

STATISTICAL AND SOCIAL INQUIRY SOCIETY OF IRELAND.

SOME THOUGHTS ON THE MAKING OF IRISH INDEX NUMBERS.

By R. C. GEARY, D.Sc.

(*Read on Friday, 27th October, 1944.*)

Ireland now possesses a fairly full range of price and quantum index numbers¹ which is not to say that they cannot be improved or their range extended. One of the prime objects of the present paper is, in fact, to invite this learned Society (which is better qualified than any other body in the country to do so) to discuss the principles and manner of computation of the new wholesale price index number, prior to its official promulgation. I should explain further that my object is not to discuss the economic trends indicated by these various series. The paper deals almost exclusively with certain methodological aspects of the construction of index numbers: it is hoped, however, that some of the figures quoted illustratively may be found to have an interest in themselves.

The treatment in the textbooks of the technique of index number making is not entirely satisfactory, for reasons which do not reflect on the excellent authors: the fact is that the subject does not lend itself readily to textbook treatment, at least in its present stage of development. The mathematical problem of making index numbers is rudimentary to the point of non-existence, though some work has been done on the problem regarded as a branch of sampling theory. The problems involved in the construction of index numbers are largely those of economics; but economists have not shown sufficient interest in the subject in the past, though, as will appear, some honourable amends are being made in the present. The fact that experience is an essential qualification in the making of index numbers militates against textbook treatment: it is hard to lay down rules in the first instance, except of the most general character, so general that they are but rarely susceptible of particular application. At the present time, especially, this is true. With changes in the quantitative pattern of production and consumption involving problems of weighting, substitution of one series for another, changes in quality of goods for which price quotations are received, etc., no general principles can be adhered to: each problem which arises must be dealt with on its merits. One finds oneself constantly saying to one's collaborators: "Do so and so but do not regard this as a precedent".

Irish practice favours the use of the "weighted aggregative" type of formula which in broad principle envisages the index numbers as the trend of the total cost of certain fixed quantities of different products, expressed as a percentage of the value in the base period. Probably the principal reason why this formula finds acceptance amongst official statisticians the world over is its comprehensibility by the general public. The tendency was accentuated in Ireland by the fact that the first official price index number produced was the cost-of-

¹ See synoptic Table 1.

living figure, in the computation of which the formula is invariably used: these index numbers are widely used in normal times for the regulation of wages and salaries of civil servants and other classes. It is obvious that a figure which so vitally affects the interests of a large number of persons should command full confidence, and such confidence can derive only from understanding the computation. The well-known legal maxim applies in this, as it should apply to other official statistics: "It is important not only that justice should be done but that it should appear to be done". The invariable experience in the Statistics Branch has been that the method has been regarded as "fair and reasonable" by interested persons when the process was described to them in detail.

Much controversy has raged around the question of the best formula to use in the construction of index numbers. For the assessment of the average increase in prices between two intervals, in each of which both prices and quantities are available for each commodity, most statisticians favour Professor Fisher's formula,¹ rather unfortunately named the "Ideal", a term unsuitable for a statistical concept. This formula is used in Ireland for the computation of import, export and industrial production indices. The formula is

$$\begin{aligned} P &= 100 \sqrt{P_0 \times P_1} \\ P_0 &= \frac{\sum p_1 \times q_0}{\sum p_0 \times q_0} \\ P_1 &= \frac{\sum p_1 \times q_1}{\sum p_0 \times q_1} \end{aligned}$$

where p , q are prices and quantities, respectively, subscripts 0 and 1 the earlier and the later periods, respectively, and indicating the summation of all priced commodities. The index P has the algebraic properties that it satisfies the *time reversal* and *factor reversal* tests, the former meaning that when the subscripts 0 and 1 are interchanged the product of the original and revised index figures is unity, and the latter that the product of the original number and the quantity index number found by reversing p and q is equal to the value index, i.e., $\sum p_1 q_1 / \sum p_0 q_0$. As Professor Fisher points out, these properties are those which are suggested by analogy from a single commodity. In practice it is a great convenience that a price index number computed by the Fisher formula¹ divided into the value index (which is always "exact") gives a consistent volume or quantum index. The fact that the separate price index numbers P_0 and P_1 are combined in the geometrical mean may seem rather artificial to the layman. Apart from Professor Fisher's two tests the matter might be looked at in this way. The two index numbers P_0 and P_1 will be regarded as equally valid so that it must appear reasonable that the final index number should be a mean between the two. Very rarely will there be an appreciable difference between the two figures, so that the geometric mean and the arithmetic mean will be almost equal: if they differ widely the price changes for individual commodities must be highly divergent, in which case each index, or any mean of them, is suspect.

Since a tendency towards an inverse relation between changes in

¹ *The Making of Index Numbers*, by Irving Fisher, Second Edition, Revised (1923). Mention of Professor Fisher's well-known book recalls the controversy in *The Statist* in which great interest was taken by this Society not entirely because no fewer than four of our Members have been associated with that journal in an editorial capacity. *The Statist* may be said to have won the controversy on a foul, since the distinguished author was constrained to admit that he considerably exaggerated the bias (according to his ideas) in the Statist-Sauerbeck computation, which error was corrected in the second edition of his book.

TABLE 1.
Synoptic Table of Official Irish Index Numbers. Principal Media of Publication: Statistical Abstract and Irish Trade Journal and Statistical Bulletin.
 (Abbreviations: Y=Yearly, H=Half-yearly, Q=Quarterly, M=Monthly, I.T.J. and S.B.= Irish Trade Journal and Statistical Bulletin.)

Series (1)	Base (2)	Periodicity (3)	Date from which available (4)	Method of Computation (5)	Weighting (6)	Scope (7)	No. of Sub-Series (8)	No. of items (9)	Sources of price, etc. information (10)	Principal sources of information as to method of construction (11)
PRICES:—										
Retail (Cost of Living) ...	VII 1914	Q	III 1922	Aggregative	Working-class consumption June, 1922.	Principal basic household, commodities, rent.	6	68	163 returns from Employment Offices plus 192 rent returns.	(1) Report on the Cost of Living in Ireland, June, 1922; (2) Report of the Committee on the Cost of Living Index Figure, 1933 (P. No. 992).
Import	1930	Y M	1924	Y: Fisher, link relative. M: Aggreg. linked	Y: quantities in consec. years. M: quans. in previous year.	Principal period imports, except obviously incomparable.	1	Y: 336 M: 387	Average unit values.	(1) Trade and Shipping Statistics, December, 1929; (2) Do., 1930 (P. No. 590).
Export	1930	Y M	Y: 1911 M: 1925	Y: Fisher, link relative. M: Aggreg. linked	Y: quantities in consec. years. M: quans. in current month.	Practically all items except horses.	1	Y: 68 M: 82	Ditto	Ditto
Agricultural—Old Series	1911—13	Y M	Y: 1840 M: 1922	Y: Aggreg. M: Do. Separate weights for each month.	Produce sold off farms, 1926-27.	Principal agricul. products, except horses.	Y: 4 M: 1	23	Reports for 444 fairs per annum and 15 markets per week from 42 reporters.	(1) <i>I.T.J. and S.B.</i> , February, 1929; (2) <i>Ibid.</i> , December, 1931.
Agricultural—New Series	1938—39	Y M	Y: 1939 M: IX 1938	Y: Fisher, link relative. M: Aggreg. linked	Ditto, previous agrl. year.	Ditto.	Y: 4 M: 1	25	—	<i>I.T.J. and S.B.</i> , March, 1943
Wholesale	X 1938	M	X 1938	Aggregative	Imports plus home production 1936-37.	Commodities in all stage of production.	24	280	80 special correspondents plus agricultural prices.	Present paper. Series has not yet been published officially.
VOLUME:—										
Agriculture ...	1929—30	Y	1929—30 (continuous from 1934-35)	Aggregative	Prices in 1929-30	All agricultural products and turf.		49	See Col. (11). Also agricul. prices above.	(1) The Agricultural Output of Saorstát Éireann, 1926-27 (P. No. 132) (2) <i>I.T.J. and S.B.</i> , September, 1938.
Industry	1936	Y Q	Y (1): 1926 Y (2): 1936 Q: III 1942	Y: Fisher, link relative. Q: Aggreg.	Y: Net output in consec. years. Q: Net output in 1941 (applied to volume indexes for indiv. industries).	Y (1) (1926-38): All industries. Y (2) (1936-), Q: industries prod. transportable goods only.	Y (2) .3 main Y (2) Q: 35 sep. industries	Y (2): 456 Q: 440	Y: Census of Ind. Prod. Q: returns for 80% sample.	(1) Census of Industrial Production, 1931 (P. No. 1243); (2) <i>Ibid.</i> 1936 (P. No. 3143); (3) <i>I.T.J. and S.B.</i> , March, 1943.
WAGES AND EARNINGS:										
Transport Earnings ...	1931	Y	1931	Aggregative	Persons engaged in different occupations.	Road, rail, workers, seamen, dockers.	1	18	Railway Staff Statistics and	Some Statistics of Wages and Hours of Work in Éire in 1937 with Comparative Figures for Certain Previous Years.
Principal Industrial Occupations ...	1931	Y	1931	Aggregative	Persons engaged in different occupations.	23 occupations (principally building).	1	23	Returns from Employment Offices in 11 large towns.	Ditto
Industry (Wages and Earnings).	IX 1939	H	IX 1939	Aggregative linked	Persons engaged in different industries.	Industries producing transportable goods.	13	130	Returns for 80% sample.	<i>I.T.J. and S.B.</i> , March, 1943.
STOCKS AND SHARES ...	I 1936	M	I 1934	Aggregative	Capital issued	Companies regd. in Éire (except railways).	1	88	Stock Exchange List.	<i>I.T.J. and S.B.</i> , December, 1936.

By R. C. Conway

quantity and price of individual commodities is to be expected, *a priori* the index P_0 , based on the "earlier" weights, should tend to be higher than P_1 . This point may be examined by reference to import and export price index numbers, shown in the following table:—

TABLE 2

Import and Export Price Index Numbers (Base previous year=100).

Year	Import Prices (Previous year=100)			Export Prices (Previous year=100)		
	Earlier Weights (P_0)	Later Weights (P_1)	Geometric Mean	Earlier Weights (P_0)	Later Weights (P_1)	Geometric Mean
1931	85.57	84.42	84.99	90.67	90.34	90.50
1932	98.10	98.00	98.05	86.66	86.80	86.72
1933	92.64	92.18	92.41	82.31	81.99	82.15
1934	100.69	99.89	100.28	94.83	94.17	94.50
1935	102.08	100.65	101.36	101.97	100.53	101.25
1936	105.21	102.95	104.07	107.81	108.07	107.94
1937	113.02	112.43	112.73	112.69	112.25	112.47
1938	98.51	96.69	97.60	114.63	116.17	115.40
1939	100.17	99.35	99.76	111.12	111.15	111.14
1940	142.67	140.93	141.79	128.38	129.19	128.78
1941	127.83	119.84	123.77	117.06	121.94	119.47
1942	122.55	118.78	120.65	111.59	111.52	115.55
1943	103.73	98.87	101.27	107.19	109.15	108.17

In every case, without exception, for import prices the index P_0 exceeds P_1 , as expected. On the contrary, no such tendency manifests itself for export prices: there are seven out of thirteen exceptions to the rule. In view of the small share which Ireland has in the British market it is not surprising to find lacking an inverse relation between quantum and price. It will be noted that, on the whole, the divergence between P_0 and P_1 is more marked in the case of imports than exports.

