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PROBLEMS AND METHODS IN THE GATHERING OF REPRESENTATIVE AND  
 COMPARABLE WHOLESALE PRICE SERIES

(Report by the Secretary-General)

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## I. INTRODUCTION

1. On the invitation of the Statistical Commission, at its tenth session, the memorandum, Problems in the Collection of Comparable Wholesale Price Series,<sup>1/</sup> was circulated to national statistical offices for comment. These offices were also requested to describe the problems encountered and techniques employed in dealing with the main questions discussed in the memorandum - namely,
- (i) detecting changes in the characteristics of transactions included in wholesale price series and correcting the series for changes in quality, (ii) compiling comparable series of prices on unique goods, such as heavy machinery or buildings, and (iii) adjusting price series for discontinuities and seasonal fluctuations in the supply of priced items. Further, the offices were asked to indicate how items and transactions were selected for pricing in order to represent the field covered in index numbers and other wholesale price statistics. The foregoing information was sought from national statistical offices from two points of view: it was essential to have more comprehensive information on country practice than was available as a basis for further examination of the question of compiling comparable series of wholesale prices. And, the Statistical Commission had requested that this investigation be extended to the related question of problems and methods of collecting series that are representative of the field of transactions covered in wholesale price statistics.
2. This paper consists of a revision and extension of the memorandum, E/CN.3/246, based on the comments and information received from national statistical offices as well as recent work on the question of collecting and compiling representative and comparable wholesale price series.<sup>2/</sup> The wealth

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<sup>1/</sup> E/CN.3/246, Statistical Commission, Tenth Session.

<sup>2/</sup> Comments and information were received from the statistical offices of the following countries: Argentina, Austria, Brazil, Canada, Ceylon, Colombia, Costa Rica, Czechoslovakia, Denmark, Finland, France, Federal Republic of Germany, Greece, Hungary, India, Jamaica BWI, Japan, Kenya, Mauritius, Mexico, Netherlands, New Zealand, Nigeria, Norway, Portugal, Romania, Singapore, Sweden, Trinidad, Turkey, Union of South Africa, Union of Soviet Socialist Republics, United Kingdom, United States and Republic of Viet-Nam.

of comments and information provided by countries was most helpful not only in revising and clarifying the material covered in the earlier paper but also in suggesting additional questions that needed to be discussed with regard to the gathering of wholesale price series and in making it possible to furnish comprehensive information on national practices in this field. National comments indicated, for example, that, in connexion with the question of the collection of representative prices, it would be useful to review, in the light of recent experience, the recommendations that the Commission had made at its seventh session on the subject of the field of transactions to be covered in wholesale price series, the type of transactions it was most practicable to price and the frequency with which price series might be gathered.<sup>3/</sup> The importance of dealing with the subject of specification in gathering comparable wholesale prices also became evident from the comments of countries.

3. The first portion of this paper is devoted to considering the field of transactions to be covered in wholesale price statistics and the question of gathering price series that are representative of this field. As part of this discussion, the related recommendations made at the seventh session of the Statistical Commission are reviewed, and criteria and methods for selecting and gathering representative price series are covered. Most of the rest of the paper deals with the question of gathering and compiling comparable price series. Techniques for precise specification of the transactions priced and for detecting changes in the specified characteristics are discussed first. Covered next are the relative merits of the alternatives for adjusting price series to a comparable basis when changes occur in the circumstances of sale involved in priced transactions, when a priced variety of a commodity is replaced by an entirely new variety, when new commodities appear on the market, etc. The pricing of capital and other unique goods is also discussed under the subject of compiling comparable price series. Considered last in this paper is the question of dealing with discontinuities and seasonal fluctuations in the supply of priced items.

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<sup>3/</sup> Statistical Commission, Report of the Seventh Session, paragraphs 69(a)-(e), E/CN.3/163.



## II. THE FIELD OF TRANSACTIONS TO BE COVERED

4. In view of the requirements for information on prices, ideally, wholesale price data should at least relate to the field of transactions recommended by the Statistical Commission at its seventh session - namely, all transactions in goods except those between retailers, on the one hand, and consumers and the service-producing industries, on the other. Price data are required on business transactions at each stage in the chain of production and distribution of all kinds of goods, whether primary, semi-finished or finished. Such information is needed, for example, in detecting the sources of origin and the spread of inflationary and deflationary pressures (i.e., imbalances between supply and demand) and in measuring the stresses and strains resulting from the differences between segments of the economy in price reaction (e.g., price flexibility) to changes in economic conditions. Price data are also wanted for purposes of assessing changes in the terms of trade (e.g., the price relationship between inputs and outputs) of each important sector of the economy and for deflating, to real terms, flows into and out of these sectors. It should be noted that for these purposes, series of prices are needed not only on commodities sold but also on commodities purchased and not only on goods but also on business services sold and purchased. For purposes of deflating current money values, there is considerable demand as well for price series on broad economic flows such as capital formation in both capital goods and inventories, exports or imports. Further, information on trends in the prices of a host of individual commodities are desired by businessmen in evaluating their competitive position and making decisions and by government in formulating tariffs and other external trade policies, stimulating the production of strategic materials, etc.

5. In practice it has not been practicable for countries to encompass the entire field of business transactions in wholesale price statistics. The field of transactions covered has had to be restricted, taking account of priorities in the need for and relative difficulties in the collection of prices on various categories of transactions. Countries have not sought price data on business services because isolating the price aspect of such transactions is extremely difficult and these transactions are not an important part of business activity.

Very few countries (e.g., Colombia) have systematically covered the sales of wholesalers as such, except for importers and exporters, in their wholesale price statistics, although the purchases of wholesalers, such as farm assemblers, have been priced as a convenient source of price information on the sales of producers. The omission of sales of wholesalers as such is due to the following: it is very difficult to unravel the place of each wholesaler in the chain of distribution and data for purposes of appropriate weighting in combining the price series gathered is often lacking. Moreover, price information is in much greater demand on the transactions involved in the initial flow of goods into the economy (i.e., the sales of domestic producers and imports) and in the flow of goods to end-uses (i.e., the sales of domestic retailers and exports). National statistical authorities have felt that having these two sets of prices, it would be possible to follow trends in the prices spread involved in the distribution of goods.

6. Countries have therefore concentrated, in their programmes of wholesale price statistics, on price series relating to the transactions of producers and to imports and exports. Price series are always gathered on the sales but not on the purchases of producers, although the collection of prices on the purchases of farmers and the like is common. Also, a few countries are considering the direct collection of price series on the purchases of selected types of goods (e.g., capital equipment) by industrial units and a greater number of countries may, in the future, compile series from available price data on the sales of producers, imports, transportation and the like. Much greater difficulties are encountered in gathering price series on the purchases than the sales of producers because of considerable intermittance and incomparabilities in the goods purchased by producers.

