

[Communicated to the Council
and the Members of the League.]

Official No.: C. 133. M. 85. 1939. II. A.

[C.E.S. 145.]

Appendix II.

**STUDIES AND REPORTS
ON STATISTICAL METHODS**

No. 6

INDICES OF INDUSTRIAL PRODUCTION

REPORT

DRAWN UP BY THE

COMMITTEE OF STATISTICAL EXPERTS

LEAGUE OF NATIONS

GENEVA

1939

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PREFACE

This pamphlet contains a report and recommendations of the Committee of Statistical Experts on Indices of Industrial Production. The recommendations have been prepared in accordance with the provisions of the International Convention relating to Economic Statistics of 1928. The report was drafted by a special Sub-Committee, the composition of which is shown on page 5.

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League of Nations,

Geneva, April 1939.

REPORT ON INDICES OF INDUSTRIAL PRODUCTION

[Reprint from the Report of the Committee of Statistical Experts on the Work of its Eighth Session (document C.133.M.85.1939.II.A).]¹

1. In virtue of Article 2, V (C), and Article 7 and Annex V of the International Convention relating to Economic Statistics, the parties to the Convention undertook to publish "statistical series, in the form either of absolute figures or relative figures referring to a period taken as a basis of comparison, at regular intervals, if possible, quarterly, or preferably monthly, showing variations of the industrial activity of the most representative branches of production".

2. As the compilation of such series in the form of general indices of industrial production is being undertaken in a steadily increasing number of countries, the Committee has studied this subject from the twofold point of view of providing theoretical and practical guidance for countries intending to compile such indices or to revise their present compilations, and of securing, as far as possible, the international comparability between them. In accordance with a decision of the Council, of September 10th, 1938, a preliminary report on the subject has been communicated for observations to all authorities or bureaux, whether official or not, which publish such indices.

3. The final report, which will be found in the Appendix, has been drawn up in the light of the comments received. The great number of replies² shows the interest taken by those concerned, and several replies have stressed the value of the Committee's recommendations for the development of national statistics in this field. The Committee was happy to note that the outline of its programme has met with general approval. The proposals received as to changes in methods or to extension of the scope of the recommendations have been considered by the Committee in the light of the basic principles underlying its recommendations, but, especially in view of the fact that these proposals were supported by relatively few countries, the Committee did not feel justified in making substantial changes in the draft recommendations. The Committee was therefore able to restrict its task to the improvement of certain statements which appeared to risk misinterpretation, and to embody in the programme suggestions of minor importance.

4. The Committee ventures to hope that the Council will decide to communicate the final report on indices of industrial production to all authorities or bureaux concerned and invite them to put into effect the recommendations made.

¹ The following members of the Committee were present at this session: M. M. HUBER, Director of Studies at the Statistical Institute of the University of Paris; Dr. C. BRÜSCHWEILER, Director of the Swiss Federal Bureau of Statistics; Mr. R. H. COATS, Dominion Statistician, Canada; M. E. COHN, Director of the Statistical Department of Denmark; M. V. DORE, Head of the General Statistical Bureau of the International Institute of Agriculture; Mr. D. DURAND, of the United States Tariff Commission; Sir Alfred W. FLUX, formerly chief of the Statistical Service of the Board of Trade; M. G. JAHN, Director of the Central Statistical Office of Norway; Mr. J. W. NIXON, Chief of Section, International Labour Office.

The preliminary report was drawn up by a special Sub-Committee which included some members of the main Committee: M. M. HUBER, M. C. BRÜSCHWEILER, Sir Alfred FLUX, M. G. JAHN; and two outside experts: Professor O. ANDERSON, Director of the Statistical Institute of the University of Sofia; and Mr. C. SNYDER, Federal Reserve Bank of New York.

Mr. O. ANDERSON was also present at the eighth session of the Committee.

² The Committee was in the possession of forty-one replies coming from thirty different countries.