It is to be observed that in this country though the custom has been to call figures of the type shown in the foregoing table "price" index numbers, the modern fashion inclines towards terming them "unit value" index numbers, since they are necessarily based on values per unit of goods, without regard to quality. Obviously this reservation applies with more force to import prices than to export prices. Strictly speaking the term *price* index should be applied only to index numbers based on quotations for exact trade descriptions of commodities, as is the case with the new wholesale price index number described in a later section of this paper.

The Cost-of-Living Index Number.

The Cost-of-Living Index Number purports to show the trend in the aggregate cost of fixed quantities of household commodities at retail prices ruling at quarterly intervals, and rent; the standard may be regarded as that of an artisan family in June, 1922. "Ce qui va sans dire va encore mieux en le disant": the cost-of-living index number gives no indication of the actual expenditure or quantum consumption by the working classes, or any other classes; it is simply a *price index number*. It may be unnecessary to make this explicit state-

ment before this learned Society; it is surprising nevertheless how constantly it has to be made in statistical practice even to intelligent people. As F. M. Williams (Chief, Cost-of-Living Division, U.S. Bureau of Labour Statistics) puts it: "Changes in the plane of living are quite different from changes in the cost of living—and it is the cost of living which the Bureau's Index measures".¹ This does not mean that changes cannot be made from time to time in the weights (i.e., "fixed quantities" referred to above): actually it would be very desirable to have changing series of weights, such as would be furnished by the periodical family budget inquiries recommended by the Committee on the Cost-of-Living Index Figure² under the chairmanship of our distinguished Member, Mr. Thomas Johnson. In this connection the Committee also stated that:—

"In recommending that budget inquiries should be undertaken at ten-yearly intervals we are mindful that the results of such inquiry may have a general sociological and economic value which will far transcend their more or less utilitarian value as expenditure weights for cost of living index figures."

In the computation of the agricultural, import and export price index numbers the weights are revised at annual intervals. This only means, however, that appropriate up-to-date weights are used in assessing the price changes in the most recent interval, throughout which the quantity weights are assumed to have remained unchanged.

This point is of prime importance under existing conditions when, on account of rationing and shortage of supplies, considerable changes have taken place in the pattern of household consumption, though the changes which have taken place are possibly less marked in this country than in most others. In this connection it may be of interest to observe that it has been estimated that between 1938-39 and 1942-43 the aggregate quantum of consumption (defined as home production plus imports, less exports) of all classes of goods (including building and other works of construction, public utilities as well as "transportable goods", agricultural and industrial) has declined by 20 per cent. approximately. Excluding milk, farm butter, eggs, potatoes, turf and other farm products consumed in farm households without process of sale, the decline amounted to just 25 per cent. A further calculation has been made which shows that the decline in the quantum consumption of household commodities (including consumers' capital, like furniture, as well as food, clothing, etc., but excluding building, works of construction, producers' equipment, etc.) was about 15 per cent. The quantum consumption of food is estimated to have changed very little in the aggregate since pre-war, while the consumption of all other products has probably declined in quantum by about one-third.

A special (and very onerous) calculation, using approximate present-day consumption standards as weights, has indicated a price increase between mid-August, 1939, and mid-August, 1943, of 62 per cent. as compared with the 64 per cent. increase in the official figure, from which it appears that the drastic changes of consumption indicated in the previous paragraph have actually had very little effect on the figure. This inference is subject to the qualification that no account has necessarily been taken of the household commodities not included in the official computation. This point is dealt with in a later paragraph. Reference may also be made to the results of a special com-

¹ Journal of the Inter-American Statistical Institute, March, 1944, page 70.

² Report of the Committee on the Cost of Living Index figure (P. No. 992), page 24.

putation which seem relevant both to the effect of changes in weights and to the inclusion of items unpriced in the official computation. For this purpose recourse was had to the very useful series of budgets submitted to the Johnson Committee by the Civil Service Federation, which were secured through the initiative of my secretarial colleague, Dr. J. P. Beddy. These data comprised summaries of household budgets of civil servants over a fairly wide range of incomes. Using average group weights for all these household budgets, in conjunction with the group prices index numbers for food, clothing, fuel and light, etc., as ascertained for the official inquiry, and including certain items, such as education and transport expenses, not taken into account in the official calculation, it is computed that between mid-August, 1939, and mid-August, 1944, the cost of living of this group of "white-collar workers" increased by 49 per cent. as compared with 71 per cent. shown by the official figure. The percentage increase, according to the standard in the "£500 or over" income class, *exclusive of income tax*, was 46 per cent.; in which connection it will be recalled that the Johnson Committee recommended income tax should not be accepted as an item to be "priced" in the cost-of-living computation for the following reason, among others:—

"It differs from indirect taxation in that it is designed specially to fall heaviest on large incomes, and its inclusion in an index figure which regulates salaries would be tantamount to accepting the principle that persons with large incomes should in some measure be relieved from the tax."

Unpriced Items. The principal criticism levelled against the official computation is that it takes no account of many important articles of consumption. On this point it must be emphasised that the standard on which the official figure is based is that of an average working-class family and it is clear that commodities included in the computation cover a large proportion of the expenditure of such families. At the present time the proportion borne by unpriced commodities is as follows:—

(a) Expenditure on Food, not included in computation:—	%
(i) as percentage of total expenditure on food ...	5.5
(ii) as percentage of total expenditure on all items ...	2.8
(b) Expenditure on Clothing, not included in computation:—	
(i) as percentage of total expenditure on clothing ...	22.6
(ii) as percentage of total expenditure on all items ...	5.8
(c) Expenditure on Fuel and Light, not included in computation:—	
(i) as percentage of total expenditure on fuel and light ...	31.4
(ii) as percentage of total expenditure on all items ...	2.3
(d) Expenditure on items not included in computation, as percentage of all items	19.3

It will be observed that expenditure on items not included represents 19 per cent. of expenditure on all items. In computing the official figure, the procedure is to assume that in each of the three groups Food, Clothing, and Fuel and Light, the general trend of prices of items not included is identical with that of items included, whereas prices of "Other Sundries" are assumed to have the same trend as prices of all items. It is important to realise accordingly that the computation is vitiated only to the extent to which these assumptions are invalid. No doubt, between two points of time prices of some items change more, and other excluded items change less than does the

general index. It is probably true that on the whole the prices of items not included are rather more static than those of items included, i.e., that in times of falling prices these prices generally fall less and in times of rising prices they rise less than do the prices of the included items.

Some idea of the magnitude of the error in the computation as a result of the non-inclusion of certain price series may be derived in the following manner. In mid-August, 1939, the official figure was 173, which means that on the average the prices of household commodities and rents are estimated to have increased by 73 per cent. since mid-July, 1914. If the prices of excluded items are assumed to have increased by only 50 per cent. the index number would have been 169, whereas if they were assumed to have increased by as much as 100 per cent. (which is extremely unlikely) the index number would have been 179. In other words, with these two extreme assumptions the "true" figure would lie between 169 and 179, which, in the circumstances, must be regarded as a narrow range. As to the trend in prices since the beginning of the emergency, the official figure increased by 70 per cent. between mid-May, 1939, and mid-May, 1944. If items not included are assumed to have advanced by 50 per cent. the increase would have been 64 per cent. (instead of the official figure's 70 per cent.) and if excluded items were assumed to have advanced by 100 per cent. the general increase in prices would have been 74 per cent.

It is interesting to observe that in the U.S. Bureau of Labour computation the weight for each item represents actual expenditures for the items included together with expenditures for goods or services with a similar price movement. This, in principle, is the procedure adopted in the Irish computation, in assuming, for example, that the prices of food items unpriced have a trend similar to that of items for which prices were obtained. No doubt, the U.S. Department of Labour have succeeded in giving their principle a more refined application than this. Nevertheless, it is obvious that this principle, if stringently applied could only affect a small reduction in the unpriced total: for instance, one would scarcely be justified in assuming that the trend in the excluded item "Travelling Expenses" was similar to that of any of the priced items.

While it is true that in the present inquiry four-fifths of the 1922 working-class household expenditure is priced, there is no doubt but that in each income group the next family budget inquiry will reveal a substantial increase in the proportion borne by "Sundries". In Great Britain the official figure is still based on a 1904 budget which showed that the proportionate expenditure on food was 60 per cent. and on sundries 4 per cent., whereas the 1937-38 inquiry (for which 8,105 budgets were secured from industrial working-class households) showed percentages of 39 and 30, respectively. For a new series of cost-of-living index numbers, based on a post-emergency budget inquiry, every effort will be made to reduce the unpriced percentage to the lowest possible level though it will be recognised that the percentage will never be negligible (a) because of the difficulty of obtaining representative and comparable price series, and (b) because of the variability from household to household in the pattern of expenditure on "Non-essentials". The official index for a broad class of persons cannot be blindly based on the average household expenditure for these classes: if the individual budgets reveal much variability in

expenditure on a particular item, should such item be included in the computation, when it is to be implied that the official cost-of-living figure is applicable not only to the totality but very approximately to *each individual* in the totality? Since the main purpose and the great importance of the cost-of-living index resides in its being used as a regulator of incomes, is there not something Procrustean in making each individual conform to a too general norm? Would it not be better not to attempt to price these disparate sundries but to assume (as at present) that the total varies proportionately with all prices, or even to assume that sundries do not vary in price at all? These questions are propounded to show that the problem is not simply to be resolved by an accumulation of statistics however good the intention or accurate the statistics.

Substitution. The problem of substitution has arisen in an acute form in regard to one item only in the cost-of-living index computation, namely, coal. The normal procedure in regard to substitution (whether due to changes of fashion or otherwise) is to require the price reporter, who has reported that the type of commodity formerly priced is no longer available, to state the price of the substitute commodity together with the price at the previous inquiry. This entails recalculation of the national average price of the commodity in question as at the previous inquiry; and a new quantum weight is computed by dividing the revised national average price into the expenditure weight as established at the previous inquiry. This procedure was adopted in principle in November, 1942, when a transition had to be made from coal to turf. The actual method was as follows: in mid-August, 1942, the fixed quantum of coal in the typical household in a certain period was 94·8 pence; between mid-August and mid-November in the same year there was no change in the retail price of turf so the expenditure "weight" for turf at mid-November was taken as 94·8 pence; and since mid-November a national average price of turf has been computed and the expenditure weight has varied *pro rata* with the resulting prices, which variation has, of course, been small.

It will be recognised at once that this is the established procedure. It may be asked if would it not have been preferable to ascertain a conversion factor for coal to turf (this conversion factor is usually taken as approximately two tons turf = one ton coal) and so vary the fixed quantum weight from coal to turf. This procedure was not adopted for the following reasons:

- (i) difficulty of ascertainment of a reasonably accurate conversion factor;
- (ii) such conversion factor would have to be ascertained at each inquiry;
- (iii) the procedure would have resulted in an unrealistically drastic change in expenditure between mid-August and mid-November, 1942.

Reference may also be made to the disappearance of margarine from the Irish regimen. This commodity is lightly weighted in the official computation, and when it ceased to be sold the expenditure was simply allocated to unpriced foodstuffs, which means that the expenditure released by the disappearance of margarine was assumed to be distributed *pro rata* amongst priced items in the food group.

