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ECONOMIC RESEARCH INSTITUTE

The Irish Woollen and Worsted Industry, 1946-59 : A Study in Statistical Method

by

R. C. GEARY

July, 1962

Paper No. 7.

73 LOWER BAGGOT STREET, DUBLIN 2.

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CONTENTS

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By R. C. GEARY

The object of the present paper is to analyse in some detail the extensive statistical data provided in the annual Censuses of Industrial Production (CIP) conducted annually by the Central Statistics Office (CSO). The Woollen and Worsted industry (hereinafter the "Industry") has been selected because, as compared with most other industries, it is relatively homogeneous in products and materials. The author has no special knowledge of the Industry's problems except that which emerges from a study of the statistics. It is hoped that this paper will bring these problems into sharper focus and thus contribute something to their solution; and if this pilot effort be deemed successful in whole or in part the methods used could be extended to other industries.

A wide range of topics is covered; of necessity the paper's unity is no greater than that of CIP itself. It is hoped, however, that some measure of orderly development will be found in it. First there is a description of the material, then a presentation of the results in the form of six appended tables, with much emphasis on the quantum (or constant price) aspect of the subject. In the later part of the paper the relationships between these many quanta, and their evolution during the period of inquiry 1947–1959 (with a small-scope extension to 1961), are studied. The paper concludes with a consideration of the application of results of the kind displayed to the determination of socio-economic policy in the industry and the firm: it is suggested that data on the lines of Tables 5 and (to a certain extent) Table 6 might be useful to this end. The paper is designed as a contribution to the economics of the industry and the firm and is addressed primarily to the economic advisers of management and work-people. On the more technical level the author would venture to direct the attention of economic statisticians in particular to the last part of section 11 in which a method is developed, and applied to the data for the Industry, for estimating from CIP observables those notoriously difficult and elusive entities, fixed capital stock, depreciation and the net capital-output ratio.

The author's indebtedness to CSO, and not only for CIP reports, will be evident from many references in the paper. He also wishes to express his thanks to the following firms in the Industry for helpful co-operation:—Fine Wool Fabrics Limited, Holdens (Ireland) Limited and Stroud Riley (Ireland) Limited.

1. *The Material*

CIP provides annually statistics of gross output and materials used in considerable product detail, showing both quantities and values for a large proportion of the totals. In addition, particulars are given of costs like fuel and power, packaging, employee compensation, numbers engaged, hours worked, gross capital formation, etc. At the outset it will be useful, from the definitional viewpoint, to set out certain of these aggregates for 1959, the latest year for which all the data are available.

WOOLLEN AND WORSTED INDUSTRY, 1959

	£000	£000
(1) Gross output		
Products	11,144	
Work in progress end of year ...	478	
Work done on commission ...	272	
Total value of goods made and work done		11,894
(2) Materials, etc.		
Materials (ingredients)	6,687	
Work in progress at beginning of year	488	
Fuel, etc.	290	
Packing materials	37	
Materials for repairs, etc. ...	119	
Amount paid to other firms ...	370	
Total cost of materials, etc. ...		7,991
(3) Net output ((1)−(2)=(4)+(5))		3,903
(4) Wages and salaries		2,082
(5) Remainder of net output		1,821
(6) Other costs of production		
Depreciation	392*	
Other	857*	
Total other costs of production ...		1,249*
(7) Profit (before tax)		572*

The author should point out that the asterisked items are his own rough estimates for which CSO has no responsibility. The item " Other " costs under (6) consists of a wide miscellany, including rent, rates, employers' contributions to social security, other insurance premiums, bank interest, stationery, advertising, repairs, professional fees, postage. The CIP definition of " net output " will be noted, a term not to be confused with "added value ", the direct factor input into the Industry, the sum of items (4) and (7), or £2,654,000 in 1959, while net output equals £3,903,000. From the economic point of view added value is the more significant as representing the amount of labour and capital combined which is used in the Industry for the transformation into products of the non-factor input of materials, services and capital consumption. In this country and elsewhere, however, difficulties of ascertainment, and of treatment when ascertainable, of item (6) above (particularly as regards the statistically notorious item depreciation) has led to emphasis being placed by official statisticians on net output. For this paper very tentative estimates have been made not only of factor input as a single total but of the constituents of profit as, in the author's view, essential for an appraisal of the trend in the Industry and for development planning.

While it was stated above that the statistics are analysed here in some detail, no consideration is given to individual products and materials. Only the broader aggregates are dealt with, to the end that a statistical picture of the level and trend for the Industry as a whole will emerge. Much attention is given to price and quantity aspects at the aggregation level. This approach necessitates recourse to price index numbers on a considerable scale, some already available in CSO, some specially constructed in the Economic Research Institute (ERI) for the present purpose. The volume or quantum of a particular aggregate is the value of the quantities of the constituents of the aggregate at constant prices taken as those ruling in 1953, the base year (i.e. the year taken as 100) for all CSO series. In actual practice the procedure usually is to establish price indexes for the series in question to base 1953 as unity and to divide the current values by the price index numbers in accordance with the formula:

$$V=PQ,$$

where V is current value, P the price index and Q the value at constant prices, sometimes termed " volume ", " quantum " or " deflated value ".

It may be well to stress the importance of price/quantity analysis of time series expressed in current values. Changes in economic welfare must be measured in quantum terms. The quantum aspect is relevant for studies of productivity, transport and the like. Prices for the most part are imposed from outside* whereas quantities of input and output are under the control of the entrepreneur. In the tortuous study of cause-effect relationships in economics pertaining to change in current value of some statistic between two points of time, the extent to which the change is due to prices and to quantities is one which the analyst can determine with some assurance. The habit of " factorisation " of value aggregates into price and quantum elements will protect the industrialist from the " price illusion " to which many Irish industrialists were victims in the later 1940's, leading to overgenerous distributions of dividends and wages to the detriment of gross business savings required not only for capital expansion but even for replacement of physical capital consumed.

Prices, absolute or relative, are the mainspring of economic activity. They determine the level of economic activity through supply and demand. In these days, when the blight of inflation-mindedness is threatening civilisation, close regard to price trends is essential. As we shall presently see, the relative trends of prices of products and inputs for any sector or for the economy as a whole (when these elements become exports and imports) are important, and measurable, constituents in welfare. We shall quantify this differential price effect which, from year to year, may be of the same order of magnitude as change in product itself.

2. *The Results*

The results are presented in the appended tables ; since the notes to the tables are fairly explicit it may not be necessary to expatiate in the text on detailed points of statistical technique and sources. It may be well, however, to point out that for the earlier years of the period, in fact up to and including 1953, the data in Table 1 differ from those published by CSO in consequence of changes in data for earlier years recorded in later issues of the Irish Trade Journal and Statistical Bulletin (ITJSB). These changes have been assumed to be due either to productive activity in the earlier year coming later to the notice of CSO or (as in 1953) to industrial reallocation of establishments, so that the method of linkage at year of change was used here. It was applied to all the aggregates. The point is not an important one since the changes were not large in magnitude—for example for 1946 gross output value was increased by 5·1%—and the object of the paper is to study trends and relationships between the aggregates which would be little affected by the

*But see remarks in section 12.

changes. Little more need be said about Table 1 though it is basic for this study.

3. *Trend in Volume of Output*

The data in Table 2 are illustrated in Chart 1. The reasonably close parallelism between trends of input and output for the Industry will be noted. This phenomenon is fairly satisfactory from the purely statistical viewpoint and unfortunately does not obtain for all other industries [(1), (2)]. The marked change in trend between input and output between 1949 and 1950 will be noted; in fact, something like a revolution seems to have taken place between these two years which redounds highly to the Industry's credit. The effect was that, for a constant price £ of input volume, output was £1·26 in 1949 and £1·38 in 1950, an increase of nearly 10% in a single year while labour productivity increased by no less than 46% (see column (9) of Table 4). It would appear that this change was due mainly to the prodigious rise in the price of wool (see Chart 2) which occurred about this time: the Industry had to devise means of securing greater output from a given input. Between 1949 and 1950, i.e. in a single year, the average weight per square yard of cloth fell from 15·2 oz. to 13·2 oz. (which was also the weight in 1959). At the same time (when wholesale prices generally were stable) price of cloth increased by 6·4%, so one surmises that attention may have also been given to improved design and other aspects of customer requirements. This may seem to be an overenthusiastic encomium based on a modest statistical showing in a period now remote. If, however, one could draw the larger inference from it that Irish industry generally, faced with a situation of extreme difficulty (as was the case of the Industry, due to the wool price increase, in 1949), would react as efficiently, the experience would be a heartening one indeed.

The shaded area in Chart 1 represents the change in net output volume during the period, derived by what is now termed the "double deflation" method,

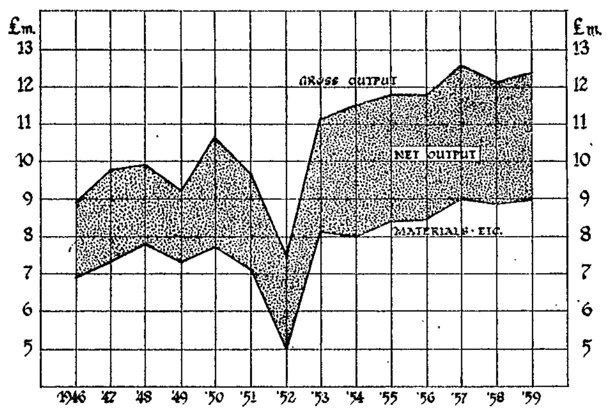

CHART 1: Gross Output, Materials, etc. and Net Output at Constant (1953) Prices, 1946–59.

i.e. "double" in the sense of involving both input and output.

Used officially in Ireland for many years in connection with agricultural output volume and in the Irish industrial context the subject of some research [(1), (2)], the notion has been fairly widely accepted abroad, though statistical difficulties of implementation have been encountered—see next section. What is implied in the concept may be illustrated by a simple example. A carpenter, working by himself, makes a single product, say doors of standard quality, for which his only ingredient is timber (also of standard quality) and tools which he replaces every year; the proviso is unimportant in the present context but is of significance later. He has no expenses other than those specified. His experience in value terms is as follows in an earlier (base) year 1 and a later (current) year 2:—

	Year 1	Year 2, at Current prices	Year 2, at Year 1 prices
	£	£	£
Timber	500	660	600
Tools	100	126	120
Profit	400	1,014	780
	1,000	1,800	1,500

	Year 1	Year 2, at Current prices	Year 2, at Year 1 prices
	£	£	£
Doors	1,000	1,800	1,500
	1,000	1,800	1,500

It will be observed that from base to current year prices of doors, timber and tools increased respectively by percentages 20, 10, 5, derived from the quotients of the year 2 figures in accordance with the formula $P = V/Q$. We may also infer that the percentage increase in prices of non-factor input (i.e. of timber and tools) together was 9·2 ($= 100(660+126)/(600+120) - 100$): the latter calculation typifies on a small scale much of the computational procedure in the paper.*

The carpenter's actual profit increased from £400 to £1,014; net output volume ("profit" in this case) increased from £400 to £780. Net output volume is therefore to be interpreted as quantum of work done. Or the carpenter may decide (if he worked the same number of hours in the two years)

*For simplicity in the "carpenter" example the Laspeyres price index formula was used, in contrast with the linked Fisher formula used for the Industry price indexes displayed in Table 3.

that his labour productivity has increased in the ratio 400 : 780 ; though in the more general context it will be recalled that net output is a *pis aller* for factor input : both are the same in this example. Perhaps the most important use of the concept of net output (or, better, added value) volume is its relevance for productivity measurement : labour productivity is the quotient of net output volume by number of hours worked. It is a concept which can be validly applied over time at the industry or at the establishment level, even if quite substantial changes take place in the structure of industry. Of course it does not tell the whole productivity story—no single statistic can, as we shall see later—but at least it is a valid starting point for other inquiries. Use of the concept will protect analysts from the doubtful assumption—which is quite common—that the quotient of *gross* output volume by hours worked represents labour productivity. In the present case this would mean an increase of 50% (i.e. from £1,000 to £1,500) whereas the correct increase is in the ratio of 400 : 780 or an increase of 95%. The carpenter, in fact, not only increased his gross output but he also achieved an economy in materials per unit of output, namely 0·6 (=600/1,000) in year 1 and 0·48 (=720/1,500) in year 2 ; the latter element is ignored in the " gross " approach.

Perhaps the outstanding feature of Chart 1 is the catastrophic fall in output in 1952. A curious feature is that the decline in net output volume in that year (8% compared with 1951) was much less severe than the decline in output (24%) and input (29%). It will be noted from Table 4 that the decreases in gross output and materials, etc., volumes are very different in magnitude from the much lesser fall of 10% in hours worked which is quite similar to this 8% fall in net output volume. Between 1954 and 1959 there was no perceptible trend in net output volume.

