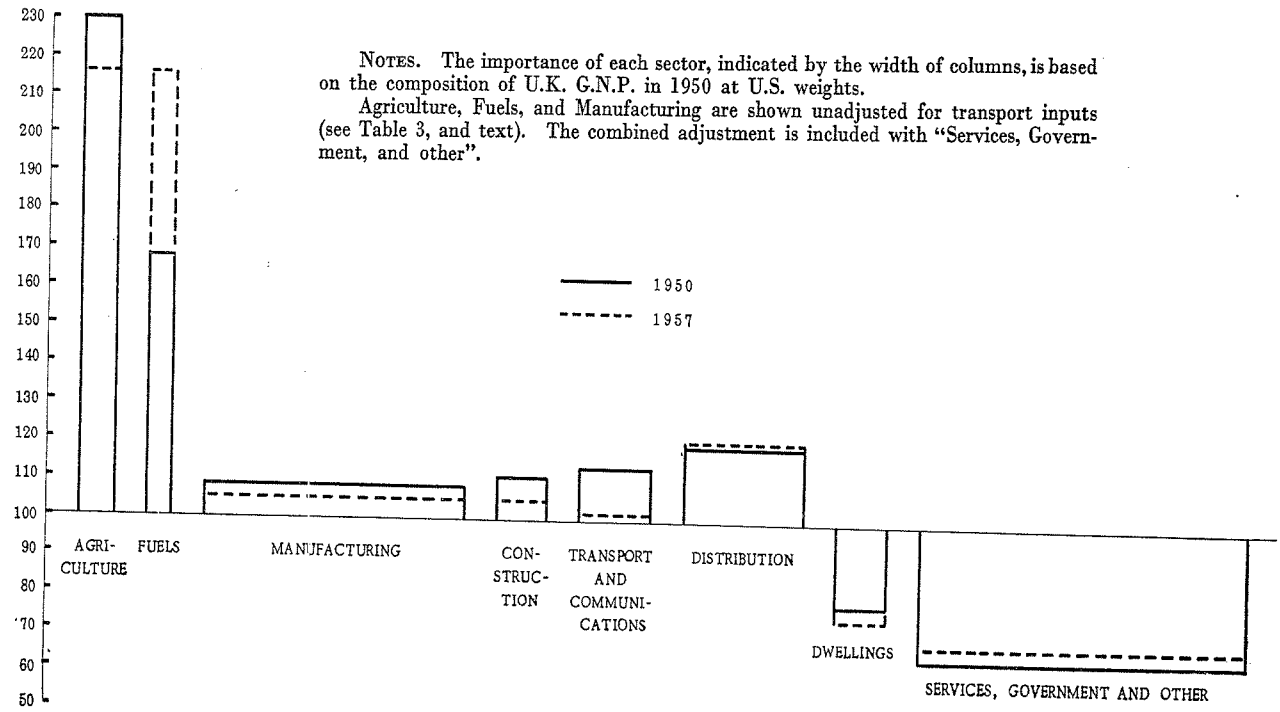
NOTES. The importance of each sector, indicated by the width of the columns, is based on the composition of U.K. G.N.P. in 1950 at U.K. weights.

Agriculture, Fuels, and Manufacturing are shown unadjusted for transport inputs (see Table 3 and text). The combined adjustment is included with "Services, Government, and other".

1. The values (taken as 100) of U.S. G.N.P. relative to U.K. G.N.P. are 539 and 581 for 1950 and 1957 respectively.

Source : Tables 3 and 6.

Figure 2 b. CONTRIBUTION OF INDICES OF OUTPUT IN COMPONENT SECTORS TO THE UNITED STATES INDEX OF GROSS NATIONAL PRODUCT (U.K. = 100) IN 1950 AND 1957[1]
(U.S. WEIGHTS)



NOTES. The importance of each sector, indicated by the width of columns, is based on the composition of U.K. G.N.P. in 1950 at U.S. weights.

Agriculture, Fuels, and Manufacturing are shown unadjusted for transport inputs (see Table 3, and text). The combined adjustment is included with "Services, Government, and other".

1. The values (taken as 100) of U.S. G.N.P. relative to U.K. G.N.P. are 447 and 492 in 1950 and 1957 respectively.

Source : Tables 3 and 6.

United States is slightly higher in the earlier period from 1950 to 1954, chiefly owing to its rapid expansion between 1950 and 1952.

During the period from 1950 to 1957 the American labour force expanded at an average rate of about 1.8 per cent per annum, compared with about 1.2 per cent in the United Kingdom. Consequently between 1950 and 1954 the relative output per worker indices for the economy as a whole became slightly more favourable to the United Kingdom, particularly when measured at United States prices. This gain was held during the later period and from 1954 to 1957 the output per worker indices are practically unchanged.

A part of the movements shown in the aggregate indices in Table 6 appears to be due to weighting shifts resulting from changes in relative prices, as price movements have slightly reduced the weights of sectors where the American advantage is greatest. Thus, in the first period, from 1950 to 1954, United States relative output increased by about 7 per cent measured in British prices, but by under 1 per cent in American prices. In the second period, from 1954 to 1957, the increase was greater when measured in American prices. The main factor here appears to be the fall in the money share of agriculture in the total product. This occurred earlier in the United States than in Britain, the effect being a reduction in the weight of a sector for which the American volume index is twice as high as the index for all sectors combined.

Quantity ratios for the three years 1950, 1954, and 1957 are shown in Table 6 for the more important sectors and the changes between 1950 and 1957 are also shown graphically in Figures 2 a and 2 b. The largest change is in the American government sector, reflecting the effects of rearmament. Fuel production, particularly of gas and electricity, expanded in both countries, but at a more rapid rate in the United States, substantially increasing the original American superiority in this sector. Transport was the only sector where the relative advantage of the United States declined. This reflects chiefly the continued replacement of public passenger transport by private automobiles, but owing to technical difficulties in calculating the volume change for this sector in the United States it is possible that the extent of the relative decline is somewhat overstated.

The aggregate price ratio shows a deterioration in the position of the United Kingdom, and approaches somewhat nearer to the official exchange rate. As this occurred almost entirely during the earlier period, and in fact mainly before 1952, it seems to be due primarily to the fact that the full effects of the 1949 devaluation were not yet apparent in 1950.

III

THE MANUFACTURING SECTOR

The Overall Comparison

We have seen that for manufacturing as a whole the United States has 5 to 6 ½ times the net output of Britain, although employment in this sector is less than twice that of the United Kingdom. Average output per worker is, therefore, 2 ½ to 3 times greater in the United States, and as this difference is not fully matched by differences in wage rates, the net cost (or value added) ratios show a considerable advantage for the United Kingdom when compared with the official exchange rate. Thus the average net cost ratio for the sector is $ 3.6 to $ 4.1 according to which country's weights are used, compared with the official rate of $ 2.80 to £ 1. Only for relatively few individual industries are rates below $ 2.80 to be found.[1]

For the economy as a whole we do not expect to find a close relationship between internal purchasing power and exchange rates because items which play no part in international trade, such as rent, services, and retail distribution costs, are important factors in determining the overall internal price level. In the manufacturing sector, where foreign trade takes place in most industries, comparisons between internal price levels and exchange rates are more meaningful, but even here they can only be made with important reservations.

In the first place, it must not be overlooked that the comparisons given here represent average 1950 costs, and at that time British prices were not fully adjusted to the September 1949 devaluation. Unfortunately, it is impossible to compare later price levels in any detail, but it appears that by 1952 manufacturing net cost ratios were, on the average, 10 to 15 pet cent more favourable to the United States than in 1950 and there is little doubt that in large part this is a result of the adjustment of British export and internal prices to the new exchange rate.

Secondly, the ratios given here are of *net* costs, excluding the costs of materials, fuels and other purchased inputs. For individual industries net cost ratios may differ very widely from those of factory selling prices as final prices are also determined by costs of materials. For manufacturing as a whole the potential difference between average selling prices

1. Among the 44 selected industries considered in Table 17, Chapter V, 10 show rates below $ 2.80 to £ 1.

and aggregate net cost is less because inputs from outside the sector are smaller, but they still account for one-third to two-fifths of total costs.[1] Prices for fuels, materials and freight transport, are substantially more favourable to the United States, and this is only partially offset by proportionately greater use of freight transport and fuels in the American

TABLE 7. NET OUTPUT AND EMPLOYMENT IN MANUFACTURING BY MAJOR INDUSTRIAL GROUPS IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950

I.S.I.C. CODE	INDUSTRY GROUP	VALUE ADDED BY INDUSTRY AT U.K. PRICES £		VALUE ADDED BY INDUSTRY AT U.S. PRICES $		EMPLOYMENT '000s	
		U.S.	U.K.	U.S.	U.K.	U.S.	U.K.
20.	Food Manufacturing	1,460	321	6,801	1,678	1,208	549
21.	Beverage Industries	523	115	1,765	409	214	129
22.	Tobacco Manufactures	278	56	738	149	94	47
23.	Textiles	1,616	544	5,366	2,022	1,281	977
24.	Clothing and Footwear	1,001	223	4,956	1,153	1,459	583
25/6.	Lumber and Furniture	1,514	147	4,216	484	1,044	313
27.	Paper and Products	1,201	115	3,170	307	481	181
28.	Printing and Publishing	1,175	178	4,487	683	751	293
29.	Leather and Products	130	40	499	153	111	55
30.	Rubber Products	347	54	1,409	230	237	92
31.	Chemicals	1,593	282	5,451	1,008	567	365
33.	Non-metallic Mineral Products	878	213	3,534	949	617	392
34.	Basic Metals	2,247	427	7,957	1,529	1,286	650
35.	Metal Products	1,587	268	6,152	1,100	1,039	521
36.	Machinery (excl. Electrical)	2,447	396	6,813	1,327	1,206	690
37.	Electrical Machinery	1,376	224	4,673	838	793	435
38 A.	Automobiles	2,774	181	6,095	502	866	296
38 B.	Other Transport Equipment	613	241	2,271	1,349	462	474
39.	Miscellaneous Industries	939	127	3,688	512	666	261
TOTAL (before adjustment for fuel inputs)		23,699	4,152	80,041	16,383	14,381	7,303
TOTAL net of fuel inputs[1]		23,150	4,152	80,041	16,430	—	—
TOTAL after weighting adjustment[2]		21,832	3,916	78,975	16,210	15,041	7,889

1. Data for the individual industries take no account of variations in fuel inputs, and adjustment for this is made globally. As the United States uses more fuel per unit of output, the effect is to somewhat increase the estimate of American production at British prices, and decrease that of British production at American prices.
2. This includes various reclassifications, and deductions of minor inputs which could not be allocated by industry (see Appendix A). Further, the employment series also include head office employees, not included in the data for individual industry groups.
NOTE. Detail may not add to total because of rounding.

manufacturing industries. Total cost ratios, even at factory price levels, would therefore be appreciably more favourable to the United States, than net costs.

1. In the United Kingdom in 1954 the share was 42 per cent but this is based on a manufacturing classification that includes petrol refining. Omitting chemicals, and food, beverages and tobacco, the proportion falls to 36 per cent (Estimates based on Table 18 *National Income and Expenditure*, H.M.S.O. 1958).

THE DISTRIBUTION OF NET OUTPUT

The distribution of net output among the 19 major manufacturing groups,[1] is shown in Table 8. In the last chapter we found that the share of manufacturing in the national product was rather similar in the two countries. Within the manufacturing sector, the shares of the various major groups also show less variation than was found among the non-manufacturing sectors, where natural resource differences are more important. This is, however, partly the result of aggregation,[2] as many of the most striking contrasts are found between individual industries within one major group.[3] In the transport equipment group the contrast in the relative importance in the two countries of automobiles and other transport equipment was so great that meaningful results could only be obtained by showing them as two separate sub-groups.

Among the major manufacturing groups, as among the main economic sectors, we find that an examination of the percentage distribution of net output in each country's own prices gives a quite misleading picture of the relative industrial structure of the two countries. In some groups the correlation of large total output with low net costs is very marked, so that comparison in national currencies understates the real advantage of the country with relatively larger output. Thus, the three groups in which the United States has the greatest relative advantage, lumber and furniture, pulp and paper, and automobiles, together account for 17 per cent of American net output and 12 per cent of United Kingdom net output when each is measured in their own prices. In real terms, however, the contribution of these industries is seen to be twice as great in the United States as in the United Kingdom, 17 per cent compared with 8 per cent, when both are measured in American prices, and 23 per cent compared with 12 per cent at British price weights. Similarly, non-metallic mineral products, and other transport equipment, the two groups for which the United Kingdom has the greatest relative advan-

1. The classification of industries in these groups is based on the International Standard Industrial Classification, but with important modifications made to meet the special requirements of this study. Full details are given in Appendix B, Introduction, but it should be noted in particular that (a) oil refining and coke ovens are excluded from manufacturing so that there is no group 32; (b) the non-metallic mineral and basic metal major groups include also mining of materials for these industries; (c) synthetic fibre production has been moved from chemicals to textiles.
2. The comparison for the sector was based on a breakdown into nearly 150 separate industries and for many of these a large number of indicators were required to give even moderate coverage of the total range of products. In this chapter, indices are given only for the major industry groups and some of the more important individual industries because various methods had to be used in the individual industry comparisons and the detailed results vary considerably in reliability. The combined group indices are believed to be generally more reliable than those for individual industries, because some errors, particularly those due to classification difficulties, tend to cancel out in aggregation. Details for all the industries for which moderately reliable indices could be obtained are included in Appendix B where the results can be evaluated in the light of the information given on the methods employed.
3. Thus, in the textiles group, the greater relative importance of the British woollen and linen industries is partly offset by the relatively larger American synthetic textile and knitting industries, while in the machinery group the large relative share of the American agricultural and refrigerating machinery industries is compensated by the importance of the British textile machinery industry.

tage, account for only 11 per cent of United Kingdom net output compared with 9 per cent of United States net output if measured in national currencies, but the real shares are 11 and 6 per cent when both are measured in British prices, and 14 and 9 per cent in American prices.

Even where the correlation between prices and quantities is rather small, however, the national currency comparisons distort the true picture. Thus, in terms of national currencies, we find that tobacco

TABLE 8. PERCENTAGE DISTRIBUTION OF NET OUTPUT AND EMPLOYMENT FOR MAJOR MANUFACTURING GROUPS IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950

I.S.I.C. CODE	INDUSTRY GROUP	DISTRIBUTION OF NET OUTPUT				PERCENTAGE DISTRIBUTION OF EMPLOYMENT	
		AT U.K. PRICES		AT U.S. PRICES			
		U.S.	U.K.	U.S.	U.K.	U.S.	U.K.
20.	Food Manufacturing	6.2	7.7	8.5	10.3	8.4	7.5
21.	Beverage Industries	2.1	2.8	2.2	2.5	1.5	1.8
22.	Tobacco Manufactures	1.2	1.3	0.9	0.9	0.6	0.6
23.	Textiles	6.8	13.1	6.7	12.3	8.9	13.4
24.	Clothing and Footwear	4.2	5.4	6.2	7.0	10.2	8.0
25/6.	Lumber and Furniture	6.4	3.5	5.3	3.0	7.3	4.3
27.	Paper and Products	5.1	2.8	4.0	1.9	3.4	2.5
28.	Printing and Publishing	5.0	4.3	5.6	4.2	5.2	4.0
29.	Leather and Products	0.5	1.0	0.6	0.9	0.8	0.7
30.	Rubber Products	1.5	1.3	1.8	1.4	1.7	1.3
31.	Chemicals	6.7	6.8	6.8	6.2	3.9	5.0
33.	Non-Metallic Mineral Products	3.7	5.1	4.4	5.8	4.3	5.4
34.	Basic Metals	9.5	10.3	10.0	9.3	8.9	8.9
35.	Metal Products	6.7	6.4	7.7	6.7	7.2	7.1
36.	Machinery (excl. Electrical)	10.3	9.5	8.5	8.1	8.4	9.4
37.	Electrical Machinery	5.8	5.4	5.8	5.1	5.5	6.0
38 A.	Automobiles	11.7	4.4	7.6	3.1	6.0	4.0
38 B.	Other Transport Equipment	2.6	5.8	2.8	8.2	3.2	6.5
39.	Miscellaneous Industries	4.0	3.1	4.6	3.1	4.6	3.6
	TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

manufactures account for 11 per cent of the United Kingdom food, beverage and tobacco groups, compared with 8 per cent in the United States. This is, however, purely a price difference, and the real share of the tobacco industries is slightly larger in the United States than in Britain — 13 per cent compared with 11 per cent in United Kingdom prices and 8 per cent compared with 7 per cent in United States prices.

REAL NET OUTPUT, PRODUCTIVITY AND COSTS

Quantity indices, relative output per worker and net cost ratios for the separate major groups are shown in Table 9. It is remarkable that for each of five very important groups, namely chemicals, basic metals, metal goods, machinery, and electrical machinery, the quantity ratios are rather close to the manufacturing average and fall within a range

TABLE 9. INDICES OF REAL NET OUTPUT OUTPUT PER WORKER AND NET COSTS FOR MAJOR MANUFACTURING GROUPS IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950

I.S.I.C. CODE	INDUSTRY GROUP	QUANTITY INDICES U.K. = 100				OUTPUT PER WORKER U.K. = 100		NET COST RATIO $ PER £	
		TOTAL		PER CAPITA		BASED ON			
		U.K. PRICES	U.S. PRICES	U.K. PRICES	U.S. PRICES	U.K. PRICES	U.S. PRICES	U.S. WEIGHTS	U.K. WEIGHTS
20.	Food Manufacturing	454	405	151	134	206	184	5.2	4.7
21.	Beverage Industries	456	431	151	143	274	259	3.6	3.4
22.	Tobacco Manufactures	494		164		251		2.7	
23.	Textiles	297	267	99	88	227	204	3.7	3.3
24.	Clothing and Footwear	449	430	149	143	179	172	5.2	5.0
25/6.	Lumber and Furniture	1,030	870	342	289	309	261	3.3	2.8
27.	Paper and Products	1,043	1,033	346	343	391	388	2.6	2.6
28.	Printing and Publishing	661	657	219	218	258	256	3.8	3.8
29.	Leather and Products	328	326	109	108	161	160	3.8	3.8
30.	Rubber products	640	613	212	203	249	238	4.3	4.1
31.	Chemicals	565	541	187	180	364	349	3.6	3.4
33.	Non-metallic Mineral Products	413	373	137	124	263	237	4.5	4.0
34.	Basic Metals	527	520	175	173	266	263	3.6	3.5
35.	Metal Products	592	559	196	185	297	281	4.1	3.9
36.	Machinery (excl. Electrical).	617	514	205	171	353	294	3.4	2.8
37.	Electrical Machinery	613	557	203	185	336	306	3.7	3.4
38 A.	Automobiles	1,523	1,213	508	402	524	415	2.8	2.2
38 B.	Other Transport Equipment	254	168	84	56	260	173	5.6	3.7
39.	Miscellaneous Industries	740	721	246	239	290	282	4.0	3.9
	TOTAL (before adjustment for fuel inputs)	571	489	189	162	290	248	3.95	3.38
	Net of Fuel Inputs[1]	558	487	185	162	—	—		
	After weighting adjustment[1]	558	487	185	162	292	256	4.14	3.62

1. See footnotes 1 and 2 to Table 7.

of 10 or 12 per cent of the average in each set of prices. These groups combined account for almost 40 per cent of net output in both countries, and as their net cost ratios are also near the average,[1] the real share of the groups in the two countries is also very similar. Output per worker is also near the manufacturing average in the basic metals and metal products groups, but in chemicals, machinery, and electrical machinery the American advantage is somewhat greater with indices ranging from 300 to 360 (U. K. = 100).

Another four groups, food manufacturing, beverages, tobacco and clothing, show quantity ratios rather more favourable to the United Kingdom than the average, with indices ranging from 400 to 500 per cent, giving an output per head of total population about two-thirds of that of

1. Apart from the machinery group, where there is rather a wide spread between the United Kingdom and United States weighted ratios.

the United States. These four groups are engaged mainly in supplying consumer goods for the internal market, and foreign trade is relatively unimportant in most of their industries. Consequently, output is determined chiefly by home demand, and as price elasticity is fairly low at this aggregated level, the results reflect chiefly the influence of higher American real incomes. In the food manufacturing and clothing industries prices are extremely favourable to the United Kingdom, and American output per worker is less than twice that of Britain. In the beverage and tobacco industries output per worker is at about the manufacturing average, but in the tobacco industry net costs are highly favourable to the United States.[1]

Omitting the miscellaneous industry group, which is too heterogeneous for meaningful analysis, there remain nine major groups whose real net output indices differ substantially from the average. In three of these groups, lumber and furniture, paper and paper products, and automobiles, the United States has an output 10 or more times that of the United Kingdom, and very high relative output per worker, with correspondingly low net cost ratios. In the first two cases, raw materials, and in the last, the size of market, clearly play an important part, but these factors do not appear sufficient to explain fully output per worker in the American paper industry nearly four times that of Britain, and in the automobile industry four to five times as high according to the price weights used. In the rubber and printing groups the United States has a real net output more than six times that of the United Kingdom, although the United States has less than average advantage in net costs. This appears to be mainly due, in the first case to the large demand of the automobile industry for tyres and in the second to the existence of plentiful supplies of low priced paper.

In the remaining major groups—other transport equipment, leather, textiles, and non-metallic mineral products—the United Kingdom shows a high relative production. They consist mainly of relatively labour intensive industries, and output per worker, while still only about half the American, is relatively favourable, giving the United Kingdom a cost advantage in view of the generally lower wage rates.

Comparisons of Individual Major Groups

In the following sections of this chapter the results for the individual manufacturing major groups are discussed, and finally we shall consider the effect of the adjustment for differences in fuel inputs in the two countries.

Food, Beverages and Tobacco

Since, for many items, the value added in food processing is rather small, net costs only marginally affect the total selling price and play a relatively minor part in determining the level of output. Some industries, such as beet sugar extraction and canning, must be located near to the raw material and the level of output is controlled by agricultural

1. This difference is almost entirely due to the fact that relative wages are lower in the United States than for the other major groups (see Chapter VI, Table 16).

production. For other products, such as bread and ice cream, the market is localised, and output is limited by internal consumption, with a correspondingly smaller elasticity of demand. The effect of both these factors is apparent in the British and American food industries. The output of the American dairy products and canning industries is very large[1] relative to that of the United Kingdom, while in meat products and confectionery, production *per capita* is about 1½ times as high. In the sugar and margarine industries, and in flour, bakery products, and biscuits, the volume index is equal to or below the population ratio.

In the majority of these industries American output per worker is about 1½ to 2 times that of the United Kingdom, which is more favourable to the latter than in the bulk of manufacturing industries. The net cost ratios are also advantageous to Britain. The canning, confectionery, brewery and tobacco industries constitute exceptions in which American output per worker is 2½ to 3 times that of the United Kingdom, while in distilling (which includes industrial alcohol production) output per worker is more than 4 times as large.

Textiles

In all the textile industries, results are relatively favourable to the United Kingdom, but there is, nevertheless, a considerable range within the group. In the cotton, rayon and linoleum industries American production is 4 to 4½ times that of the United Kingdom and output per worker 222 to 256 per cent. In knitting mills, also, the volume index is nearly 450 although output per American worker is less than 190 per cent of output per British worker.

The United Kingdom shows a relative advantage in the woollen and carpet industries, in both of which output per American worker is also about 190 per cent, but where British production is relatively larger. For carpets the volume index is just under 300 (U.K. = 100) i.e. output per head of population is about the same in the two countries ; but in the woollen and worsted industry the United Kingdom has a substantial export trade and British production per head of population is more than twice that of the United States. The United States volume indices are also between 200 and 300 in the cordage and twine, narrow fabrics, and finishing industries but the comparisons in these cases are less reliable.

The United Kingdom has substantial exports of linen products and the linen and jute industry is the only one where British output is absolutely very much larger than the American (in the neighbourhood of 15 times as great), and output per worker also is considerably more favourable than in the industries considered above. In this case, however, the American industry is so small that a precise comparison is very difficult.

Clothing and Footwear

In the clothing and footwear group American production is generally 4 to 4½ times that of Britain, but in miscellaneous made-up textiles

1. 17 times as high in the case of dairy products, 8 times in the case of canning industries.

(chiefly household textiles) it is considerably larger. In the footwear industry, as in the larger clothing industries, the net output per American worker is 170 per cent of that of the British worker. Results in this group may be somewhat biased against the United States as the only comparison which could be made was rather crude and it was necessary to ignore quality differences in making-up. The range of qualities in the two countries appears similar, but it is likely that in the higher income country bulk sales are at a higher quality level. In view of high American labour costs, however, it is by no means certain that this quality difference extends to the making-up operations, and it must be remembered that many of the quality differences in the final product are due to differences in materials used and are measured elsewhere in the study.

Lumber and Furniture

This group includes logging, in which, of course, the United States has an enormously larger production than the United Kingdom, so that American net output of timber and timber basic products is 14 to 19 times the British. In furniture and wooden containers which account for most of the remainder of the group, American output is only about 5½ times that of the United Kingdom.

Paper and Paper Products, Printing and Publishing

Not only has the United States a far larger output of paper than the United Kingdom but the major group includes an additional process because the British paper industry relies predominantly upon imported pulp, while a substantial part of American pulp is home-produced. American final production of paper is a little over 8 times that of Britain, but when account is taken of the additional process involved, the net output ratio is increased to nearly 11.

In paper products American production is of the same order of magnitude—11 times British production for containers, boxes and envelopes, and 9 times for miscellaneous paper and board products. A substantial part of this output is used as intermediate products by other industries, particularly for packaging, and it would have been desirable to make allowance for this as an input elsewhere. Unfortunately, the data available were inadequate for this purpose.

Only a rather crude comparison—mainly by means of their paper input—could be made for the printing and publishing industries. The results, therefore, can only give an idea of the general order of magnitude of output in the two countries. The production of newspapers presents a particular problem in view of their much greater average size in the U.S.A. In the comparison, the output of the newspaper industry was assumed to move mainly with newsprint consumption (representing the actual volume of printing), and a small adjustment was made for the number of papers produced.[1]

1. In the distribution sector, on the other hand, the full weight was given to the number of copies circulated, as it is at that stage that the number of units becomes of greatest importance.

Leather and Leather Products

This is a rather small group where both production and output per worker are relatively favourable to the United Kingdom. The comparison is of interest as an illustration of the effect of distribution of employment among industries on the value-weighted average output per worker. Compared with the United Kingdom, the United States has a relatively small output of tannery products and a large production of finished leather goods. The first of these industries is highly capital intensive and in both countries net output per worker is high, whereas in the leather products industry it is very low. The effect of this unfavourable distribution of labour is that relative output per worker in the combined group (160 to 161 per cent) is lower than in either of the component industries (168 per cent and 184 to 201 per cent).

Rubber Products

In the tyre and tube industry American output is 7 to 8 times that of the United Kingdom and in other rubber goods it is about 6 times as high, output per worker in both industries being about 250 per cent (U.K. = 100). In the rubber footwear industry British production is relatively larger, and the index of output per American worker is only 155, but the weight of this industry in the group is small.

Chemicals

Of the 10 industries recognised in this major group three account for more than 70 per cent of total net output. The most important of these is the basic chemicals industry which carries nearly half the weight of the group. The comparison for this industry was very difficult owing to the very large number of items produced, and was based on a price study of about 20 major items. The results cannot, therefore, be given the same degree of reliability as those for more homogeneous industries. The United States was found to have a net output over 5½ times that of the United Kingdom, and an output per worker index of 370.

The other two leading industries are medicinal and pharmaceutical preparations, and paint and varnish. In the former industry, also based on a price comparison of a small sample of products, the American output, which was 7 times that of the United Kingdom, was produced with a labour force only 30 per cent greater than the British, giving a relative output per worker index of 460. In the paint and varnish industry American net output was 7 times that of the United Kingdom and comparative output per worker about the same as in the basic chemicals industry.

Non-metallic Mineral Products

In four of the ten industries in this major group the United Kingdom has a larger output per head of population than the United States, and in all four cases the index of American output per worker is less than 200 (U.K. = 100). The two most important industries are pottery and china, and structural clay products (of which the largest item is

bricks), for both of which American output is in the range 170 to 190 per cent of the British.

In the cement industry American output is just under 400 per cent of the British and output per worker only 116 per cent. This is the second most productive of the sizeable British industries (the first being shipbuilding) and is of particular interest in that the industry is highly capital-intensive with a large net output per worker in both countries.

The United States has a relatively larger volume of production, and an output per worker between 2 and 3 times that of the United Kingdom in the glass and precast concrete goods industries, but the main factor in raising the average of the major group is the inclusion of non-metallic mineral mining, where natural resources and the scarcity value of the minerals produced are all important. The average volume indices for the group, excluding mining, are 294 and 348 (compared with 373 and 413 per cent) and output per worker is reduced from 237 and 262 per cent to 188 and 224 per cent.

Basic Metal Industries

The basic metal industries occupy a very similar relative position in both countries, volume, net cost and output per worker indices all being very near the manufacturing average. In both countries steel works and rolling mills account for about 40 per cent of net output, and for this leading industry American production is 547 per cent of British production weighted by British prices, and 533 per cent weighted by United States prices. The corresponding output per worker indices are 273 and 266 per cent. In blast furnaces where, however, the volume of employment is small, American productivity is still higher—just over 4 times that of Britain. Non-ferrous metals and foundries (which include plants attached to firms in other industries) each account for about 20 per cent of total net output, and in both cases volume and output per worker indices are slightly less favourable to the United States : 486 and 264 for non-ferrous metals and 378 and 202 for foundries (U.K. = 100).

The group includes metal mining, in which American production is many times greater than that of Britain and output per worker 5 times as high, but even in the United States the weight attributable to mining is rather small. Excluding mining the volume indices for the group are 477 and 468 per cent according to the weights used, and output per worker 260 and 254 per cent.

Metal Products

This group is a heterogeneous one, comprising 16 industries none of which account for much more than 10 per cent of the total.

The United States has a major advantage in the metal can industry, in heating, cooking and plumbing equipment, and in sheet metal work. In each of these industries American production is more than 10 times that of Britain, and in the first two output per worker is more than 5 times as high. The United Kingdom has a relative advantage in cutlery and tools, where American production is less than 3 times the British, and output per worker just under double.

Machinery (except Electrical)

This group includes 16 industries making a very wide range of products and direct comparisons could only be made in industries covering about 65 per cent of the total weight. This introduces a rather large margin of error into the indices for the group as a whole, because the results in the industries which could be compared show wide differences not only between the industries, but even among individual products of the same industry. The differences follow the traditional specialities of the two countries. The United States has a production per worker more than 3½ times that of Britain in agricultural machinery, refrigeration, and laundry equipment, office machinery and mechanical handling equipment. In each of these industries net cost ratios are extremely favourable to the United States, with production 10 or more times that of the United Kingdom. Britain has relatively low costs in textile and sewing machines, metal working machinery and ball and roller bearings, in all of which output per worker is about half that of the United States. In textile machinery the importance of British exports is revealed by the American volume index of 124 (U.K. = 100), indicating an output per head of British population about 2½ times that of the United States.

Electrical Machinery

This group includes important items of durable consumer goods, as well as producer's plant and equipment. In electrical household equipment and radios the results show, as might be expected, a marked advantage for the United States, whose net output is about 8 times the British, with an output per worker about 4 times as high. These two industries account for about one-third of the net output weight of the major group. Generators, motors and transformers account for a further 22 per cent, and these show a result more favourable to Britain, with output indices for the United States of about 390 and 470, according to the weights used, giving output per worker indices of 220 and 265 (U.K. = 100). Prices are also favourable to Britain, the net cost ratios being $4.2 and $3.6 to £1, according to the weights. This result conceals, however, a wide divergence within the group : the United States has a large output and relative advantage in fractional horsepower motors, and the British position is more favourable for the larger units. Comparisons for the remaining industries in this group were exceedingly difficult because a large part of their output is of highly specialised equipment for which comparable typical products rarely exist.

Transport Equipment

The contrast found in this group has already been mentioned above. In automobiles, trucks, and tractors (which are treated as a separate major group) American output is 13 to 16 times that of Britain and output per worker 4 to 5½ times as high.[1] In shipbuilding, on the other

1. This advantage is, however, partly due to particular cyclical factors in 1950, and is somewhat smaller in later years.

hand, American production is only 40 per cent of the British and output per worker only about 110 per cent. In the motor cycle and bicycle industry the United Kingdom also has a major advantage, and United States production is shown as only 61 per cent, with an output per worker just over twice the British.

Miscellaneous Industries

This group includes a very large number of items ranging from scientific and optical instruments, to cinematograph film production and toys. Owing to the large number of minor products involved, only a small sample of items could be compared, and even for these the comparisons had often to be rather crude. Consequently the results are not considered sufficiently reliable for detailed discussion.

Fuel Inputs

In the comparisons described above, little or no account was taken of differences in purchased inputs per unit of output. For the specific raw materials that are transformed by manufacture we have assumed that differences in the material input are reflected in differences in the quality of the product, e.g. that more or better quality wool input per sock knitted results in heavier or higher quality socks being produced. This assumption cannot be made, however, for the secondary or non-specific inputs such as fuels and business services.[1]

Fuels are the most important non-specific input in the manufacturing industries, and, while it was not possible to allow for differences in fuel used in each individual industry, an adjustment was made in broad groups. The 7 major groups in which fuel inputs are largest in relation to net output were adjusted individually, and the remainder, in which fuel inputs are mainly less than 3 per cent of value added, were combined in one group.

When net output and fuel inputs are measured at British price the United States has a 33 per cent greater input of fuels per unit of ne output in manufacturing as a whole, and indices above 100 are noted in bvery group (except paper for which the ratio is practically the same in eoth countries). Part of this difference is due, however, to the high value given to the large American consumption of natural gas when British prices are used. When measured in American prices, fuel consumption is still about 50 per cent higher in the United States in food and beverages and in textiles, and nearly 20 per cent higher in primary metals, but is about 20 per cent lower than that of the United Kingdom in chemicals and paper. In the remaining groups there is little difference between the two countries.

American fuel inputs for the whole manufacturing sector are 740 per cent of those of the United Kingdom when measured in British prices and 530 per cent in American prices, the corresponding figures for unadjusted net output being 553 per cent and 474 per cent respectively. The volume of fuel used per unit of output is, therefore, about

1. This question is discussed more fully in Chapter VI.

34 per cent larger in British prices and 12 per cent larger at American price weights. Its is necessary to correct the total real product index to allow for this factor.[1] From a technical point of view the British weighted indices exaggerate the difference in fuel consumption because of the effect of natural gas prices, with a corresponding distortion when fuel output is measured. Moreover, not only is the difference in consumption smaller when measured in American prices, but in addition fuel prices in the United States are extremely low in relation to other manufacturing costs, so that the adjustment, in American prices, is smaller. Thus, the reduction in the index on American weights is very small—only 2 points or 0.5 per cent, while in British prices, the index is reduced by 14 points or 2.5 per cent.

Estimates for 1954 and 1957

Table 10 gives an extrapolation of the manufacturing volume indices for major groups to 1954 and 1957, based on relative movements in

Table 10. INDICES OF REAL NET OUTPUT FOR MAJOR MANUFACTURING GROUPS IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950, 1954 AND 1957

U.K. = 100.

I.S.I.C. CODE	INDUSTRY GROUPS	AT U.K. 1950 PRICES			AT U.S. 1950 PRICES		
		1950	1954	1957	1950	1954	1957
20/2.	Food, Beverages, Tobacco	459	440	430	416	390	390
23.	Textiles	297	350	270	265	310	240
24.	Clothing and Footwear	449	440	430	430	420	410
25/6.	Lumber and Furniture	1,030	840	890	870	710	750
27/8.	Paper and Printing	811	760	830	773	730	790
31.	Chemicals	565	510	560	541	490	530
33.	Non-metallic Mineral Products	413	410	460	373	370	420
34.	Basic Metals	527	430	470	520	430	470
35.	Metal Products	592	600	650	559	560	610
36/7, 38B.	Machinery, and Vehicles other than Automobiles	514	630	700	392	480	530
38A.	Automobiles	1,532	990	1,010	1,213	780	800
29, 30, 39.	All other industries	642	600	630	625	590	620
	Total (unadjusted for fuel input)[1]	571	555	585	489	481	502
	Output per worker	299	283	295	256	246	253

1. See footnote 1 to Table 7.

the production indices of the two countries. As the classification of sub-groups in these indices does not exactly conform to that used in this study the results for the separate groups must be treated with some reserve. Moreover, it was only possible to adjust the weights in respect of volume change so that 1954 and 1957 are compared in 1950 prices.

1. See Chapter IV.

Over the seven-year period the change in the aggregate index was fairly small. United States manufacturing output increased by about 26 per cent over the period and that of the United Kingdom by about 23 per cent, so that there is a shift in the relative real net output indices of about 2½ per cent against Britain. The rate of expansion in the two countries was unevenly distributed, however, and in the first four years the rate of growth in the United Kingdom was somewhat higher than in the United States, so that by 1954 the relative net output indices were some 2 or 3 per cent more favourable to Britain than in the base year.

Throughout the period employment in manufacturing increased slightly faster in the United States than in the United Kingdom, and in 1957 relative output per worker was the same as in 1950. The more rapid British expansion in the first four years resulted in a change of 4 to 5 per cent in Britain's favour between 1950 and 1954, but this was reversed in the following three years.

Among the individual industries the most striking changes are in the two groups where the American production advantage is greatest —lumber and furniture, and automobiles. Automobile production in the United States reached a level in 1950 which was to be exceeded in only one other year, 1955, while British production, on the other hand, was in the early stages of a boom which continued through 1957 (although 1955 was a peak year for the United Kingdom also). Consequently the comparisons for 1954 and 1957 are more favourable to the United Kingdom than the 1950 comparison—the American production advantage in the two later years being only two-thirds of its 1950 level, on either set of weights. The fact that the American automobile industry had reached a cyclical peak in 1950 is also reflected in the indices of American output per worker (U.K. = 100). On British weights, the index fell from 520 in 1950 to about 400 in 1954 and 1957 ; on American weights, the corresponding figures are 410 and 315.

Among the other industry groups between 1950 and 1957, the United Kingdom's relative position improved by about 10 per cent in basic metals and in textiles, while the United States had relative gains of about the same order of magnitude in the metal products, non-metallic mineral products, and machinery and other vehicles groups. In the latter group, however, the change is mainly due to the very rapid growth of aircraft production in the United States during the period. In the remaining groups changes were rather small.

IV

THE NON-MANUFACTURING SECTORS

The value added in the non-manufacturing sectors accounts for two-thirds or more of the gross national product of each country. The service industries and distribution are the largest sectors in the group, the net output of the service industries accounting for about 17 per cent of total net output in both countries, that of the distribution sector for a further 15 per cent in the United States and 11 per cent in Britain. Transport and communications, agriculture and the fuel industries are the other most important sectors, and the group also includes construction, government, and services of dwelling units.

Agriculture

The results given in the following paragraphs relate mainly to farm production, which constitutes by far the most important part of this sector. Additions had to be made, however, to take account of fisheries and the output of small agricultural holdings excluded from the farm statistics. These two items account for 13 per cent of the net output of the agricultural sector in the United Kingdom but are of negligible importance in the United States. Although only rough comparisons could be made, their inclusion produces aggregate quantity indices more favourable to Britain than those for farms alone.

In the comparison of farm production both outputs and inputs were measured, mainly by direct quantity comparison, and the individual quantity ratios were weighted by the prices received and paid by farmers. Net output was thus obtained as a residual. The comparison was based on the purchases from and sales to other sectors, excluding inter-farm transactions and intermediate products produced and consumed on the farm. Consumption by farm households was included as this is part of the final product.

Gross output in the United States was found to be about 10 times that of the United Kingdom, but this level was obtained with less than 7 times the volume of inputs purchased from outside the sector. Relative net output is, therefore, still higher, and the index shows net American agricultural product to be 13½ times that of the United Kingdom when valued at British prices and 11½ times using American price weights.

The main results of the comparison are given in Table 11. Output was sub-divided between animal products and crops. The animal products group consists of a small number of important items—production of beef, pork, milk and eggs alone account for more than five-sixths of the total in both countries. The United States advantage is less marked in this group, gross output being 8 to 8½ times that of the United

Kingdom. To a large extent this is due to the fact that Britain is largely a food importing country, whereas fluid milk requirements must be met entirely out of home production.

TABLE 11. NET OUTPUT OF AGRICULTURE IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950

	DISTRIBUTION OF OUTPUT		QUANTITY RATIO U.K. = 100		COST RATIO $ PER £	
	U.K.	U.S.	U.K. PRICES	U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Gross output	1,630	1,317	1,094	980	2.96	2.66
of which :						
Animal products	1,113	789	847	805	3.17	3.01
Crops	517	528	1,626	1,456	2.52	2.26
Inputs	— 630	— 317	695	656	2.76	2.60
Net output	1,000	1,000	1,346	1,163	3.09	2.67
(Adjusted to true net basis)[1]	— 3.0%	+ 5.4%			3.30	2.85
Net output including fisheries and small units			1,183	1,028	3.28	2.85
Employment ratio			532			
Output per worker			222	193		

1. Subsidies, stock changes and other minor items could not be allowed for in the calculation (see Appendix C, Agriculture).
The percentage adjustments are made to the value of net output and alter the cost ratios to those shown here and used in the sector tables in Chapter II.

For comparing the output of crops a much larger number of indicators is needed than for animal products, but here also a large share of output is attributable to a rather small number of staple products. About half of American crop production consists of major items not grown on a significant scale in the United Kingdom. Tobacco, cotton and corn are the most important of these. British import prices c.i.f. were used to value American production of these in the calculation at British weights. This procedure gave an average price ratio of $2.50 to £1, extremely near to the ratios of $2.53 and $2.26 obtained for items grown in both countries.

The larger volume of inputs per unit of output shown for the United Kingdom is due entirely to two factors : the substantial volume of imported feeding stuffs, and a relatively higher consumption of fertilisers. The other farm purchases compared did not show sufficient variation in input per unit of output to materially affect the net index. The most important of these other items are fuel and maintenance expenditures on farm tractors, trucks and other machinery. Only a rough comparison of these could be made but it appeared that real expenditure per unit of output was about as high in the United Kingdom as in the United States. Bearing in mind the very different systems of cultivation practised in the two countries, it appears that the relative advantage of the United States in respect of machinery per unit of manpower is offset by the use in Britain of more machinery per unit of land.

The price ratios, both for outputs and inputs, show an average that is not far removed from the official exchange rate. This partly reflects the influence of international trade in agricultural staples, but the general averages are somewhat deceptive since they conceal a rather wide distribution of prices within the groups. Moreover, although animal products show a price ratio within 10 per cent of the official rate, internal farm prices for these items were, in both countries, well above the world level as represented by prices paid for United Kingdom imports.

The remaining items in the agricultural sector are fisheries and small agricultural units. Their inclusion reduces somewhat the American advantage and the aggregate net output indices fall to 1183 and 1028 (U.K. = 100) according to the price weights used.

Output per worker is given only for the aggregate agricultural sector as the labour force used on farms could not be separated from that on the small agricultural holdings.[1] The United States is found to have an output per worker about twice that of Britain, but this is only an approximation because it is extremely difficult to obtain comparable estimates of agricultural employment.[2]

The output per worker indices obtained for the United States are about 220 (U.K. = 100) when production is weighted by United Kingdom prices, and 190 with American weights, and are about 30 per cent more favourable to Britain than those for the manufacturing sector. This result is rather remarkable in view of the much more intensive cultivation system of British agriculture. Net output per acre in the United States appears to be only about 47 to 54 per cent of that in the United Kingdom, so that American agriculture uses roughly twice as much land and half as much labour per unit of output as the British.

Comparisons of land input are extremely vulnerable because there appears to be no way to take account of fertility differences. The rough estimates given above ignore this factor, but some adjustment is made for the larger proportion of rough grazing in the United States. The total area of farm land is about 27 times that of the United Kingdom, but land under crops, other than grass, is only 21 times as large. In general, yields per acre for individual crops were correspondingly lower in the United States, ranging in 1950 from 105 per cent for sugar beet and 87 per cent for potatoes to 60 per cent for barley and little over 40 per cent for wheat.

FUEL

The comparison of fuel output in the United Kingdom and the United States affords a dramatic example of the effect of natural resource differences upon the real product. American net output was found to be 9½ times that of the United Kingdom when measured in British prices

1. In fisheries, the rather crude comparison made indicated a slightly higher output per worker in the United Kingdom than in the United States, but the weight of this industry in the total for the sector is very small.
2. This is due mainly to the importance of family workers and seasonal labour, particularly in the United States (see Johnson and Nuttenbury, *A Critical Examination of Farm Employment Estimates*, Journal of the American Statistical Association, June 1954). Part time small holdings and part time subsistence farming introduce further difficulties.

and nearly 8 times with American weights. The net price ratios are also highly favourable to the United States : $2.2 or $1.8 per £ according to the weighting system used.

The most striking difference, however, is shown when these levels are related to employment. Output per worker in the American fuel

TABLE 12. GROSS AND NET FUEL OUTPUT, PRICE RATIOS, AND OUTPUT PER WORKER IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950

	DISTRIBUTION OF OUTPUT		QUANTITY RATIO U.K. = 100		GROSS PRICE RATIO $ PER £		OUTPUT PER WORKER U.K. = 100	
	U.K.	U.S.	AT U.K. PRICES	AT U.S. PRICES	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
A. GROSS OUTPUT								
Coal, Total production	—	—	232	242	2.22	2.32	374	390
Excluding fuel sector's own consumption :								
Coal, output net of use in fuel sector	379	105	261	275	2.24	2.37	—	—
Coke	121	53	251	246	3.93	3.85	—	—
of which :								
Coke ovens	(60)	(49)	468		3.84		194	
Total solid fuels (including other minor products)	546	168	255	260	2.63	2.68	—	—
Gas	162	115	1,645	1,691	1.21	0.95	—	—
Electricity	281	286	602	556	4.06	3.75	—	—
Petroleum products	105	448	2,712	3,530	2.67	2.54	—	—
Less : imported crude oil	— 94	— 17	168		2.23		—	
TOTAL gross output	1,000	1,000	951	781	2.84	2.33	—	—
B. NET OUTPUT					*Net Cost Ratio*			
Solid and liquid fuels[1]	477	508	923	886	—	—	—	—
Gas and electricity[1]	487	443	986	664	—	—	—	—
Water works	36	49	574	531	—	—	—	—
TOTAL net output	1,000	1,000	942	750	2.31	1.83	—	—

1. Account is taken of solid and liquid fuels used in gas and electricity works in the allocation of weights between these two groups.

industries was 700 per cent to 860 per cent of that of the United Kingdom. A difference of this magnitude is clearly due primarily to the vast differences in the natural resources of the two countries. There is, furthermore, evidence which indicates that American production of fuel is almost certainly more efficient, in relation to its own potentialities, than British,[1] but it is not possible to separate real differences in efficiency from other factors.

1. See, for example, the Anglo-American Productivity Team reports on coal mining and electricity.

The direct effect on aggregate productivity of the extremely high American output per worker is seen in the fact that the United States has a fuel output per unit of total real product $1\frac{3}{4}$ times as great as that of the United Kingdom, while only employing 2.3 per cent of its total labour force in fuel production compared with 5.2 per cent in Britain. The indirect effects of higher fuel production are less easily measured, because about two-thirds of total fuel consumption is in the form of inputs to other industries. A large part of the total higher American fuel consumption is accounted for by the greater requirements of fuel for transport—requirements that themselves result largely from natural resource differences. In manufacturing, as we have seen above, fuel consumption per unit of output is generally greater, although the difference is not as great as the divergence in fuel production levels might lead one to expect.

An indirect result of cheaper and more plentiful fuel supplies is that productivity in fuel-using industries is increased, but this element cannot be separated statistically from the other causes of high American output per worker. At the same time, it is necessary to avoid double counting the effect of higher fuel consumption on total real output by including the cost of the additional fuel used when calculating the net output of user industries. Fuel inputs into manufacturing, transport, and agriculture have, therefore, been deducted from the unadjusted total real outputs of these sectors. These adjustments are purely technical corrections made to arrive at a closer measure of *net* output, and do not alter the fact that net output is itself higher as a result of the additional power used.

The far larger scale of fuel production in the United States, and the importance, in that country, of two unique commodities, crude petroleum and natural gas, introduced serious technical complications into the comparison of fuel output. To simplify these problems a special fuel sector was created, incorporating all fuel mining, the gas, electricity, and water utilities, and the production of manufactured fuels in coke ovens and oil refineries. The output of the fuel sector was then measured net of inputs of primary fuels (e.g. coal, crude oil and natural gas) into its secondary industries (such as coke, electricity and manufactured gas). Thus the coal output compared excludes, not only colliery consumption, but coal used in electric power stations, coke ovens and gas works, the latter establishments being weighted to allow for the coal content of their production.

On this basis it was possible to bring American crude oil production into the comparison by valuing refinery products in full, and deducting net *imports* of crude oil as a purchased input. Petroleum extraction and refining are thus treated as one industry, and the additional activity of extraction carried out in the United States is measured in a higher net output index, because purchases of imported crude oil are very small.

Natural gas presented more serious difficulties since it is one of the final products of the sector and has no precise equivalent in the United Kingdom. In general, coal and oil are more likely to be substituted in Britain for natural gas than is manufactured gas, whose price would be uneconomic for many purposes for which natural gas is used in the United States. However, because coal is transported and distributed by

separate industries, while these functions are combined in the gas industry it was decided to equate natural and manufactured gas on the basis of thermal content, subdividing the product according to type of user (which substantially affects distribution costs), but not by type of gas. The greater part of the spread between the fuel indices at British and at American prices is due to the differences in the price and production of gas, thus defined, in the two countries.

Details of the more important results obtained are given in Table 12. It will be seen that solid fuels account for more than half of final fuel production in the United Kingdom, but only one-sixth in the United States. Output per worker in coal mining is nearly four times as high in the United States as in the United Kingdom while in coke ovens it is almost twice as high. Separate indices cannot be given for other industries within the sector. For petroleum and gas these would have little meaning owing to the differences in activities, and unfortunately comparable employment data for the electricity industry in the two countries could not be obtained.[1]

Transport and Communications

The most outstanding difference in the public transport systems of the United States and the United Kingdom is the overwhelming influence of internal freight transport in the United States, and the far greater relative significance of passenger transport and ocean shipping in the United Kingdom. This is best seen in a comparison of gross output since it is difficult to divide the net output of railways and airlines between passenger and freight services.