The "substitution problem" has arisen in all countries, usually in a more acute form than it has arisen here. In the U.S.A.,

"when the field agents of the Retail Price Division report that a lower price line has been discontinued and that a new and higher price line has been introduced which comes within the limits of the same specifications, the entire difference between the two prices is treated as a price increase; when a lower-price line is discontinued, and a higher-price line which comes within the limits of the same specification was available in the previous pricing period and is still available in the current period, the price increase is computed as the difference between the price of the higher line in the current period and the average price of the two lines in the earlier period. This procedure is followed on the assumption that many members of the group to which the index applies purchased the higher-price line in the earlier period. Since it is impossible to obtain information on the volume of sales for each price-line to the public at large, much less to the wage-earner and clerical group, the two prices for the earlier period are given equal weight in the average."¹

In Ireland we would be chary about the adoption of this method as a general principle, while in full sympathy with the intention. We would prefer to consider each case on its merits. If the principle resulted in a too drastic increase in price we would not feel justified in assuming that the worker would buy the same quantum of the commodity in question (even if this were available) but rather that he would withhold expenditure altogether or would purchase some less expensive substitute. Certainly it would not appear correct to assume that he was burdened by the full amount of the increase in price even though the statistical problem of measuring precisely what the burden was is impossible of solution. Regard must, of course, be had in this connection to the relative elasticity of demand for different commodities and also to the relative income groups. In general it may be assumed that the demand is elastic for the commodities in which this difficulty has arisen in an acute form. At the same time it must be recognised that amongst the lower income groups the possibility of substitution is extremely circumscribed.

Seasonality. The Johnson Committee recommended that the cost-of-living index number should be corrected for seasonality:—

"In our view it is a defect in the existing computation that it is based on a budget which is presumed constant all the year round. This is manifestly not in accordance with the facts but it accounts for the regular seasonal oscillations which the existing figure exhibits. This fluctuation is due almost entirely to the seasonal changes in the price of eggs and in a lesser measure to the seasonal changes in the prices of milk, butter and potatoes. When seasonal expenditure weights have been ascertained at the new inquiry which we recommend it will be possible to eliminate these fluctuations."

If seasonal weights were available, i.e., the consumption pattern appropriate to the dates of inquiry mid-February, mid-May, mid-August and mid-November, no doubt the method of computation would be very similar to that in the computation of the monthly agricultural price index number, prior to revision. Since the seasonal variations in family budget weights would be far less marked than in the case of agricultural weights it is unlikely that, even in the stress of present-day conditions, the cost-of-living index figure corrected for seasonality would exhibit the pathological condition described in the section of this paper relating to the agricultural index. The method would involve the establishment of a period (perhaps the years 1931-38) which might be regarded as "normal" from the point of view of seasonality of prices, though experience has shown that from the index statistician's point of view the search for a normal base period is a "will o' the wisp".

¹ Williams, *op. cit.*, page 70.

The following figures indicate the seasonality of the official figure during the years 1931-38:—

	Mid-February	Mid-May	Mid-August	Mid-November	(a) Annual average
Average 1931-1938	160.1	157.3	158.6	164.3	160.1
Ditto, as percentage of annual average	100.0	98.3	99.1	102.6	100

It will be seen that, on the experience of the years 1931-38, the mid-February figure is the most representative; the figures for mid-May and mid-August are lower than in the remaining two months; actually the mid-November figure is six points or $3\frac{1}{2}$ per cent. higher than the figure for mid-August.

In recent years certain particulars have become available which make possible a rough and tentative estimation of seasonal variation in the consumption of eggs, milk and butter. Applying seasonal factors to the cost-of-living quantities (which, it may be recalled, referred to the month of June) for these commodities, weights more or less appropriate to mid-February, mid-May, mid-August and mid-November have been computed; the seasonal "expenditure" (i.e., the fixed weights valued at official national average prices) in each of the years 1931 to date was determined; the expenditures for mid-February, 1939, 1940, etc., were expressed as a proportion of the simple average expenditure in the period 1931-38 and the resulting figures multiplied by the annual average official figure in the same period; similarly for mid-May, etc. The resulting figures represent the series described as "corrected for seasonality" in columns B of Table 3.

TABLE 3

Cost-of-Living Index Numbers: (A) Official Series and (B) Official Figures Corrected for Seasonality.

Base July 1914=100.

	A.—Official series				B.—Official figures corrected for seasonality			
	Mid-Feb.	Mid-May	Mid-Aug.	Mid-Nov.	Mid-Feb.	Mid-May	Mid-Aug.	Mid-Nov.
1939	174	172	173	192	174	175	174	188
1940	197	204	206	214	196	207	208	209
1941	218	220	228	237	217	223	228	232
1942	237	240	250	273	235	243	250	267
1943	273	275	284	294	271	279	283	289
1944	296	292	296	—	294	297	297	—

The "corrected" figures indicate no appreciable increase in the cost of living between the last two inquiries despite the rise of 4 points in the official figure. The increase since the beginning of the present year has been imperceptible.

The Monthly Agricultural Price Index Number.

This is an interesting casualty of the emergency. The method of computation of the former index was described in detail in the issue of *The Irish Trade Journal and Statistical Bulletin* of December, 1931, in which the series extending back to January, 1922, was inaugurated. It was there stated:—

“The marked seasonality in marketing, as well as in the production of agriculture renders it extremely difficult, if not impossible, to construct a completely satisfactory index number which will correctly reflect the monthly trend in prices . . .

“The most satisfactory method of construction in all the circumstances is to determine for each month a series of weights representing the approximate quantities of produce sold in the month, these weights, different in different months of the same year, to remain constant from year to year . . .

“This series compares correctly the level of agricultural prices in one month with the corresponding month in other years. The comparison of one month with another in the same year is not so satisfactory. It is true that the method of construction has eliminated seasonal fluctuations of prices. Furthermore, the spreading of the base period over six years gives a considerable measure of stability to the figures. But it is necessary to bear in mind that a fall in the index between April and October, for example, in a given year may be due as much to a change in weights as to a fall in price.”

Except for the weighting of wheat and beet, the production of which has greatly increased in recent years, the weights (which were proportional to the estimated quantities of agricultural produce sold in each month of the year 1926) were not changed since the series was inaugurated. The weights used for wheat and beet are those of current production, the combinatory formula being Irving Fisher's.

In the first instance the estimated fixed quantities appropriate to, say, the month of January were valued at the prices ruling in the “current” January and the result expressed as a proportion of the average value for January in the years 1924-29; the resulting figure was then multiplied by the annual average agricultural price index number for the years 1924-29 (to base 1911-13=100) to give the agricultural price index number for the “current” month January to base 1911-13=100. It had been intended to broaden the period for seasonal correction of prices beyond the original six years 1924-29 and to use ultimately a moving period of ten or fifteen years. It is essential, however, that the period should be fairly “normal” in the sense that during it no violent price changes should have occurred. Actually the last period of comparative economic stability was 1924-29. These years were followed by the world depression on which, in this country, were superimposed the effects of the economic war, which had barely ended when the present war began and with it a steep rise in prices. In such circumstances a spreading of the period used for the correction of seasonality seemed to create more problems than it could solve.

As a general principle it must be assumed that there is sufficient measure of inherent stability in the economic system to render unlikely irregular month to month fluctuations of wide amplitude in the index number, while recognising that agricultural prices are more variable than those of industrial products. It may fairly be claimed that, during the period of twenty-one years for which they have been computed (a period during which agricultural prices have ranged from an index minimum of $79\frac{1}{2}$ to a maximum of 203) this criterion has been fulfilled by the official index numbers of agricultural prices. In recent years, however, it was becoming apparent that the regular

decline recorded between December and January and, in a lesser degree, the rise between September and October were due rather to arithmetical aberrations in the index figure than to real changes in price.

At first sight it may appear that the difficulties mentioned might have been met by using in the following manner the series of weights representing the quantities of produce sold in each month of some typical period different from month to month but in general the same from year to year: between consecutive months a price index is established using the Fisher formula and the resulting month to month index figures linked to an appropriate base. This procedure has the grave theoretical objection that a considerable change in price of an important product during months when the weights attributed to the product are small will clearly never find a sufficient reflection in the index number.

In the present abnormal circumstances there seemed to be no alternative but to use a fixed series of weights throughout the different months of the year. In so doing it must be recognised that a considerable distortion is being applied to the reality of the Irish agricultural economy. Justification for the change is to be sought in the fact that it results in a smoother curve of prices and that at the present time, when prices have risen steeply, weighting is not so important as it would be at normal times of comparatively small price movements.

At the present time the index numbers during a given year represent the trend in the aggregate value of the quanta of produce sold during the previous agricultural year at prices ruling in the "current" month linked to the simple average of the index numbers during that agricultural year. The method used prior to 1944 is described in some detail in the basic (1943) article referred to in the synoptic Table 1. The method now used involves a change in weights each January and in theory could result in a discontinuity; in practice it has not done so yet and if and when it does there will be no difficulty in dealing with the situation.

The formula used in the computation of the old series is unusual, though in a sense it might be regarded as a variant of Paasche's $p_2q_1/\sum p_0q_1$. The extent to which comparisons can validly be made between different months in the same year depended largely on the degree of "normality" which the seasonal base period 1924-29 could be said to possess. This point was particularly stressed by the late Sir Alfred Flux (Chief of the Statistical Department of the British Board of Trade) with whom the speaker had the advantage of discussing the proposed method of computation prior to the inauguration of the series. Probably a farmer, accustomed to think of crop yields as a percentage of "fair normal" would readily accord a meaning to a price change indicated by the index number computed by the former method between different months in the same year.

From the technical point of view it will be interesting to compare the trend of the present official series with the old series (to the same base) which is still being computed (Table 4). The considerably greater variability in the old series will be immediately apparent. A statistical measure of the difference in smoothness may be found in the root mean square deviation from five-monthly moving average trend which is equivalent to 3.4 points for the old series and only 1.8 points for the new, over the whole period of 66 months. The

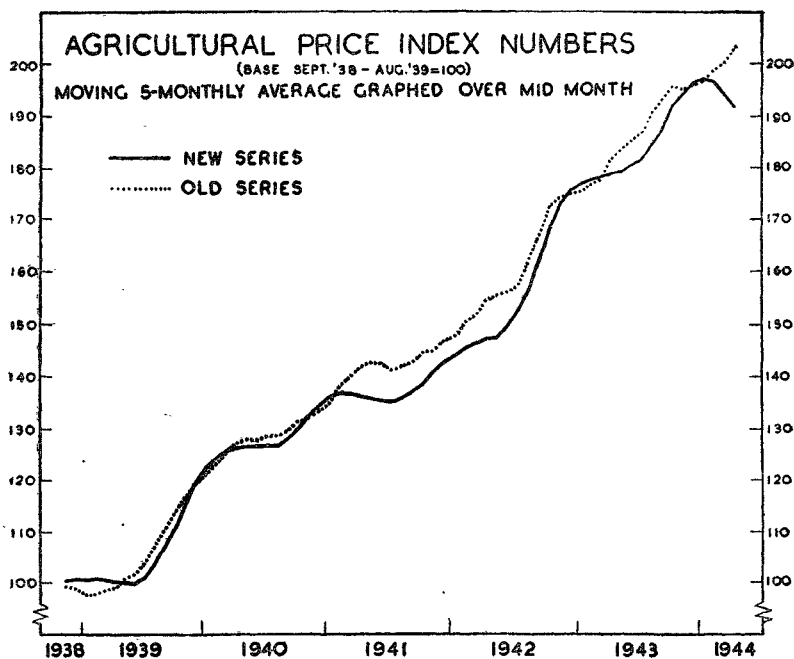
TABLE 4

Agricultural Price Index Numbers—Old and New Series
(Base September, 1938—August, 1939=100).