7. Thus, the field of transactions which countries have found most essential and feasible to cover in wholesale price statistics consists of the transactions which the Statistical Commission suggested be given first priority in the development of these data. In view of this, the recommendations of the Commission should perhaps be revised to emphasize the necessity and desirability of concentrating on price series relating to the transactions of agricultural and industrial producers at home and to imports and exports. In this revision, stress might also be put on the substantial difficulties and lack of urgency of

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covering the transactions of wholesalers, as such. Recommendations along these lines would furnish clear and practicable international guidance on wholesale price statistics, especially to the statistically less developed countries. This field of statistics is, at best, difficult and costly to deal with adequately, and referring to it as wholesale prices tends to mislead some of these countries although it does not seem practicable to adopt another name. In fact, in the case of statistically less developed countries, it may be desirable to recommend that they give first priority to prices of imports and exports.

8. In recent years, a number of countries, especially in Europe, have widened the field covered in their price series on the sales of producers to include explicitly manufacturers of highly finished consumer and capital goods and constructors of buildings, bridges, etc. Although it is much more difficult and costly to gather price information on the output of these producers than on that of producers of raw and semi-finished commodities, this extension has been due to the demands for more comprehensive price information for purposes of modern analysis and the deflation of economic flows. As was noted above, another extension, resulting from similar requirements, that is being considered in some countries is the compilation of prices on the purchases of industrial producers, especially of machinery and equipment.

### III. THE GATHERING OF REPRESENTATIVE PRICES

#### A. The Selection of Transactions to be Priced

9. Even if the transactions for which price data are wanted are limited to the sales of producers and imports and exports, the multiplicity of different kinds of transactions is obviously far too great to gather price series monthly or more frequently on all of these transactions. For purposes of comparability, transactions must be distinguished, for example, according to the variety of each commodity dealt in, the market in which it is sold and the circumstances of sale. All countries have therefore drastically restricted the transactions priced by choosing from the field of transactions to be covered, certain commodities and respondents, particular varieties for these commodities and selected circumstances of sale for these varieties. This selection has been purposive, based, generally, on criteria designed to yield transactions for pricing which are representative of the field covered in wholesale price statistics. However, in making the selection, considerable weight has had to be given as well to expectations or experience with regard to the co-operation and ease of collection and the priceability (e.g., ease of specification, regularity and frequency of transactions, complexity of circumstances of sale) of the items selected. Partly because of the extent to which these factors can be stumbling blocks to the administration of programmes of wholesale prices, probability sampling has not been utilized in the selection of transactions to be priced. However, the possible use of this technique will be examined in a forthcoming study of the methodology of the United States in the field of price statistics.

10. The major criteria that have been utilized in seeking to select representative transactions for pricing are (i) the relative importance of the various kinds of transactions, as measured by value of sales, (ii) the extent of correlation in price trends (e.g., price leadership) within each class of transactions of the field covered, and (iii) the magnitude of variation over time in prices for each of these classes. The last two criteria are, of course, the consequence of the following: The greater the intra-class correlation in price trends or the smaller the variation over time in prices for a class of transactions, the fewer the number



of transactions that need to be priced to attain a given level of reliability. The first criterion has been used systematically more commonly than the other two standards. This reflects, in part, differences in the availability of information. Systematic data on the relative importance of different commodities in the sales of producers may be compiled from agricultural and industrial censuses and similar sources; and such compilation is an essential step in working out the weighting pattern for a system of wholesale price statistics. And trade associations, establishments or others who are interviewed are ready to judge relative magnitudes of sale of the various varieties or circumstances of sale for each commodity. Measurement of the intra-class correlation and of the variation over time of prices for classes of transactions not only requires the accumulation of price data over a considerable period on at least the most important kinds of transactions of each class but also involves time-consuming calculations. Further, businessmen are more reluctant to provide information on price leadership and fluctuations than on the relative importance of sales and the judgements obtained are likely to be less accurate on the first two topics than on the third question.

11. Giving insufficient or little consideration to the relative movement in prices of transactions of the same class (e.g., in cognate items) and to the magnitude of fluctuations in these prices is likely to result in a programme of price collection that is not efficient statistically. In other words, too few price series may be sought for classes of transactions with relatively low intra-class correlations or high variance over time in prices to attain the highest possible degree of reliability in price series in the light of the available statistical resources. On the other hand, too many price series may be gathered for classes of transactions showing relatively high intra-class correlations or low variance over time in prices. It should also be noted that information on the extent of fluctuation in prices is wanted in determining the frequency with which various price series should be sought. In view of the advantages of attending to intra-class correlation and variance over time in prices, countries have taken pains to gather the information required for this purpose. For example, the United States has gathered data on the relative trends and fluctuations of more price series than actually utilized in its system of price statistics, and this and other countries have tested price series from these points of view before introducing them into

their regular price programmes. Also, the United Kingdom has undertaken a systematic review of intra-class correlation and variance over time in prices for each kind of industry in order to evaluate the statistical efficiency of her collection of prices. In this evaluation, the character of the markets for the goods of each industry (e.g., the extent of competition, the presence of price leadership, the diversity of geographic location and circumstances of sale) will also be considered.

12. In applying the criterion of relative importance, systematically, most countries have started by making a selection, on this basis, from the commodities falling into the categories for which price indexes or other summary measures are wanted - for instance, for various industries or classes of commodities. They have then pinpointed the sources from which price data on specified transactions in these commodities were to be gathered - for example, specified industrial establishments, importers, exporters, farm assemblers, organized markets, trade journals or trade associations. In this process, consideration has been given to the costs and ease of collection and representativeness with regard to the range of locations, size and other characteristics of dealings in each of the commodities as well as to the relative volume of sales at each source for each of these commodities. A few countries (e.g., the Federal Republic of Germany) have started by making a systematic selection, based on relative importance, from the producers and other sellers in each kind of industry and, then, from the commodities dealt in by the producers selected. In this selection, other factors, such as the distribution of sellers according to area or type of market dealt in, have also been taken into account. In the second approach to the selection of sources of price information, sellers are almost invariably the respondents and in selecting them, the criterion of relative importance is utilized objectively. In either approach, selection of the varieties and the circumstances of sale for each of these varieties that are to be priced has taken account of relative sales volume, priceability, price leadership, etc., based on consultations with respondents, trade associations, commodity experts and the like.

13. Countries have systematically employed the criterion of relative importance in different fashions. A number of countries have selected all commodities or sellers of each class in the field to be covered by their wholesale price

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statistics which account for sales in excess of a given value and have sometimes sampled the remainder of each class in order to gather price series that are more representative of the class as a whole. A few countries have fixed this value of sales without regard to class of commodity and may have not therefore included representation in the price series gathered for some classes of the field to be covered by these statistics. Other countries have chosen commodities or sellers in each class of the field to be covered which account for a given proportion of the sales of the class. This would be statistically more efficient than the use of cut-off values, provided all members of the class were given a chance to be selected.

14. Countries have usually decided on the transactions to be priced when computing or revising weights for their system of wholesale price statistics. In order to maintain the representativeness of the transactions being priced, national statistical authorities have also found it essential to adjust, between these intervals of time, the circumstances of sale and varieties being priced for individual commodities to the many changes occurring on the market. This has also been necessary, but to a somewhat more limited extent than in the case of varieties or circumstances of sale, with regard to the commodities for which price series are gathered. Many of the circumstances in which such shifts are required in the transactions being priced have been detected while dealing with reports on changes in the characteristics or the disappearance from the market of priced items. In this connexion, countries might find it useful to review with respondents annually the relative importance, as measured by sales, of the different commodities as well as varieties and circumstances of sale for selected commodities in which they currently deal. It has been suggested, for example, that respondents be asked to classify the types of transactions being priced into those of constant declining and increasing importance and to indicate also types of transactions not being priced which are becoming important. This would provide a means for systematic and early detection of the required modifications in the type and characteristics of the transactions being priced and would greatly facilitate the adjustments that must be made when this occurs.