Table 13. GROSS OUTPUT OF THE TRANSPORT INDUSTRIES IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950

	Distribution of output		Quantity ratio U.K. = 100		Price ratio $ per £	
	U.K.	U.S.	U.K. prices	U.S. prices	U.K. weights	U.S. weights
Passenger	251	166	249	177	6.2	4.4
Internal freight	522	800	1,284	1,229	2.1	2.0
External freight[1]	227	34	70	67	3.3	3.6
Total gross output	1,000	1,000	801	507	3.5	2.2

1. Including ocean passenger shipping.

American output of internal freight transport is more than 12 times that of the United Kingdom, the transport requirement per unit of output of transportable goods being roughly twice as great. This reflects, of course, the greater distances in the United States; the average haul of goods on the railways is 5½ times longer than in Britain. In passenger transport, on the other hand, the greater volume of private motoring in the United States greatly outweighs any additional public transport required by a more scattered population, and Britain has a larger *per capita* consumption of these services. In shipping, British output is absolutely greater than that of the United States.

1. This is due to the number of combined gas and electricity undertakings in the United States.

Prices reflect strongly the advantages of large scale and intensive use of transport facilities. American prices for freight transport are relatively low, while in passenger services the United Kingdom has a marked price advantage. As a result of these differences in the price and pattern of transport services, when the ratios for the various services are combined there is a large difference in the aggregate transport indices according to the price weights used.

The difference in the pattern of transport services in the two countries is particularly significant in the real product comparison because freight transport (unless supplied to other countries as an export) is an intermediate product, contributing only indirectly to the final real product, while the bulk of passenger transport is a final product. Internal freight transport was therefore deducted as an input, but as it was not possible to calculate the transport purchases of each industry separately, the adjustment was made globally to the aggregate sub-index of all industries producing transportable goods (i.e. all physical commodities except gas, electricity and water). The amount of the deduction is quite substantial, and makes the net output index of this group of industries 16 per cent more favourable to the United Kingdom when measured in British prices and 10 per cent in American prices.

Nothing was deducted in respect of internal freight transport because it was simpler to allow for this input by treating imports as entering the system at c.i.f. prices and all external transport as final output (i.e. as exported services). This approach avoids complicated adjustments in respect of imports carried in foreign bottoms, but does not give the most interesting comparison of actual transport requirements of industry in the two countries. Internal freight accounts for 97 per cent of total United States freight inputs, but only 75 per cent of British freight inputs, the remainder being made up of freight on imports. In Table 14, therefore, the total transport requirements of British and American

Table 14. COMPARATIVE FREIGHT TRANSPORT REQUIREMENTS OF BRITISH AND AMERICAN INDUSTRY IN 1950

U.K. = 100.

	Relative share		Quantity ratio		Input per unit of net output	
	U.K.	U.S.	at U.K. prices	at U.S. prices	at U.K. prices	at U.S. prices
Internal freight transport	755	974	1,284	1,229	192	218
Transport of imports	245	26	55		8	10
Total	1,000	1,000	982	792	147	123

industry are compared, including transport of imports. It will be seen that although the United States uses twice as much internal freight transport per unit of output as the United Kingdom, its total transport requirement is only 123 per cent of that of Britain on American weights, and 147 per cent on British weights. The rather wide spread between these indices is due to internal freight charges being very low in the United States while shipping freight charges are relatively favourable to the United Kingdom.

The wide differences in the structure of the transport industry in the two countries suggest that there are likely to be major differences in inputs per unit of output in the two countries. Owing to lack of statistical data, account could only be taken of these differences for railways and, on a rather crude basis, road passenger transport. Shipping and road freight transport, which are the two most important of the other transport industries, could be only very roughly compared by taking active tonnage and gasoline input indicators respectively. Road freight transport presented particular difficulties because total trucking activity is split between the for-hire trucking industry and trucks owned by establishments in the various productive and distributive industries. A comparison that only covered commercial carriers could give a quite false impression of the transport industry of the two countries and so it was decided that, as in other industries, trucking must be compared on an activity basis.[1] The employment and net output attributable to trucking can, however, only be very roughly assessed, and no meaningful price or output per worker indices can be given. Estimates are in fact included in the totals for the transport sector, which must thus be treated

TABLE 15. NET OUTPUT OF THE RAILWAY INDUSTRY IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950

	DISTRIBUTION OF OUTPUT		QUANTITY RATIO U.K. = 100		PRICE RATIO $ PER £	
	U.K.	U.S.	AT U.K. PRICES	AT U.S. PRICES.	AT U.K. WEIGHTS	AT U.S. WEIGHTS
Gross output	1,521	1,298	1,339	991	3.0	2.2
Input	521	298	792	791	2.5	2.5
Net output	1,000	1,000	1,624	1,067	3.2	2.1
Output per worker			771	505		

with some reserve since trucking accounts for nearly one-third of the total weight in both countries.

The most reliable results obtained in the transport sector are those for railroads, for which relatively good data are available. These show

1. Agricultural trucks are however excluded since these are also used for internal farm operations.

an extremely high relative output per worker in the American industry but there is a considerable spread between the indices at each country's weights owing to the substantial differences in passenger and freight prices and volume in the two countries. American gross output was found to be 10 to 13 times that of the United Kingdom according to the prices used. Since this output was obtained with only 8 times the volume of inputs, net output was even higher—11 to 16 times that of Britain. Employment in the American industry is little more than twice that in the British, so that gross output per worker is 4.7 to 6.3 times, and net output 5.1 to 7.7 times the British level.

This wide difference appears to be largely due to the major differences in scale of operations, equipment, train-loads, and hauls, all of which are of substantially larger average size in the United States. In fact, if wagon-loads and wagon-kilometres are substituted for tons and ton-kilometres in the calculations, gross output per worker is rather less than twice that of the British—a relationship nearer to that found in other sectors.

It would appear that in internal freight transport generally, output per worker in the United States must be roughly five times that of the United Kingdom.[1] We have seen that productivity is also extremely high in the fuel industries which provide the largest input into transport. The effect of these differences is that the United States, in spite of the longer distances and greater volume of transport involved, uses a smaller proportion of its total real resources in meeting the transport needs of industry than does the United Kingdom.

Other Non-manufacturing Industries

The results obtained in the remaining non-manufacturing sectors do not justify giving more detail than that shown in the summary tables. Any further information available is included with the description of methods in the technical appendix. The following paragraphs include only a brief description of points that appreciably affect the interpretation of the results.

CONSTRUCTION

The comparison of construction presented major difficulties, and the results shown are extremely tentative. In the first place this sector presents complex measurement problems because both the product and the methods employed in the industry vary widely between the two countries. In addition, the data available are less complete and less reliable than those for other sectors, and there is a considerable risk of large cumulative errors when the various statistics are combined.

The construction activity compared differs somewhat from the usual national accounts definition. It includes all new construction (including work done by building workers directly employed by firms in other industries) and also repair and maintenance of residential, institutional and government buildings, but excludes repair and maintenance pur-

1. This is a crude estimate only, as there is no sound basis for splitting the labour force of the railways between passenger and freight transport.

chased by industry and commerce. This latter item is treated as an input whose final product is measured by the output of the purchasing industry.

The results obtained were calculated partly as the result of direct estimates of output per worker, which were checked by their consistency with the other data. The rather low output per worker in the United States compared with other industries is partly due to substantially shorter working hours in the United States. Output per man-hour was tentatively estimated as about 190 per cent of that of the United Kingdom.

Distribution

Distribution was measured by the volume of goods distributed, no account being taken of any difference in the quality of the service rendered. With the exception of agricultural and building supplies, intermediate products are excluded. The comparison was based on total distributive activity, i.e. it excludes manufacturing or other work done by distributive firms, but includes goods distributed directly by producers. It was not possible to adjust the net output and employment estimates of the sector to correspond to this definition, but the net error is likely to be very small.

In practice the majority of the indicators used were derived from the various production indices obtained in other sectors selected by excluding intermediate products as far as possible. They were adjusted for imports and exports and weighted by distributive margins, so that the aggregate index is not necessarily the same as for the production of physical goods, although in fact it differs from it by very little. By this method errors in the original production index are carried into the distribution index, but the total margin of error in the latter is somewhat greater since errors may also originate in the adjustments made.

Ownership of Dwellings

This sector corresponds to the housing group in the expenditure series, and includes the net income and depreciation accruing from the ownership of dwellings, whether rented or owner-occupied. Farm houses are included but not commercial or industrial buildings, rent from which is regarded, in principle, as part of the product originating in the user industry.

The comparison was based on that made for the expenditure study,[1] and no adjustment was made for any difference in inputs in the two countries. Conceptually, however, the net rent measured in this sector excludes repair and maintenance, insurance, management, etc., and there is, therefore, no employment in the sector.

Consumer Services, Health, Education and Government

Private domestic service, and the personnel elements of health, education and government expenditures were treated as direct purchases

1. Gilbert and Kravis, *op. cit.*, pp. 140-155.

of labour service in the expenditure study, and so the same data are used here. No adjustment was made for any differences in output per worker. The various consumer services were also measured mainly by the same indicators as in the expenditure study—partly price ratios applied to gross output, and partly by employment. For commercial services some adjustment for differences in output per worker was made on the basis of results derived from the price comparisons, but the adjustment was small and was only applied to trading and repair services. As mentioned above, no output per worker index can be shown for these groups since the comparisons rest largely on an assumption of equal productivity.

Business and Financial Services

Business and financial services were assumed to move with the total real product (excluding government). The greater part of this group consists of intermediate services which do not contribute directly to final output, and for these the method adopted has the same result as if all these activities were performed by direct employees of the industry purchasing the service. Institutional differences between the two countries in this respect are thus eliminated. It would have been preferable to transfer the relatively small item of financial services to consumers from this sector to the main services industries sector, but in view of the great difficulty of finding indicators to measure financial services and of dividing them between business and final users on a comparable basis in both countries, this could not be done. Their inclusion here is rationalised on the assumption that they may be a function of real income.

As far as business services are concerned, the method used does not require the assumption that the volume of such services per unit of real product is identical in the two countries, but merely that as intermediate products their contribution to final output is fully measured by the production of the user industries. It follows that output per worker indices for this sector by itself are meaningless, but the inclusion of this employment in the total index corrects the final total by adding a certain volume of indirect employment to the direct employment already measured.

V

LABOUR PRODUCTIVITY

In the last two chapters, we have considered the results obtained for the various economic sectors and major manufacturing groups. These results include, in addition to indices of real net output and net costs, information concerning relative output per worker in the two countries. It is now proposed to consider this latter item, i.e. labour productivity, in somewhat more detail, discussing both the significance of global productivity ratios of the kind obtained, and the implications of the results.

Overall Productivity Levels

We found that, for the economy as a whole, output per worker in the United States was about twice as high as that in the United Kingdom —213 per cent when weighted at British prices, and 175 per cent at American price weights. In manufacturing industry, for which a rather more precise content can be given to the concept of labour productivity, the American advantage is higher, the indices being 292 at British prices and 256 at American prices.

Three main factors account for the fact that the American advantage is lower for the economy as a whole than that for the manufacturing sector only. In the first place, relative output per worker is less favourable to the United States in agriculture, construction, distribution and services, where scope for mechanisation and labour economy are smaller than in most of the manufacturing industries. Secondly, the United States uses more fuel and freight transport per unit of output as inputs into other industries than the United Kingdom, and this factor virtually offsets its productivity advantage in the fuel and transport sectors. In fact, after the deduction of fuel and transport inputs the influences on the aggregate index of high American productivity on the one hand and low British utilisation of fuel and transport on the other, almost offset each other. Thus the proportion of the labour force used in meeting these input requirements is almost the same in both countries. Finally, relative American output per worker for the whole economy is somewhat reduced because the United States employs a larger proportion of its labour force in sectors with a relatively low *per capita* net output.[1] The

1. See L. Rostas, *Comparative Productivity in British and American Industry*, Cambridge University Press, 1948, pp. 90-91.

second of these three points was discussed in the fuel section of Chapter IV above, and the other two items will be considered more fully below.

Comparison with Results of Other Studies

Earlier statistical investigations of labour productivity in the United Kingdom and the United States have been limited almost entirely to selected manufacturing industries. They indicate, however, that (at any rate in the manufacturing sector) substantial differences in labour productivity in the two countries are no new phenomenon—they have certainly existed for the whole of the present century, and possibly for considerably longer.[1] In 1925, Taussig drew attention to major differences in physical output per head in various basic industries, including coal mining, iron and steel, tin plate, cement, sugar refining and flour milling.[2] Flux[2] shows that similar differences existed after the first world war on the basis of comparisons for 1924-25. No general comparison covering a major part of industry was made, however, until Rostas published his survey based on census data for the period immediately prior to World War II.[1] This study covered 31 industries which accounted for "about half of the value of net output in Britain, and two-fifths of the value of net output in U.S. manufacturing industry". More recently, somewhat similar comparisons for 1947-48 have been made by Frankel,[1] but these are restricted to more narrowly defined product groups, so that although 34 such groups are covered, they account for only 16 to 18 per cent of manufacturing employment.

The results obtained in the present investigation do not change the broad picture presented by Rostas and Frankel. In fact, in view of the differences in method and the much greater coverage of this study, the manufacturing averages are surprisingly close. The Rostas and Frankel comparisons were, for practical reasons, limited to industries producing reasonably homogeneous products and some doubt remained whether such industries really provided a typical sample for the whole manufacturing sector.

Here the necessity of obtaining comprehensive coverage has forced us to be bold. The manufacturing comparison identified 146 separate industries for about 120 of which independent estimates of output per worker were made. There was great variation in the quality of the comparisons which could be made, but the average of the results for the 44 most reliable industries is almost identical with the general manufacturing average.[1] Moreover, the comparisons include fairly detailed studies of industries with highly heterogeneous products, such as certain chemical and engineering industries, which had received but slight attention previously. It is encouraging to observe that this extension of the investigation does not materially change the manufacturing average from that given by a smaller sample of industries. Thus the mean obtained by Frankel for his 34 product groups is 269 (U.K. = 100) when weighted by American employment, and 274 weighted by British employment, both being within the spread of 252 to 296[2] (weighted by net output) obtained in the present study.[3] Similarly, the averages obtained by Rostas for the pre-war period, of 212 to 224 per cent (U.K. = 100) appear to be broadly consistent with the later estimates, when account is taken of the more rapid growth of American productivity in the subsequent decade.[4]

1. Frankel estimates that American manufacturing productivity was probably equal to that of Britain by about 1830, and has been higher ever since. This is a highly tentative estimate subject to a wide margin of error, but it gives an indication of the historical nature of the problem. See M. Frankel, *British and American Manufacturing Productivity*, University of Illinois, 1957, p. 29.
2. F. W. Taussig, "Labor costs in the United States compared with costs elsewhere". *Quarterly Journal of Economics*, November 1924.
3. A. W. Flux, "Industrial Productivity in Britain and the United States". *Quarterly Journal of Economics*, November 1933.
4. Rostas, *op. cit.*
5. Frankel, *op. cit.*

Definitions and Concepts

Before proceeding to a more detailed examination of the results, it is necessary to consider a little more precisely the concepts underlying the output per worker indices of the present study. Our objective has been to present a comparison of the total real product in the two countries, and the indices of output per worker obtained are a by-product of this task. The indices obtained are global and aggregative. They reflect all the factors influencing productivity ; compare industries not products ; and cover all the plants in an industry, and all the sectors of the economy. In this they contrast sharply both in purpose and in interpretation with plant level productivity studies, which are based on a sample of plants, selected with some particular objective in mind, usually the isolation of those factors that, because they can be controlled by industrial and economic policy, enable the less productive country to learn from the more productive. The global approach includes of necessity *all* the factors affecting output per worker and consequently the indices bear little relevance to the concept of productivity as determined mainly

1. See Table 17 below. The indices for the other industries are considered sufficiently reliable to make an independent contribution to the total result, but do not justify individual analysis.
2. The advantages of a comprehensive coverage are indicated, however, by the fact that Frankel himself appears to consider (*op. cit.*, p. 18) that his result is raised unduly by the large weight given in the sample to the atypical motor vehicle industry. In fact this is not the case.
3. Detailed comparison of Frankel's results with those in the present study is unrewarding. Differences arise from the fact that his investigation is based on *product groups* for 1947-48 and ours on *industries* for 1950, but reconciliation after allowing for this difference does not provide independent confirmation, since both studies are subject to the basic limitations of the census data. Moreover, arbitrary decisions have to be made to allow for differences in quality and product mix (see Frankel *op. cit.*, pp. 21-22, for an account of the effect of such differences in the motor vehicle industry), and the effect of individual decisions of this kind is larger in the relatively homogeneous product groups Frankel has selected, than in more heterogeneous industries for which a larger range of indicators is required.
4. It must be emphasised that on account of the substantial differences in coverage, methods, and weighting, the differences between Rostas' results and the results obtained for the post-war period cannot be used to derive any precise measure of differences in the rate of growth of productivity in the two countries.

by technical and individual efficiency. They give a more comprehensive survey of actual productivity differences, and show how different industries contribute to aggregate differences in real output per person employed, but they can offer less direct advice to industry and technicians.

The measurement of output is almost entirely determined by the requirements of the real product comparison, and is discussed more fully in the following two chapters. Here it is sufficient to note that, in principle, a comparison of total final output by industry requires the measurement of the *net* output of each industry, taking account of differences in purchased inputs from other sectors, regardless of whether these are the result of substitution between external purchases and work done in the industry, or purely circumstantial (as in the case of additional freight requirements). On this basis we obtain a measure of output per worker which takes account of all factors influencing total productivity, whether these arise within the industry or externally. We have then the advantage that the results are directly related to real costs, and that our decisions on particular items are made within a clearly defined conceptual framework. In particular cases these decisions may, however, differ quite substantially from those made in productivity investigations, such as those of Rostas and Frankel, whose main object is to derive, from global data, results approximating more closely to an efficiency concept of labour productivity.[1]

In the non-manufacturing sectors the practical effect of the net output concept outlined above is considerable, but the structures of the industries in the two countries differ so substantially that a global statistical comparison of the type made here appears to be the only meaningful one. In the manufacturing sector, real differences in inputs per unit of output are smaller, and no attempt was made to adjust for them in the individual industries.[2] The comparisons made are still of net output per worker but only in the more limited sense that weights and units of measurements for individual items are selected to measure as nearly as possible the volume of work done in the industry, and not the total value of the end products. For the manufacturing industries, therefore, the results obtained approximate more closely to a technical concept of productivity, based on comparing identical processes and the comparison of net output in this more restricted sense gives a better basis for labour productivity comparisons than would, for example, a comparison of gross output, which ignores differences in the relative value added of the various products.

Before leaving the discussion of net output, it must be emphasised

1. Thus a comparison of the "efficiency" of British and American public bus services might well show an advantage to the United States, because labour requirements are mainly connected with the vehicle miles run, and the labour input per vehicle mile is smaller in America. The real output of the industry does not, however, correspond to the number of vehicle miles, and can be better measured by the number of passenger miles ; moreover real *net* output must take account of the fact that, when fewer passengers are carried per bus, inputs of fuel and other items per passenger mile are greater. On this basis the British industry shows a much higher real *net output* per worker than the American as a result of the more intensive utilisation of its services.

2. Adjustments were made for differences in fuel and transport, on an aggregate basis, but the results for individual industries and major groups take no account of differences in inputs of these items.

that the indices given in the report show the relationship between employment and the total net output of each industry. No account is taken of differences in utilisation of capital, land, or other factors of production employed within the industry. For many purposes, this concept is the most useful one since differences in the *per capita* real product and standards of living depend ultimately on net output per unit of labour. Even from this standpoint, however, account should be taken of differences in the indirect labour input required for the replacement of capital.[1] This would, however, have required the comparison of Net National Product (exclusive of depreciation) rather than that of the Gross National Product on which this study is based.[2]

The measurement of employment presents fewer conceptual problems, but there are certain practical alternatives in the definitions chosen. In the first place, output can either be related to the total number of employees, including supervisory staff and salary earners, or to the number of operatives alone. The use of direct labour only has certain advantages in plant level comparisons, but it seems clear that for a global comparison total employment is the most useful basis inasmuch as total output is determined by both direct and indirect employment. Statistically also, the use of total employment is preferable, because the available figures have a higher degree of comparability.

Moreover, output has been related solely to the number of workers, with no adjustment for differences in hours worked. The indices thus measure output per man-year, and not per man-hour. There are major practical obstacles to the latter comparison as data are available only for rather broad industrial groups, and in addition it is difficult to ensure that the same definitions are observed in both countries in respect of meal breaks, paid holidays, sick leave, etc.[3]

We have already seen that in construction the hours worked in the United States in 1950 were only about 80 per cent of those in the United Kingdom. In other industries, United States hours were also shorter but the difference was rather less marked. For manufacturing as a whole, average hours worked in the United States were 40.5 per week, compared with 45.7 in the United Kingdom, so that output per man-hour for the sector as a whole would be even more favourable to the United States, about 330 or 290 per cent according to the weights used. This is, however, a rough estimate, and substantial variations may exist among the individual manufacturing industries.

Finally, it must be emphasised that the output per worker index is a statistical ratio rather than an analytical concept. It measures the full difference in labour input per unit of output whether arising from personal efficiency, variations in the quantity and quality of capital, differences in management and organisation, or factors quite external to the industry, such a natural resources and the size of the market served.

1. See Rostas, *op. cit.*, p. 3.

2. This would present a large number of practical difficulties of measurement and comparability. See Gilbert and Kravis, *op. cit.*, p. 62.

3. See "Methods of Labour Productivity Statistics ", I.L.O., Geneva, 1951, Chapter I.

In Chapters III and IV above, output per worker indices for the main economic sectors and the 19 major manufacturing groups were discussed in conjunction with other results obtained in the comparison. In the following paragraphs some of the implications of productivity differences in the major manufacturing groups are considered more fully, and results are also given later (in Table 17) for a selected number of individual industries.

Manufacturing Sector : Major Groups

The output per worker indices within the manufacturing sector are widely dispersed. Even the indices for major groups, where dispersion is already substantially reduced by aggregation, range from 160 (U.K. = 100) for leather and leather products, to about 400 or 500 (according to the weights used) for automobiles. Even if these two extreme groups are omitted, the range of indices for the remaining groups is still wide—from about 170 to about 350.

In Chapter III it was pointed out that throughout the manufacturing sector there is a rather close connection between relative output per worker and net cost ratios. The effect of productivity differences upon relative net costs may be seen from Table 16 in which output per worker indices, wage ratios, and relative "unit labour costs" are shown for each individual major group. Relative unit labour costs are arrived at by dividing the wage ratio by the output per worker index, and thus obtaining a ratio (expressed in $ per £) of the labour component of net costs. Labour costs, in both countries, account for roughly two-thirds of total net output, the balance being made up of capital costs (interest and depreciation) and profits. Relative unit labour cost is thus the largest factor in determining the total net cost ratio.

TABLE 16. THE RELATIONSHIP OF OUTPUT PER WORKER UNIT LABOUR COSTS AND NET COSTS FOR MAJOR MANUFACTURING GROUPS IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950

	WAGE RATIO $ PER £	AT U.K. WEIGHTS			AT U.S. WEIGHTS		
		OUTPUT PER WORKER U.K. = 100	UNIT LABOUR COST	NET COST RATIO	OUTPUT PER WORKER U.K. = 100	UNIT LABOUR COST	NET COST RATIO
			$ PER £			$ PER £	
	1	2	3	4	5	6	7
Food Manufacturing	9.79	206	4.74	4.66	184	5.32	5.22
Beverage Industries	9.57	274	3.49	3.37	259	3.69	3.57
Tobacco Manufactures	7.16	251	2.86	2.66	251	2.86	2.66
Textiles	9.87	227	4.35	3.32	204	4.84	3.69
Clothing and Footwear	9.57	179	5.34	4.95	172	5.57	5.17
Lumber and Furniture	7.48	309	2.42	2.78	261	2.87	3.29
Paper and Products	10.72	391	2.74	2.64	388	2.77	2.66
Printing and Publishing	10.10	258	3.91	3.82	256	3.94	3.84
Leather and Products	7.90	161	4.89	3.83	160	4.93	3.86
Rubber Products	10.16	249	4.09	4.07	238	4.27	4.25
Chemicals	9.33	364	2.56	3.42	349	2.68	3.57
Non-metallic Mineral Products	8.00	263	3.05	4.02	237	3.38	4.46
Basic metals	9.51	266	3.58	3.54	263	3.62	3.58
Metal Products	10.78	297	3.63	3.88	281	3.84	4.11
Machinery (excl. Electrical)	10.10	353	2.86	2.79	294	3.44	3.35
Electrical Machinery	9.78	336	2.91	3.40	306	3.20	3.74
Automobiles, Trucks, Tractors	9.44	524	1.80	2.20	415	2.28	2.78
Other Transport Equipment	10.02	260	3.85	3.71	173	5.80	5.59
Miscellaneous Industries	9.74	290	3.36	3.93	282	3.45	4.03
Total (before adjustment for fuel inputs)	9.55	290	3.30	3.38	248	3.85	3.95

Average wage ratios for the major groups show rather little variation and for 14 of the 19 groups fall within the range of $9.3 to $10.8 per £. At least three of the four groups outside this range are subject to special environmental or structural factors which give the American worker a smaller advantage in wages in these groups than in manufacturing as a whole.[1] The factors affecting relative wage differences have little direct connection with productivity, and over manufacturing as a whole not only are wage ratios much more narrowly dispersed than the output per worker indices but they show no significant correlation with them. Relative unit labour costs, therefore, show much the same range as the productivity indices and vary from $2.3 to $5.8 per £.

Table 16 shows clearly the importance of relative unit labour costs in determining the net cost ratios. In 11 of the 19 major groups the net cost ratios are within 10 per cent of the unit labour cost ratios, and for 8 of these the difference is less than 5 per cent. Of the 8 major groups for which the ratios differ appreciably, two (non-metallic mineral products and the miscellaneous industries group) are heterogeneous groups with important structural differences in the two countries so that the results are of limited analytical value.[2] The remaining groups show a consistent pattern in that low unit labour costs, resulting from exceptional productivity advantages, reduce total net cost ratios, but not proportionately, so that the net cost ratios are nearer to the manufacturing average. Thus in four of the groups where the United States has a considerable advantage in productivity and unit labour costs (automobiles, lumber and furniture, electrical machinery, and chemicals) the reduction in labour costs is not fully matched by savings in other net costs, and total net cost ratios are less favourable. In the first three groups mentioned the difference is not very great, but in the chemicals group it is quite substantial. This is not surprising, for capital charges and research and development costs are major components of net costs in the

1. Thus in two of the groups, tobacco products and lumber and furniture, relatively low American wages result from the wider regional and rural/urban wage differentials in that country. The lower *average* wage for the leather and leather products group results from the fact that by comparison with Britain proportionately less of the American labour force is employed in the relatively high-wage tannery industry and more in the low-wage leather products industry. The remaining group, non-metallic mineral products, is probably affected to some extent both by geographic differentials and differences in the distribution of labour in the two countries.

2. In both of these, relative unit labour costs are somewhat more favourable to the United States than the manufacturing average, but net cost ratios are relatively favourable to the United Kingdom.

chemical industries, and wages constitute a smaller share of net costs than in manufacturing as a whole. Similarly, in two groups where the United Kingdom has a substantial advantage in unit labour costs, textiles, and leather and leather products, net cost ratios are less favourable.[1] It is noticeable, however, that in the two groups (food manufacturing and clothing) where the British advantage in labour costs is greatest, net cost ratios and relative unit labour costs are extremely close.

Manufacturing Sector : Individual Industries

Productivity indices for the individual manufacturing industries are dispersed over a range extending from about 100 to 500 (U.K. = 100). The distribution of the indices within this range is shown in Figure 3. This chart includes all the industries for which separate comparisons were made,[2] although some of the comparisons were extremely crude. The distribution of indices for the 44 more reliable industries included in Table 17 below does not, however, differ markedly from that of the total.[3] About 85 per cent of all the 119 industries fall within a range of 150 to 410 (U.K. = 100) and 56 per cent within a range of 185 to 335. For the 44 most reliable industries the corresponding proportions are 80 per cent and 56 per cent.

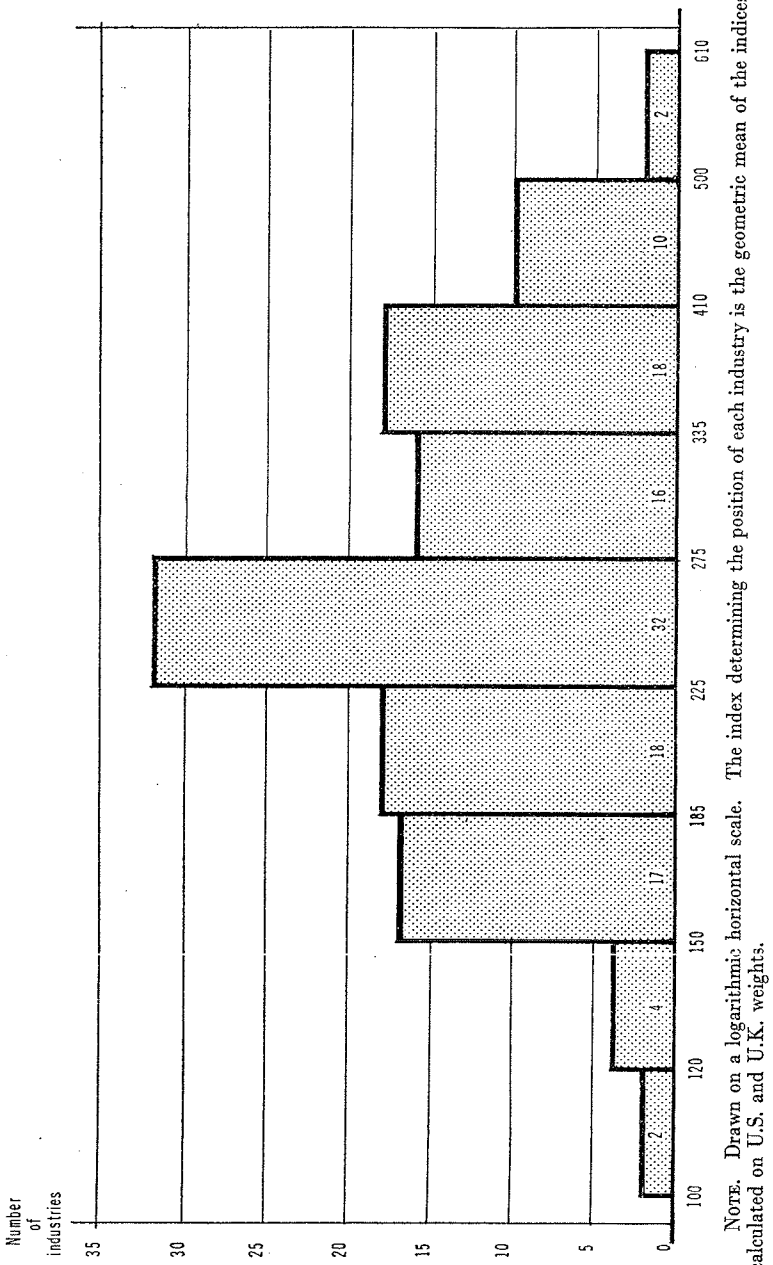
Data corresponding to those for the 19 groups are given in Table 17 for 44 selected industries for which the individual results were considered fairly reliable.[4] These 44 industries account for 51 per cent of total manufacturing net output in the United Kingdom, and 48 per cent in the United States. Although selected solely according to reliability they appear to form a fairly representative sample as the average ratios of productivity, wages and unit labour costs are almost identical with those for all industries.

The industries are arranged in a productivity ranking, those for which the United Kingdom has a relatively high productivity advantage at the top, and those most favourable to the United States at the bottom.[5] As in Table 16, relative unit labour costs are arrived at by dividing the output per worker indices by the wage ratios of the individual industries.

In only two industries, cement and shipbuilding, are the absolute

1. In textiles the difference is considerable but the reasons for this are less obvious than in the chemicals group.
2. Excluding the three non-fuel mining industries which were included with the manufacturing sector merely for convenience.
3. There is, however, an under-representation in the 275- and 335-groups.
4. In selecting these industries, three criteria had to be considered : (a) that the output comparison was relatively good ; (b) that the employment estimates were not liable to substantial errors resulting from reclassification difficulties ; and (c) that industries where productivity had been assumed similar to that in associated industries were excluded. It should be noted that only the first of these criteria seriously affects the aggregated indices for major groups and the whole manufacturing sector, as errors in (b) are offset in aggregation and (c) is a problem of independence rather than accuracy. Thus the comparisons for many industries which are fairly reliable as contributions to the overall indices were not considered sufficiently reliable to warrant individual analysis.
5. For about two-thirds of these industries no index spread could be measured within the industry. To simplify presentation and ranking, therefore, the geometric mean of the indices calculated at British and American weights is shown as the result for those industries for which different results were obtained on the two sets of weights.

Figure 3. THE DISTRIBUTION OF THE PRODUCTIVITY INDICES FOR 119 MANUFACTURING INDUSTRIES IN THE UNITED STATES RELATIVE TO THE UNITED KINGDOM IN 1950 (U.K. = 100)



NOTE. Drawn on a logarithmic horizontal scale. The index determining the position of each industry is the geometric mean of the indices calculated on U.S. and U.K. weights.

Source : All the independent comparisons made in the study. For details of the majority of these comparisons, see the Industry Tables in Appendix B.

TABLE 17. THE RELATIONSHIP OF OUTPUT PER WORKER UNIT LABOUR COSTS, AND NET COSTS FOR 44 SELECTED MANUFACTURING INDUSTRIES IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950

		SHARE OF TOTAL VALUE ADDED IN MANUFACTURING		WAGE RATIO $ PER £	OUTPUT PER WORKER[1] U.K. = 100	UNIT LABOUR COST[1] $ PER £	NET COST RATIO[1] $ PER £
		U.K.	U.S.A.				
		1	2	3	4	5	6
1.	Shipbuilding and repairing	27.1	4.4	8.99	111	8.10	8.02
2.	Cement	3.5	4.1	7.56	116	6.52	5.72
3.	Sugar factories and refineries	3.4	2.3	7.81	148	5.28	4.65
4.	Tanneries	7.6	4.0	9.04	168	5.38	3.70
5.	Outerwear and underwear	33.5	38.2	10.16	170	5.98	5.35
6.	Footwear, except rubber	12.1	10.7	8.05	171	4.71	4.40
7.	Grain mill products	6.3	6.3	8.78	183	4.80	6.25
8.	Woollen and worsted	32.0	8.1	10.17	185	5.50	3.35
9.	Knitting mills	13.9	11.6	9.14	187	4.89	3.59
10.	Tools and implements	4.6	3.2	10.41	190	5.48	5.70
11.	Cutlery	2.4	1.4	9.47	193	4.91	4.17
12.	Structural clay products	9.9	4.6	8.04	197	4.08	4.98
13.	Iron and steel foundries	25.3	19.8	9.28	202	4.59	3.98
14.	Ball and roller bearings	3.7	3.1	9.89	208	4.75	4.46
15.	Metal-working machinery	13.4	14.3	11.08	221	5.01	4.59
16.	Rayon, nylon, and silk	14.2	11.9	9.58	226	4.24	3.54
17.	Canning and preserving of fruits and vegetables	6.1	10.8	8.94	235	3.80	4.08
18.	Generators, motors, and transformers	12.1	12.5	9.98	239	4.18	4.66
19.	Tyres and tubes	4.4	7.7	10.14	241	4.21	4.38
20.	Wirework	3.7	7.4	10.42	244	4.27	4.09
21.	Soap, candles, and glycerine	5.2	7.1	11.01	249	4.42	5.81
22.	Cotton spinning and weaving	34.6	19.5	9.28	249	3.73	2.80
23.	Rubber products, except tyres and footwear	7.3	9.1	10.13	250	4.05	3.93
24.	Tobacco manufactures	13.5	9.2	7.16	251	2.85	2.65
25.	Linoleum and leathercloth	2.2	1.9	9.09	256	3.55	3.77
26.	Bolts, nuts, rivets, screws	5.8	6.9	12.23	256	4.78	5.23
27.	Steel works and rolling mills	41.6	39.3	8.79	269	3.27	3.38
28.	Glass containers	3.0	3.1	9.04	274	3.30	4.16
29.	Breweries and manufacturing of malt	18.9	10.9	11.18	300	3.73	3.77
30.	Pulp, paper and board	12.8	21.2	10.21	338	3.02	2.97
31.	Wire drawing	3.9	3.0	9.58	339	2.83	3.11
32.	Electronic tubes	0.7	3.5	10.94	355	3.08	4.85
33.	Electric light bulbs	1.2	2.2	10.98	356	3.08	3.87
34.	Paint and varnish	7.5	7.1	9.80	363	2.70	2.55
35.	Basic industrial chemicals	32.7	30.7	9.47	372	2.55	3.22
36.	Matches	0.6	0.4	10.56	376	2.81	2.46
37.	Radio	10.4	12.8	9.48	400	2.37	2.91
38.	Blast furnaces	4.5	5.0	8.28	408	2.03	3.70
39.	Storage batteries	1.7	1.4	9.13	411	2.22	2.10
40.	Electrical household equipment	4.2	6.1	11.06	412	2.68	3.59
41.	Containers, paper and card	8.9	11.5	11.46	428	2.68	2.29
42.	Agricultural machinery, except tractors	3.8	5.5	9.58	429	2.23	2.24
43.	Automobiles, trucks, and tractors	43.6	76.1	9.42	466	2.02	2.47
44.	Metal cans	2.2	3.9	13.36	561	2.38	3.10
	Selected manufacturing industries	510.0	483.9	9.53	267	3.57	3.58
	Other industries	490.0	516.1	..	..	..	..
	Total manufacturing before adjustment for fuel inputs	1,000.0	1,000.0	9.55	268	3.56	3.65

1. Geometric mean of U.K. weighted and U.S. weighted data.

levels of productivity about the same in the two countries. In view of the difference in wage levels this gives the United Kingdom a major advantage in relative unit labour costs and net costs. In shipbuilding, which is highly labour intensive, both these ratios are about $8 per £, but in the cement industry the British advantage is smaller, partly because the wage ratio is less favourable and partly because it is a capital-intensive industry in which non-wage costs constitute a larger share of the total.

In 12 of the 44 industries the index of output per worker lies between 150 and 210 (U.K. = 100) compared with the manufacturing average of 269. Thus the United Kingdom has a substantial cost advantage in about a third of the industries covered, when account is taken of the difference in wage levels, and unit labour costs for all but one of the group are above $4.6 per £. Net cost ratios are also favourable to Britain and are at or above $4.2 per £, except in the textile industries and tanneries where the non-wage element appears to be substantially higher in Britain than in the United States.

These 12 industries include several important British export industries, such as the woollen and worsted industry, knitting mills and the tool and cutlery industries. It would appear that productivity in a number of other traditional export industries (such as those producing textile machinery, sewing machines, pottery and china, and linen and jute) falls within the same range, but the comparisons in these cases are less reliable. The group also includes iron foundries, whose costs play an important part in determining the total prices of engineering and metal products, and a number of major industries mainly concerned with supplying internal markets, e.g. the clothing and footwear industries, grain mills, sugar refineries, and the structural clay products industry.

Indices for a further 14 industries ranging from 220 to 274 (U.K. = 100) are somewhat more favourable to the United Kingdom than the manufacturing average of 268, but are close to the median which is about 250 both for the 44 selected industries and for all industries. The most important item in this group is the steelworks and rolling mills industry, whose productivity index is practically identical with the manufacturing average. The group includes various industries in which both countries are competitive in world markets, such as cotton textiles (for which the net price ratio is extremely favourable to the United States), metal working machinery, and motors and generators, and also tyres and tubes, other rubber products, and tobacco manufactures.

The productivity indices for the remaining 16 industries range from 300 for breweries, to 560 for metal cans, but 13 of these fall within the range of about 340 to 430 (U.K. = 100). In all of these the United States has a substantial productivity advantage, and in spite of the higher American wage levels relative unit labour costs for 13 of the 16 are equal to, or below, the official exchange rate. In five industries (blast furnaces, and those producing automobiles, storage batteries, radios and agricultural machinery) unit labour costs are less than $2.4 per £. The group also includes basic chemicals, paint and varnish, pulp and paper, paper containers, and electrical household equipment. Less reliable comparisons indicate that the American productivity advantage is of the same order of magnitude in the industries producing laundry,

office, and refrigerating machinery, heating and cooking equipment and pharmaceuticals.

Among the 44 selected industries the productivity indices show a coefficient of dispersion of 41 per cent if measured at United Kingdom weights[1] but the coefficient of dispersion of the wage ratios is 10 per cent, which is small compared with that of the productivity indices. Furthermore, the wage ratios show no significant correlation with the output per worker indices. This is not surprising as relative wage rates are in part determined by institutional factors, such as the proportions of male, female and juvenile labour, labour organisation and the geographical location of the industry.[2]

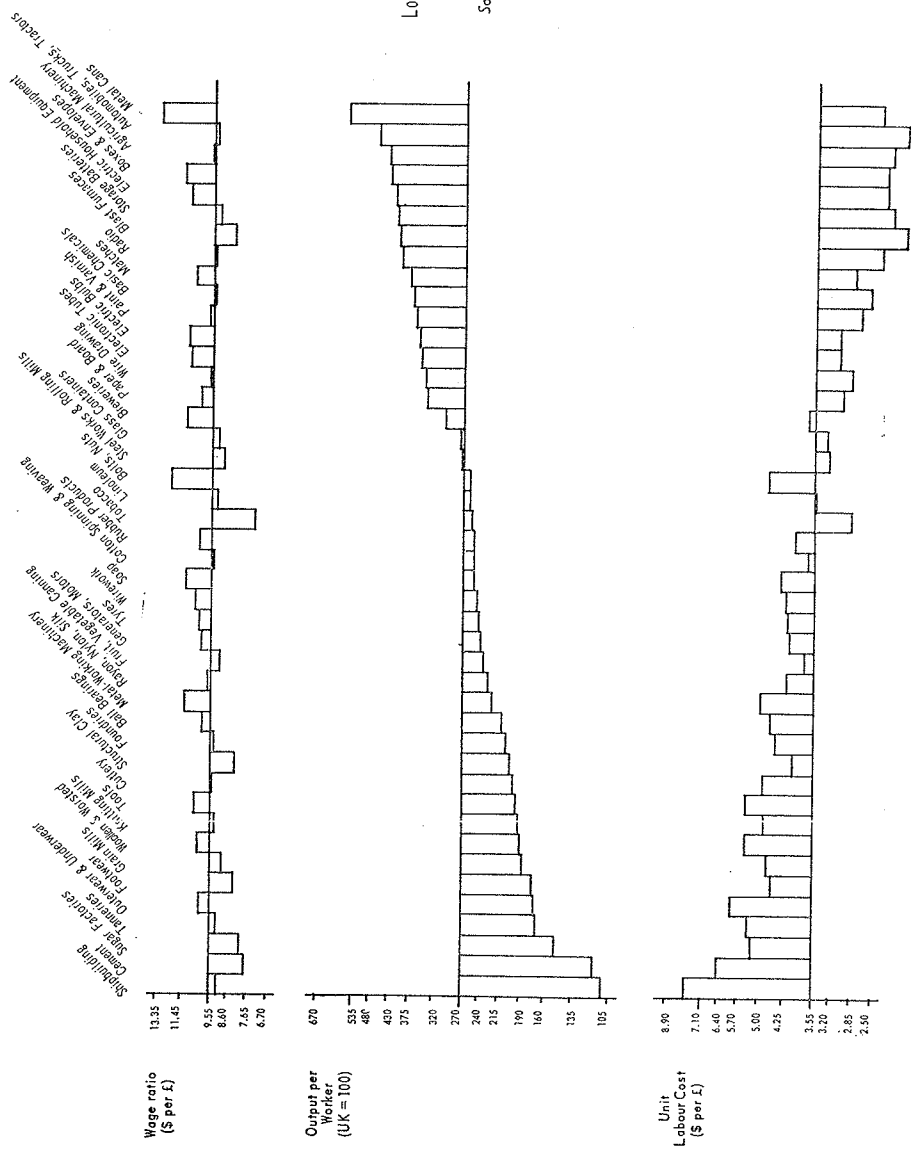
Consequently relative unit labour costs show a coefficient of dispersion of 40 per cent which is almost identical to that of the productivity indices. The contribution of wages and productivity differences to unit labour costs is illustrated in Figure 4, which shows, on a logarithmic scale, the deviations of the individual industries from the manufacturing average.

The coefficient of dispersion of the net cost ratios is somewhat lower than that of the relative unit labour costs—36 per cent compared with 40 per cent. Moreover, net cost ratios are dependent upon both relative labour costs and relative non-wage costs, but as for most industries labour costs are the larger part of net output a considerable degree of association between the net cost ratios and relative unit labour costs is to be expected. For the selected group of industries as a whole the two ratios are almost identical, but it can be seen from Table 17 that the differences between relative unit labour costs and net cost ratios vary from industry to industry and are quite large in some cases. Only tentative inferences can be drawn from these differences because the influence of non-wage costs on the net cost ratio depends not only on variations in the relative non-wage cost of the two countries, but also on their share in the total for the particular industry.[3] In addition the net cost ratios shown are for technical reasons subject to a wider margin of error than the other data in Table 17.[4]

Subject to these limitations it would appear that there is a tendency for the cost advantage gained from the effect of high relative productivity to be reduced by the inclusion of non-wage costs, i.e. that high productivity is associated with high non-wage costs *per worker*. It is not, however, clear from the data available whether this implies that a productivity advantage is associated with a higher expenditure on non-wage items

1. This is arrived at by dividing the weighted standard deviation by the weighted average of the individual ratios (i. e. the aggregate ratio for the group). United Kingdom net output weights were used throughout.
2. This last point is particularly important in the United States where regional and urban/rural wage differences are greater than in Britain.
3. This is determined largely (but by no means entirely) by the degree of capital intensity ; thus in both countries the weight attributable to non-wage costs in the highly capital-intensive cement industry is more than twice that in the highly labour-intensive shipbuilding industry.
4. This is because they are subject not only to the same limitations as the productivity and unit labour cost indices in respect of the general accuracy of the comparisons, but are also affected by particular difficulties in estimating the non-wage elements of net output for individual industries. (See Appendix B, Introduction.)

Figure 4. CONTRIBUTION OF RELATIVE BRITISH AND AMERICAN PRODUCTIVITY AND WAGES TO UNIT LABOUR COSTS FOR 44 MANUFACTURING INDUSTRIES IN 1950



(e.g. capital equipment) or whether it merely indicates that the saving in labour costs resulting from high productivity is not fully matched by savings in other items.

The Significance of Labour Productivity Comparisons

The Relationship between the Factors Determining Productivity

So far we have described only the facts that emerge from the productivity comparisons made. These measured productivity solely in terms of real net output per worker. A causal analysis needs to take account of the various factors determining productivity, and in time series one of the most useful methods of analysis has been based on sub-dividing these factors into three categories : labour, real capital, and "technical progress". In this context technical progress is a residual group covering all the remaining factors influencing productivity. Among the most important of these are the level of technology, types of organisation and management, the degree of standardisation of products, production control techniques, size of market, etc. Various empirical investigations have been made, based on this analysis. Solow, for example, considered these three elements determining increases in total productivity, and found that, in the private non-farm sector of the United States economy, in the period 1909-1949, the growth in productivity attributable to technical progress alone was 81 per cent (i.e. about 1.4 per cent per annum).[1]

In comparisons between countries at a single point in time the same three classes of factors are equally appropriate, but in international comparisons the residual group, corresponding to technical progress in time series, requires more careful consideration. Differences in natural resources constitute an important item in this group. We have already seen that in the comparison between the United States and the United Kingdom natural resource differences are the predominant factor in some of the non-manufacturing sectors, and their effect, through variations in quality and cost of raw materials and fuels, is also important in a number of manufacturing industries. Differences in historical, environmental and institutional factors also play a large part. There remain, however, important differences in the level of technology and organisation which are more difficult to explain between countries than over time, inasmuch as the greater part of the technical knowledge of a particular period is available to all developed countries.

The main difficulty in an empirical application of this kind of analysis is that of finding appropriate comparable measures of the quantity of capital available in different countries.[2] This difficulty has so far made a complete interspatial analysis impossible, but some rather general inferences can be drawn respecting the results of such an inves-

1. R. Solow, "Technical Change and the Aggregate Production Function". Review of Economics and Statistics, Vol. 39 (1957), pp. 312-320.

2. Attempts have been made to compare capital available in Britain and the United States for the pre-war period in terms of horsepower available (Rostas, *op. cit.*) and for the post-war period by relative fuel consumption (Frankel, *op. cit.*). The indicators, however, although they are the only ones available, constitute extremely crude measures of capital availability in developed countries.

tigation. Various studies have shown the differences in capital/output ratios both between countries and over time to be surprisingly small. Larger real variations may, of course, be concealed by differences in price structures[1] and in the definitions used, but it is clear that, at any rate for relatively developed countries such as the United States and the United Kingdom, the differences in capital/output ratios are extremely small by comparison with the differences in output per worker.

It would seem that, although output per worker in the United States is rather more than 2½ times that of the United Kingdom, output per unit of capital employed may be about the same in the two countries. Thus it follows that capital available per worker in the United States may also be about 2½ times that in the United Kingdom, but it would, of course, be quite incorrect to argue from this that the higher productivity of American industry is attributable predominantly to a larger capital input. The productivity advantage of the United States, related to both capital and labour inputs, would, of course, be below that shown by the simple output per worker index relating to labour input only. The important factor is, however, that owing to the various technological and natural resource differences referred to above, the combination of capital and labour employed in the United States has a higher productivity than the combination of capital and labour used in Britain.

The Relationship between Productivity and Scale of Production

Another factor that has provoked considerable discussion is the question of the scale of production. It has often been observed[2] that, over time, there is an association between rapid growth in the tota' output of particular industries, and rapid increases in productivityl The causal factors here are obviously interrelated. On the one hand, increases in total production stimulate productivity both by enabling increased economies of scale and, as a result of an increase in the proportion of new plants, enable more use to be made of the most modern equipment and technology. On the other hand, increases in productivity must lead to an expansion of output through the effect of reduced costs upon demand.

The connection between high relative productivity and high relative total production is also evident in interspatial comparisons, and the marked association of the two factors is a striking result of the present investigation. Among the 44 selected manufacturing industries there is a rank correlation of + 0.789 between the output per worker indices and the volume indices.[3] The relationship is naturally of greater interest at the extremes of the distribution, because in the middle of the distribution there are only small quantitative variations which may not be significant, and which would in any case be too small to have causal influence.

It is for this reason that only the two extreme quartiles of the distri-

1. e.g., in a less developed country the prices of capital equipment are usually relatively high, so that the capital/output ratio would be higher in its own price structure than in that of a more highly developed country.

2. See, for example, P. J. Verdoorn, *On an Empirical Law Governing the Productivity of Labour*, Econometrica, Vol. 19, No 2, April 1951, page 209.