4. *Practical Difficulties with Net Output Volume Concept*

As remarked earlier, the concept of net output volume, as defined, is regarded as theoretically acceptable but has proved difficult to apply in practice in this country and elsewhere, for reasons developed in some detail in [2]. These reasons may be summarized as follows :—

(1) Censuses of industrial production, very useful and sufficiently accurate for the supply of such primary data as gross output (or sales) of individual commodities, numbers engaged in industry, wages and salaries, hours worked, etc., are not reliable enough for refined analysis.

(2) These censuses, of their nature, cannot afford such detail and information as to prices as to enable the official statistical authority to derive accurate enough price indexes for the deflation of value aggregates at the individual industry level ; recourse must be had to unit values instead, which necessarily means that insufficient account is taken of changes in quality of individual commodities described in such terms as " woven woollen and worsted tissues—union " (as in Section II of the CIP schedule) which may not be specific enough to define a particular quality.

Let us assume that in any industry the " Total Value of Goods Made and Work Done " in Section II of the CIP schedule is accurately rendered. Then in the derivation of the corresponding volume (or value at constant prices) the price index used as a deflator constitutes one possible source of error : it is really a unit value index which may take insufficient account of quality changes, even if the schedule is quite detailed as in the case of our Industry. But in the derivation of net output volume, essential for productivity studies not only at the level of the industry but of the firm, and recalling the manner in which net output volume is compiled, there are *three* possible sources of error (i) the price deflator used for gross volume output (as above), (ii) the *value* of input of materials (which for various reasons may not bear quite the right relation to value of output) and (iii) the price deflator used for materials, etc. No doubt in the typical case the errors of these three kinds are small but the point is that the net output volume estimate has to bear the brunt of all of them ; and proportionately the effect of the errors is greater the lesser the percentage which net output value bears to gross output value. In the case of the Industry this percentage is rather low (33% in 1959 and much less if added value at constant prices is required). Accordingly the year to year fluctuations in net output volume and series derived from it, illustrated on most of the charts, are probably of wider amplitude than was actually the case, especially in the earlier years. In interpreting the charts and the tables—and the main object of this study is the presentation of the appended tables—the reader is advised to concentrate on general trends and averages for groups of years rather than on individual figures as far as net output volume is concerned.

In the circumstances indicated it is not surprising that the Irish statistical authorities are reluctant to adopt the net volume concept as the basis for the official series of output indexes classified by industry; actually the official series is based on gross output. This desirable change cannot come about unless and until industrialists co-operate with the CSO to the extent of (*a*) giving greater attention to the accuracy of the data they already supply and (*b*) giving additional data, which CSO cannot obtain from any other source. Specific suggestions to this effect will be made in the concluding section of this paper where the point will also be made that for the efficient conduct of his business the individual industrialist should have, and use, this additional data.

Another difficulty is that the choice of base year may effect the result to a significant degree. In CSO annual price and quantum index numbers are computed on the link relative principle using the Fisher formula; the same method was used here in computing input and other indexes. The advantage of using the link relative (in contrast with a base-weighted Laspeyres) is that between consecutive years the indexes are as correctly weighted as one can make them and that *any* year in the series can be made the base year (i.e. with value 100). Clearly if one contrasts the same series, computed using two different base years (i.e. as 100), the two series will be consistent in that the ratio of the two indexes for a given year will be a constant. This kind of consistency will not necessarily obtain with net output volume indexes.

To see this, consider the following two net output volume series, one based on (i) 1953 prices (i.e. as in Table 2 and elsewhere in this paper) and (ii) average prices in 1951–55, each with 1953 as 100:—

WOOLLEN AND WORSTED INDUSTRY:
NET OUTPUT VOLUME ON TWO BASES, 1946–59

	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Based on:—														
(i) 1953 prices	64	83	71	64	98	86	79	100	118	114	111	117	109	116
(ii) 1951–55 prices	61	82	67	59	98	85	82	100	122	116	112	118	110	117

The differences between the two series will be seen to be fairly substantial especially during the period 1946–49 when prices were increasing considerably. However, the same general picture emerges from both. It is the author's belief that the best way to use the net output volume is on a year-to-year basis, i.e. by double deflation at earlier year prices. In temporal comparison, interest centres predominantly on the current year compared with last year, except, of course, for comparisons for political ends when the base year is invariably the year before the last change of government.

5. *The Two Groups of the Industry*

Attention is directed to the two groups of establishments in the Industry for which certain of the statistics are displayed in Tables 1 and 2, namely (1) Matched Sample (MS) and (2) Other (O) establishments: the author is indebted to CSO for making this division, at his request. Group (1) consists of a sample of 30 establishments identical throughout whereas group (2) represents the rest, including therefore the eight establishments which began production during the period 1950–59. This segregation was originally devised for an examination of capital formation in relation to output, for CIP includes gross physical capital formation only for establishments already in production and excludes the large amount of initial capital formed before year in which production begins; the MS group should have helped for a study of the incremental capital-output ratio and the like. This project proved abortive for, as Table 2 shows, there was no appreciable growth in the MS series during the period 1950–59 and gross fixed capital input, in quantum terms, showed a declining tendency*; all physical growth during the years 1950–59 was due to the O establishments, mainly no doubt to the fact that new establishments entered the Industry. Nonetheless the segregation proved useful, as may appear from what follows.

6. *Prices*

Price trends are shown in Chart 2, derived from Table 3. The outstanding feature will be seen to be the prodigious rise in prices of materials during the period 1946–51: the increase was of 169% while wholesale prices generally advanced by 43%. During the same period output prices also rose considerably (they more than doubled) but, as is always the case since wages and other costs rise more slowly, output prices rose much less than non-factor input prices. In the period 1951–59 output prices remained stable while the trend of input prices was downward.

The concept of net output price will be less familiar than that of input and output prices. It is the quotient ($\times 100$) of the net output *value* index by the net output volume index, all to base year 1953 as 100. To appreciate what it means consider again the earlier example of the carpenter making doors. Between year 1 and year 2 his profits in current values increased from £400 to £1,014 or in the ratio $1{,}014/400 = 2{\cdot}535$; the quantity of work done increased in the ratio $780/400 = 1{\cdot}95$; hence

*See note to Table 2.

the *price* of each unit of work increased in the ratio 1,014/780=1·30. This price increase of 30% is therefore not to be confused with his increase in rewards per hour of 153½% assuming no change in hours worked per week between year 1 and year 2.

The outstanding showing of Chart 2 is that the *trend* in the net output price is quite different from that of materials and gross output; the author presumes to warn his colleagues in other countries about their propensity to cavalier practice in the price indexes they sometimes use to deflate net output or added value. During the period of steeply rising prices, from 1946 to 1951, net output price, on the whole, remained steady. From 1951 to 1959 on the other hand the trend in the net output price was unmistakably upward, the resultant of steady product prices and declining material prices.

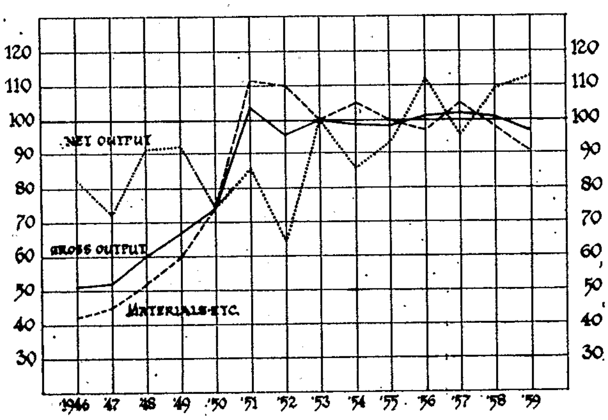

CHART 2: Price Index Numbers (1953 as 100) of Gross Output, Materials, etc. and Net Output, 1946-59.

As might be expected, when product price rises more than material price the net output price rises; and vice versa. Only when price indexes of products and materials are the same is there coincidence with the net output price index; note the position at 1950 and the three intersections during the period 1955–58. The author confesses that it is hard to rationalize the substantial rise in net output price between 1947 and 1948. The considerable fall in net output price in the bad year 1952 is the consequence of a large fall in value (see Table 1) but a much lesser decline in net output volume (see Chart 1).

7. *Real Earnings and Labour Productivity*

This aspect is illustrated in Chart 3. The data are derived from Table 4, the notes to which explain how the figures were obtained. The graphed data are juxtaposed in deference to popular interest in this kind of comparison; they do not imply the author's endorsement (or lack of it) of well-known arguments bearing on this comparison. Statistically the juxtaposition can be sustained in the consideration that if labour only (without capital, and added value instead of net output) were involved in production the two series would be identical. The graph of net output volume per hour worked, which defines labour productivity, increased (to base 1953 as 100) from 79 in 1946 to 113 in 1959 but the graph fluctuates in a very aberrant way during the whole period, partly no doubt because of statistical defects in the basic series, dealt with in [2] and to which reference was made in section 4. The plunge in 1948–49 is associated with high net output prices—see Chart 2. The real earnings per hour graph is much more smooth. The only exceptions to the regular rising tendency were in 1952 (the very bad year for the Industry) and in 1957 when the decline was insignificant. In the period 1946–53 labour productivity increased more than real earnings but from 1953 on, real earnings increased more than productivity.

To draw any valid kind of inference with regard to growth rates from fluctuating data of this kind

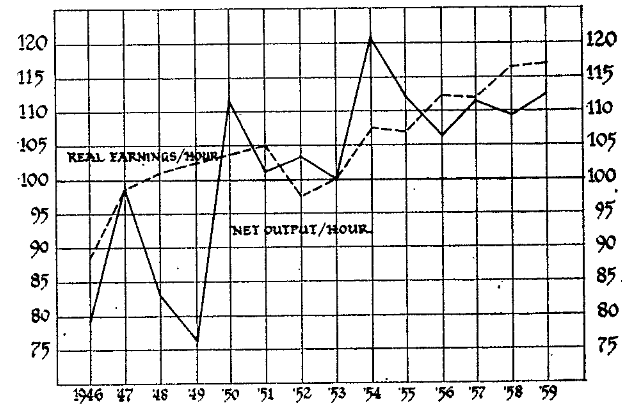

CHART 3: Index Numbers of Net Output Volume per Hour and Real Earnings per Hour, 1946–59.

it is necessary to have recourse to smoothing. The labour productivity index (X_1) and the real earnings index (X_2) are related to time ($t=1, 2, \ldots, 14$) by the following formulae:—

$$X_1 = \text{const} \times e^{0.024t}$$
$$X_2 = \text{const} \times e^{0.016t}$$

using least square procedure for fitting. Accordingly annual average rates of increase during the period 1946–59 were 2·4% for labour productivity and 1·6% for real wages.

In this matter there is some interest in contrasting the experience of the two divisions of the industry, the MS group of 30 establishments and the O group containing the establishments which began during the period 1950–59. During this period labour productivity for the MS group showed an insignificant rise of 0·2% per annum while the O group increased by 1·9%; the respective increases in real earnings were not very different in the two groups 1·7% and 2·2%, though the differential of 0·5% in favour of the growing group O is probably significant. National wage agreements and more or less uniform rounds of wage increases irrespective of the growth rates in industry or establishments may be expected to have effects like these.

For the Industry as a whole during 1950–59, annual average percentage increases were 0·9 for labour productivity and 1·9 for real earnings. For further remarks on this topic see section 11.

8. *Accounts*

For Table 5 the Industry is envisaged as a sector of the economy in which employees and employers are living by the product of the Industry. The table consists of four balancing accounts at current values pertaining to production, household, capital and external (to the sector, that is, not to the country). It is compiled on the articulated (or double-entry) principle whereby each entry appears twice, as a debit to one account and a credit to another. To save space the particulars for each year are displayed in single column (instead of the usual double column form) with debits on top, and credits at bottom of each account. Also to save space two items 12 and 23 are consolidations of items 3+4 and 6+7 respectively: if one wished they could be written out in full. Though the Industry contains non-corporate firms all firms have been treated as if they were corporations; in particular they are envisaged as placing part of profits to reserves and distributing part as dividends. *It should be emphasised that most of the figures in the table are speculative (though based on genuine, if incomplete, information for certain items for certain years during the decade) and they will not bear the burden of case-making, as they stand.* The author's object in presenting the table is to provoke discussion as to the usefulness for each sector (or even for each firm in each sector) of data presented in this manner, from the viewpoint of the economics of the sector in general, and for labour-management purposes in particular. Figures have been inserted in order to lend reality to such discussion. The reader will recognise the identity of items 1 and 9 with corresponding entries in Table 1; also that employee compensation in Table 1 equals the sum of items 3 and 6 in Table 5. Profits before taxes (and their segregation into the categories (*a*) tax, (*b*) allocation to reserve (i.e. business saving) and (*c*) distributed profit after tax (i.e. dividends)) and depreciation estimates are based on returns pertaining to about one-fifth of the Industry, by value of net output, for certain years: the author cannot judge the representative character of these returns. Item 2 (other costs) emerging as a residual seems too large, possibly because in CIP gross output (item 9) is overvalued and/or possibly because profit (before tax) is under-estimated. At any rate, it will be clear that employee compensation forms a large proportion of added value (i.e. the difference between values of item 9 and the sum of 1, 2 and 8): on average the proportion was 80% during the earlier five years 1950–54 and 78% in the later five years 1955–59. From the internal point of view the main function of the Industry is the creation of employee income.