15. The Statistical Commission, at its seventh session, made rather general recommendations on the selection of representative transactions for pricing and

emphasizing the criterion of importance.<sup>4/</sup> The Commission may feel it desirable to amplify and modify these suggestions in the light of developments in national practice and experience since that time. In particular, it would seem advisable to add to these recommendations the criteria of the correlation in price trends between the items of each class of commodities or industries for which price series are sought and of the extent of variation over time in these prices.

B. Frequency of Collection of Price Series

16. The frequency with which prices are gathered on the various transactions being priced also has bearing on the representativeness of the price information that is being compiled. In particular, the frequency of collection affects the extent to which average or relative prices for a period (e.g., a month or a quarter) for individual commodities reflect prices that were prevalent, in fact, during this period. In order to compile reliable measures of the prices prevalent during a month or quarter for individual commodities or varieties of these commodities for which prices fluctuate markedly, it is essential to gather, during this period, a number of price quotations on the pertinent transactions. It may, for example, be necessary to gather price quotations as of a number of selected days or even every day of each week of the period covered. Such frequent collection of price data is practicable, however, only if price quotations are available from organized exchanges or trade associations. If price data are sought from individual dealers by mail, monthly collection of price quotations referring to a selected day of each week of the month is likely to be the best that can be done. If personal visits are utilized for this purpose, weekly collection of price quotations has, in some cases, been feasible. On the other hand, if prices for the transactions on which quotations are sought tend to be stable, collection of these quotations once a month or quarter, depending on the period of time for which these prices are compiled, would be sufficient.

17. The frequency with which national statistical authorities compile price data on individual commodities or varieties also depends, in part, on the relative

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<sup>4/</sup> See paragraphs 69 (c) and (d) of Statistical Commission, Report of the Seventh Session, E/CN.3/163.



variation over time in these prices. This is also the case, but to a lesser extent, with regard to broader aggregations of price data. A month is a very common period for which figures of price indexes and other summary measures for relatively broad classes of transactions are compiled in view of the important use of price data as current economic indicators. However, for this purpose, more frequent price information is often wanted on classes of transactions which exhibit considerable sensitivity in price to changing economic conditions. Therefore, some countries which have sufficient statistical resources to do so, issue summary price data weekly on these types of transactions.

#### IV. SPECIFICATIONS OF AND DETECTING CHANGES IN THE CHARACTERISTICS OF PRICED TRANSACTIONS

##### A. Need for and Nature of Specifications

18. All of the uses of price data depend on the compilation of comparable series of prices on transactions - i.e., prices which do not reflect changes in the quantum (e.g., quality, quantity) aspects of these transactions. Countries seek to compile comparable prices by initially gathering series of price quotations from one time to another on transactions that are comparable with respect to price - i.e., on a series of transactions which if executed at the same time and in the same market, would fetch the same price. This involves specifying the aspects of each type of transaction priced which are pertinent to the setting of prices on the market. Such specifications should relate to the characteristics of transactions which enter into determining prices at which sellers and buyers are willing to complete the transactions.

19. Ideally, therefore, the specifications of transactions being priced should relate to the physical and operating characteristics of the varieties of the commodities priced and the circumstances and conditions under which the transactions in these items are conducted. Examples of physical characteristics that have been utilized in specifications are generic terms for items, the stage and type of processing of items, the nature and type of processing of constituent materials or parts, the way in which these components are combined or the size, shape, packaging or style of items. Illustrative of the operating (i.e., performance) characteristics that have been employed for this purpose are the uses to which an item may be put and its capacity, power, speed of operation or durability. Description of the portion of the market for which the item is intended - for example, utility or low priced - has also been resorted to in such specifications. Indicative of the circumstances of sale that have been described in specifications are the market and lots in which the item is sold and the type of buyers, the terms of delivery and payment, the services to be rendered (e.g., delivery, installation, repair) the guaranties involved and whether or not excise taxes, duties and other indirect taxes are included.

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20. It has been common national practice to specify, in the collection of price quotations, the physical characteristics of commodities. Description of the circumstances of sale for the transactions in these varieties that were to be priced have been included in these specifications somewhat less frequently. Operating characteristics have, however, been specified rather infrequently. This is due to the following reasons: Information is more readily available and recognizable on physical characteristics and circumstances of sale than on performance. The latter type of specification may, for example, require laboratory testing and other technical measurements and is often not included in trade descriptions, except for selected producers' equipment. In addition, while physical characteristics are often indicative of operating characteristics, the contrary is less frequently the case. Further, physical characteristics tend to be more highly correlated than operating characteristics with the price at which sellers are willing to offer the variety. However, when countries have, in recent years, added capital goods or finished cognate items to their price series, they have found it necessary to include, in the specifications of these types of transactions, descriptions of performance (e.g., capacity, speed of operation) as well as of physical characteristics and circumstances of sale. A number of countries, in revamping and extending their wholesale price statistics, have also increased the precision of specifications for transactions to be priced with a view to attaining a high degree of comparability in series of price quotations.

21. In general, the difficulties of devising specifications that will ensure the collection of comparable series of price quotations increase as the degree of fabrication of commodities involved increases. To be useful, specifications must be more detailed for finished goods than for semi-finished or raw goods. Specification of at least some operating characteristics in addition, to physical characteristics and circumstances of sale may be required in the case of finished goods but not in the case of semi-finished or raw goods. It should be noted that inclusion in specifications of operating characteristics is desirable not only for machinery or equipment for producers but also for items such as vacuum cleaners, washing machines or motor tyres for consumers. Further, specification is more complicated in the case of finished goods than in the case of most kinds of semi-finished or raw goods because of the relatively smaller degree of



standardization in items and transactions for finished goods than for the other types of goods. Finally, in the case of heavy capital goods (e.g., locomotives, ships, buildings, large turbines), each transaction becomes unique and cannot, therefore, be priced directly in gathering comparable series of quotations.

B. Detecting Changes in the Characteristics of Transactions Being Priced

22. As was noted earlier, changes occur relatively frequently in the characteristics of marketed varieties of priced commodities and in the common circumstances of sale of priced varieties. Unless precautions are taken to detect and define such changes, serious incomparabilities may be accumulated in series of price quotations. Some national statistical authorities have therefore introduced into their procedures for collecting price quotations, devices for isolating and defining any significant changes that may take place in the characteristics of the transactions for which prices are gathered. Some of these devices have also been utilized to detect the appearance on the market of important new commodities and the gradual replacement or disappearance of price commodities.

23. One approach to detecting changes in the characteristics of transactions for which prices are collected is based on a periodic (monthly, quarterly, annually) querying of respondents. The specifications of the types of transactions for which price quotations are being gathered are described in a questionnaire, sometimes the same one utilized for reporting price quotations; and the respondent is requested to indicate whether the price quotations he is providing still refer to these specifications and whether the types of transactions described still account for an important part of his sales. If either is not the case, the respondent is asked to describe, in some detail, the types of transactions for which he is furnishing price quotations or which have become important in his sales. In place of such explicit queries, the respondent is more frequently requested to notify the national statistical authority of any changes of either type, taking account of the specifications set out in the questionnaire on which he records price quotations.