Appendix

INDICES OF INDUSTRIAL PRODUCTION

PART A. — THE OBJECT AND MEANING OF INDICES OF INDUSTRIAL PRODUCTION

The suggestions and recommendations made in the present report relate to current indices of industrial production. Such monthly or quarterly indices are compiled in some countries so as to provide, on a representative basis, information on current quantitative changes in aggregate production.

There can be no doubt that the reliability of current production indices, which are not weighted on the basis of complete production records, and which cannot be checked from time to time against such records, is not satisfactorily established. The Committee was of opinion that the various emergency methods, for the construction of the framework of an index of industrial production, applied by countries undertaking no complete survey of their production cannot constitute a basis for its recommendations. The Committee's recommendations start therefore from the assumption that complete production statistics are available at intervals, or that, at least, for weighting purposes, data similar to those which are generally obtained by such censuses can be approximately estimated.¹ If this is not the case, replacement data have to be estimated on the basis of other sources. The recommendations might nevertheless serve as a guide in the choice of such data.

Further, all recommendations made in this report start from the assumption that indices of industrial production are intended, in principle, to measure changes in the physical volume of industrial production during a given period. The Committee preferred the term "indices of industrial production" to the description "indices of industrial activity", which was used in the Convention of 1928, as the object of the indices is to measure changes in the results of production rather than in the activity displayed. This new terminology was adopted with a view to avoiding different interpretations of the term "activity".

The term "physical volume of production" is meant to cover the quantities or "quantum" of goods produced for final use as well as for further industrial transformation. A general index of this kind should cover all stages of production, each stage being taken into account in proportion to its "net output"—*i.e.*, only to the extent of the productive contribution made by each industry to the products which it manufactures or finishes during a given period.

It should be noted that production indices of the type described above cannot be used as such for measuring changes in the supply of goods to the community as a whole or to various groups of consumers. The supply of commodities to the community is the object of all branches of economic activity—*e.g.*, agriculture, mining, manufacture, building, and also of distribution (transport,

¹ The Committee has not yet laid down any uniform rules concerning censuses of production. Certain conceptions used in such censuses, especially that of the "value added", have, however, been employed in the present report, although an exact definition cannot be given without anticipating the recommendations that may eventually be framed regarding the problems of those censuses.

commerce, etc.). Even if an index of *industrial* production were to include only goods ready for consumption, leaving aside goods in the earlier stages of production, it would still be incomplete and would therefore not serve to illustrate changes in supply. The Committee has drawn attention to this difference between "production" and "supply" indices, because in existing indices of production the elements of both types are sometimes mixed. In measuring fluctuations of supply, it is, for instance, irrelevant at what time the productive contributions of earlier stages were made; the time at which the finished product comes into the market is alone of importance in this connection. An extreme example will illustrate the difference. The "net production" of a shipyard constructing a big vessel will be recorded over a long period of time; from the point of view of actual "supply", however, a record is required only at the moment when the ship is ready for use. Although the Committee excluded from its recommendations indices intended to measure the supply of goods, it considered it necessary to emphasise the difference in conception, as this difference will have some bearing on the methods of measurement dealt with below.