Much of the analysis in the following sections while not, it is hoped, entirely devoid of interest to industrialists, is admittedly technically statistical in character and it is not argued that it is essential for the efficient conduct of business at the industry level, and still less so at the establishment level. It is hoped, however, that all the appended tables will be found useful in revealing not only the recent historical trend in the industry but also the relationships between the entities displayed, most of which will continue in their essentials, it may be surmised, in the future. It is argued that, to understand properly the economics of industry at the macro and micro levels, presentation of the data on the lines of Table 5 is essential. It may be well, therefore, to spell out in some detail the principles underlying the table. The "carpenter" illustration to which appeal is made at many points in the paper may make the main points fairly clear.

Table 5 represents the adaptation of the tenets of national accountancy, i.e. the accounts of the nation as published each year (e.g. by the CSO for Ireland) to the level of the industrial sector, in this case the Industry. In the case of the national accounts proper the "sector" is the nation as a whole; for Tables 5 and 6 the Industry with all its members (employees, owners and members of their families) is regarded as a "nation", its transactions with the rest of the country and abroad being its "imports" and "exports". If all the sectoral accounts (like those of Table 5)—and even if the "sector" were the individual establishment—of the nation were consolidated, and if the necessary supplementary information about intra-sectoral transfers were available, the national accounts (in somewhat modified form) would emerge. It will be clear that certain items in the table are strictly additive, including employee compensation, dividends, saving, taxes, capital formation, National accountancy, in turn, derived all its ideas from professional accountancy whose members will have no difficulty with the ideas underlying the table: a national accountant may temerously suggest, in commending this table (and Table 6) respectfully to their notice, that in many important details they may have something to learn from national accountancy in the matter of presenting data to their clients in a manner which will be useful for decision-making. The author is most anxious to carry conviction with professional accountants in this matter since without their cooperation no progress will be possible. He hastens to add that Tables 5 and 6 are experimental and will, without doubt, benefit from professional criticism.

As its title indicates, Account I of Table 5 is a consolidation of the ordinary production and appropriation accounts: the existing account could be deconsolidated into the two accounts if desired. In the present form item 9—gross output—is the sum of items 1–8. As explained at the beginning of the paper the crucial total "added value" is found as the difference between item 9 and the total of 1, 2 and 8. It is perhaps a disadvantage that this figure does not explicitly appear in the table, as it would, as the balancing item in the production account, were the existing Account I deconsolidated into two. This would be the case according to national accountancy principles but *not* so by the rules of professional accountancy which regards labour as an input into production, a commodity purchasable like wool, instead of a factor to be distributed (like dividends, through the appropriation account) from the net factor income of industry. May the author gently twit his professional friends and suggest that they have a look to their philosophy! Employee compensation (in the ordinary sense, i.e. before tax) is found as the sum of items 3 and 6. It may seem unusual to display taxes paid by employees in an account pertaining to an industry: it was found convenient for the form of accounts adopted, in particular to simplify II—the Household Account. The "households" are obviously those of the employees and dividend recipients combined. Item 12—disposable income (i.e. income after tax)—has been carried down from Account I and distributed into consumption and personal saving (including all saving of employees and saving of dividend holders in their personal capacity) as distinct from business saving —item 5.

The Capital Account (III) is financed by item 8—depreciation—and the two saving items 5 and 11. This is regarded as invested in the industry by way of gross fixed capital added (to cover capital replacements as well as net additions to fixed capital stock) and changes in inventories assessed (*pace* professional accountants) as changes in physical quantities between beginning and end of year valued at average prices ruling during the year. The value of each constituent is given in a note to the table. (In this Industry stocks are relatively very large and fluctuate greatly between the beginning and end of each year, as the figures in the note show. Is there not scope for rationalisation in stock policy?)

"External" in Account IV means, of course, external to the Industry including in the sector all households of members of the Industry. Gross output (item 18=item 9) is the only credit item in the account: dividends, interest, etc. receivable are subsumed in item 24 (=item 14). All the other items are "imports" into the sector. Physically this is evident as regards "other" costs—item 20—personal consumption—item 21 and the fixed capital constituent of item 22; it may be less clear as regards gross output (item 18) and materials (item 19) for each of these contains a considerable volume of intra-establishment sales and purchases. The treatment in the account as regards these two items and the change in inventories constituent of item 22 can be rationalised by postulating a "Warehouse" outside the sectoral boundary to which gross output of each establishment goes and from which it draws its requirements for materials and makes its distribution of products.

For more detailed explanations and for sources attention is directed to the notes to the table.

Account III in the table shows that net external investment (item 14) in the decade 1950–59 fluctuated considerably from year to year (because of stock changes, as the note to the table shows); for the ten year period total disinvestment amounted to £400,000 or an annual average borrowing of £40,000, small, therefore, in relation to other figures in the table. Both employees and shareholders must have a considerable interest in the magnitude of business saving affecting, as it does, the wage and dividend level. One would like to know more about the principles governing reserve allocation in Irish industry. Reserves, one would think, should have primarily the character of funds for future capital investment in the industry or for contingencies: on the latter aspect the considerable loss in the year 1952 will be noted: reserves must be adequate to mitigate such fortuities as these. Examination of particular accounts, however, fails to reveal any common policy or attitude towards reserve allocation amongst industrialists. A very simple and comprehensive presentation like that of Table 5 should help in lending perspective to the broad economics of the Industry, and give some coherence to reserve policy in particular.

Perhaps the main feature of the table is, however, the magnitude of the aggregate in Account IV—the external account—in relation to the value created in the Industry.

Table 5 owes its origins to professional accountancy. Table 6, on the contrary, is conceptually due to national account statisticians and, a very recent development, has not yet been fully accepted even by economic statisticians. There is no difference of opinion as to the usefulness of the various items which appear implicitly or explicitly in the table, i.e. of various aggregates of gross output, materials, consumption, etc. expressed at constant (in this case 1953) prices; on this aspect see remarks in section 1. Where opinion differs is as to the usefulness of presenting these data in a set of double-entry accounts, on the analogy of the ordinary accounts at current prices (e.g. as in Table 5). The author himself has no doubt about his attitude. Accounts at constant prices are useful both from the definitional and analytical points of view. Once the concept of added value at constant prices has been accepted the notion of a full accountancy presentation is inevitable.

The author agrees that there may be formidable statistical difficulties in deriving accounts at constant prices and that certain consolidations of items in the current price system are necessary to achieve the constant price set of accounts: reference to the notes to Tables 5 and 6 should make evident how this has been effected in the present case. The balancing and double-entry principles bring to light new relationships and even new entities.

The most important of the latter is the *trading gain*, a quantum phenomenon due solely to differences in trends (compared with the base year) in prices (in the aggregate) of goods and services (i) sold and (ii) purchased. As will be seen this element assumes particular importance in the case of the Industry because of the magnitude of external transactions and the considerable price fluctuations, both already noted. The trading gain is closely related to the more familiar concept the *terms of trade*, the ratio of prices of exports to those of imports in relation to some base year: in fact when the terms of trade index is unity the trading gain is zero; when less than unity or greater than unity the trading gain is respectively negative or positive—see the formula in (iii) below. What the trading gain does is to quantify the differential price effect and thereby set the effect into proper scale relationship with other elements such as productivity. Index numbers (of terms of trade, productivity or anything else) tell us nothing about relative magnitudes involved. To understand how the trading gain arises in the accounts and its effect on real income we revert to the earlier example of the carpenter who is now regarded as a trading unit with " exports " doors and " imports " timber, tools and consumption goods. We now assume that he replaces his tools and consumes his whole income every year, i.e. his personal consumption at current prices is £1,014 and he does not save, so that he has no capital account. His external account in year 2 at year 1 prices is as follows:—

External Account

	£		£
Exports		Imports	
Doors ...	1,500	Timber ...	600
Trading gain	168	Tools ...	120
		Consumption goods ...	948
Total ...	1,668		1,668

The £948 for consumption is the value at year 1 prices of personal consumption (£1,014 at year 2 prices), i.e. prices of consumer goods are assumed to have advanced by 7%. The trading gain (£168) is the balancing item on the left side. It is a price phenomenon arising through the fact that the increase in import prices (10%, 5% and 7% respectively for the three items) is less than the increase of 20% in the export price. It is evident that if the import price in the aggregate increased by the same percentage as the export price the trading gain would be nil.

Now the product account in year 2 (always at year 1 prices) may be synthesised as follows:—

Product Account

	£		£
Product ...	780	Income ...	780

Product (net equals gross in this case since depreciation is nil) is envisaged as added value, i.e. the difference between the value of gross output (£1,500) and cost of materials (£720). As has been seen the £780 is the figure relevant to the study of labour productivity. But consumption is £948, the difference between the £948 and the £780 is £168, namely the trading gain. His consumption (or household) account is therefore:—

Household Account

	£		£
Consumption	948	Income ...	780
		Trading gain	168
	948		948

The carpenter is enabled to enjoy increased consumption through his gain from the terms of trade as they affect him. In the interest of simplification he has been assumed to have no capital account, having no savings and no physical capital formation.

Three remarks—

(i) The trading gain is a physical concept in that it is expressed at base year prices though, of course, it equals zero in the base year. It is purely a price phenomenon which enables the carpenter to enjoy a higher consumption than would otherwise be the case.

(ii) In any consideration of the trend of an industry or of the distribution amongst factors of its product, it is not enough to have regard to labour productivity; the trading gain may be at least as important, and this may be positive or negative as will appear from Table 6.

(iii) With E and M the values of exports and imports at base year prices the formula for the trading gain T is

$$T=(E+M)(p_E-p_M)/(p_E+p_M)$$

according to the deflation formula for net external investment adopted here—see below. In the present application $E=1{,}500$, $M=1{,}668$, $p_E=1{\cdot}2$ and $p_M=1{\cdot}079$ $(=1{,}800/1{,}668)$. On substitution it will be verified that $T=168$.

In any realistic application of these ideas to the actual case there are admittedly difficulties, not all of them yet solved. Certain items can be unambiguously deflated; all goods and services are in this category (though there may be technical difficulties in deriving appropriate deflating price indices). On the other hand, in the case of items like saving and employee compensation more than one deflator can be contemplated. For instance saving, regarded as consumption deferred, might be deflated by a consumer price index or as funds available for capital investment when the capital price index would be appropriate. Similarly employee compensation might be measured in quantum terms by what employees contribute to production (i.e. hours of labour) or by what they consume represented by current compensation deflated by a consumer price index, usually termed "real" earnings. Of course, where one has a choice there is little point in discussing which index is "right"; that depends altogether on the uses to which the deflated data are to be put. Actually the juxtaposition of the figures for a given item, deflated in different ways, may be economically revealing. Difficulties of this kind can largely be met by a consolidation of the accounts and by using the balancing property of the accounts for the purpose of *defining* the "doubtful" items at constant prices. It may also be assumed that, as in the case of accounts in current values, a debit item in one account must be a credit item, entered at the same value, in some other account: the set of accounts should be articulated.

These principles are observed in the construction of Table 6. To get rid of the awkward (from the deflation viewpoint) item taxation, the industrial sector is extended beyond the narrow confines of the Industry to include the small part of government represented by the amount of taxation collected from members of the Industry and, for simplicity, government is assumed to make no saving on this income. The consuming unit is in fact the members of the Industry and a small part of government so that, in fact, the Industry is consolidated with general government (i.e. including local government) in these accounts.

In the first account gross product is the sum of consumption, net capital formation and exports *minus* imports. To give effect to the double entry principle this is the most convenient form of account but it may be useful to remark that the total so obtained is identical with added value+depreciation as defined earlier. Thus for 1953 (in which the figures in Table 6 must be absolutely reconcilable with those in Table 5 since 1953 is the base year) gross product of £2,208,000 equals gross output £11,104,000 (item 9 of Table 5) less materials, etc. (item 1) £8,109,000 less other costs (item 2) £787,000. All saving (business and personal) including depreciation has been steered into the consumption Account II, the item gross saving being *defined* itself by Account III as the sum of gross capital formation and net external investment.