24. Another approach to detecting changes in the characteristics of transactions for which price quotations are gathered is based on questioning respondents

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concerning significant month-to-month increases or decreases in reported prices - for example, of 10 per cent or more. Unless such fluctuations are readily explainable - for example, in the light of similar variations in price series for cognate items - respondents are questioned on the differences, if any, between the transactions for which they have provided price quotations and the transactions specified by the national statistical authority. This approach is more commonly used than the devices described in the preceding paragraph.

## V. ADJUSTING PRICE SERIES TO A COMPARABLE BASIS

A. The Problem and Character of Adjustments

25. As was indicated above, in keeping the quotation series of their wholesale price statistics aligned with the type of transactions taking place on the market, national statistical authorities must, in a significant number of instances, substitute new series for old series of quotations, add new quotations series or discard series of quotations that were being gathered. The conditions under which priced varieties are being sold may change, a priced variety of a commodity may be replaced by another variety, or a new commodity may appear on the market. Or, the transactions being priced with regard to varieties of a commodity, individual commodities or classes of these commodities or industries, may be replaced in importance or representativeness by other types of transactions. Such changes are much more common for highly finished goods than for semi-finished or raw goods and in the case of the less industrialized countries, for imports than for exports. An indication of the frequency with which national statistical authorities must deal with shifts in the character of series of price quotations is given by experience in the United Kingdom during 1958, when about 4 per cent of the series gathered showed such changes. It should be noted that in the case of countries with centrally directed economies, in addition to the statistical offices facing the problems outlined above, other authorities must assign prices to new items which are aligned with the prevailing prices for related items being produced or marketed.

26. In substituting one quotation series for another, national statistical authorities are faced with making comparisons between prices, often at different periods of time, and economic worth for the substituted and former types of transactions. They may decide that the difference in price between new and the replaced transaction is due entirely to a difference in quality, does not reflect any difference in economic worth or is accounted for in part by a difference in quality. Or, the decisions may be expressed as no change in "pure" price, a change in "pure" price equivalent to the two prices, a change in "pure" price that lies between these two extremes, respectively. In the first case the new series of price quotations would be spliced (linked) to the old set of price quotations and in the second case, the new price quotations would be substituted for the old



series of price quotations. In the third case, the price series relating to the new types of transactions would be reduced by an adjustment factor termed "g" in this paper, which measures the economic worth of the newly priced transactions relative to the formerly priced transactions before being substituted for the price series relating to the old type of transactions.<sup>5/</sup> In adding new price series without replacing price series which were being gathered, national statistical authorities are not confronted with the problem of assessing the economic worth of the newly priced transactions relative to other priced transactions. This is so because the new price series may be spliced to price series for transactions which are closely related (i.e., cognate) to the newly priced transactions and prices for both sets of transactions are available for the same time and market. Under these circumstances, the relative prices for the two sets of transactions are and can be taken as a measure of their relative economic worth.

27. The comments of a number of national statistical offices on the earlier version of this paper,<sup>6/</sup> as well as their practises, suggest that in evaluating the relative economic worth of two variants of related transactions, they should like to approximate the relative values that would be assigned in the market to these variants if they were on sale at the same time. In some circumstances (e.g., when both variants are in fact on the market at the same time), data are available on the relative market values assigned to the two types of transactions. In many circumstances, however, such information is not available, and other means of evaluating "g" (relative economic worth) must be found. The technique chosen for this purpose depends on the nature and circumstances of the change in

5/ What has been said may be expressed symbolically as:  $r_{12} = \frac{Pb2}{Pal}$  where  $r_{12}$  is the

relative for the change in "pure" price from period 1 to period 2; Pb2 is the price quotation gathered for the substituted set of transactions and Pal is the price quotation for the replaced type of transactions; and "g" is the measure of the economic worth of the substituted series of transactions relative to the replaced set of transactions. If "g" is equal to  $\frac{Pb2}{Pal}$ , then  $r_{12} = 1$  and

Pb2 is linked to Pal when introduced into the price series. If "g" is equal to 1, then  $r_{12} = \frac{Pb2}{Pal}$  and Pb2 is substituted for Pal when introduced into the

price series. If  $\frac{Pb2}{Pal} \ll "g" \ll 1$ , then  $\frac{Pb2}{"g"}$  is substituted for Pal when injected into the price series.

6/ Problems in the Collection of Comparable Wholesale Price Series, E/CN.3/246, Statistical Commission, Tenth Session.

characteristics (physical, operating and/or conditions of sale) of the newly and formerly priced set of transactions and the avenues and resources that are available for the collection and evaluation of the economic worth of the shift in characteristics.

28. An effort is made in some situations to simulate what occurs in the market in evaluating the economic worth of the difference in characteristics between the two types of transactions - i.e., the value of this difference is considered from the point of view of both sellers and buyers. Implicit in this is the balancing against one another of what would be the sellers' supply-price (costs plus usual profits) and the buyers' offering price (utility) for each variant of transactions if on the market at the same time. Explicitly, however, the evaluation of relative economic worth may be in terms of differences, between the two variants, in some characteristics with which price from both the sellers' and buyers' points of view is thought to be correlated or in terms of circumstances of the change (e.g., shifts in fashion) which are thought to be indicative of the change in price from both these points of view. In practice, it is often not feasible or possible to evaluate the economic worth of the difference between the two variants of related transactions from the points of view of both sellers and buyers. Under these circumstances, the evaluation is most commonly carried out in terms of sellers - e.g., their supply price or costs - in part because information is most readily available for them. This is especially the case for finished producer goods. However, evaluations have also been carried on exclusively from the consumers' point of view.

29. National practice and comments have emphasized the serious limitations, in most countries, on resources and possibilities for dealing with the difficult but important problems of adjusting price series to a comparable basis. Technical (e.g., laboratory testing or cost accounting) facilities are rarely available, except in the Eastern European countries, and the statistical resources available to programmes of wholesale price statistics are not adequate in many countries. Further, the reporting of wholesale price data is usually voluntary; and, in any case, the practicable bounds to the demands for information which can be made on respondents restrict the techniques that can be employed. At the same time, a number of national authorities are aware of the material distortions in price data

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that can result from poorly founded and considered adjustments for changes in the quality of a series of priced transactions and of the significance of these distortions to the uses to which wholesale price data are put. A number of national statistical authorities are therefore evaluating the methods which they now use in adjusting successor and predecessor price series to a comparable basis and exploring more objective and precise techniques which they may find practicable to use for this purpose. The discussion in the following paragraphs relates to the details and merits of the methods that have been utilized or considered for adjusting price series to a comparable basis in the light of the situations in which this problem arises.