PART B. — THE BRANCHES OF INDUSTRY TO BE INCLUDED IN THE INDEX AND THEIR GROUPING

I. "*Industries*" or "*Commodities*".

Existing production indices show a lack of uniformity of practice in the use of series relating to the output of given "commodities" and of such as relate to the production of given "branches of industry". Mixtures of descriptions of commodities and descriptions of branches of industries are even to be found in one and the same index. Although the physical volume of production is a concept corresponding more easily to the output of commodities, the basic information as to the "net production" or the "value added" can, as a rule, in the case of establishments carrying out all stages of a varied production, only be obtained for the establishment as a whole, as it will probably be often impossible to segregate by commodities the amounts of the "value added". Indices relating to the output of separate classes of commodities would have the advantage of being more easily classified by use, for instance, into producers' goods and consumers' goods, or into similar groups. The individual series of such indices can also be compared better with statistics of changes in the international trade of the country concerned. Production censuses and other complete production statistics, however, generally start from the data referring to specific establishments and the branch or branches of industry to which they belong; complete production statistics on a purely commodity basis are nowhere available. In view of the importance of production censuses as a basis for production indices, and particularly for their weighting factors, and of the fact that data reflecting changes in production, if statistics of actual output are lacking, are also more easily obtainable for industries than for commodities, the Committee has based its recommendations on the assumption that the basic series composing the index will relate to branches of industry. It is for this reason that the branches of industry, and not the kinds of products, to be included are discussed here.

II. *Scope of "Industrial" Production.*

The meaning of the term "industrial production" has already been defined in Annex IV, 2, of the Convention of 1928, where it is stated that industrial production should cover all branches of manufacturing activity, including building and other works of construction, and also mining and metallurgy. With regard to operations on the border-line between manufacturing industry and agriculture, fishing, transport or commerce, it has been laid down, as a rule, that it will be necessary to determine in each case whether the nature and the organisation of the work, and the processes employed, are characteristic of industry rather than of agriculture, transport, etc.

The Committee has in the course of its work prepared a nomenclature of branches of economic activity, primarily for the purpose of grouping the gainfully-occupied population.¹ The following sections of this nomenclature cover the branches of economic activity the output of which should be considered as "industrial production":

Mining and quarrying;
Manufacturing industries (including the production of electricity and gas);
Building and other construction.

The exact scope of these groups will be seen from the list of industries given below under IV (b). "Industrial production", as thus interpreted, does not cover the purely distributing trades (transport; communications; commerce) or hotel and personal services.

III. *Scope of the Index.*

Changes in industrial production can be measured for a single establishment, for a certain number of establishments belonging to the same branch of industry, for a branch of industry as a whole, for certain groups of branches of industry or for the total industry of the country. The Committee is of the opinion that the value and meaning of any general index of industrial production, whether weighted or unweighted, is seriously impaired if the index does not cover or represent production in a fairly comprehensive and clearly defined field of economic activity. Incomplete indices, which cover or represent only the movement of some industries, but do not cover or represent all the important industries of the country concerned, have, strictly speaking, only the significance of an average facilitating comparisons among the series included. The Committee is fully aware that this statement is a criticism of many of the existing general indices of industrial production, from which, owing to lack of information, certain branches of industry are excluded. From the point of view of international comparability, the completeness of the index or of its groups is, however, essential. If the output included in the index of one country covers, for instance, the food industries and other "consumers' goods" industries, while these branches are not covered in another country—as is frequently the case—the two indices are not directly comparable, as the branches mentioned generally show less violent fluctuations than "producers' goods" industries.

The Committee is aware that it is usually impossible, in practice, to obtain monthly or quarterly records of production for the total industry of a country or even for the total output of a given branch of industry. The indices will therefore have to be compiled on the basis of the representative current data which can be made available, and those used for the purposes of monthly, of quarterly and of annual indices frequently differ in the range of production covered. In such conditions, the need for complete indices referred to above can only be met by the adoption of an adequate weighting system (see Part C, II, below). If it proves impossible in a given country to compile complete indices in this way for all the branches covered by the total index, international comparability would gain if they could be computed at least for comparable sub-groups of economic significance.

IV. *Grouping of the Branches of Industries included in the Index.*

(a) *Principles of Classification adopted.*

When preparing the Minimum Nomenclature of Industries for the purpose of grouping the gainfully-occupied population, the Committee, for reasons set out in its report on this subject,¹

¹ See Studies and Reports on Statistical Methods, No. 1.

adopted a compromise solution, as the consistent application of a single principle of classification leads to results which are far removed from what is commonly recognised, and often organised, as a branch of industry. The grouping suggested for the manufacturing industries has been based mainly on a combination of the raw-material principle with the technique of work, while for the industries producing articles ready for consumption, for which the above principles cannot reasonably be applied, the use of their products has been taken into consideration.