Controversy has raged about the deflation of the item net external investment and the end is not yet. The author has used as deflator the simple average of the price indexes of imports and exports, for reasons given in [4] though he admits that his practice in the past in this matter has not been ideally consistent. It is from this assumption that the formula for the trading gain T, given some paragraphs back, emerges.

All comparisons in the table should in the first instance be between 1953 and the year of reference. Different results would be obtained if a different year or group of years were taken as base.* Actually

*A perennial difficulty, e.g. in labour-management discussion, is that of choice of "base year". Ideally the base year for index numbers should be a "normal" year but the worst of normality in this sense is that the so-called "normal year" cannot be identified until a decade or so has elapsed, which is not very helpful. The author advocates systematic annual examination of the position by parties affected whereby the previous year becomes the base year in regard to the current year. The difficulty about the base year of the present paper being 1953 is largely overcome by concentrating attention on *changes* between consecutive years rather than the absolute figures. These changes are affected by the choice of base year but to a far lesser extent than are the absolute levels of the figures.

(as appeared when this study, involving a good deal of computation, was too far advanced to change) 1953, though the base for official price index numbers, was not very suitable for this Industry. This will be clear from the rows for the trading gain in which it will be seen that eight of the nine significant figures have negative signs, indicating that export (or gross output) prices were particularly unfavourable compared with import prices (business costs and consumption) in that year. Changes from year to year are more significant. Before dealing with the change aspect, however, it may be well to consider the *labour productivity increment* defined in the following manner :—

changes in trading gain, in absolute value, will be seen to be greater than those in the labour productivity increment.

The end of economic effort is consumption so perhaps the most useful approach to interpretation of the foregoing figures is to compare changes in *d*—Consumption—on the one hand with changes in *a*—Trading gain—and *c*—Labour productivity increment—on the other. The figures can speak for themselves. For example, in 1950–51 the increase in the trading gain considerably mitigated the large fall in the labour productivity increment; similarly the large increase in consumption in 1952–53 was entirely due to the trading gain. Of course the causal

Value (£000)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
a Gross product	2,179	1,901	1,755	2,208	2,827	2,710	2,465	2,863	2,627	2,725
b Expected product (based on labour hours) ...	1,939	1,872	1,680	2,208	2,159	2,246	2,299	2,310	2,204	2,268
c Productivity increment (*a*−*b*)	240	29	75	0	668	464	166	553	423	457

"Expected product" represents simply what product would be at the labour productivity level of 1953, calculated by changing the actual product in 1953 *pro rata* with labour hours worked (column (8) of Table 4). The fact that in all nine of the years a positive quantity emerges for *c*, the productivity increment, indicates that in 1953 labour productivity was exceptionally low.

Year to year changes in certain important elements in Table 6 as well as changes in the productivity increment are as follows :—

chain is blurred by the fact of isolating particular elements. To understand what is happening it is necessary to have recourse to the accounts as a whole, comprehensive yet in not too great detail for the trees to conceal the wood.

It is therefore necessary in any consideration of the fair division of product of industry to have regard to the differential price effect, quantified in the trading gain. The normal manner in which the benefits of greatly increased production and in productivity are distributed amongst the whole

Change in Value (£000)

	1950–51	1951–52	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59
Change in—									
a Trading gain	+174	−666	+757	−541	+238	+456	−640	+274	+206
b Gross product	−278	−146	+453	+619	−117	−245	+398	−236	+ 98
c Labour productivity increment	−211	+ 46	− 75	+668	−204	−298	+387	−130	+ 34
d Consumption	− 64	−398	+574	+115	+ 53	+152	−102	+ 5	+122

Perhaps the first thing to note in these figures is the magnitude of the changes for the trading gain, the resultant of the very large volume of external trade of the Industry in relation to its gross product and changes in the relative price trends of exports and imports. What might appear quite small differences in price trends from year to year can have substantial effects on the trading gain. Incidentally, it will be observed that the signs (+ or −) for trading gain coincide with the upward or downward changes in the net output price graph on Chart 2 for the reason, of course, that gross output and materials predominate in the prices of exports and imports. In seven out of nine cases

community (domestic and foreign) is by reduction of price of product, absolute or relative. In such circumstances the trading gain is likely to be negative so that it may be neither prudent nor equitable to have regard only to productivity in determining the level of wages and dividends available for distribution.

9. *The Industry since 1959*

The last year for which CIP data have been published for the Industry is 1959. Certain of the particulars in which we are interested are, however, available for 1960 and 1961 from the quarterly industrial production inquiries which have a wide industrial coverage. The following index numbers have been constructed from these inquiries :—

INDEXES TO BASE 1953 AS 100

	1959	1960	1961
(1) Net output	115·5	147·2	139·2
(2) Persons engaged	107·6	115·5	112·1
(3) Hours per person per week	95·4	95·4	95·7
(4) Total hours worked ...	102·7	110·2	107·3
(5) Real earnings per hour ...	116·8	128·4	131·9
(6) Net output per hour (labour productivity)	112·5	133·6	129·7

The 1959 indexes agree, of course, with those in Table 4. The " net " output index is really the gross output index linked to the 1959 (net) index, i.e. it is assumed that during 1960 and 1961 the proportion borne by net output to gross output (at 1953 prices) remained the same as in 1959.

The Industry obviously participated in the industrial upsurge of the past two years. The output index of 147 in 1960 was by far the largest ever recorded for the Industry and the recession in 1961 in both output and numbers engaged was slight and possibly insignificant. As so often happens, the increase in employment was not nearly so marked as in output with the result that (since hours worked per person/week were about the same in the three years) labour productivity (6) also increased considerably. Perhaps the most remarkable feature is the similarity of the rises in labour productivity and real earnings : note the big jump in both in 1959–60 and the lesser changes in 1960–61. In 1961 compared with the base year 1953 the rise in both indexes was almost the same, at about 30%. The author [4] has noted this striking phenomenon also in Irish agriculture. During each of the two periods 1938–50, 1950–54 and in certain degree in 1954–57 the rise in real (minimum) wages was nearly the same as the rise in productivity. Are there forces in the economy tending to bring this equality about even at the sectoral level, possibly with some time lag in earnings? This subject certainly merits further study. It would indeed be curious if despite national agreements on *wage* rates (minimal in effect) crossing industrial boundaries that *earnings* of their own accord tend to find what many would regard as their natural level.

10. Production Functions

These functions are designed to "explain" changes in output, usually over time, in terms of input. The best-known model is the Cobb-Douglas of the form

$$q = \alpha H^{\beta} K^{\gamma} e^{\delta t}, \qquad (8{\cdot}1)$$

where q is quantity of output, H number of labour hours, K is quantity of capital ; α, β, γ and δ are constants to be determined from the data. If one assumes that proportionate rises in H and K should occasion a similar rise in q then $\beta+\gamma=1$. The last term on the right, $exp\delta t$, is designed to allow for the time trend, the coefficient representing that very important element the rate of change of *residual production*, i.e. the change in production after allowing for the inputs of capital and labour. This coefficient therefore reflects managerial skill and all that this connotes, including especially the measure of the ability to obtain increased output from given inputs of labour and capital.

In applying the foregoing formula it is customary to take for K the physical stock of capital (plant, machinery and buildings) valued at constant prices ; the coefficients are estimated by least squares the time interval being a year. It is the author's opinion that the procedure is unsound. On a year-to-year basis capital stock cannot reflect falls in output due to economic causes, e.g. the dip in 1952 shown for the Industry. It would be quite otherwise if statistics of capital *in use* were available but they rarely if ever are. It is, of course, true that H, quantity of labour in use, is a more stable figure than output (see e.g. Chart 4) which is why labour productivity tends to rise and fall with quantum output ; H is, however, far more acceptable than K, as defined in the formula. The good fit of theory to data found for many countries during the inter-war period was due, in the author's opinion, to the protracted depression of 1929–35 in which every economic variable (including on this occasion, and quite exceptionally, capital stock K) declined and later recovered ; and this protracted dip was insufficiently corrected for in the regression by the time factor $exp\delta t$. Computations of the Cobb-Douglas kind involving fixed capital stock can rationally be based only on averages for terms of years when the assumption can be more or less justified that in the different periods on average the ratio of capital in use to capital stock is unchanged in all periods. That, on purely statistical grounds, the coefficients β and γ, considered as individual entities, are of dubious significance will be the subject of a communication elsewhere.

Apart from the fact that statistics of capital stock are not available in Ireland (and, though they are hard to get, these would be useful for many purposes other than construction of the production function) it seems profitable to use for K some measure of physical capital consumption, i.e. as used up in the production process. The most suitable available measure appeared to be consumption of fuel, light and power, a term abbreviated in the tables to " Fuel, etc.", i.e. it is assumed that capital consumption is proportional to fuel, etc. consumption. *

*It is not necessary to assume that fuel, etc., is a measure of capital consumption. The reader, if he wishes, can regard what follows as a study of the relation between man-hours and fuel, etc., on the one hand and net output volume on the other.

In CIP the various items (coal, electricity, etc.) are given as values only (without quantities) but from price data kindly supplied by CSO price indices were constructed (given in column (8) of Table 3) and used to deflate the current value totals to give fuel, etc., quanta, i.e. values at 1953 prices. In index number form the three series are graphed in Chart 4.

It will be evident from the chart that the whole period may be divided into two (i) 1946–52 and (ii) 1953–59 at which the Industry might be said to be operating at different levels. Both labour and fuel productivity increased markedly in the later sub-period as may be seen from a comparison of the ratios of the average indices of output to those of (*a*) labour hours and (*b*) fuel, etc. (see Table 4):—

	Sub-period	*Labour*	*Fuel, etc.*
(i)	1946–52	0·93	0·84
(ii)	1953–59	1·10	1·08

If we assign these ratios to the middle years of the sub-periods it may be stated that from 1949 to 1956, or in seven years, labour productivity increased by 18% (i.e. from 0·93 to 1·10) and fuel productivity by 29%.

One of the most striking features of Chart 4 is perhaps the constancy of labour hours in each of the two sub-periods, the more remarkable since this series was rather roughly computed as the product of average number of persons engaged throughout the year by average hours worked per wage-earner in four weeks in each year. These hours per person (as an index to base 1953 as 100—see column (7) of Table 4) averaged 99·0 in 1946–52, (with no decided trend) and 96·9 during 1953–59 (with a regular declining trend from 100 in 1953 to 95·4 in 1959).

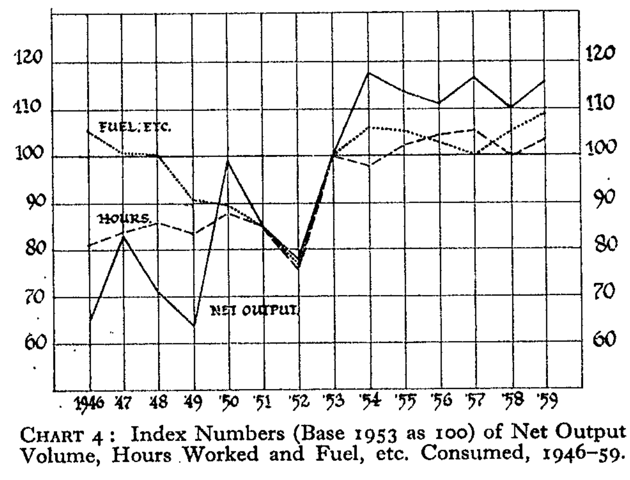

CHART 4: Index Numbers (Base 1953 as 100) of Net Output Volume, Hours Worked and Fuel, etc. Consumed, 1946–59.

The labour productivity showing of the Industry during the whole period is therefore less favourable when based on average *persons* rather than on average hours worked.

To return to the production function problem, a glance at Chart 4 will suffice to indicate that statistically satisfactory results are scarcely to be expected from these data. The irregular behaviour of the net output index in the period 1946–49 must raise doubts about the statistical quality of this series in this period—see section 4. At the same time the remarkable conjunction of the three groups in 1951–53 centering round the "bad" year 1952 is a point in favour of all three series; if, as one usually perforce does, one used either the materials, etc. or gross output volume series—see Table 4—the plunge in 1952 would be much greater: in fact the respective indexes are 62·4 and 66·8 compared with 78·6 for net output volume.

Taking logarithms of both sides of formula (8·1) and fitting by least squares to the data for the 14 years 1946–59 we find

$$(8{\cdot}2)\qquad q=\text{const}\times H^{\underset{(0\cdot62)}{1\cdot81}}\, K^{\underset{(0\cdot37)}{-0\cdot48}}\, e^{\underset{(0\cdot0124)}{0\cdot0113t}},\quad R^2=0{\cdot}8548,$$

where q is net output volume, H employee hours, K quantum of fuel, etc. (as a measure of capital consumption) and t is time (unit one year). The figures in brackets under the estimated coefficients are the estimated standard deviations. Only the exponent of H can be adjudged significantly different from zero; furthermore the negative exponent of K, and the fact that the sum of the exponents of H and K do not add to nearly unity as they dimensionally should, lead us to reject the right side of (8·2) as adequately representing the trend in net output volume q.