MONTH	1938		1939		1940		1941		1942		1943		1944	
	Old	New	Old	New	Old	New	Old	New	Old	New	Old	New	Old	New
January	—	—	96	101	117	123	130	138	141	146	165	176	188	198
February	—	—	96	100	124	125	138	139	149	145	174	176	196	197
March	—	—	97	100	128	126	142	137	153	144	181	178	205	197
April	—	—	101	102	128	127	146	137	160	150	185	182	208	192
May	—	—	102	100	133	129	146	134	156	149	183	179	204	187
June	—	—	101	99	126	126	141	134	155	149	184	179	203	185
July	—	—	103	99	126	125	141	137	153	147	185	178	204	186
August	—	—	102	99	128	128	140	135	156	154	190	185	—	—
September	100	98	111	107	131	127	141	136	169	163	193	187	—	—
October	102	100	117	112	134	129	148	138	180	172	202	193	—	—
November	100	101	118	117	130	132	146	141	178	178	197	194	—	—
December	99	101	121	121	135	135	151	144	178	177	197	200	—	—

computation makes very evident the distortion introduced into the old series by the "January aberration", omitting which reduces the deviation to 2.9 which, however, is still considerably in excess of the figure for the new series. From any point of view the new series is less variable than the old; and smoothness is a great virtue in an index number, though it may be dearly bought.

In the chart the trends in the old and new series are compared by means of five-monthly moving averages. It will be observed that at the beginning of the present year the percentage increases in price



since pre-war, as recorded by the two index numbers, were practically identical. Since then there has been a marked divergence. To what extent is the fall recorded in the new series due to that discordant element in both the agricultural price and the cost-of-living index, namely the price of eggs? Omitting eggs it is found that between January and June the new series indicates a fall of 10 points as compared with 13 points in the official series, so that the seasonality of egg prices accounts only to a small extent for the fall in prices.

It seems not unlikely that some time in the near future the Statistics Branch will officially resume publication of a seasonally corrected monthly series, using the former method of computation or some variant of it. Probably the idea of using a *fixed* system of six or any number of years for seasonal correction (i.e., as the term 1924-29 was used heretofore) will be abandoned. Many people must have had the feeling in regard to the past thirty or forty years that what seemed an "emergency" or a "crisis" while one lived through it seemed in retrospect almost a haven of peace, of "normality"; in its statistical application this reflection would point to the futility of search for the "normal" period for even so inherently unchanging a branch of economic activity as farming; that the correction for seasonality should be based on a constantly changing period, perhaps of some fifteen years prior to the "current" year. A further modification may be the progressive modernisation of the monthly weights.

Volume or Quantum Index Numbers.

The emergency has endowed the quantum index numbers with increased importance. Under existing conditions the unreality of value as a guide to the businessman or to the economist may perhaps best be exemplified by reference to trade statistics: the value of imports in the twelve months ended July, 1944, was 36 per cent. below the value in the corresponding period of 1938-39 whereas the volume or quantum of imports had declined by 72 per cent. and exports and re-exports have increased slightly in value but in quantum have declined by 48 per cent. Between 1938-39 and 1942-43 the quantum of gross agricultural output has *declined* by 8 per cent. but the value has *increased* by 61 per cent.; value of net output of industrial transportable goods has *increased* by 19 per cent. between 1938 and 1942 while quantum has *declined* by 21 per cent. In most of these cases the trend in quantum and price has been sharply opposed, giving a measure of stability to their "product", i.e., value. In this paper it is proposed to discuss only the quantum index numbers of home agricultural production. For what follows it may be well briefly to define the terms "gross" and "net" output. The value of the *gross* output of agriculture represents the value, at prices which farmers receive, of the estimated quantities of products sold or products consumed in farm households without process of sale; the value of *net* output represents the differences between the value of gross output and the cost of animal feeding stuffs, fertilisers and seeds purchased by the agricultural community as a whole, i.e., excluding inter-farm transactions. An important distinction between the definitions of *gross* output in the case of agriculture and industry will be noted at once: there is no duplication in the concept for agriculture whereas in the total for all industries and even in the total for particular industries, there may be duplication since the product of one industry may be an ingredient for another. In the case of agriculture, the

concepts of both gross and net output have great importance; in the case of industry the net output, or the increment created by the manufacturing process, has incomparably the greater significance.

The Volume of Gross Output of Agriculture represents the value at 1929-30 prices of the "current" quantum of production expressed as a percentage of the 1929-30 value. More than once in discussions in this Society, the question has been raised of the justification for using 1929-30 prices in particular. Why not use as fixed prices the present-day prices, or prices in 1938-39, for instance? Several points in support of the present procedure might be adduced, including the following:—

- (i) The 1929-30 prices are more normal; valuation at "fixed" prices implies the fixing of exchange values between different products, e.g., one cwt. farmers' butter=14 cwt. wheat: such ratios at the present time would be quite abnormal.
- (ii) The present series has the sanction of usage; it should not lightly be set aside, as a new series would be apt to cause confusion.
- (iii) The volume of production of agriculture has shown a marked degree of stability under varying conditions for many years.
- (iv) Any "reasonable" system of fixed valuation will result in very similar index numbers.

The last argument has considerably the greatest force; less weight would be attached to point (1) than might at first sight be supposed, particularly by partisans of the Fisher formula. It has accordingly seemed desirable to compare the trend indicated by the official figures with two new series, one computed using fixed (1938-39) prices and the other computed according to the Fisher formula, *all expressed to base 1938-39=100*. For the new series (C) below a price index number was computed for each pair of consecutive years, representing, as usual, the geometric mean of figures using "back" and "forward" weights; and the price index divided into the value index gave the volume index. The year-to-year volume figures were multiplied to give the series shown.

TABLE 5
*Comparison of Index Numbers of Volume of Gross Output of Agriculture
Computed by Three Methods.*
(Base 1938-39=100).

	1938-39	1939-40	1940-41	1941-42	1942-43
(A) Official figures—using fixed (1929-30) prices	100	103.4	96.3	99.8	92.1
(B) New Series—using fixed (1938-39) prices	100	103.7	97.5	100.6	94.2
(C) New Series—Fisher formula	100	102.6	96.9	99.1	93.0

The three series yield very similar results, though one would have wished the figures at (A) and (B) to be closer in 1942-43. Still it is reassuring that the official figure is quite close to series (C).

Concept of the Volume of Net Output of Agriculture. The value of materials purchased by the agricultural community as a whole normally constitutes only a small fraction (about one-sixth) of the value of output, so that the trend in the gross output was very similar to that of the net output. With the great shortage of animal feeding-stuffs and fertilisers during the emergency there has occurred a sharp decline in the value of materials purchased from £8,698,000 in 1938-39 to £2,596,000 in 1942-43. On account of the increase in prices the fall in quantum of materials was even much greater than these figures indicate. In these circumstances it becomes clear at once that, while the gross volume of output is an indication of the amount of agricultural production available for home consumption or export, it understates the quantum increase in agricultural effort.

The simplest method of assessing the trend in this volume of net output would be to value products and materials at fixed prices. For the following table 1938-39 prices have been used.

TABLE 6

Estimation of Index Numbers of Volume of Net Output of Agriculture using (A) Fixed (1938-39) Prices and (B) the Index Numbers using the Fisher Formula.

	Values in £000				
	1938-39	1939-40	1940-41	1941-42	1942-3
Gross output (at 1938-39 prices).	53,481	55,459	52,120	53,780	50,357
Materials " "	8,698	9,537	7,999	3,419	1,571
Difference = Net output	44,783	45,922	44,121	50,361	48,786
(A) Index number—Fixed prices	100	102.5	98.5	112.5	108.9
(B) Index number—Fisher	100	102.0	99.2	116.1	112.6

Series (B) was found by computing price index numbers (as the geometric mean of figures computed from "back" and "forward" weights) for products and materials separately. The details of the remainder of the computation for 1939-40 are indicated in the next table.

TABLE 7

(1)	Estimated actual values		Price Index number 1939-40 (1938-39=1) (4)	1939-40 quantities at 1938-39 prices (5)	1938-39 quantities at 1939-40 prices (6)
	1938-39 (2)	1939-40 (3)			
Gross Output	£000 53,481	£000 60,924	1.110	£000 54,894	£000 59,355
Materials	8,698	9,412	1.019	9,235	8,865
Difference = Net Output	44,783	51,512	1.020	45,659	50,490

Notes: Col. (5) = Col. (3) ÷ Col. (4); Col. (6) = Col. (2) × Col. (4).
Index number of volume of net output in 1939-40 (Base 1938-39=1)

$$= \sqrt{\frac{45,659}{44,783} \times \frac{51,512}{50,490}} = 1.020$$

Similarly the figure for 1940-41 to base 1939-40 was found and multiplied by 102.0 to give the figure (B) for 1940-41 in Table 6.

The table shows that between 1940-41 and 1941-42 the figures at (A) and (B) tend to diverge. In 1942-43 the "Fixed Prices" index is nearly 4 points less than the value found using the Fisher formula. The divergence must be regarded as an arithmetical aberration due primarily to the marked fall in the volume of materials used. In general principle the concept of volume of net output, for all its theoretical validity, has the disadvantage that it is less "stable" arithmetically than the gross output volume, since there enter into its computation *two* price index numbers (those of products and materials) each of which has margins of instability. This observation has particular force in its application to net volume of industry which will be dealt with elsewhere.

The Wholesale Price Index Number.

The position generally about wholesale price index numbers is a curious one. Professor Irving Fisher listed 56 current wholesale price index numbers for 24 countries in 1922, since when there has no doubt been a further net increase in the number; he also listed no fewer than 92 extinct index numbers in 18 countries, the majority probably being wholesale price indexes. Quite a number of the series are nearly a century old. Despite their ubiquity and (by statistical standards) their antiquity, indicative of their fulfilling a real (if largely instinctive) want, it has proved impossible to define the *purpose* of these *general* figures, i.e., to state clearly the uses to which they can validly be put.

The diversity of purposes for which price indices are or can be used is perhaps best illustrated by the enumeration given in 1915 by the U.S. Bureau of Labour Statistics:—

"Once published they are used for many ends—to show the depreciation of gold, the rise in the cost of living, the alterations of business prosperity and depression, and the allowance to be made for changed prices in comparing estimates of national wealth or private income at different times. They are cited to prove that wages ought to be advanced or kept stable; that railway rates ought to be raised or lowered; that 'trusts' have manipulated the prices of their products to the benefit or the injury of the public; that tariff changes have helped or harmed producers or consumers; that immigration ought to be encouraged or restricted; that the monetary system ought to be reformed; that natural resources are being depleted or that the national dividend is growing. They are called in to explain why bonds have fallen in price and why interest rates have risen, why public expenditures have increased, why social unrest prevails in certain years, why farmers are prosperous or the reverse, why unemployment fluctuates, why gold is being imported or exported. . ."¹

To these might be added the following (which are not entirely distinct from the foregoing):—

- (1) to measure changes in the purchasing power of the currency unit;
- (2) to compare the trend of prices of individual commodities with prices generally;
- (3) to measure the "purchasing power parity", i.e., by means of a comparison between the general trend of prices and the rate of exchange between two countries;

¹ Quoted from the League of Nations Committee of Statistical Experts (Sub-Committee on Prices) Document (C.E.S./S.C./Prices/7). This and other very useful documentation of the Sub-Committee have kindly been placed at the disposal of the Statistics Branch.

- (4) comparison of wholesale and retail price trends;
- (5) comparison of prices of home-produced and imported commodities;
- (6) wholesale price index numbers have been used to indicate the general economic trend;
- (7) for comparison with the total value of money transactions (as indicated by total value of bank debits or bank clearances) to show changes in volume of such transactions;
- (8) deflation of value series to indicate quantum trend.