Existing indices of industrial production show, however, that several countries have aimed at preparing a consistent grouping, in accordance with the "use" principle, into "producers' goods" and "consumers' goods". In view of the different courses taken by production in these broad groups in the various stages of the economic cycle, a consistent grouping by use would appear to be the best procedure, in order to secure groups of economic significance. It is true that, in the case of branches of industry which transform raw materials and deliver semi-finished products, which may be put to very different uses, the "use" principle cannot be correctly applied. It would appear useful, nevertheless, to adopt a classification which supplies, as correctly as possible, the elements for a grouping by use. Certain approximations will have to be accepted, but the claims to correctness which can be made by any index of industrial production are in any case not so great as those which might be claimed, for instance, with regard to a production census.

(b) *Classification by Branches of Industries.*

The Committee recommends the division of the index into the four branches of industry indicated below as A, B, C and D. This grouping is largely based on the Minimum Nomenclature of Industries. The numbered sub-groups are intended to show the content of the four main groups and to serve, if occasion arises, as a framework for a more detailed classification. The references to "sections", "chapters" and "items" refer to the nomenclature mentioned, by reference to which the exact scope of each group may be ascertained.

Classification by Branches of Industries.

A. Mining and quarrying (Section B) :

1. Ores (Chapter IV, 5-6).
2. Quarrying of stone and other materials used principally for construction (Chapter V).
3. Coal, oil and other non-metallic minerals (Chapter IV, 4, 7-8).

B. Manufacturing industries (Section C, without Chapter XVIII) :

1. Manufacture of food (Chapter VI).
2. Beverage industries, distilleries (Chapter VII).
3. Tobacco industries (Chapter VIII).
4. Manufacture of animal and vegetable oils and fats, including margarine (Chapter IX).
5. Chemical industries, n.e.s. (Chapter X).
6. Manufacture of rubber (Chapter XI).
7. Manufacture of wood and cork (Chapter XII).
8. Pulp- and paper-mills, manufacture of paper articles (Chapter XIII).
9. Printing and bookbinding, photography (Chapter XIV).
10. Skin, hide and leather industries (Chapter XV).
11. Textile industries (Chapter XVI).
12. Manufacture of wearing apparel and of made-up textile goods, n.e.s. (Chapter XVII).
13. Manufacture of mineral fuels (Chapter XIX).
14. Manufacture of non-metallic minerals, n.e.s. (Chapter XX).
15. Smelting, casting, rolling, forging and drawing of base metals (Chapter XXI).
16. Manufacture of articles of base metals, n.e.s. (Chapter XXII).
17. Manufacture of machinery, including all electrical appliances, means of transport by land, water and air (Chapter XXIII).
18. Manufacture of instruments, clocks and watches, and jewellery (Chapter XXIV).
19. Miscellaneous manufacturing industries, n.e.s. (Chapters XXV and XXVI).

C. *Production of electricity and gas (part of Chapter XVIII):*

1. Electricity.
2. Gas.

D. *Building and other construction (Chapter XXVII).*

1. Residential building.
2. Building for industrial, commercial and public purposes.
3. Railway, road, telephone line, and other construction.

The Committee recommends that indices relating to groups A, B, C and D, which have economic significance in themselves, should always be calculated separately, that the scope of such indices should be stated as exactly as possible, and that for each group the aggregate values or the weighting coefficients should be published. This procedure would permit of the inclusion or exclusion, in making international comparisons, of one or more of the three groups A, C and D from the general index—group B being always covered in principle.

Production within each of the four groups is influenced in varying degree by special factors apart from the general trend of business activity. The omission or inclusion in the general index of any of the non-manufacturing groups here considered tends, therefore, to affect both its level and movement.