3. This correlation is calculated on Spearman's formula.

bution of the 44 industries are shown in Table 18, from which the correspondence of the rankings is easily seen. The table is arranged in the same way as Table 17, i.e. in order of relative labour productivity, with those industries where the United Kingdom's comparative advantage is greatest appearing first. It would, of course, also be possible to rank the table in the order of the total output indices, but in this case the two end quartiles would show a somewhat different group of industries. In the top quartile of the table, i.e. among the industries where the United Kingdom has a relative advantage, seven of the industries appear in the same quartile whether ordered by productivity or by total output. These include shipbuilding, sugar factories, tanneries and grain milling, where the ranking differences are very small, and both the output and productivity indices are highly advantageous to the United Kingdom, and also the woollen and worsted, cutlery, and tools and implements industries where the total output ranking is even more favourable than the productivity ranking. In the other four industries, clothing, footwear, knitting mills and cement, high British relative output per worker is not fully matched by high relative total output, largely because for many of their products output is determined predominantly by home demand. It may be remarked that the two most important industries where the volume ranking is markedly more favourable to Britain than the productivity ranking are structural clay products and breweries which are also industries serving a fairly localised market.

Similarly, in the lower quartile of Table 18, i.e. among the industries where the United States productivity advantage is highest, it is particularly notable that the four industries with most favourable productivity (metal cans, automobiles, agricultural machinery, and paper and card containers) are among the five with the highest relative United States output. Among the other seven industries in this category the correlation is less marked and in the cases of basic chemicals and blast furnaces the difference in ranking exceeds 7 points. Among the most important industries omitted from Table 18 as a result of using a productivity rather than an output ranking order are the pulp and paper, and fruit and vegetable canning industries in which output per worker is near the median value. In both these cases it is clear that a large total output results primarily from plentiful supplies of raw materials in spite of only a moderate productivity advantage.

It has been pointed out that it is difficult to determine how far high productivity is the result and how far it is the cause of high total output when making intertemporal comparisons. It is even more difficult to make this analysis when the comparison is being made between two countries at a single point in time. We have already seen that productivity is a major determinant in price, and consequently, at least in industries entering international trade, high productivity in relation to wage levels is essential if the industry is to compete in world markets. On the other hand, in some industries large markets certainly afford opportunities for economies of scale. Measured by employment there is no marked difference in the average size of British and American firms. If, therefore, the productivity advantage of the United States is to a significant extent attributable to advantages arising from economies of scale, it would appear that these must be mainly economies arising in

TABLE 18. RANKING OF LABOUR PRODUCTIVITY AND REAL NET OUTPUT INDICES OF SELECTED MANUFACTURING INDUSTRIES IN THE UNITED KINGDOM RELATIVE TO THE UNITED STATES IN 1950

	RANK ORDER (GIVING INDUSTRIES WITH RELATIVE U.K. ADVANTAGE FIRST)	
	OUTPUT PER WORKER	QUANTITY INDEX
a) *Quartile with greatest relative U.K. advantage :*		
Shipbuilding	1	1
Cement	2	14
Sugar factories and refineries	3	7
Tanneries	4	5
Outerwear and underwear	5	15
Footwear	6	12
Grain milling	7	9
Woollen and worsted	8	2
Knitting mills	9	19
Tools and implements	10	4
Cutlery	11	6
b) *Quartile with greatest relative U.S. advantage :*		
Paint and varnish	34	31
Basic industrial chemicals	35	27
Matches	36	29
Radio	37	35
Blast furnaces	38	28
Storage batteries	39	32
Electric household equipment	40	34
Containers, Paper and card	41	40
Agricultural machinery	42	42
Automobiles	43	43
Metal cans	44	41

the industries as a whole rather than in individual plants. It has frequently been pointed out that individual American manufacturers derive considerable advantage from increased specialisation on a smaller number of lines.[1] This may be partly an economy of scale, in that a larger market permits a higher degree of specialisation. The advantage is also due, however, to a larger amount of standardisation of American manufactured goods which is a result not of larger markets but of more uniformity of product within the market,[2] and over manufacturing industry as a whole it is difficult to distinguish between the effects of these two factors.

Finally, it may be noted that there appears to be some tendency for the United Kingdom to show a relative productivity advantage in older industries which have grown little in recent decades, such as shipbuilding, linen and woollen textiles, and for the highest American

1. This is referred to, for example, in a number of the Anglo-American productivity team reports on particular industries.
2. See Frankel, *op. cit.*, pp. 72-80.

advantage to be in rapidly growing industries such as automobiles, radio and chemicals. Statistically, this is largely, if not wholly, the result of factors already observed : the gap between the two countries has been widening over time, and in each country productivity gains have been greatest in the rapidly growing industries. There may be, however, some analytical significance in the fact that the differences in average age of capital equipment[1] in the two countries are likely to be smaller in relatively stationary industries than in rapidly growing ones. Thus part of the American productivity advantage may be explainable in terms of the proportion of plants in which modern production methods (common to the best plants of both countries) can in fact be applied. This is, however, a subject for further investigation that is outside the scope of this study.

The Effect of Employment Distribution on Aggregate Net Output Per Worker

Aggregate net output per worker indices reflect not only relative productivity in the individual industries compared, but the distribution of employment between industries with a high and low net output per head (in money values). This factor has often been remarked in inter-temporal comparisons, the most typical case being when, in the process of industrialisation, there is a movement of workers from agriculture to industry. In this case the change in the distribution of the labour force will result in a rise in aggregate productivity, measured in terms of net output per worker in base year prices, even if the productivity coefficients of the two sectors remain the same. We can, however, only measure relative output in different industries in terms of a particular price structure. If in the example quoted above the shift from agriculture to industry results in a change in the terms of trade between the two sectors, such that relative agricultural incomes rise, then the productivity increase will be reduced, or may even disappear altogether, if measured in the prices of the later year.

Thus, although in many countries opportunities undoubtedly exist to increase productivity by shifting workers to more productive industries, these opportunities cannot be identified or the gains measured simply by a comparison in base year prices. We have to be able to distinguish between "real" gains resulting, say, from a shift of workers from labour intensive to capital intensive industries, and apparent gains due to fortuitous or temporary fluctuations in relative incomes, and particularly in profits.

In comparisons between countries, as well as over time, aggregate productivity indices may be substantially affected by the distribution of employment between industries, for the productivity index of a particular sector obtained by dividing the aggregate real net output index by the relevant employment index may differ markedly from a simple weighted average of the component indices.

For example, in both the cement and structural clay products[2]

1. Or rather between the age of the equipment determining the type of technology employed, since gradual replacements in an established plant may not be able to take full advantage of modern technology.
2. The most important of which are bricks.

industries, the United Kingdom has a relative productivity advantage (compared with the manufacturing average) but whereas in structural clay products the advantage is only moderate with indices of 186 and 208 (U.K. = 100) according to the price weights used, in the cement industry it is very marked and output per American worker is only 116 per cent of that of the British worker. The United States has, however, an almost exactly offsetting advantage in the distribution of employment, because (by comparison with Britain) a substantially larger proportion of its employment in the two industries is engaged in the highly capital intensive cement industry, which has a high net output per worker in both countries, and a smaller share in the relatively labour intensive brick industry. The result is that the combined productivity index for the two industries is almost identical with that of the structural clay products industry alone, i.e. 189 (U.K. = 100) when compared at British price weights, and 207 at American price weights. If the net output were the same in the two industries the index would be about 160 at either country's weights. To the extent that bricks and cement are substitutes for one another, it is possible to envisage a change in British construction methods such that American coefficients of brick and cement inputs would be applied. Disregarding the effects on productivity in the construction industry, the effect of this hypothetical change would be to increase overall British productivity even if there were no change in output per worker in the two component industries.

For manufacturing as a whole, differences in the distribution of employment among the major groups with high and low net outputs per head are offsetting, and the output per worker index obtained in this study does not differ significantly from an employment weighted average. There is, however, a structural effect when the manufacturing and agricultural sectors are aggregated, although this is less marked than in the pre-war period when the terms of trade were less favourable to agriculture.[1]

In the United Kingdom, in fact, net output per worker in industry and agriculture were almost identical in 1950, and the combined American productivity index for the two sectors is 270 (U.K. = 100). At American prices, on the other hand, net American output per worker in industry in 1950 was about 70 per cent higher than in agriculture. Consequently in terms of its own price structure American total productivity would appear to gain by a further shift of workers to manufacturing industry. At American prices the aggregate productivity index for the two sectors is 230 (U.K. = 100) but if the net output per worker were the same in each of the two sectors (as in Britain) the index would be 244.

This is a clear illustration of the importance of price factors, and it would be difficult to determine whether the British or the American price structures, both of which contain large subsidy elements, give a better measure of the relative "real" net output per worker in agriculture and industry.

1. See Rostas, *op. cit.*, p. 90.

VI

CONCEPTUAL AND TECHNICAL PROBLEMS OF THE INDUSTRY OF ORIGIN APPROACH

The discussion in the present chapter will be concerned with the general principles involved in an inter-country comparison of real product by industry of origin, and the basic methods which may be used. The conceptual framework of such a comparison differs little from that of an intertemporal comparison for one country, but as the two situations which we have to compare show sharper and more fundamental differences than are generally found over a short to medium period of time, close attention must be paid to the underlying assumptions.

The methods used in the comparison by industries can only be discussed in the context of the objectives of the study, which are, firstly, to obtain a measure of the total real product which is conceptually identical with that obtained from the expenditure approach, and secondly, to obtain useful comparisons for the individual industries for analytical purposes. At a theoretical level these objectives are compatible, but, when statistical problems and difficulties in the data are taken into account, we shall see it is not always easy to find a solution that will give the best aggregate index, and at the same time permit satisfactory comparisons of the individual industries.

In the present chapter we shall be concerned mainly with the measurement of the net output of the various domestic industries, which together make up the gross domestic product. In a closed economy the total domestic product would be equal to the sum of domestic expenditures, and no further adjustment would be necessary. In countries entering into world trade, however, the effects of imports, exports, and other external transactions have also to be considered, and these will be discussed in the final section. The following chapter is again concerned with the domestic product, when we discuss alternative methods of measuring particular products and processes.

The Measurement of Net Output

To obtain a comparison of the total final product, we need to compare the *net* output or value added, in real terms, for each of the component industries. Net output is arrived at as the value of total production less that of inputs from other industries and sectors. These inputs include materials and purchased services, but not capital and labour

costs which are part of the net output. We can measure the value added in real terms preferably by comparing both gross output and inputs and obtaining net output as a residual, or else by using indicators chosen to give the best approximation of the work actually done in the industry.

It would, of course, be possible to measure the total gross output of all the industries and add these together, but such an index would not give a result conceptually identical with a final product index, and would not be very interesting or meaningful in itself. No account would be taken of real differences in inputs per unit of final product, i.e. of the fact that one country may produce a given volume of final goods with a smaller amount of fuels and raw materials than the other. Over and above this, however, it would contain a large amount of double counting in that materials that change hands a number of times in the course of production would be included as a component in the gross output of each industry through which they pass.

For a single industry a gross output comparison is quite meaningful, although if there are appreciable differences in inputs per unit of output in the two countries its usefulness is somewhat limited.[1] Such a comparison can be made simply by aggregating all the products valued at the factory prices of each country in turn. Two indices would then be obtained, according to the weights used, corresponding to the Laspeyres and Paasche indices of time comparisons. If we denote the two countries by X and Y, and the price and quantity of output by P and Q these indices would then be:[2]

$$\bar{q}_{(x)} = \frac{\Sigma P_{(x)}\ Q_{(y)}}{\Sigma P_{(x)}\ Q_{(x)}} \qquad (1)$$

and

$$\bar{q}_{(y)} = \frac{\Sigma P_{(y)}\ Q_{(y)}}{\Sigma P_{(y)}\ Q_{(x)}} \qquad (2)$$

The Single Indicator Method

The simplest method of obtaining an approximate net output index is to make gross output comparisons for the individual industries, as described above, but to use net output weights to combine these various sub-indices in an index of total production. Such an index has three main deficiencies :

1. It takes no account of variations in input per unit of output for individual commodities within the industries (i.e. the technical input coefficient).
2. In making comparisons within an industry, the quantity relatives are weighted by factory prices. In terms of a net output comparison, the result is to give too much weight to those of the industry's products with relatively high inputs per unit of output, and too little to those with lower than average inputs.
3. To the extent that the commodities selected for the comparison of individual industries are not homogeneous, the index may not use the best *net* output quantity relatives for particular goods.

The first of these deficiencies is inherent in the single indicator method, and can only be avoided by measuring inputs and outputs separately (i.e. by the double indicator method which is discussed below). The other two are practical difficulties that would not arise if we could compare production in the form of an array of homogeneous single product industries.

In a short term intertemporal production index the practical effect of the three deficiences listed above may be unimportant, and gross output may move very closely with net output within individual industries. Thus changes in the technical input/output co-efficients may be rather small. Further, the products of an industry show a tendency to move together, so it may be reasonable to assume both that goods with a high input content will move similarly to those with a low input content, and that changes in the product mix of classes that have been treated as one "commodity" will not matter very much.[1]

In an international comparison a gross output index for individual industries may differ substantially from a net output one, as all the factors mentioned above are apt to be important. Differences in production methods, in types of material used, and in the amount of imported material, may produce major differences in the technical input/output co-efficients. Even in industries where these differences are not too great, we cannot assume any tendency towards a similar distribution of output among the individual products of an industry. Indeed, the major product of country X may be only a minor item in country Y and vice versa. In this case, the index obtained will depend very largely on the weights and product classes used, and those applicable in a net output comparison are very different from those of a gross output comparison.

Net Output Commodity Weights

The first step towards the replacement of a gross output comparison by a net output comparison within individual industries, is the use of net costs instead of factory prices as the weights for the individual commodities. We then get an approximate net output index which excludes the obvious forms of double counting due to incorrect weights, but still assumes that for each commodity inputs per unit of output are the same in both countries.

Net cost weights for individual commodities within an an industry cannot be obtained directly from published sources, such as census of production data, because of the problem of "joint costs" which cannot be assigned to individual commodities. In the majority of cases, however,

1. If, for example, the construction industry of country A uses factory-made components while that of country B makes these on the building site, the gross output comparison will tell us the total volume of building in the two countries, but could not legitimately be related to employment in the industry.
2. It will be noted that, for convenience, country X is used as the numerical base of both indices, although one is based on X's and the other on Y's weights.

1. Both these latter assumptions, however, are dangerous when there is a trend towards the substitution of a cheaper (or more expensive) material, such as rayon for silk (or nylon for rayon), and in such cases the type of index described may have a substantial bias even in a short term comparison.

these joint costs are mainly overhead items the bulk of which are part of net output. The main inputs of raw materials and components can usually be fairly accurately assigned to individual commodities, given sufficient technical information about the industry concerned. Serious conceptual problems occur, however, in the case of completely joint products, such as wheat flour and offals for feed, where almost all costs are joint, and the relative prices of the two products are determined primarily by demand. The single indicator method provides no theoretical solution in such a case, and the assumption that input costs and net costs are proportionate appears to be the only practical approach.

In the present study we had to use very crude methods of estimation simply because the technical knowledge and resources of a small research team were inadequate to make detailed inquiries into the cost of hundreds of different commodities.[1] It cannot be overemphasized, however, that it is preferable to use even crude net cost estimates rather than factory prices. This is obvious when the products to be included in an index are the result of successive processes performed in a single industry,[2] but it is also important when similar processes are applied to materials of very different value, as in the case of knitting rayon and nylon stockings, or when the amount of value added to a given volume of raw material can vary widely, as is the case in many of the metal products industries.

Measurement of Processes Rather Than Products

The comparison of net output with single indicators can be further improved by selecting the indicators to measure processes rather than end products. At first sight this may appear to be a rather trifling distinction in that virtually all the statistical data available relate to products. Nevertheless, in many industries the result is substantially affected by the units of measurement and product classes selected. Our choice of these may be quite different if we are trying to find an indicator of the work done in the industry than it would be if we wish to measure its gross output.[3]

The Single Indicator Formula

The various devices discussed for improving the single indicator

1. In a comparison of a single pair of countries, however, for which the individual quantity data are already available, resources can be concentrated on securing the best estimates in cases where the weights are very important, i. e. where the quantity relatives are widely dispersed. In an intertemporal production index, on the other hand, crude estimates of weights for the base year may lead to distortion through unforeseen divergencies in the output trend of individual commodities.

2. In sugar production, for example, the earlier process of producing raw sugar has about 1.75 times as great a net cost per ton as the later refining process, although its *price* is less than 2/3 of that of the refined product.

3. These points can, perhaps, be made clearer by two examples. Thus the gross output of cloth may be most usefully measured by weight because this gives full value to the higher material content of heavier cloths. Square yards or square yards adjusted for yarn count would give a better measure of net output, because a yard of heavy cloth contains less and not more weaving activity than a yard of light cloth. Similarly, the important product classes in comparing the gross output of stockings would be type of material, cotton, rayon, nylon, etc., but in measuring net output the distinction between fully fashioned and seamless stockings is of much greater importance because the latter contain far less value added.

method do not alter the basic formula given above. As, however, we are considering net costs and processes, it is more appropriate to weight the quantity relatives by value, rather than to weight quantities by price. In this way, it is possible to make a comparison for a single industry with a range of processes, or to aggregate the various industry ratios to obtain a sector index or the overall index for total real product. In its value weighted form, the overall index is

$$\bar{q}_{nx} = \frac{\Sigma N_{(x)}\, q_n}{\Sigma\, N_{(x)}} \qquad \left(q_n = \frac{Q\,(y)}{Q\,(x)}\right)$$

Where N(x) denotes the value of country X's net output of the individual commodity (or industry) of which qn measures the relative quantity produced in country Y, and $\bar{q}_{n(x)}$ is the aggregate index using X's values as weights.[1] (The suffix n relates to the fact that net and not gross output is being compared ; in the latter case, the suffix g will be used.)

THE DOUBLE INDICATOR METHOD

The conceptual deficiencies of the single indicator method discussed above can be overcome if we compare both the gross output and inputs of each industry, obtaining net output as a residual. By this approach we get a result that is formally identical with that obtained by a direct comparison of expenditures, as all intermediate products cancel out since they are included both as the output of the producer industry, and, with negative weight, as the input of the user industry. The residuals thus give the sum for the whole economy of the final products of each industry.

This can be visualised most clearly in terms of an input/output table, the rows of the table giving the gross outputs of each industry, classified by user, and the columns giving the inputs which are deducted to arrive at net output. In this form it can be seen that all the intra-industry transactions cancel out, leaving the final output of industry classified by commodities in the final column, while the net outputs of each industry are shown in the final row.

In algebraic terms the double indicator formula can most conveniently be presented as follows :

Let G, I, and N represent gross output, inputs and net outputs, respectively. For country X, net output is by definition the difference between gross output and inputs, viz.

$$\Sigma N_{(x)} \equiv \Sigma G_{(x)} - \Sigma I_{(x)} \qquad (3)$$

A measure of Y's net output in X's prices is obtained if we convert both

1. This presentation has the disadvantage that expressed in terms X = 100 the Y-weighted index is rather unwieldy viz :

$$\bar{q}_{ny} = \frac{\Sigma N_{(y)}}{\Sigma N_{(y)} \cdot \frac{1}{q_n}}$$

In the subsequent discussion, therefore, only the X-weighted index will be discussed in detail, but it must be remembered that in an interspatial comparison both countries' weights are equally valid and the difference between the two indices may be substantial.

gross output and inputs by appropriate quantity ratios q_g and q_i. Y's net output in X's prices is then

$$\Sigma G_{(x)}\ q_g - \Sigma I_{(x)}\ q_i \qquad (4)$$

and the net output index is the ratio between these two expressions:[1]

$$\bar{q}_{nx} = \frac{\Sigma G_{(x)}\ q_g - \Sigma I_{(x)}\ q_i}{\Sigma G_{(x)} - \Sigma I_{(x)}} \qquad (5)$$

$$= \frac{\Sigma G_{(x)}\ q_g - \Sigma I_{(x)}\ q_i}{\Sigma N_{(x)}} \qquad (6)$$

Not only the various inputs into each industry, but also the outputs classified by user must be compared, otherwise it is impossible to ensure that intermediate products are treated consistently both as inputs and outputs. If, for example, the output of coal is measured by grade but it is impossible to follow the same classification in comparing other sectors' purchases of coal, and as a result coal inputs are deducted as if they were homogeneous, the two estimates will not cancel out, and the final index will be biased in favour of the country using higher grades of coal for intermediate purposes.

In practice, lack of detailed comparable data in this form makes a complete application of the double indicator method impossible in inter-spatial comparisons.[2] It appears, however, that the difficulty is not due merely to a deficiency at the present time in the material available, but arises from the fact that the consistency requirements of the method are extremely difficult to satisfy if we are to get adequate comparisons both of the total real product and of the individual industries.

As far as the total real product index is concerned it will be seen that since intermediate products cancel out, they do not in any way affect the final comparison, and the aggregate result is exactly the same as if we had compared only the end products of each industry. The margin of error in each intra-industry comparison does not enter the final index, provided that it is the same in both entries of the transaction. The comparison for individual industries, however, depends fundamentally on the accuracy of the comparison of intra-industry transactions, and unless we can secure reasonably reliable results for at least the majority of the separate industries, there is no object in comparing this part of the input/output table.

The accuracy of the individual industry net output comparisons thus depends upon consistent measure of the inputs and outputs of each industry. This could be obtained if we were able to make adequate

1. Alternatively in terms of quantity and price :

$$\bar{q}_{nx} = \frac{\Sigma P_{g(x)}\ Q_{g(y)} - \Sigma P_{i(x)}\ Q_{i(y)}}{\Sigma P_{g(x)}\ Q_{g(x)} - \Sigma P_{i(x)}\ Q_{i(x)}}$$

2. It must be remembered that the existence of similarly classified input/output tables is only the first step towards the attainment of the data required, as such tables are presented in value terms. For our purpose we require to compare each transaction in the table in *real* terms, i.e. we require information on the price and quantity relationships implied in each entry.

independent price comparisons for both inputs and outputs. But, at any rate for international comparisons, this is extremely costly in time and resources. If we have to rely, when comparing either inputs or outputs, on quantity (or average value) data,[1] there is a considerable risk that quality variations identified in the output comparison will be ignored in the input comparison or vice versa. Thus country A may be credited with too high a net output in a particular industry because its higher quality output actually results from better quality materials, but this was not reflected in the measure of material inputs.[2]

Alternatively, A's relative net output may be under-estimated because an apparent use of more inputs per unit of output is actually due to higher quality outputs that could not be differentiated.[3]

In practice we found that inconsistencies of this type are almost unavoidable in the majority of industries if quantity comparisons are used. Their effect on the result, for the individual industry, is magnified by the fact that we obtain net output as a residual, and the *percentage* error in the net output estimate may well exceed that in either inputs or gross output.[4]

To sum up, we find that (1) an unbiased real product index requires that the measure of the producer industry's output of a particular intermediate product should be consistent with the measure of the input of the product into user industries (2) accurate comparisons for individual industries require consistency between the outputs and inputs of the industry considered. To try meeting both these requirements would in a sense mean using the lowest common denominator of the available data, for quality variations cannot be taken into account at any one stage in the table unless there is information available to follow them through all the stages.

If we followed this to its logical conclusion we would be restricted to rather crude final output measures that would not fully exploit all the data available.

The Choice between Single and Double Indicators

The statistical difficulties of adhering to a complete double indicator comparison have been emphasised in the previous section because they reveal fundamental difficulties in application that would not be solved

1. The full implications of the three types of comparisons by price survey, quantity, and average value, are discussed in Chapter VII. Here it need only be noted that a price comparison takes account, in sample form, of all quality differences but that quantity and average value comparisons can only take account of a few major quality variations.

2. e.g. if a price comparison for the clothing industry takes account of all quality differences (many of which originate in the fabric used), but inputs of fabrics could only be deducted in rather crude quantity terms.

3. This would happen, for example, if we deducted yarn inputs, by weight, in a comparison of British and American sock knitting industry, without taking account of the fact that the average British sock is heavier than the typical American sock.

4. If, for example, there is a 10 per cent error in the measures of both inputs and gross output, and this happens to act in opposite directions, then—if inputs account for half of gross output—an error in the net output index of 30 per cent or more may arise. If, however, the errors in inputs and outputs are correlated (as is likely to be the case if we use sample data that are internally consistent but may be unrepresentative), this cumulative effect does not occur. In this case, however, it is more difficult to ensure the consistency required for a reliable total real product index.

simply by an extension of the data available in each country regarding its industrial inputs and outputs. At present, however, the national data are not adequate for a complete application of the double indicator method, and in most cases where the method can be applied it is impossible to ensure that inputs and outputs are handled consistently from the point of view of getting the best aggregate real product index.

In practice, therefore, the only check on the accuracy of the total result is to obtain the best possible measure of net output in each industry. Here we find that the single indicator method—although not so tidy and conceptually less satisfying—has substantial advantages, and may in many cases give a better measure of the final product than can be obtained using double indicators. This is because the double indicator method, by the very fact of its formal identity with a direct measure of final expenditures, does not enable us to make use of certain practical advantages that exist in approaching the comparison from the industry side.

These practical advantages arise from two factors. Firstly, a large part of net output originates in industries producing rather homogeneous basic products, such as cement, steel and basic textiles, whose output can be relatively easily compared. Thus, if it is assumed that these industries' contribution to the final product is not disproportionate to their net output, a substantial share of the total comparison rests on a fairly sound statistical basis. Secondly, the comparison of individual production processes with quantity indicators is very much easier than the comparison of products, simply because the products are subject to a wider range of potential quality differences resulting from variations in both the inputs and the processes of the individual industry.[1]

Thus by the single indicator method we can often compare, with simple quantity indicators, all the processes contributing to a final product which would require more elaborate comparison by the expenditure approach. These quantity comparisons, which can be derived mainly from published data, can then produce a final output comparison that recognises a considerable degree of quality variation, and may in some cases be more reliable than the corresponding results obtained in a direct expenditure comparison, simply because we are able to exploit the available data more fully.

This argument depends, however, on the assumption that real inputs per unit of output are identical. If a higher rate of inputs from the spinning industry into the weaving industry reflects not higher quality fabrics, but more wastage, then the reliability of the aggregate index is reduced. Thus for a particular industry, or group of industries, we have to select the method that gives the least final error. If variations in inputs per unit of output appear to be mainly due to differences in wastage, or substitution between purchased components and work done in the industry, then measured inputs should be deducted. But if the apparent differences in inputs are likely to be due predominantly to quality factors that have not been measured in the output, the final

1. It is, for example, possible to compare weaving output adequately with a rather small number of indicators, as against the number of product classes required to take account of all the qualities of finished fabrics which may result from raw material differences, spinning differences, and weaving differences.

index will be improved if no deduction is made (and, incidentally, the result for the industry will be more meaningful).

In practice it was found that in respect of practically all inputs of materials that are transformed in later production processes, but remain physically part of the end product, it was more reasonable to assume that variations in input/output ratios mainly reflected quality differences, and that wastage differences were rather small.[1] These inputs were designated as *specific* inputs, and were not deducted.

The remaining inputs are described as *non-specific*. They include fuels, transport, services, and other auxiliary inputs used in all industries, and also the main inputs into the extractive industries, and a few others, such as fuel conversion and transport. The common feature of these inputs is that they do not remain physically part of the end product, and they should be deducted because they are in general likely to affect the quality of the final product very little, but have a big influence on its quantity. If we do not deduct them we credit the country using, for example, more fertilisers per unit of agricultural output, with *both* the fertilisers and extra produce resulting from their use.

As far as possible then, all inputs should be deducted only in industries such as mining, agriculture, electric power, and transport, where outputs are rather homogeneous, and inputs almost entirely non-specific.[2] For other industries it is desirable to adjust for all non-specific inputs, but not for the main raw materials. In practice, however, only the more important non-specific inputs could be deducted, and on a rather global basis. The way in which this was done is described below. Moreover, for the industries requiring a complete input deduction, a short-cut method had sometimes to be adopted.

The Ring-fence Method

The "ring-fence" method constitutes a short cut to the double indicator method in that a group of related industries is combined as one "ring-fence" industry and only the inputs entering and the outputs leaving the group as a whole are measured.[3] If the measure of inputs and outputs of the group is complete the result is the same as a full double indicator comparison (where inputs and outputs within the group

1. It has been pointed out earlier that the resources available for the study did not permit the complete price surveys of both inputs and outputs which would have been necessary to avoid having to make these assumptions.

2. It may at first sight appear paradoxical that it is in just these industries that rather startling net output indices are sometimes obtained, i.e. A's net output measured in B's prices may be extremely small or even negative. This is due, however, not to weaknesses in our measuring rods but to real differences in the two countries for which adjustment is essential if we are to obtain a true final index. Thus the net output of British electricity in Norwegian prices might well be negative, but this would illustrate the fact that the production of electricity from coal would be uneconomic in Norway. It does not tell us much about the relative efficiency of the British industry which is operating under quite different conditions. All the same the negative index makes the correct adjustment to the total real product index because, without the deduction, the part of British coal production that is used as an intermediate product not required in a country with ample water power would bias the final index in Britain's favour.

3. See W.B. Reddaway, "Movements in the Real Product of the United Kingdom 1946-49", *Journal of the Royal Statistical Society*, Series A., Vol. CXIII, Part IV, 1950.

would be computed but would cancel out), but, of course, information on the individual industries within the group is incomplete. Thus in the fuel industries, in the present comparison, measurement was restricted to the outputs leaving the fuel sector, and primary fuels (coal, crude oil, and natural gas) used within the sector to produce secondary fuels (coke, refined petroleum, manufactured gas and electricity) were omitted from both outputs and inputs. In this case the input deduction from the sector as a whole was not complete because only inputs of imported crude oil were taken into account.

The ring-fence method is, of course, only useful as a substitute for the full double indicator calculation. In industries where better results could be obtained with single indicators the method would result in a loss of accuracy for the whole comparison.[1]

The ring-fence method can also be used with single indicators to combine industries for which the total output of the group may be measured by the products of the final stages. In this case the net output weights of the intermediate industries are added to those of the final industries, and only the end products are measured.[2]

The assumption made is that inputs into the group as a whole are proportionate to output.[3] This method is particularly suitable for industries, such as those providing professional and trade services to industry, which produce no direct final products and whose output is difficult to quantify. In the case of business services there is an additional advantage in that differences in the degree of integration of professional services within industry do not affect the result—e.g. the treatment of lawyers and accountants with business clients and those employed in industrial establishments is identical.

The Partial Use of Double Indicators

It has already been mentioned that in a number of cases it is desirable to deduct important non-specific inputs such as fuels, while assuming that the bulk of inputs vary with output. Here we have already obtained an approximate net output index by the single indicator techniques discussed above, which we will call $q'_{n(x)}$ and wish now to adjust this to get nearer to the actual net output ratio for the industry $q_{n(x)}$. If, in

1. e.g. a ring-fence comparison of cotton spinning and weaving would have been the simplest way of overcoming the difficulties introduced by vertical integration of the two processes in the United States but in this case the easy solution had to be discarded because no account could then have been taken of yarn qualities which make an important contribution to the quality of final output of textile products.

2. In the present study this method was used in effect to handle business services and the industrial consumption of public water supplies, but instead of actually assigning the weights of these intermediate services to industries, the industrial indices were applied to them. The result is, of course, identical, but presentation was made simpler, as weights could only be arbitrarily assigned.

3. It must be emphasized that we do not assume that the input requirement of the intermediate product per unit of output is the same in both countries, but merely cancel out the intermediate transactions, which may be of any size. When, however, single indicators are used, some proportionality is still assumed, as inputs into the unmeasured intermediate industry are not accounted for, and are thus tacitly assumed to be proportionate to the output of the end product.

the double indicator formula [(5) above], we subdivide the inputs $I_{(x)}$ and q_i into two groups $K_{(x)}$ and q_k, and $J_{(x)}$ and q_j, the latter covering those for which we wish to adjust, the formula can be rewritten

$$q_{n(x)} = \frac{G_{(x)}\, q_g - K_{(x)}\, q_k - J_{(x)}\, q_j}{G_{(x)} - K_{(x)} - J_{(x)}} \tag{7}$$

We are assuming that gross output and the non-measured inputs move with our approximate index $q'_{n(x)}$ so that

$$q_{n(x)} = \frac{(G_{(x)} - K_{(x)})\, q'_{n(x)} - J_{(x)}\, q_j}{G_{(x)} - K_{(x)} - J_{(x)}} \tag{8}$$

Since $G_{(x)} - K_{(x)} - J_{(x)} = N_{(x)}$ this can be more conveniently written as

$$q_{n(x)} = \frac{(N_{(x)} + J_{(x)})\, q'_{n(x)} - J_{(x)}\, q_j}{N_{(x)}} \tag{9}$$

$$= q'_{n(x)} - \frac{J_{(x)}}{N_{(x)}} (q'_{n(x)} - q_j) \tag{10}$$

In this simple form without aggregation signs the formula is correct for the deduction of a single input from the approximate index for one industry. If we consider that a certain non-specific input is of sufficient importance to warrant an adjustment being made, this is usually because —as in the case of fuels and transport—it is purchased by many industries and a bias may result if one country consistently uses less than the other. In this case the aggregate net output index for all industries, or for all industries using the output, can be adjusted globally, viz.

$$\bar{q}_{n(x)} = \frac{\Sigma(N_{(x)} + J_{(x)})\, q'_{n(x)} - \Sigma J_{(x)}\, q_j}{\Sigma N_{(x)}} \tag{11}$$

To complete this formula information on the prices and quantities of the non-specific input into every industry is required. Total quantity consumed can be substituted if we are prepared to assume that each industry pays the same price for its input, as then $\Sigma J_{(x)}\, q_j$ has no internal weighting. If the distribution of expenditures among the industries is not available a still further simplification can be made by using a simple net output weighted index for $q'_{n(x)}$ but in this case there is a loss of accuracy if J_x is relatively large and is unevenly distributed.

In the present study, freight transport inputs into all industries producing physical goods, and fuel inputs into manufacturing were deducted globally.[1] Transport costs could not be distributed among the industries and one overall adjustment was made. For the fuel adjustment the manufacturing industries were arranged in large groups,

1. One advantage of making these deductions globally is that it is then possible to ensure that the intermediate outputs are deducted thus ensuring consistency in the real product total (see above).

and separate adjustments were made for those major groups with substantial fuel costs. In this instance, however, the more refined weighting had little effect, and practically the same result was obtained as if one global deduction had been made.

External Transactions

The previous sections of this chapter have been concerned with the comparison of the net output of domestic industries, i.e. the measurement of the gross domestic product. To make a comparison of gross national product, net factor income from abroad must be added ; this gives the total of the gross national product, which can be considered from this point of view as the sum of industrial value-added and net factor income from abroad.

In original money values this total is equal to gross national expenditure, but it covers a different bill of goods because the value-added aggregate includes exports but omits imports, whereas the expenditure total includes imports but omits exports (apart from the balancing item of net investment abroad arising from net exports). Consequently when gross national product and gross national expenditure are expressed in the prices of some other time or place, the two aggregates will no longer be equal, and an adjustment is required similar to the terms of trade adjustment made in intertemporal comparisons.

The Concept To Be Compared

Before considering the details of this adjustment it is necessary to specify exactly the concept which is to be measured. Foreign trade must be taken into account since it constitutes an essential part of the economic process. If the comparison from the production side were limited to the national product based on value-added, the fact that this entity when measured in different prices is no longer equal to national expenditure would imply an adjustment which would simply be a reconciliation between the two concepts. But the final object of production is consumption, and changes in the terms on which imports are obtained in exchange for exports are relevant in the measurement of the complete process of production.[1]

The practical significance of this is clearly illustrated in a comparison of two countries such as the United Kingdom and the United States, whose dependence on foreign trade varies substantially. Here, use of gross national product defined as the sum of industrial value-added and net factor income from abroad would mean a comparison between two countries one of which provides a proportion of its requirements from domestic production, while the level of final output in the other is determined in part by the terms on which it exchanges exports for imports.

Since, within the gross domestic product the general level of productivity is determined by the distribution of workers between industries

1. See Gilbert and Beckerman, "International Comparisons of Real Product and Productivity by Final Expenditure and by Industry", Conference on Research in Income and Wealth, October 1958.

as well as by relative productivity within the individual industries,[1] the measurement is in fact incomplete without the inclusion of the terms of trade which show the other aspect of the advantage or disadvantage of the degree of specialisation in each country.

The Nature of the Adjustment

To get from a comparison of the gross domestic product to a comparison of the gross national product that is conceptually equal to that of final expenditures, three changes are necessary.

a) Net factor income from abroad must be compared in real terms. For this purely monetary flow the most useful approach appears to be to convert the value series with the official exchange rate.[2] Logically this is defensible on the grounds that it represents the equivalent purchasing power made available in world markets, and it has the additional advantage that it is consistent with the way in which some categories of imports and exports have in practice to be handled.

b) Account must be taken of the change in the relative valuation of imports and exports when they are compared in another country's prices. This corresponds approximately to the familiar intertemporal adjustment for changes in the terms of trade.

c) Finally, adjustment must be made for changes in price weights of the base country resulting from imports and exports at differential prices. This adjustment is necessary because the comparison of domestic production is based upon the prices of home-produced commodities only. If a significant volume of imports (or exports) takes place at different prices (for identical goods) this will affect the price structure of final expenditure.

The precise nature of the adjustments required under (b) and (c) can be most clearly seen in algebraic terms. To simplify presentation it will be assumed that net factor income from abroad and net exports are zero, and only the index on country X's weights will be considered. Suffixes d, f, m, and e are used to represent domestic production, final output, imports, and exports respectively. The comparison based on domestic production is then represented by

$$\frac{\Sigma P_{d(x)}\, Q_{d(y)}}{\Sigma P_{d(x)}\, Q_{d(x)}} \qquad (12)$$

and that based on final output (i.e. after exchange of exports for imports) by

$$\frac{\Sigma P_{f(x)}\, Q_{f(y)}}{\Sigma P_{f(x)}\, Q_{f(x)}} \qquad (13)$$

1. See Chapter V.
2. This follows the practice used in the expenditure studies for the rather similar item of net exports.

In the latter formulation the aggregate is necessarily equal to that obtained by a direct comparison of final expenditures, but for our purpose the prices and quantities are used to denote items in the various stages of production at which foreign trade occurs.[1]

For any single item

$$Q_{f(y)} = Q_{d(y)} + Q_{m(y)} - Q_{e(y)} \qquad (14)$$

and the "final" price of each item is a weighted average of the production, import, and export, prices viz. :

$$P_{f(x)} = \frac{P_{d(x)}\,Q_{d(x)} + P_{m(x)}\,Q_{m(x)} - P_{e(x)}\,Q_{e(x)}}{Q_{d(x)} + Q_{m(x)} - Q_{e(x)}} \qquad (15)$$

On the assumptions made above regarding net exports and factor income from abroad

$$\Sigma P_{d(x)}\,Q_{d(x)} = \Sigma P_{f(x)}\,Q_{f(x)}$$

and for each country in its own prices

$$\Sigma P_m\,Q_m = \Sigma P_e\,Q_e$$

The adjustment required, therefore, is to the numerator of (12) and (13) only and may be written :

$$\begin{aligned} &\Sigma P_{f(x)}\,Q_{f(y)} - \Sigma P_{d(x)}\,Q_{d(y)} \\ &= \Sigma P_{f(x)}\,[Q_{d(y)} + Q_{m(y)} - Q_{e(y)}] - \Sigma P_{d(x)}\,Q_{d(y)} \\ &= \Sigma Q_{d(y)}\,[P_{f(x)} - P_{d(x)}] + \Sigma P_{f(x)}\,Q_{m(y)} - \Sigma P_{f(x)}\,Q_{e(y)} \qquad (16) \end{aligned}$$

which, using r to denote the official exchange rate, may also be expressed as [2]

$$\Sigma Q_{d(y)}[P_{f(x)} - P_{d(x)}] + \Sigma Q_{m(y)}[P_{f(x)} - rP_{m(y)}] - \Sigma Q_{e(y)}[P_{f(x)} - rP_{e(y)}] \qquad (17)$$

The three terms given in equation (17) then give us the three components of the foreign trade adjustment which may be described as follows :

1. Country Y's domestic production valued at Country X's production prices must be adjusted to allow for differences between production prices and final prices in X. X's final prices depend, of course, not only on production but upon the import and export prices of the separate commodities.
2. Country Y's imports, valued at country X's final prices, must be adjusted to allow for differences between X's final prices and Y's import prices converted at the official exchange rate.
3. Similarly Y's exports must be adjusted for differences between X's final price and Y's export price converted at the official rate.

1. Retail transport and distribution then become additional items in the total, for which there is no import or export item.
2. This form of the equation is obtained by adding to equation (16)
$$r\Sigma Q_{e(y)}P_{e(y)} - r\Sigma Q_{m(y)}P_{m(y)}$$
i. e. the total of Y's imports and exports converted at the official exchange rate. Since net exports are assumed to be zero, and both imports and exports are converted by a constant, this leaves the total unchanged.

Revaluation of Domestic Output at Final Prices

This adjustment is represented by the first term of equation (17) above. The comparisons are made at factor cost, and owing to the effects of tariffs and subsidies the most usual case is that the import price is lower than the domestic production price. Unless there is a large offsetting export price differential, final prices will then also be below production prices, and thus a negative adjustment is most probable.

In principle, the adjustment is required for all country X's domestic production falling within the following two categories:[1]

i) Items produced and imported by X (i.e., the country whose price weights are used) at different prices ;
ii) Items produced by X, partly for export, which are sold abroad at differential prices.

Whether in fact the adjustment required for any particular commodity is large enough to be of practical significance depends, of course, both on the volume of Y's production, and the extent of the difference between X's production and final prices. There will only be an appreciable price difference if, in addition to an appreciable margin between import (or export) prices and production prices, the relative quantities entering international trade are large enough to affect significantly the weighted average.

In the present investigation it was found that the revaluation of American domestic output in British final prices was of considerable importance for certain items. These were mainly agricultural commodities of which the United States has a large output, and for which British final prices are substantially below production prices (owing to cheap imports). Similarly, the exported proportion of British output of many classes of manufactured goods was sufficiently large for final internal prices to be affected by differential export prices. No account could be taken of this, however, on account of the difficulties of estimating the differentials concerned. No adjustment was made for the corresponding revaluation of British output in American prices because in nearly all cases the volume of American foreign trade is too small in relation to home production for the average final prices to be significantly affected.[2]

Revaluation of Imports

The adjustment required here is represented by the second term of equation (17). Its importance is, of course, determined both by the

1. The categories excluded for which no adjustment is required are the following :
   i) Items that do not enter foreign trade at all (e. g. haircuts, bread, retail distribution, etc.). For these $P_{f(x)} = P_{d(x)}$.
   ii) Unique commodities of country Y not produced by X for which there is therefore no $P_{d(x)}$. To the extent that these are imported by X we try to value them at X's import price. In this case $P_{f(x)} = P_{m(x)}$ and no adjustment is needed.
   iii) Items produced by X only for export. In this case $P_{f(x)}$ does not exist, $P_{d(x)} = P_{e(x)}$, and there is no basis for adjustment. In the present study freight shipping services were treated entirely as an export and, therefore, fall into this category. (See Chapter IV).
2. The only exception to this is in the case of some agricultural items where, owing to the incidence of subsidies, exports may occur at differential prices. British production of these commodities, however, is small.

volume of Y's imports, and the difference in price level between X's final prices and the original values converted at the official rate. The extent and direction of the price difference will depend upon three main factors :

i) Where country X meets its requirements of a certain commodity from a protected home industry while Y's supplies are obtained in world markets, the adjustment will tend to be positive, and in some cases substantial ;

ii) For commodities that Y imports and X exports—in the absence of substantial export price differentials—a rather small negative adjustment is likely, corresponding roughly to the extra transport costs incurred by X ;

iii) For commodities that neither country produces in significant quantity, which constitute the bulk of the remainder, there would be no adjustment if both countries were trading in a perfect world market. In practice, of course, preferential trade agreements and currency limitations may lead to quite large differences in particular items, but the direction of the adjustment will depend entirely on the trading position of the two countries.

In the present study the data available did not permit us to take account of adjustments in the last of these three categories and it had to be assumed that on balance both countries were buying at world prices the goods that neither produced.

As these goods accounted for 70 per cent of United States imports, very little adjustment was required in the evaluation of American imports at British final prices. In the evaluation of United Kingdom imports at United States final prices, however, quite substantial adjustments were called for. For some items, such as petroleum and certain fruits and vegetables, these adjustments reflected the extra transport costs incurred by Britain through having to import items which the United States produces at highly competitive prices, but these were greatly outweighed by adjustments on items such as meat and dairy produce which the United Kingdom buys abroad considerably more cheaply than the United States produces them for its home market.

Revaluation of Exports

The export adjustment required is given by the third term of equation (17). The difference between the value of Y's exports, converted at the official rate, and Y's final prices depends primarily upon the difference in the two countries' production costs, revealed in the gross domestic product comparison. It will, however, also be affected by export price differentials in country Y, and the divergences already discussed between X's production and final prices.

As already stated, it was not possible in practice to take account of differential export prices. The adjustment made in this investigation for the revaluation of United Kingdom exports in American prices was quite substantial, but arises solely from the fact that British exports are almost entirely of manufactured goods, and for these, price ratios in 1950 were below the official rate, in $ per £, even after allowance for

the fact that total costs were relatively less favourable to the United Kingdom than net costs.[1]

For the United States the net adjustment required was rather small because relatively high price ratios for manufactured goods, less favourable to the United States than the official rate, were largely offset by the American price advantage in cotton, tobacco, and a few other staple raw materials.

Comparison with the Standard Intertemporal Terms of Trade Adjustment

Conceptually, the formulae given in the preceding paragraphs are equally applicable to a comparison of two different periods of time in one country. The usual intertemporal terms of trade adjustment, however, only covers the effect of revaluing imports and exports in the respective import and export prices of the base period. It is, therefore, of some interest to consider the relationship between the two approaches. In fact, the simpler intertemporal adjustment can be identified with the formulae given above if two assumptions are made. These are :

i) That the export price of any item is identical with that at which it is sold on the home market ;

ii) That differences between prices of imports and home produced goods reflect quality differences that should properly be measured in a final output comparison.[2]

The first of these assumptions may be factually incorrect, but is nevertheless often the only practical possibility because of the difficulty of measuring export price differentials. The second assumption is subject to serious objection because the comparisons are made at factor cost. Thus, it may be permissible to assume that differences in market prices reflect corresponding quality differences, but it is quite unacceptable to assume that factor cost differences arising from tariffs and domestic subsidies do so.

In the rather crude calculations made for the present study it was found that about 60 per cent of United Kingdom food imports were of items also produced internally in significant quantities, and that the prices of these, at factor cost, were some 8 per cent below domestic production prices. The method of evaluation used was not entirely appropriate to an intertemporal comparison but probably gives the order of magnitude involved,[3] and shows that as between periods when the propor-

1. See Chapter III.

2. In this case the imported and the home produced goods may be regarded throughout as separate commodities. It then follows from the two assumptions that for all home produced items $P_{d(x)} = P_{e(x)} = P_{f(x)}$, and for all imported items $P_{f(x)} = P_{m(x)}$. Thus, the first term of equation (17) above becomes zero, and the price elements of the other two terms are equal to $P_{m(x)} - P_{m(y)}$, and $P_{e(x)} - P_{e(y)}$ respectively.

3. The difference here is that for our purpose it was necessary to use the same assumptions regarding qualities as were used in comparing domestic output. Otherwise the absurd situation arises that, for example, British wheat is assumed equal in quality to American wheat, but wheat imported by the United Kingdom from the United States is of different quality. For this reason, quality differences which would be relevant in an intertemporal comparison were deliberately excluded. This is not, however, likely to affect greatly the averages given above, as the quality differences ignored were not all in the same direction.

tion of imported food had changed, the adjustment called for would not be insignificant.[1]

Technical Notes on the Double Indicator Method

1. *Miscellaneous Inputs in the Double Indicator Formula*

In any application of the double indicator formula there will almost certainly be a heterogeneous group of miscellaneous inputs for which no direct comparison can be made. The conversion of value series by a price index[2] is frequently undesirable because the values are usually a residual containing a high margin of error. There are three remaining possibilities : miscellaneous unmeasured inputs may be assumed to move with those of measured inputs, with gross output, or with net output. For different industries different assumptions may be more plausible, but, in practice, the assumption that the miscellaneous unmeasured inputs will move with the measured ones seems the least fruitful because the latter frequently reflect definite differences in production techniques, such as larger fuel inputs reflecting older and less efficient equipment, while the miscellaneous inputs include the very general elements of production, such as packing materials, office supplies, and communications whose use depends rather on the general levels of activity. It is more reasonable, therefore, to assume that unmeasured inputs move either with gross or with net output. If their quantities are allowed to move with gross output the method is the same as in equation (10) above. If they are assumed to move with net output no measure is required since

$$\frac{\Sigma K_{(x)}\ \bar{q}_{n(x)}}{\Sigma K_{(x)}} = \bar{q}_{n(x)}$$

Thus in fact we assume that

$$\bar{q}_{n(x)} = \frac{\Sigma G_{(x)}\bar{q}_{g(x)} - \Sigma K_{(x)}\ \bar{q}_{n(x)} - \Sigma J_{(x)}\ \bar{q}_{j(x)}}{\Sigma G_{(x)} - \Sigma K_{(x)} - \Sigma J_{(x)}}$$

from which, multiplying both sides by the right hand denominator

$$\bar{q}_{n(x)} = \frac{\Sigma G_{(x)}\ q_{g(x)} - \Sigma J_{(x)}\ q_{j(x)}}{\Sigma G_{(x)} - \Sigma J_{(x)}}$$

From a technical point of view this is the most satisfactory approach because errors in our information about the miscellaneous inputs do not affect the aggregate quantity index (though they will of course influence the total net price index). Logically, too, it is often the most reasonable assumption. In agriculture, for example, the net output index of the United States, relative to the United Kingdom, is higher than the gross output index largely because the United States supplies from its own resources certain feeding stuffs whereas Britain relies upon imports for

1. The calculation of the adjustment presents practical difficulties because of the quality factors mentioned in note (3), page 91. These do not, however, appear insuperable if it is accepted that market price differences reflect real quality differences.
2. See Chapter VII.

its supplies. This additional intermediate activity requires additional inputs, so that it is reasonable to measure the miscellaneous inputs by the higher net index.

2. *The Effect of the Double Indicator Method on the Index Number Spread*

It is of interest to note that the use of the double indicator method also influences the total index number spread in the final index. When output is measured by several indicators the spread between the aggregate X and Y weighted indices nearly always give results more favourable to X when output is weighted by Y's prices and vice versa. This is to be expected from the fact that each country tends to produce more of the items for which its prices are low, so that its relative output is increased when these special lines are weighted by the other countries' higher prices. When inputs are deducted the effect is to reduce or even reverse this spread, because each country is more efficient in its own prices, and net output appears smaller when inputs are deducted at prices irrelevant to the actual market position. If single indicators are used throughout, therefore, a wider index number spread would be obtained than when double indicators are employed. This reflects the fact that part of the diversity of the production pattern is in substitutable intermediate products, such as different types of fuels, which are cancelled out in the double indicator measure.