Some wholesale indexes have been put to all the uses enumerated above and more besides: it is obvious, at any rate, that the same figure, however carefully computed, cannot be used for all purposes. The arithmetical simplicity of the method of computation has often been in ludicrous contrast with the economic complexity of the system which the index number was assumed to summarize. When the economist has defined clearly the purpose for which he requires the figure the statistician will have relatively little difficulty in solving the arithmetical problem of the determination of weights. In the past both the economist *and* the statistician have been too easily satisfied with the figures which were ready to hand, assuming too complacently that they approximated to the trend of the phenomenon under investigation.

The assumption, sometimes made, that the wholesale price index number reflects the "general level of prices" can find some justification in the fact that undoubtedly the aggregate exchange value of transactions at "wholesale" (which may be defined as all commodity transactions other than at retail) constitutes a substantial proportion of the value of all goods (at wholesale or retail), services, securities, rents, etc., exchanged in any given period. In actual fact, the coverage of any existing wholesale index does not approach one-half of the aggregate exchange value of all transactions, even when generous assumptions are made as to the "representativeness" of the index number. In such circumstances, it is obvious that correspondence between the "general level of prices" and the level of wholesale prices would be largely fortuitous, particularly since the "price" trend in the different constituents of the exchange can be widely dissimilar, as they are, for instance, at present, compared with pre-emergency. The result of a very tentative computation of the "general level of prices" for this State is given below.

This objection of "indefinitiveness" to the *general* index has considerably less force in regard to *constituent groups* of commodities, and, of course, wholesale price series of individual commodities are an essential part of the corpus of official statistics. It may be suggested that a price (or a quantum) index number has a definite meaning when it relates to goods "observed" at definite points in the economic process: index numbers for consumption goods (wholesale or retail), agricultural products, goods imported, goods exported, obviously satisfy this condition. The official statistician can usually "play for safety" by publishing "everything", combining the individual series in every way which he can conceive as useful for administrative purposes or for the public. Nevertheless, much theoretical guidance is required and official statisticians will give every encouragement to the Committee of Statistical Experts of the League of Nations which had been examining the whole question but whose labours have presumably been interrupted by the war.

In June, 1935, the Sub-Committee on Prices of that Committee decided:—

“As a preliminary step to its further work, to undertake a study of the various purposes for which price indices are or could be employed. This study is intended to serve as a basis for future recommendations as to the construction of adequate price indices. In this connection it decided to take the work done in Paris in 1930 as the point of departure.”

At the Paris meeting the statisticians agreed that it was useful to compile group indices in addition to the general wholesale price index for the main groups (a) Raw materials, (b) Semi-manufactured products, and (c) Finished articles, and certain sub-groups thereof. In addition it was recommended that group index numbers for capital goods, consumption goods, domestic farm produce and farm requirements (fertilisers, feeding stuffs, machinery and seeds) should be computed.

With regard to weighting, the Sub-Committee's report laid down the following principles which throw some light on the purpose for which price indices are, or could be, employed.

“The weighting of each group should be based on the relative consumption of the commodities contained within that group; no reduction should be made from the weights of raw materials and semi-manufactured products on account of amounts entering into exported manufactured goods.

“The weights of raw and semi-manufactured products such as coal, coke, refined petroleum and lubricating oils, which are not only used for industrial purposes but also enter the hands of final consumers without undergoing a further process of manufacture, should be based on total consumption and not industrial consumption only.

“The ‘total goods sold wholesale’ index should be looked upon as partially reflecting the variations in the purchasing power of the national dividend. It should therefore theoretically be confined to finished articles, including foodstuffs. Unless a sufficient number of representative quotations for finished articles could be obtained, it would be necessary to represent such articles by goods in earlier stages of treatment. When this course is adopted, the weight to be assigned to such partly finished goods should correspond to their contribution to the finished goods thus represented. Where the whole weight of a raw material or semi-manufactured product was reflected in that of a finished product in the manufacture of which it was employed, only the finished product should be included in the calculation.

“At the first meeting it had been agreed that the weighting for agricultural produce should be based on relative values sold off the farm. Two distinct methods were possible under this definition; either the whole agricultural community could be treated as a single economic group and its sales to other groups alone to be considered, or each individual farm might be taken as a unit, and sales between farms be considered in the weighting. It was agreed that the first method should be adopted.”

The Irish practice in the computation of agricultural price index numbers is entirely in accordance with the last paragraph of this quotation from the Report of the Committee of Statistical Experts of 1930. More recent thought would scarcely endorse the recommendation in the last sentence of the penultimate paragraph which would mean, for instance, that in compiling its wholesale price index number this country would ignore the prices of wheat and flour since such prices would be fully accounted for in the price of bread. It is obvious that the Sub-Committee had in mind rather a wholesale price index number of *consumers'* goods. In October, 1936, the Sub-Committee made the following statement:—

“The Sub-Committee did not wish to raise objections to the compilation of general price indices covering all fields where such compilations were possible and sufficient elements for an appropriate weighting were available. On the other hand, the Sub-Committee did not contemplate preparing any recommendations with regard to such composite indices.

“The Sub-Committee, however, believed that an index reflecting the prices paid by consumers, including only goods ready for consumption (or the nearest stage to consumption which could be obtained) would be valuable to give an idea of the general movement of prices. Such an index should be based on a family budget (as were most of the cost-of-living indices), but it should refer to the total of turnover of finished goods, ready for consumption by all classes of the population and sold for that purpose.”

A very realistic discussion took place at the Conference of British Commonwealth Statisticians which was held in September and October, 1935, in Ottawa. From that conference the following recommendation emerged :—

“The Conference is generally of opinion that the basis of weighting a wholesale price index should be the aggregate value of commodities produced for sale plus the value of retained imports. The total value of the commodities within each group should be estimated free from duplication.”

Possibly because the Irish economy is so largely agricultural, the individual agricultural price series, available for nearly a century, fulfilled most of the functions of a wholesale price series. The import and export price (or “unit value”) index numbers are, of course, wholesale price index numbers of a kind. The lack of public demand and the sense of indefiniteness of purpose of these index numbers also militated against the establishment of a series for this country. On the other hand, with increased industrialisation domestic non-agricultural wholesale prices have been assuming increased importance. Decision to inaugurate a wholesale price series was also influenced by the recommendation of the Commission of Inquiry into Banking, Currency and Credit, 1938 (paragraph 176): “No index number of wholesale prices is compiled in the Free State—and this deficiency should, in the opinion of the Commission, be remedied at an early date. . . .” It has been decided, however, to withhold publication for the present on the ground that the series is still in the experimental stage and subject to expert examination and criticism; the most severe testing-time lies ahead (in other countries there were index number casualties in the period 1918-1921) and it would obviously be undesirable to publish a series and then have to withdraw it or amend it after its initiation.

The Monthly General Wholesale Price Index Number for Ireland purports to represent the trend of prices of goods exchanged at wholesale. Each commodity included is “weighted” in accordance with its importance in exchange in a base year; actually the weight represents the value of goods home-produced and imported in the year 1936 (or, for home-produced agricultural products, the agricultural year 1936-37). In general principle the method of computation is in conformity with the resolution (quoted above) adopted by the Commonwealth Government Statistical Officers at Ottawa.

The Ottawa recommendation that the total value should be estimated free from duplication is obviously very desirable. If all commodities were weighted according to their exchange value in the base year, changes in prices of certain raw materials would unduly influence the index figure. For instance, the price of wheat almost automatically affects the prices of flour and bread. In 1936 £100 of wheat went to the making of approximately £113 of flour which was manufactured into £188 of bread. If these weights were assigned proportionally to the three commodities specified, in net effect wheat would be weighted thrice, and flour twice, as much as it should be,

compared, say, with a commodity imported "ready for use". The elimination of this type of duplication from the weighting raised some exceedingly intricate technical problems which have been fairly successfully solved, at least to the degree of approximation required for index number computation. In the calculation of the General index number each allied group or *complex* of goods (for instance, wheat—wheat offals—flour—bread) manufactured from the same group of raw materials has been accorded a weight equal to the value of final product (for consumption or export). Within each complex each commodity at each stage of manufacture has been accorded a value weight proportional to its value in exchange. Since the price series for industrial products are available only since October, 1938, it was necessary to adjust the 1936 (or 1936-37) weights according to price changes between the years 1936 and 1938 using for this purpose such price series as were available, for example, agricultural prices, retail prices and import and export prices.

For the computation of the index number there were available for a great number of years agricultural prices collected by Fair and Market Reporters. From these prices have been calculated the national average prices compiled monthly and published quarterly in the *Irish Trade Journal and Statistical Bulletin*, which average prices are used in the calculation of the monthly agricultural price index numbers. The problem of obtaining the other series of prices required is complicated by the fact that, in this country even in more normal times, there are very few organised wholesale commodity markets and prices of only a few commodities are published in the Press or in trade journals. The latter are the principal sources of information in other countries. It was, accordingly, necessary to make special arrangements with upwards of 80 wholesalers, manufacturers and trade associations in this country to supply regular monthly prices of a pre-determined list of the most important home-produced industrial and imported commodities; the exact trade specifications of the commodities were arranged in consultation with these "correspondents". It is pleasing to record that in every case, without exception, correspondents have furnished the required information punctually and accurately.

About 1,050 price quotations of 289 different commodities received from 122 correspondents were used in the computation before the present emergency. It will be evident that many wholesalers supplied prices for a wide range of commodities and that several quotations are used for determining the average prices of many articles. Commodities included ranged over the whole gamut of degree of production, for example, from raw wool (through tops, woollen and worsted yarns, woollen and worsted tissues) to woollen clothing; from hides, via leather, to boots and shoes; from pig iron to machinery. Prices of public utilities (gas, water, electricity, laundries, etc.) or of houses are not included as such, but the materials used in these industries are included. Prices of beer and spirits, not usually taken into account in these computations are used here because there appears to be no valid reason for excluding them; and since Customs and Excise duties are included in prices, these commodities are accorded very heavy weights. Horses and two or three other commodities were omitted because satisfactory prices were not available and their prices could not be assumed to vary even very approximately with any known series.

The term "wholesale" as used in the present connection must not be interpreted in the literal sense of the price charged to retailers. It includes prices paid to producers (all agricultural prices may be regarded as in this category), prices (inclusive of import duties) paid by importers, prices paid by retailers, and in one or two important cases (of which bread is one) retail prices were regarded as the most suitable indicators of the wholesale trend. It is, of course, evident that what is required is that the price series used should correctly reflect the *trend* in prices (i.e., percentage increase or decrease since the base period) and not necessarily that it should represent the national average price for all grades of each commodity.

As far as possible prices quoted from month to month are for unchanged qualities and descriptions of goods. This ideal has been difficult to maintain during the present period. In a very few cases where no other price series were procurable, import prices (c.i.f., plus duty) and export prices (f.o.b.) were used for commodities of a highly standardised character.

For all home-produced agricultural products prices used are monthly averages computed from returns received from many fairs and markets held throughout the month. For other important commodities (including wheat, flour, bran, pollard, fruit and imported vegetables) prices represent simple averages of the quotations on one day of each week in the month. Prices of fish, which fluctuate so considerably, are averages of prices on each working day of the month.