Let us try again with a model omitting K. The formula then becomes

$$(8{\cdot}3)\qquad q=\text{const}\times H^{\underset{(0\cdot42)}{1\cdot26}}\, e^{\underset{(0\cdot0106)}{0\cdot0198t}},\quad R^2=0{\cdot}8407.$$

Formula (8·3) is more satisfactory than (8·2), even if the coefficient of t is of doubtful significance, since, though it contains one variable less the value of R^2, the general regression squared, the measure of adequacy of fit, is nearly as large for (8·3) as for (8·2), despite the fact that (8·3) contains independent variable less. The actual data and those calculated using formula (8·3) are compared in Chart 5. The

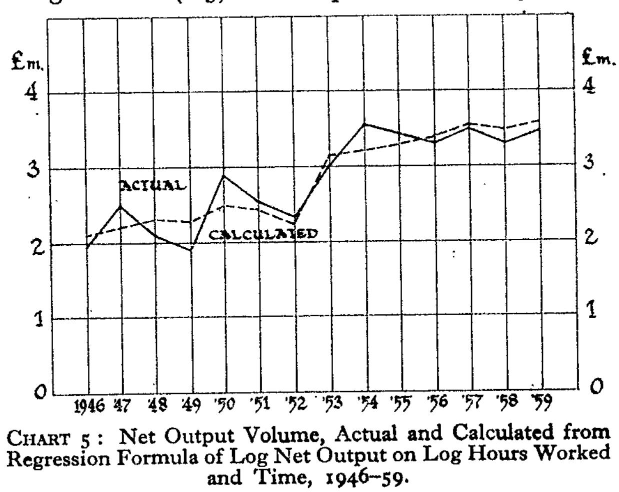

CHART 5: Net Output Volume, Actual and Calculated from Regression Formula of Log Net Output on Log Hours Worked and Time, 1946–59.

representation is as good as might be expected from relatively trendless data.*

The most important inference to be drawn from formula (8·3) is that during the period 1946–59 in the Industry a rise of one per cent. in hours worked occasioned a rise of 1·26 per cent. in quantum output.

It will be recalled that, mainly or perhaps entirely because it contains the eight firms which started production in the period 1950–59, the O group showed considerable growth during the period. It is accordingly proposed to compute a production function for this group. The three series, net output volume, hours worked and fuel, etc. volume are graphed (in index number form) in Chart 6. It will be seen that hours worked and fuel, etc. now move closely together but, since 1953, output rises more steeply than either. From the diagram alone we can infer that (*a*) residual production is going to show a satisfactory increase and (*b*) it will not be possible to establish a production function of form (8·1) above because of the closeness of relationship (the " colinearity ") between H and K. In fact we find that, the correlation between log H and log K when the effect of time t is eliminated (i.e. the partial correlation) is $r=0{\cdot}88$.

It may be stated at once that the estimates of the coefficients for the O group are as follows :

$$(8{\cdot}4)\qquad \begin{aligned}\beta&=0{\cdot}60\ \ (0{\cdot}41)\\ \gamma&=0{\cdot}26\ \ (0{\cdot}35)\\ \delta&=0{\cdot}032\ (0{\cdot}021)\end{aligned}$$

where the values in brackets are the estimated standard deviations. The β and γ coefficients " look " better than in the case of the whole Industry, in particular since the estimated ratio β/γ lies between 2 and 3, about the value found in many studies elsewhere during the inter-war period. Still the standard deviations indicate that the values found for these two coefficients cannot be regarded as significant for purposes of general inference. The value of δ, the coefficient for time must, on the other hand, be regarded as significant, despite its relatively large standard deviation, on commonsense grounds. Residual production for the O group of establishments was increasing at the rate of about 3% per annum during the period 1950–59.

Following are the results when log q for the O group is regressed on (log H, t) and (log K, t) separately

$$(8{\cdot}5)\qquad q=\text{const}\times H^{\underset{(0\cdot22)}{0\cdot86}}\, e^{\underset{(0\cdot022)}{0\cdot032t}},\ R^2=0{\cdot}9504$$

$$(8{\cdot}6)\qquad q=\text{const}\times K^{\underset{(0\cdot20)}{0\cdot70}}\, e^{\underset{(0\cdot021)}{0\cdot046t}},\ R^2=0{\cdot}9427.$$

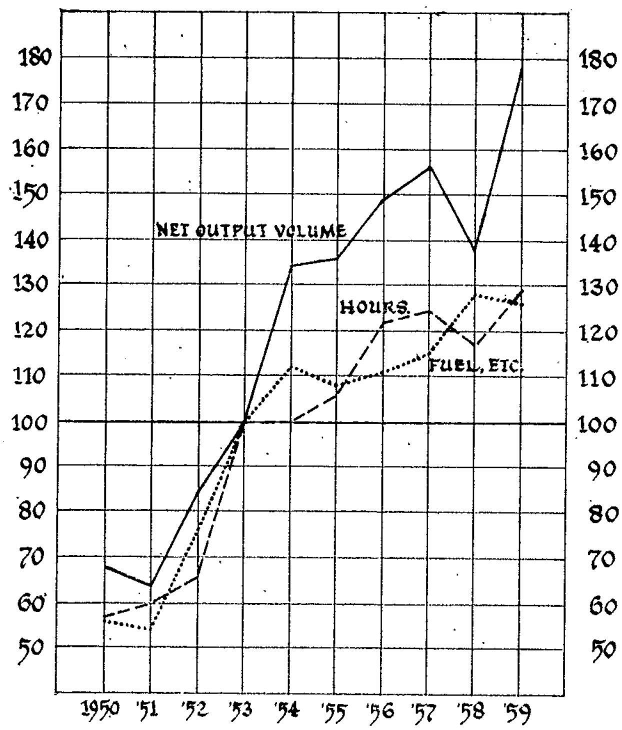

CHART 6 : Index Numbers (1953 as 100) of Net Output Volume, Hours Worked and Fuel, etc. for OTHER Establishments, 1950–59.

The value of R^2 indicates that both formulae afford an adequate fit of the observations, almost as good as where both H and K are used as independent variables with the added advantage that the coefficients of these variables are now seen to be highly significant. The actual data are compared with the two calculated series in Chart 7.

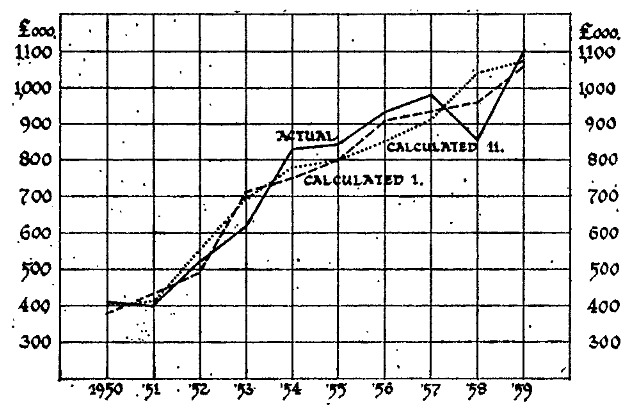

CHART 7 : Net Output Volume for OTHER Establishments, Actual and Calculated from Regression Formula of Log Net Output on I Log Hours and Time, II Log Fuel, etc. and Time, 1950–59.

11. Capital

It has proved extremely difficult in this country or in others to obtain reliable statistics on physical capital stock or on capital consumption. It has even proved difficult to define these concepts in other

*The von Neumann ratio is 2·45 indicating probable absence of serial correlation in the residuals. This test indicates that even if the fit (as measured by R^2) of the curve to the data is not particularly good, it satisfies one important test of adequacy.

than financial terms whereby capital is entered at value in year of initiation, subsequently written down over a more or less arbitrary term of years. The resulting balance sheet figure has little relation to assets of the firm if sold as a going concern, though sometimes it is the practice to revalue the assets for balance sheet purposes with a balancing item on the liabilities side. Many years ago CSO had a question (long since discontinued for reasons which will be obvious) on the CIP form "what is the capital value of your building, plant and machinery as written down for income tax purposes?" The author recalls being telephoned at the time by the secretary of a very large concern to inquire how this question should be answered. The official stated that the written-down value of assets was £25,000 but the estimated selling value was £500,000! What is really wanted is the value of the physical assets at constant prices, to be estimated as the various additions at the prices of one particular year less the value (similarly priced) of assets which have been sold or scrapped. It goes without saying that it is extremely difficult to give statistical effect to such a definition. It is equally certain that, in general, balance sheet entries are useless for functional analysis, in particular for the study of average or marginal relationships between net physical capital formation and net product of industry, a problem crucial for analysis of productivity in the wider sense, and industrial efficiency.

It will be useful to distinguish terminologically between the financial and physical concepts of capital consumption, the former may be called *amortization*, the latter *depreciation*. The difference between the two concepts can be illustrated by the case of a machine purchased in a given year and we may postulate no change in capital prices during its lifetime. Suppose further that labour costs of running the machine are negligible. During its lifetime (subject to reasonable costs of repair and maintenance—if these become excessive it will presumably be scrapped) it maintains the same output per time unit. Suppose its lifetime is ten years and that amortization is arithmetical. Its value is zero in the eleventh year so that its capital productivity becomes infinity after steadily increasing during its lifetime, which is absurd. From the depreciation point of view this machine should be maintained at its full price while it is working and disappear from the assets at one total when it no longer functions in the establishment. This treatment is accordant with the gross fixed capital concept. It is true that if assets were maintained in a large number of small units at a constant level with constant equal "births" and "deaths" this effect would be corrected for. Such a supposition is quite unreal. Granted the usefulness of financial accounts of the usual type (though with so much irritating variation in presentation and definition in practice) for purely financial purposes, surely the statistics of asset values and capital consumption are at least as important and should be produced, despite the admitted difficulties.

Following is an attempt to estimate the average depreciation ratio δ and the average capital-output ratio κ when the growth ratio ρ of product is known. These parameters are defined as follows. At constant prices in year t let

> Z_t=gross product*; Y_t=net product; G_t= gross fixed capital formation; D_t=fixed capital consumption (depreciation); I_t=net fixed capital formation; K_t=gross fixed capital stock at beginning of year.

Of these entities Z_t and G_t only are presumed measurable. Then, by definition,

$$(9{\cdot}1)\qquad \begin{aligned} Z_t &= Y_t + D_t \\ G_t &= I_t + D_t \\ I_t &= K_{t+1} - K_t \end{aligned}$$

It will now be assumed that the parameters κ and δ, to be defined presently, are constant (i.e. independent of time) during the period of inquiry (ten years in the case of the Industry). It is the author's belief that inferences of the kind developed here can be validly derived only on average over a term of years. Certain it is that incremental capital-output ratios based on individual year to year changes in capital and output yield nonsensical results.

With the constancy assumptions with regard to κ and δ we have by definition

$$\text{Capital-output ratio } \kappa = \frac{K_t}{Y_t} = \frac{K_{t+1}}{Y_{t+1}} = \frac{I_t}{Y_{t+1} - Y_t}$$

indicating that no distinction is made between average and incremental κ).

$$\text{Capital consumption ratio} = \delta = \frac{D_t}{K_t}$$

$$\text{Growth ratio of net product} = \rho = (Y_{t+1} - Y_t)/Y_t$$

From the assumed constancy of δ it is easy to show that

$$\rho = (Z_{t+1} - Z_t)/Z_t,$$

so that ρ is known. The problem is to estimate

*Not to be confused with gross output (see Table 1 etc.). The term has its national accounting meaning, i.e., gross product = employee compensation + profits + depreciation =added value + depreciation.