VII

SELECTION OF INDICATORS

In the last chapter the different methods of comparing net output were considered, and it was seen that indicators may be chosen either to compare gross output and inputs separately, or to give an approximate direct measure of net output. Whichever method is adopted indicators of various types may be used. The formulae given above are applicable to a direct quantity comparison using indicators that measure the volume of gross output and inputs, or net output. With suitable adaptation the same formulae can be used to calculate appropriate price and cost indices which may be applied to convert the value estimates in the original currencies. Where neither direct price nor quantity comparisons are possible resort has to be made to cruder indicators, such as employment with or without adjustment for differences in productivity. However, before proceeding to discuss the implications of these different kinds of indicators it is necessary to consider the formulae required for price comparisons.

Price Index Formulae

In interspatial comparisons the price relatives of individual commodities are spread over a wide range, and consequently the choice of the best indicators and weights is as important as when quantity indicators are used. Any of the formulae discussed in the previous chapter may be adapted to measure price instead of quantity relationships. The simplest index is one applicable to total factory prices of either purchases or sales. Expressed in terms of quantities and prices :

$$\bar{P}_{(x)} = \frac{P_{(y)}\,Q_{(x)}}{P_{(x)}\,Q_{(x)}} \quad \text{and} \quad \bar{P}_{(y)} = \frac{P_{(y)}\,Q_{(y)}}{P_{(x)}\,Q_{(y)}}$$

Comparison of these indices with the quantity indices previously quoted gives the "golden rule" of price comparisons, namely, that a Y-weighted price index must be used to obtain an X-weighted quantity index and vice versa.[1] This index can be used to calculate a quantity index for

1. $$\bar{q}_{(x)} = \frac{P_{(x)}Q_{(y)}}{P_{(x)}Q_{(x)}} = \frac{P_{(y)}Q_{(y)}}{P_{(x)}Q_{(x)}} \cdot \frac{P_{(x)}Q_{(y)}}{P_{(y)}Q_{(y)}}$$
$$= \frac{P_{(y)}Q_{(y)}}{P_{(x)}Q_{(x)}} \cdot \frac{1}{\bar{P}_{(y)}}$$

either gross output or inputs, from the value series G_x and G_y with price ratios p_g, or from the series I_x and I_y with ratios p_i.

It often happens, however, that the data available are inadequate for a complete double indicator calculation, and it would be preferable to calculate the net output quantity index q_n directly. The initial price comparisons made provide gross price ratios, p_g. The ratio of material costs between countries is liable to differ markedly from the unit labour and capital costs which are the main determinants of relative net cost, p_n. Serious errors would arise, therefore, from the assumption that $p_n = p_g$. Three courses are open :

1. The gross price ratio, p_g, can be used to convert gross sales values and derive q_g. We then assume that inputs and outputs are proportionate so that $q_g = q_n$.

This method was used in the present study for some service industries where gross price ratios and values were available but data on inputs were lacking. It could not be employed in manufacturing as gross value in census of production data are unreliable for just those heterogeneous industries that require comparison.[1]

2. In principle, net costs for each country could be calculated directly by deducting the cost of materials from the selling price of the commodity, thus obtaining a direct estimate of the net cost ratio. In practice, however, it is difficult to obtain net cost estimates for individual commodities that are accurate enough for this purpose because of the problems of joint costs.[2]

3. The double indicator method may be applied with rather crudely estimated weights and input prices, not with the object of adjusting the indices for differences between the countries in the volume of inputs per unit of output but merely to correct the price ratios for major divergences between prices of materials and net costs. This method was used in the present study in a number of manufacturing industries where, for reasons discussed in the last chapter, the single indicator method was preferred as giving the best final product index from the data available. The assumption made was that the volume of inputs of the main specific materials was, for technological reasons, fairly similar in the two countries, and so a rather crude adjustment for conspicuous price differences could be made to correct the gross price index. In such cases, even if a detailed input price index cannot be constructed sufficient data may be obtained from the production censuses and from the output comparisons of other industries to cover the main items and to provide approximate weights. The double indicator formula may then be used in a form corresponding to that given in Chapter VI for the partial deduction of inputs, viz.

1. This is because they contain a large volume of double-counting due to intra-industry sales of semi-finished products and components.
2. See Chapter VI, p. 77.

$$p_{n(x)} = p_{g(x)} + \frac{I_{(x)}}{N_{(x)}} (p_{g(x)} - p_{i(x)})$$

Then $q_{n(y)} = \frac{N_{(y)}}{N_{(x)}} \cdot \frac{1}{p_{n(x)}}$ and similarly for $q_{n(x)}$.

Price indices for the completion of the formulae may be obtained either by the comparison of prices for identical goods by means of special surveys, or the study of catalogue prices, or by comparing average values obtained from quantity and value data given in the production censuses and similar sources. The implications of a price comparison depend on the type of information used. In particular, an average value comparison carries much the same assumptions as a direct quantity comparison, and it will be convenient, therefore, to consider these together before discussing the independent price indices.

Quantity and Average Value Comparisons

In a direct quantity comparison, whether of gross or net output, the aim is to select indicators that give the maximum coverage for each industry while representing commodities or commodity groups that are as nearly as possible identical in the two countries. This can be done partly by sub-division of indicators for different grades or qualities of product, partly by adjustment of the quantity series to allow for variations in average quality, and occasionally by the use of two or more indicators to measure different attributes of the same commodity or service.

Limits are set to the sub-division of indicators by classification differences in the original data, and by the difficulty previously discussed of obtaining net output weights where a very fine commodity classification is adopted. A common cause of difficulty is a different basis of classification in the two countries such that conversion factors are difficult to obtain or are only approximate. Even when the same technical units are used, however, the group intervals for the commodity classes may not be identical in the two countries, thus making it impossible to establish comparable classifications for more than a few broad groups.[1]

Adjustment of quantity indicators for quality variations can usually only measure the more striking variations. In the motor vehicle industry for example, some account must obviously be taken of the difference in the average size of British and American cars, but the "standard car" compared may still contain many other quality differences, apart from overall size, of which no account can be taken.

The use of several indicators to measure different attributes of one commodity presents considerable difficulty in finding correct weights for the indicators. In principle, the weights should be based on the share of net costs attributable to the different qualities measured, but

1. In such cases it may be preferable to assume a similar size distribution where this is determined largely by factors such as the age structure of the populations or technological requirements, rather than to base a comparison on differently defined commodity classes.

in practice this can usually be only arbitrarily assessed. Thus in the present investigation it was clearly necessary to take account of the differences in size of British and American newspapers, and this was done by using indicators both of circulation and of paper input, but it was extremely difficult to assess the relative production costs of small and large newspapers.

The general advantages of the quantity approach are that the data are usually available in published material without special fieldwork, and that a large part of the output of an industry is measured directly, if crudely, without assuming that total production moves with the small sample compared. Against this must be offset the fact that quantity comparisons based on the data normally available ignore many quality differences. The loss of accuracy is, as we have seen, likely to be smaller in a single indicator industry index where individual comparisons are concerned with separate production processes, than it would be if applied crudely to an expenditure comparison. All the same it is often by no means negligible.

In some industries quantity indicators can be more conveniently derived using inputs rather than gross output. This applies particularly to industries such as the printing and furniture industries, where the main input material is rather homogeneous, but output highly heterogeneous. In general, this measure gives rather crude results because the value added per unit of input may vary widely according to the products made, but it has the advantage of giving complete coverage to industries where a price or quantity comparison based on the final products could only cover a small part of total output.

Apart from these rather crude input comparisons, quantity indicators can seldom be found that cover the whole production of a particular industry. Generally there is a residual group of products for which indicators cannot be obtained because the products are unique to one country, very different in quality, or too heterogeneous to measure in simple quantity units ; or because of statistical difficulties in obtaining comparable breakdowns. It may then be assumed that either the price, or the quantity, of the unmeasured items moves with that of the measured ones. In monthly intertemporal indices it is usually necessary to assume that the quantities are related because the value series required for a price deflation are not available on a monthly basis. In this case the weights attributable to the indicators used are increased to include all the output of the group, but no change is made in the quantity index. This procedure is more vulnerable in international comparisons, because the composition of output varies widely from country to country, but often there is no practical alternative. In the case of by-products, production may be related to that of the main product by some more or less fixed technical relationship, but relative prices of the main product and the by-product may vary widely according to demand. It then appears justifiable to assume, say, that the output of the by-products of coke ovens moves with the coke indicator. In other industries, particularly in the engineering and vehicle groups, the gross output values available contain substantial double counting because they include intra-industry sales of parts and components. There is then no alternative but to assume that production of replacement parts (which is

recorded under the same headings as the intra-industry sales) is a fixed proportion of the production of the major products.

When possible, however, it is preferable to assume that the prices rather than the quantities of unmeasured output are related to those of the major products. If only one indicator is used to measure the output of a single major product this may be done by expressing the output of miscellaneous items in terms of a standard commodity, i.e. by increasing the volume indicator proportionately to the value of the unmeasured output. If several major product indicators are used it is easier to calculate the average value ratio and apply this to the value of output. This is, however, only another way of looking at the same operation, and in both cases the same assumption is made, namely, that the price relationships of the unmeasured items are the same as those of the major products.

Thus, at a certain point a direct quantity comparison in which some unmeasured products are assumed to have the same price relationship as those compared becomes indistinguishable from an average value comparison based on a sample of products. In some industries, such as chemicals, however, measurement is complicated, not by quality variation in the individual commodities, but by the enormous number of products manufactured, none of them accounting for more than a few per cent of the total value of output. Commodities have then to be selected for comparison not because they account directly for a large proportion of output but because they are typical products of the industry in both countries, whose prices do not appear to be influenced by any special factor favouring one country only. The sample is thus selected to be as representative as possible of the general price level of the industry and, in particular cases, the inclusion of commodities from other closely related industries may be justified if they appear to be produced under similar conditions, although they are not actually in the population covered by the index.

The chemical industry is particularly suited to a price comparison of this sort, because many basic chemicals are defined by their scientific formula, leaving virtually no room for quality variation. In some other industries a sample of homogeneous products can be selected, although they are not identical products, as basic chemicals may well be. When average value comparisons have to be based on commodities that admit of a good deal of quality variation, the margin of error may become substantial because a double risk is incurred, firstly, that the price ratio is not a true one because of unmeasured quality differences—a risk inherent in any quantity comparison—and, secondly, that the prices of other products in the industry may not in fact move with those of the sample selected.

Independent Price Comparisons

An independent price comparison based on specially collected series is the only feasible approach to heterogeneous industries such as those manufacturing engineering products, radios or cameras. In such a comparison the identity of the products compared is established by field work or examination of detailed specifications. The methods used

were described in the report on the expenditure studies,[1] and the same data were employed for the present investigation, supplemented by additional information collected for this study. The main difficulties in using the additional price information arise from the fact that the sample is necessarily an exceedingly small one. In the first place it is not always possible to ensure that the quotations obtained are representative of the national average prices of the commodity[2] and, secondly, it is even more uncertain that the items priced are typical of the whole group to be measured. Many items have to be omitted from the sample because the products made are not identical in both countries, or because, as in the case of much specialised industrial machinery, production is carried out on a bespoke basis and list prices do not exist.

The use of a rather small sample, which often shows a wide dispersion of individual ratios, introduces difficult weighting problems. In this respect the industry classification has certain advantages over the expenditure one, both because more detailed value series are usually available for weighting purposes, and because an industry classification, which groups together products made largely in the same establishments, will generally give a narrower dispersion of price relatives than the wide classification by type of user. Even so, a wide price dispersion for a particular industry is often found. If sufficient quotations are available, and the data show a clustering of ratios about a "typical price level", then the use of a median or mode may be more satisfactory than that of a weighted average on the grounds that the extreme ratios may refer either to isolated special cases, or undetected quality differences. If, as in the machine tools industry in the present study, no typical ratio for the whole industry exists, it is necessary to weight the ratios by allocating the weights of the unpriced items to the price ratios of commodities that appear to be influenced by similar cost factors. This necessarily involves some arbitrary decisions.

Other Indicators

When the data do not permit a direct comparison with either price or quantity indicators, some cruder type of measure has to be made. Often the only possibility is to assume that either the price or the productivity relationships are the same as in some associated industry. If the price relationships are assumed to be the same then the industry is treated in the same way as are treated the unmeasured products of an industry for which a price or quantity comparison has been made. The only difference is that when this method is applied to an entire industry net output values are available to which the net cost ratio selected may be directly applied.

When possible, however, it is usually preferable to assume that productivity relationships are the same as those in some other industry or group of industries. This is partly because productivity relationships

1. Gilbert and Kravis, *op. cit.*, pp. 132-5 and pp. 185-192.
2. In the expenditure study this difficulty could be largely met for consumers' goods by relating prices collected to those collected for more broadly based internal indices, but data were not generally available to make this type of adjustment for producers durables.

are more directly determined by technical factors and less liable to random fluctuation than net costs in which price fixing, monopoly profits and cyclical movements play a substantial part. In addition, however, owing to difficulty in estimating some non-wage costs for individual industries it was considered that in the present study the employment estimates were generally more reliable than the net output estimates.

Employment indicators may also occasionally be used with an adjustment for productivity based on some independent appraisal for the industry concerned,[1] and in some industries they provide the only possible measure of output although no adjustment for productivity differences is feasible. Thus in health, education, government, and some professional services, adjustment for differences in the output of the professional personnel employed would involve value judgments beyond the scope of economic measurement.

Finally, mention should be made of the use of substitute indicators based on some activity which is likely to be correlated with that which it is desired to measure. Thus, in the absence of other data, it might, for example, be possible to assume that, in an intertemporal comparison, some final requirements varied with temperature. In comparisons between countries such assumptions are, of course, liable to a high degree of error, but in the present study it was found that it was preferable to assume that some transport inputs moved with various activity indicators, such as vehicle miles, rather than to make no adjustment for differences in inputs per unit of output.[2]

The Choice between Indicators

It should be noted that there is a considerable practical advantage in using either price or quantity comparisons consistently for the individual industries in a major group or sector. This is because the net output value estimates for broad groups are generally fairly reliable, while those for individual small industries may contain a fairly large margin of error as a result of classification difficulties. It can be shown that, if price (or quantity) comparisons are used throughout the group, errors in the individual industries, arising from unreliable net output figures, tend to be offsetting and the error in the total index will be rather small. If, however, price comparisons are used for some industries and quantity comparisons for others, there is no compensating effect, and errors in the net output estimates for individual industries will be carried into the total for the group. In the present study, we found that for the majority of industries the nature of the products and data available did not leave much choice in the selection of methods, but whenever there was any alternative, price comparisons were made in groups and sectors in which the price method had already been used predominantly, and a crude quantity index was preferred to the application of a price index in a group where the comparisons were already based mainly upon quantity series.

1. This was done in the comparison of the construction industry in the present study (see Appendix C, Construction).
2. See Appendix C, Transport.

In conclusion, it is desirable to give some indication of the contribution of the various methods to the final result of the investigation but this can only be rather crudely estimated. In the first place, as explained above, the distinction between price and quantity comparisons is sometimes rather arbitrary. Also, particularly in the industries for which reliable comparisons were difficult to make, two methods were often applied as a check, and in such cases it is rather misleading to assign the result to the one employed in the final calculations, since both were taken into account in accepting this. A further complication is introduced because business services were assumed to move with the general index, and distribution was largely measured by using adjusted indices from the production sectors. The estimates given in the following table are intended, therefore, to give merely a broad indication of the relative importance in the study of the various methods described above.

TABLE 19. SHARE OF THE COMPARISON CONTRIBUTED BY DIFFERENT TYPES OF INDICATORS[1]

In % of U.K. net output.

METHOD	MANUFACTURING	ALL SECTORS
Industries based mainly on quantity comparisons	59	43
of which, input comparisons	(8)	(5)
Industries based mainly on price comparisons	29	15
of which, independent price series	(10)	(5)
Industries based on employment indicators	12	26
Industries with derived quantity indicators[2]	—	16
	100	100

1. As the breakdown is very rough, it is only given at U.K. weights, but the distribution at U.S. weights is not very different.
2. I.e. distribution and business services, which were mainly measured by output ratios of other industries.

VIII

THE INDUSTRY AND EXPENDITURE APPROACHES COMPARED

Following the description in the preceding chapters of the methods used in the present study and the type of results obtained, it is now possible to compare the industry method with the expenditure method followed in the earlier studies. In this chapter, after a brief recapitulation of the conceptual relationship between the two methods, there is a discussion of the value of the individual industry results which are obtained by the industry method, and finally a short general survey of the relative statistical advantages and disadvantages of the two approaches.

THE CONCEPTUAL IDENTITY OF THE TWO APPROACHES

It has already been explained in Chapter VI above that, whether the expenditure or the industry approach is adopted, the concept of total real product which one is trying to measure is the same. There may, of course, be differences of opinion as to which concept of total real product is the most useful for analytical purposes ; for example, different views may be held as to whether the real product should be net or gross of depreciation or which government (or other) services should be regarded as entering into it. But these differences have nothing to do with the choice of method used for measurement. The method used in practice must be consistent with whatever view of real product it has been decided to adopt. This means, quite simply, that a difference in method of measurement should not itself give rise to an independent and different concept of what it is that is being measured.

This conceptual identity is illustrated most clearly by consideration of the double indicator method. As has been explained in Chapter VI, if it were possible to carry out a double indicator comparison by means of complete input-output tables (of quantities *and* prices) for the two situations being compared, all intermediate transactions would cancel out and the remaining aggregate value of net outputs for all the industries identified would necessarily be identical to the aggregate of final demands.[1] In comparing two situations with the aid of such tables,

1. For a formal proof see J.R.N. Stone, "Quantity and Price Indexes in National Accounts", O.E.E.C., Paris, 1956, pp. 39-44.

the results obtained by the two methods could only diverge for purely statistical reasons, such as small changes in the final product estimates resulting from differences in classification of the items.

We have seen, however, that it has not been possible, in practice, to use a full double indicator method, and that, in fact, if all the data required for such a method were available there might be little point in using the data in this way rather than simply comparing the final demand data contained therein. A mixture of various techniques has, therefore, been adopted in the industry approach : double-indicators for some sectors, single indicators for others, and for some the ring-fence short cut. It has also been argued that given this mixture of techniques the single-indicator method has been deliberately chosen for some sectors, even where crude double indicators might have been used, because it was considered that in these industries single indicator comparisons were likely to give a more accurate measure of total real output.

This claim is made because, in some instances, the use of single indicators enables the investigator, by greater exploitation of published production data,[1] to measure aspects of the real product (mainly quality differences) better than they can be measured in an expenditure comparison, given limited time and resources. Each single indicator is only required to measure an individual production process, for which relatively crude quantity comparison is often permissible in industries where it could not be applied to the complete product without great loss of quality differentiation.[2] Therefore, provided that technology is rather similar in the two countries, the single indicator assumption of constant input/output ratios may produce smaller statistical errors than those resulting from quantity comparisons of end products, or price comparisons based on rather small samples.

It is thus clear that there may be *statistical* independence between the industry and expenditure method, without any conceptual independence. Where the single indicator method is used, in order to make appropriate allowance for quality differences, this is because the differences in question are recognised as being appropriate to include in the concept of the real product.[3]

The Significance of Individual Industry Comparisons

Whatever the merits of the industry method as an alternative approach for the comparison of the total final product, its particular value lies in the fact that it is only by this method that we can obtain information on the relative contributions of different industries to the aggregate result. However, the individual industry indices present conceptual difficulties that are inherent in the comparison of net output in two situations where prices and quantities of inputs are different.

1. In particular the wealth of material available in the production censuses.
2. See Chapter VI.
3. If, for example, we decide to use single indicators in the engineering and metal production industries, so that steel output is not deducted, this is because we believe that differences in the steel output of the two countries will reflect differences (that we are not otherwise able to measure) in the engineering and metal products entering final demand.

The conceptual problem can be clearly seen when the double indicator method is employed. In this case we compare the value added in a particular industry in Country X with that of the same industry in Country Y, Y's net output being valued on the basis of its own input coefficients but X's price structure. This is of course a situation which could not occur in reality. Were entrepreneurs in Country Y actually operating in the prices of Country X their input coefficients would be quite different.

This is the counterpart of the problem found in expenditure comparisons, when relative prices and quantities differ substantially. It is difficult, for example, to attach meaning to a comparison that values the Frenchman's consumption of wine in English prices, and the Englishman's consumption of tea in French prices, because we know that if presented with the other country's price relationships either party would change his consumption pattern substantially. However, in a production comparison that applies artificial prices both to gross output and to inputs (leaving net output as a residual) the problem appears in a particularly acute form because the inherent inconsistencies of the situation are concentrated on the balancing item, and may produce strange results, such as the familiar example of an extremely small or even negative net output.

Consequently, it may at first appear that single indicator comparisons can give more meaningful results for the individual industries. This is, however, not the case. The use of single indicators is only justified on the assumption that input/output relationships are rather similar. If the assumption is correct, approximately the same results are obtained as by double indicators (apart from actual measurement problems) and the conceptual difficulty discussed above is of no great practical importance. If input coefficients in the two situations vary substantially, then the single indicator comparison simply does not give us a correct measure of net output. In such cases it may, of course, be of interest to make single indicator comparisons of gross output, in order to compare the production of a particular group of commodities in the two countries, but this does not give us what we are wanting to measure. If the input coefficients differ substantially, such production comparisons tell us little or nothing about the relative contribution of the industry to the economy, and cannot be related to the factors of production employed in the industry to give valid productivity comparisons.[1]

The conceptual difficulty of comparing real net output in two different situations, does not, at least in the majority of cases, debar reasonably precise and meaningful conclusions about the actual relationships. If input coefficients and price structures are different, it cannot be *proved* that the industry of one country is more productive than that of the other, but if the differences in the index are moderately large, and the structural divergences fairly small, the results become acceptable for most purposes.[2]

1. This is most obvious in a comparison (such as that of British and American agriculture), where Country X relies extensively on imports from outside the economy to replace intermediate products produced within the economy of Country Y.
2. See I.M.D. Little, *A Critique of Welfare Economics*, Oxford, 1950, p. 218, for a discussion of the parallel problem in consumption comparisons.

In a comparison between countries at a broadly similar level of economic development, the industries compared may be divided into four categories :

1. Industries in which the input coefficients for the two countries are broadly similar[1] because they are mainly determined by technological factors, substitution as the result of price differences being mainly limited to marginal items, and interchange of factors (e.g. capital and labour) within the industry. For these industries single and double indicators will give rather similar results, and the conceptual problem is of little importance.[2]
2. Industries in which input coefficients vary substantially, but price relatives are not too widely dispersed, so that in either country's price structure the industry in Country X uses substantially more inputs per unit of output than that in Country Y. Here, allowance for input differences is essential, and the result leaves us in no doubt that the industry of Country Y in fact has a higher value added per unit of gross output.
3. Industries in which both input coefficients and price relatives differ widely in the two countries, so that comparison in terms of X's input ratios and Y's prices produces absurd results, and possibly even negative net output. For such industries some form of double indicator calculation is essential to obtain a true aggregate real product index,[3] but the production structures of the two industries are too diverse for any meaningful result to be obtainable for the individual industry. If, however, industries can be grouped in such a way that the inputs into the group as a whole are fairly comparable—or form so small a part of gross output as to be unimportant—highly interesting and meaningful results can be obtained.[4]
4. The final category comprises those industries whose input coefficients vary substantially in response to price variations, each country appearing to be more "efficient" in its own price structure. In such cases, of course, net output indices show a wide index number spread, and the difference between the net and gross output levels is more or less indeterminate. In the present study industries of this class did not appear to be of great practical importance.[5] One cannot generalise on so limited an experience, but it would appear that, apart from the fuel conversion and extractive industries, major input variations are most often associated with important differences in the quality and product mix of gross output, so that the industries most affected, such as the construction industry, are difficult to compare even using the output approach.

1. Or can be made similar by treating directly substitutable items (such as wooden or steel pitprops, or different fuels) as one commodity with appropriate quality adjustment.
2. Given modern interchange of technological knowledge, it may well be that more industries come within this category in an interspatial comparison between developed countries, than in a medium term intertemporal comparison.
3. See Chapter VI.
4. Thus little meaning can be attributed to a double indicator comparison of hydro-electric power and electricity produced from coal. In these circumstances, however, an extremely instructive comparison can be made if coal mining and electricity are combined in one sector, and their joint net output is compared. In this form we are able to appraise the full contribution made to total productivity by the availability and exploitation of water power.
5. This may, of course, have been partly due to the fact that only limited data were available for experiment with the use of double indicators.

To sum up then, it appears that the conceptual problem of comparing net outputs of individual industries with different input coefficients and price structures cannot be ignored, since for certain industries individual comparisons may have little meaning. Such industries are, however, relatively few in number, and a "correct" if rather valueless calculation of their net output enables us to obtain a true total index, and to obtain interesting and meaningful results for the great majority of industries, for which the conceptual limitations have small practical application. Moreover, even among the few "meaningless" industries, interesting results can be obtained by using wider definitions of the industry to obtain more comparable aggregates.

Consumption Compared by Industry of Origin

We have seen that the conceptual identity of the industry and expenditure methods lies in the fact that, after adjustment for foreign trade, both methods require the comparison of an identical final bill of goods and services. If we could use double indicators throughout, and arrange the data in input-output table form, this identity could be traced through to the various expenditure classes that make up final demand.

With the combination of methods that was used in the present study, a complete reconciliation of this kind is, of course, impossible. In Table 20, however, a rough attempt is made to estimate relative consumption of food, beverages and tobacco products in the United Kingdom and the United States, from the results obtained in the industry study. The method adopted is to combine the gross output of agriculture, with the net output of the food, beverage, and tobacco processing industries, making appropriate adjustments for foreign trade, and for a few of the more important non-food products of the industries covered.

The object of this estimate is primarily to demonstrate how, in principle, final expenditure indices can be built up from the output indices of the various contributory sectors. The food and agriculture industries were selected for this experiment because they constitute a relatively self-contained group whose transactions with other commodity producing industries are relatively small.[1] The consumption indices thus obtained show United States consumption to be about 460 per cent of that of the United Kingdom, measured at British producer's prices, and about 390 per cent measured at the corresponding American prices. These indices are about 10 to 15 per cent more favourable to the United States than those obtained in the expenditure study (in which retail prices were measured at factor cost). The margin of error in the produc-

1. The inputs of services, especially transport and distribution, are, of course, considerable, but they can be ignored for the present purpose, as they are considered to add to the cost but not the quantity of final output.

tion to consumption calculation is, however, considerable,[1] and no account has been taken of the effects on the indices of the way in which inputs were handled in the study.[2] This comparison should not, therefore, be regarded as a check on the implied relationship of the industry and expenditure studies for these categories.

TABLE 20. ESTIMATION BY INDUSTRY OF ORIGIN OF CONSUMPTION OF FOOD, BEVERAGES AND TOBACCO IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950

	INPUTS MEASURED U. K. PRICES £ MILLION		INPUTS MEASURED U. S. PRICES $ MILLION		VOLUME INDEX U.K. = 100 BASED ON	
	U.S.	U.K.	U.S.	U.K.	U.K. PRICES	U.S. PRICES
	1	2	3	4	5	6
1. Gross output of agriculture and fisheries	10,300	1,006	27,450	3,020	1,024	909
2. Less fibres and other industrial raw materials	— 1,110	— 38	— 3,110	— 150		
3. Agricultural food and feed output (1)-(2)	9,190	968	24,340	2,870	905	811
4. Value added in the food, beverage, tobacco and vegetable oil industries	2,390	511	9,750	2,320	468	420
5. Net import and foreign trade adjustment	— 370	+ 988	+ 150	+ 3,660		
6. Total of (3) to (5)	11,210	2,467	34,240	8,850	454	387
7. Animal feeds, inedible oils, and industrial alcohol included in (6)	— 650	— 166	— 1,800	— 450	394	400
8. Food, beverage and tobacco consumption measured at factory prices (6)-(7)	10,560	2,301	32,440	8,400	459	386

NOTES. Lines 1-2 Derived from the agriculture comparison.
4. Derived from the manufacturing comparison.
5. Derived from the foreign trade comparison. Cols. 2 and 3 cover the net imports in original c.i.f. values. Cols. 1 and 4 measure both the price and quantity changes resulting from these import swhen consumption is measured at another country's prices. (See Appendix D)
7. Rough estimate.

STATISTICAL APPRAISAL

Before considering the relative methodological advantages of the industry and expenditure approaches, it must be pointed out that of the two studies the industry investigation has one advantage that is

1. In particular, the deduction of non-food items produced in the sectors is extremely crude, and as British food imports account for 40 per cent of total consumption (measured at factory prices), errors in the foreign trade adjustment (which is discussed in Appendix D) will have a considerable influence.
2. In principle we do not want these to affect the final index, but to the extent that inputs of packing materials and similar items were not deducted, and inputs of agricultural purchases, transport and fuels only crudely measured, inputs do in fact affect the consumption indices *implicit* in the industry results.

in no way connected with the intrinsic merits of the method—namely that of being of later date. Several years elapsed between the completion of the two studies and during this period a number of revisions were made to the national accounts and other basic data of the two countries, so that the detail of the gross national product compared is not identical in the two cases. As far as can be seen, these revisions operate in both directions and do not materially affect the total indices. A more important factor is that in carrying out the industry investigation we had available the detailed results of the earlier study, and in cases where the same material can be applied to both comparisons we were able to start at the point where the earlier comparison left off. A few minor factual amendments were made as the result of further investigation, and where the price material collected for the expenditure study was appropriate it could be supplemented by further inquiries.

The Extent of Interdependence in the Two Studies

One object in selecting 1950 as the base year for the industry comparison was to obtain results that could readily be compared with those of the expenditure study. In order to make such comparison meaningful, however, it is necessary first to ascertain to what extent identical data were in fact used in both studies. A distinction must be made here between the sections of the investigations where the same real aggregate is being compared so that identical indicators and weights are appropriate to both studies, and sections where, owing to lack of data, the same indicators were used. In the one study they are used to measure expenditure categories, and in the other to compare the net output of particular industries, so that the weighting systems are quite different.

The only group for which both the indicators and the weights used in the two studies were identical[1] covers those items which were treated in the expenditure study as direct purchases of labour, i.e. domestic service and the personnel element of health, education, and government. These account for about 10 per cent of the total gross national product in both countries.

Similar indicators had to be used to measure expenditures and net output, respectively, for a number of items, mainly in the service industries. In a number of cases these were employment indicators (as in the catering and a large part of the entertainment industry) which are more appropriate to the net output comparison in which other inputs are measured elsewhere. On the other hand, the price comparisons for services, such as those for laundering and hairdressing, which were used to measure expenditures in the earlier study, had to be applied in the industry comparison to derive net output quantity indices on rather unlikely assumptions of proportionate inputs. The weighting system used in the two studies in these cases is quite different, and since the weights are of fundamental importance in many of these industries, there is no reason for the indices obtained to be the same. Both studies contain, however, the same errors and weaknesses for these items al-

1. In fact some minor revisions in the series used resulted in a change of some 3 per cent in favour of the United Kingdom.

though their influence is different. This group accounts for a further 10 to 15 per cent of the gross national product, and includes some of the weakest sectors in both comparisons.

It is thus true to say that, for about 25 per cent of the total product, the two studies may give different results, but they are nevertheless completely interdependent statistically. For the remaining 75 per cent the position is quite different. Here are included on the expenditure side all the commodity groups, e.g. food, consumer goods, producers' durables, and the commodity expenditures in respect of government, health, and education, and on the industry side the products of agriculture, manufacturing and the fuel industries together with the transport, distributive and other services associated with them. In these groups some of the material used in the expenditure study was also employed in the industry study but with a very much smaller influence. Thus the price material used to compare expenditure on producers' durables was also used, with adjustment of inputs to measure the net output of the engineering industries but the steel and other components of engineering products were compared separately.

The precise degree of interdependence between the two studies in these industries cannot be assessed because the national series are themselves related. Thus the same financial and operating statistics for passenger transport are used in both studies but indicators are chosen that compare private expenditures on passenger transport in one case, and net output of the passenger transport industry in the other case. In food and agriculture separate production and consumption series were available for the two studies but the national consumption series are largely derived from production statistics. Finally, of course, both studies are dependent on the national estimates of the gross national product, and would reflect any under, or over, estimate in these. Even in this case the effect would not be the same in both comparisons since the influence of a change in the basic value series depends upon the proportion of price and quantity comparisons made.

Statistical Advantages of the Two Approaches

The relative merits of the two approaches can best be examined by dividing the total product in three parts :

a. Final services.
b. Food, beverages and tobacco.
c. All other groups.

1. *The Final Service Industries*

For these industries, it has already been seen that the methods used in both approaches are similar. Where the comparisons are weak, either because of conceptual difficulties or because of lack of data, neither approach offers a particular advantage. The industry method does not enable any of the measurement problems found in the expenditure study to be avoided because in the last resort the components to be measured are the same.

2. *Food, Beverages and Tobacco*

The comparison of food, beverages and tobacco in the expenditure study, and of the corresponding industries in the present investigation, were made almost entirely on a quantity basis. The products here are relatively homogeneous and the results in both investigations are considered to be among the more reliable. The rough calculation of consumption from the industry side made in Table 20, while not conclusive, does not throw up any major discrepancies between the two studies. This is rather to be expected since the methods used in the two studies are basically similar, and the national series used are largely related. At the same time, in view of the fairly large range found among the detailed price and volume indices, significant differences in results could be due to variations in weights, and the treatment of quality variations and unique commodities.

Although by comparison with other sectors the products in these groups are relatively homogeneous, it is still difficult to take sufficient account of quality variation. Here the industry method has some advantage. Little adjustment could be made for quality differences either in agricultural output, or in the individual processes of the food manufacturing industry, but the separate measurement of these two stages automatically reflects differences in the ingredients of processed foodstuffs which are difficult to allow for when the comparison is made at retail level. Against this must be offset the failure of the industry comparison to measure wastage differences during transport and distribution, or the effect of those services on relative price weights within the group. The industry method also introduces a potential source of error into the total real product index in the deduction of agricultural inputs. Conceptually, agricultural purchases from industry are measured first as output with a positive weight, and then as inputs with a negative weight. In practice there is no check on the consistency of these calculations since the items are scattered over a large number of manufacturing industries.

In short, there is little to choose between the two studies in the best and the weakest sections of the comparisons. Neither approach enables the inherent difficulties of service comparisons to be overcome, and both give reasonable results for the more homogeneous groups of products.

3. *All Other Groups*

In the remaining groups, there are basic differences in the assumptions and techniques of the two methods. This group includes most of the non-food manufacturing industries with their associated services in the industry comparison, and the bulk of non-food commodities— whether for private or government consumption or for investment— in the expenditure series.

In the expenditure study, price comparisons account for the greater part of this field. The advantage of price studies for these commodities is that they enable more account to be taken of quality differences than is possible by a quantity comparison. One practical difficulty of price comparisons is that the field study involved is costly in time and resources. Consequently for some groups, such as furniture, miscellaneous house-

hold equipment, drugs, and toilet wares, adequate coverage could not be made with the resources available, and, even for those groups which were fairly fully covered, the sample was necessarily a small one in view of the large number of products in the groups and the wide dispersion found among the price relationships. The weighting of the sample price ratios obtained then becomes a major problem which has considerable influence on the result.

In the industry comparison the extensive use of census of production data makes greater direct coverage possible with limited resources and the total weight is spread over a far larger number of indicators with a corresponding reduction in the influence of individual errors.[1] Also, quantity comparisons are used much more extensively, thus making the results less dependent on the accuracy of the detailed value series (which are then required only as weights). The use of quantity comparisons results, of course, in some loss of quality differentiation, but this is partially offset by the fact that indicators are only required to measure a single production process, and that a significant proportion of the total weight is attributable to the earlier and more homogeneous processes. Where price series are still required, weights can more easily be allocated within the census of production framework. The assumption (unavoidable in both studies), that unmeasured items carry the same price or quantity relationship as measured ones, can be applied with less risk with the aid of census of production value series which enable separate weights to be allocated for each country to moderately homogeneous groups, whereas final expenditures are classified into rather broad groups.

The industry method thus has quite considerable advantages, but it has also one basic weakness in a comparison between countries—namely that in practice it is only possible to measure a few of the potential real variations in input per unit of output. Among the non-specific inputs, adjustment was made for inputs of fuel and freight transport, but not for inputs of business passenger transport, communications, stationery, packing materials, etc. Respecting the specific inputs it was felt that on balance it was preferable to assume that their variations were reflected in the finished products, but of course, important differences in wastage and substitution of factors may exist.

The effect of these various deficiencies depends mainly upon the distribution of the resultant error, i.e. whether they are offsetting or cumulative in the actual comparison. Thus the industry method appears to introduce some bias against a country with higher average qualities, smaller utilisation of travel, communications and general business supplies per unit of output, or low raw material wastage rates. Prima facie one would expect the United States, as the higher income country, to have higher qualities. On the question of the minor non-specific inputs it seems likely that here also the United States has some advantage, because many of these are related to the number of workplaces, and the number of orders, rather than output. Consequently although American business almost certainly uses more of these items per worker,

1. It is, however, rather easy to overemphasise this point, as the influence on the final index of a few major products remains greater than that of a large number of indicators measuring items with a small aggregate weight. See "*Measurement of Production Movements*", Carter, Reddaway and Stone, p. 75.

it seems unlikely that in view of its higher overall productivity, it uses as much per unit of output as the United Kingdom. On the wastage factor there is little evidence. Relative prices in the two countries would lead one to expect some substitution of materials for labour by comparison with the United Kingdom. This substitution is conspicuous in the construction industry. In other industries, however, the economies arising from greater scale of production and more extensive use of by-products appear to offset the price substitution effect.

The industry approach has the great advantage that a large volume of material available in production censuses may be drawn upon, although in order to use it fully, reliance must be placed on relatively undifferentiated quantity comparisons, using mainly the single indicator method with its basic conceptual limitations. The fact that good data are available is thus partially offset by the various simplying assumptions required. In the expenditure comparison the conceptual difficulties are smaller and a more direct approach is possible to the aggregate which it is wished to compare. However, the data available are more limited, and more reliance must be placed on special enquiries and rather small samples. In addition, factual errors are spread over a smaller number of indicators. Consequently there are less data in the expenditure approach to enable assessment of the probable direction of errors in the estimates. Quite large discrepancies may thus exist between the two studies in the relationships implicit for individual groups, and the fact that the final indices are fairly close is encouraging, since it suggests that the various differences between the two methods do not all act in one direction.

Conclusion

How far has this pilot study of the industry method justified the approach as a useful tool for further comparisons ? We feel that the method is a valid one for suitable pairs of countries, but clearly its application is not as wide as that of the expenditure study. Among developed countries production is specialised, so that consumption patterns are usually more similar than production patterns. Thus in many pairs of countries for which expenditure comparisons appear quite practicable, an industry study would break down owing to the volume and type of unique commodities encountered. In the Anglo-American comparison this problem was greatly simplified since nearly all the unique products were basic raw materials and agricultural staples, which are relatively easy to deal with. A large volume of unique manufacturing industries, such as might be found, say, in a comparison between Britain and Denmark would present much greater difficulties.

It should not be assumed, however, that the method is only suitable for comparison between more advanced and highly industrialised countries. The relative ease with which agriculture and the primary industries can be compared, and the fact that production statistics are often in a more advanced state than consumption statistics, suggest that while clearly unsuitable for comparing an undeveloped with a developed country, the method might have considerable advantage in comparing the real product of two relatively undeveloped countries.

APPENDICES
ON TECHNICAL METHODS
AND SOURCES

APPENDIX A

REARRANGEMENT OF THE NATIONAL ACCOUNTS AND EMPLOYMENT DATA

GROSS NATIONAL PRODUCT

The estimates of the total gross national product at factor cost used for the investigation were taken from the official national accounts of the United States and the United Kingdom.[1] No adjustment was made for any conceptual differences in coverage in the two countries, as quantitatively these are small.[2]

The net output of the individual industries and sectors is given in the national accounts either as "gross national product by industry of origin", or "net national income plus depreciation". The official national estimates were used as far as possible to obtain the breakdowns required, but a large number of reclassifications, interpolations and adjustments had to be made to the various industry totals for three main purposes :

1. To secure aggregates for the individual industries on a common conceptual basis.
2. To obtain industry data on an activity instead of the usual establishment basis.
3. To arrange the various industries in a common classification suitable for the comparison.

1. Conceptual Adjustments

Although the definition of the total gross national product is virtually identical in the two countries, there are two important differences in the coverage of the breakdown by industries. For the United States the detailed breakdown is of net national income only, and depreciation and other capital consumption allowances are not distributed by industry. The United Kingdom breakdown of the gross national product includes

1. The main comparison for 1950 was based on the following sources :
United States : National Income Supplement to the Survey of Current Business, 1954.
United Kingdom : National Income and Expenditure 1956, Central Statistical Office.
Later estimates were used for the extrapolations to 1954 and 1957, but no amendments were made for subsequent revisions to the 1950 data, as these were very small.

2. The most important conceptual difference is that the United Kingdom aggregate includes earnings overseas of British firms in the oil and insurance industries, whereas according to the "Standardised System of National Accounts" only earnings of establishments and offices in the United Kingdom and profits remitted to the United Kingdom should be included. No basis could be found on which adjustment for this item could be made.

depreciation, but also includes income arising from stock appreciation, which is then deducted from the total as a single item.

United States depreciation adjustments. Unpublished data regarding the distribution of depreciation and other capital consumption allowances were provided by the Department of Commerce, and further details for corporate enterprises were obtained from Statistics of Income, 1950, Part II (Bureau of Internal Revenue). These sources did not, however, provide a sufficiently detailed breakdown for the individual industries defined in the study. For the individual manufacturing industries estimates were made mainly from the census of production data, and these are discussed in the introductory section of Appendix B. In the other sectors, the necessary interpolations were made on the basis of data from the published statistics of some industries, supplemented by information on relative capital intensity.[1]

United Kingdom stock appreciation adjustment. In 1950, income from stock appreciation, which it was necessary to distribute over the various industries, amounted to more than 5 per cent of the total gross national product. Some information on the distribution of stocks and annual changes in their value is available[2] but was insufficient for the purposes of this study, and the actual distribution of stock appreciation had to be roughly estimated from these data together with information about the price movements in the various sectors. For the manufacturing sector no attempt was made to distribute stock appreciation among the 144 industries recognised in the investigation, and a general adjustment is made to the sector before combining the results with those for other sectors.

2. Adjustment from an Establishment to an Activity Basis

The data used for the national accounts in all countries are necessarily based upon a classification by establishments (or even companies), because the financial information on which the series are based is only available in this form. Each establishment is classified according to its major products, but the result will differ from that of a classification of the products themselves, since many firms make a range of goods which cover more than one product group in the classification code. Thus in the British and American production censuses, details are given both of the secondary products (classified to other industries) made by firms of a particular industry, and of the products appertaining to the industry made by firms outside it.

If no adjustment is made for this factor one of two things will happen. Either the indicators relate to the total output of the product or service while the net output and employment data relate to the establishments so that, if secondary products are a significant proportion, the weights, net cost ratios and output per worker indices will be distorted. Alternatively indicators could be used which relate to the output of a particular group of establishments but the results are less interesting because the proportion of secondary products may be different in the two countries.

1. Taken from *Studies in the Structure of American Industry*, Leontief and others, O.U.P., New York, 1953.
2. National Income and Expenditure, *op. cit.*, 1956, Tables 52 and 53.

In the manufacturing sector, adjustment from an establishment to an activity basis was made from the detailed information given in the censuses. The exact methods are described in Appendix B (Introduction). For the other sectors no information was available from which a similar adjustment could be made, except where corresponding adjustments were indicated in the so-called "overlapping trades" such as bakeries, milk bottling and shoe repairs.

In two industries, however, it was evident that without some adjustment the comparisons would be meaningless. These were construction and road goods transport. In both these industries a substantial share of total output on an activity basis is contributed by employees of firms in other industries. A construction comparison that excluded this contribution or a transport comparison based on common carrier trucking only would have little economic meaning, because the proportion of the activity excluded might be quite different in the two countries. Moreover, as the single indicator method is used in most of the user industries, there is no compensating factor elsewhere because the additional work done is reflected in smaller inputs of the firms using their own labour force, and not in larger outputs.

For these two industries, therefore, it was considered essential to make an adjustment to an activity basis although it could only be rather crudely calculated.[1] It must be remarked that as a result the net output and employment data for these two industries have a rather high margin of error. The industries from which the deductions are made are not significantly affected as the share of their total net output affected is small.

3. Classification Adjustments

The reclassification of the national data of the two countries to a comparable basis was a major task. For the manufacturing sector the classification adopted was based, as far as possible, on the International Standard Industrial Classification (I.S.I.C.) as it was considered that this would facilitate the extension of the comparison to other countries at a later date. The I.S.I.C. is a three digit code, and where a further subdivision was necessary, a fourth digit was introduced.

Many minor changes were made in the code for the manufacturing sector. Where the activity measured differs from the I.S.I.C. classification, this is noted at the relevant points in Appendix B. The policy adopted was to employ the I.S.I.C. code as far as possible, but not if this would involve greater sub-division of industries in both countries and thus reduce the accuracy of the comparison. The majority of the changes made were between industries within a single major group, but the following are among the more important changes affecting the Major Group totals :

1. The creation of a separate fuel sector resulted in the transfer out of manufacturing of the most important products of Major Group 32 (coal and petroleum products). The few remaining items of this group were included in Major Group 33. (Non-metallic mineral products.)

1. Details are given in the sections on construction and transport in Appendix C.

2. Also as a result of the special treatment of fuels, the mining sector was greatly depleted, and for convenience non-fuel mining was included in manufacturing in Major Groups 33 and 34.
3. To facilitate the comparison of successive processes, forestry and logging were transferred from Agriculture to Major Group 25 (Wood products) and wholesale slaughtering was transferred from Major Group 20 to Agriculture.
4. Synthetic fibre production was transferred from Major Group 31 (Chemicals) to Major Group 23 (Textiles).
5. All repair work except that of ships and aircraft was transferred to services.

In the non-manufacturing sectors a less detailed breakdown by industry was necessary, and the classification used was dictated by the data available and the special requirements of the comparison. It may, however, be useful to give a broad reconciliation of the sector classification with the I.S.I.C. code.

	I.S.I.C. Code No.
Agriculture	Division O (except Major Group 02).
Fuels	Major Groups 11, 13, 32 and 51 and Group 521.
Construction	Division 4.
Transport and Communications	Division 7.
Distribution	Major Group 61.
Ownership of dwellings	Major Group 64 (part).[1]
Government	Major Group 81, Group 522.
Health and Education	Groups 821 and 822.
Services	Major Groups 62, 63, 64 (part), 82 (part), 83, 84 and 85.

The United States data could be fairly easily adjusted to the classification required (apart from the depreciation problems already discussed) because net national income by industry of origin is published in considerable detail. For only a few items was a more detailed breakdown required than that given in the published series. The most important of these were Real Estate, and the income of Government Enterprises.

The United Kingdom estimates presented greater difficulty as the published breakdown is in rather comprehensive groups, and for a number of these the method of compilation does not permit a very detailed breakdown. A variety of sources had, therefore, to be employed. Considerable use was made of detailed unpublished estimates prepared for the intertemporal comparison of the Real Product of the United Kingdom.[2] In addition, data on mining and on some distributive and service

1. Real estate services and business rents were included in services. In principle business rents, which are largely included in group 64, should be allocated to the industry concerned as part of the net output originating in the industry. For the United States a partial adjustment on this basis could be made, but owing to lack of information the major part had to be included with other business services which are treated as a general input into production.

2. The series used were those prepared in the Department of Applied Economics by W.B. Reddaway, C.F. Carter and A.A. Adams and published in the London and Cambridge Bulletin annually until 1953. This series has now been taken over by the Central Statistical Office and is discussed in *National Income Statistics*, Sources and Methods, H.M.S.O., 1958.

industries could be obtained from the Census of Production, and the 1950 Census of Distribution. In other cases fairly accurate estimates could be made from the published accounts of public corporations. A few industries remained, however, for which only crude estimates could be made.

Details of the individual reclassifications of net output cannot be given for either country since these incorporate confidential material. Some idea of their coverage and order of magnitude can be obtained from the reclassification of the American employment data given below.

EMPLOYMENT

In order to calculate output per worker indices, employment estimates had to be made on the same basis as the net output data, including the adjustments discussed above insofar as these affect employment. For the United States this was a relatively simple operation because statistics of whole-time equivalent persons engaged are included in the national accounts in a classification identical with that of national income. This series includes working proprietors as whole-time workers regardless of the hours actually worked, but excludes all family helpers. These factors are roughly offsetting for most industries but it appeared that this definition underestimated agricultural employment in terms of whole-time man-years. An addition of 600,000 persons was, therefore, made to agriculture to represent family workers net of part-time proprietors.[1] Details of the adjustments made to the United States employment series are shown in the table below.

The United Kingdom employment estimates were based on the Ministry of Labour series "Distribution of Total Manpower by Industries in Great Britain". Additions for Northern Ireland were made from less detailed information contained in the Northern Ireland Statistical Digest. In some cases the rather broad breakdown of the Ministry of Labour "Total Manpower" series was inadequate for our purposes, and had to be supplemented from the more detailed series covering employees only, combined with data on working proprietors and family helpers from the 1951 Population Census. Moreover, the Ministry of Labour series includes part-time workers and whole-time workers on a one for one basis. Adjustment to a "whole-time equivalent" basis was made from the 1951 Population Census, two part-time workers being regarded as one whole-time worker.

For both countries, census of production estimates for employment were used within the manufacturing sector. These exclude employment in head offices of manufacturing concerns, and so this employment was added to that of the manufacturing sector as a whole without adjustment of individual industry totals. The United States national accounts and the census series for the manufacturing sector as a whole agree rather well when this adjustment is made. In the United Kingdom although a common classification is used both in the Census of Production and the Ministry of Labour employment estimates, there are some unresolved

1. The estimate was based on details of hours worked from the 1950 Census of Agriculture.

statistical discrepancies between the two sources. In general the Census of Production figures are smaller, even after adjustments for all known differences are made. It is not certain whether this is due mainly to an underestimate of employment of small firms in the Census data, or to the inclusion in the Ministry of Labour estimates of workers who, on an activity basis, should be classified to distribution or services (e.g. canteen workers, and employees of sales departments).[1] For the present study it was assumed that the discrepancy was due partly to each of these causes, and while a large part of the difference between the Ministry of Labour and Census estimates was transferred to the distributive and service sectors, the total addition made to the employment estimates given in the production census is somewhat greater than could be accounted for solely by head-office workers.

1. See *National Income Statistics, Sources and Methods*, Central Statistical Office, 1956, p. 81 et seq. for a full discussion of this problem.