In addition to the General index, there are computed certain Main Group index numbers, each such group consisting of cognate materials and products†. Following are the value weights (as in October, 1938) attributed to each group, together with the index numbers which I am permitted to quote so as to clarify the discussion:—

Main Group	£ million	Index Number in June, 1944 (Oct., '38 = 100)
Live animals, and food, drink and tobacco	72.84	176.9
Non-metalliferous mine and quarry products and manufactures	6.16*	213.5
Metals and manufactures thereof	11.05	197.9
Wood and timber and manufactures thereof	2.76	273.7
Textiles and apparel (including boots and shoes)	12.69*	261.7
Hides, skins and manufactures thereof (including boots and shoes of leather)	2.90*	164.6
Rubber and rubber manufactures (including boots and shoes of rubber)	0.63*	178.3
Paper and cardboard	1.88*	227.7
Chemicals (including oils, soap, paints, fer- tilisers)	5.83*	259.4
Miscellaneous	4.65	223.7
Total (free of duplication)	119.13	198.1

* Includes some duplication with other groups.

† It will be noted that the logic of "cognate materials and products" has the effect of making the groups very disparate in economic importance. In this official series the first group is broken down further.

Representative price quotations have been found for commodities aggregating (in October, 1938) £111 million, or 92 per cent. of the total of £119 million shown. Since there is a certain amount of overlapping between the groups (for instance, boots and shoes are included with textiles and apparel, with hides, skins, and manufactures thereof and with rubber and its products), the total of the group value weights exceeds the total of the weights for the General Index. The Main Group weights are of great interest as showing the very different importance of the different groups in the Irish wholesale price structure. It will be seen that the main group—Live Animals and Food, Drink and Tobacco—accounts for about 60 per cent. of the weighting. The effect of home agriculture on the General Index number may be gauged very roughly from the fact that, in 1936, the net output of agriculture constituted 32 per cent. by value of transportable goods, home-produced and imported, inclusive of duties. Imports, inclusive of Customs duty, represented 39 per cent. of the latter figure in the same year.

Sectional index numbers are also computed in the following two classes :—

	Index Number in June, 1944 (Oct., '38 =100)
I. Classification by Stage of Production :—	
1. Crude commodities	197·8
2. Simply transformed commodities	213·1
3. More elaborately transformed commodities	182·7
II. Classification by Use :—	
1. Materials for food, drink and tobacco industries	211·4
2. Materials for agricultural production	151·2
3. Materials for other industries	259·2
(i) <i>Durable</i>	264·2
(ii) <i>Non-durable</i>	256·4
4. Capital equipment	153·5
5. Food	164·9
6. Other goods ready for consumption	226·0
(i) <i>Durable</i>	166·1
(ii) <i>Non-durable</i>	239·9

The underlying principle in each of these sectional index numbers is the same as that of the General index number—each of the thirteen figures represents the trend of the particular category of goods weighted according to the value in exchange, free from duplication. Accordingly the system of weights used was different from that used in the compilation of the General index number, which were also used in the computation showing the figures for groups of commodities classified according to main basic materials. It will be evident that, for many uses to which these figures may be put, sectional index numbers (or some combination of them) will be regarded as more suitable than the General index.

As to the commodities covered by the different series, wool, for example, would be included in the category Crude, yarn would be regarded as Simply Transformed and cloth and clothing as More Elaborately Transformed. As to Use, the categories are perhaps self-

explanatory. A few important commodities are included in more than one description: for instance, flour used by bakeries, suitably weighted, is included in the Use category 1, whereas flour, as home baked, is included in Use category 5. The heading Materials for Agricultural Production requires, perhaps, some amplification. It includes a very large weighting in respect of store cattle, as exported, as well as commodities like wheat offals, fertilisers and seeds, purchased by the farming community. In consequence, this figure has a fundamentally different scope from the index number formerly computed annually for Feeding-stuffs, Fertilisers and Seeds purchased by the farming community as a whole (and not including inter-farm transactions). The present figure might not differ very much from prices of materials as this factor affects the *individual* farmer working a medium-sized farm.

While almost all the more important specific commodities, home-produced and imported, have been included in this computation, it would obviously be quite impracticable and unnecessary to include all of the many thousands of commodities which enter into trade. It has generally been assumed that the price trend of these excluded commodities has been in accordance with that of similar commodities which have been included.

Agricultural commodities are weighted according to their value in trade, i.e., no account is taken of the hypothetical values of commodities which are consumed on farm households on which they are produced; nor is any account taken of the considerable traffic in farm produce between farmers themselves.

Were it not for the emergency the price index numbers would have been more broadly based on some year or years. In existing circumstances the single month October, 1938, seems to be fairly suitable as a base period: that it was about "normal" for the pre-war period may be gauged from the fact that in October, 1938 (compared, in brackets, with the average price for the 13 months centred at that month), import prices were 88 (88) and export prices were 89 (90), to base 1930=100; and the agricultural price index (new series, base September, 1938-August, 1939=100) happened to be 100 in October, 1938.

It must be admitted that times like the present, when many commodities are in short supply, when the movement of prices, though steeply upward, is highly irregular as between different commodities and different groups and when the desideratum of unchanged quality can no longer be maintained, are not propitious for index numbers. Yet it might be argued that this is just the time when these figures are most useful—so useful that they can be utilised even if subject to a reasonable margin of imprecision. Many of the commodities included in the original computation are no longer in supply. The number of specific commodities included in the General figure was 289 and this has declined to 220. To maintain so many price series different expedients have had to be adopted. In a few cases home products are now substituted in the price series for more or less similar commodities formerly imported; for instance, the leather group which before the emergency consisted of various descriptions of home-produced and imported leather, now consists only of home-produced leather which carries the total weight attributed to leather in the computation. Commodities have been substituted for others with cognate use—the outstanding instance is turf, which is now used instead of household coal in the pre-war calculation; it may be observed that the

price of turf used represents the weighted average of prices in "Turf Areas" and "Non-Turf Areas", the former being the simple average of prices in more than 100 centres. Pre-war weights are used for almost all commodities included and since the patterns of production and consumption have undergone profound changes, a certain distortion is introduced thereby into the figures. The extent of the change in the economic pattern since pre-war is not so large as is commonly supposed, however, and, when many commodities are included in the calculation, index numbers are affected only in a minor degree by changes in weights. The recalculation of weights based on war-time standards would be a most onerous task which would not be completed until a long time after the period to which the figures could purport to relate, when the new weights might be out of date. On the whole, it has seemed best to adhere to the existing system of weights.

General Level of Prices.

This concept envisages the money value index of all transactions in respect of goods and services during any period and the "factorisation" of this aggregate index into "price" and "quantum". For the types of transactions indicated in the first column of the following tables, "price" index numbers shown in the third column have been computed.

TABLE 9

Computation of General Level of Prices in 1944 to Base 1938-39=100.

Type of Transaction (1)	Value Weights 1938-39 (very approximate) (2)	Price Index 1944 (Base 1938-39=100) (3)
(A) Wholesale	£ million 145	198
(B) Retail	80	176
(C) Wages and Salaries	70	127
(D) Rents	5	101
(E) Securities	20	110
Weighted Index for Above Items		170

Notes as to weights (col. (2)) :—(A) : home production plus imports ready for use plus duties ; (B) : based on Census of Distribution, 1933 ; (C) : based on particulars of remuneration for 80 per cent. of employees at work adjusted to aggregate for 1936 ; (D) : T. J. Kiernan, Ph.D., JOURNAL, 1932-33, p. 94 ; (E) : conjectural, purporting to include purchases and sales of extern as well as home securities other than by banks.

It is unnecessary to point out the incompleteness of the foregoing computation : it excludes, for example, transactions in land and houses which may amount to £5 million per annum. The General Price Index Number as computed is estimated at 170 to base 1938-39=100. According to the Bulletin of the Central Bank, average daily bank debits in the first six months of 1944 have increased by 32 per cent. compared with the corresponding period of 1939 which would appear to indicate that the quantum index for cheque transactions is about

78 (=100 × 132/170). The quantum index for all transactions by cheque, notes and token coinage together is probably larger than this, since the amount of notes and coin in circulation has doubled and there has possibly been a proportionate increase in the value of transactions financed by such means.

I would like to express my indebtedness to Mr. Stanley Lyon, Director of Statistics, and Vice-President of this Society, for valued advice, to my colleagues, Messrs. A. S. Ó Coineáin, M.Sc., B.A., and M. J. Quinn, B.Sc., for technical assistance, and to the members of the staff of the Statistics Branch for help in computation in the preparation of this paper.

DISCUSSION ON DR. GEARY'S PAPER.

Mr. Brennan said that Dr. Geary's paper was of great value for the comprehensive character of its survey of our present series of index-numbers and for the new light which it gave on several features of interest in their composition. Amongst other uses, the various series were regarded as indications of the changing value of money and were sometimes thought of as shots at a target directed from so many different angles and elevations. There were those, however, who doubted whether there was in fact any objective target in the sense of a single general value of money. Purchasing power had a subjective character and the same income might have a different meaning for two individuals of different tastes and circumstances. The cost-of-living index did not mean the same to the urban worker who bought all his requirements and the farmer who produced much of his own food.

A price index might change for a reason other than a change on the side of money. Factors such as taxation or subsidies could be very disturbing. Thus a tax on retail sales would produce an effect on a cost-of-living index without any effect on a wholesale prices index.

The use to which it was to be put was as the paper fully recognised a vital consideration in determining the best type of construction for any index-number. Conversely anyone making practical use of an index number was liable to fall into error if he had not present in his mind the method of construction adopted and the paper was most useful in affording guidance on this point.

For price comparisons over long periods of years a type of index devised for short-term comparisons seemed unsuitable. Where provision is made for varying the list of commodities or their weighting so as to reflect a changing pattern of consumption, the degree of comparability must inevitably decrease with the lengthening of the time interval. Statisticians who were inclined to be facetious about the lack of refinement in the wholesale price indexes of the "*Statist*" and the "*Economist*" did not seem to have produced any admittedly superior alternative for long-term use. For most practical purposes, however, it was an index for periods up to, say, ten years that was important.

Professor Shields.—I have heard this lecture with great pleasure. It is highly informative, and replete with constructive suggestions. The lecture as a whole, especially the latter part dealing with a new wholesale price index number for Eire, will command serious attention

not only by the chiefs of State statistical departments, but also by statisticians of international repute.

Let us first consider our cost of living index number. It is based on retail prices in July, 1914, some thirty years ago, with weights taken from household budgets compiled in 1922. Obviously, a new basic period and a more up-to-date system of budget weighting are essential. Sometime in the near future, we will have passed, since July, 1914, through two world wars, the consequent technical, economic and social changes of which, and the alterations in the distribution of expenditure and modes of living of different classes of the community will have caused the first pre-war period to be regarded as somewhat dim history. I can see the objections to establishing a new basic period: it will not follow step by step the British cost of living index number; it may upset some existing arrangements for determining salaries or wages or bonuses, or the historical continuity of our index number. As regards the old weights, it has been found, as a result of household budget enquiries for industrial towns in 1937/38 in Great Britain, that the percentage figures differed radically from those of the official figures. For the latter, the percentages for food, clothing, fuel and light, rent and miscellaneous are 60, 12, 8, 16 and 4 respectively; while for the former the percentages were: 40, 9.5, 7.6, 12.7, and 30.1 respectively. There is no reason why a new official series on a more recent budget basis should not be calculated, even if it is decided to continue the old series. A cost of living index number to be generally accepted should be free from obvious objections from those able to understand it, and who take the trouble of ascertaining the methods by which it is calculated.