B. The Use of Overlapping Prices

30. As was noted above, prices are sometimes available for the same time and market for type of transaction which is to be added and the type of transaction which is to be replaced. These prices provide the basis for splicing quotations for the successor transactions and quotations for the predecessor transactions, and countries have taken full advantage of this information whenever it was available. This situation occurs most frequently when shifts take place in the relative importance or representativeness of transactions in a commodity or industry. The two sets of transactions may involve different circumstances of sale, two varieties of the same commodity or even different but related commodities. National experience suggests that simultaneous price data is most likely to be available for different conditions of sale (e.g., type of customer, terms of delivery or payment, size of lots or grades of sales) and more likely to be had for variants of a commodity than for two related commodities. Examples of differences between varieties for which simultaneous price data are likely to be available are additions or eliminations of common accessories or changes in most popular capacities in the case of metal products. In dealing with the gradual substitutions in the market between sets of transactions, questions arise concerning the point in the overlapping period when quotations for one set should be substituted for quotations for the other. It would seem most desirable to make this substitution when both the earlier and the later variants of the transactions command a considerable part of the market - for example, when roughly equivalent volumes of transactions are completed. By that time the later type of

transactions will have taken place on the market long enough to be known and produced efficiently and the earlier type of transactions will not have become too unimportant.

31. The advantages of utilizing market valuations of the relative economic worth of successor and predecessor types of transactions re-emphasize the desirability, discussed earlier in this paper, of periodically querying respondents concerning the relative importance of the different types of transactions in which they engage and the emergence of new variants of these transactions. Simultaneous price data on successor and predecessor sets of transactions are also likely to be more available if countries more frequently gathered series of price quotations which were not immediately required in compiling price data.

32. Because of the advantages of price data for the same period in substituting sets of transactions for one another, countries make an effort to gather such information from respondents if they do not already have the data when making the substitutions. This often involves the gathering of market prices on only the difference in circumstances of sale (e.g., with and without freight paid) or in components (e.g., with or without certain accessories). In the absence of this information, national statistical offices have also asked respondents to estimate the market price that the old variant of the transactions would command at present or that the new variant of the transactions would have commanded in the past. Some offices (e.g., the United Kingdom) have found it valuable to carry this search for data on market valuations even farther by examining price trends in cognate items over the gap in time between the substitution for one another of two sets of transactions in order to measure the change in "pure" price during this interval.<sup>7/</sup> Either of the preceding two techniques for adjusting the price series on successor and predecessor sets of transactions to a comparable basis are most useful if the interval of time involved in the substitution of one for the other is relatively short and the change in prices during this interval is relatively small.

<sup>7/</sup> The ratio between the price at the end of the period for the successor set of transactions and the price at the beginning of the period for the predecessor type of transactions divided by the change in pure price of the cognate items would, of course, measure the relative economic worth of the two sets of transactions.



C. Substitution or Splicing

33. The use, to the greatest possible extent, of techniques based on overlapping prices still leaves unresolved a number of cases in which it is necessary to adjust price quotations on different types of transactions to a comparable basis. These situations generally involve rapid and drastic shifts from one variety to another of a commodity that is being priced. For example, the general design or style of the item may change abruptly - as is common in wearing apparel, automobiles, the packaging of processed foods or machines. Or, abrupt alterations may occur in the type or character of textiles used in clothing, the composition or processing of the materials used in automobiles or machines, or the power, capacity or other operating characteristics of machinery. Rapid changes may also take place in the composition of paints and other products, or the weights of a loaf of bread or a bar of chocolate. In situations such as the foregoing, it becomes necessary to evaluate the economic worth of the change in characteristics by means other than that of direct reference to market prices. This task is often complicated by the practice of producers of linking together shifts in quality and "pure" price. For example, manufacturers of durable consumer goods may raise prices in association with modifications in design or other aspects of these articles and attribute the rise in prices entirely to these changes. Alternatively, manufacturers may keep prices constant and reduce the quality of their products in not too obvious ways if costs of production are rising slowly. During periods of general price decline, some manufacturers keep prices unchanged or lower them only slightly, over-emphasizing the increases in quality which they have introduced in their products.

34. In circumstances such as described in the preceding paragraph, substitution or splicing is frequently utilized by national statistical authorities. The use of substitution or splicing, of course, implies a decision that the economic worth of the two sets of transactions for which price quotations referring to different periods of time are to be compared, is either equal or proportional to these price quotations, respectively. This decision is, in a number of countries, reached by commodity specialists, based on an examination of the differences in characteristics (physical and sometimes, in addition, operating) between the two types of transactions and the circumstances surrounding the shift from the predecessor to the successor type of transaction. The trade may be consulted

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as well for these purposes. Substitution or splicing is also commonly and appropriately used when more exact estimates of relative economic worth of "g" are too difficult or costly to make and the available information suggests that the more exact estimate would approximate the result of substitution or splicing. Splicing may also be the only practicable method of reaching comparability between successive price quotations because it is almost impossible to gather the information required for an alternative estimate of "g". However, there is a danger of misusing substitution or splicing because of the convenience of either one of these approaches.

35. Substitution is often and appropriately utilized when a change in an item is trivial (e.g., an alteration in the colour of a fountain pen) or involves an appeal to fashion (e.g., a shift in the styling of a class of dresses, hats, automobiles or radios). Changes in "luxury" articles are frequently of this character. Such alterations rarely involve changes in the economic worth of articles, and are sometimes even circular - i.e., a model becomes fashionable again some years after it has been discarded. Substitution also seems suitable in the case of minor improvements in the composition or performance of an item which is linked with an increase in price of the same magnitude as the rise in "pure" price for related articles. On the other hand, substitution is not appropriate when significant changes occur in the made-up or operating characteristics of articles.

36. Splicing is usually employed when significant changes occur in the make-up or character of items, particularly as a result of technological developments or efforts to expand markets substantially. It has been suggested that the use of splicing in these situations may result in an upward or downward bias in the measures of "pure" price change. This is so because relative prices of successor and predecessor items may not reflect entirely the relative economic worth of these items as producers frequently also change "pure" price when they switch from one variety to another. Splicing is also generally and appropriately utilized in circumstances, such as were noted earlier in this paper, when it is necessary to relate price quotations for two commodities, one of which is new on the market. Illustrations of such cases are the substantial changes which often occur in the design of industrial machinery, the replacement of radios by



television sets, or the substitution in apparel of nylon, dacron or other artificial fibres for natural fibres. An important consideration in these instances is to introduce into the series the price quotations for the new article only after sufficient time has been allowed for efficient production and marketing. At the same time, in this use of splicing, as well as in other instances, care should be taken to make the interval of time between the price quotations for the new and predecessor article as short as possible. For the same reasons as for price quotations for new items, splicing is often used in dealing with the substitution in imports or even exports of one item by another, particularly in countries whose external trade is not diversified.

D. The Quantitative Use of Physical or Other Characteristics

37. Substitution or splicing is not the appropriate means of relating price quotations for successor and predecessor transactions when it is apparent that the value of "g" is quite different from one or the ratio of these two price quotations. Further, the decision to use substitution or splicing is usually the result of a non-quantitative, although often systematic, comparison of the relative economic values of the successor and predecessor transactions. For these reasons, in selected situations, countries have utilized, or are exploring the use of, quantitative methods of evaluating "g" in adjusting price series to a comparable basis. These methods depend on isolating the physical or other characteristics of the successor and predecessor items with which economic worth can be expected to be correlated and evaluating "g" from the relative magnitudes for these pertinent characteristics.