RECONCILIATION OF UNITED STATES EMPLOYMENT ESTIMATES USED WITH THE NATIONAL INCOME SERIES[1]

	U.S. NATIONAL INCOME SUPPLEMENT CLASSIFICATION	SPECIFIC ADJUSTMENTS	OTHER TRANSFERS (NET)[2]	TOTAL
Agriculture	Agriculture, Forestry and Fisheries	6,477		
	Family Helpers	600		
	Slaughtering	126		
	Forestry	— 26		
			— 134	7,043
Fuels	Coal and Petroleum Mining	748		
	Utilities	558		
	Manufactured Fuels	184		
			— 41	1,449
Manufacturing	Manufacturing	15,154		
	Non-fuel Mining	204		
	Retail Manufacturing	67		
	Forestry	26		
	Motion Picture Production	35		
	Slaughtering	— 126		
	Manufactured Fuels	— 184		
			— 135	15,041
Construction	Contract Construction	3,370		
			+ 742	4,112
Transport	Transportation	2,842		
			+ 655	3,497
Communications	Telephone and Telegraph	669		
			+ 410	1,079
Distribution	Wholesale and Retail Trade	11,428		
	Retail Manufacturing	— 67		
	Catering	—1,620		
			— 402	9,339
Consumer Services	Hotels	629		
	Personal Services	1,203		
	Private Households	1,768		
	Miscellaneous Repair Services	474		
	Motion Pictures	235		
	Amusement and Recreation	289		
	Non-profit Membership Organisations	561		
	Broadcasting and T.V.	55		
	Catering	1,620		
	Motion Picture Production	— 35		
	Private Legal and Other Services	33		
			— 30	6,802
Business Services	Finance, Insurance and Real Estate	1,999		
	Business Services n.e.c.	497		
	Legal Services	222		
	Engineering and Other Professional Services	157		
	Private Legal and Other Services	— 33		
	Employment Agencies, etc.	15		
			— 5	2,852
Health Services	Medical and Other Health Services	1,238		
	Public Health Services	500		
			— 3	1,735
Educational Services	Educational Services n.e.c.	490		
	Commercial and Trade Schools, etc.	45		
	Public Education	1,536		
	Employment Agencies, etc.	— 15		
			— 3	2,053
Government and Government Enterprises	Federal General Government	3,130		
	State and Local (non school)	1,948		
	Government Enterprises	754		
	Public Health Services	— 500		
			— 1,054	4,278
	TOTAL[3]	59,280	0	59,280

1. Derived from Table 28, "Number of Persons Engaged in Production", 1954 National Income Supplement, Survey of Current Business.
2. Includes (1) allocation of government enterprises to industry groups,
(2) transfer of trucking work done by producing and distributive firms to the transport industry,
(3) transfer of force account construction to the construction industry.
As these adjustments could only be roughly estimated, only the net totals are shown.
3. This reconciles with the National Income Supplement total as follows :

Official total	58,685
— Rest of the world	— 5
+ Agricultural family workers	600
	59,280

APPENDIX B

THE MANUFACTURING INDUSTRIES

Introduction

In the manufacturing sector the comparison was based on a detailed analysis of census of production material, supplemented by price and quantity information from a number of other sources. The use of census data, besides providing a large volume of information that is not available elsewhere, has the advantage that, for this sector, gross output quantities and values, net output values, and employment, together with a good deal of supplementary data, are available from a single source covering the same collection of establishments. It is thus possible to assume a higher degree of internal consistency than in most other sectors. The census material presents, however, a number of specific problems of its own.

In neither country are full production censuses taken annually. The 1950 Census of Production for the United Kingdom and the 1950 United States Survey of Manufactures give the total values of net and gross output and employment for each industry but they include no product information either in values or quantities. Further details were obtained from the British 1948 Production Census[1] and the United States 1947 Census of Manufactures. Thus although the main value series used as weights (and in price comparisons as the indicator) relate directly to 1950, detailed weights and the various adjustments and reclassifications had to be based on relationships derived from the earlier censuses. As far as possible the quantity indicators used were derived directly from the annual production series for 1950. In many cases, however, the annual series were not sufficiently detailed for our purpose and had to be used to extrapolate indicators taken from the 1947 and 1948 censuses. In other cases it was more satisfactory to make the comparison on a 1947/48 basis and to extrapolate the volume index thus obtained. Frequently it was found most convenient to project the American data with a price-deflated value series, and the British by a production index.[2]

1. At the time the bulk of the individual industry comparisons in this study were made detailed results of the 1951 Census were not available.

2. This was necessary because of the break in the United Kingdom wholesale price index between 1948 and 1950.

Census Net Output Definitions

In both countries net output or value added is defined for census of production purposes as gross output less the cost of purchased materials, fuel, and contract work. It still includes, therefore, a number of purchased inputs and certain local taxes. The most important purchased inputs are repair and maintenance of buildings, plant and vehicles, and advertising expenditures, commercial insurance premiums, and post, telephone and other miscellaneous expenses. To arrive at the national accounts concept of net output, i.e. the income produced in manufacturing, these various costs must be deducted from the census value added for each industry.

For the United Kingdom, information on expenditures on the more important of these items was included in the 1948 Census of Production, and is thus available for individual industries in that year. These expenditures were expressed as a percentage of net output in 1948, and the same percentage was applied to the 1950 values, thus assuming that there were no significant changes in input co-efficients between the two years.

No corresponding information was available for the United States, and in the 1947 Census of Manufactures it is stated that the necessary information "can only with great difficulty, if at all, be reported on an establishment basis". The income series used in the national accounts are collected on a company basis, and while the net classification difference for manufacturing as a whole does not appear to be very large, for some industries it is substantial. The industry totals required are national income plus depreciation which in a common classification would equal census value added minus "miscellaneous expenses". The classification difference proved too great, however, for control totals to be obtained from the national income data, and these would not in any case be available in sufficient detail for our purpose. Therefore, only the census data were used, although a rough check on the deductions made could be obtained from the income side.[1]

After the various reclassifications affecting the manufacturing sector as a whole had been made, the total difference between census value added and national income and depreciation was $12.4 billion. A substantial part of this represents expenditures, such as repair and maintenance and insurance, which are closely related to the volume of capital. About three-quarters of the deduction—$9.4 billion—was, therefore, distributed in proportion to the capital invested in the industry.[2] The remaining $3 billion were assumed to be distributed over the various industries in proportion to net output.[3]

The allocation of $9.4 billion among the individual industries was made according to the volume of capital, as far as the data permitted.

1. Income Statistics, Part II, 1950 *(op. cit.)* gives information on repair, advertising expenses and some other items, but those that can be separately identified only account for a small part of the total deductions to be made.

2. Creamer and Bernstein, *Capital and Output Trends in Manufacturing Industries*, 1880-1948. National Bureau of Economic Research, Occasional Paper No. 41, 1954.

3. To facilitate final adjustments to the value series, this amount was not allocated to individual industries in the tables but included as a general deduction to manufacturing as a whole. The effect on the total manufacturing indices is, of course, the same.

More detailed breakdowns were made proportionately to net output per worker in the industries concerned. It was found that between the major groups there was quite a good correlation between total capital per worker and net output per worker, and it was assumed that the same relationship would hold between the industries of a particular major group.

In a comparison of total national products the net output weights used to aggregate the sub-indices of the various industries must approximate as closely as possible to the national accounts concept of net output. Consequently even if the margin of error in the adjustments is high, the aggregate results are improved by making some allowance for known discrepancies. However, when net output value estimates are used with price indices as the basis of the comparison, comparability between the estimates of the two countries is the most important factor. For this reason, after completion of the study it was felt that it might have been preferable to use the unadjusted "census net" estimates as the basis of price comparisons, but the possible advantages to be gained did not justify the large amount of revision involved.

Differences in Coverage of the Censuses

The 1947 United States Census of Manufactures appears to give virtually complete coverage for the industries included,[1] but the British Censuses of Production for 1948 and 1950 collected full information only from "large establishments", employing 11 or more employees. In nearly all industries the small firms were only required to give information on employment. To obtain estimates of total net output it is necessary therefore to make some assumption concerning the net output per worker of the small firms in each industry. The 1948 census gave details of net output per worker in "larger establishments" of different sizes, and this showed that net output per worker of the smallest firms recorded (those with 11 to 24 employees) usually differed markedly from the average. In most industries net output per worker in small firms is below that of the larger firms, but for certain industries it is substantially higher. Net output per worker in 1950 for small firms was estimated by assuming the same relationship between that of small and large establishments as in 1948.

Reclassification to the I.S.I.C. Code

The reclassification of output must ensure that not only the end products but also the intermediate processes of the industries compared are the same in the two countries. In the automobile industry, for example, a similar classification should be used for items such as foundry, forging and stamping operations, and the production of components such as lighting fixtures, which may be produced either within the automobile industry itself, or in the general industries producing such

1. In Volume II, page 2, it is stated that for the country as a whole the Census obtained and included reports from firms employing over 98 per cent of all manufacturing employees.

products for other purposes.[1] In practice, however, while the reclassification of end-products was fairly comprehensive, only the more important and obvious process differences could be taken into account due to end-product identification difficulties.

The reclassification of both processes and end-products presents no difficulty if an industry treated as a unit in the census is combined with another or transferred to another major group. When, however, only part of an industry is to be reclassified the only information usually available is in respect of gross output values. In this case some assumption has to be made about the gross/net ratio and output per worker of the part transferred. In general it was assumed that the relationships of the industry which is the main producer of the products or similar products would apply. Thus when it was necessary to transfer American production of industrial alcohol from chemicals to the spirit distilling industry, the relationships of the latter were used, since the conditions of manufacture of industrial alcohol are closer to those of alcohol for beverages than those of the organic chemicals industry. When, on the other hand, automotive stampings in the United States were transferred from the metal stampings to the automobile industry, the gross net ratio and output per worker assumed were those of the metal stamping industry in preference to those of the more comprehensive automobile industry.

Only a few subdivisions of census industries were necessary for the United States. In the United Kingdom data some very comprehensive industry classifications such as Mechanical Engineering and General Chemicals presented considerable difficulty. In these cases, however, gross/net ratios, and net output per worker for separate parts of the industry could be estimated from the information given for specialist producers of particular product groups in Table 6 of the 1948 Census.

Adjustment from an Establishment to an Activity Basis

A similar adjustment is required to take account of the fact that part of the total output of the "typical products" of a particular industry are produced by establishments classified elsewhere, and that the firms classified to this industry also produce "secondary products" appertaining to other industries. Here also the only information available relates to gross output, and assumptions have to be made regarding net output and employment relationships. The most logical basis for adjustment would be to use the relationships of the industry making the products concerned, i.e. transfers-in would be based on the ratios of the industry to which they are added, and transfers-out on those of the industry to which they are moved. Even then, however, the adjustment made would only be an approximation, and since in nearly all cases the amounts are small, this procedure did not appear to justify the extra work involved. Adjustment was, therefore, made only in respect of the net difference between the gross values of transfers-in and transfers-out, using the ratios of the industry being adjusted.

1. In a double indicator calculation many differences of this kind would be adjusted in the deduction of inputs, but this is not the case when single indicators are used (as in manufacturing generally), since this requires the assumption of a constant ratio of specific inputs per unit of output.

Presentation of Industry Results

The results and the methods and sources used for each industry are shown in the sections which follow. For each I.S.I.C. major group an "Industry Table" presenting the numerical details of individual industry comparisons is followed by a general description of the methods used, together with a note of any unusual factors which caused special methods or classifications of data to be adopted.

The following section "Methods and Sources" deals in tabular form with the methods and sources used for each individual industry comparison. No attempt has been made to present the information in a way which would permit the original calculations to be reproduced ; the details given merely indicate the type of comparison used, the indicators chosen, the main sources from which data were taken, and the weighting bases used, together with remarks concerning definitions, adjustments for quality differences, special procedures utilised, etc.

Details are given in the Industry Tables of 83 industries accounting for about 73 per cent of the total value added in manufacturing in both countries. The industries excluded comprise those for which the comparison was based on assumed price or productivity relationships from other groups, and those for which the results were considered insufficiently reliable for individual publication. It has already been pointed out that in some cases errors in the results for individual industries tend to be offsetting in aggregation, so that the results for the major groups are generally more reliable. Brief details of the methods used for the excluded industries are included in the review of the methods used for each major group.

A supplementary section is added where necessary to the major group description giving more detailed results than those shown in the Industry Table.

The following abbreviations have been used in the tabular presentation of methods and sources :

ECD	Extrapolated Census data. The data for the base year have been extrapolated to 1950 by the use of a relevant volume (or price) index.
INRPUK..	C.F. Carter, "Index Numbers of the Real Product of the United Kingdom" (Department of Applied Economics, Cambridge, 1952) was used where indicated as a source for the extrapolation of U.K. volume data from the base year to 1950.
DVS	Deflated Value Series (used mainly for extrapolation of U.S. data). The change in the volume of production has been estimated by deflating the change in the value of output by the change in prices in the period. Unless otherwise stated, the change in prices is taken from the relevant series in the Bureau of Labour Statistics Wholesale Price Index.
SCB	Survey of Current Business.
SA.....	Statistical Abstract of the United States, or U.K. Annual Abstract of Statistics, as relevant.

FOOD MANUFACTURING INDUSTRIES
I. S. I. C. 20

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
20	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	454	405	5.22	4.66	206	184
	of which :										
2010	Bacon, sausage, and canned meat	102	129	98	121	438		5.95		157	
2020	Dairy products	29	121	39	124	1,720	1,661	4.05	3.91	187	180
2030	Canning and preserving of fruits and vegetables	92	148	79	127	891	779	4.36	3.81	252	220
2050	Grain mill products	62	47	82	74	302	308	6.19	6.31	182	185
2061	Bakery products	373	224	367	195	260	198	5.64	4.30	196	150
2062	Biscuits	68	39	55	41	302		5.28		238	
2070	Sugar factories and refineries	32	29	43	27	287		4.65		148	
2080	Cocoa, chocolate and sugar confectionery	122	80	109	75	444	541	2.71	3.31	308	376

1. GENERAL

a) Slaughtering is included in Agriculture for purposes of this study.

b) Certain food products are produced by industries engaged primarily in distributive activities (e.g. retail bakeries, sausage production in butcher shops). On the other hand, industries primarily engaged in food production also undertake some distributive activities (e.g. milk bottling by dairies). Productive activities were separated from distributive activities and included in the relevant manufacturing sub-group by an appropriate transfer of gross output between the manufacturing and distribution sectors. Employment and net output in the affected manufacturing groups were assumed to change by the same percentage as gross output, and appropriate transfers were made in respect of these items from distribution to the relevant manufacturing sub-group.[1]

c) Direct quantity comparisons were made for all industries except sub-group 2099, where employment was used as an indicator.

1. The assumption that factory and retail productivity and gross/net ratios in respect of products produced in both sectors are the same was unavoidable because it was not possible to split profits of retail organisations between their different activities. For U.S. retail single-outlet bakeries the only information available related to employment and in this case gross output had to be adjusted in proportion to employment.

2. METHODS AND SOURCES (for interpretation of the entries in this table see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
2010	X	Bacon, Sausages and Canned Meat[1]	Quantity : tons U.K. : S.A. U.S. : E.C.D.	*a)* Smoked and Cured Meat *b)* Sausages and Meat Pies[2] *b1* Sausages[3] *b2* Meat Pies[4] *c)* Canned Meat	U.S.[5]	1. Excluding slaughtering (included in Agriculture). 2. Indicators *b1* and *b2* combined with U.K. factory price weights. 3. U.K. "sausages" were equated to U.S. "fresh sausages". 4. U.K. meat pies were equated to U.S. "delicatessen sausages." 5. U.S. net cost weights for indicators *a* and *b* were derived by adjusting U.S. gross output by the U.K. gross/net ratio.
2020	X	Dairy Products (Milk Bottling is classified in Retail Trade)	Quantity : tons U.K. and U.S.: S.A.[1]	*a)* Creamery Butter *b)* Cheese *c)* Condensed Milk *d)* Milk Powder *e)* Ice-cream	U.S.[2] U.K.[3]	1. Except indicator *e* (E.C.D.). 2. E.C.D. (extrapolated by volume index). 3. Index of Industrial Production weights, except indicator *e* (net output data from census).
2030	X	Canned and Preserved Fruits and Vegetables	Quantity : tons U.K. and U.S.: E.C.D.	*a)* Jams and Marmalades *b)* Canned Fruits and Juices[1] *c)* Canned Vegetables *d)* Pickles and Sauces[2] *e)* Canned Soups and Baby Foods *f)* Frozen Fruits and Vegetables	U.S.[3] U.K.[3]	1. Fruit juices were expressed in terms of canned fruit on a net output basis. 2. For indicator *d*, the price ratio for catsup was applied to gross output of products included in this group. 3. Net cost weights, based on gross/net ratios from census data.
2040		Canned and Preserved Fish and other Sea Food	Quantity : tons U.K. and U.S.: S.A. and E.C.D.	*a)* Canned Fish *b)* Smoked, Salted, Cured Fish *c)* Fish Cakes	U.S.[1] U.K.[1 2]	1. Net cost weights, based on gross/net ratios from census data. 2. For indicator *a*, the gross/net ratio is that for Miscellaneous Preserved Foods, which includes Fish Canning.

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
2050	x	Grain Milling	Quantity : tons U.K. : S.A. and E.C.D. U.S. : S.A. and E.C.D., also S.C.B, Stat. Supp., 1951	*a)* Grain, Mill Products other than Breakfast Cereals *a1* Wheat Flour *a2* Wheat Offals *a3* Milled Rice *a4* Maize Meal *a5* Oatmeal *b)* Breakfast Cereals	U.K.[1] U.S.[2]	1. U.S. net cost weights for combining indicators *a1* to *a5* were not available (factory prices are unsuitable because value added is small). 2. U.S. and U.K. weights were used to combine indicators *a* and *b*.
2061	x	Bakery Products	Quantity : tons U.K. : Unpublished Min. of Food data U.S. : E.C.D.[1]	*a)* Bread *b)* Flour Confectionery	U.S. U.K.[2]	1. Adjusted to include single outlet bakeries not covered by census. 2. Gross output values. The gross/net ratio could not be calculated for *a* and *b* separately.
2062	x	Biscuits	Quantity : tons U.K. : Annual Production Series U.S. : E.C.D.	Biscuits		
2070	x	Sugar : Manufacture and Refining	Quantity : tons U.K. and U.S. : Annual Production Series	([1]) *a)* Raw Sugar Production *b)* Sugar Refining	U.S.[2]	1. By-products were assumed to be produced in proportion to main products. Weights for indicators *a* and *b* were increased accordingly. 2. See footnote to Supplementary Table, Section 3.

2080	x	Cocoa, Chocolate and Sugar Confectionery	Quantity : tons U.K. : E.C.D.[1] U.S. : E.C.D.	*a)* Cocoa Powder *b)* Cocoa Butter *c)* Chocolate Products other than *a* *d)* Sugar Confectionery *e)* Chewing Gum	U.K.[1] U.S.[2 3]	1. Adjusted to include production in small establishments. 2. Gross/net ratio for chocolate and cocoa industry applied to gross output of products in indicators *a* and *b*. For indicators *c* to *e* the gross/net ratio of the confectionery and chewing gum industry was used. 3. U.S. weights result in an index 20% more favourable to the U.S. than U.K. weights, possibly because no adjustment was made for quality differences.
2091		Margarine	Quantity : tons U.K. and U.S. : S.A.	*a)* Margarine *b)* Oils, Cooking Fat, etc.	U.S.	
2092		Cattle, Dog and Poultry Foods	Quantity : tons U.K. : E.C.D. U.S. : E.C.D.	Cattle, Dog and Poultry Foods		
2093		Ice	As for 2092	Ice		
2099		Miscellaneous Food Preparations[1]	Employment[2]			1. All food industries n.e.c. 2. Adjusted for productivity differences by the (unweighted) output per worker index for I.S.I.C. group 20 except 2099.

3. SUPPLEMENTARY TABLE: *Major group 20*

Group Reference	INDUSTRY AND INDICATOR	QUANTITY RATIO (U.K. = 100)		WEIGHTS	
		U.K. WEIGHTS	U.S. WEIGHTS	U.K.	U.S.
2010	Bacon, Sausages and Canned Meats	..	440	..	100
	Bacon Curing	595		..	35
	Sausages and Meat Pies	270		..	45
	Canned Meats	(4,700)		..	20
2020	Dairy Products	1,720	1,660	100	100
	Creamery Butter	3,930		17	16
	Cheese	970		20	9
	Condensed Milk	1,280		30	19
	Milk Powder	1,160		20	
	Ice-cream	1,770		13	56
2030	Fruit and Vegetables Canning and Preserving	890	780	100	100
	Jams and Marmalade	107		27	5
	Canned Fruit and Fruit Juices	2,490		10	23
	Canned Vegetables	700		26	28
	Canned Soup and Baby Foods	890		20	15
2070	Sugar Factories and Refineries	..	287	100[1]	
	Raw Sugar Products	304		38	
	Sugar Refining	277		62	

1. Weights based on U.S. cost structure converted to U.K. base by applying U.S. proportions to 1950 U.K. production data. The value added in making 1 ton of raw sugar in the U.S. was 1.78 times the value added in refining one ton of sugar.

BEVERAGE AND TOBACCO INDUSTRIES
I.S.I.C. 21 and 22

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
21	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	456	431	3.57	3.37	274	259
	of which :										
2110	Distilling, rectifying and blending of spirits	110	130	188	225	853		2.16		437	
2130	Breweries and manufacturing of malt	659	390	683	494	295		3.77		300	
2140	Soft drinks and carbonated water	197	444	99	237	786		4.70		210	
22	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	494		2.65		251	

1. GENERAL

Direct quantity comparisons were made for all industries in these two major groups.

2. METHODS AND SOURCES (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
2110	X	Distilling, Rectifying and Blending of Spirits (including Industrial Alcohol[1])	Quantity : gallons (adjusted for alcohol content except for indicator *c)* U.K. : E.C.D. U.S. : E.C.D. See also Remarks column	*a)* Distilling[2] *b)* Rectifying and Compounding[3] *c)* Bottling.	U.K.	1. U.S. census data include industrial alcohol with chemicals and were correspondingly reclassified. 2. Production data from tax statistics. 3. U.K. : census data adjusted to include output of small firms. The index of "potable spirits distilled" was used for extrapolation. U.S. : Average of 1949/50 and 1950/51 production (S.A. and Annual Report, Commissioner of Internal Revenue).
2120		Wine (including fermented beverages except malt liquors)	Quantity : gallons U.K. : E.C.D. U.S. : E.C.D.	Wine[1]		1. No allowance was made for quality differences.
2130	X	Brewing and Manufacture of Malt	Quantity : barrels[3] U.K. : S.A. and E.C.D. U.S. : S. A. and E.C.D.[1]	(2) *a)* Draught Beer *b)* Canned and Bottled Beer	U.S./U.K. average[4]	1. Additional information was taken from (*a*) Report for year ended 31st March 1951, Commissioners of H.M. Customs and Excise, (London, 1952); (*b*) Annual Report, Commissioner of Internal Revenue, year ended June 30th, 1950 (U.S. Treasury Dept., Washington, 1951). 2. By-products were assumed to be produced in proportion to main products. 3. A rough estimate of net cost per gallon was made for each country and the average taken. No adjustment was made for differences in specific gravity. 4. The results are more favourable to U.S. than those of Rostas (*op. cit.*, pp. 198/9) for the pre-war period. Rostas combines bottling and brewing, but makes no allowance for the higher proportion of bottled beer in the U.S.
2140	X	Soft Drinks and Carbonated Waters	Quantity[1] U.K. : E.C.D. U.S. : E.C.D.	Soft Drinks and Carbonated Waters[2]		1. No allowance was made for quality differences which may reflect either higher inputs or higher net costs per unit of output. 2. Concentrated drinks were expressed in terms of diluted equivalent.
2200	X	Tobacco Manufacture	Quantity U.K. : E.C.D. and S.A.[1] U.S. : E.C.D. and S.A.	*a)* Stemming[1] *b)* Finished Tobacco Products[2] *c)* Other Tobacco, incl. Snuff[3]	U.S.	1. Data for stemming from U.K. Tobacco Statistics (J.R.S.S., Series A, Part IV, 1950). 2. Measurement unit: number of cigarettes. Cigars were converted to cigarettes on a net cost basis (giving them a higher weight than a gross price conversion). 3. Measurement unit : tons.

3. SUPPLEMENTARY TABLE : *I.S.I.C. 22*

INDUSTRY AND INDICATOR	QUANTITY RATIO (U.K. = 100)	WEIGHTS[1]
Tobacco Manufacture	494	100
Cigars and Cigarettes	528	79
Tobacco (Smoking, Snuff, etc.)	526	8
Tobacco Stemming	346	13

1. U.S. Net cost weights.

MANUFACTURE OF TEXTILES

I.S.I.C. 23

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
23	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	297	267	3.69	3.32	227	204
	of which :										
2311/12	Cotton spinning and weaving	286	339	264	292	388		2.80		249	
2313	Woollen and worsted	207	124	244	120	144	146	3.33	3.37	184	186
2314	Rayon, nylon, and silk	81	123	109	177	464	445	3.61	3.47	231	222
2317	Carpets	28	33	30	47	296		5.35		190	
2320	Knitting mills	111	203	106	173	448		3.59		187	
2391	Linoleum and leathercloth	14	18	17	28	435		3.77		256	

1. GENERAL

a) The industries for which quantity comparisons were made account for about 95 per cent of each country's output in I.S.I.C. 23. Employment indicators were used for the remaining industries.

b) Cotton spinning and weaving were not separated, as they are mainly an integrated operation in the U.S., and the efficiency of the yarn mills that do exist is quite different from that of the integrated cotton mills (Rostas, *op. cit.*, pp. 130-9).

c) Northern Ireland production of linen is covered only in the 1950 British census. To utilise the fuller 1948 data, it was assumed that Northern Ireland's share in U.K. output was the same in 1948 as in 1950.

2. METHODS AND SOURCES (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
2311/12	X	Cotton Spinning and Weaving (Manufacture of Narrow Fabrics is classified in 2316)	Quantity U.K. : S.A. and E.C.D. U.S. : S.A. and E.C.D. Also : The Cotton Board Quarterly Statistical Review, No. 28, (Manchester, 1952)	*a)* Spinning[1] *a1-a5* Cotton Yarn, distinguished in 5 grades of yarn count[2] *a6* Yarn doubling *a7* 100% Spun Rayon Yarn *a8* Mixed Cotton/Rayon Yarn *b)* Weaving[3]	U.K.[4]	1. Measurement unit : tons. 2. The group intervals in the two countries' statistics permitted a fair degree of comparability. 3. Measurement unit : square yards. 4. The results on U.S. weights would undoubtedly differ. A "ring-fence" comparison (see Chapter VI) would have permitted both sets of weights to be used, but would have ignored quality differences. These differences are to a large extent accounted for by indicators *a1* to *a5*.
2313	X	Woollen and Worsted (Manufacture of Narrow Fabrics is classified in 2316)	Quantity U.K. : S.A. and E.C.D. U.S. : S.A. and E.C.D.[1]	*a)* Scouring and Combing[2] *b)* Spinning[2] *b1* Woollen Yarn *b2* Worsted Yarn *c)* Weaving *c1* Woollen Fabric[3 4] *c2* Worsted Fabric[4]	U.S. and U.K.	1. Additional sources : Wool Industry Bureau of Statistics, Monthly Bulletin, No. 29 (Bradford, 1952); 21st International Conference, pp. 75/76 (London, 1952); "Facts for Industry", U.S. Bureau of the Census, Industry Division, M.15H.-110 Table 4. 2. Measurement unit : tonnage. 3. Including blankets. 4. Measurement unit : square yards.

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
2314	X	Rayon, Nylon, Silk (Spinning of Staple Fibres is classified in 2311; Manufacture of Narrow Fabrics in 2316)	Quantity U.K. : S.A. and E.C.D.[1] U.S. : S.A. and E.C.D. Also : "Basic Statistics of Industrial Production 1913-1952" (O.E.E.C., Paris, 1953)	*a)* Synthetic Fibres[2] *a1* Staple Fibre *a2-a5* Filament Yarn, classified in 4 divisions of denier scale *b)* Rayon, Nylon, etc., weaving[3] *b1* 100% Filament Rayon Fabrics *b2* 100% Spun Rayon Fabrics *b3* Filament Spun Mixture *b4* all other mixtures	U.S. and U.K.	1. Extrapolated by production data for *a* synthetic fibres and *b* rayon weaving. 2. Measurement unit : tonnage. 3. Measurement unit : square yards.
2315		Textile Finishing	Quantity U.K. : S. A. and E.C.D. U.S. : S.A. and E.C.D. Also: The Cotton Board Quarterly Statistical Review, No. 28, p. 7 (Manchester, 1952)	*a)* Yarn Processing[1] [2] *b)* Piece Bleaching and Dyeing[3] *c)* Machine Printing[4] *d)* Woollen and Worsted Finishing[5] *e)* Hosiery Finishing[6]	U.K.[7]	1. Extrapolated by index of cotton consumption. 2. Bleaching and dyeing. Measurement unit : tonnage. 3. Plain dyed and finished goods (linear yards). 4. Printed and finished goods (linear yards). 5. Index for 2313 used as quantity ratio. 6. Index for 2320 used as quantity ratio. 7. Source : U.K. Index of Industrial Production.
2316		Narrow Fabrics	Employment	Employment, adjusted for productivity[1]		1. The productivity ratio of 2311/12 was used for the adjustment.
2317	X	Carpets	Quantity (sq.yds) U.K. : S.A. U.S. : E.C.D.[1]	Woollen Carpets[2]		1. U.S. census data were adjusted to transfer employment and net output for carpet yarn spinning to 2313, and for linoleum, wall covering, etc., to 2391. 2. No adjustment made for quality differences.
2318		Linen and Jute[1] (Narrow Fabrics classified in 2316)	Quantity U.K. : E.C.D. U.S. : E.C.D.[2]	*a)* Linen (square yards) *b)* Jute Goods[3]		1. This industry accounts for 8% of U.K. net output in group 23 (U.S. : 0.4%). The results indicate that the U.S. productivity advantage is small, and the net cost ratio very favourable to the U.K. See also note (*c*) e Sction 1 (General). 2. Extrapolated by employment. 3. Measured in Jute Yarn equivalent.
2320	X	Knitting Mills (excluding Making up of garments from warp knitting fabric)	Quantity[1] U.K. : S.A. and E.C.D. U.S. : S.A. and E.C.D.	*a)* Socks and Stockings (pairs)[2] *a1* Men's and Youths' Half-Hose and Stockings *a2* Women's Seamless Stockings *a3* Women's Fully Fashioned Stockings *a4* Other Socks and Ankle Socks *b)* Outerwear (number) *b1* Women's Cardigans and Jumpers[3] *c)* Underwear (number) *c1* Men's Underwear[4] *c2* Women's Underwear[4] *c3* Children's Underwear[4] *c4* Infants' Underwear[4] *d)* Knit Cloth for sale (tons)	U.S./U.K.[5]	1. See Supplementary Table, Section 3 and note thereto. 2. Indicators *a1-a4* aggregated with U.S. weights. 3. Indicator *b* was converted to *b1* on a gross value basis. 4. Measurement unit : number of garments (to a large extent, price differences reflect different input materials and quantities rather than net cost variations). 5. Weights are intermediate between U.S. and U.K. weights compiled from censuses.

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
2330		Cordage, Rope and Twine	Quantity U.K. : S.A. and E.C.D.[1] U.S. : S.A. and E.C.D.[2]	*a)* Hard Hemp Products *b)* Soft Hemp Products *c)* Products of Cotton, etc	U.K. U.S.	1. Extrapolated by index of hard hemp (home) consumption. Hard hemp is the most important input material. 2. Extrapolated by DVS.
2391	x	Linoleum and Leather Cloth	Quantity (sq. yds) U.K. : S.A. U.S. : E.C.D.	*a)* Linoleum *b)* Felt Base *c)* Leather Cloth	U.K.[1]	1. Weights derived from census data.
2399		Textiles n.e.c.	Employment	Employment, adjusted for productivity[1]		1. An average of the productivity ratios for 2311/13 was used for the adjustment.

3. SUPPLEMENTARY TABLE : *Major Group 23*

Group Reference	INDUSTRY AND INDICATOR	QUANTITY RATIO (U.K. = 100)	WEIGHTS
2380	Knitting Mills	448	100
	a) Stocks and Stockings	455	48
	b) Outerwear	334	22
	c) Underwear	571	21
	d) Knit cloth for sale	405	9

In view of the importance of this industry, and the difficulties met (in particular in comparing outerwear), a rough check was made by an average value comparison based on census data. The gross price ratios were converted to a net cost basis, and the results extrapolated to 1950. The average of the net cost ratios thus obtained is almost the same as that derived from the quantity comparison above, and shown in the Industry Table.

FOOTWEAR, OTHER WEARING APPAREL AND MADE-UP HOUSEHOLD TEXTILES
I.S.I.C. 24

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
24	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	449	430	5.17	4.95	179	172
	of which :										
2410	Footwear, except rubber	199	181	225	173	388		4.40		171	
2431/33	Men's, boys', women's and girls' outerwear and underwear, infants' wear	662	640	624	617	424	398	5.52	5.18	175	165
2435	Gloves	18	17	17	12	427		3.79		183	
2437	Hats, caps and millinery	35	31	37	37	592		3.75		270	

1. GENERAL

In view of the wide variety of products, the method generally adopted was to derive a quantity ratio for that part of each industry's output for which a satisfactory quantity comparison could be established. A net cost ratio was then calculated by applying this quantity ratio to the net output of the comparable products, and this net cost ratio was then used to derive a quantity ratio for the non-comparable products.

2. METHODS AND SOURCES (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
2410	X	Footwear (Rubber Footwear is classified in 3020)	Quantity (number of items)[1] U.K. : S.A. and E.C.D. U.S. : S.A. and E.C.D.	*a)* Footwear, except Rubber *a1-a7* See Supplementary Table, Section 3	U.K./U.S. average	1. Some quality differences arise as a result of input variations and are accounted for by the single indicator method used here. As for quality differences arising in the process of adding value, the average quality may not differ greatly, more style in the U.S. being offset by greater durability in the U.K.
2431 *2432* *2433* *2439*	X	All Men's, Boys', Women's, Children's and infants. Under and Outerwear and Miscellaneous Apparel n.e.c. (Garments manufactured in Knitting Mills are classified in 2320)	Quantity[1] (Number of items) U.K. : E.C.D.[3] U.S. : E.C.D.[3]	*a)* Men's and Boys' Clothing *a1* Men's Suits *a2* Coats, Trousers, Waistcoats, etc., sold separately *a3* Men's Overcoats *a4* Boys' Suits *a5* Boys' Overcoats *b)* Women's and Misses Underwear *b1* Dresses *b2* Costumes *b3* Women's Overcoats *b4* Girls' Overcoats *b5* Skirts, Blouses, etc	U.K.[4] U.S.[4]	1. See note *a*, General Section, and Supplementary Table, Section 3. 2. The single indicator method takes account of input variations and it is assumed that these account for most of the quality variations in the finished garment. 3. U.K. : extrapolated by production index for clothing, excluding footwear. U.S. : extrapolated by index combining separate indices for "men's apparel", "women's outerwear", and "shirts and underwear". 4. To allocate net output between the various indicators, gross output was adjusted to a net basis using gross/net ratios from Table 6, U.K. census, and Table 1, U.S. census.
				c) Shirts, Underwear, Infants' wear *c1* Shirts *c2* Pyjamas and Nightwear *c3* Men's Underwear *c4* Women's Underwear *c5* Aprons *c6* Neckties *c7* Handkerchiefs		
2434		Corsets and Brassieres	Quantity (number of units)[1] U.K. : E.C.D. U.S. : E.C.D.	*a1-a5* Five typical products	U.K.[2] U.S.[2]	1. See note 2 to 2431/3-39 above. 2. Gross price weights.
2435	X	Gloves	Quantity (number of pairs) U.K. : S.A. U.S. : E.C.D. (D.V.S.)	*a1* Leather Gloves—Dress *a2* Leather Gloves—Work *a3* Other Gloves—Dress *a4* Other Gloves—Work	U.S.	
2436		Fur Goods	Quantity (number of units) U.K. : E.C.D. U.S. : E.C.D.	Fur Coats		
2437	X	Hats, Caps, Millinery	Quantity U.K. : E.C.D. U.S. : E.C.D.	*a)* Fur Felt Hats *b)* Wool Felt Hats *c)* Cloth Hats, Straw Hats Millinery	U.S.	1. For each indicator a product was chosen for which quality differences seemed likely to be smallest, and the remaining products were converted to the compared items on a gross price basis.
2490		Miscellaneous Fabricated Textiles	Employment	Employment, adjusted for productivity[1]		1. The productivity ratio of the clothing industry was used for the adjustment. The net cost ratio obtained was close to that of the clothing industry.

3. SUPPLEMENTARY TABLES

Group Reference	INDUSTRY AND INDICATORS	QUANTITY RATIO (U.K. = 100)	WEIGHTS
2410	Footwear	388	100
	a) Men's Dress and Work Shoes	401	29
	b) Women's Shoes	397	39
	c) Boy's and Youths' Shoes	419	4
	d) Girls' Shoes	280	8
	e) Infants' and Babies' Shoes	330	3
	f) Slippers	209	10
	g) Other Shoes	658	7

U.K. : 1947; U.S. : 1948

Group Reference	INDUSTRY AND INDICATORS	NET OUTPUT		VALUE RATIO	NET COST RATIO - $ PER £	
		U.K. (£000)	U.S. ($000)	(U.K. = 1)	U.K. WEIGHTS	U.S. WEIGHTS
2431/33-9	Outer- and Underwear	81,182	2,455,860	—	4.86	5.01
	Men's and Boys' Clothing	30,850	722,600	23.42	5.64	5.53
	Women's and Misses' Outerwear	37,662	1,162,275	30.86	4.14	4.66
	Shirts, Underwear, Infants' Wear	12,670	570,985	45.07	5.07	5.18

A check was made on the results of the quantity comparison by the calculation of net cost ratios directly from census data. For each industry or group selected, average values were compared for a number of typical products and a weighted average of the price ratios was calculated. The combined gross price ratio thus obtained was converted to a net cost basis and extrapolated to 1950. The results are as follows :

COMPARISON OF NET COST RATIOS FOR SELECTED INDUSTRIES

$ per £ : U.K./U.S. Average Weights.

Group Reference	INDUSTRY	FROM QUANTITY COMPARISON	FROM AVERAGE VALUE COMPARISON
2410	Footwear	4.40	4.19
2431/33-9	Men's and Boys' Clothing	5.35	5.19
	Women's and Misses' Outerwear		3.87
	Shirts, Underwear, etc.		4.87
2434	Corsets and Brassieres	6.99	7.18
2435	Gloves	3.79	4.82

* * *

LUMBER AND FURNITURE

I.S.I.C. 25 and 26

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
25/26	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	1,030	870	3.30	2.78	309	261
	of which :										
2510	Lumber and timber basic products	370	611	354	592	1,893	1,426	3.35	2.53	344	259
2610	Furniture and upholstery	347	230	345	233	563		3.43		254	
2620	Soft furnishings	50	24	46	28	466		3.76		292	
2640	Metal furniture	70	57	88	79	814		3.18		298	

1. GENERAL

In the I.S.I.C., this sector is split into two major groups, namely "Wood and Cork, except Furniture", and "Furniture and Fixtures". In this study, the wood and cork group has been treated as one industry "Lumber and Timber Basic Products", and the two major groups are combined for purposes of presentation.

2. METHODS AND SOURCES (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
2510	x	Lumber and Timber Basic Products (including Millwork and Preserving of Wood)	Quantity U.K. : S.A. and E.C.D. U.S. : S.A. and E.C.D.	*a)* Logging[1] *b)* Timber Basic Products[2] *b1* Sawmill and Planing Mill Products[3] *b2* Veneer[4] *b3* Plywood[4] *b4* Manufactures of Timber and Cork (Millwork)[5]	U.K. U.S.	1. This activity is almost exclusive to the Unites States, and the quantity ratios for indicators *a* and *b* were combined using only U.S. net cost weights. 2. See Supplementary Table, Section 3. 3. Measurement unit : cubic metres of lumber sawn or planed. 4. Measurement unit : sq. metres. 5. The net cost ratio for manufacture of wooden doors was assumed to apply to all millwork products.
2520		Wooden Containers	Employment	Employment, adjusted for productivity[1]		1. The productivity ratio for the Wood and Furniture Group was used for the adjustment.
2610	x	Furniture and Upholstery (excluding Metal Furniture, classified in 2640)	Quantity[1] U.K. : S.A. and E.C.D. U.S. : S.A. and E.C.D.	*a)* Lumber input[2]		1. An attempted price comparison failed because the products compared were not identical 2. The value added varies according to the type of furniture made, but there seems no reason that this indicator should bias the results against either country.
2620	x	Soft Furnishings	Average Value U.K. : E.C.D. U.S. : E.C.D.	*a)* Innerspring Mattresses[1]		1. The gross price ratio obtained ($ 3.04 = £ 1) was applied to total output of industry 2620.
2630		Shop and Office Equipment	Employment	Employment, adjusted for productivity[1]		1. The productivity ratio for group 2610 was used for the adjustment.
2640	x	Metal Furniture	Quantity U.K. : E.C.D. U.S. : E.C.D.	*a)* Input of Steel and Lumber[1]		1. An average value comparison for metal bedsteads gave a price ratio of $ 3.15 = £ 1, an almost identical figure to that derived from the input comparison.

3. SUPPLEMENTARY TABLE

Group Reference	INDUSTRY AND INDICATORS	QUANTITY RATIO (U.K. = 100)		WEIGHTS	
		U.K. WEIGHTS	U.S. WEIGHTS	U.S.	U.K.
2510	Lumber and Timber Basic Products, except Logging	1,730	1,300	100	100
	a) Saw- and Planing Mill Products	2,560		48	66
	b) Veneer	1,820		2	2
	c) Plywood	3,950		6	7
	d) Millwork	510		44	25

PAPER AND PAPER PRODUCTS, PRINTING AND PUBLISHING

I.S.I.C. 27 and 28

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
27	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	1,043	1,033	2.66	2.64	391	388
	of which :										
2710	Pulp, paper and board	378	452	460	536	1,085	1,072	2.99	2.96	340	336
2721	Containers, boxes and envelopes	380	363	320	291	1,102	1,081	2.31	2.27	433	424
2722	Miscellaneous paper and board products	242	185	220	173	868		2.49		426	
28	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	661	657	3.82	3.84	258	256

1. GENERAL

a) The methods used for the comparisons varied according to the data available and the nature of the industries treated. They include quantity comparisons (both of output and input) and average value comparisons.

b) For Newspapers and Periodicals (2810), a comparison based on circulation, weighted by net costs, resulted in an index U.S. = 257 (U.K. = 100). However, U.S. publications are larger than those in the U.K., and if the work done in the industry is measured by the input of paper, the index becomes 887. In fact, both circulation and size affect costs, and indicators of both circulation and paper input were used.

2. METHODS AND SOURCES (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
2710	X	Paper and Board (including Pulp Milling)	Quantity (tonnage)[1] U.K. : S.A. and E.C.D. U.S. : S.A. and E.C.D. Also : "European Timber Statistics 1913-1950" U.N. (Geneva, 1953)	*a)* Paper and Board *a1-a10*. See Supplementary Table, Section 3 *b)* Pulp Manufacture[2]	U.K.[3] U.S.[3]	1. Where 1950 output data were not available in sufficient detail, the proportions applicable in census years were applied to break down totals. 2. Little pulp making is undertaken in the U.K., and U.S. net cost weights were used to include indicator *b*. The U.K. quantity is then zero, while U.S. net pulp output is expressed in terms of net output of the various kinds of paper. The overall indices on both sets of weights increase in the same proportion, the spread remaining unchanged. 3. U.K. Census of Production, Table 6. 4. U.S. weights were derived by applying U.K. gross/net ratios to U.S. factory prices.
2721	X	Containers, Boxes and Envelopes	Quantity (tonnage, input of paper) U.K. : E.C.D. U.S. : E.C.D.	*a)* Boxes, Cartons and Fibreboard Packing Cases (1)	U.K.[3] U.S.[3]	1. The use of three indicators was necessary because the value added in each activity differs significantly, and the importance of the activities varies between the two countries. See also Supplementary Table, Section 3.

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
				b) Paper Sacks and Bags[2] *c)* Envelopes[2]		2. U.S. input weight was related to U.K. output weight, but there is likely to be little difference between the weight of an input and that of the sacks and bags (or envelopes) made of this input. 3. Estimates were made from the censuses of the value added per ton of each of the three types of products.
2722	X	Miscellaneous Paper and Board Products	Average Value U.K. : E.C.D. U.S. : E.C.D.	([1]) *a)* Wallpaper *b)* Toilet Paper *c)* Corrugated Paper *d)* Gummed Tape *e)* Tubes of Industrial Paper		1. The price ratios for indicators *a* to *e* were converted to a net basis before extrapolation to 1950.
2810		Newspapers and Periodicals	Quantity U.K. : E.C.D.[1] U.S. : E.C.D.[1]	([2]) *a)* Paper Output *b)* Circulation	([3]) 80% 20%	1. Extrapolated by index of daily newspaper circulation (U.N. Statistical Yearbooks, 1948 and 1951). 2. The overall index calculated from indicators *a* and *b* was U.S. = 750 (U.K. = 100). Compare this with the results mentioned in Section 1, note *b*. 3. Weights arbitrarily allocated on the basis that the volume of printing is the predominant factor in the determination of costs.
2820		Books and Commercial Printing	Quantity (tonnage, input of paper) U.K. : E.C.D.[1] U.S. : E.C.D.[2]	([3]) *a)* Paper Input		1. Extrapolated by series "printing and writing paper consumed" (Annual Abstract of Statistics). 2. Extrapolated by production data for various types of writing paper (S.A.). 3. On account of the small weight of products which might have been compared, a price comparison was not undertaken.

3. SUPPLEMENTARY TABLES

Group Reference	INDUSTRY AND INDICATORS	QUANTITY RATIO (U.K. = 100)		WEIGHTS	
		U.K. WEIGHTS	U.S. WEIGHTS	U.S.	U.K.
2710	Paper and Board (excluding Pulp)	835	826	100	100
	a1) Newsprint	166		13.1	2.1
	a2) Other Printing Paper	612		24.0	16.8
	a3) Fine Paper	473		15.1	10.9
	a4) Greaseproof, Parchment	565		1.4	1.4
	a5) Packing and Wrapping	620		16.6	13.3
	a6) Tissue Paper	583		1.9	1.4
	a7) All Other Paper	1.286		5.2	4.6
	a8) Boards for Packing	1,544		19.6	37.7
	a9) Wet Machine Board	1,079		0.6	0.9
	a10) Construction Paper Materials	3.869		2.5	10.9
2721	Paper and Card Containers, Boxes and Envelopes	1,100	1,080	100	100
	a) Boxes, Cartons and Fibreboard Packing Cases	1,390		65	79
	b) Paper Sacks and Bags	690		19	13
	c) Envelopes	460		16	8

LEATHER AND LEATHER PRODUCTS
I.S.I.C. 29

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
29	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	328	326	3.85	3.83	161	160
	of which :										
2910	Tanneries and leather finishing plants	620	495	793	634	272		3.70		168	
2920	Leather products, except footwear and apparel	380	505	207	366	545	499	4.45	4.07	201	184

1. GENERAL

a) This major group comprises two successive stages of the production process : the tanning and finishing of leather, and the manufacture of leather products. Tanning and finishing accounts for about three-quarters of U.S. net output and two-thirds of U.K. net output in I.S.I.C. 29.

b) A quantity comparison was made for Tanning and Finishing, while an average value comparison was made for Leather Products.

2. METHODS AND SOURCES (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
2910	X	Tanneries and Leather Finishing Plants	Quantity U.S. : S.A.[1] U.S. : E.C.D.[2]	*a)* Heavy Leather (including Industrial Leather Belting) *b)* Light Leather	U.K.[3] U.S.[3]	1. Leather belting was included in the same proportions as in the census. 2. Output of leather : S.A. Output of heavy leather was assumed to move proportionately with footwear, and an index for light leather was calculated as a residual (using 1947 census weights). 3. Factory prices were used as weights ; however, the quantity relatives were very close so that the weights have little importance.
2920	X	Leather Products (except Footwear and Apparel)	Average Value U.K. : E.C.D. U.S. : E.C.D.	([1]) *a)* Women's Handbags *b)* Trunks *c)* Hand Luggage and Briefcases	U.S. U.K.	1. The products chosen as indicators account for over 50% of net output in U.K. and almost 75% in U.S. An average net cost ratio for indicators *a* to *c* was used to derive the quantity ratio for the remainder of the industry's products.

RUBBER PRODUCTS
I.S.I.C. 30

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
30	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	640	613	4.25	4.06	249	238
	of which :										
3010	Tyres and tubes	295	358	342	435	794	718	4.61	4.17	254	229
3020	Rubber footwear	102	65	100	46	252		4.71		155	
3030	Other rubber products	603	577	558	519	616		3.93		250	

1. GENERAL

a) A quantity comparison was made for each of the three industries in this group.

b) Production of synthetic rubber is classified in I.S.I.C. 31 (Chemical Industry).

2. SOURCES AND METHODS (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
3010	X	Tyres and Tubes	Quantity U.K. : E.C.D. U.S. : E.C.D.	(1) *a)* Passenger Car Tyres[2] *b)* Truck and Bus Tyres[3] *c)* Other Tyres[4] *c1* Tractor Tyres *c2* Aeroplane Tyres *c3* Motor Cycle Tyres *c4* Pedal Cycle Tyres *d)* Tubes for :[4] *d1* Passenger Cars *d2* Trucks and Buses *d3* Motorcycles and Bicycles *d4* Aeroplanes *d5* Tractors	U.S.[5] U.K.	1. For aggregation of indicators see Supplementary Table. 2. Adjusted for differences in average tyre size. (The price spread was estimated from catalogue prices, and the average of the quantity ratios in U.K. and U.S. prices was applied to express U.S. production in terms of U.K.-size tyres. A rough check confirmed that the gross/net ratio of tyres of different sizes is the same.) 3. Average size is about the same in both countries. 4. Sub-indicators combined with U.S. and U.K. gross price weights. 5. A rough comparison of 1950 rubber inputs gave a quantity ratio almost identical with the U.S.-weighted ratio for 3010.
3020	X	Rubber Footwear	Quantity U.K. : S.A. and E.C.D. U.S. : E.C.D. (D.V.S.)[1]	*a)* Rubber input		1. The U.S. Wholesale Price Index was used for the deflation.
3030	X	Rubber Products, except Tyres and Footwear	As for 3020	*a)* Rubber input[1]		1. The comparison was checked by an average value comparison for 5 products which gave very similar results.

3. SUPPLEMENTARY TABLE

Group Reference	INDUSTRY AND INDICATORS	QUANTITY RATIO[1] (U.K. = 100)		WEIGHTS	
		U.K. WEIGHTS	U.S. WEIGHTS	U.K.	U.S.
3010	Tyres and Tubes	900	820	100	100
	a) Tyres for Passenger Cars	1,760		25	45
	b) Tyres for Trucks and Buses	640		50	38
	c) All Other Tyres	430	310	15	7
	d) Inner Tubes	740	670	10	10

1. U.K. : 1948 data, U.S. : 1947 data. U.K. production in 1950 was some 10 per cent higher than in 1948, while between 1947 and 1950, U.S. production had declined by 12 per cent. Hence the reduction in the quantity ratios to 794 and 718 in the extrapolation to 1950.