On the subject of weighting for the cost of living index number, the aggregative method for a standard year might be applied to the different items in the number, except rent. Approximate figures for the total consumption of the community might be obtained from the total production less exports plus imports of the various items. This would be a somewhat difficult procedure, but if it were feasible to calculate it, it would introduce something approaching a cost of living number, in which the expenditure of all the citizens would be taken into account. Then again, another method might be used, by which the nutritional values of the different items of foodstuffs in the index number could be calculated and used as weights. The more information we have on, and the more publicity can be given to this subject, the greater will be the efforts to improve the health of the community.

Personally, I am sorry that a change was made in the compilation of the monthly agricultural price index numbers by the introduction of the Fisher ideal number, 353, and the substitution of fixed weights for the former system of monthly weighting varying according to the particular month, even though it gave a distorted sequence to the index number for January in each year. Under the old method the index number for any one month could be readily compared with that of the same month in previous years. As a result of employing the Fisher ideal number in the case of the new series there is an inverse relationship between the old and new series of index numbers from February to July this year, which is confirmed by the tread of the moving 5-monthly average graph on p. 357. Professor Fisher asserts, in discussing the different formulae for determining index numbers, that all methods agree, as Professor Busted has stated, but Fisher added, if free of freakishness and bias.

As regards the proposed wholesale price index number, the weight

to be attached to the first group on p. 366 will, in its applications, overbalance most price variations in the other groups. The problem of introducing manufactured goods is a difficult one, where a particular industry produces a variety of articles of different qualities with variable prices. The difficulty is all the greater in the case of a large number of industries in this country, which do not specialise to the same extent as those of other countries. Personally, I would prefer to see an index number of the same commodities or of a group of those of a more or less similar class than an index number in which many different items in varying stages of production are combined in a composite figure. One thing that people would be anxious to ascertain is the index numbers of a raw material of a definite quality, e.g. raw wool, and compare them with those of woollen or worsted yarns, and, if possible, with those of cloth of specific qualities. In this way, upward trends or fluctuations in prices of a product in its different processes of production can be noted.

I have again to emphasise the indebtedness of this Society to Dr. Geary for his carefully finished paper, and the determination of our State Statistical Office to base the various series of index numbers on solid scientific foundations.

Mr. Quinn compared certain British indexes with their Irish counterparts. The Board of Trade Index of Wholesale Prices does not take the commodities to the later stages of production, e.g., wool and cotton are not taken to the clothing stage and leather is not taken to the boot and shoe stage, as is done in the Irish index. Modern thought inclined to favour the Irish practice. The British index uses the geometric method of averaging. It is difficult to give any concrete significance to the geometric method, while there is something very understandable about the arithmetic method (which might be described as the "budget" method) which makes it intelligible and acceptable to the layman, and, as Dr. Geary emphasised, this is a virtue in itself. A justification of the geometric method which has been urged is that in a period of rising prices, it tends to damp down the effect of very large increases. But would it not be true to say that in a period of falling prices, the effect would be to exaggerate the items which have *fallen* most?

In present company it was perhaps advisable to tread warily as regards the *Statist* index. However, this index was perhaps oversimplified for modern uses because of its insufficiency of range (only 45 commodities, as against 150 in Board of Trade Index and 220 in Irish index) and because its weighting (simple average) was scientifically untenable. Weighting *does* matter in spite of the famous text-book dictum that it doesn't. Weighting is unimportant only when the percentage price-changes of individual commodities have all been of the same sign, and fairly close together, which is a very theoretical concept. In actual practice, when prices in general have changed considerably, there is a large "spread" between the different price changes.

The British Agricultural Prices Index has a special importance for us in view of the dominant position of agriculture in our economy. The weighting is by output in the five most recent crop-years, and the monthly index is corrected for price seasonality. It will be seen that the British index occupies an intermediate position between the two Irish indexes, since the old Irish index corrects for both price and quantum seasonality, the British index corrects for price seasonality, while the new Irish index corrects for neither.

The hub of the problem of index numbers is their use. Sir Alfred Flux in his paper to the Royal Statistical Society on "The Measurement of Price Changes" referred to the construction of index numbers as a search for a system of commercial meteorology so as to enable us to recognise types of disturbance and to scent the approach of commercial cyclones and anti-cyclones. To continue the metaphor, the administrator or business man is headed for trouble if he bases his navigation on a commercial meteorology which was not calculated for his particular line of flight. In other words, index numbers should be used only for the purposes for which they have been designed.

Professor G. A. Duncan wrote :—The index number of wholesale prices fills a very long felt want in our Irish collection of statistics. But I feel in regard to it the same uncertainty that is expressed in another part of this paper about index numbers in general, namely, what is it designed to show? I think the ruling idea behind most wholesale indices has been the belief that in the wholesale markets the participants are more strictly *homines economici* than in retail dealings, and that therefore the prices struck for wholesale bargains are both more of distinctive economic events and more sensitive than prices in other markets, so that they are a better indication of what is happening or about to happen. They are unaffected by various lags and stickinesses that affect other prices. If this is so, the coverage of a wholesale index should clearly be the kind of transaction which can be described as a wholesale trade between two middlemen. The coverage should be defined by the nature and not by the size of the transaction, nor by the type of product. It is, for example, difficult to think of properly wholesale transactions in bread or clothing, except when retailers furnish themselves with made-up clothing under competitive conditions from a number of different suppliers. Most of the so-called wholesale index numbers with which we are acquainted have stopped short at a list of primary materials or semi-processed goods, very often because data on these are so easy to get. I am not clear from Dr. Geary's description whether perhaps he has not reached too far in the other direction, and included in his coverage a number of transactions which are not really of a wholesale kind at all. The same question arises in regard to weighting further on. While I admit the difficulty of arriving at any entirely satisfactory conclusion it seems to me definitely wrong to weight the movement of any wholesale price by reference to the value of retail transactions or rather the total value of the end-product the great bulk of which must be disposed of retail (e.g. bread and clothing). I was rather surprised that Dr. Geary did not, in these paragraphs, specify the precise method of calculation of the wholesale price index, namely, whether he uses the Fisher formula or the straight arithmetical one.

2. There are a couple of points arising out of the breakdown of the general index. One of the perennial troubles in the practical use of index numbers is that it is impossible to relate the movement of two indexes which ostensibly cover much but not quite the same ground—for example, an index of retail prices and an index of wholesale prices whose coverage is different. If the general wholesale index can be broken into groups and classes, will it not be worth while to consider seriously the reconciliation of these groups and classes with the other indices which might have to be used in conjunction with the wholesale index?

3. I agree most strongly with what is said about the unsatisfactory treatment of index numbers in the text-books, and I agree that the

reason is that the philosophical background of index numbers has never been systematically enough explored, i.e., people have interested themselves too much in the arithmetical technique of computing the various numbers but not enough in the purpose for which the number is designed. Clearly if all you are trying to do is to show the movement over a period of time of a universe whose composition is taken as complete and constant, then one can concentrate wholly on the mathematical problems involved. The tendency to do so has very naturally been reinforced by considerations of administration and continuity, considerations whose importance cannot be over-estimated and which may very often advise the acceptance of a purely arbitrary universe in default of the more logical one. If we consider what the index number is intended to reflect, then the universe which is selected cannot be entirely arbitrary, and it seems to me that there are three quite separate ideas between which the compilers of index numbers have never completely made up their minds :

- (a) The first is tracing the movement of a set of items which are picked as being representative or fundamental, and where the idea is to give the impressionistic picture of something which is regarded as basic in economic life. Here, of course, a fixed quantities base or fixed weighting is appropriate.
- (b) The second is where it is desired to show the movement of, say, the cost of some standard or minimum budget which is selected on external grounds as being of exceptional importance even though it may not represent any objective fact at any particular time—here also the composition or weighting must remain constant.
- (c) The third and most difficult case is where it is intended to represent the process of changing patterns as well as the process of changing costs of a given pattern, to allow for the disappearance of old items and the introduction of new items or to allow for the presence of certain items in one place and their absence in another, or for the changing relative importance of different items. Here, of course, the fixed base is entirely inappropriate and some arbitrary compromise such as the Fisher formula is the only recourse—but it must be recognised that the Fisher formula is an arbitrary compromise, and can have a meaning attached to it only where the gradations that have to be made are relatively small. The application of the Fisher formula to show the comparison of the cost of living in Dublin in 1744 and 1944 or the comparison of the cost of living in Dublin and Tokyo in 1944 would give results that are meaningless if not absurd.

4. I have a feeling that the real criticism to be made of things like the cost-of-living index is that of falling between the two stools of (b) and (c) in the preceding paragraph. If it purports to measure changes in the cost of maintaining a working-class family then an element of judgment as to what a working-class family ought to consume or ought not to consume is entirely appropriate, and the inclusion in weighting of items based simply on average budgets is not a conclusive answer at all. On the other hand if it endeavours to take account of the actual patterns of consumption in working-class families and their changes, it ought to include a number of items (such as alcoholic liquors and direct taxes, including social insurance contributions) which are not now

included. But the argument remains evident that an index computed on the latter basis would not be an appropriate one to be used as a standard for determining wages and so on. The answer to that, of course, is that the modification of wages and salaries by reference to the cost-of-living index is in itself a reprehensible practice.

5. The first table is an extraordinarily useful summary of the available indices. I may perhaps be permitted to make a few general remarks on it about what I should think should be there but isn't, without at the moment enquiring too closely whether it is technically possible to fill the radical gaps or not. The whole aim of any collection of official or semi-official indices published in any country should be to give a synoptic picture of the movement of the economy as a whole. For this purpose we would need in addition to those mentioned :—

- (a) A retail-price index covering all retail transactions.
- (b) Cost-of-Living indices for groups other than that section of the working class which is covered by the existing cost-of-living index.

(These two indices would, of course, have to include services such as hotel and restaurant meals and domestic service as well as the actual prices of commodities.)

- (c) An index of costs, which in an economy like ours would have to be divided into agricultural and industrial. In each case it would have to be compounded of sub-indexes of wage rates (which in turn would need to be split into at least skilled and unskilled wage rates), interest rates and material costs.
- (d) In the indices of agricultural production and prices I feel more than ever doubtful about the propriety of including turf.
- (e) An index of the rate of investment and correspondingly an index of the average value of investment properties. The current index of stocks and shares is rather meaningless as it stands. The stocks and shares of companies registered inside the State (except railways) is only a small fraction of all the property which is dealt with on the Stock Exchange, and the movement of that index is affected not only by the shareholders' reading of the fortunes of these local companies, but also by the current quotations of the other stocks and shares that are dealt with there.
- (f) An index of the total productive effort of the economy, i.e., its source of income in real terms. The difficulties facing such an index are so enormous that I am doubtful how successfully it could be accomplished. The total monetary value of the source of income can be computed without too great a margin of error ; it is the question of a price index whereby to correct it that is so difficult. I made a ham-handed attempt at such an index in the report of the Banking Commission and the index of the general level of prices in the last two paragraphs of this paper is a better attempt at the same thing. But the doubt in my mind is whether any appropriate price index can be logically contemplated at all. Presumably what one wants is a measure of the meaning of £1 in 1934 and 1944 irrespective of what it is spent on or how it is spent inside the economy. It must,

therefore, take account of the possibility of it being used to purchase either goods or services and to buy either wholesale or retail. But how this wide range of uses can be logically brought into a single index I do not quite know. I certainly think it is logically wrong to, as it were, add up a wholesale index and a retail index, weighing each by the value of total sales at wholesale and retail and still more wrong to add in an index of wages and salaries, since the retail index is in a very great sense only the resultant of the other two. That is, however, only a very superficial reaction for the moment. It is a problem which has been present in my mind but to which I have not had the opportunity of devoting a great deal of thought.