38. This approach to evaluating "g" has been employed most frequently when a simple linear relationship can be expected between economic worth and a single, measurable characteristic of the successor and predecessor items. Examples are the weight of bread or soap, the metal content per unit of ore, the purity and specific gravity of sulphuric or nitric acid or other basic chemicals, or the number of pages in a particular magazine. In the USSR this technique has been applied as well to operating characteristics when introducing new items into price series - for example, price or cost per unit of energy content in the case of peat or wood or per unit of power that can be generated in the case of turbines,

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electric generators or steam boilers. It has been reported from Hungary that the use of quantitative relationships between physical and operating characteristics, on the one hand, and economic worth, on the other, has been extended to much more complicated situations than the preceding.<sup>8/</sup> More than one measurable attribute is dealt with and the relationship between "g" and the quantified characteristics need not be linear. This has been accomplished by assigning point values to measures for each of the attributes which are totalled over all of the attributes for each of the items being compared. The point values assigned to each attribute seem to depend on (i) the variation of worth with the quantity of the attribute and (ii) the weight of the attribute in determining total economic worth. It is not known what basis was utilized in computing points - for example, whether from the point of view of cost of production, utility to users, or both. It should also be noted that in Sweden tests and measures, by an independent technical agency, of the characteristics of new models of automobiles are also utilized in assessing relative economic worth.

39. Utilizing simple or more complicated measurements of physical or other characteristics, as described in the paragraph above, involves assumptions as to the functional relationship between these attributes and price on the market. There may be general agreement on the pertinent characteristics and the nature of the relationship in simple situations such as a change in the weight of a particular kind of bread. However, this is unlikely to be so in the case of more complex changes in highly finished goods, where a multiplicity of characteristics, some of them of an operating type and difficult to measure, are likely to be significant. Choosing the appropriate characteristics with which economic worth is correlated and deciding on the functional relationship between economic worth and the magnitude of these characteristics then becomes difficult and hazardous. Further, unless testing and other technical facilities are available, the use of this technique is necessarily restricted to situations in which a linear or other simple relationships may be expected between economic worth and an easily measured attribute. In the absence of such facilities, in some countries (e.g., Sweden), the opinion of a number of experts is sought and reconciled concerning

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<sup>8/</sup> See Annex I for excerpts from an article describing the techniques utilized.



the economic worth of the significant differences in characteristics between the two variants of an item that are being compared.

40. One part of the paper, E/CN.3/246, was devoted to discussion of a statistical technique which was designed to determine the extent and nature of the correlation that in fact exists on the market between price and one or more selected measurable attributes of two variants of an item.<sup>9/</sup> This approach was termed the "hedonic index" although a more appropriate name might be "principal factor indexes of quality". In brief, the method consists of measuring the extent and nature of the functional relationship between market price and the magnitude of each of selected attributes for variants of a commodity actually on sale at the same time as either of the two variants of the commodity for which price quotations are being compared. The relative economic worth of these two variants may then be estimated from the equation. The results obtained will usually be different for the period when the successor variant is on the market than for the period when the predecessor variant was on the market.

41. The United Kingdom explored this statistical technique in the case of motor cars.<sup>10/</sup> The major conclusion resulting from this exploration was that the functional relationships, however close, between market prices and one or more attributes at one period of time for motor cars could not be utilized to evaluate changes in economic worth of predecessor and successor models of these motor cars, which are on the market at different periods of time. Moreover, perhaps because of the high degree of intra-correlation between the various attributes that were, or might have been, selected, in measuring the functional relationship, statistical analysis was not found to be useful in making this selection more objective.

42. It appears from the experience of the United Kingdom that the use of regression or variance analysis for purposes of assessing the relative economic worth of two variants of a commodity in the light of the relative magnitudes of selected characteristics of these items has little advantage over the use of

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<sup>9/</sup> See Problems in the Collection of Comparable Wholesale Price Series, pp. 9-11 and Annex.

<sup>10/</sup> See Annex II for the description of the experiment and of the conclusions reached that has been received from the Statistical Division, Board of Trade, the United Kingdom.

less objective methods for this purpose. The use of regression or variance analysis does, however, provide a means for determining whether the hypothesized relationships between economic worth and magnitudes for attributes does not exist. In other words, if the relationship between the two is not close at the time either one of the variants is on the market, it certainly does not exist over the two periods of time. The use of these statistical techniques may also be of value in defining hypothesized non-linear functional relationships.

E. Use of Cost, Supply Price and Similar Data from Producers

43. In view of the limited number of cases in which use of quantified characteristics in evaluating "g" has been found practicable, an increasing number of national statistical offices are seeking data from producers for this purpose whenever substitution or splicing does not seem to be appropriate or overlapping price data are not available. This approach to obtaining data for adjusting price series to a comparable basis is most common for highly fabricated consumer and producer goods which do not fall into the category of unique goods. The requests made to respondent producers usually consist of queries as to (i) the cost, supply price, or even estimated market price of components or materials which account for the difference between successor and predecessor varieties of an item, (ii) the cost or supply price for the successor variant when the predecessor was on the market or for the contrary situation or (iii) the proportions of the difference in the price quotations between the successor or predecessor variants that are due to changes in "pure" price and characteristics. The latter two types of queries may be utilized in the case of additions or eliminations of components as well as more general changes in composition, design, capacity, etc. In making these requests for information, national statistical offices have generally not specified the records or the procedures that should be utilized in providing data. It has been felt that doing this might strain the co-operation of respondents and requires a more intimate knowledge of the records and organization of respondents than most national statistical offices have. Nevertheless, the view was expressed that it would be useful, once excellent relationships had been established with respondents, to inquire into the methods used by respondents in providing such information in order to formulate criteria for this purpose.



44. In gathering information from producers in order to evaluate "g", for successor and predecessor variants of a commodity, it is advantageous to define precisely and concretely, to the extent possible, the differences between the two varieties and to request data on the resulting difference in producers' supply price. Focusing the respondents' attention on the differences for which information is wanted should be of assistance in procuring more pertinent and objective data. In this connexion, it is interesting to note that in the case of the evaluation of changes in the characteristics of automobiles in the United States, a reporting form is in use which inquires into the details of change for each key component and part of the automobile. However, it may not be feasible to be so specific in a number of instances of changes in general design and the like. In these situations it seems desirable to ask explicitly for the difference in producers' supply price or cost attributable to the general difference between the two variants. It is also preferable to request producers' supply price rather than cost in order to include, in the data gathered, expected or usual profits as well as overhead and direct costs. Some countries have even sought, from producers, estimated market prices for the two variants in an effort to approximate more closely their relative economic worth. In any case, it is essential to specify whether the comparative figures are desired for the time at which the successor or predecessor variant was on the market because there may be marked differences between the two periods in the estimates that are obtained. It might be advantageous, from the point of view of gathering more reliable data, to utilize the more recent time for this purpose. In any case, it is desirable that the two periods be as close together as possible.

45. Data on relative producers' supply prices for successor and predecessor variants of a commodity that may be expected to approximate relative market prices if these variants were on the market at the same time would, of course, be a sound way of evaluating the relative economic worth of these items. This is likely to be true in the case of industrial machinery and equipment and more highly fabricated, complex consumer goods. Difficulties may arise, however, in utilizing producers' supply price because of the differences between producers in the way in which they assess overhead and related burden and expected profit and allocate it to individual products. It, therefore, would be useful to gather and average data if possible on supply price from more than one producer.