CHEMICALS AND CHEMICAL PRODUCTS
I.S.I.C. 31

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
31	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	565	541	3.57	3.42	364	349
	of which :										
3111	Basic industrial chemicals, including fertilisers and plastic materials	448	435	482	450	561		3.22		372	
3120	Oils, fats and greases	62	99	66	81	661	507	4.65	3.57	269	206
3191	Medicinal and pharmaceutical preparations	156	130	139	162	599		3.75		463	
3192	Soap, candles and glycerine	83	97	76	104	454		5.81		249	
3194	Paint and varnish	99	125	110	104	715		2.55		363	
3197	Matches	12	13	9	7	599		2.46		376	

1. GENERAL

a) In view of the great number of individual products, price comparisons were made for most industries in this group. Only for some smaller and relatively homogeneous industries were quantity comparisons possible.

b) In general, price ratios for each indicator were derived as the weighted average of the sub-indicator ratios. Conversion to net cost ratios from the available data was impossible, but this was of no practical importance because the input and output price ratios were generally very close. The average price ratios were used to convert gross output to derive a quantity ratio for the indicator, and the quantity ratios were combined with net cost weights.

2. METHODS AND SOURCES (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
3111	X	Basic Industrial Chemicals, including Fertilisers and Mining thereof, and Plastics Materials. (Synthetic Fibres are classified in I.S.I.C. 23, and Distilling of Ethyl Alcohol in I.S.I.C. 21)	Average Value U.K. : S.A. and E.C.D.[1] U.S. : S.A. and E.C.D. Also : "Basic Statistics of Industrial Production 1913-1950" (O.E.E.C., Paris, 1953); U.N. Statistical Yearbook 1951 (New York, 1951)	*a)* Inorganic Chemicals[2] *a1-a10*[3] *b)* Organic Chemicals *b1* Plastics Materials[4] *b1*(1)-*b1*(7) [5] *b2* Other Organic Chemicals *b2*(1)-*b2*(8) [6]	U.S.	1. In the U.K. census, most branches of this industry are included in one heading "General Chemicals". Detailed comparison on a net output basis was therefore impossible. 2. Price ratio for indicator *a*, \$3.24 = £1. 3. The most important indicators were sulphuric acid, oxygen, superphosphates, compound manures, acetylene. 4. A quantity comparison was made for sub-indicator *b1*. 5. 7 different plastics materials. 6. 7 different organic chemicals, and synthetic fibre products. The latter are classified in 2314, but they were considered as a representative product of the organic chemicals industry for the derivation of the price ratio.
3112		Explosives	Average Value U.K. : E.C.D. U.S. : E.C.D.	*a)* Explosives *a1-a3*[1]		1. Three types of explosive.
3120	X	Oils, Fats, Greases	Quantity[1] U.K. : E.C.D. U.S. : E.C.D.	*a)* Lubricating Oils and Greases[2]	U.K. U.S.	1. Except indicators *c* and *d*, where the net cost ratio of indicator *a* was applied to net output to derive a quantity ratio.
				b) Seed Crushing and Oil Refining[3] *b1* Manufacture of Crude Oil *b2* Hydrogenation of Oil *b3* Oil Refining *b4* Oil Cake Manufacture *c)* Grease, Tallow and By-products[4] *d)* Marine Animal Oils[4]		2. Measurement unit : tonnage. Greases were expressed in terms of lubricating oil on a gross value basis. 3. Indicators *b1-b4* combined with U.K. net cost weights. Since *b1* and *b4* are joint products (see Chapter VI), weights of 85% and 15% were arbitrarily allocated between them, based on relative factory prices. 4. Quantity comparison impossible. A gross price comparison would have compared input prices rather than net costs, and the net cost ratio of indicator *a* was assumed to apply.
3191	X	Medical and Pharmaceutical Preparations	Price (special enquiries)[1]	*a)* Drugs and pharmaceutical products[2] *a1* Salicylic Acid *a2-a13* Other Drugs, etc.		1. Wholesale Prices, U.K. and U.S. Differences in respect of wholesale margins and transport costs are too small to distort the result. 2. The distribution of price ratios was wide. The price ratio for indicator *a1*, \$3.75 = £1 was also the average, and was used to convert gross output, since the input and output ratios for this industry are very close (see Note *b*, Section 1).
3192	X	Soap, Candles, Glycerine	Quantity (Average Value) U.K. : S.A. and E.C.D. U.S. : S.A. and E.C.D. Also : INRPUK, and the U.S. Wholesale Price Index	*a)* Soap[1] *a1* Hard Soap in bars *a2* Toilet Soap *a3* Washing Powder, including Granulated Soap *b)* Fatty Acids[1] *b1* Glycerine *b2* Oleine and other Fatty Acids *b3* Stearine	U.K./U.S.[5]	1. Measurement unit : tonnage. 2. Gross output values converted by price ratio for hard soap. 3. Gross output values converted by price ratio for floor and furniture polish (data from censuses). 4. Gross output values converted by price ratio for stearine. 5. Net cost weights for indicators *a* to *d* from U.K. census. For indicator *e*, U.S. gross/net ratio was applied.

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
				c) Other Cleaning Materials and Abrasives[2] *d)* Polishing Preparations[3] *e)* Candles[4]		
3194	X	Paint and Varnish	Average Value U.K. : E.C.D. and INRPUK U.S. : E.C.D.[1]	*a1-a6* 6 Paints and Varnishes of which *a1* Ready Mixed Oil Paints *a2* Varnishes		1. Extrapolated by employment index.
3195		Glue, Gum, Gelatine	As for 3194	*a)* Glue, Gum, Gelatine *a1* Edible Gelatine *a2* Photographic Gelatine *a3* Hide Glue *a4* Bone Glue		
3196		Ink	As for 3194	*a)* Ink *a1* New Ink *a2* Other Printing Inks *a3* Writing Ink		
3197	X	Matches	Quantity (number[1]) U.K. : S.A. U.S. : E.C.D.[2]	*a)* Matches		1. Packaging differences not taken into account. 2. Extrapolated by excise tax revenue (S.A.).

NON-METALLIC MINERAL PRODUCTS, EXCEPT PETROLEUM AND COAL
I.S.I.C. 33

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
33	MAJOR GROUP TOTAL	1.000	1,000	1,000	1,000	413	373	4.46	4.03	263	237
	of which :										
3310	Structural clay products	214	124	193	103	169	189	4.71	5.27	186	208
3321	Glass containers	62	69	58	70	477		4.16		274	
3322	Glass, other than containers	114	155	121	171	473		4.99		221	
3330	Pottery, china and earthenware	182	109	127	80	172		6.07		182	
3340	Cement	29	62	69	92	389		5.72		116	
3391	Pre-cast concrete goods	78	99	69	87	583		3.57		293	

1. GENERAL

a) Non-metallic mineral mining is generally classified as a separate mining sector, but was included in I.S.I.C. 33 for purposes of this study.
b) Certain small industries in the I.S.I.C. Petroleum and Coal major group are included in I.S.I.C. 33 for purposes of this study. The remainder of the Petroleum and Coal group was included with the Energy Sector.

2. METHODS AND SOURCES (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
3301	x	Non-metallic Mineral Mining[1]	Quantity[2] U.K. : Ministry of Fuel and Power Statistical Digest, 1953 Tables 73 and 74[3] U.S. : Minerals Year Book,1950 (Summary Table)[4]	*a)* 15 Non-metallic Mineral Products *a1* Sand and Gravel *a2* Building and Other Stone *a3* Clay *a4-a15* Other Non-metallic Mineral Products[5]	U.K.[5] U.S.[5]	1. The labour productivity index derived for this industry is not meaningful. The proportion of scarce minerals varies in the two countries. Since their value added includes a high element accruing to ownership, their weight in the quantity index bears little relation to the labour required for extraction. 2. The indicators used cover 94% of U.K. and 76% of U.S. output. Remaining output was assumed to have the same gross price ratio as the products compared. 3. Data relate to Great Britain, but an estimate for Northern Ireland was included in 3399. 4. Lime and cement are classified in 3340 and 3393, but limestone used in production of lime and cement was included in 3301 at an estimated value. 5. Gross values used as weights.
3310		Structural Clay Products	Quantity (Average Value) U.K. : E.C.D. (INRPUK) U.S. : E.C.D. (D.V.S.)	(1) (2) *a)* Standard Bricks *b)* Glazed Drainpipes *c)* Unglazed Drainpipes	U.K. U.S.	1. Remaining output was assumed to have the same gross price relationship as the products compared. 2. Structural clay products—of higher relative importance in U.K. as house-building material— were found to be comparatively expensive in U.S.
3321	x	Glass Containers	Quantity U.K. : E.C.D. (D.V.S.) U.S. : E.C.D.[1]	*a)* Bottles for Food *b)* Beer Bottles *c)* Mineral Water Bottles *d)* Wine and Spirit Bottles *e)* Containers for Medical and Health Supplies *f)* Perfume Bottles *g)* Other Containers	U.K.	1. Extrapolated by index from S.C.B., Statistical Supplement, 1951.
3322		Glass, other than Containers	Average Value U.K. : E.C.D. (INRPUK) U.S. : E.C.D.	*a1-a6* 6 Glass Products[1]		1. Two of the 6 products selected (lamp chimneys and mouth-blown tumblers) gave price ratios suggesting major quality differences, but those for the remaining products were close so that weights are of little importance.
3330	x	Pottery, China and Earthenware	Quantity(Average Value) U.K. : E.C.D.[1] U.S. : E.C.D.	*a)* Earthenware Goods[2] *a1* Glazed Floor and Wall Tiles[3] *a2* Lavatory Basins[4] *a3* W.C. Pans[4] *a4* Ceramic Electrical Supplies[5] *b)* Pottery and China[6] *b1* Undecorated China *b2* Undecorated Earthenware *b3* Decorated China *b4* Decorated Earthenware		1. 1948 and 1951 census data were used. 2. 45% of gross output of 3330, measured mainly by quantity comparison. 3. Measurement unit : square yards. 4. Measurement unit : number. 5. Indicator *a4* was assumed to have the same gross price ratio as the average of *a1* to *a3*. 6. Gross price ratio (Source : Census data) for indicator *b1* was assumed to apply to *b3* and for *b2* to *b4*. Average gross price ratio for *b1* and *b3* was used to convert gross output to derive quantity ratio. The price advantage ($6.06 = £1) appears reasonable given the U.K.'s trading position in this field.
3340	x	Cement[1]	Quantity (tons) U.K. : S.A. U.S. : S.A.	*a)* Cement		1. The labour productivity ratio for this industry may not be typical of the 33 group as a whole because of its higher capitalisation.

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
3391	x	Pre-cast Concrete Goods	Average Value U.K. : E.C.D. (INRPUK) U.S. : E.C.D. (DVS)	*a)* Concrete Bricks *b)* Concrete Pipes *c)* Concrete Roof Units *d)* Concrete Floor Units		
3392		Asbestos Goods	As for 3391	(1) *a)* Asbestos Yarn *b)* Asbestos Cloth *c)* Asbestos Cement Goods		1. It was not possible to obtain average value data for brake linings and clutches although these are of some importance in the United States.
3393		Lime	As for 3340	*a)* Lime		
3399		Non-metallic Mineral Products n.e.c.	Employment	Employment, adjusted for productivity		The productivity ratio for I.S.I.C. 33 excluding I.S.I.C. 3301 and 3340 was used for the adjustment (see notes 1 to I.S.I.C. 3301 and 3340).

BASIC METAL INDUSTRIES
I.S.I.C. 34

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
34	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	527	520	3.58	3.54	266	263
	of which :										
3411	Blast furnaces	42	30	44	51	584		3.70		408	
3412	Steel works and rolling mills	387	392	405	396	547	533	3.42	3.35	273	266
3413	Iron and steel foundries	281	266	246	199	378		3.98		202	
3420	Non-ferrous metal basic industries	182	164	201	179	471		3.51		264	
3430	Wire drawing	39	28	38	30	486		3.11		339	

1. GENERAL

a) Metal Ore Mining is transferred to this group from the mining sector. It accounts for 11 per cent of U.S. output in the group, but is of little importance in the U.K.

b) Quantity comparisons were made for most industries in the group (see note *c*).

c) For industries 3401 and 3402, price comparisons proved unsatisfactory. A quantity comparison was impossible for 3402, since the main product mined in the U.K. (tin) is not produced in economic quantities in the U.S., while for 3401, a gross price ratio of $7.56 = £1 was derived—obviously an incorrect result. For both industries, therefore, gross output was converted at the official exchange rate : controlled prices for non-ferrous metals in the U.K. in 1950 were closely related at the official exchange rate to the New York open market quotations, while U.K. imported iron ores, when related to U.S. home-produced ores, had a gross price ratio of $2.04, and were probably somewhat richer in Fe content than U.S. ores.

d) Had a quantity comparison been made for industry 3411 (Blast Furnaces), using indicators for both pig-iron and by-products, an incorrect result would have been obtained unless an adjustment was made simultaneously for input differences (double indicator formula—see Chapter VI). This would have necessitated complicated adjustments in the fuel industry where the entire coke input has been allocated to the primary metal group, no allowance being made for secondary fuels produced in manufacturing industry.

At the same time, it was necessary to make allowances for differences in iron ore quality in the two countries. It was possible to make the comparison for this industry by considering four distinct types of iron, making no adjustment for the proportion of gas produced. There appears to

be a tendency for the use of low-grade ore to be associated with a greater coke input per unit of pig-iron output, but this higher coke consumption is at least partially offset by the larger output of by-products, particularly gas.

e) A large share of foundry production (3413) takes place in other industries. It was necessary to transfer net output and employment from these industries to 3413. This avoided the distortion of the overall manufacturing comparison which would have resulted from the omission of the foundry output of the other industries—in which foundry production is an intermediate process—and enabled the comparison to be based on official production figures which cover the output of all foundries. The adjustments made to the data were as follows :

U.S. (1947 Census data). 70.2 per cent of production workers in foundry departments were in foundries classified in 3413. The corresponding ratio for wages was 70.0 per cent. These proportions were applied to 1950 census data to obtain estimates of 1950 employment and net output. This assumes that the relationships between employment, wages and net output inside and outside the industry did not change between the two dates, and that the proportion of foundry products manufactured outside the industry did not change. The breakdown of the employment and net output transferred from the industries operating foundry departments was taken from Table 8 (Vol. II) of the 1947 Census.

U.K. Only output data were available. Total production of iron castings in 1948 was 3.28 million tons, of which 2.38 million tons were produced by the iron foundry industry covered in the census. Employment and net output for 3413 were therefore increased by 38.1 per cent. The transfers of employment and net output from the industries affected were made by assuming that, after adjustment for differences in the relative total size of these industries, the same proportions should be deducted as in the U.S.

f) Similar considerations to those in note *e)* affect industry 3414 (Iron and Steel Forgings), but no data were available to make any adjustment. The weight of this industry is small, however, in relation to that of 3413.

g) In addition to data from production censuses and statistical abstracts, information for the industries in group 34 was also taken from the following sources :

"Basic Statistics of Industrial Production 1913-1952." O.E.E.C., Paris (1953). British Iron and Steel Federation, Statistical Yearbook for 1950, Part I, London (1951). American Iron and Steel Institute, Annual Statistical Report 1950, New York (1951). Statistisches Jahrbuch für die Eisen-und-Stahlindustrie 1951/52, Düsseldorf (1952). Die Eisen-und-Stahlindustrie, Statistisches Vierteljahresheft, April-June 1952, Düsseldorf, August 1952.

2. METHODS AND SOURCES (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
3401		Iron Ore Mining	(1)			1. See note *c*, Section 1 General.
3402		Metal (except Iron Ore) Mining	(1)			1. See note *c*, Section 1, General.
3411	x	Blast Furnaces (including Blast Furnace Gas)	Quantity[1] Sources : see note *g*, Section 1, General	*a)* Haematite Iron *b)* Basic Iron *c)* Foundry Iron *d)* Other Iron		1. See note *d*, Section 1, General.
3412	x	Steel Works and Rolling Mills (Manufacture of Wire is classified in 3430, 3571 and 3760)	Quantity Sources : see note *g*, Section 1, General	*a)* Conversion of Pig-iron and Scrap into Steel; Hot Rolling into Semi-finished Products[1] *b)* Rolling into Basic Shapes[2] *b1* Railway Permanent Way Material *b2* Heavy and Light Sections *b3* Hoops and Strips *b4* Plates and Sheets *b5* Seamless Iron and Steel Tubes *b6* Welded Iron and Steel Tubes *b7* Other Steel Products	U.K.[3] U.S.[4]	1. There is no need to subdivide indicator *a* since most steel is rolled into semi-finished form on leaving the furnace. Measurement unit : tonnage. 2. Net cost weights for both countries for *b5* and *b6* from census data. For *b1* to *b4* and *b7*, the weights were derived by subtracting the price of a corresponding weight of steel input from factory prices of the finished product. 3. Indicators *a* and *b* combined only with U.K. Index of Production weights (allocation of net cost weights is difficult because the processes are usually carried out in the same plant, but in this case the quantity ratios did not vary greatly). 4. From census data, used to combine sub-indicators *b1* to *b7* only.
3413	x	Iron and Steel Foundries[1]	Quantity : tons Sources : see note *g*, Section 1, General	*a)* Soil Pipe *b)* Other Pipe and Fittings *c)* Other Cast Iron Products *d)* Steel Castings	U.K.[2] U.S.[2]	1. See note *e*, Section 1, General. 2. Estimated net cost weights (see Note 2, 3412).
3414		Iron and Steel Forgings[1]	Average Value Sources : see note *g*, Section 1, General	*a1-a2* 2 types of forgings		1. See note *f*, Section 1, General.
3420	x	Non-ferrous Metal Basic Industries (Wire drawing is included in 3430)	Quantity : tons Sources : see note *g*, Section 1, General	*a1-a6* Primary Smelting and Refining[1] *b1-b4* Secondary Smelting and Refining[2]	U.S.	1. Copper, lead, zinc, tin, nickel, aluminium. 2. Copper, lead, zinc, aluminium. 3. Consumption was used as the indicator because although both countries are

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
				c) Non-ferrous Metal Mill and Foundry Products Consumption[3] of : *c1* Copper[4] *c2* Lead *c3* Zinc *c4* Tin *c5* Nickel *c6* Aluminium[4]		importers they mainly import semi-finished products, the processes which add value (rolling, drawing, foundry and forging operations) being generally carried out in the countries using the products. 4. Weights from U.S. census. For other indicators it was assumed that the net cost per ton of finished product is the same for each metal.
3430	x	Wire drawing (Wire work such as Cable and Rope, Springs, etc., is classified in 3571; Insulated Wires and Cables in 3760)	Quantity Sources : See note *g*, Section 1, General	*a)* Iron and Steel Wire[1] *b)* Wire from Non-ferrous Metals[2]	U.S.	1. Measurement unit : tons of input 2. Measurement unit : tons of output.

METAL PRODUCTS, EXCEPT MACHINERY AND TRANSPORT EQUIPMENT

I.S.I.C. 35

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
35	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	592	559	4.11	3.88	297	281
	of which :										
3510	Metal cans	49	49	34	51	1,120		3.10		561	
3521	Cutlery	28	21	36	18	278		4.17		193	
3522	Tools and implements	75	45	72	41	229		5.70		190	
3530	Heating, cooking and plumbing equipment	105	110	112	117	1,047		2.30		503	
3541	Structural iron and steel	93	83	106	104	606		3.72		339	
3551	Steel metal work and metal stampings	119	191	115	178	1,062		3.34		334	
3571	Wirework	55	106	58	97	946		4.09		244	
3572	Needles, pins, and metal small-ware	42	23	38	20	278		4.36		254	
3581	Bolts, nuts, rivets, etc.	93	81	89	90	442		5.23		256	

1. GENERAL

1. Two methods were generally used to establish the comparison for each industry in this group :
   a) Average values from the U.K. 1948 census were compared with the corresponding U.S. 1947 figure. The gross price ratio thus obtained was converted to a net cost basis, and extrapolated to 1950, with appropriate price indices. The 1950 net cost ratio was then applied to 1950 net output to obtain the 1950 quantity ratio. Where a weighted 1947/48 price ratio was calculated only in respect of a proportion of an industry's output, it was generally assumed that this ratio was applicable to the entire output of the industry concerned.
   b) A 1947/48 comparison was made for those products which could be measured in tons or in number. The gross price ratio for these products was assumed to apply to the entire output of the industries concerned, and the quantity ratios thus obtained were extrapolated to 1950.

   Where a marked difference in the two results was found, preference was given to method *b*, in view of the difficulty of finding appropriate price indices for the extrapolation in method *a* of 1948 U.K. prices to 1950.

2. The U.K. census includes a large proportion of metal products under one trade, and the calculation of average price ratios is therefore generally based on U.S. proportions.

2. METHODS AND SOURCES (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
3510	X	Metal cans	Quantity[1]	Metal cans		1. See *b*, note 1, Section 1, General.
3521	X	Cutlery	Average Value[1]	([2]) *a)* Razor Blades *b)* Safety Razors *c)* Scissors (same length)		1. See *a*, note 1, Section 1, General. 2. Remaining products assumed to have same gross price ratio as scissors.
3522	X	Tools and Implements	As for 3521	([1])		1. Screwdrivers, wrenches, precision files, other files and rasps, hammers, heavy hand saws.
3530	X	Heating, Cooking and Plumbing Equipment (except Cast Iron Products)	Price[1]	*a)* Gas Stoves[2] checked by : *a')* Boilers[3]		1. 1950 factory prices (source : manufacturers) converted to net cost basis. 2. Net cost ratio applied to net output of 3530. 3. Average value comparison, measurement unit : tonnage. Gross price ratio close to that for indicator *a*.
3541	X	Structural Iron and Steel (except products in 3542)	Average Value (tonnage)[1]	*a)* Bridge Components *b)* Other Structural Iron and Steel *c)* Iron and Steel Staircases		1. See *a*, note 1, Section 1, General. Since the price ratio of main inputs was near that of gross output, the gross price ratio was applied to net output to derive the quantity ratio.
3542		Metal (including non-ferrous) Doors and Window Frames	Quantity (tonnage)[1]	*a)* Iron and Steel Doors and Window Frames		1. See *b*, note 1, Section 1, General.
3551	X	Sheet Metal Work and Metal Stamping	Average Value[1]	*a)* Fabricated Steel Plate[2] *b)* Metal Canning Closures *c)* Crown Corks[3]		1. See *a*, note 1, Section 1, General. 2. Measurement unit : tonnage. No quality adjustment. 3. Measurement unit : units.
3560		Steel Springs (except Wire)	Average value[1]	([2]) *a)* Locomotive Laminated Springs *b)* Automobile Springs		1. See *a*, note 1, Section 1, General. 2. In calculating the weighted price ratio to be applied to 3560, remaining products were assumed to have same ratio as indicator *a*, since the ratio derived for *b* seemed differentially favourable to the U.S.
3571	X	Wirework	Average Value[1]	([2]) *a)* Wire Cable and Netting *b)* Woven Wire and Netting *c)* Wire Fencing *d)* Steel Wire Nails and Tacks		1. See *a*, note 1, Section 1, General. 2. Price per ton.
3572	X	Needles, Pins and Metal Small-wares	Average Value[1]	([2]) *a)* Domestic and Industrial Machine Needles *b)* Knitting Machine Needles *c)* Safety Pins		1. See *a* note 1, Section 1, General. 2. Price per unit.
3581	X	Bolts, Nuts, Rivets, Screws, etc.	Average Value[1]	([2]) *a)* Cut Nails *b)* Tacks *c)* Rivets (7 1/2″) *d)* Bolts *e)* Wood Screws *f)* Washers		1. See *a* note 1, Section 1, General. 2. Price per ton (except indicator *e*—price per unit).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
3582		Metal Barrels and Drums	Average Value[1]	[2] *a)* Barrels, Kegs, Drums of Wrought Iron and Steel		1. See *a* note 1, Section 1, General. 2. Price per ton.
3599		Other Metal Products (including ordnance)		Employment, adjusted for productivity[1]		1. The average productivity ratio for those industries in group 35 for which a reasonably satisfactory comparison had been made was used for the adjustment. The quantity ratio thus calculated was almost identical with that for the major group.

MACHINERY, EXCEPT ELECTRICAL MACHINERY

I.S.I.C. 36

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
36	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	617	514	3.35	2.79	353	294
	of which :										
3610	Agricultural machinery, except tractors	41	67	40	64	1,239		2.24		429	
3621	Construction and mining machinery	33	69	33	72	1,175		3.23		320	
3622	Textile machinery	99	38	95	36	124		5.26		183	
3630	Metal working machinery	137	159	140	168	448		4.59		221	
3651	Refrigeration machinery	37	82	40	87	1,711		2.20		446	
3652	Pumps and compressors	32	29	31	29	524		3.08		322	
3660	Mechanical handling equipment	48	41	51	35	548		2.18		375	
3670	Office machinery	34	67	32	63	1,279		2.68		369	
3681	Laundry machinery	18	24	21	27	963		2.24		416	
3691	Ball and roller bearings	40	39	39	36	360		4.46		208	

1. GENERAL

a) In the U.K. census, the majority of establishments belonging to this major group are classified in one trade "Mechanical Engineering". The division of this trade into the sub-industries required for purposes of this study may introduce a high margin of error into the net output and employment estimates for individual sub-industries.

b) The use of quantity comparisons for some industries and price comparisons for others would increase the margin of error (see Chapter VII), and most industries were therefore covered by price comparisons. In any case, the few quantity indicators available in this major group rarely referred to comparable products—e.g. a comparison of internal combustion engines on a horsepower basis would ignore major quality and composition differences.

c) The price ratios used were based partly on material collected for the Expenditure Study; some additional information was collected through special enquiries, and census data on average values were also used. Gross price ratios were converted to a net cost basis by adjustment for differences in input price ratios (see Chapter VII, and note at end of Section 2 below).

d) It should be noted that the user classification of investment goods (as in the Expenditure Study) differs from the industry of origin classification, and the fact that the sample of prices is inevitably a small one affects allocation of the weights of unpriced items to the items compared. In practice, the allocation was made to the sample products which appeared to involve the most similar production methods; and this may have a marked effect on the aggregate price ratio where (as in industry 3630) there is a wide spread in the individual ratios. The weights used are based on value data from the 1947 and 1948 censuses.

e) Prices for the following items were compared for industries 3610, 3621 and 3630. They are shown here in order to save space in Section 2.

3610	*3621*	*3630*
1. Plough, tractor-drawn	1. Shovel, 1-1 1/2 cubic yard; diesel	1. Milling machine, horizontal
2. Plough, tractor-mounted	2. Shovel, 2 1/2 cubic yard; diesel	2. Milling machine, universal
3. Disc-harrow, tractor-drawn	3. Bucket, dragline, 3/4 cubic yard	3. Milling machine, vertical
4. Cultivator, drawn	4. Bulldozer, hydraulic	4. Shearing machine, power straight
5. Mower, horse-drawn	5. Scraper (4 wheels), 12-14 cubic yard capacity	5. Milling cutter, side : 4 different types : 2 1/2″—7″
6. Combine harvester - thresher, self-propelled	6. Mixer 6 cubic feet capacity	6. Milling cutter, plain size : 2 1/2″
7. Cream separator	7. Mixer 14 cubic feet capacity	7. Tap, hard—6 different types, 1/4″—2″
	8. Rock bit, 8″-9″	8. Electric drill, 1/4″
	9. Rock drill, hand held	9. Electric drill, 1/2″
		10. Electric saw, 6-8″
		11. Electric arc welder, AC transformer type, 15-180 amp.
		12. Electric arc welder, DC, 200 ampere
		13. Electric arc welder, DC, 300 ampere.

176

2. METHODS AND SOURCES (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
3610	X	Agricultural Machinery (Tractors are classified in I.S.I.C. 38A, Agricultural Hand-tools in 3522)	Price	(1)	(2)	1. See note *e*, Section 1, General. 2. In view of the small spread between price ratios, weights were unimportant.
3621	X	Construction and Mining Machinery	Price	(1)		1. See note *e*, Section 1, General.
3622	X	Textile Machinery	Average Value U.K. and U.S. : E.C.D.	(1) *a)* Cotton Spinning Frames[2] *b)* Twisting Frames[2] *c)* Hosiery Knitting Machine *d)* Braiding Machine		1. The aggregate price ratio for indicators *a* to *d* was used to compare 1947/8 output, and the derived quantity ratio was extrapolated to 1950. 2. With same number of spindles.
3630	X	Metal Working Machinery (Hand-tools are classified in 3522)	Price	(1) *a)* Milling Machines[2] *b)* Small Cutting Tools *c)* Power Hand Tools *d)* Electric Welding Machinery	52%[2] 35 % 8% 5%	1. See note *e*, Section 1, General. The price ratios for the 13 products ranged from \$2.24 to \$7.22 = £1, and there was no typical price ratio. Four groups of products were distinguished, and their price ratios weighted as indicated. 2. The price ratio for Milling Machines was assumed applicable to all big machine tools.
3641		Internal Combustion Engines (except Automobile and Aircraft)	Price	(1) *a)* Petrol Engine 3-6 HP *b)* Diesel Engine 53-70 HP		1. The two price ratios were almost identical. A check was made against the quantity ratio obtained by application of census data on average value : the results differed by 10%.

177

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
3651	X	Refrigeration and Air-conditioning Machinery		(1) *a)* 3 cu. ft. refrigerators		1. The price ratio for *a* was assumed applicable to the entire industry. In fact, a comparison was also made for 7/8 cu. ft. refrigerators, which indicated a U.S. price advantage 20% greater. This was assumed offset by the lower advantage indicated by census data in respect of Industrial Refrigeration and Ice-making Machinery for which, however, it was impossible to make a comparison due to the non-standardisation of the products.
3652	X	Pumps and Compressors (Refrigerating and Air-conditioning units are classified in 3651)	Price	(1) *a)* Stationary Air Compressors *b)* Portable Air Compressors		1. There was a 12% spread between the price ratios and their average was taken to apply to the industry as a whole.
3660	X	Mechanical Handling equipment	Price	*a)* Electric Hoist (Lug Type)[1]		1. The price ratio for indicator *a* was taken to apply to the industry as a whole.
3670	X	Office Machinery (Scales and Balances are classified in 3699)	Price	*a)* Portable Typewriter *b)* Non-portable Typewriter		1. The average price ratio for *a* and *b* was taken to apply to the industry as a whole. The choice of products may bias the results since the U.S. has a differential advantage in respect of calculating machines for which a comparison could not be made.
3681	X	Laundry Machinery	Price	(1) *a)* Washing Machine semi-automatic, Electric *b)* Semi-automatic Wringer, Electric		1. Price ratios for *a* and *b* are close, so that there is no weighting problem. The prices for *a* were for an identical product, and those for *b* an average value for several models.
3682		Sewing Machines	Price	(1) *a)* Cabinet Machine A *b)* Cabinet Machine B		1. The lower of the two price ratios was applied to the industry because the quotations were "delivered retail distributor", and would thus be somewhat biased against the U.S.
3691	X	Ball and Roller Bearings	Price	(1) *a)* 25 mm. Radial Ball Bearing *b)* 35 mm. Radial Ball Bearing		1. An unweighted average of the two price ratios was applied to the industry as a whole.
3692		Non-electric Integrating Meters	Quantity (number) U.K. and U.S. : E.C.D.	*a)* Gas and Water Meters		
3699		Remaining Industries : [1] Printing and Book-binding Special Machinery[2] Steam Engines General Industrial Machinery and Equipment	Employment	*a)* Employment, adjusted for productivity[3]		1. About one-third of output of group 36. 2. Food Products Machinery, Wood Working Machinery, Paper Industries Machinery, etc. 3. The productivity ratio of the 13 industries in group 36 for which a satisfactory comparison had been made was used for the adjustment.

3. ADJUSTMENT FOR DIFFERENCES IN INPUT PRICE RATIOS

As stated in note *c*, Section 1, General, gross price ratios were converted to a net basis by allowance for differences in input price ratios. It is neither possible nor necessary to adjust each input item in detail. The major input items were combined in two groups, the first covering the iron and steel products input (castings, bars, sheet and strip, steel plate). The second group is less important and comprises non-ferrous metals, timber, lumber, packing materials, paint, enamel, varnish and machinery belting. An aggregate price ratio was calculated for these groups from the production censuses (the adjustment requires use of purchasers' prices which are somewhat less favourable to the U.S. than producers' prices).

The group I inputs were comparatively expensive in the United States, and the group II inputs comparatively cheap. The weights assigned to the two aggregate price ratios vary according to the input coefficients of each industry.

For some industries, the adjustments are of considerable importance ; an unusually substantial price advantage implies that gross price ratios will differ markedly from input price ratios. The agricultural machinery gross price ratio, for example, was reduced by about 20 per cent. On the other hand, for some industries whose relative prices were near the average, the adjustment was of little or no importance.

ELECTRICAL MACHINERY, APPARATUS, APPLIANCES AND SUPPLIES

I.S.I.C. 37

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
37	MAJOR GROUP TOTAL	1,000	1,000	1,000	1,000	613	557	3.74	3.40	336	306
	of which :										
3711	Generators, motors and transformers	216	211	225	214	472	385	5.15	4.21	265	216
3720	Electric cooking and heating and small electric household appliances	84	87	78	105	779		3.59		412	
3731	Radio	219	246	193	220	818		2.91		400	
3733	Electronic tubes	25	60	14	60	1,994	1,792	5.12	4.60	375	337
3740	Electric light bulbs	25	34	23	37	868		3.87		356	
3751	Storage batteries	21	20	31	23	737		2.10		411	

1. GENERAL

Only for industry 3711 was it possible to undertake a direct quantity comparison. For the remaining larger industries price comparisons based on a limited number of typical products were used. The price approach was necessary both because of the vast range of products involved and because the quantity data available were not sufficiently detailed to ensure that the products compared were reasonably similar.

2. METHODS AND SOURCES (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
3711	X	Generators, Motors and Transformers	Quantity (number)[1] U.K. : E.C.D. (INRPUK) U.S. : E.C.D. (DVS)	*a)* Fractional Horsepower Motors[2] *a1* under ½ HP[3] *a2* ½-1 HP *b)* A.C. Generators *b1* Under 50 KW *b2* 51-300 KW *b3* Other Generators[4] *c)* A.C. Motors *c1* 1-50 HP *c2* 51-250 HP *c3* Other A.C. Motors *d)* D.C. Motors and Generators *d1* Under 50 HP *d2* 51-250 HP *d3* Other D.C. Motors and Generators *e)* All other Motors, Generators and Transformers[5]	U.K.[6] U.S.[6]	1. The size classification in the censuses is not identical but was sufficiently similar to permit a quantity comparison. The net cost ratio derived for 1950 was consistent with the price ratios for motors and generators used for the expenditure study. 2. About 10% of U.K. output and 25% of U.S. output in 3711. 3. On account of the difference in average size in the two countries, the gross price ratio for indicator *a2* was applied to *a1*. 4. The gross price ratio for indicator *b2* was applied to *b3*. 5. A quantity comparison was impossible for this group, and the price ratio for indicator *b* was applied. 6. Gross value data from censuses.
3712		Electrical Control Apparatus and Measuring Instruments	Price U.K. and U.S. : Censuses and special price enquiries	*a)* Watt-hour Meters[1]		1. The price ratio for indicator *a* was applied to industry 3712.

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
3713		Electrical Cooking and Heating Apparatus	Price[1] U.K. and U.S. : E.C.D. and data from Expenditure Study	([2]) *a1/2* Cooking Stoves (2 sizes) *a3/4* Vacuum Cleaners (Upright and Tank) *a5/7* Electric Irons (3 types)		1. The aggregate price ratio was converted to a net basis by adjustment for the more important inputs. 2. The spread in the price ratios was small, and the products included cover a high proportion of total output.
3731	x	Radio and Television (Electronic Tubes are classified in 3733)	Price U.K. : Manufacturers' Catalogues[1] U.S. : Manufacturers' Catalogues[1]	*a)* Radios and Radiograms[2] *a1* Midget Sets[3] *a2* Table Receivers *a3* Portable Radios *a4* Table Radiograms *a5* Console Autoradiograms *b)* Television Sets[4] *b1* Table Receivers[5] *b2* Console Receivers[5] *c)* Other Products[6]	U.K. U.S.	1. Retail prices were converted to factory prices where necessary by deducting estimated retail margins and sales taxes. 2. A number of models of similar specification were priced for each sub-indicator. Weights were allocated on a somewhat arbitrary basis between the indicators, because production statistics were insufficiently detailed. 3. Price ratio exceptionally favourable to U.S. 4. A 17″ tube U.K. set was compared with a 21″ tube U.S. set (these being the volume sellers in the two countries), prices being adjusted for cost differences attributable to tube-size. In order to obtain more comparable specifications, 1955 data were used and adjusted for 1950/55 price changes by the appropriate wholesale price series for each country. 5. Conversion factors on account of tube size : *b1* 25%, *b2* 20%. 6. e.g. radar equipment. Other products could not be priced, and their weight was allocated equally between indicators *a2* and *b*.
3732		Telephone, Telegraph and Communication Equipment	Employment	Employment, adjusted for productivity[1]		1. The productivity ratio of 3731 was used for the adjustment. The resulting net cost ratio was almost identical with that of 3731.
3733	x	Electronic Tubes (X-ray tubes are excluded)	Quantity (number)[1] U.K. : E.C.D. U.S. : E.C.D.	*a)* Radio Receiving Tubes *b)* Cathode Ray Tubes *c)* Radio Transmitting Tubes[1]		1. Quantity ratio could not be calculated for indicator *c* andwas derived by application of the price ratio for *a* to gross output.
3740	x	Electric Light Bulbs	Quantity (number)[1] U.K. : E.C.D. (INRPUK) U.S. : E.C.D. (D.V.S.)	*a)* Electric Light Bulbs *b)* Motor Vehicle Bulbs *c)* Other Bulbs and Lamps[1]		1. Indicator *c* accounts for about one-third of total output. Quantity ratio was derived by application of the price ratio for *a* to total output of *c*.
3751	x	Storage Batteries	Quantity (number)[1] U.K. : E.C.D. (INRPUK) U.S. : E.C.D. (D.V.S)	([1]) *a)* Automobile Accumulators		1. Price ratio derived for indicator *a* assumed applicable to entire industry.
3752		Primary Batteries	Quantity U.K. : S.A. U.S. : E.C.D. (D.V.S.)	*a)* Number of Cells produced		
3760		Electric Wires and Cables (Manufactured from purchased wire.	Price (Special enquiries)	([1]) *a)* 3 core circular, rubber-insulated 250 V, 23/.0076 Wire		1. The price ratios varied widely. The allocation of weights of other products to the indicator products was arbitrary and the results for this industry are

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
		Wire drawing is excluded)		*b)* 7 mm. plain rubber ignition, wire flexible with 13/.012 copper conductor *c)* Auto. Battery Cable 35/.012, single core, rubber-insulated		therefore less reliable than for other industries in I.S.I.C. 37.
3790		Miscellaneous Electrical Products	Employment	Employment, adjusted for productivity[1]		1. The productivity ratio for those industries in I.S.I.C. 37 for which a reasonably satisfactory comparison had been made was used for the adjustment.

TRANSPORT EQUIPMENT
I.S.I.C. 38

INDUSTRY TABLE

I.S.I.C. Code	INDUSTRY	DISTRIBUTION OF EMPLOYMENT		DISTRIBUTION OF NET OUTPUT (WEIGHT)		QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	U.K.	U.S.	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS	AT U.K. WEIGHTS	AT U.S. WEIGHTS
		1	2	3	4	5	6	7	8	9	10
38 A	Automobiles, trucks and tractors	1,000	1,000	1,000	1,000	1,532	1,213	2.77	2.20	524	415
38 B	Transport equipment other than automobiles, trucks and tractors	1,000	1,000	1,000	1,000	254	168	5.59	3.71	260	173
	of which :										
3810	Shipbuilding and repairing	513	184	466	155	38	40	7.85	8.20	109	114
3822	Railroad and street cars	41	83	57	79	283	236	5.56	4.64	141	118
3850	Motorcycles and bicycles	80	23	102	21	61		3.11		216	

1. GENERAL

a) This sector was considered as composed of two major groups: (1) Automobiles, Trucks and Tractors (I.S.I.C. 38 A) and (2) Shipbuilding, Aircraft Manufacture, Railway Locomotives, etc. (I.S.I.C. 38B). I.S.I.C. 38A accounts for 75 per cent of U.S. output and over 40 per cent of U.K. output, and its separation was necessitated by the differentially large U.S. productivity and price advantage as a result of which the index spread for the I.S.I.C. 38 group taken as a whole is about 90 per cent. It was felt, therefore, that a combined comparison would be of little analytical value.

b) I.S.I.C. 38.

1. For the comparison of automobiles, the methods used in the Expenditure Study (Gilbert and Kravis, *op. cit.*, pp. 162 ff) to compare domestic purchases was used to compare gross production. Scatter diagrams were drawn relating prices and weights of cars in the two countries, and were used to provide estimates for the ratio between the prices of models weighing the U.K. and U.S. averages (1,000 kg and 1,450 kg respectively). This procedure gave the conversion factor for comparing gross production or expenditures. In both countries, the larger car has a higher cost per kg, and for the conversion to a net cost basis, it was assumed that the additional cost was evenly split between inputs and net output. Two net output conversion factors were obtained based on U.S. and U.K. data, the index spread being about 10 per cent.

2. For trucks, the U.K. data are grouped according to carrying capacity, while the U.S. data are given in G.V.W. terms. The conversion factor was based on the relationship between the two measures.

3. For the U.K. weighting pattern, two sets of weights were considered, but gave results which differed very little. These weights were derived: (1) by extrapolating the C.S.O. Index of Industrial Production from 1948 to 1950 by the relevant volume indices, (2) by converting gross output (1948 census) to a net cost basis (Table 6, 1948 census) and extrapolating to 1950. For the U.S., it was not possible to determine weights for separate categories (except tractors) and the weights used assume that gross/net ratios will be roughly the same for each category compared.

2. METHODS AND SOURCES (for interpretation of the entries in this table, see Introduction, Appendix B).

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
38 A	X	Automobiles, Trucks, Tractors and Parts (excluded are: Tyres and Tubes, Head Lamps, Ignition Systems, Storage Batteries)[1]	Quantity U.K. and U.S. : Census data Also : SMMT Year book, 1952; Automobile Facts and Figures, 1953; Truck Facts and Figures, 1953	*a)* Passenger Cars[2] *b)* Trucks[3] [4] *b1* under 5,000 lb. GVW *b2* 5,000-19,500 lb. GVW *b3* 19,500-26,000 lb. and over GVW *c)* Tractors, except Garden *c1* Wheel-type Tractors[5] *d)* Garden Type Tractors *d1-d5* Three Size Classes *e)* Motor Coaches[6] *e1* Single Decker Buses, under 40 seats *e2* Other Buses *f)* Trailers[7]	U.K.[8] U.S.[8]	1. See notes *b*, Section 1, General. 2. See note *b1*, Section 1, General, for adjustment in respect of car size. 3. Indicators *b1-b4* aggregated with U.S. factory price weights. Spread in quantity ratios was so small that the approximate estimation of net cost weights would not have significantly affected the comparison. 4. The quantity index was adjusted to allow for exports, most of which are chassis, the proportion of exports to total production being higher in the U.K. The adjustment was based on average export values shown in trade returns. 5. No adjustment made for quality differences (the average size of wheel-type tractor in the two countries is much the same). Other tractors were expressed in terms of the comparable product. 6. No adjustment for quality differences; the greater luxury of U.S. buses is assumed offset by the inclusion of small school buses in the U.S. total and the inclusion of U.K. *double-deck buses in indicator e2.* 7. Gross output value was converted with a price ratio based on that of industries supplying parts and components to derive a quantity ratio. (The trailer industry requires relatively less processing than the automobile industry.) 8. See Supplementary Table, Section 3.
38 B						
3810	X	Shipbuilding and Repairing (Manufacture of Propelling Machinery is classified in I.S.I.C. 35 and 36)	Average value per gross ton[1] U.K. : E.C.D. U.S. : E.C.D.	(2) *a)* Passenger Ships *b)* Cargo Lines and Refrigerator Ships *c)* Tankers *d)* Fishing Vessels *e)* Other Vessels	U.K. U.S.	1. A quantity comparison was impossible due to conceptual measurement difficulties. 2. Quantity ratios were derived (*a*) by applying the extrapolated weighted average gross price ratio to gross value of work done in 1950 (*b*) by converting the gross ratio to a net basis and applying to 1950 output. The two results differed by 15% and their average was taken.
3821		Locomotives (excluding Locomotive Repair Shops)	Quantity (tonnage)[1] U.K. : Net exports and "Locomotives added to stock" (British Railways) U.S. : E.C.D. (D.V.S)	*a)* Electric and Diesel-electric Locomotives *b)* Steam Locomotives *c)* All Other Locomotives	U.K.[2] U.S.[2]	1. Aggregate tractive power would have given more accurate results but less statistical data were available than for the tonnage comparison, which neglects differences in average size. 2. The structure of the industry is completely different in the two countries, and little significance can be attached to the productivity ratio. Indicator *a* carries some 80% of the U.S. weight, while indicator *b* accounts for two-thirds of the U.K. weight.

I.S.I.C. Sub-Group	INCLUDED IN INDUSTRY TABLE	MAIN PRODUCTS OR ACTIVITY	BASIS OF COMPARISON AND SOURCES	INDICATORS	WEIGHTS AVAILABLE	REMARKS
3822	X	Railroad and Street Cars	Quantity (tonnage) U.K. : E.C.D. U.S. : E.C.D.	(1) *a)* Passenger Coaches *b)* Freight Wagons	U.K. U.S.	1. The price ratio obtained by applying the volume index to net output was compatible with the ratio obtained by adjusting to a net basis prices collected for the Expenditure Study.
3850	X	Motorcycles, Bicycles and Parts	Quantity (number) U.K. : E.C.D.[1] U.S. : E.C.D. (D.V.S.)	*a)* Bicycles[2]		1. Number of bicycles produced in 1950 was used for extrapolation. 2. Other products expressed in terms of bicycles on a gross price basis.
3860		Aircraft and Parts	Employment	Employment, adjusted for productivity[1]		1. The productivity ratio used for the adjustment was that of the machinery (excluding Agricultural and Textile Machinery, where either country has a differential advantage) group. Production methods in the other Transport industries differ too greatly from the Aircraft industry to offer a suitable basis for the productivity adjustment.
3899		Miscellaneous Transport Equipment[1]	Employment	Employment, adjusted for productivity[2]		1. Weight : about 1% of group 38B. 2. The adjustment was based on the same ratio as that mentioned in note 1 to 3860 above.

3. SUPPLEMENTARY TABLE : I.S.I.C. 38

Group Reference	INDUSTRY AND INDICATORS	QUANTITY RATIO (U.K. = 100)		WEIGHTS	
		U.K. WEIGHTS	U.S. WEIGHTS	U.K.	U.S.
38A	Automobiles, Trucks and Tractors	1,532	1,213	100	100
	Passenger cars	2,420	2,140	53	75
	Trucks	569		27	15
	Tractors, except Garden-type	593		11	8
	Garden-Type Tractors	566	478	•	•
	Motor Coaches	56		7	•
	Trailers	1,172		1	2

• = Less than 0.5.

39. MISCELLANEOUS MANUFACTURING INDUSTRIES

This major group covers all manufacturing industries not specified elsewhere, and includes such diverse trades as the manufacture of :

Laboratory and mechanical measuring instruments ;
Surgical, medical and dental instruments ;
Optical instruments and ophthalmic goods ;
Photographic equipment ;
Watches and clocks ; jewellery ;
Musical instruments ;
Toys and games, and sports requisites ;
Brushes and brooms ;
Umbrellas and walking sticks ;
Pens, pencils and other office materials ;
Cinematograph film production and printing.

Little analytical value can be attributed to the total indices for this "catch-all" group, but the results obtained were not considered sufficiently reliable to warrant publication in greater detail. Comparison presented considerable difficulty owing to the wide variety of products (many of which are only recorded by value in the production censuses) and the predominance of goods subject to wide quality variation. Consequently, although a fairly wide range of products was included in the comparison, the direct coverage is not very large, and the results probably contain a higher margin of error than those for the other manufacturing groups. The weight attributable to the group is relatively small, however, 3 per cent of the manufacturing total in the United Kingdom and 4.5 per cent in the United States.

Three methods of comparison were used :

1. Direct quantity comparisons, based on 1947-48 Census of Production data, extrapolated to 1950.
2. Average value comparisons on the same basis. (In both these cases it is assumed that the average quality of the commodities is the same in both countries.)
3. Price comparisons based on enquiries and catalogues.

Average value or quantity comparisons were made for the following products :

Ophthalmic goods :

Ophthalmic lenses
Ophthalmic frames, except metal
Ophthalmic frames, metal.

Toys and games :

Dolls, soft toys, scooters, children's bicycles, toy perambulators, perambulators, strollers, toy trains.

Sports requisites :

Golf balls, tennis balls, golf clubs, tennis rackets. (These products account for a rather high proportion of the total output of the sports requisites industry.)

Watches and clocks :

Alarm clocks (electric and other than electric), motor vehicle clocks.

Musical instruments :

Pianos ; gramophone records. (Gramophone records account for about 50 per cent of this industry.)

Office materials :

Pencils ; fountain pens, except ball point.

Other industries :

Print and varnish brushes ; tooth brushes ; shaving brushes ; household brooms ; umbrellas.

Production and printing of cinematograph film :

The comparison was based on the number of 35 mm. long feature films produced (United Nations Statistical Yearbook 1952, page 518), adjusted on the basis of production values for the much higher share of other types of films produced in the United States.

Photographic equipment and supplies :

A price comparison based on catalogues and special information received from producers of cameras and films was made. The output per worker index found for the photographic equipment industry was also applied to the optical instruments industry.

The following types of cameras and films were included in the comparison :

1. 35 mm. high precision camera with coupled range finder (Leica type), f/2, 1 sec. to 1/1,000 th.
2. Twin lens reflex camera 2 1/4 inch × 2 1/4 inch, f/3.5, 1 sec. to 1/300 th.
3. Folding camera with automatic range finder, f/4.5, 4-component lens.
4. Folding camera without range finder, f/4.5 3-component lens.
5. Full-vue super base camera, twin lens system.
6. Rollfilm, type 120.

Since most of the catalogue prices available were retail, it was necessary to deduct sales taxes (which are often high for these goods), and to adjust for a slight difference in trade margins. The 1950 factory price ratio thus obtained was then converted to a net basis, to allow for an appreciable difference between the gross price ratio, and the price ratios of the input materials bought by the industry.