The Committee considers it highly desirable that separate indices should also be calculated for those of the above sub-groups or combinations thereof which are of importance in the country concerned. In this case also, the aggregate-values or the weighting coefficients should be published.

(c) *Classification by Use.*

The Committee is of the opinion that a classification of industries according to the use of their products should, in the first instance, make a distinction between the industries concerned mainly with capital goods and the industries producing mainly goods currently consumed—a distinction which coincides largely with the distinction expressed by the use of the terms "durable" and "non-durable" goods. Further, a distinction between producers' goods and consumers' goods should also be available. The Sub-Committee considers that these requirements could best be met by the classification suggested below, in which Categories I and II, as opposed to III, correspond to the first distinction, and Category I, as opposed to Categories II and III, to the second.

For the purposes of this grouping, oils and fats (Group B, 4), chemicals (B, 5) and mineral fuels (B, 13), which are consumed only in part by the general public (or transformed into products thus consumed), have been considered as consumption goods. It is true that the remaining part of these commodities are used up in the capital goods industries, but as they ultimately form no material part of the products of these industries, their inclusion in the consumption goods industries appears to be justified.

For the regrouping of the nineteen industrial branches shown under "B, Manufacturing industries," according to the use of their products, the following three groups are proposed:

I. *Industries producing mainly or wholly producers' equipment and materials for capital goods*

to include:

- 7 (or part thereof): Manufacture of wood and cork.
- 14 (or part thereof): Manufacture of non-metallic minerals, n.e.s.
- 15: Smelting, casting, rolling, forging and drawing of base metals.
- Part of 16: Manufacture of articles of base metals, n.e.s.
- 17 (or part thereof): Manufacture of machinery, etc.
- Part of 18: Manufacture of instruments, clocks, etc.

II. *Industries producing mainly or wholly consumers' permanent equipment (consumers' capital goods)*

to include:

- Part of 7: Manufacture of wood and cork.
- Part of 14: Manufacture of non-metallic minerals, n.e.s.
- Part of 16: Manufacture of articles of base metals, n.e.s.
- Part of 17: Manufacture of machinery, etc.
- 18 (or part thereof): Manufacture of instruments, clocks, etc.
- 19: Miscellaneous manufacturing industries, n.e.s.

III. *Industries producing mainly or wholly goods currently consumed or materials therefor*

to include:

- | | |
|--|--|
| 1. Manufacture of food. | 8. Pulp- and paper-mills, etc. |
| 2. Beverage industries, etc. | 9. Printing, etc. |
| 3. Tobacco industries. | 10. Skin, hide and leather industries. |
| 4. Manufacture of animal, etc., oils and fats. | 11. Textile industries. |
| 5. Chemical industries. | 12. Manufacture of wearing apparel, etc. |
| 6. Manufacture of rubber. | 13. Manufacture of mineral fuels. |

The above grouping shows that the separation of Category III—Industries producing mainly or wholly goods currently consumed—from the rest of the manufacturing industries, producing capital goods, can be roughly effected without splitting up the groups given in the above classification (by branches of industries). On the other hand, the distinction between Categories I and II requires a further subdivision of certain groups. In some cases—especially if the changes in industrial production are measured by changes in the output of various types of commodities—it will be possible to make the necessary distinctions on the basis of the commodities produced. For example, it will be possible to segregate in large degree the production of motor-cars for private use from the manufacture of machinery and other vehicles.

There remain, however, numerous cases in which there are used, for measuring quantitative changes of output, substitute series which do not permit of distinguishing products by their use (*e.g.*, hours worked in factories producing various kinds of products). In such cases, it may be possible, as a rough approximation, under certain conditions, to include the same industry, as to part of its weight, in one group, and as to the remaining part, in another. This procedure assumes that the output of the kinds of goods distinguished move on parallel lines, and presupposes that the distinction according to use can be made, or estimated, for production during the base period and can be introduced into the weighting system (see also below, Part C, II). The proportions in which the basic weighting, for the industry concerned, as a whole, is divided between different groups of the index may, however, have to be adjusted from time to time.