- (g) An index of consumption. This obviously is different from (f) above and presents none of the same logical problems since the correct deflator is simply the index of retail prices.

6. I had some difficulty in following the argument about the monthly agricultural price index number, in particular the reference to normalcy and to stability of the indices. I may have got hold of the wrong end of the stick but I do not see how any particular choice of base period for the purpose either of selecting the base prices or of fixing weighting can give stability to subsequent indices. If the prices whose movement one has subsequently to measure are fluctuating wildly both absolutely and relatively to one another, then the relative movement of indices will be just as wild whatever the weighting and whatever the base period designed. Incidentally, the selection of a normal base period appears to me to be appropriate only to the selection of weights and not at all to the selection of the base year in terms of which subsequent movements are expressed. Would, for example, the use of a 10 to 15 year moving average in place of a fixed period 1924 to 1929 affect the latter? If, as is done, the figures are finally expressed as a percentage of the 1911 to 1913 base, in absolute terms, of course, it would. But in terms of the relation of each current index to each other current index it would make no difference unless there were some long term trends present. In that case the effect would be undesirable because it would understate the effect of the trend. A further question in my mind is whether the index in its present form does correct seasonality. Both the question and the answer seem ambiguous. In the sense that the index allows for the seasonally varying *q*'s that are entered at seasonally varying *p*'s, it certainly does. In the sense that it gives, in place of the actual prices current month by month, the prices that would have ruled over the season as a whole if there had been no intra-seasonal variation, it equally certainly does not. Also I do not entirely agree with the statement that a smooth movement of prices ought to be assumed. Prices do in fact jig about and an index which conceals that is not fulfilling all the functions of an index.

7. Turning now to agricultural production, would it not be well to point out that two big differences between it and the industrial census are :—

- (a) The addition to the latter of separate enterprises makes the concept of Net Output necessary to eliminate duplication in a way that is not required by the global treatment of agricultural production. If the attempt were made to estimate agricultural production *farm by farm*, and add it up, the same technique would be necessary as in industry. In the agricultural computa-

tions the technical question of possible duplication arises only in regard to the estimation of the quantities of potatoes, corn, milk, etc. used for human consumption and for further production on the farm respectively. When adding agricultural and industrial activity together, of course, there is the question of duplication between them, a question which I am afraid, speaking without the book, I overlooked in my Social Income estimates.

- (b) The treatment in changes in stocks: for reasons which we discussed long ago, these are ignored in agriculture and only sales or consumption counted. For example, calves added to stock, either because they cannot be sold or because the farmer is building up his herd, are not counted. On the other hand, industrial *production* is counted, whether sold or put into warehouse stock. The difference is imposed by circumstances, but is still a noticeable difference.

8. I should say that an additional reason for accepting 1929-30 as a base year is that, as our best achievement to date, it represents both a target and a standard. In this connection I should like to stir up a more general suggestion in your minds. To the layman presented with a group of index numbers it must be profoundly confusing and irritating to find that one is referred to 1936 as base, another to 1924-29, another to 1930, another to 1911-13, another to August, 1914 and so on. Could we not have all our principal series, as published, referred to one standard base? It brings me back to the point I made earlier, of the confusing way the word "base" is used in statistics, as a base of reference (which is purely a matter of arithmetic and convenience), a base of calculation (which is also a matter of judgment) and a base of weighting (which is wholly a matter of judgment).

9. Should not Col. 5 in Table 7 come out the same as Col. 3 in Table 6? I find the conclusion at the end of the preceding paragraph doubtful: it might also be the result of consumption of agricultural capital.

Dr. Geary said that Dr. Brennan discussed the important question of the weighting of an index number purporting to represent the general level of prices. He (Dr. Geary) agreed that probably the best weighting of such an index figure would have been the aggregate value in exchange for the various categories of the types indicated in Table 7. Unfortunately such weights were not available, even for cheque transactions which, in this State, constitute only a fraction of all exchange. He (Dr. Geary) had always been puzzled by the extent to which such figures as the national income, the value of goods entering into the exchange, etc., fell short of the £1,500 or £2,000 million of the total annual value of all transactions. The contrast revealed an unexpectedly large volume of exchange transactions which, for the greater part, must be at the wholesale stage of exchange of goods. If this were the case it would appear that for Table 7 wholesale prices should be more heavily weighted than they were, so that the aggregate figure for the whole level of prices would actually be higher than the 170 shown. He (Dr. Geary) was still open to conviction as to the weighting to be used in the computation of this figure. As a possible objection to the concept of the exchange value weighting he might instance the hypothetical case in which, say, woollen mills purchased all their wool requirements direct from farmers in an earlier period. A wholesaler interposes himself between sheep shearers

and manufacturers. The exchange concept would mean that the weighting for wool should approximately be doubled, yet one had the feeling that the effect on a price index designed to indicate the trend in the purchasing power of the currency unit would not be influenced to the extent of such a doubling in the weighting. He (Dr. Geary) agreed with Dr. Brennan that, as stated in the paper, the computation was very tentative. It was submitted as a challenge for somebody else to do better.

On Professor Busteed's point he agreed that accuracy of basic data was important, but he could not agree as to the relative unimportance of weighting. In fact, almost every table in the paper indicated the contrary.

With regard to Professor Duncan's interesting letter, it would appear that in places my argument must have been unduly condensed. Long as the paper is, it has been ruthlessly purged of matter which has appeared elsewhere (e.g. in regard to the cost-of-living index in the Johnson Report) and of a considerable section relating to the new concept of the net volume of industrial output which will appear in the *Journal of the Royal Statistical Society*.

In regard to Professor Duncan's first paragraph, the actual procedure used in the computation of the General wholesale price index number may be illustrated by reference to the treatment of the wool-wool yarn-woollen cloth sold retail complex. The figures shown for weights in column (a) in the following table are rather simplified but they will serve to illustrate the principle.

Commodity	Wholesale	Price June, 1944	Product
	value in base period	(Base period=1)	
	(a)	(b)	(a) x (b)
Wool	37	2.435	89.80
Wool yarn	65	2.675	173.88
Woolen cloth sold retail ..	100	2.611	261.10
	<hr/>	<hr/>	<hr/>
Total	202	2.598	524.78

The figures in column (a) mean that by value 37 of wool were made into 65 of wool yarn which went to the making of 100 of woollen cloth (other than that which was sold to wholesale clothing factories, dealt with in an analogous manner in another complex). The weight 202 is duplicated twice in respect of wool and once in respect of wool yarn so that, to eliminate this duplication, the entries in the computation sheet of the general index number are the unduplicated figures of 100 for the base period and 259.8 (=100 x 2.598) for June, 1944.

I need hardly say that the application of this arithmetical principle involved extremely onerous computations. After giving the matter the closest thought and after reference to all the authorities it is thought to be the best manner in which to give effect to the rather irreconcilable concepts of (1) freedom from duplication, and (2) the "exchange principle" in weighting.

Still dealing with paragraph 1, Professor Duncan seems to have the impression that the weights for the wholesale index computation are largely retail values. This, of course, is not the case. For a few items the wholesale values are not very different from the retail values and in such cases (of which bread is one) the retail price is taken as indicating

the wholesale trend. I have a good deal of sympathy with what he says about the desirability of instituting price index numbers which will indicate what is about to happen. Experiments have been made in some countries with the "sensitive price" indexes but they were not attended with success. In such cases weighting is of little or no importance: what matters is the selection of the commodities.

In regard to his paragraph 2, we have actually in contemplation very many more breaks-down of the general figure than those mentioned in paper. One of the most interesting experiments in hands consists in using the wholesale price series for the purpose of deflating imports and industrial production to show volume figures which would thereby implicitly take account of quality. The times, of course, are not propitious for such experiments. The answer to the query at the end of the paragraph is, accordingly, an enthusiastic "Yes."

I am very interested in paragraph 3, which I think I can best deal with by re-stating my philosophical position in regard to index numbers. I find that a price index conveys little to my mind unless it can be used to deflate a "value" (which is "true") to give a "real" or quantum concept. In practice this viewpoint always implies the use of Fisher when it can be used and the arithmetical aggregate when it cannot. With a fair knowledge of the literature of the past half-century it is my considered opinion that the method adopted is the most useful principally in that it provides a rational quantum index and also that it goes as near as one can get to that generally accepted but hard to define concept of "General Level of Wholesale Prices." My paper has been in vain if it has not conveyed a considerable measure of undissipated scepticism in regard to the concept of the *general level*. I need not remind you that for 20 years the Statistics Branch has evaded this comparatively simple task, principally for the reason that it could find no rational definition of a wholesale price index number, except in arithmetical terms, and that the principal stimulus to the official computation was the recommendation of the Banking Commission. Our position might almost be defined as "if there is such a thing as a general wholesale price index number then this is it."

On paragraph 3 (c) I think I agree. There is, of course, the chain theory (in space of time) whereby one can compare Dublin with Tokyo or Dublin, 1944, with Dublin, 1774, proceeding stage by stage, provided the weighting pattern does not change too drastically between consecutive stages. This, of course, brings us up against the difficulty that the Fisher formula does not work for the triangular test, where one would get different answers if one travelled to Tokyo via Russia or America. You will remember that Fisher discusses this difficulty and comes to the triumphant conclusion that the failure of this test in the case of his formula is a further proof of its value.

I am in complete agreement with (a), (b) and (c) of Professor Duncan's paragraph 5. As regards (d), the point has often been made and there would be no difficulty whatever in making an index number excluding turf. Our definition of an agricultural product has always been that which is produced by agriculturists: hence turf. As to (e), I think that "meaningless" is definitely too strong. You will remember that the index is intended as an "Economic Indicator": it is not an investors' index such as I had in mind in the figure shown in Table 9, which takes into account not only Irish but external securities which Ireland owns. The object of the index is merely to show how Irish business is doing.

As to (f), I envisage in the first place the correct *value* of all cash transactions, goods at wholesale and retail, wages, salaries, securities and services, represented by, say, the total of bank debits plus the total of debits settled by notes and coin. The General Level of Prices which I was trying to find was an index figure which would give quantum expression to this total, by division.

As regards Professor Duncan's paragraph 6, I think my treatment of the agricultural price index must have been too abridged. I am quite satisfied that, for all its faults, the old system of price index numbers *did* fully correct for seasonality, normality being defined as that obtaining during the period 1924-29. The stability and representativeness of this base period is of importance but one is in the quandary that if one extends it for the sake of stability, it ceases to be representative. As regards the third sentence of the paragraph, the point in the paper was simply that if A and A^1 were the sum-products for, say, January in the base and in the current periods, respectively, and if B and B^1 were the corresponding sums for February, then the (former) agricultural price index number for January would be KA^1/A and for February KB^1/B , K being the annual agricultural price index number in 1924-29 to base 1911-13=100. The point is simply that the variation in the current index between January and February will depend as much on the denominators A and B as on the numerators A^1 and B^1 .

I agree that if the data are inherently variable the index numbers should reflect it. What happened in the case of the old agricultural price index number, however, was that a fall was recorded between December and January which was not reflected in the individual prices, a situation not to be tolerated.

I am in complete agreement with paragraph 8. As regards paragraph 9, the differences in the figures for 1939-40 are due to the fact that in Table 6 the figures represent the sum-product of the 1939-40 quantities literally valued at 1938-39 prices, whereas the figures shown in column (5), Table 7, represent the quotients of the figures in column (3) divided by the Fisher index in column (4). There is no arithmetical reason why the figures should be identical in the two tables.