* * *

Fuel Inputs into Manufacturing Industry

The results given above for individual manufacturing industries do not give a true measure of net output, in that no account was taken of different fuel inputs per unit of output in the two countries. Conceptually, it would have been desirable to adjust each industry for this item by the double indicator method, but, although fairly detailed fuel consumption statistics are available in the censuses, the statistical and technical problems of such detailed adjustments would have been enormous. Adjustment was made, therefore, only to aggregate indices for large industry groups. Separate estimates were made for seven major groups in which fuel consumption is higher than average (food and beverages, textiles, paper, rubber, chemicals, non-metallic mineral products, and primary metals), and the remaining industries, whose fuel consumption is only a small part of the value of output, were treated as one group.

The method used was to estimate fuel expenditures by these industry groups, in each country's own prices, and to convert these into the other country's prices with price indices for each commodity, obtained chiefly from the fuel output comparison. Gas and electricity consumption were measured by actual expenditures because for these fuels the price paid varies considerably between industries according to the average consumption of individual establishments. Expenditures were then converted using average exchange rates, on the assumption that relative prices for each class of industrial consumer were the same in the two countries. Solid and liquid fuels were measured initially in quantity terms, and the quantities were then priced at the output prices of fuels, omitting transport and distribution costs. This procedure was necessary because there was no information on which the transport costs of industrial fuels could be excluded from the overall freight transport input, which is deducted in the final calculations. To have deducted fuels in manufacturing at purchasers' prices would, therefore, have resulted in a double deduction

of the transport input on these fuels, and a bias against the United States where this item is relatively more important.

The fuels covered include all purchases of solid and liquid fuels except for a few unspecified items and minor fuels such as wood, peat and pitch. The omissions account for less than 3 per cent of fuel consumption in both countries. Gas and electricity consumption should, in principle, exclude fuels produced by manufacturing concerns since these are omitted from the outputs of the fuel industry, and are measured by the purchases of primary fuels from which they are obtained. In order to arrive at the true consumption of each industry, however, total net purchases of gas and electricity should be measured, inter-industry sales cancelling out in aggregation. With the data available only approximate estimates on this basis could be made. For the United States net purchases of electricity could be calculated, but for the United Kingdom data of purchases from public utilities had to be used on the assumption that inter-plant sales cancelled out within each industry. This factor may result in an underestimate of up to 4 per cent of total fuel consumption in the paper industry but is negligible in other industries. In both countries difficulty was experienced in identifying inter-industry sales of blast furnace gas, but this is unlikely to have caused any serious errors since this gas is produced and mainly consumed within the primary metal group.

The fuel consumption quantity and price ratios of the individual industries were as follows :

RELATIVE QUANTITIES AND PRICES OF FUELS
USED BY MAJOR MANUFACTURING GROUPS
IN THE UNITED KINGDOM AND THE UNITED STATES IN 1950

	QUANTITY RATIO (U.K. = 100)		GROSS PRICE RATIO $ PER £	
	U.K. PRICES	U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Food and Beverages	979	663	2.16	1.46
Textiles	387	377	2.19	2.13
Paper	1,028	820	2.19	1.75
Rubber	722	605	2.24	1.88
Chemicals	642	413	2.48	1.58
Non-metallic minerals	791	377	2.25	1.07
Basic metals	797	577	3.01	2.18
Other industries	678	550	2.02	1.64
TOTAL MANUFACTURING INDUSTRY	740	529	2.46	1.76

The very wide spreads between some of the pairs of indices, particularly for non-metallic mineral products, are due to the large consumption of gas in certain industries in the United States. On account of this distortion, the quantity indices at United States weights give a truer picture of relative fuel consumption in the two countries, but the United Kingdom weighted indices give the adjustment required to arrive at the gross national product at United Kingdom prices. The large deduction for fuels used in the United States, when measured at British prices,

corrects the high value given to gas in the calculation of United States total fuel output at British prices.

The manufacturing indices were adjusted for fuel inputs by the double indicator formula adjusted because inputs other than fuels are assumed to move with gross output. Thus, if q_m and q_f are the manufacturing and fuel quantity ratios, G_m and N_m the gross and net output values of manufacturing in the base country, and I_f and I_m the corresponding values of inputs of fuels and all other items, the formula may be written

$$q(m-f) = \frac{(G_m - I_m)\, q_m - I_f q_f}{G_m - I_m - I_f}$$

$$= \frac{(N_m + I_f) q_m - I_f q_f}{N_m}$$

$$= \left(1 + \frac{I_f}{N_m}\right) q_m - \frac{I_f}{N_m} q_f$$

Details of the weights and indices used, and the revised manufacturing indices net of fuel inputs, are given in the table below. It will be noted that the United States uses more fuel per unit of output in all industries except paper, when the calculation is made at United Kingdom weights, but at United States prices the fuel deductions result in small declines in net manufacturing output for only five of the eight industry groups.[1] For manufacturing as a whole the ratio is reduced in both sets of prices when allowance for fuel consumption is made, but in American prices the reduction is extremely small. It may be concluded, therefore, that apart from the distortion due to natural gas, differences in fuel consumption are not great enough to substantially affect total output. The high relative advantage of the United States in fuel prices is demonstrated by the fact that in spite of higher fuel consumption the weight attributable to fuels is appreciably smaller in all industries.

COUNTRY NOTES

United Kingdom

Annual estimates of consumption of solid and liquid fuels by industry groups are published in the Ministry of Fuel and Power Statistical Digest. These are in rather broad groups whose classification differs from that

1. It may be noted that this result differs appreciably from that obtained by Frankel (*British and American Manufacturing Productivity*, p. 42 ff) who compared fuel inputs by coal equivalents for 29 product groups. Of these 29 groups, 17 showed a higher fuel input per unit of output in the United States and the average for all groups was virtually the same in the two countries. This difference is certainly due to the use of coal equivalents (i.e. calorific content adjusted for efficiency differences in use) rather than price weights, but it must not be assumed that the calorific basis necessarily gives a better technical comparison than the price basis. Efficiency in utilisation varies widely, so that adjustment for this factor is rather hazardous, and it seems possible that even after adjustment, Frankel's results still contain some bias in favour of the major coal using country (Britain), and against the United States which uses a large proportion of gas and electricity, whose heat loss in conversion is very small.

used in this study. Further breakdowns were made, therefore, on the basis of a special survey for 1951/2 in the United Kingdom Standard Industrial Classification[1] and data from the 1948 Census of Production. No breakdown of gas and electricity consumption by industries was available for 1950, except for coke oven gas, and for the other items values of purchases from the public utilities, as given in the 1948 Census, were reclassified, adjusted for the consumption of small firms not included in the Census, and extrapolated to 1950. The extrapolation was made by multiplying the value figures for each industry by the appropriate production index to obtain estimates of 1950 requirements at 1948 input coefficients and prices, and then adjusting for price changes. This gave a consumption of electricity by industries within 0.5 per cent of estimated actual 1950 consumption, but for gas the industry estimates fell short by 9 per cent and proportionate increases in the co-efficients for all industry groups were assumed.

United States

Expenditures on purchased electricity in 1950 are given in the Statistical Abstract 1953, and were adjusted for detailed reclassifications and inter-industry sales on the basis of the 1947 Census of Manufactures.

MANUFACTURING INDICES ADJUSTED FOR FUEL INPUTS

INDUSTRY GROUP	WEIGHTS FOR TOTAL INDICES (ΣN_m)		WEIGHTS FOR FUEL DEDUCTION $\frac{I_f \times 100}{N_m}$		MANUFACTURING q_m		FUEL q_f		MANUFACTURING NET OF FUEL INPUTS q_{m-f}	
	U.K.	U.S.	U.K.	U.S.	U.K. PRICES	U.S. PRICES	U.K. PRICES	U.S. PRICES	U.K. PRICES	U.S. PRICES
Food and Beverages	105	107	4.66	3.39	454	409	979	663	430	404
Textiles	131	67	4.54	3.79	297	268	387	377	293	265
Paper and paper products	28	40	9.68	6.34	1,043	1,033	1,028	820	1,044	1,051
Rubber products	13	18	6.63	3.45	641	613	722	605	635	613
Chemicals	68	68	10.47	5.49	542	516	642	413	532	523
Non-metallic mineral products	51	44	17.45	8.91	413	373	791	377	347	372
Primary metals	103	99	21.67	20.16	522	490	797	577	462	476
Other industries	501	557	2.76	1.43	633	517	678	550	632	517
TOTAL MANUFACTURING	1,000	1,000	6.65	4.50	553	474	740	529	539	472

Data on consumption of other fuels by the Iron and Steel Industry in 1950 were obtained from B.I.S.F. Overseas Year Book 1953. Estimates for other fuels had to be made by extrapolating data given in the 1947 Census of Manufactures. This presented some difficulty owing to the

1. Ministry of Fuel and Power Statistical Digest, 1952.

major shift in consumption from solid fuels to oil and natural gas. The method adopted was to calculate 1950 requirements of fuels on 1947 technical co-efficients by multiplying the 1947 data by production indices. This gave practically the same total fuel consumption in coal equivalents[1] as the global 1950 consumption estimates obtained from the Mineral Year Book, but actual 1950 consumption showed a decline (on the basis of requirements on 1947 co-efficients) of nearly 25 per cent in solid fuel consumption and increases of 20 per cent and 50 per cent in oil and natural gas respectively. The necessary shift was made by arbitrarily assuming that all industries had made similar changes in the proportion of the three classes of fuel. As the price ratio for natural gas is markedly more favourable to the United States than that of the other items, this assumption may appreciably affect the results for some industry groups, but is offsetting in the total for manufacturing. Estimates of expenditures on gas were made by assuming the same price differentials between industries in 1950 as in 1947.

1. Four barrels of fuel oil and 20,000 cu. ft. of natural gas were taken as equivalent to one short ton of coal.

APPENDIX C

THE NON-MANUFACTURING INDUSTRIES

AGRICULTURE

The agricultural sector includes all farm production, the output of small and semi-commercial agricultural units and fisheries, but not forestry, the small weight of which was transferred to manufacturing and assumed to move with timber production. Farm production accounts for practically all of United States output in this group, and 87 per cent of that of the United Kingdom.

Farm Production

The relative homogeneity of agricultural products and the high proportion of agricultural output accounted for by a fairly small number of staple products greatly facilitated comparison in this sector, and, in spite of the major differences in scale and methods of production in the United States and the United Kingdom, the results obtained are considered fairly reliable. A quantity comparison was made of output and the major inputs of the sector as a whole. Output was defined to include all sales of farm products to industry or final consumers and produce consumed in farm households, but intermediate products used for further production within agriculture, whether on the same farm or by other agricultural enterprises, were excluded from both sides of the account. These consisted mainly of seed and unprocessed feeding stuffs. Feed materials sold to industry for processing were, however, included in output, and the full value of the resulting processed feeds in inputs. This avoided the necessity of assigning separate values to the feed content of crops, such as wheat and oil seeds, whose by-products are resold to agriculture.

Farm Output—Animal Products

Production of animal products accounts for more than two-thirds of United Kingdom agricultural production and three-fifths of that of the United States. Output of beef, pork, milk and eggs accounts for more than 85 per cent of the total gross value of the group in both countries, and the inclusion of indicators for mutton and lamb, poultry, and clip wool brings total direct coverage to over 99 per cent.

The table below gives the relationships derived for the various products.

OUTPUT OF ANIMAL PRODUCTS

	WEIGHTS		QUANTITY RATIO (U.K. = 100)		GROSS PRICE RATIO $ PER £	
	U.K.	U.S.	AT U.K. PRICES	AT U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Meat products :						
Beef and veal	155	282	836		5.55	
Mutton and lamb	58	18	183		4.33	
Pork	122	231	1,760		2.76	
Total meat products	335	531	1,055	934	4.33	3.84
Milk	441	266	545		2.82	
Eggs	167	105	862		1.86	
Poultry	40	86	2,557	2,510	2.19	2.15
Clip wool	10	8	386		5.21	
Minor items	7	4	—	—	—	—
TOTAL	1,000	1,000	847	805	3.17	3.01

Meat Products

Farm output of livestock for meat was measured in terms of the meat produced, and the value added in slaughtering was included in agriculture. The net output of the slaughtering industry is very small (about 5 per cent of the United States value of meat produced and considerably less in the United Kingdom) and independent comparison is difficult because the proportions of farm, wholesale, and retail slaughtering vary between countries. Moreover, the output of meat animals can most easily be measured in terms of meat produced as this allows automatically for differences in the average weight of livestock, and avoids any risk of duplication of production owing to inter-farm sales of stock.

The output of hides and skins and other by-products was assumed to move with meat output. The value of these by-products is included in the weights which represent the total receipts of farmers from the sale of livestock for slaughter, plus the value added in slaughtering. No distinction was made between beef and veal, and mutton and lamb, because of differences in the grading system in the two countries. It was found, for example, that the *average* weight of calves at slaughter in some states of the United States exceeded the official *maximum* weight for calves in the United Kingdom. A quality adjustment had to be made for pig products because pigs are not fattened for lard in the United Kingdom. The comparison was, therefore, made using pigmeat as the standard commodity, American lard output being converted into an equivalent output of meat on a price basis.

Milk

Output of milk was measured as bulk production less waste and stock feed, and no allowance was made for quality differences. Butter and cheese produced on farms were included as milk equivalent. The proportion of milk turned into butter and cheese on farms is about 5 per cent in the United States and about 2½ per cent in the United

Kingdom. In both countries the milk processed on farms is cheaper than the national average as a result of seasonal and regional price variations. The value of the products is thus less than that of their milk content valued at overall prices, and no adjustment for value added in processing is practicable.

Eggs, Poultry and Wool

Eggs were measured by weight, and included all sales and household consumption, less an allowance for inter-farm sales of eggs for hatching. Poultry output was measured by weight in terms of chickens and turkeys, production of ducks, geese, etc., being converted into an equivalent output of chickens on a price basis. Clip wool was measured by weight, but the output of lamb and sheep skins is included with that of mutton and lamb.

Farm Output—Crops

Output of crops, although of smaller total value than that of animal products, is very much more diverse and 38 indicators were used which gave a direct coverage of about 88 per cent of United Kingdom production and 86 per cent of that of the United States. A large share of the weight is, however, attributable to a few staple products, and the six most important commodities account for 60 per cent of United Kingdom and 50 per cent of United States output. The introduction of further indicators would, therefore, add little to the total accuracy of the comparison.

The commodities for which quantity indicators were used can be divided into two classes—*identical goods* and *import goods*. The latter group consists of 11 staple items grown only in the United States but imported on a substantial scale by the United Kingdom, and their treatment is discussed below. The identical goods accounted for the whole of the 88 per cent of United Kingdom output covered by direct measurement but only 37 per cent of that of the United States. Quality being assumed to be identical in the two countries, tonnages of output were directly compared, weighted by farm gate prices, and adjusted as far as possible to factor cost by the inclusion of such subsidies and price support payments as could be attributed to specific crops.

The 11 items which have been designated *import goods* are extremely important to the comparison as they include such important American agricultural staples as cotton, tobacco and corn, and account for 49 per cent of United States output. From the production stand-point they are unique goods but they are common items of consumption in the United Kingdom as a result of large scale imports. It was decided, therefore, to include them in the direct quantity comparison using as United Kingdom price weights the import price at port. This may, in a certain sense, be regarded as the minimum production price in the United Kingdom, since there would presumably be some home production if it could compete successfully with this import price level. A stronger reason for the procedure adopted is that these are the prices at which these commodities enter the United Kingdom production system and, with

appropriate additions for value added in processing and distribution, are the prices relevant to a direct comparison of expenditures.

The use of import prices might in some circumstances produce considerable distortion, but in the present comparison it was found that all the American staple items could reasonably be measured by United Kingdom import prices, and only in the case of citrus fruit, where packing and transport charges are high, did this result in a price ratio markedly favourable to the United States. In fact the average price ratio of import goods, $2.50 per £ was practically the same as that of the identical goods, $2.53 to $2.26 per £ according to the weighting system. There was a fairly wide spread among the ratios for the seven smaller items, but three-quarters of the weight is attributable to four staple products whose price ratios were within 7 per cent of the average.

The output not directly covered by the quantity indicators used accounted for 12 per cent of United Kingdom and 14 per cent of United States output. It was made up of a wide range of minor commodities, and items which (though produced in both countries) could not be directly compared for statistical reasons. The American unique commodities included (melons, egg plant and sorghum grains, etc.) constitute a very small proportion of the total.

The comparison for crops is summarised in the table below.

GROSS OUTPUT OF CROPS

(NET OF QUANTITIES USED WITHIN THE AGRICULTURAL SECTOR)

	WEIGHTS		QUANTITY RATIO (U.K. = 100)		GROSS PRICE RATIO $ PER £	
	U.K.	U.S.	AT U.K. PRICES	AT U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Grains	295	239	1,119	1,237	2.40	2.65
Major field crops	369	473	1,728	1,728	2.72	2.72
Fruit	92	125	2,688	1,729	2.90	1.86
Vegetables	178	114	1,869	1,119	2.11	1.26
Miscellaneous	66	49	1,202	1,077	(2.52)	(2.26)
TOTAL CROPS	1,000	1,000	1,626	1,456	2.52	2.26
of which						
Identical	878	366	676	604	2.53	2.26
Import	0	490	—	—	—	2.50
Other	122	144	2,577	1,773	2.44	1.68

Grains

The output of five major crops covered practically all output of grains. The comparisons are summarised below :

OUTPUT OF GRAINS

	WEIGHTS (IN TOTAL CROP OUTPUT)		QUANTITY RATIO (U.K. = 100)		GROSS PRICE RATIO $ PER £	
	U.K.	U.S.	AT U.K. PRICES	AT U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Wheat	164	151	1,243		2.72	
Barley	102	15	297		1.86	
Oats	25	7	376		2.59	
Rice	0	17	—		3.51	
Corn	0	39	—		2.62	
TOTAL (including misc.)	295	239	1,119	1,237	2.40	2.65

Major Field Crops

The identical crops included in this group were potatoes, sugar crops, flax and linseed, hops and dried peas. American production of sweet potatoes was converted into equivalent Irish potatoes on a price basis, and similarly, all sugar crops were expressed in terms of sugar beet, and flax straw in terms of linseed. The group also included some important import goods—cotton and cotton seed, tobacco, soya beans, dried beans, and peanuts. The results for the more important commodities are as follows :

OUTPUT OF MAJOR FIELD CROPS

	WEIGHTS (IN TOTAL CROP OUTPUT)		QUANTITY RATIO (U.K. = 100)		GROSS PRICE RATIO $ PER £	
	U.K.	U.S.	AT U.K. PRICES	AT U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Potatoes	232	37	205		2.85	
Sugar crops	94	21	346		2.35	
Cotton	—	185	—		2.68	
Tobacco	—	97	—		2.47	
Soya beans	—	62	—		2.64	
TOTAL (including other items)	369	473	1,728	1,728	2.72	2.72

Fruit

Five indicators were used to measure the output of identical fruit, for apples, pears, cherries, stone fruit (other than cherries) and strawberries. It was considered that aggregating stone fruit, other than cherries, gave a better basis of comparison than the separate measurement of plums, damsons, peaches and apricots, because the first two of these are cheaper and more plentiful in the United Kingdom while peaches and

apricots are the bulk items in the United States. Citrus represented the bulk of U.S.-type fruit imported by the United Kingdom. The unspecified items which were assumed to move with the price ratio of the whole group accounted for a quarter of the total in the United States and a little less in the United Kingdom.

Vegetables

Production of vegetables is dispersed over a large number of commodities, none of which carried a very high weight. Thirteen indicators were used which gave direct coverage for nearly 80 per cent of United Kingdom output. In the United States, quantity data were only available for vegetables produced in commercial areas, and output from farm gardens and for local markets could only be measured in total value. This part of production was therefore included with the minor and unique items which were converted with the average price ratio of the directly compared items. Direct coverage is only 50 per cent of the total, but this figure gives no indication of the total proportion of United States output accounted for by the thirteen identical items.

Farm inputs

Direct comparisons were made of farm consumption of fertilisers, imported and processed feeding stuffs, imported seed and livestock, oil fuels and electricity. Expenditures on repair and accessories for vehicles and machinery were assumed to move with oil fuel consumption. These items accounted for four-fifths of United Kingdom and two-thirds of United States inputs when interfarm transactions are excluded. The remaining expenditures covered a wide range of small items for which no quantity comparison could be made. Since the value series available were not very reliable, they were assumed to move with net output.[1] The results are given below.

AGRICULTURAL INPUTS

	DISTRIBUTION OF INPUTS		QUANTITY RATIO (U.K. = 100)	
	U.K.	U.S.	AT U.K. PRICES	AT U.S. PRICES
Fertilisers	186	142	489	
Imported and processed feed	363	183	319	338
Imported seed and livestock	59	13	77	69
Electricity	5	16	1,202	
Oils, and vehicle and machinery upkeep	217	331	1,076	
Sub-total : Measured Inputs	830	685	561	546
Unmeasured Inputs	170	315	1,346	1,163
TOTAL	1,000	1,000	695	656

1. See Chapter VI.

Fertilisers

Fertiliser consumption was compared on the basis of nitrogen, potash and phosphate content, basic slag and phosphate rock being first converted on a price basis, into an equivalent quantity of super-phosphates. In view of the higher relative consumption of mixed fertilisers in the United States, bulk consumption of mixed fertilisers weighted by the additional value added in mixing was used as a further indicator. Lime was also included in the group but was measured in bulk as information on the C_aO content was not available.

Weights were estimated from United Kingdom prices, converted to factor cost by the addition of subsidies. Fertiliser prices for the three basic elements were calculated from the price per unit of content of the more important fertilisers in each group. The additional value of ready mixed fertilisers was estimated by comparing expenditures on mixed fertilisers with expenditures on an equivalent quantity of separate basic fertilisers.

Details of the comparison are given in the table below.

FERTILISER INPUTS

	WEIGHTS	QUANTITY RATIO (U.K.=100)
N content	245	493
P_2O_5 content	356	498
K content	105	528
Mixing cost of ready mixed fertilisers	134	612
Lime	160	332
TOTAL	1,000	489

Imported Seed and Livestock were compared with value series converted by the price ratio for output of crops and animal products.

Feeding Stuffs

Consumption of imported and processed feeding stuffs was compared in five groups—oil cake and meal ; milling offals ; brewers grains, beet pulp and molasses ; meat and fish meal ; and imported food grains. Quantities consumed in each group were weighted by prices paid by farmers in both countries, United States production prices of oats, barley and corn being used to value United Kingdom imported feed grains at U.S. prices.

Electricity

Electricity consumption on farms for production purposes was estimated by assuming that consumption by farm households of electricity was the same per household as that of other residential consumers, and deducting the corresponding amount from total farm consumption.

Oil consumption and machinery and vehicle repairs

Oil consumption was compared using gasoline as the standard commodity. Farm expenditures on all oil fuels were adjusted to factor cost by deducting estimates of motor fuel taxes paid by farmers. The factor cost value series was then converted by a price ratio calculated from average service station and tank wagon prices for gasoline, net of tax. In both countries the major fuels used are rather cheaper than gasoline (at factor cost), but it was considered that standard grades of gasoline gave the best basis for comparison as there is less quality difference and reasonably reliable price information is available. The expenditure series used included gasoline used in trucks and the part of automobile consumption attributed to business use.

The quantity index for gasoline was also used to measure expenditure on repairs and parts for machinery, tractors, trucks, and the business share of automobiles. This gives a result very close to the proportion of tractors in use in the two countries, but may somewhat underestimate American real expenditures in view of the large number of farm trucks in the United States. The ratio of machinery in use for the few items for which comparable data are available is as follows :

	United States as percentage of United Kingdom.
Tractors	1,090
Milking machines	810
Combine harvesters	6,830
Trucks	22,700

Price adjustment to farm net output

It was necessary to adjust the weights obtained from the direct estimates used in the above calculations of net and gross output to a true national accounts basis. This adjustment includes changes in stock valuation ; the addition of the weight of agricultural service stations which were treated as an intermediate service measured by agricultural output ; general subsidies net of taxes, including gasoline taxes, and the United Kingdom fertiliser subsidies (inputs being priced at factor cost) ; and a number of minor statistical adjustments. The net effect is to increase the United States weight by about 5 per cent and reduce the United Kingdom weight by 3 per cent so that the derived price ratios are increased by about 7 per cent.

Output of Small Units

The farm output discussed in the preceding sections includes all production from holdings classified as farms in the national statistics of the two countries. For the United Kingdom this includes the output of all holdings of more than one acre in Great Britain and of more than ¼ of an acre in N. Ireland. In the United States 1950 Census of Agriculture "places of 3 or more acres were counted as farms if agricultural products, exclusive of a home garden, with a value of more than $150 were produced in 1949" and "places of less than 3 acres were counted as farms only if the agricultural produce sold in 1949 amounted to $150 or more."

The United States definition appears to cover virtually all economic production as no allowance is made in the national accounts for production of smaller units, but in the United Kingdom it is estimated that about 9 per cent of agricultural gross production is produced on holdings of less than one acre, and allowance is made in the national accounts for their output. The holdings of less than one acre are a heterogeneous group but it cannot be assumed that they are wholly non-commercial in type. Although they undoubtedly include a large proportion of allotments and domestic holdings they also include some highly intensive production units such as poultry farms, hatcheries, and horticultural establishments.

It was decided, therefore, that the production of small units not covered in the agricultural statistics must be included in the comparison, but as the United Kingdom group certainly includes some non-commercial output, it was assumed that United States output for the non-farm population would be about one-quarter per capita of that of the United Kingdom. This token adjustment adds about 0.5 per cent to United States agricultural output, and was made very roughly by converting the net output values with the net price ratio for farms.

Fisheries

The net output weight attributable to fisheries is only 6 per cent of that of the total agricultural sector in the United Kingdom and 1 per cent in the United States. A detailed comparison would bring in a number of unique products, as different fish are available in the two countries. Fishery products were therefore measured by the total weight of fish landed with no adjustment for quality. The United Kingdom output of whaling products, for which there is no American equivalent, were converted into an equivalent volume of other fish on a value basis.

Country Notes and Sources

United Kingdom

The calculation for the United Kingdom was facilitated by the fact that estimates of the ring-fence output of the national farms are published by the Ministry of Agriculture and Fisheries, in "Agricultural Statistics, United Kingdom", Part II, 1953. The quantities and values used in the gross farm output calculation taken from this source were supplemented by later and more detailed unpublished figures provided by the Ministry of Agriculture and Fisheries. Adjustment from an agricultural year to a calendar year basis for animal products was made by taking 7/12 of agricultural year 1949/50 and 5/12 of that of 1950/51. For crops, *ad hoc* estimates were made according to the harvest season.

Material on quantities of inputs and some price data were obtained from the Statistical Abstract, supplemented by unpublished data from the Ministry of Agriculture and Fisheries. Data on fertiliser expenditures are also available in "Agricultural Statistics", Part II, and adjustment for subsidy payments was made from the Civil Appropriation Accounts, and Trading Accounts and Balance Sheets.

Information on holdings under one acre was obtained from a report,

not yet published, by E.B. Butler, "A Regional Analysis of the Net Output of Agriculture in the Harvest years 1947/8 and 1948/9 and Calendar year 1948".

United States

The data used were obtained from the annual publication "Agricultural Statistics" of the Department of Agriculture, and from articles on the Gross National Farm Product in the Survey of Current Business for July 1951 and August 1954. A number of adjustments had to be made to these data to correspond to the definitions used in the present study. The United States national accounts estimates are calculated on the basis of gross farm sales net of purchases, and for the present purpose interfarm sales had to be deducted. The rental value of farm homes was transferred to services of dwelling units, but the deduction in the original source for rents to non-farm landlords was restored, as this item is regarded as part of the income originating in agriculture.

Quantity data for individual commodities were obtained from "Agricultural Statistics". For fruits, vegetables and minor items the value series for farm sales and home consumption were used, since these are more complete than the direct quantity information. Quantity estimates were then obtained by dividing the values by average prices received by farmers. Some arbitrary adjustment of small items for interfarm sales was made. For grains and major field crops output was calculated by deducting amounts used for seed, feed and waste on farms, and valuing the remainder at prices received by farmers. These estimates differ from the income series, therefore, both in respect of interfarm sales and changes in stocks on farms reflected in the time lag between harvest and sale.

Farm electricity consumption was estimated from the Statistical Abstract, and information on gasoline consumption obtained from the "Automotive News and Almanack, 1953". Other information on inputs was obtained from "Agricultural Statistics" and the Survey of Current Business.

* * *

FUELS

The fuel sector is defined on a comprehensive basis to cover all sources of power and includes the extraction and subsequent processing of solid and liquid fuels and natural gas, and also production of manufactured gas and electricity. Water supplies from public utility companies are for convenience included with the other utilities, but their weight in the total sector is small.

This somewhat unconventional classification was adopted to minimise the difficulties of comparing fuel production in two countries with widely different natural resources. The extraction of mineral oil and natural gas are unique industries of the United States, and, although

a British price for crude oil could have been imputed from the import price, as was done in the case of some staple agricultural products, this solution could not be applied to natural gas which is neither produced nor consumed in Britain. The use of these unique goods as inputs into electricity, and also the greater proportion of hydro-electric power in the United States, presented further difficulties.

These structural differences make a meaningful comparison of the separate industries in the two countries extremely difficult, but, owing to the high degree of substitution between fuels, significant comparison of global fuel output and availabilities is possible. The method of comparison adopted, therefore, was to include all the fuel producing industries in one "ring-fence"[1] group, and to measure the output of the group net of intra-industry sales of fuels for conversion. Thus output of coal, petroleum and natural gas were measured by deliveries to outside consumers, excluding own use in collieries and refineries, and also excluding deliveries to secondary fuel producers. Output of the secondary fuels could then be given the full weight of the value added both in conversion and in the original extraction of the input fuels. On this basis the ratio of value added to gross sales value is rather high for all fuels, and it was considered that no appreciable bias would result from weighting the various indicators by gross price, although the correct weighting for each indicator would actually be gross value minus inputs other than fuels produced within the sector.

Inputs of imported crude oil were deducted, petroleum products being measured at the refinery level, but no allowance was made for variations in other inputs. These other inputs are extremely diverse and the few items that could be measured, such as pit props, carried too small a weight to affect the result appreciably.

Solid Fuels

Four indicators covered 90 to 95 per cent of the output of the group. These were bituminous coal, anthracite, coke oven coke, and coke from

OUTPUT OF SOLID FUELS
(NET OF SALES TO OTHER FUEL INDUSTRIES)

	DISTRIBUTION OF OUTPUT		QUANTITY RATIO (U.K. = 100)		GROSS PRICE RATIO $ PER £	
	U.K.	U.S.	AT U.K. PRICES	AT U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Bituminous coal	669	512	240		2.19	
Anthracite	25	114	823		3.78	
Coke (coke oven)	111	290	468		3.84	
Coke (gas works)	111	23	35		4.02	
TOTAL (including other items)	1,000	1,000	255	260	2.63	2.68

1. See Chapter IV.

gas works. Indicators were also used for manufactured fuels (briquettes, etc.) and coke breeze, but their weight was very small. Production of coke by-products was assumed to move with the production of coke.

Differences in quality and grading in the two countries made it impossible to subdivide bituminous coal by type, and so there may be some quality bias against the United Kingdom which uses a larger proportion of high grade domestic coal. One result of the aggregation of all types of bituminous coal in one group is the major difference between the price ratio of coke and that of bituminous coal ; the prices of coking coal are much more favourable to the United Kingdom than is the case for the crude average of all coals, although differences in transport costs between mines and coke ovens may also play some small part.

Gas

Natural and manufactured gas were treated as one commodity, measured by thermal content. This has obvious disadvantages because natural gas is a very cheap fuel in many regions of the United States, and is used for purposes for which coal rather than manufactured gas would be used in Britain. To measure natural gas in terms of coal equivalent presents great practical difficulties, however, both because of their greatly varying efficiency in use,[1] and because coal distribution entails a major input from the transport industry, while production and distribution of gas are integrated in the fuel industry.

The main objection to combining manufactured and natural gas is that this gives too high a weight to American industrial consumption of natural gas, particularly in the comparison at British prices. This distortion is, however, reduced to a minimum by subdividing gas output according to consumer classes, as part of the higher general average price in Britain is due to the larger proportion of small users, for which distribution costs are high. Three classes of consumers of public utility gas were, therefore, compared separately, and a further category was included to cover direct sales of coke oven gas to final users, not passing through the utility network. Detailed results are given in the table below.

OUTPUT OF GAS

TYPE OF USER	DISTRIBUTION OF OUTPUT		QUANTITY RATIO (U.K. = 100)		GROSS PRICE RATIO $ PER £	
	U.K.	U.S.	AT U.K. PRICES	AT U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Residential	638	580	1,021		1.39	
Commercial and miscellaneous	161	144	1,419		0.98	
Industrial (excl. coke oven gas)	177	241	4,284		0.50	
Coke oven gas (direct sales and transfers)	24	35	678		3.41	
TOTAL	1,000	1,000	1,654	1,292	1.21	0.95

1. Which makes it extremely difficult if not impossible to compare them on the basis of calorific content.

Electricity

The output of electricity covers only supplies from the public utilities. Electricity generated by industrial firms for their own use is excluded, because the output of fuels from which this electricity is produced is included in the other subgroups[1] and there is no basis on which the additional value added by their conversion to electricity could be separated from the total net output of the industries concerned. In any case the inclusion of electricity generated by industry would not significantly affect the comparison as it contributes a similar proportion of total supplies in both countries—roughly 12 per cent in the United Kingdom and a little under 15 per cent in the United States.

Electricity output was compared in three categories, according to the type of consumer, as shown in the table below.

OUTPUT OF ELECTRICITY

TYPE OF USER	DISTRIBUTION OF OUTPUT		QUANTITY RATIO (U.K. = 100)		GROSS PRICE RATIO $ PER £	
	U.K.	U.S.	AT U.K. PRICES	AT U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Residential and farm	373	411	499		4.99	
Commercial and small industrial	273	313	500		5.17	
Large industrial	354	276	789		2.24	
TOTAL	1,000	1,000	602	556	4.06	3.75

Petroleum Products

The comparison of petroleum production was affected by technical as well as structural factors, and the results obtained are less reliable than those for the other fuel sectors. The main technical difficulty arises from the fact that prices of refinery purchases of crude oil and sales of finished products are somewhat artificial. Owing to the extent of vertical integration in the industry, there are few actual sales at these points, and the prices available are either hypothetical, or represent book values of transfers within firms. This problem is acute in the United Kingdom, where, as a result of artificial pricing, the census data as available appear to show a decline in net output from 39 per cent of gross sales value in 1935, to 17 per cent in 1948, 6 per cent in 1950 and 2 per cent in 1951.

The method adopted was to compare gross output of refineries using 6 indicators of the chief petroleum refined products with gross price weights. These indicators covered nearly 95 per cent of total refinery production in both countries, and the remaining minor products were measured by value series converted with the average price ratio of the major products. The results showed that American *gross* output was 35 to 37 times that of the United Kingdom. In addition, however, the

1. This takes no account of a small quantity of hydro-electric power produced by industrial concerns, but the amount is little over 1 per cent of total supplies in the United States and the corresponding figure for the United Kingdom would be negligible.

American industry was producing practically all its own crude oil input, while the British industry merely processed imported crude oil, so that United States relative *net* output is far greater. Owing to the difficulty, discussed above, of obtaining true price weights the double indicator calculation contains a wide margin of error, and it can only be said that American net output in the petroleum industry is probably at least 150 times that of the United Kingdom.

Although relative net output of the petroleum industry can only be very crudely assessed this does not greatly affect the overall comparison for the fuel sector. In the United Kingdom the gross output of refineries only accounts for just over 10 per cent of total. The price data available suggest that net output is little more than 1 per cent, so that even if this value is greatly underestimated it cannot seriously affect the measure of total British production. In the United States, petroleum production is the most important item accounting for 45 per cent of the total value of output of the fuel sector, but as net imports of crude oil are only 5 per cent of refinery output, inaccuracy in the weighting of the input deduction is again of little significance.

Public Utility Water Supply

For convenience the net output of waterworks was included with fuels. Two indicators were used. Water supply to final consumers was measured with the same indicator of per capita consumption as was used in the expenditure study.[1] Industrial use of water was related to the index of total manufacturing output. This procedure was adopted, not on the assumption that water usage per unit of output was the same in the two countries, but because industrial water consumption is an intermediate product making no direct contribution to final output. The effect of using the manufacturing indicator is the same as that of combining the industries on a ring-fence base assigning the weight of the intermediate product to that of the final product.[2] No indicator was used for agricultural water consumption as a substantial part of this is

	WEIGHT	QUANTITY RATIO (U.K. = 100)	
		AT U.K. PRICES	AT U.S. PRICES
Residential water consumption	45	600	
Industrial water consumption	55	553	474
TOTAL	100	574	531

Sources :

United Kingdom. Fuels used : Ministry of Fuel, "Statistical Digest", 1951 and 1953. Water supply : 1950 Census of Production, supplemented, for residential supplies, by national accounts estimates of residential water rates.

United States. "Minerals Year Book", 1950 and 1951, and the Statistical Abstract.

1. *Op. cit.*, p. 156.
2. See Chapter VI.

obtained from sources outside the public supply system. The two indicators were combined and were added to the total output of fuels with weights estimated from the United Kingdom Census of Production, no corresponding data being available for the United States.

* * *

CONSTRUCTION

The construction industry presented more serious difficulties than those encountered in any other sector for which a comparison was made. Not only are there serious conceptual problems, but at the same time the statistical data available are less reliable and less complete than those for most other industries. The results obtained must, therefore, be regarded as extremely tentative.

The conceptual problems arise from the fact that there are basic differences in construction methods and in the typical products of the industry in the United States and in the United Kingdom. The output of the industry is difficult to quantify, and between the two countries it proved impossible to find sample units for a price comparison that were typical of methods used in both countries. In the expenditure study[1] an attempt was made to compare a sample house and factory, but the house comparison had to be dropped, and that of the factory was not altogether satisfactory. We did not feel that further investigation on these lines would be any more successful and recourse was had to rather crude methods of comparison.

The deficiencies in the statistical data are due to three main factors :

1. The large number of small firms and self-employed workers in the industry complicates the initial collection of information.
2. The time required for completion of many construction projects is considerable, and so output for a particular period must be based on work put in place. This has usually to be estimated on rather general assumptions from series relating to work started or completed.
3. A large volume of construction work is done by "force account" employees of concerns classified to other industries, particularly the utility industries. Gross output statistics (new construction and repair and maintenance) include this force account work, but net output and income statistics in the national accounts relate to construction industry workers only.

The Definition of Construction Activity

In view of these difficulties it was decided to define the construction industry to include all new construction, but only residential, institutional and government repair and maintenance. It was necessary to include new construction on an activity rather than on an industry basis

1. Gilbert and Kravis, *op. cit.*, p. 192.

because the construction work done on their own behalf by utility undertakings and manufacturing firms is not measured by the indicators of output of these industries. Industrial and commercial repair and maintenance on the other hand is an intermediate product, and there is little to be gained by measuring it independently, particularly as the construction indicators used are weak. The weight attributable to industrial repair work done in the construction industry was, therefore, allocated to the industries concerned. Much building repair and maintenance work is in any case carried out by industrial firms on their own account, and the method adopted, which treated all building repair as being done on this basis, involved less arbitrary adjustment than the transfer of all such repairs to the construction industry. Residential, institutional and government repair work were not, however, transferred since the indicators used to measure the output of the user industries cannot be assumed to cover this item, and it is preferable to regard it as making a net contribution to the final product.

The gross output values of the changes required to include force account new construction in the construction industry, and to exclude industrial repair and maintenance, were estimated from the national breakdown of construction work done. The corresponding output and employment involved were calculated by applying estimated gross/net ratios for the main types of construction, and for the most part assuming a constant net output per worker. The net output per worker of the construction industry was used for all industries except agriculture where, particularly in the United States, much construction work is put in place by agricultural workers in the course of their normal duties and a lower rate was therefore assumed.

The Construction Comparison

The problems involved in the comparison can be simplified if the structure of the industry in the two countries is considered in terms of material inputs and labour employed *per unit of gross output.* For this the following information is available :

1. The approximate breakdown of costs in the two countries, expressed as percentages of gross output is as follows :

	U.K.	U.S.
Materials	44.0	52.8
Labour[1]	46.3	43.4
Profits and depreciation	9.7	3.8
Gross output	100.0	100.0

1. Includes an imputed wage rate for self-employed persons and working proprietors. As, in fact, many self-employed persons have a lower income than the corresponding employees this imputation results in a very low profit residual.

2. The price ratio for building materials (delivered site basis) is approximately $3.8 per £.
3. The price ratio for labour (average annual earnings of all employees) is $9.5 per £.

If this information is combined with the gross price ratio of $5.0 per £ obtained in the expenditure study,[1] the inputs of both materials and labour per unit of gross output can be obtained as follows :

$$\text{Materials input ratio, } q_i = \frac{I_u}{I_k} \cdot \frac{1}{p_i}$$

If the unit of gross output is taken as £100 = $500 (since the gross price ratio is $5.0 per £), then

the United Kingdom input, I_k = £44
and the United States input, I_u = $52.8 × 5
The materials price ratio, p_i = 3.8
from which q_i = 158 (United Kingdom = 100)

Similarly the American labour input per unit of output is 49 per cent of the British.

We are thus able to state that, on the basis of the gross output price ratios found for the expenditure study, American *gross* output per worker is twice that of the United Kingdom, but this output is attained with a material input more than 1½ times the British. This additional material may take the form of more prefabricated parts (e.g. more factory joinery products replacing carpenters' work on site), or it may arise from a different type of product containing more expensive materials and less labour (e.g. houses with little brickwork but expensive fixtures). Either case represents a substitution of materials for labour, so that *net* output per worker will be below the gross output level of 204 per cent.

It must now be determined how much the net output per worker index should be below the gross index in view of the additional materials used in the United States. Conceptually this can be done by deducting inputs in both countries by means of the double indicator method. However, it was found that obtaining net output as a residual was an extremely hazardous operation if the data have a large margin of error or are liable to contain internal inconsistencies—as is the case for the construction sector. The gross output comparison is particularly vulnerable, because reliance had to be placed largely on comparative costs of performing various unit operations. These unit operations unavoidably exclude carpentry, plumbing and some other items which cannot be satisfactorily quantified. A large part of the additional American input of materials is associated with these particular operations, and adjustment for the larger input may result in over-compensation for factors not measured in the output comparison.

Moreover, the difference in the real input-output ratio is substantial, so that the application of the double indicator formulta resuls in a highly unstable index[2] with a wide index number spread. We considered, therefore, that while the information we had was adequate to estimate

1. Gilbert and Kravis, *op. cit.*, p. 113.
The actual ratios were $4.57 and $5.53 according to the weights but for the present calculation an average has been used.
2. i. e. American materials when priced at British prices account for such a large part of total gross values that the residual net output is small and subject to significant change if the components are even slightly altered.

the order of magnitude of gross output per worker it could not be used to derive an accurate measure.

The alternative was to accept the gross output per worker index of 200 per cent as the upper limit, since it was clear that net output per worker would be substantially less. The lower limit of net output per worker was established by comparison with the results obtained by the Anglo-American productivity team,[1] who estimated that output of craftsmen per man-hour in the United States in 1949 was about 150 per cent of that of the United Kingdom. Working hours in the United States were, however, only 79 per cent of those in Britain, so that output per man-year would only be about 120 per cent of the United Kingdom level. This estimate excludes indirect labour both on and off the site, but the report states that the American industry uses more indirect labour on the site, and has less overheads and office work, so that total indirect labour may be fairly similar in the two countries.

This productivity estimate was not arrived at as a statistical average, but as experts' estimates of output of craftsmen on the job-bricks laid per hour, area plastered per hour, etc. It is almost inevitable, therefore, that it approximates to "normal" rather than "actual" working, and from other comments in the report it would appear that a large part of the higher efficiency of the American industry results from standardisation and simplification of techniques, maintenance of a steady flow of work and supplies, and better advance planning to avoid programme changes during erection and the necessity for repeating or repairing jobs as the result of later operations. It is impossible to evaluate how much these factors add to the productivity estimated for individual craftsmen, but it appears possible that in fact they account for all of and perhaps more than the American advantage in overall level of output per worker. In other words, while "normal" working is only 120 per cent of United Kingdom output per worker, American average output may be much nearer the "normal" than that in Britain. Moreover, the productivity team report deals only with building proper, and it seems clear that relative American efficiency is greater, and perhaps substantially greater, in other types of construction, such as highways, and railroad and public utility operations, where there are more opportunities for mechanisation. These latter types of construction accounted for about 2/5 of the American total in 1950.

Thus net output per worker may be taken as "substantially above" 120 per cent and "substantially below" 200 per cent. It was convenient to use an index of 150 per cent for computational purposes, although we cannot claim to have established more than the probable range within which this average lies.

Some confirmation of this level is given by an independent comparison of residential building included in the notes at the end of this section. This suggests that American net output per worker for single family houses is about 120 per cent of the British. Since the United States certainly has a greater advantage in the construction of larger buildings and in non-building construction, this result appears broadly consistent with that given above.

1. *Building Productivity Team Report*, Anglo-American Council on Productivity, 1950.

The construction comparison was based on an employment indicator adjusted by a productivity index of 150 per cent giving a volume index (United Kingdom = 100) of 498, and a net cost ratio of $5.4 per £.

A. Sources

1. *The Distribution of Costs*

United Kingdom. The proportions are based on those given for 1950 in Table 17, National Income and Expenditure, 1956. The profit and wage proportion was adjusted to give an imputed wage to working proprietors on the basis of the 1948 Census of Production.

United States. Considerable difficulty was experienced in obtaining suitable estimates for the United States as no gross output data are available corresponding to the National Income definition of contract construction. Estimates prepared for the 1947 Interindustry relations study[1] were taken as a basis but a slight upward adjustment in net output had to be made as this source stated that the non-material costs had been underestimated. Extrapolation to 1950 was made with the aid of National Accounts data and the Department of Commerce construction estimates; this presented some difficulty as there appear to have been structural changes in the composition of construction during the period. If anything, the share of materials has been underestimated and that of labour over-estimated—i.e. the difference from the United Kingdom in real terms may be even greater.

Adjustment to impute a wage to self-employed and working proprietors was made from national accounts data for contract construction. These persons account in the United States for about 30 per cent of contract construction employment, and as many in fact have lower incomes than the average wage earner this leaves a rather small profit item. There appears to be no alternative, however, than to regard the self-employed group as receiving the standard wage but negative profits.

2. *Building Materials Price Ratio*

This was based upon comparison of prices of the more important building materials from census of production and other sources weighted by both the United Kingdom building index and by data from the United States 1947 Interindustry study.[2] This gave ratios of $3.5 to $3.75 per £, but as it appeared that inadequate allowance had been made for higher American transport and distribution costs, a single index of $3.8 per £ was used.

3. *Earnings Price ratio*

This is based on annual average earnings of all employees taken from the United States National Accounts and the United Kingdom 1948

1. D. I. Siskind, *Construction in the 1947 Interindustry Study.* (Paper presented to 1952 Conference on Research in Income and Wealth.)
2. Siskind, *op. cit.*

Census of Production and extrapolated to 1950. The differential for skilled workers is higher in the United States, and hours of work only 80 per cent of the British, so the hourly rate for skilled workers is considerably more favourable to the United States.[1]

B. Residential Construction

The comparison is based on the average costs and inputs of one-family dwellings in the United States and of traditional type 2-3 bedroom local authority houses in the United Kingdom. In the United States 80 per cent of the dwelling units started in that year were single family structures, and in the United Kingdom 85 per cent of housing erected was local authority financed, and mainly of this type.

The two "average houses" are similar in general size, both having a floor area of approximately 1,000 square feet (very slightly more in the United Kingdom) and usually 5 rooms. Both include bathrooms and a hot water system. The British house includes a separate W.C. and provision for outhouses, but these factors are offset by more built-in cupboards and often a garage in the American case.

Again, the American house includes a more elaborate heating system (93 per cent have central heating) than the British, and other more expensive equipment and fixtures. Against this must be offset the more solid type of structure used in Britain where 2-storey brick semi-detached houses with slate or tile roof predominate, compared with the lighter American structure. 88 per cent of the American houses were one storey buildings, 72 per cent of frame construction, and roofs were usually of asbestos or asphalt shingles (which require a far smaller labour input than slate or tile, but have an estimated life of only about 20 years). A technical appraisal of relative real values of the two average houses is obviously extremely difficult, but it seems reasonable to assume that the American house is of somewhat higher quality although the difference may not be very large.

The labour input in the United Kingdom was 2,525 man-hours per house compared with 1,420 in the United States, i.e. 178 per cent of that of the United States in man-hours, or 140 per cent in man-years. The material input was, however, substantially greater in the United States—145 per cent of that of the United Kingdom (see the table below). The breakdown of labour requirements given below supports the view that part of this extra material input represents substitution of materials for labour in the structure (i.e. a large part of the difference is in bricklayers and carpenters) but as every class of labour shows a smaller man-hour input in the United States, there appears also to be a higher real output per worker. It would appear, therefore, that part of the additional material input consists of substitution of materials for labour and part represents a higher valued finished product, i.e. a better average house.

1. The Productivity team Report (*op. cit.*) gives a ratio for 1949 as high as $16 per £.

MAN-HOURS REQUIRED PER HOUSE IN THE UNITED STATES AND THE UNITED KINGDOM

	U.K.	U.S.	U.K. AS PERCENT OF U.S.	
			MAN-HOURS	ADJUSTED TO MAN-YEAR BASIS
A. *Bricklayers and carpenters :*				
Bricklayers (included unskilled)	991	174	570	450
Carpenters	375	548	68	54
Sub total	1,266	622	204	161
B. *Other specialist trades :*				
Painters	176	84	210	166
Plasterers	134	70	191	151
Plumbers	187	121	155	122
Electricians	46	31	148	117
Sub total	543	306	177	140
C. All other (mainly unskilled) : *Subtotal*	716	492	146	115
TOTAL	2,525	1,420	178	140

Sources :
United Kingdom. "Productivity in House-Building", Second Report, National Building Studies Special Report No. 21, 1953.
United States. L. G. Haegar, "Housing and the Emergency", The National Association of Home Builders.
Some adjustments to the original data were made to secure greater comparability, but classification differences remain. In particular the "all other" group appears to include a wider range in the United States than in the United Kingdom.

The table below gives the structure of costs for the average house in each country in real terms on the assumption that the additional material input in the United States results partly in less on-site construction, i.e. a real net output 85 per cent of that of the United Kingdom, and partly in a better quality finished product, i.e. a house of 110 to 120 per cent higher quality. Since the American labour input in man-years is 71 per cent of the British, a net output per house of 85 per cent implies a net output per American man-year of just under 120 per cent of the British.