The subdivisions in Groups A and D of the classification by branches of industries are made with a view to permitting of a regrouping of all series included in the general production index according to the "use" principle. Group A, 1 and 2, would go with materials for capital goods; A, 3, and C, with goods currently consumed; D, 1, with consumers' capital goods; and D, 2 and 3, with producers' equipment.

(d) *Combined Classification by Main Branches of Industries and by Use.*

The Committee recommends that the two types of classifications discussed above should be combined as shown below.

If countries, for their own use, prefer a more detailed classification or a classification taking into account other or additional principles of grouping, the Committee recommends that such

classifications should nevertheless be so arranged as to allow a regrouping, for purposes of international comparison, in accordance with the following scheme:

- A. Mining and quarrying
subdivided, if possible, into:
 - (a) Ores and construction materials (building stone, etc.);
 - (b) Coal, oil and other minerals.
- B. Manufacturing industries:
 - I. Producing mainly or wholly producers' equipment and materials for capital goods;
 - II. Producing mainly or wholly consumers' permanent equipment (consumers' capital goods);
 - III. Producing mainly or wholly goods currently consumed or materials therefor.
- C. Production of electricity and gas.
- D. Building and construction:
 - I. Residential building;
 - II. Other building and construction
subdivided, if possible, into:
 - (a) Building for industrial, commercial and public purposes;
 - (b) Railway, road, telephone line, and other construction.

The total A-D constitutes the general index of industrial production.

The Committee further recommends the current publication, by each country concerned, of supplementary summaries of the national indices according to the above international classification, which could be done, it believes, without involving undue expense.

PART C. — MEASUREMENT OF QUANTITATIVE CHANGES OF PRODUCTION

I. *The Mathematical Formula.*

It has been stated in Part A of this report that indices of industrial production are intended to measure changes in the aggregate net output of industries. In algebraic symbols, the net production of each branch of industry can be expressed as the product of two factors, one of which, q , represents the quantity produced, and the other, p , is a weighting coefficient which corresponds to the "value added" by the production operations of the particular branch of industry concerned. The total production in all branches in the year, 0, would then be stated as $\Sigma q_0 p_0$, and in any other year as $\Sigma q_n p_n$. The factor, p , serves a twofold purpose; first, to convert the quantities, measurable in physical units, to a commensurable (value) unit; secondly, to give to each quantity the proper weight in the total.

The Committee is, of course, fully aware that the statistical information available in the various countries does not allow of an exact and current measurement of the factors q and p . A clear statement of what was intended to be measured, however, appeared to the Committee to be indispensable, as the suitability of the various practical procedures adopted in measuring these factors or their changes can only be determined in the light of the theoretical desiderata.

The simplest form of presentation of what it is desired to measure is the aggregative formula:

$$I_1 = \frac{\Sigma q_1 p_0}{\Sigma q_0 p_0}$$

This formula can, in practice, only be employed directly if data showing the quantitative measure of the output of each branch of industry included in the index are available. This is seldom the case, and other data of various kinds must be utilised as substitutes in expressing the measure of changes in the quantities. The quantity relatives (of the form $\frac{q_1}{q_0}$) may be used to obtain a weighted arithmetic average in which the weighting coefficients are proportional to the products of the form $q_0 p_0$, since, by a simple transformation, the formula above given for the Index I_1 is equivalent to

$$I_1 = \frac{\sum \left(q_0 p_0 \frac{q_1}{q_0} \right)}{\sum q_0 p_0}$$

The weighting coefficients remain, it will be noted, unchanged throughout the period for which the index is calculated with the year 0 as the base period. There are thus two problems that require solution.

- (a) The determination of the weighting coefficients;
- (b) The measurement of indices of the type $\frac{q_1}{q_0}$ representing changes in quantities.