κ and δ from the G_t and Z_t. Using (9·1) and the definitions, we find

$$(9{\cdot}2) \qquad \frac{\kappa(\rho+\delta)}{1+\kappa\delta}=\frac{G_t}{Z_t}=\pi.$$

As already remarked, in this equation ρ, G_t and Z_t are presumed statistically measurable. Since this single equation contains two unknowns κ and δ neither can be determined without some assumption about the value of the other. Suppose, however, that data are available for two separate parts of the industry (or economic sector), in regard to each of which G and Z are known, and that it is plausible to assume that each part has the same capital-output ratio κ and capital consumption ratio δ. Let π_1 and π_2 represent the values of the ratio G_t/Z_t in the respective parts, and ρ_1 and ρ_2 the increase ratios. Then, from (9·2) and on setting

$$\kappa'=1/\kappa,$$

we find the two equations

$$(9{\cdot}3) \qquad \begin{aligned} \pi_1\kappa'-(1-\pi_1)\delta&=\rho_1 \\ \pi_2\kappa'-(1-\pi_2)\delta&=\rho_2 \end{aligned}$$

which, solved for κ' and δ, give

$$(9{\cdot}4) \qquad \begin{aligned} \delta&=(\rho_1\pi_2-\rho_2\pi_1)/(\pi_1-\pi_2) \\ \kappa'&=(\rho_1-\rho_2)/(\pi_1-\pi_2)-\delta \end{aligned}$$

Naturally we try to apply this theory to the Industry using as the two parts (i) the O establishments and (ii) the MS establishments. Fitting log gross product to linear time by least squares during the ten years 1950–59, the curves of closest fit are

$$(9{\cdot}5) \qquad \begin{aligned} &\text{O establishments: const}\times e^{0{\cdot}06456t} \\ &\text{MS establishments: const}\times e^{0{\cdot}00967t} \end{aligned}$$

so that the value of ρ_1 and ρ_2 are

$$(9{\cdot}6) \qquad \begin{aligned} \rho_1&=0{\cdot}06456 \\ \rho_2&=0{\cdot}00967 \end{aligned}$$

The value of ρ_2 perhaps cannot be regarded as significantly different from zero; nonetheless, since the purpose of this exercise is illustrative, the value shown will be taken. For Z and G average values $\overline{Z}$ and $\overline{G}$ during the decade are as follows:

		$\overline{Z}$=gross product £000	$\overline{G}$=gross fixed capital formation £000
	O establishments	564·0	175·7
(9·7)	MS establishments	1,862·0	179·5
	All establishments	2,426·0	355·2

when

$$(9{\cdot}8) \qquad \begin{aligned} \pi_1&=0{\cdot}31152 \\ \pi_2&=0{\cdot}09640 \end{aligned}$$

Inserting the values at (9·6) and (9·8) into (9·4) we find

$$(9{\cdot}9) \qquad \begin{aligned} \delta&=0{\cdot}01494 \\ \kappa'&=0{\cdot}24023 \\ \kappa=1/\kappa'&=4{\cdot}16 \end{aligned}$$

The values estimated for δ and κ are to be regarded as the average values ruling during the decade 1950–59. To estimate from these the annual average values of net product $\overline{Y}$, fixed capital stock $\overline{K}$, capital consumption $\overline{D}$ and net annual increment to capital stock $\overline{I}$, we have, from the foregoing definitions,

$$\begin{aligned} \overline{Y}&=(\overline{Z}-\overline{G})/(1-\kappa\rho) \\ \overline{K}&=\kappa\overline{Y} \\ \overline{I}&=\kappa\rho\overline{Y} \\ \overline{D}&=\overline{G}-\kappa\rho\overline{Y} \end{aligned}$$

Also the average value of ρ is obviously

$$\rho=(\overline{Z}_1\rho_1+\overline{Z}_2\rho_2)/(\overline{Z}_1+\overline{Z}_2)$$

Using the figures for All establishments for $\overline{Z}$ and $\overline{G}$ at (9·7), for δ and κ at (9·9) and with $\rho=0{\cdot}02245$ for All establishments during the period 1950–59 we find at constant (1953) prices

Net Product=Added value	$=\overline{Y}=$ £2,284,000
Fixed capital stock	$=\overline{K}=$ £9,501,000
Capital consumption	$=\overline{D}=$ £142,000
Net annual increment in capital stock value	$=\overline{I}=$ £213,000

Of course these results, like so many others in the paper, are presented merely as an exercise in methodology. Their accuracy depends on the accuracy of the estimates of the parameters δ, κ and ρ, as well as the data $\overline{Z}$ and $\overline{G}$.

The average value found for depreciation from the foregoing exercise is £142,000 which compares with an average of £208,000 derived from Table 5 by deflating item 8 by column (6) of Table 3. It was decided to adhere to the latter value for the purpose of Table 5 (and Table 6) since these figures were derived from genuine data, if of limited scope, whereas the theory in this section is still at the experimental stage. The discrepancy suggests, however, that the depreciation allowances used in the Irish national accounts, always regarded as too low (perhaps because of amortization bias in other countries) may be nearer than we thought to the real capital consumption figure.

It may appear that, despite the deficiencies in the data and the model (including the assumption that the parameters δ and κ are the same for both groups of the Industry when the O group contains all the establishments recently founded), the value of the capital-output ratio estimated, namely 4·2, is not implausible. On the other hand the estimate of δ, namely 0·015, must seem almost impossibly low, since our ideas on this subject are based on conventional amortization rates of 0·05, 0·10 and the like. It must be emphasised that δ, the depreciation ratio, has pretentions to reality; it pertains to the actual amount of fixed capital used up in a year in the production process. In this connection attention may be directed to the work of R. Krengel [3] who estimates that the lifetime of fixed capital assets in consumer goods industries in the German Federal Republic is 50 years for buildings and 33 years for equipment which together would imply a ratio δ of about 0·025. Furthermore, the Industry is of a rather undynamic type or, perhaps more correctly, in 1950–59 it was in an undynamic phase, so that, in the light of Krengel's showing, a rate of 0·02 might be appropriate, in excess, it is true, of the 0·015 found.

The author has had an expert's opinion that fixed capital in the O group (and therefore the value of gross capital formation in the Industry in Table 6) may have been over-estimated by as much as £350,000 during the decade. Furthermore dubiety attaches to the statistical quality of the gross product estimates on account of the profit constituent. Consequently the calculations were repeated using the annual average of £140,000 for gross fixed capital formation in the O group instead of the £175,700 shown above, and using net output instead of added value.

The values of the " known " parameters are then as follows :—

$$\rho_1=0{\cdot}05662\;;\quad \rho_2=0{\cdot}00516$$
$$\pi_1=0{\cdot}18667\;;\quad \pi_2=0{\cdot}07527$$

which, on substitution in (9·4), yield the values

$$\delta=0{\cdot}02957\;;\quad \kappa'=0{\cdot}43220\;;\quad \kappa=2{\cdot}3.$$

The parameter δ has now the value 0·03 which, in the light of the foregoing, may appear too large. The contrast of the 0·015 and the 0·03 shows that the method used here is sensitive to changes in the figures used for gross fixed capital formation. At the same time the method seems promising provided that reasonably accurate data are forthcoming to apply it to.

If one does not care to accept the capital consumption coefficients found for the Industry in the foregoing exercise and instead prefers to regard as given the value of δ, and if net output volume be preferred to gross product volume as statistically the sounder, following are the results for different conceivable values of δ, derived from the formula

$$\kappa'=\frac{\rho}{\pi}+\frac{(1-\pi)\delta}{\pi} \qquad (9{\cdot}10)$$

For All establishments the trend curve for net output volume in 1950–59 is

$$\text{const}\times e^{0.01653t} \qquad (9{\cdot}11)$$

The values of κ' and κ for All establishments and for the O group for a " reasonable " range of values of δ are then as follows : –

	κ'			κ		
δ	All	MS	O	All	MS	O
0·01	0·250	0·191	0·347	4·0	5·2	2·9
0·02	0·338	0·314	0·390	3·0	3·2	2·6
0·03	0·426	0·437	0·434	2·3	2·3	2·3
0·04	0·515	0·560	0·478	1·9	1·8	2·1

It will be borne in mind that the computations have been based on the net output (as distinct from the gross product=added value+depreciation) concept. The gross product approach, theoretically the more desirable, would have yielded lower values of κ' and, in consequence, higher values of the capital-output ratio κ. Within the limitations of the definitions and the theoretical model the figures in the MS column must be regarded as relatively the more reliable.

The technique of division of the Industry into two parts for the purpose of estimating average δ and κ from gross product and gross fixed capital formation records could be greatly improved if data for individual establishments were available. The model might then be

$$\pi_i\kappa' - (1-\pi_i)\delta - \rho_i = u_i, \; i=1, 2, \ldots, n$$

where n is the number of establishments, π_i the capital-product ratio and ρ_i the growth rate of product for establishment i, while u_i is a random variable with mean zero. The parameters κ' and δ would then be estimated by least square procedure. The resulting values would be regarded as the averages for the industry during the period of inquiry. This is also the character of the estimates produced in this section, found by splitting the Industry into two groups with different growth rates. Within the logic of the capital-output model used there are no obvious objections to the basic hypothesis that on average the parameters κ and δ apply to both groups (apart from individual random aberrations); and, as has been seen, the method yielded estimates which could be regarded as reasonable. If one were in a position to use the least squares methods the estimates would be more efficient, in the statistical sense.

12. Conclusion

The author ventures to commend favourably not only to industries but to individual establishments the use of the double deflation device for the assessment of labour productivity and industrial efficiency generally. This should be part of a general policy for firms to use their CIP and quarterly industrial production returns as a basis for their internal statistical systems. Such systems could be set up at negligible cost. In conversation, industrialists have often informed the author that they have their own bell-wethers for deciding how things are going and the author has not always been able to refrain from pointing out (as perhaps in politeness he should) that these were always inadequate and usually misleading. Any statistical system designed as a base for wise policy decisions should be simple, comprehensive yet not too detailed; for the mind cannot encompass too much detail, though recourse must be had to detail in studying why particular aggregates behave in the way they do.

A case has been made earlier in the paper for industrialists to have close regard to the trend in various aggregates in quantum (or constant price) terms. Of these the most revealing is added value at constant prices. To derive this, all management has to do is to add a column to the output and input sections of the CIP form (to which the full list of "supplementary costs" should be restored) showing for each item (in addition to current value already provided for) what the value would be *at last year's prices*. Added value for current year at last year's prices is then ascertainable for comparison with the actual corresponding figure for the previous year. In conjunction with total labour hours for the two years the change in labour productivity is immediately ascertainable. If this exercise is carried out each year there will be no difficulty in linking the records to obtain the trend over an extended period. Thus the CIP and quarterly returns which are costly and troublesome to prepare will surely become of direct value to the firms who compile them. And, may a statistician add, their statistical quality and promptitude will be improved when the returns are seen to be useful for prudent management; and there is much room for improvement in these respects.

The philosophy underlying the form of accounts presented in Table 5 is a simple one, namely that all in the Industry, shareholders, management and workpeople, are in the same boat: their welfare is bound up with the prosperity of the Industry. There is increasing recognition in Irish industry that the notion that there are two "sides" within the industry or firm, a kind of artificial split right across all the elements of industry, is anachronistic nonsense, inimical to industrial development. Management's function is to increase the two constituents of factor income, employee compensation and profits, and, in point of size, employee compensation is by far the more important, as the figures in the tables so clearly show. It is an important part of management's business to see that employee compensation is as large as possible, consistent with capital's being adequately rewarded, and this attitude should be made manifest to workpeople. This is not only ethically sound but it is good business, since obviously all staff members will work harder and more skilfully when they are convinced that their improved efforts will be reflected in their pay packets.

The author can see no good reason why accounts on the lines of Table 5 should not be frankly discussed between representatives of management and staff even at the firm level. The only objection might be the danger of leaks of such confidential information to rival firms. But it could surely be argued that representatives of staff would be as well aware as management of the inimical effects of such leaks to their own interests and so their discretion could be relied on. Entire frankness with workpeople not only as regards past records, but also as to future prospects, has almost everything to commend it. If the slack of worker disinterest and detachment could be substantially reduced there would be a notable increment in productivity, even with existing capital equipment.

It is not argued that some magic formula for the automatic regulation of earnings emerges from tables of the kind displayed in this paper. What the author believes to be true is that agreements as to the division of factor income after tax into its constituents employee compensation, dividends and reserves (and, in particular, reserve policy, if any, is at present chaotic) is brought very much nearer than would otherwise be the case. Exaggerated claims will be seen to be unrealistic ; in time, with the increase in mutual trust, margins in dispute may become small, but humanly speaking they never can be entirely eliminated.

In the past there have been fashions in the basis of claim of workpeople (very largely shared—or at least tactily accepted—by employers) to increased wages. First came escalation, regulation of wages by a consumer price index ; then came the " fair " division of factor income ; and now labour productivity is all the rage. At all times there were variations on more than one of these themes at the same time for very naturally the trade union case was an *ex parte* one, the arguments chosen at any time being those most apt to the occasion. There is, of course, a great deal to be said in favour of all bases ; in fact all three should be used as well as others to form a synthesis of the situation facing the industry or the firm.

This is what has been attempted in Tables 5 and 6. In Table 6 all the items are expressed in constant prices so that the picture presented is a quantum or " real " one. The factors mentioned in the previous paragraph, as well as others, are implicitly revealed in these tables. Thus the real Consumption items (2 or 6 in Table 6) are derived from the current values in Table 5 (sum of items 6, 7, 10) by deflating the latter by the consumer price index ; the division of factor income into its constituents is derivable from Table 5 ; and the best measure of labour productivity is real factor income (item 1 in Table 6 less item 8 of Table 5 deflated by a capital goods index—column (6) of Table 3) divided by labour hours—column (8) of Table 4.