RELATIVE CONSTRUCTION COSTS OF THE BRITISH AND AMERICAN "AVERAGE HOUSE"

	U.K. HOUSE £	U.S. HOUSE $	U.K. HOUSE *valued in* $	U.S. HOUSE *valued in* £	QUANTITY INDEX (UK=100)	PRICE RATIO $ PER £
	a	*b*	*c*	*d*	*e*	*f*
Materials	790	4,340	3,002[1]	1,142[2]	(145)	3.8
Net output (real volume)	540	3,860	4,541[3]	459[4]	85	(8.4)
Gross output	1,330	8,200	7,543	1,601	109-120	5.1-5.7

1. $a \times b$. 2. $b \div f$. 3. $b \div \frac{e}{100}$. 4. $a \times \frac{e}{100}$.

The breakdown of construction costs used in the above table covers costs of construction proper excluding site and land development costs. The division made between net output and inputs is not on a true national accounts basis as all overheads and purchased services are included in net output. This definition is, however, suitable for our present purpose as these items may most reasonably be expected to move with net output.

Sources :

United Kingdom. "The Cost of Housebuilding." Third Report of the Committee of Inquiry, H.M.S.O., 1952.

United States. Siskind, *op. cit.* The extrapolations to 1950 are based on the B.L.S. series on Dwelling Units Started and their estimated construction cost.

* * *

DISTRIBUTION

The distribution sector is defined to cover all trading activity excluding physical transport. Manufacturing carried out by distributive firms, such as retail baking and sausage-making, are excluded and were transferred to the manufacturing sector. Catering, and the majority of repair activities, such as shoe, clothing and watch repairs were also excluded here and measured in the service industries. Milk bottling was, however, included in distribution, as were motor vehicle repairs and servicing.

The comparison was made on an activity basis, the indicators used measuring the total volume of goods distributed with no adjustment for any difference in the quality of the service rendered. Food produced and consumed on farms was excluded, but the distribution of goods sold to final consumers by farmers and manufacturers was included, because in the latter case a distributive activity is performed although not by a separate distributive firm. Conceptually the weights should be adjusted for distributive work carried out by producers by an appropriate transfer of net output and employment from the production sectors to the distribution sector. No basis for making this adjustment could be found, however, and it is not believed that the volume of activity involved is sufficient to appreciably affect the results in either the distribution or the production sectors.

The comparison was made in three sub-groups : food, beverages and tobacco ; other goods sold mainly through retail channels ; and goods sold to final purchasers through wholesale channels. The results are as follows :

	WEIGHTS PER 1,000		QUANTITY INDEX (U.K. = 100)	
	U.K.	U.S.	AT U.K. PRICES	AT U.S. PRICES
Food, beverages and tobacco	380	280	435	361
Other retail goods	518	615	784	685
Wholesale goods	102	105	578	564
TOTAL	1,000	1,000	630	538

The data available did not permit the calculation of price ratios and output per worker indices for the separate groups. The indicators and weights used in the two retail groups cover all trade from factory to final consumer, and include wholesale trade in the commodities covered.

Food, Beverages and Tobacco

Four indicators were used—milk, all other food and soft drinks, alcoholic beverages and tobacco. A separate indicator was used for milk because extra activities, namely, bottling and pasteurising are involved. Variations in the proportion of milk so treated could not be measured, however, and there may be a slight bias against the United States on this account, although the difference in this respect between the two countries is not believed to be large. Since catering service is excluded the weights for the group covered distribution to retail level on household purchases, and distribution to the catering establishment for food and beverages served in restaurants, etc.

Other Retail Goods

11 commodity groups were compared separately, the breakdown being the most detailed that permitted the combination of volume indices derived from production data (i.e. in an industry classification), with weights derived from types of retail outlet. These groups were as follows :

Vehicles, agricultural machinery, spares and parts
Motor fuel
Garage repairs and services
Household equipment and appliances, ironmongery, radios
Furniture
China and glass
Textiles, clothing and shoes
Household solid and liquid fuels
Drugs, toilet requisites, soap, matches, etc.
Toys, sports goods, fancy goods
Reading matter and paper products.

Wholesale Goods

This group covered four classes, plant and machinery (other than agricultural), exports, agricultural supplies and building materials. In the agriculture and building sectors, inputs at purchase prices had been taken into account in measuring production, and so the distributive activity involved needed to be included in the present sector. No indicators were included for other intermediate products because the output of their user industries is measured mainly with single indicators, so that a separate comparison here would have attributed a higher gross national product to the country with more intermediate distribution, i.e. with more indirect production methods or less vertical integration. The weight attributable to this intermediate distribution is small in relation to the sector as a whole, and was spread over the other groups. In a few cases, the intermediate weight was added to that of the specific final

commodities incorporating the raw material (e.g. yarn merchants' net output was added to textiles and clothing) but this method could not be applied throughout.

The results for the producers' goods group are affected by the omission of the weight attributable to manufacturers' distributive activity, because the proportion is large in plant and machinery, and exports. Since, however, the weight for the group would be small, even if this adjustment were made, and the volume indices are within 10 per cent of the average of the other two groups, this cannot appreciably affect the aggregate result.

Selection of Indicators

Indicators for four commodity groups, milk, alcoholic beverages, motor fuel, and household fuels were calculated directly from national consumption data. Garage service was roughly measured by the automobiles and trucks in use, a smaller weight being given to the latter since they are often owner-serviced. Comparison of the other items was based on indices obtained in other sections of the study, adjusted for foreign trade.

For food, tobacco and the clothing and textile sub-group, rather detailed calculations could be made. Agricultural gross output of the raw materials in own prices and in the other country's prices were obtained from the agricultural comparison and the real net output of processing added from the manufacturing results. Imports were added and exports deducted in real terms using the individual price ratios calculated in the foreign trade sector. In the case of food, farm food consumption was excluded, and some non-food products such as inedible oils and feeds which could not be omitted at the intermediate levels, were taken off the final values. In this way, consumption indices in both countries' weights were calculated from a weighted average of basic production, processing and foreign trade indices that took account of the more important commodity flows.[1]

For the other retail groups, the complexity of the commodity flows prevented a detailed aggregation of successive processes, and reliance was placed almost entirely on the production indices of the final stage. Adjustment for foreign trade was made on a quota basis, i.e. consumption for each country was estimated as a percentage of production, and the production indices multiplied by an appropriate factor. Thus, if for a particular commodity, the United Kingdom had a net export of 25 per cent of production thus giving a consumption ratio of 75 per cent, and the United States a net import of 10 per cent, the conversion factor for the production index, U.K. = 100, would be 0.75 : 1.1 = 0.68. In all cases, the adjusted indices were calculated at both countries' weights.

Reading matter and paper products could not be calculated from production data because of the large intermediate consumption of these items. It was found, however, that newspapers and periodicals accounted for about the same proportion of consumers' expenditures in this group, and the same share of the total distributive gross margin.

1. A similar calculation in summary form is made for food, beverages and tobacco in Chapter VIII, Table 20.

Distribution of the whole group was, therefore, measured by the newspaper and periodical index. The circulation index appeared the most appropriate and the whole weight was given to this indicator.

In the producer goods group, distribution of plant and machinery was measured by domestic investment expenditures on this item, converted by an approximate gross factory price ratio calculated from the manufacturing comparison. Indices for agricultural supplies and building materials were derived from the input comparisons of these industries. Distribution of exports was measured by the volume of exports calculated in the foreign trade sector.

Calculation of Weights

Weights for the individual indicators were based on gross margins (i.e. sales less purchases of stock), and it had to be assumed that the ratio of gross margin to actual net output was the same for the various commodity groups.

United Kingdom

Gross margins were obtained from the 1950 Census of Distribution. For retail trade, the percentage margin applicable to the various commodity groups was estimated from the margins of shops specialising in each group, and the rate thus obtained applied to total sales. Thus, for tobacco, where a large proportion of total sales are handled by outlets other than specialist tobacconists, the percentage gross margin of shops selling only tobacco products was applied to total sales of tobacco obtained from the Consumer Expenditure series of the National Accounts. For items such as motor vehicles and furniture, where consumer expenditures do not cover all retail sales, total sales were estimated from Jeffries,[1] and from the Distribution Census, Volume II, Table 23. No information on wholesale trade by commodity groups was available, and total sales data could not be used since not all sales pass through wholesale merchants. The wholesale element in total margins of retail goods, and the margin on producer's goods had, therefore, to be based on the census classification of establishments by trades. Transport costs incurred by wholesalers are given separately in the census and these were deducted.

United States

Weights were based on combined wholesale and retail mark-ups used to estimate expenditure by the commodity flow method in the national accounts, unpublished breakdowns being provided by the Department of Commerce. These mark-ups include some transport expenses, and also wholesale margins on some export items and inventory changes, but these are not believed to be sufficiently large to appreciably affect the totals for the groups. For items not included in the commodity flow method, such as new automobiles, gasoline, and fuels, or not separately identified, such as milk, margins were estimated by deducting trans-

1. J. G. Jeffries, *Retail Trade in Great Britain, 1850-1950* (1955).

port costs from the spread for individual commodities between factory and retail prices. For exports and for the service element in motor repairs, no weights were available and it had to be assumed that the price relationship between the United Kingdom and the United States was the same as for other items.

For both countries the margin of error in estimating these weights is considerable, particularly in view of the difficulty of classifying production indices and distributive margins on an identical basis. No significance can, therefore, be attached to derived price ratios for the separate items, but the fact that, with a few exceptions, these did not show any unexpected divergences, does to some extent confirm the independent estimates made for the two countries. The spread in the total indices arises mainly from the separately weighted production indices used, and a rather small part of it is due to apparent differences in the distribution price structure.

* * *

OWNERSHIP OF DWELLINGS

This sector was defined to include the net contribution to the gross national product made by the existing stock of dwelling units. Farm dwellings are included, but agricultural land and service buildings were allocated to the user industry, as were industrial and commercial rents. Real estate services and house management were classified to the business service sub-group, their contribution to gross rents being treated as a purchased service.

On this definition the services of dwelling units consist solely of property income with no labour content, and constitute a net rent (including depreciation) which corresponds in coverage to the gross rent used in the expenditure series, but excludes management expenses, insurance, etc., which are regarded as purchased inputs. The same indicator of gross rent has, therefore, been used as in the expenditure study.[1] In the latter study it was found that there were about 10 per cent fewer dwelling units in the United Kingdom than in the United States, and that they were slightly smaller in size but with no marked difference in the measurable facilities. The comparison was, therefore, based upon the age structure of the houses since it was considered that age for age there was little difference in the standard of houses in the two countries, but that the greater number of older units resulted in a slightly lower average standard in the United Kingdom.

Conceptually it would have been desirable to arrive at a comparison of net rent by adjusting the gross rent comparison for variations in inputs of repair and maintenance. In view, however, of the rather crude indicators of gross rent available in the original comparison, and of the highly tentative nature of the construction comparison in the present study, it was felt that the data did not justify this treatment. Net rent was, therefore, assumed to be directly proportionate to gross rent.

1. Gilbert and Kravis, *op. cit.* pp. 135-138 and 145-146.

* * *

TRANSPORT AND COMMUNICATIONS

I. TRANSPORT

A summary of the results for the transport sector is given in the table below.

OUTPUT OF TRANSPORT

		WEIGHTS		QUANTITY RATIO (U.K. = 100)		PRICE RATIO $ PER £		OUTPUT PER WORKER (U.K. = 100)	
		U.K.	U.S.	AT U.K. PRICES	AT U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS	AT U.K. PRICES	AT U.S. PRICES
A.	*Gross Output :*								
	Railways	205	362	1,339	991	2.97	2.20	..	..
	Road passenger	171	109	175	148	7.19	6.04	..	..
	Road goods	298	377	1,117		[3]		..	..
	Air lines	25	30	1,096	1,017	1.96	1.82	..	..
	Ocean shipping	218	31	63		[3]		..	..
	Other[1]	83	91	850	715	[3]		..	..
	TOTAL	1,000	1,000	801	507	3.48	2.22	..	..
	of which :								
	Passenger	251	166	249	177	6.20	4.40	..	..
	Internal freight	522	800	1,284	1,229	2.08	1.99	..	..
	External freight[2]	227	34	70	67	3.72	3.55	..	..
B.	*Net Output :*								
	Railways	233	435	1,624	1,067	3.23	2.12	808	525
	Road passenger	180	110	123	119	9.38	9.13	123	112
	Road goods	283	313	1,117		[3]		[3]	
	Airlines	21	29	1,096	1,017	2.52	2.34	388	360
	Ocean shipping	184	26	63		[3]		[3]	
	Other[1]	99	87	748	758	[3]		[3]	
	TOTAL	1,000	1,000	825	460	3.98	2.22	458	255

1. Inland and coastal shipping, pipelines, and services allied to transportation.
2. Includes ocean passenger transport.
3. Data are not reliable enough to give separate results but estimates are included in the total.

For railways and road passenger transport, comparison was made of gross output and inputs, arriving at net output as a residual by the double indicator method. The data available for the other industries were inadequate for this approach, and inputs had to be assumed proportionate to gross output. The net and gross output volume indices for these industries are, therefore, identical. In spite of this, complete results are shown for both gross and net output because although the output comparison in the present sector is, of course, net, gross output estimates were required for the deduction of the transport input into other industries.

Rail Transport

Although good statistical data are available in both countries and the service rendered is superficially similar it proved difficult to make a meaningful comparison of the real net output of rail transport in the United States and the United Kingdom because of the great differences in the scale of operation in the two countries. On the output side there is a wide index number spread because passenger transport is relatively cheap in the United Kingdom and carries 31 per cent of the weight, while in the United States the price advantage is with freight transport which accounts for 90 per cent of railway earnings. Fuels, rails and sleepers, which were specifically measured, accounted for about half the total inputs and the remainder were assumed to move with a number of indicators of intermediate activity such as the length of track and number of train, coach and wagon miles. There is a large margin of error in the latter calculation owing to the very wide dispersion of the component indices.

The overall results are shown in the table below.

RAILWAY OUTPUT, INPUTS AND NET OUTPUT

	WEIGHTS		QUANTITY RATIO (U.K. = 100)		PRICE RATIO $ PER £	
	U.K.	U.S.	AT U.K. PRICES	AT U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Output :						
Passenger	476	119	187		4.64	
Freight	889	1,070	1,997		2.08	
Total (including miscellaneous)	1,521	1,298	1,339	991	2.97	2.20
Input :						
Fuels	180	78	664	667	2.25	2.26
Other	341	220	859	860	2.58	2.58
Total	521	298	792	791	2.47	2.49
					Net cost ratio	
Net Output	1,000	1,000	1,624	1,067	3.28	2.12

The extremely high relative output per worker in the United States is clearly due to a considerable extent to the larger scale of operations and heavier equipment in that country. The differences in this respect are illustrated in the following table.

	United States as percentage of United Kingdom.
Average freight haul	560
Average passenger journey	320
Steam locomotives, average tractive power	240
Freight cars, average capacity	360
Average number of cars per train	190
Average train load (freight)	620

Since many of the net output costs vary with the number of wagon loads handled rather than the total tonnage, the gross output calculation

was repeated using wagon kilometres and wagon loads originating as the measure of freight output in place of ton kilometres and tons originating. No deduction of inputs was made as fuel and other purchased inputs are clearly affected by the tonnage carried. This gave an output index of 369 on United Kingdom weights and 405 on United States weights, with an output per worker index of 175 to 192. As a measure of labour productivity this takes no account of variations in the efficiency of capital equipment other than wagon size, or of extra labour costs per wagon incurred for larger units, but it gives a rough impression of the influence of the load factor.

Output

Passenger travel was measured in the same way as in the expenditure study[1] in terms of passenger kilometres of third class or coach travel, revenues from higher classes of travel and sleepers being converted into third class units on a price basis. The present study includes both private and business travel, which increases the quantity index in favour of the United States as business travel is relatively more important in that country. The price index is also slightly affected because of the reduction in the weight attributable to season and excursion tickets.

Freight transport was measured by two indicators—ton kilometres and number of tons originating. The introduction of the second indicator was considered necessary in view of the longer average freight haul in the United States, because an appreciable part of the cost of freight transport is attributable to loading and unloading, regardless of the length of haul. There was a wide divergence between the two indicators and so the influence of the weighting system used was considerable. Weights were estimated from the British railway accounts, by dividing total costs between items reflecting chiefly the handling cost and those reflecting the distance hauled. The result contains a large margin of error as many items covered both freight and passenger travel, but it was estimated that approximately one-quarter of the U.K. weight should be attributed to tons originating and three-quarters to ton kilometres. This gave the following average :

	WEIGHT	QUANTITY RATIO (UK = 100)
Ton kilometres	75	2512
Tons originating	25	451
Average freight indicator	100	1997

Inputs

Direct quantity comparison was made of inputs of rails and sleepers, electricity, and liquid and solid fuels. The latter item was measured using coal as the standard commodity and converting oil expenditures on a price basis. Details are given in the table below.

1. *Op. cit.*, pp. 167-8.

RAILWAY INPUTS

	WEIGHTS		QUANTITY RATIO (U.K. = 100)		PRICE RATIO $ PER £	
	AT U.K.	AT U.S.	U.K. PRICES	U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Solid and liquid fuels	308	273	714		2.27	
Electricity	37	10	247		2.14	
Sleepers	37	57	978		2.57	
Rails	35	42	889		2.98	
Other inputs	583	628	850		2.41	
	1,000	1,000	792	797	2.38	2.40

Measurement of the other inputs, which covered items ranging from fire insurance to staff uniforms, presented a particular difficulty because of the wide differences in scale of operations. In these circumstances it did not appear reasonable to assume that they would move with gross output or with the measured inputs, and the values, which were a residual of a large number of calculations, were not sufficiently reliable for the comparison to be based upon a price index. It was decided therefore to assume that inputs moved with various indices of intermediate activities which reflected both the work done and the type of equipment and operations. Thus permanent way ballast was assumed proportionate to the length of road, uniform clothing issues to the number of employees, and stationery and publicity expenditures partly to the number of passenger journeys and partly to the volume of goods carried (tons originating). Maintenance materials were split between indicators reflecting the volume of work done by the equipment and those which also took account of its size i.e. wagon maintenance materials were assumed to move partly with the number of wagon kilometres and partly with the number of ton kilometres. Twelve such activity indicators were used, weighted according to United Kingdom expenditures, and giving a composite index for the United States of 850 (U.K. = 100). This can only be regarded as a very rough estimate, however, as there was an extremely wide dispersion among the individual indicators.

Sources :

United Kingdom. Annual Reports and Accounts of the British Transport Commission.

United States. Statistical Abstract, and Statistics of Railways in the United States.

Road and Local Passenger Transport

This sub-group included the net output of long distance and local buses, trams, local electric railways, and taxis and hire cars. The same indicators of gross output were used as in the expenditure study, adjusted

to include both business and private transport. Inter-city bus transport was measured by passenger kilometres, and all transit traffic (including school buses) by the number of passenger journeys. Revenues from taxis and hire cars were converted by the price ratio used in the expenditure study, but this gives only a rough indication of the order of magnitude, as the revenue series for both countries are unreliable owing to the large number of small enterprises.

Local public transport is relatively very much cheaper in the United Kingdom than in the United States and this appears to be due mainly to a higher load factor over the country as a whole. Inputs into transit and bus traffic were, therefore, assumed to move with vehicle kilometres. This assumption gives very much more reasonable results than taking inputs directly proportionate to gross output, but it may still understate the United States volume of inputs as the average fuel consumption of public service vehicles in that country may be higher than in the United Kingdom, although there are proportionately more small school buses in the United States. For taxis and hire cars a rough adjustment was made for the higher fuel consumption of American vehicles, by taking the quantity ratio of inputs as 112 per cent of that of gross output.

The results for the sub-group are given in the table below.

NET OUTPUT OF ROAD AND LOCAL PASSENGER TRANSPORT

	WEIGHTS		QUANTITY RATIO (U.K. = 100)		PRICE RATIO $ PER £	
	AT U.K.	AT U.S.	U.K. PRICES	U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Gross Output :						
Inter-city buses	1,112	810	324		8.50	
Transit traffic	203	262	98		4.52	
Taxis	348	481	336		4.66	
Sub-total	1,663	1,553	175	148	7.19	6.04
Inputs	— 663	— 553	258	257	3.77	3.76
					NET COST RATIO	
Net output	1,000	1,000	123	119	9.38	9.13

Sources :

United Kingdom. Annual Report and Accounts, British Transport Commission ; Public Road Passenger Transport Statistics for Great Britain, 1949 and 1950 ; Report of the Committee on the Operation of the Taxi Service, Cmd. 8804.

United States. Statistical Abstract ; Transit Facts and Figures ; National Income Supplements to the Survey of Current Business, 1951 and 1953.

Road Goods Transport

Road transport of freight was measured on an activity basis to include the work done by all commercial vehicles, except farm trucks, petrol consumption being used as the volume indicator of output. Since in both countries the proportion of total trucking activity performed by manufacturing and distributive firms is different, a comparison limited to for-hire trucking would reflect neither the quantity of road freight transport in the two countries, nor the full contribution of road transport

to the whole transport system. There was no statistical basis on which distinction could be made between trucks affected to bulk transportation of goods, and those used for purely local journeys. The petrol consumption of the latter group is relatively small, however, and it has thus little influence on total output as measured by this indicator. The greater use of trucks for such purposes in the United States was taken into account in estimating weights. Farm trucks were omitted from the industry because they are used partly for road transport and partly for internal transport on farms.

Petrol input was used to measure the output of the industry, because estimates of tonnage and distances of goods carried by road contain a large margin of error. For many items petrol consumption may give a better approximation to the actual work done than a global comparison of ton kilometres, because the movement of bulky and fragile loads, special deliveries and short hauls, are relatively costly, and require a larger input of petrol per ton kilometre. Diesel oil used by road vehicles, which is of relatively greater importance in the United Kingdom, was converted into an equivalent volume of petrol by a factor of 1.5. Apart from this, no adjustment was made for differences in the average fuel consumption for vehicles of the same carrying capacity.

It was extremely difficult on an activity basis to estimate the appropriate gross and net output weights, as it was necessary to transfer to the trucking industry the net output weight attributable to trucks operated by firms in production and distribution. For the United Kingdom an estimate was available of the total cost of road transport of goods[1] from which gross and net output could be assessed. No corresponding data were available for the United States and only the crudest estimates could be made. The average vehicle mileage of all trucks in the United States is rather small, about 18,000 kilometres per vehicle, although the Class I Common Carrier vehicles do about five times this average. It was clear, therefore, that the group contains a large number of vehicles, particularly in the distributive and service trades, that are only in occasional use, and so a rather low depreciation and nominal labour element was assumed for the net output of these. The large number of trucks with a low annual mileage in the United States reflects the differences in factor prices in the two countries, as the price ratio of trucks is about four times as favourable to the United States as that of wage rates for transport workers.

In view of the large possible error in the net and gross output values, and employment estimates for trucking, no figures are given for the price ratio and productivity of the industry, but rough estimates have been included in the transport totals. In view of the dispersion between the indicators for road and rail freight transport, any error in the trucking weights will influence the estimate of total output of freight transport but this influence is unlikely to be large and, since freight transport inputs for the economy as a whole are deducted, errors in this item cannot appreciably influence the comparison of the gross national product.

1. Ernest Rudd, "Estimates of Expenditure on Road Transport in Great Britain", J.R.S.S., Series A, vol. CXV, Part II, 1952.

Sources :

United Kingdom. Report and Accounts of the British Transport Commission ; Ernest Rudd, "Estimates of Expenditure on Road Transport in Great Britain". J.R.S.S., Series A, Vol. CXV, Part II ; K. F. Glover and D. N. Miller, "The outlines of the Road Goods Transport Industry". J.R.S.S. Series A. Vol. CXVII, Part III ; "Evasions of Petrol Rationing Control", Report of the Committee of Inquiry, 1948, Cmd. 7372.

United States. Statistical Abstract ; "Truck Facts and Figures 1953". Automotive News Almanack 1953. Automobile Manufacturers Association.

Airlines

Three output indicators were used covering passenger transport (unit : passenger kilometres), and internal and external freight transport including mail (unit : ton kilometres). The distinction between internal and external freight movements was made because external freight is regarded as a final product in the present study and is excluded from the global adjustment of freight transport inputs. The definition of passenger transport includes all passenger revenues of national companies, and is quite different from the expenditure concept of private internal air travel. No separate calculation was made for inputs which were assumed to move with gross output. The results are given in the table below.

OUTPUT OF AIRLINES

	WEIGHTS		QUANTITY RATIO (U.K. = 100)		PRICE RATIO $ PER £	
	AT U.K.	AT U.S.	U.K. PRICES	U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Passenger transport	645	783	1,286		1.88	
Freight and mail, internal	7	124	26,500		1.38	
Freight and mail, external	348	93	252		2.12	
TOTAL	1,000	1,000	1,096	1,017	1.96	1.82

Sources :
United Kingdom. Statistical Abstract ; Reports and Accounts of B.E.A. and B.O.A.C.
United States. Statistical Abstract.

Ocean Shipping

Insufficient statistical material was available for a detailed comparison of ocean shipping services, and output of both freight and passenger shipping was assumed to move with the total active gross tonnage of shipping. The same indicator was used to measure gross and net output.

Other Transportation

This group includes inland and coastal shipping, pipeline transportation, and services allied to transportation, of which the most important

are warehousing and storage, and the upkeep of ports and harbours and canals. Inland and coastal shipping and pipeline transportation were treated as one commodity, with an indicator based on estimates of the total volume of ton kilometres. The other services were measured from data on the value of output, which were converted using the gross price ratio of freight transport. Inputs and outputs were assumed to be proportional for both groups.

Sources :

United Kingdom. Coastal Shipping : "Coastwise Shipping and the Small Ports", Ford and Bound, Oxford, Blackwell 1951.

United States. Ton miles for inland waterways and pipelines : "Motor Truck Facts and Figures", Automobile Manufacturers Association, 1953.

II. Communications

The communications industry, which includes postal, telegraph and telephone services, was compared with single indicators of the volume of work done. The indicators used and the quantity ratios for the individual items were as follows :

	QUANTITY RATIO (U.K.= 100)	DERIVED NET COST RATIO $ PER £
Post (items of mail handled)	519	3.18
Telegraph (number of messages)	337	4.78
Telephone (number of instruments in use)	831	n.a.
Telephone (number of calls)	1,631	n.a.
Average for telephones	1,126	3.26

In the case of telephone service a difficulty arose because there are two possible indicators of the work done, the number of instruments in use and the number of calls. The average number of calls per instrument is nearly twice as great in the United States as in the United Kingdom so that the weighting of the two indicators has considerable influence, and no satisfactory way could be found of dividing net output costs between the provision and servicing of instruments, and the load factor represented by the number of calls. In the expenditure study, where only private telephone expenditures were to be measured, this difficulty was overcome by making a price comparison based on the cost of a telephone with a given number of calls, but the greater variety of charging systems and wider variations in each country in the number of calls per instrument makes this solution impracticable as a measure of total telephone service including business use. Weights were therefore assigned on the assumption that depreciation and maintenance costs moved mainly with the number of instruments, and current operating costs with the number of calls. On this basis, some 60 per cent of the United Kingdom weight was allocated to the number of instruments and the remainder to the number of calls. No corresponding calculation could be made for the United States, and a single average was used

indicating that the United States has about 11 times the volume of telephone service of the United Kingdom.

The indicators for the three communication services were then aggregated using the net output weights of each country in turn, and output per worker was calculated for the industry as a whole.

	QUANTITY RATIO (U.K.=100)	EMPLOYMENT RATIO (U.K. = 100)	OUTPUT PER WORKER (U.K.=100)	NET COST RATIO $ PER £
United Kingdom price or quantity weights	794	300	264	3.24
United States price or quantity weights	783		261	3.20

Sources :

United Kingdom. Post Office Commercial Accounts, except employment data (wholetime-equivalent figures ; Statistical Abstract).

United States. Quantity data : Statistical Abstract. Net output weights were estimated from National Accounts and financial data in the Statistical Abstract.

* * *

SERVICES

Under this heading are considered :

a) Service industries catering chiefly for final consumers, including private domestic service, entertainment and catering, laundries, dry cleaning, hairdressing, consumer repair services and various professional and welfare services.

b) Health, education and government.

c) Services to business and miscellaneous financial and real estate services.

a) Services to Final Consumers

The indicators used for this group are basically the same as those used for personal and household services in the expenditure study, but are weighted by net output and include a small volume of business expenditure on household services, e.g. laundry and dry cleaning. In addition some of the data have been revised as a result of revised national statistics, and different assumptions are made for the miscellaneous items not directly covered by the indicators. The quantity ratios for the main sections are given below. No price ratios are given as the value weights used are only rough approximations. Since employment indicators were used, output per worker could be calculated only for Personal and Household Services.

SERVICES TO FINAL CONSUMERS

	WEIGHTS		QUANTITY RATIO (U.K. = 100)		OUTPUT PER WORKER (U.K. = 100)	
	U.K.	U.S.	U.K. PRICES	U.S. PRICES	U.K. WEIGHTS	U.S. WEIGHTS
Personal and household services	133	173	492	407	142	118
Domestic service	133	164	253		—	—
Entertainment and catering	571	463	333	315	—	—
Other trade and professional services	163	200	495	502	—	—
TOTAL	1,000	1,000	358	340	—	—

Personal and Household Services

These include laundries, dry cleaning, shoe repairs, hairdressing and beauty parlours. The gross price ratios used in the expenditure study[1] were applied to gross earnings, and the resulting quantity indices were used to measure net output on the assumption of proportionate gross/net ratios for the two countries.

Domestic Service was measured by numbers employed. The slight difference in the results from those used in the expenditure study is due to revised national data and the inclusion for the United Kingdom of a small number of domestic servants in doctors' and other professional houses whose earnings are excluded from consumer expenditures.

Entertainment and Catering

Net output of cinemas was measured by the number of admissions, and that of other entertainment by employment, adjusted for productivity by an assumed index of 120 (U.K. = 100), based on output per worker in personal and household services and cinemas. Employment with the same adjustment for productivity was used to measure the value added in catering establishments, but 10 per cent of the weight was given to an additional indicator of the number of hotel beds.

Other Trade and Professional Services to Consumers

This residual group contains a high margin of error. Employment was the only available indicator but it was impossible to ensure that the employment series in the two countries were completely comparable. Trade services to consumers, consisting mainly of miscellaneous repair and hand trades, photographic studios and funeral services, were measured by employment adjusted for productivity. The professional services included religious and welfare activities and personal legal services (arbitrarily assessed at 15 per cent of total legal services). Employment was used as the indicator, but, as in the case of professional medical and educational personnel, no productivity adjustment was made.

1. Gilbert and Kravis, *op. cit.*, pp. 159-161.

Sources :

United Kingdom. Estimates of gross earnings in respect of personal and household services, and of the net output of all the groups : 1950 Census of Distribution ; unpublished detail of consumer expenditures in the national accounts ; net output weights used in the London and Cambridge Economic Service estimates of the Real Product of the United Kingdom ; Social Survey reports on consumer expenditures. Employment estimates : Ministry of Labour series of employed persons, with estimates of self-employed persons from the 1951 Census of Population 1 per cent Sample Tables. Adjustment for part-time workers was also made from the census on the basis of two part-time workers to one whole-time worker.

United States. Net output and employment data from the national accounts were used, with rough estimates of depreciation. Further breakdown needed for some items was made on the basis of the 1948 Census of Business. Gross earnings of personal and household service industries were estimated from consumer expenditure and the Census of Business.

b) HEALTH, EDUCATION AND GOVERNMENT

These three groups were all measured in the expenditure study on the basis of inputs of labour, goods, and purchased services. The same indicators of labour were used in the present investigation to measure net output, and the reader is referred to the earlier publication[1] for a full description of the methods and sources used.

The net output of the health services was measured by the numbers of professional personnel, in two categories of doctors and dentists with equal weights, and nurses. The groups were combined with price weights based on average earnings.

Education was measured by the number of teachers engaged in primary, secondary and higher education, the division between the grades being determined by the age of the pupils taught in order to avoid distortion resulting from differences in the institutional pattern of education. The three classes were aggregated with weights based on average salaries in the three types of school.

HEALTH, EDUCATION AND GOVERNMENT

	QUANTITY RATIO (U.K. = 100)		NET COST RATIO $ PER £	
	AT U.K. PRICES	AT U.S. PRICES	AT U.K. PRICES	AT U.S. PRICES
Health	425	415	4.93	4.81
Education	450	461	5.30	5.43
Government	220	218	9.45	9.35
of which Civilian	225		10.36	
Military	206		7.83	

1. Gilbert and Kravis, *op. cit.*, pp. 176-184 and 197-8.

In the case of government personnel it was found possible to distinguish between civilian and military personnel only, so that overall employment was used as the indicator.

c) Miscellaneous Business and Financial Services

This group consists mainly of services to business but includes also financial services to consumers such as the appropriate share of banking, insurance and stockbrokers' activities. In business services are included, in addition to financial services, business legal services, activities of self-employed professional men such as architects, accountants and engineers, and work done by advertising agencies. The output of these services is extremely difficult to quantify, so that direct comparison is virtually impossible, and it is also difficult to secure a comparable division in each country of the financial services to business and those to final consumers. No direct comparison was made, therefore, and output was assumed to move with total real product.[1]

1. The justification for this procedure is discussed in Chapter IV.

APPENDIX D

THE FOREIGN TRADE ADJUSTMENT

The principles on which adjustment should be made for differences in the final product due to the exchange of exports for imports are discussed in the section of Chapter VI dealing with External Transactions.

In equation (17) of that section the adjustment required is shown to be equal to :

$$\Sigma Q_{d(y)}(P_{f(x)}-P_{d(x)})+\Sigma Q_{m(y)}(P_{f(x)}-rP_{m(y)})-\Sigma Q_{e(y)}(P_{f(x)}-rP_{e(y)})$$

where suffixes f, d, m, and e relate to the prices and quantities of final output, domestic output, imports and exports respectively, and r is the official exchange rate.

In the present study some simplifying assumptions had to be made before the formula could be applied. This was necessitated both by lack of data and by the insufficient time and resources available for the extremely detailed analysis of export and import prices that would otherwise have been needed. The difficulty here is that a crude price comparison based on rather broadly defined commodities, and ignoring differences in product mix and in average qualities, and not taking account of differences in the two countries' valuation procedures, is quite inadequate for even a rough estimate of a net price difference. Thus, unmeasured quality differences might result not merely in the adjustment for particular commodities being under, or over, estimated, but in a positive adjustment where the true one should have been negative or vice-versa. It is, therefore, preferable to restrict the adjustment to items where the data are adequate to make its direction and order of magnitude quite clear.

A further difficulty arises from the methods used in the production comparisons. In agriculture, gross output was measured by the double indicator method, and the price used to weight output can be directly compared with import and export prices. In manufacturing, where the single indicator method was adopted, the gross output prices implicit in the comparisons are not easily calculable, and a comparison of some quite different price information, for example from wholesale price indices, might not enable the correct adjustment to be made. The object of the foreign trade adjustment is to correct the calculations already made in the industry study for differences from the expenditure method, and not to correct the calculations which might have been made had more time and material been available.

In view of these difficulties, the following simplifications were made :

a) It was assumed throughout that export and production prices of a particular commodity were identical (i.e. any export price differentials were ignored).[1]

b) For commodities of which the entire domestic supply is imported by both countries their respective import prices were assumed to be identical, when converted at the official exchange rate (i.e. preferential trading positions in world markets were ignored).

c) In view of the difficulty of pricing services no adjustment was made for invisible imports and exports, other than shipping.

1. The Revaluation of Domestic Output

The revaluation of domestic output for differences between production prices and final output prices of the base country is given by the first term of the equation

$$\text{i.e. } Q_{d(y)} (P_{f(x)} - P_{d(x)}).$$

As export prices and production prices had been assumed to be identical, adjustment was only required for the effect of imports on final prices.

No adjustment was made for the revaluation of British production in United States final prices. Foreign trade plays a relatively small part in the United States economy and consequently there are few commodities both imported and domestically produced of which the proportion imported is large enough to effect the final output price in the United States. Moreover, the exceptions consist mainly of commodities, such as crude petroleum, of which there is no United Kingdom production, and items, such as bicycles and linen goods, which carry a rather small weight in the production of both countries. The only commodities for which the adjustment appeared likely to be of importance were sugar and wool. However, for these commodities both the United Kingdom and the United States import a large proportion of their requirements, and it appeared, therefore, that no significant distortion would arise if imported wool and sugar were treated as separate commodities from home-produced wool and sugar respectively.

The revaluation of United States production in United Kingdom prices was, however, of considerable importance because British imports of many items constitute 50 per cent or more of total supplies, and when measured at factor cost, there is sometimes a considerable difference between import and home production prices. Also the commodities involved are ones where the United States has a large total production so that the error resulting from pricing these items incorrectly could be considerable. Reasonably accurate adjustments could be made because the important commodities involved are homogeneous and easily measured.

The commodities for which adjustment was made included grains, potatoes, eight varieties of fruit and vegetables, eggs, dairy products, meat and bacon, poultry and refined petroleum products. The full net

1. In evaluating the effect of this assumption, it must be remembered that all the price data used are at factor cost, so that differentials due to the operation of taxes and subsidies would in any case be excluded.

adjustment may, however, be roughly attributed to dairy products, meat and bacon, as the adjustments for the other items were relatively small, and were offsetting, in some cases import prices being lower than production prices and in other cases higher. Some of these differences were clearly due to quality or seasonal factors, e.g. imports of high priced new potatoes and offseason tomatoes on the one hand, and low priced frozen meat on the other. However, as no account had been taken of differences in quality and seasonal availability in the production comparison, it would have been incorrect to introduce them here.

For meat the adjustment was straightforward. British meat imports of fresh meat, bacon, and ham accounted for 50 per cent of total supplies. Average consumption prices were about 12 per cent below home production prices. American production was revalued accordingly, but no adjustment was made for canned meat as this would have involved a double adjustment on home produced meat canned in America.

The adjustment for dairy products, however, raised serious difficulties, because the difference in price lay mainly in the valuation of the milk content. Agricultural milk output was treated as a homogeneous commodity, and the manufacture of dairy products was measured by single indicators weighted by the value added. In both countries, however, the value of the milk content of butter and cheese exceeds the value of the final product, when milk input is valued at average farm gate prices. Moreover in America more than 50 per cent of milk output was used for manufacturing, while the corresponding proportion of British output was less than 20 per cent. British imports of dairy products accounted for 95 per cent of total butter supplies, 75 per cent of cheese supplies and about a third of condensed and dried milk supplies. In these circumstances an adjustment based on the finished prices of butter and cheese would have underestimated the overall adjustment required, and it was decided to adjust on the basis of milk content. The price per ton of milk equivalent of British imports was found to be only half that of home produced dairy products, and the consumption price of dairy products, in terms of milk content was only 73 per cent of the production price. That part of American milk output going to the manufacture of dairy products was revalued accordingly.

2. The Revaluation of Imports

For imports the revaluation required is for the difference between the final output prices of the base country, and the original c.i.f. values of the other country converted at the official exchange rate. It is given by the second term of the equation: $Q_{m(y)} (P_{f(x)} - rP_{m(y)})$.

As already stated no adjustment was made for the invisible items. Further, given the general assumptions made, no adjustment is needed for commodities which neither country produces. For convenience metal ores and primary non-ferrous metals, sugar and wool were included in this category. Metal ores were measured in the production comparison by conversion at the official exchange rate, and the internal cost ratios of primary non-ferrous metals were extremely close to the official rate. The special cases of sugar and wool have already been discussed.

The category for which no adjustment was made accounted for 25 per cent of British merchandise imports and nearly 70 per cent of American merchandise imports.

Individual adjustment was made for important raw materials and food imports produced in the base country for which comparable price data could be obtained. These items accounted for nearly 60 per cent of British merchandise imports, but barely 5 per cent of American imports. Thus, fairly rough estimates were adequate for the adjustment arising from the revaluation of American imports at British prices.

The estimates for the adjustment of British food and raw material imports measured at American prices were made for about 75 commodities or commodity groups. The British import prices used were average values calculated from the Trade and Navigation accounts, and the corresponding United States final prices were taken mainly from the production comparisons, supplemented in a few cases by separate wholesale price statistics. Some items for which complete price data were not available were assumed to have the same price relation as similar commodities in the same group, e.g. all wood imports were assumed to be subject to the same price relation as that applicable for sawn soft wood, and the relation for paper was assumed to be the same as that found for newsprint. The overall adjustment for food and raw material imports was calculated by aggregating the individual price differences with values for each commodity taken from the detailed trade statistics.

The remaining imports for which detailed price estimates could not be made included nearly all manufactured goods and a few small groups of heterogeneous raw materials. They accounted for 15 per cent of United Kingdom merchandise imports and 25 per cent of those of the United States. Both countries have a substantial production of nearly all the commodity groups in this category, and are net exporters of the majority of the goods concerned. Relative final prices in the two countries may, therefore, be equated to the domestic output price ratios obtained in the production comparisons (adjusted from a net cost to a gross price basis), and it was assumed that in each country import prices and domestic output prices of individual commodities were identical. The adjustment therefore merely reflects the difference between the domestic output price ratios and the official exchange rate. The basic assumption regarding import prices cannot be defended on any logical basis, but it enables a rough adjustment to be made that takes account of the fact that whereas raw materials are cheap in the United States by comparison with the official exchange rate, the United Kingdom has a price advantage in the manufactured goods to which the adjustment applies. Moreover, as the method used is identical with that used in the revaluation of exports the aggregate effect on the foreign trade adjustment is the same as if adjustment had only been made for the net exports of these commodities.

3. The Revaluation of Exports

In principle, the revaluation of exports is based on the difference between the base country's final price and the export price of the other

country, converted at the official rate. It is given by the third term of the equation: $Q_{e(y)} (P_{f(x)} - rP_{e(y)})$. However, since it has been assumed that there are no export price differentials, export prices are equated to domestic production prices. The adjustments actually made then fall into three classes :

a) United States exports of items for which a revaluation adjustment of domestic output had been made under (1) above were adjusted for the difference between the American production prices used in the production comparisons and the United Kingdom final prices calculated for the Domestic Output adjustment.

b) United States exports of items entirely imported by the United Kingdom (e.g. tobacco, cotton and corn) were adjusted for differences between the American production price and the British import price (as used in the agricultural and fuel comparisons).

c) For the remaining United States exports and for all British exports,[1] no differences were found between production prices and final prices, and the adjustment is based on the difference between the gross output price ratios of domestic production and the exchange rate.

For products of industries compared by the double indicator method the gross price ratios of domestic production were directly available. For other products the gross price ratios were estimated by adjusting the net cost ratios of the appropriate industries for differences in input costs. About 130 separate commodity groups were recognised in the revaluation of British exports and 50 in that for the United States. The British data were handled in more detail because of the greater share of foreign trade in the gross national product.

For both countries the adjustment for shipping constituted a substantial part of the total foreign trade adjustment. This is partly due to the fact that as imports were measured c.i.f., all output of shipping services was treated as an export,[2] and partly to the fact that the gross price ratio found in the output comparison was very favourable to the United Kingdom by comparison with the exchange rate.[3]

Results of the Adjustment

Details of the adjustments made for the main items are shown in the summary table below :

1. No major items were found which were exported by Britain and not produced in the United States.

2. See Chapter IV.

3. Only a very crude comparison of the output of shipping services was possible, and it may be that this exaggerates the price advantage of the United Kingdom. Should this be the case, however, the adjustment made here is a compensating one, and corrects any bias in the total final product index.

SUMMARY OF FOREIGN TRADE ADJUSTMENT

	ORIGINAL VALUES IN OWN CURRENCY	VALUES CONVERTED BY EXCHANGE RATE	VALUES IN FINAL PRICES OF BASE COUNTRY	ADJUSTMENT (3)-(2)
	1	2	3	4
I. REVALUATION OF UNITED KINGDOM ESTIMATES AT UNITED STATES PRICES				
	£ m.	$ m.	$ m.	$ m.
Imports, merchandise, c.i.f.	2,523	7,064	8,009	+ 945
Exports, merchandise, f.o.b.	— 2,171	— 6,079	— 7,342	— 1,263
Shipping	— 362	— 1,013	— 1,369	— 356
Balance of above items[1]	— 10	— 28	— 702	— 674
Revaluation of domestic output	..	..	..	..
TOTAL ADJUSTMENT	..	..	..	— 674
II. REVALUATION OF UNITED STATES ESTIMATES AT UNITED KINGDOM PRICES				
	$ m.	£ m.	£ m.	£ m.
Imports, merchandise, c.i.f.	10,007	3,574	3,593	+ 21
Exports, merchandise, f.o.b.	— 10,142	— 3,622	— 3,451	+ 171
Shipping	— 860	— 307	— 227	+ 80
Balance of above items[1]	— 995	— 355	— 83	+ 272
Revaluation of domestic output[2]	..	..	..	— 749
TOTAL ADJUSTMENT	..	..	..	—477

1. This does not represent the total balance on current account since the data exclude invisible items, and shipping was the only element of these for which an adjustment was made.
2. The total gross value of the items for which adjustment was made was £ 9,804 m. when measured at U.K. production prices and £ 9,055 m. when measured at U.K. final prices. Thus, there was a price reduction of some 7½ per cent on the items affected.

For both countries the overall adjustment is negative, but as the one value is the numerator and the other the denominator of the two real product indices, the final effect is somewhat to reduce the spread between the indices, reducing the real product index based on British prices and increasing that based on American prices. This result is to be expected since production is more specialised than consumption, and the process of international trade modifies the diversity both of prices and volumes.

The adjustment of imports and exports alone, however, shows a rather large negative adjustment for the United Kingdom and a smaller positive one for the United States. The price level of United Kingdom imports was 13 per cent below American internal prices reflecting mainly the effect of cheap food imports at prices substantially below those of the United States. The net adjustment required to American imports was negligible since 70 per cent of these were of items wholly imported by both countries, and the adjustments for the remaining 30 per cent

were largely offsetting. Prices of British merchandise exports were about 21 per cent below the American internal level, but this is not surprising as they consist almost entirely of manufactured goods whose production prices in 1950 were generally favourable to the United Kingdom by comparison with the exchange rate. Moreover, since exports are concentrated on the items for which the exporting country has the largest price advantage, we would expect average export prices to be more favourable than average production prices. United States exports are shown to be about 5 per cent below the British internal price level but in this case exports of some agricultural items such as tobacco, cotton, grains and citrus fruit, whose prices are relatively cheap in the United States, partially offset the higher relative prices of manufactured goods. The adjustment for shipping reflects the marked price advantage of the United Kingdom shown in the production comparison, but as already stated, owing to the crude basis of this comparison little meaning can be attributed to the magnitude of this item which may be considered merely as a "correction".

APPENDIX E

THE EXTRAPOLATIONS TO 1954 AND 1957

Estimates of real net output in the main economic sectors in 1954 and 1957 were made by extrapolation with separate British and American intertemporal indices. From these, the relative movement in each sector in the two countries over the period was estimated, and volume indices were calculated by applying these relatives to the corresponding indices for 1950. For the non-manufacturing sectors it was only possible to calculate 1954 and 1957 indices for entire sectors, and the estimates, therefore, assume that the relative prices and volumes of output of the component industries remain broadly the same as in 1950. The spread between the British and the American weighted indices for each sector, therefore, remains the same as in 1950. Within the manufacturing sector, separate extrapolated indices were calculated for most of the major groups, and these were combined with weights obtained by adjusting the 1950 net outputs for volume change only. The manufacturing comparison is thus made in 1950 prices but takes account (at major group level) of structural changes between 1950 and 1957.

The quantity indices for the separate sectors were combined with 1954 and 1957 price weights for both countries to obtain indices of the total real product for the later years. It was not, however, possible to repeat in full the extremely detailed reclassifications made for 1950. Consequently the weights for the later years contain a higher margin of error, and do not justify the calculation of separate net cost ratios for the individual sectors. The sources and methods used in the calculation were as follows :

1. Estimates of Volume Change

a) Manufacturing Sector

The Major Group estimates for both countries were based upon their respective production indices. The only difficulty that arises here is that the classification of the sub-indices available does not exactly correspond to that used in the study. In most cases the error likely to arise from classification differences appeared small, but for the automobile group it was necessary to calculate a special United Kingdom sub-index, based on the individual indicators used in the official production index. As the result of classification changes the aggregate indices obtained in this way for each country differed slightly from the corresponding official indices, and overall adjustments were made to the manufacturing total to compensate for this. The error in both countries was

in the same direction, however, so that the net adjustments were extremely small, 0.6 per cent in 1954 and 0.7 per cent in 1957.

Sources :

United Kingdom. Monthly Digest of Statistics and Annual Abstract of Statistics.

United States. Federal Reserve Bulletin.

b) Non-manufacturing Sectors

For the United Kingdom the movement in most of the sectors was based on the official index numbers of output at 1948 factor cost. The only exceptions were dwelling units, government, and services for which the official series could not be used partly on account of classification difficulties, but chiefly because comparable United States indices were not available. For both countries, therefore, indices for the dwelling unit sector were calculated by adding house completions to the 1950 stock of houses (demolitions being assumed to be offset by the increase in average quality resulting from new building). Government and services were extrapolated by employment indicators.

For the United States the following indices were used :

i) Agriculture. Farm gross national product in constant prices.

ii) Fuels. The indices for mineral fuels and petroleum and coal products of the production index were combined with a specially calculated index for gas and electricity based on total output.

iii) Construction. New construction at constant prices.

iv) Transport and communications. A special index was calculated using mainly the output indicators used in the United Kingdom index for this sector. The index contains a rather larger margin of error than those for the other sectors, because of the difficulty of finding net output weights for the components. The weights were of particular importance as there was during the period a substantial decline in passenger rail and road transport, and a large increase in the relative importance of air transport.

v) Distribution. Consumers' expenditure on *goods* measured in constant prices.

vi) Dwellings, government and services. See above.

As in the case of the index for the manufacturing sector a small overall adjustment was required because the total movement of the real product within each country, obtained by combining the sector indices with weights appropriate for this study, did not exactly correspond to the official series. For the United Kingdom official real product indices are calculated both by the expenditure and industry of origin methods, but for the United States these indices are only available on the expenditure basis. To secure greater comparability, therefore, adjustment for both countries was made on the basis of the "expenditure" real product indices. The net adjustment factors required were 1.4 per cent in 1954 and 0.4 per cent in 1957.

Sources :

United Kingdom. National Income and Expenditure, 1958 (H.M.S.O.) Table 14 ; Monthly Digest of Statistics ; Annual Abstract of Statistics.

United States. Survey of Current Business ; Annual Statistical Abstract ; Federal Reserve Bulletin.

2. Estimates of 1954 and 1957 Price Weights

For both countries, estimates of 1954 and 1957 price weights were made by arranging the most recent official national accounts data as nearly as possible to the classification of the present study, both for 1950 and for the two later years. Detailed reclassifications and adjustments in 1954 and 1957 were then assumed to be proportionate to those for 1950. This method of estimate is fairly reliable for the United Kingdom for which the changes required were relatively small, but for the United States the data available for the later years relate only to net national income, and depreciation had also to be estimated on this basis.

Sources :

United Kingdom. National Income and Expenditure, 1958 (H.M.S.O.).

United States. Survey of Current Business, July 1956 and July 1958, and National Income Supplement, 1954.

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