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46. Relative supply prices should furnish a closer approximation than relative producers' costs to the relative prices that would prevail if two variants were on the market at the same time. This is due to the inclusion of profit in producers' asking price and not in producers' costs, even if these costs relate to all direct and overhead expenses. The inclusion of profit adds an element which not only is ordinarily part of market price but also should reflect, at least in part, the judgement of producers as to the comparative worth of the two variants from the point of view of consumers. It has been suggested that the use of relative cost data tends, when substantial technological improvements are incorporated into machinery or equipment, to underestimate the relative worth of the successor and predecessor items because account is not taken of the relative prices that users of this machinery or equipment would be willing to pay in the light of differences in operating characteristics between the two variants. Producers, particularly where they dominate the market, are likely to take account of this in setting their supply prices. Methods of taking explicit account from the points of view of both users and producers in evaluating the relative economic worth of machinery and equipment have also been given some consideration. These methods are based on computation of producers' cost per unit of some key operating characteristic for the price of machinery. However, the differences between two variants of a machine cannot generally be related to only one operating characteristic, and it does not seem practical to utilize a multiplicity of operating and physical characteristics. It is interesting to note that, nevertheless, methods based on computations of this type seem to have been successfully utilized in the USSR.



## VI. UNIQUE GOODS

### A. The Pricing Problem

47. As was indicated earlier in this paper, in the case of heavy capital goods (e.g., railroad rolling stock, ships, dredges, buildings, bridges and other construction projects, large turbines), each transaction is unique and cannot, therefore, be priced directly in gathering comparable series of quotations. In other words, the differences between successive transactions in these goods are so great that meaningful and comparable price data cannot be derived directly from information on these transactions. Both the characteristics and dimensions of the piece of heavy machinery or construction project and the circumstances of sale involved in successive transactions are generally incomparable. Each piece of machinery or construction project is generally completed to order, according to a particular set of specifications, and each contract usually extends over a considerable period of time and contains particular guarantees, terms of payment, perhaps escalator clauses and other special provisions. Moreover, long periods of time may elapse between successive contracts for a particular type of heavy goods. Despite the impossibility of gathering comparable price quotations on transactions in unique goods directly, a number of countries have felt it essential to compile price series on these types of transactions in view, for example, of the importance in their economies of transactions in capital goods and the demands for price data with which to deflate value figures on capital formation to real terms.

48. Because of the inability to gather price data on heavy goods directly from transactions in those commodities, countries have utilized a number of alternatives in order to include heavy goods in their indexes of prices. In a few instances, it has been implicitly assumed that prices for heavy machinery varied in the same way as the over-all index computed from price quotations for most other important commodities. In other instances, it has been decided to utilize the fluctuation of price relatives or indexes of cognate items or groups as indicators of the fluctuation in the price of heavy machinery or construction project - for example, small, mass-produced electric motors for large, order-made

electric motors; mass-produced metal products for heavy machinery in general; or building raw materials for construction. This has been accomplished by adding the weight in the index of heavy goods to the weight of the cognate item or group for them. Because of the lack of suitable cognate items or groups, as well as the questioning of the assumptions underlying the use of this method, national statistical offices are, to an increasing extent, utilizing or exploring alternative methods of compiling comparable price data on unique goods despite the difficulties and considerable statistical resources involved in these methods. These alternative methods are based on the compilation of comparable series for specified models of important kinds of machinery or construction projects. One alternative consists of computing a price index of direct inputs for the model. The other approach consists of gathering information on the total cost or producer's supply price for the model. Each of these alternatives to the compilation of comparable price series on models for unique goods are discussed below.

#### B. Specification of the Models

49. In order to ensure the compilation of comparable price data on representative models, it is desirable to specify the characteristics of the models for which data are being sought in the light of the types of heavy goods actually being constructed. Specification of the characteristics of the models is an essential part of the procedure if these price data are based on index numbers of input - for example, of materials on the amount of various labour and perhaps other costs. These specifications coupled with other information provide the basis for computing the weights that are required for combining the price indexes for each of the inputs. Therefore, countries utilizing the approach to pricing models have specified these models in considerable detail. Most countries employing the alternative approach to pricing models have also formulated rather detailed descriptions in order to be aware of the nature of the price data being gathered and to ensure the comparability of the data from period to period. These specifications have always been developed in association with representatives of the trade or respondents. Such consultation is also a necessary step in devising realistic and representative models for use in the approach based on prices of inputs. It should be noted that in a few instances when data are



gathered on total cost or supply price for models from trade associations or individual producers, explicit specifications have not been set out in order to avoid straining their co-operation.

50. It is possible to specify the model subject to pricing in at least three different ways. The most frequently used approach is to describe the model in terms of the physical and key operating characteristics with which the direct costs of producers are most closely correlated - for example, material used, components, process of construction, dimensions, design and capacity. Specification in these terms is essential to weighting when compiling price data from price series on inputs of materials, labour, etc. and is particularly common for construction projects. Also, this mode of specification furnishes producers who may be supplying data on the total cost or bid (supply) price of a model the most precise basis for estimating these figures. However, in order to keep the model representative, changes will be required in the specifications with changes in the materials, components and processes actually used in construction.<sup>11/</sup> Further, to attain representativeness at any one time, it may be necessary to specify a number of different models for each type of unique good.

51. Ways of describing models that are more general than that outlined above are being explored or considered. One approach, which is the subject of experimentation in the United Kingdom, is to specify models for industrial plants of given capacity per unit of time. This type of specification would only be useful when gathering figures of total cost or supply price from manufacturers of plants and provides less control on the method utilized by respondents in arriving at the price data sought than detailed descriptions of

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<sup>11/</sup> It should be noted that when the nature of the model is changed, the same problems of comparing price series for the successor and predecessor models arise as were discussed in the preceding part of this paper.

the physical and other characteristics of models. However, for purposes of representativeness, it would not require as frequent change in specification as models described in detail, as it allows for flexibility in the materials, components, processes and design utilized in the construction of plants. Another approach which has been considered in the United Kingdom is to gather figures of supply price for plants which may be utilized to manufacture a given output with a given input of raw materials, labour and other types of inputs. This mode of specifying models might be utilized in the same situations and is, on the whole, as general as the preceding method of specifying models. In addition, it has the advantage of giving more weight to the point of view of the user of the plant or machinery than either of the other two ways of specification that have been discussed. Essentially this method is a complex form of the techniques of computing cost per unit of operating characteristics that were mentioned earlier in this paper. However, one wonders to what extent producers of plants or machinery are in a position to supply price data in terms of specifications of given outputs resulting from given inputs. Also account is not taken in either this or the other general mode of specification of a number of other factors which are of importance from the point of view of users - for example, durability, maintenance costs or the processes they use in manufacturing and the organization and layout of the plant that is involved in these processes.