II. *The System of Weighting.*

For the reasons set out in Part A and Part B, III, dealing with the scope of the index, the constant weighting coefficients applied to the quantitative changes actually measured should correspond to the "value added" by each branch of industry to the raw materials or semi-finished products which it takes over from the previous stage of production. Regardless of what method of measurement is used for the relatives $\frac{q_1}{q_0}$, and regardless of whether the quantities statistically observed correspond with the total production or only with a representative part of it, the weighting coefficients should, in principle, correspond with the value added by the total branch of industry under consideration. It is only by this procedure that the relative importance of the various branches and their influence on the index of the total industrial output of the country can be duly taken into account.¹

In view of the divergences of methods in use for measuring the changes in quantities produced and of the fact that the percentage of production considered sufficient to represent adequately the movement of the total production of the branch concerned depends on the structure of each branch of industry in each country, the Committee refrained from drawing up uniform rules for the degree of representation to be obtained (by fixing, for example, the percentage of total output which should be covered by the establishments or products regularly observed).

The Committee is aware that the adoption of the weighting system recommended above requires a knowledge of the value added by the various branches of industry, which can in general only be obtained by detailed censuses of production. For the purposes of grouping according to use, the information available from production censuses may even need completion by special enquiries. If no production census is taken in a country, the compiling of adequate weights is, of course, a very difficult task; but, even in such cases, an attempt should be made to estimate approximate figures corresponding as nearly as possible to the "value added", instead of using weighting coefficients derived from other conceptions of the "importance" of an industry. The

¹ If, for instance, owing to technical difficulties of statistical observation, the food industries enter into the weighting with 1/10 of their actual volume, while motor-car production enters with 100%, the general index becomes meaningless. It is therefore indispensable that the "value added" of the total branch of industry, and not the values (or added values) of the quantities actually observed, should be used as weighting coefficients.

information available from wage statistics, balance-sheets and profit-and-loss accounts of typical establishments, combined with statistics of the number of establishments and the number of persons employed, may serve as a basis for such estimates. The statistics of other countries may also furnish useful data.

The Committee recommends that the weighting coefficients and, as far as possible, the total net value of production during the base period should be published separately for each series. For the compilation of indices of industrial production by groups of countries or in the world as a whole, it is important to know the total net values in absolute figures.

III. *The Measurement of Quantity Indices.*

The changes in the physical volume of production in each branch of industry which the index is intended to measure may be a result of one or several or all of the following elements:

- (a) Changes in the number of establishments ("opening" and "closing-down" of establishments, seasonal suspension and resumption of production);
- (b) Changes in the quantities produced by each establishment:
 - (1) Due to changes in the size of production equipment (men and machinery);
 - (2) Due to changes in the average performance per unit of means of production, for instance, due to:
 - (i) Changes in working-hours, in efficiency of human work or in the general organisation of human work;
 - (ii) Changing yield of processes by which the materials used for production are treated;
 - (iii) Changes in efficiency of equipment (not measurable by the number of machines, containers, etc.).

If it were possible to observe statistically the total quantities produced in each period, no difficulties would arise as regards purely quantitative changes. The relation $\frac{q_1}{q_0}$ for the particular branch could be calculated by comparing the two quantities expressed in numbers, weight or any other quantitative measure.

For a complete and correct index, the statistical observation should be exhaustive, and it should in particular take account of the changes in the number of establishments. If a representative method is adopted, care should be taken that the group of establishments selected maintains its representative character throughout the period under review.

The recording of the quantities actually produced, although theoretically the best method, meets with numerous practical difficulties. It presupposes first that the commodities produced during each period remain the same in quality as in the base period. This assumption is frequently unjustified. Further, there are many industries for the products of which no quantitative measure can be reasonably applied. To measure, for instance, the output of machinery or of garments by number or weight would often be meaningless, and such basic data are usually not available. Changes in the number of hours worked, in the quantities of raw materials used, in the power consumed, in values deflated by appropriate price indices or in other indirect production data, may, in the case of such industries, reflect more correctly the actual changes in output or may even, in the case of other industries, be the only basic data actually available. In such cases, the relation $\frac{q_1}{q_0}$ may be calculated on the basis of the most representative "replacement" series.