Curiously enough one rarely hears nowadays of the oldest economic precept " buy in the cheapest market and sell in the dearest ", possibly because, until recently, it has proved impracticable to measure with any degree of precision the quantum effect of the difference between prices of goods bought and sold, i.e. the quantum effect of the price differential in isolation. This is the item 9 (or 14) of Table 6 ; and it has been seen that in the case of the Industry under review this phenomenon is much larger than productivity in effect on changes from year to year in real gross product. Perhaps, as suggested earlier, there is a fatalistic element in management's attitude : " there is little we can do to influence prices ". This is true in the main but the " little " is very well worth achieving. Especially in an Industry in which added value is a relatively small proportion of gross output even a very small improvement in the price differential (through skilled salesmanship, attention to packaging and design, etc. as applied to products) can effect a disproportionately large increase in added value, to the benefit of shareholders and workpeople. There is much more to efficiency than labour productivity.

It is customary for the analyst to adimadvert on statistical inadequacy and the present author will not be an exception to the rule. His viewpoint will be different from the usual one which implies how much better the paper would be if the basic statistics were more voluminous and more accurate. He has emphasised that most of the statistics in the paper are not to be taken too seriously as such : this is designed as an essay in the *kind* of statistics which should be produced and how they should be prepared for analysis. It is now up to the CSO, economists, industrialists and their advisers to criticise the presentation. In general, is this the kind of thing that is needed ? And, if so, what modifications should be imparted to the system ?

This country may be justly proud of its industrial statistics as of wider scope and longer range in time than for the great majority of other countries. As stated in section 4, there can be no doubt about the usefulness of the system for broad general conclusions, as showing trends of gross output, numbers engaged, wages and salaries and the like. When the figures are submitted to more intensive analysis, however, such as trying to derive added value by using the double deflation method one must have doubts about the accuracy of the figures. The author should in fairness add that the same defects have been found in these statistics put to the use indicated in other countries, but this does not make the fact less reprehensible. He should also add that, while there is undoubtedly scope for improvement, the Woollen and Worsted Industry emerges with more credit than most Irish industries in the matter of reliability. As the author was associated for many years with the production of these statistics he is in a position to state that the CSO is not at fault in this matter. The Office has done everything it can, pressing querying, reminders, prosecutions for non-response and all the rest to the limits of practicability but these limits are restricted on account of cost and because, as they do not realise the importance of these returns, industrialists are prone to regard pressure to improve, beyond narrow bounds, as harassment. The Office has used every instrument at its disposal to improve the time schedule of the annual and quarterly returns but, in the past, even public appeals by the Taoiseach have fallen on deaf industrial ears. The author would venture to make five suggestions to CSO :—

(1) Publish figures not only for average numbers engaged but for hours worked.

(2) (*a*) Restore the full Supplementary Costs part of the schedule suspended in 1950 and (*b*) take steps to ensure that the final balance is equal to profit before tax.

(3) Obtain systematically statistics of new fixed gross capital formation, i.e. of capital formed even prior to production, under the present headings.

(4) Pursue inquiries, even on a voluntary sample basis, with a view to ascertainment of gross fixed capital stock at current and fixed (e.g. 1953) prices.

(5) Also on a voluntary basis try to induce a sizeable number of large firms to supply CIP details of current year's gross output and of non-factor costs at previous year's prices with a view to ascertainment of current year's added value at previous year's prices, from capital-consuming industries. In the Irish national accounts full account is taken of gross fixed capital formation since these statistics are derived from capital-producting industries and external trade statistics. From producting sources, however, it is not possible to derive a detailed industrial classification of capital formation (including initial capital formation) which is very much to be desired.

Of these (1), (2) (*a*) and (3) should be easy. As to (2) (*b*), presentations on the lines of Tables 5 and 6 will not be adequate without building profits into the picture. The proposal at (4) is designed as an end in itself (how is the capital structure of the country growing, industry-wise ?) and also for the study of productivity in the wider sense : factors of production include capital as well as labour ; productivity defined as product per factor unit [4] is a more correct measure of productivity than product per man hour (labour productivity) ; and fixed capital data are required for studies in labour-capital substitution. The figures should be gross in the sense that no allowance should be made for depreciation, i.e., all items, buildings, plant and machinery in use or in reserve should be valued at original cost showing year of purchase and these values brought to the required year by the use of appropriate price index numbers.

There can be no doubt whatever that during the past few years the wind of change has been blowing across the perhaps complacent attitudes of Irish industrialists, reflected in a welcome increase in output and a concern about productivity and industrial efficiency. As well there might, for in a short term of years the signs are that Irish industry is to be exposed to the full blast of European competition. Unfortunately there is as yet no indication of much interest in the economics of the firm or the industry. For a proper study of these aspects, the creation of a statistical system within the firm is essential and, as suggested above, the CIP and quarterly returns would form an ideal basis for such a system. How otherwise can the firm know if in respect of individual products or for total output, the firm is advancing or losing ground compared with the Industry as a whole ; how can the firm otherwise adapt itself most profitably to change with the least delay by shedding bad selling lines and adopting more profitable ones ? How can the firm judge whether its productivity is advancing satisfactorily when it maintains no comprehensive measure of productivity ?

TABLE I : GROSS OUTPUT, ETC., AT CURRENT VALUES AND AVERAGE NUMBER OF PERSONS ENGAGED

Year (1)	Gross Output (2)	Materials, etc. (3)	Net Output (4)	Wages and salaries (5)	Remainder of net output (6)	Fuel, etc. (7)	Average No. of persons engaged (8)
				All establishments			
	£000	£000	£000	£000	£000	£000	
1946 ...	4,458	2,871	1,587	779	808	174	4,535
1947 ...	5,059	3,266	1,793	957	836	224	4,855
1948 ...	6,006	4,064	1,942	1,029	913	188	4,875
1949 ...	6,151	4,387	1,764	1,015	749	166	4,694
1950 ...	7,868	5,687	2,181	1,096	1,085	170	4,923
1951 ...	10,140	7,954	2,186	1,159	1,027	194	4,901
1952 ...	7,062	5,570	1,492	1,044	448	195	4,341
1953 ...	11,104	8,109	2,995	1,488	1,507	238	5,614
1954 ...	11,372	8,372	3,000	1,567	1,433	250	5,557
1955 ...	11,473	8,303	3,170	1,664	1,506	254	5,793
1956 ...	11,847	8,142	3,705	1,864	1,841	274	6,014
1957 ...	12,906	9,573	3,333	1,950	1,383	308	6,143
1958 ...	12,205	8,635	3,570	2,016	1,554	292	6,046
1959 ...	11,894	7,991	3,903	2,082	1,821	290	6,042
				Matched Sample establishments			
1950 ...	7,078	5,197	1,881	955	926	144	4,274
1951 ...	9,037	7,219	1,818	994	824	164	4,194
1952 ...	5,915	4,819	1,096	840	256	148	3,568
1953 ...	9,093	6,721	2,372	1,167	1,205	180	4,471
1954 ...	9,377	7,123	2,254	1,223	1,031	186	4,401
1955 ...	9,470	7,106	2,364	1,291	1,073	191	4,561
1956 ...	9,463	6,745	2,718	1,406	1,312	202	4,586
1957 ...	10,387	8,014	2,373	1,461	912	222	4,656
1958 ...	9,666	7,017	2,649	1,503	1,146	205	4,607
1959 ...	9,039	6,326	2,713	1,521	1,192	208	4,503
				Other establishments			
1950 ...	790	490	300	141	159	26·0	649
1951 ...	1,103	735	368	165	203	30·1	707
1952 ...	1,147	751	396	204	192	47·4	773
1953 ...	2,011	1,388	623	321	302	58·1	1,143
1954 ...	1,995	1,249	746	344	402	64·2	1,156
1955 ...	2,003	1,197	806	373	433	63·4	1,232
1956 ...	2,384	1,397	987	458	529	72·2	1,428
1957 ...	2,519	1,559	960	489	471	86·2	1,487
1958 ...	2,539	1,618	921	513	408	87·4	1,439
1959 ...	2,855	1,665	1,190	561	629	82·2	1,539

Notes to Table 1

All figures derived from CIP, published in ITJSB. In certain years up to and including 1953 when changes in coverage were recorded, original figures were proportionately amended by single year linkage.

The Matched Sample (MS) series are those for a particular thirty firms founded before 1950, for which statistics in aggregate were furnished by CSO. Other establishments (O) include amongst others the eight firms started during the years 1950–59. Figures in col. (5) differ slightly from those published in ITJSB in that former include small amounts in respect of pensions and contributions to pension funds.

TABLE 2: GROSS OUTPUT, ETC., AT CONSTANT (1953) PRICES

£000

Year (1)	Gross Output (2)	Materials, etc. (3)	Net Output (4)	Real earnings (5)
	All establishments			
1946	8,850	6,921	1,929	1,067
1947	9,772	7,272	2,500	1,240
1948	9,938	7,800	2,138	1,293
1949	9,239	7,322	1,917	1,272
1950	10,638	7,705	2,933	1,353
1951	9,705	7,139	2,566	1,326
1952	7,417	5,064	2,353	1,103
1953	11,104	8,109	2,995	1,488
1954	11,526	7,989	3,537	1,564
1955	11,748	8,342	3,406	1,622
1956	11,759	8,435	3,324	1,739
1957	12,581	9,085	3,496	1,744
1958	12,114	8,837	3,277	1,729
1959	12,359	8,899	3,460	1,786
	Matched Sample establishments			
1950	9,565	7,042	2,523	1,180
1951	8,648	6,480	2,168	1,138
1952	6,213	4,381	1,832	887
1953	9,093	6,721	2,372	1,167
1954	9,501	6,797	2,704	1,220
1955	9,703	7,142	2,561	1,258
1956	9,388	6,990	2,398	1,312
1957	10,124	7,603	2,521	1,307
1958	9,599	7,182	2,417	1,289
1959	9,396	7,045	2,351	1,304
	Other establishments			
1950	1,073	663	410	173
1951	1,057	659	398	188
1952	1,204	683	521	216
1953	2,011	1,388	623	321
1954	2,025	1,192	833	344
1955	2,045	1,200	845	364
1956	2,371	1,445	926	427
1957	2,457	1,482	975	437
1958	2,515	1,655	860	440
1959	2,963	1,854	1,109	482

Notes to Table 2

Col. (2): Figures for All establishments derived by raising actual figure for 1953 proportional to official CSO annual gross volume output indexes—col. (2) of Table 4. Figures for MS establishments found by deflating current values in Table 1 by the derived price indexes in Table 3. Figures for O establishments found as differences between All and MS.

Col. (3): Figures in col. (3) of Table 1 deflated by price index in Table 3, col. (3).

Col. (4): Difference between cols. (2) and (3).

Col. (5): Figures in col. (5), Table 1 deflated by official general consumer price index—col. (5), Table 3.

For the record, the statistics of fixed capital formation (purchases less sales) for the 30 MS establishments were as follows (£000):—

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
At current prices	222	205	177	178	282	157	168	165	105	159
At constant (1953) prices ..	247	217	176	178	285	155	157	147	93	141

The increase in manpower (col. (8), Table 1) though with some decreases in hours per person/week (see col. (7), Table 4), the decline in fixed capital formation (second line above) on the one hand and the more or less constant net output volume (see col. (4), Table 2) indicates some tendency towards substitution of labour for capital in the MS group during the decade.

TABLE 3: PRICE INDEX NUMBERS, ALL ESTABLISHMENTS

Base Year 1953 as 100

Year (1)	Gross Output (2)	Materials, etc. (3)	Net Output (4)	Consumer goods (general) (5)	Capital goods (general) (6)	Goods at wholesale (general) (7)	Fuel, etc. (8)
1946 ...	50·3	41·4	82·3	73·0	71·4	66·0	69·3
1947 ...	51·8	44·9	71·7	77·2	82·8	73·4	93·5
1948 ...	60·4	52·1	90·8	79·6	89·8	77·6	78·6
1949 ...	66·6	59·9	92·0	79·8	88·8	77·3	76·9
1950 ...	74·0	73·8	74·4	81·0	90·1	81·6	79·8
1951 ...	104·5	111·4	85·2	87·4	94·3	94·5	95·7
1952 ...	95·2	110·0	63·4	95·0	100·4	99·8	107·0
1953 ...	100	100	100	100	100	100	100
1954 ...	98·7	104·8	84·8	100·2	98·7	98·6	98·9
1955 ...	97·6	99·5	93·1	102·6	101·5	101·6	100·8
1956 ...	100·8	96·5	111·5	107·2	107·4	103·1	112·5
1957 ...	102·6	105·4	95·3	111·8	112·0	109·9	129·2
1958 ...	100·7	97·7	108·9	116·6	113·6	113·5	116·4
1959 ...	96·2	89·8	112·8	116·6	113·3	113·5	112·2

Notes to Table 3

General. Though described as " price index numbers ", all series, except the consumer price index (col. (5)) are unit value indexes or contain unit value constituents. Figures in cols. (5), (6), (7) are " general " in the sense that they relate to the whole economy and not specifically to the Industry. This year to year Fisher formula was used in the computation of cols. (2) (CSO), (3) and (8) (ERI).