Which series can be regarded as the best replacement series is a question depending on the organisation and technique of the industry concerned in each country and especially on the possibility of obtaining statistical records. This question does not lend itself therefore to a uniform answer on international grounds.

In branches of industry depending on one raw material, or using a raw material in quantities varying in proportion to the quantity produced, the quantities of raw materials used may be the best indicator. In other industries, in which human work is the main contribution, the number of hours worked may be a better basic series. There is a great variety of replacement series which

can be used for calculating the ratio $\frac{q_1}{q_0}$; all that matters from the international point of view is

that these series should be selected in such a way as to correspond as closely as possible to the actual quantitative changes of output. Exact correspondence cannot be expected, since the use of a replacement series relating to one of the elements enumerated above under (b) 2 entails the assumption that conditions remain unchanged as regards the other elements. For instance, an index using hours worked as basic series does not take into account changes due to an alteration in the methods of using raw materials nor changes in the efficiency equipment and vice versa. Such changes might, however, be taken into account by means of an appropriate correction coefficient.

When replacement series are used, special attention should be paid to the difference in time between the facts recorded as basic data for the index and actual production. In industries dealing with the earlier stages of production, the time-lag between the work done on the materials and the completion of the product is usually not considerable as compared with the interval of the index computation. In coal-mining, for instance, the results will be identical from the point of view of time, regardless of whether the hours or shifts worked or the quantities of coal produced are taken as a basis. In the case of industries producing highly elaborate products which might take a considerable time for completion, indices based on the delivery (or export) of products may reflect an activity which has already taken place many months earlier. The construction of a ship might be quoted as an extreme case; but in engineering, too, the time-lag may be considerable. On the other hand, if the consumption of raw materials is used as basis for the index, and the figures are derived from import statistics, the facts recorded anticipate production at a later date. Moreover, the raw materials imported may be put into stock or the raw materials consumed may be taken from stocks, so that data based on trade statistics are not altogether reliable. The necessary adjustments should be made in such cases, so that the index really reflects the industrial production of the period for which the index is calculated.

The Committee is aware that the measurement of quantitative changes in building and construction raises numerous special problems somewhat different from those affecting manufacturing industries. The Committee is engaged in its current work in examining these problems.¹

IV. Base Period.

The Committee refrained from recommending an international uniform base year for reasons similar to those which were regarded as valid in the case of price indices and quantum indices of foreign trade. As the aggregate formula (or the weighted arithmetic average of quantity relatives) recommended in this report permits of a shifting of the base period if desired, the adoption of the same base period in all countries is not necessary for international comparisons. In order to keep in touch with the reality of economic life, however, the base period should be shifted and the weighting system adjusted at reasonable intervals to take account, *inter alia*, of new industries or of new information as to the relative importance of the different branches of the industrial system, and of changes in the quality of products.

¹ In virtue of a resolution by the 1937 Assembly on urban and rural housing, the Committee was instructed to study the methods employed for building statistics, and it will prepare more detailed recommendations on this subject than those contained in the present report. In particular, a distinction between private and public building and construction might be envisaged.

When a change of the base period takes place, the indices should be made available, on the old and on the new basis, for an overlapping period not shorter than a year.

V. Adjustments for Differences in the Number of Working-days per Month.

In certain countries, indices are calculated as an average per working-day of the period under review, and not for the total period, in order to eliminate the effect of the different number of working-days per month, due to holidays and the unequal length of the months.

If such adjustments are made in the total index, the Committee recommends that the number of working-days used for the calculation should be stated.

VI. Adjustment for Seasonal Variations.

If adjustments for seasonal variations are made, the Committee recommends that the unadjusted figures should be published, together with the adjusted series, and that the method of adjustment should be clearly stated.