Col. (2): Quotient (×100) of cols. (2) in Tables 1 and 2.

Col. (3): Unit value series constructed in the ERI by the link relative method as regards the largest constituent, the ingredients for which value and quantity were both given in the official reports in ITJSB. Special price indexes were constructed for (i) the value in each sector of ingredients for which value only was furnished using appropriate CSO wholesale price indexes, (ii) work in progress, (iii) fuel, etc., and (iv) work done on commission, to cover "materials, etc." as a whole. Constant price series were constructed for each of the constituents, the aggregate giving the constant price series for materials. The quotient (×100) of the current value series by the constant price series yielded the price indexes shown.

Col. (4): Quotient (×100) of cols. (4) in Tables 1 and 2.

Col. (5): *Source:* ITJSB.

Col. (6): *Source:* National Income and Expenditure series, compiled by CSO.

Col. (7): *Source: Statistical Abstract.* This index, which receives only passing reference in the text, has been included to enable comparison to be made with trend of indexes in cols. (2) and (3).

Col. (8): Computed in ERI from general price and unit value data supplied by CSO. The index was computed on the link-relative principle using value weights for principal constituent items for the Industry derived from CIP.

TABLE 4: QUANTUM INDEX NUMBERS. ALL ESTABLISHMENTS

Year (1)	Gross Output (2)	Materials, etc. (3)	Net Output (4)	Real earnings (5)	Persons engaged (6)	Hours person/ week (7)	Total hours (8)	Net output/ hour (9)	Real earnings/ hour (10)	Fuel, etc. (11)
1946	79·7	85·3	64·4	71·7	80·8	100·5	81·2	79·3	88·3	105·6
1947	88·0	89·7	83·5	83·3	86·5	97·6	84·4	98·9	98·7	100·7
1948	89·5	96·2	71·4	86·9	86·8	99·0	85·9	83·1	101·2	100·3
1949	83·2	90·3	64·0	85·5	83·6	100·0	83·6	76·6	102·3	90·4
1950	95·8	95·0	97·9	90·9	87·7	100·1	87·8	111·5	103·5	89·5
1951	87·4	88·0	85·7	89·1	87·3	97·1	84·8	101·1	105·1	84·9
1952	66·8	62·4	78·6	74·1	77·3	98·4	76·1	103·3	97·4	76·3
1953	100	100	100	100	100	100	100	100	100	100
1954	103·8	98·5	118·1	105·1	99·0	98·8	97·8	120·8	107·5	106·2
1955	105·8	102·9	113·7	109·0	103·2	98·5	101·7	111·8	107·2	105·7
1956	105·9	104·0	111·0	116·9	107·1	97·2	104·1	106·6	112·3	102·3
1957	113·3	112·0	116·7	117·2	109·4	95·6	104·6	111·6	112·0	100·1
1958	109·1	109·0	109·4	116·2	107·7	92·7	99·8	109·6	116·4	105·1
1959	111·3	109·7	115·5	120·0	107·6	95·4	102·7	112·5	116·8	108·6

Notes to Table 4

Cols. (2), (3), (4), (5): Derived from corresponding columns in Table 2, for All establishments.

Col. (6): Derived from col. (8) in Table 1 for All establishments.

Col. (7): For 1950 on, based on sample averages of hours of work for a week in each quarter published in ITJSB. For 1946-1950, on hours worked in a week in October of each year.

Col. (8): (6) × (7)/100.

Col. (9): (4) × 100/(8).

Col. (10): (5) × 100/(8).

Col. (11): Based on values at current prices deflated by col. (8) of Table 3.

TABLE 5: FOUR ARTICULATED ACCOUNTS AT CURRENT PRICES, 1950–59

£000

Item	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
	I.—Production and Appropriation Account									
1 Materials, etc. (=19) ...	5,687	7,954	5,570	8,109	8,372	8,303	8,142	9,573	8,635	7,991
2 Other costs (except employee compensation and depreciation) (=20) ...	611	581	566	787	712	713	921	708	778	857
Disposable income—										
3 Employee compensation (=12*) ...	1,042	1,104	995	1,416	1,492	1,584	1,776	1,857	1,919	1,983
Employer—										
4 Distributed profit (=12*) ...	93	85	50	132	102	92	124	79	94	159
5 Undistributed profit (=16)	134	123	−218	230	180	212	221	158	168	172
Taxes—										
6 Employee (=23*) ...	54	55	49	72	75	80	88	93	97	99
7 Employer (=23*) ...	142	135	—	145	217	232	262	199	219	241
8 Depreciation (=15) ...	105	103	50	213	222	257	313	239	295	392
9 Gross output=input (=18)	7,868	10,140	7,062	11,104	11,372	11,473	11,847	12,906	12,205	11,894
	II.—Household Account									
10 Personal Consumption (=21)	1,060	1,110	982	1,446	1,490	1,567	1,776	1,811	1,883	2,001
11 Personal saving (=17)	75	79	63	102	104	109	124	125	130	141
12 Disposable income (=3+4)	1,135	1,189	1,045	1,548	1,594	1,676	1,900	1,936	2,013	2,142
	III.—Capital Account									
13 Gross capital formation (=22)	291	614	124	1,561	823	−196	782	970	−599	651
14 Net external investment (=24)	23	−309	−229	−1,016	−317	774	−124	−448	1,192	54
TOTAL	314	305	−105	545	506	578	658	522	593	705
15 Depreciation (=8) ...	105	103	50	213	222	257	313	239	295	392
Saving—										
16 Undistributed profit (=5)	134	123	−218	230	180	212	221	158	168	172
17 Personal (=11) ...	75	79	63	102	104	109	124	125	130	141
TOTAL	314	305	−105	545	506	578	658	522	593	705
	IV.—External Account									
18 Gross output (=9) ...	7,868	10,140	7,062	11,104	11,372	11,473	11,847	12,906	12,205	11,894
19 Materials, etc. (=1) ...	5,687	7,954	5,570	8,109	8,372	8,303	8,142	9,573	8,635	7,991
20 Other costs (=2) ...	611	581	566	787	712	713	921	708	778	857
21 Personal consumption (=10)	1,060	1,110	982	1,446	1,490	1,567	1,776	1,811	1,883	2,001
22 Gross capital formation (=13)	291	614	124	1,561	823	−196	782	970	−599	651
23 Taxes (=6+7) ...	196	190	49	217	292	312	350	292	316	340
24 Net external investment (=14)	23	−309	−229	−1,016	−317	774	−124	−448	1,192	54

*Part.

Notes to Table 5

General. Most of the figures in this table are to be regarded as merely rough approximations. The table is mainly designed as an experimental model. For its construction all firms in the Industry are treated as if they were corporations, i.e., capable of distributing dividends and of making allocations to reserve. Gross profit and its constituents, tax, dividend, depreciation and reserve, were estimated by applying to remainder of net output percentages derived from the summary available to the author for a few corporations in the Industry (covering about 25% of the output of all establishments), for the years 1953, 1956 and 1959.

The amounts shown for Item 2 seem overstated by reference to total of " Supplementary Costs " last published for 1950. Accordingly profit totals (Items 4+5+7) may be understated. The author does not attempt to correct the figures since no sound basis for doing so is available to him.

The four accounts are compiled according to double entry principles. Cross references of items are shown.

Item 1: Col. (3) of Table 1.

Item 2: Residual in Account I. See General note above.

Item 3: Together with Item 6 equals col. (5) of Table 1.

Items 4, 5, 7, 8: See General note above.

Item 6: Employee taxation at a uniform 5% of income.

Item 10: Residual in Account II.

Item 11: Uniformly 6% on employee compensation (before tax) and 10% on dividends.

Item 13: Source CPI together with very rough estimates of " new " fixed capital formation for firms starting after 1950. Constituents are as follows (£000) :—

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
(*a*) Gross fixed capital formation	250	378	571	525	505	197	471	234	186	297
(*b*) Additions to stock ...	41	236	−447	1,036	318	−393	311	736	−785	354

Item 24: Balance item. " External " means external to the Industry regarded as a sector.

TABLE 6. FOUR ARTICULATED ACCOUNTS AT CONSTANT (1953) PRICES, 1950–59

£000

Item	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
					I—PRODUCT ACCOUNT					
1 Gross product (=8) ...	2,179	1,901	1,755	2,208	2,827	2,710	2,465	2,863	2,627	2,725
2 Consumption (=6) ...	1,551	1,487	1,089	1,663	1,778	1,831	1,983	1,881	1,886	2,008
3 Gross capital formation (=10)	332	617	137	1,561	822	−206	759	923	−642	654
4 Exports (=13) ...	10,638	9,705	7,417	11,104	11,526	11,748	11,759	12,581	12,114	12,359
5 Imports (minus) (= −15)	−10,342	−9,908	−6,888	−12,120	−11,299	−10,663	−12,036	−12,522	−10,731	−12,296
					II—CONSUMPTION ACCOUNT					
6 Consumption (=2) ...	1,551	1,487	1,089	1,663	1,778	1,831	1,983	1,881	1,886	2,008
7 Gross saving (=12) ...	363	323	−91	545	508	576	635	495	528	710
TOTAL	1,914	1,810	998	2,208	2,286	2,407	2,618	2,376	2,414	2,718
8 Gross product (=1) ...	2,179	1,901	1,755	2,208	2,827	2,710	2,465	2,863	2,627	2,725
9 Trading gain (=14) ...	−265	−91	−757	—	−541	−303	153	−487	−213	−7
TOTAL	1,914	1,810	998	2,208	2,286	2,407	2,618	2,376	2,414	2,718
					III—CAPITAL ACCOUNT					
10 Gross capital formation (=3)	332	617	137	1,561	822	−206	759	923	−642	654
11 External investment (=16)	31	−294	−228	−1,016	−314	782	−124	−428	1,170	56
12 Gross saving (=8) ...	363	323	−91	545	508	576	635	495	528	710
					IV—EXTERNAL ACCOUNT					
13 Exports (=4)	10,638	9,705	7,417	11,104	11,526	11,748	11,759	12,581	12,114	12,359
14 Trading gain (=6) ...	−265	−91	−757	—	−541	−303	153	−487	−213	−7
	10,373	9,614	6,660	11,104	10,985	11,445	11,912	12,094	11,901	12,352
15 Imports (= −5) ...	10,342	9,908	6,888	12,120	11,299	10,663	12,036	12,522	10,731	12,296
16 External investment (=11)	31	−294	−228	−1,016	−314	782	−124	−428	1,170	56
TOTAL	10,373	9,614	6,660	11,104	10,985	11,445	11,912	12,094	11,901	12,352

Notes to Table 6.

General. For the *rationale* of this table see section 8 of text of paper. Compiled on national income accounting principles but at constant prices, it is based on items in Table 5 suitably deflated but with items re-combined as indicated below. Item-wise reconciliation between Tables 5 and 6 can most easily be effected by reference to the figures for the base year 1953, since in that year deflated and current figures are identical. Terms " exports " and " imports " are to be interpreted in relation to the sector, not to the country as a whole.

Item 1: The sum of Items 2, 3, 4 and 5, equals Item 9 less sum of Items 1, 2 in Table 5, deflated.

Item 2: Includes general government as well as private consumption taken as the sum of Items 6, 7, 10 in Table 5 deflated by the general CPI (col. (5) of Table 3).

Item 3: Constituents are as follows (£000):—

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
(*a*) Gross fixed capital formation	277	401	569	525	512	194	439	209	164	262
(*b*) Additions to stock ...	55	216	−432	1,036	310	−400	320	714	−806	392

Sub-item (*a*) is found by deflating (*a*) of note on Item 2 to Table 5 by col. (6) of Table 3; (*b*) is the deflated value of sub-item (*b*) of the same note.

Item 4: Col. (2) of Table 2 for All.

Item 5: Items 19 to 23 inclusive in Table 5 deflated. The principal constituent is Materials, etc. (col. (3) of Table 2) for All; for other non-factor costs plus personal consumption plus taxes deflator was CPI (col. (5) of Table 3).

Item 7: Residual in Account II

Item 9: See note on Item 14.

Item 11: See note on Item 16.

Item 14: Balancing item in Account IV.

Item 16: Item 24 in Table 5 deflated by $\frac{1}{2}(P_E+P_M)$ where P_E and P_M are respectively the import and export price index numbers for the sector. These index numbers were derived from Accounts IV of Tables 5 and 6 as the quotients of current values by deflated values.

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