### C. Price Index Numbers

52. Index numbers of the prices of the principal raw materials consumed and the labour directly employed have been utilized to measure price trends for construction projects and, to a lesser extent, for other types of heavy goods. These indexes are generally weighted in terms of the estimated quantity of each kind of raw material that would have been consumed and labour that would have been employed in producing model pieces of construction or machinery during a base year. The index numbers, therefore, do not reflect changes, from the base year, in the cost of the models resulting from changes in the productivity of labour, in the efficiency with which raw materials are utilized or in the types



of raw materials consumed. The models for which the price indexes are computed may also become outdated and unrepresentative. These deficiencies in the price index numbers can be remedied by changing the base year of the index numbers. However, in view of the work involved in defining the models and in computing the associated price and volume data for raw materials and labour, it is not practicable to make frequent changes in the base year. Further, these index numbers do not take account of changes in cost which reflect variations in overhead charges or profit margins.

53. The Dominion Bureau of Statistics of Canada is testing a method of keeping the weighting and character of price index numbers for selected models of construction projects up-to-date as well as of introducing overhead charges and profits. These construction projects - for example, the building of roads and bridges - have been subdivided into the key steps involved. For each step, data are gathered currently on the quantity of work done or materials used and price per unit of work or materials used, where applicable, and on total cost, in all cases. This provides the basis for making adjustments for changing combinations or efficiency in the use of materials and labour and for taking account of shifting profit margins. Work is also proceeding in the United Kingdom on including data on overhead costs and profit margins in price index numbers that are computed for selected models. The difficulties that have been encountered in this work are not so much obtaining a weighting pattern for the base year for purposes of including these items as obtaining data in order to reflect the overhead charging prices for overhead costs and changing margins of profit.

54. Price index numbers of direct inputs would seem to be useful measures of price fluctuations for construction projects. Changes in technology in this industry are not too frequent and the variation in market values probably reflects closely the fluctuation in direct costs. Without adjustments for overhead and changing technology, price index numbers are not suited to measuring price movements for other heavy goods than for construction projects. Although the correlation between market value and total cost is high,

technological changes are much more frequent in the production of heavy machinery than in the construction industry and overhead, such as research and development and advertising, may make up a larger share of total costs in the former than the latter industries.

D. Total Cost or Producers' Supply Price

55. In the case of heavy machinery or transport equipment, some countries have sought information on the movement in prices by periodically (e.g., every quarter or month) gathering data on total costs or producers' supply price for representative models. For example, the Netherlands and the United Kingdom utilize this approach for ships and, in the case of the latter country, certain types of manufacturing plants; the Federal Republic of Germany, seeks such information for construction projects and railroad rolling stock and the United States employs it for lifts. The data which are sought on total cost or producers' supply price for the models of pieces of heavy machinery or transport equipment should reflect the changes in the value of transactions in or bids made for these items resulting from changes in the productivity of labour, the efficiency with which materials are utilized or in other aspects of the technology of production. Drastic shifts in design might be taken account of by changing the models priced and linking the successor model to its predecessor. The data sought should not only include overhead and profits, but also should reflect the overhead and profit margins included in current bids or transactions. Thus, it would be preferable to seek data on supply price rather than data on total costs.

56. Collection of reliable data on the total cost or producers' supply price for complex goods requires extensive co-operation from key producers of these goods. Knowledge on the part of the statistical authority of the market and production and accounting records for these goods is also desirable. In practice, national statistical offices have not found it feasible to inquire too closely into the methods utilized by respondents - producers or trade associations - in arriving at the price data furnished.



## VII. DISCONTINUITIES

### A. The Nature of the Difficulty

57. In contrast to a change in the characteristics of a type of transaction being priced where, in effect, the type of transaction is permanently discontinued, in the case of discontinuities in price quotations, an item being priced disappears from the market but is expected to be on sale again at some future time. Discontinuities in the sale of items may be unforeseen and irregular or may follow seasonal or other regular patterns in the supply or demand for them. The suspension of imports of an article being priced because of a special quota or duty involves an irregular discontinuity in price quotations. The bunching of sales of fertilizers or summer clothing during particular seasons of the year results in seasonal discontinuities in price quotations for these commodities. Most of the difficulties arising out of discontinuities in price quotations are due to the fact that first excluding and then including the type of quotation in a price index or relative, results in showing unreal changes in price in either of these indicators if the weight of the involved item in the price index or relative is not negligible. Methods, therefore, are needed for dealing with discontinuities in price quotations so that the price indexes or relatives into which they enter will portray the real short-run fluctuations, as well as long-run relationships, in prices.

### B. Irregular Discontinuities

58. The method of dealing with an irregular discontinuity in price quotations which is most appropriate depends, to a great extent, on the relative importance of the price quotations in the price indexes or relatives in which they are used and the past relationships in price between the item which is temporarily not on sale and other items for which price quotations are included in the price statistics. If the temporarily discontinued price quotations have negligible weights in the indexes or relatives or if they have show little fluctuations in the past, it is appropriate to drop the price quotations temporarily from the indexes or relatives or, better, to carry forward the last available price quotation. The second alternative is easier to effect and is less likely to

result in illusory changes in the indexes or relatives because of, firstly, the exclusion and, then, the inclusion of the discontinuous price quotation.

Carrying forward the last available price quotation is more common among countries under these circumstances than dropping the series.

59. When the foregoing conditions do not hold, countries have generally included the item for which price quotations are temporarily unavailable in the price statistics, based on price quotations for a cognate item or group of items. If the item is one among a number of varieties of a commodity being priced, it is best to use for this purpose the price quotations for the variety with high correlation in past price fluctuation and level to the discontinued variety. If one variety is not to be preferred from this point of view, in computing price indexes or relatives, the movement in price for all of the varieties of the commodity which remain on sale might be imputed to the variety which is temporarily not on the market. If the item is the only one of a commodity being priced, it will be necessary to impute to it movements in price of a cognate commodity or even of the group of commodities of which it is part. The considerations in choosing the cognate commodity are similar to those in selecting a cognate variety. If a commodity meeting these specifications is not available or the difference has been considerable in the past in fluctuations in price between the discontinued variety and the group of commodities of which it is a part, it may be best to include in price indexes or relatives, the last available price quotation for the temporarily discontinued variety.

60. In any of the alternatives outlined above for dealing with irregular discontinuities in price quotations, again including in the price series the actual price quotation for the item when it reappears in the market, may result in a sharp illusory change from the immediately preceding periods in the price indexes or relatives. In these circumstances the sharp unreal change in the price indexes or relatives might be eliminated by proportioning the change in the level or price quotations for the item over each month or other interval of the period during which the item was not on sale. In the case of an integrated system of price index numbers, this is a laborious procedure and it probably should not be carried out except where the reintroduction of the temporarily discontinued price quotations results in very marked distortion in published price data.



C. Seasonal Discontinuities

61. Recurrent and regular discontinuities are encountered in pricing items, such as fresh fruits and vegetables, clothing for summer wear, which are on the market in significant quantities only during certain times of the year. Such items do not usually have considerable weight in broad aggregates for wholesale price statistics of most countries.

62. A common national practice in dealing with the pricing of seasonal items is to carry forward the last acceptable price quotation for the item between the time of its usual disappearance and reappearance on the market in sufficient quantity. It has been suggested that the last acceptable price quotation should relate to some time before instead of to the time of the disappearance from the market of the item because of the typical price situation at the time of disappearance. For similar reasons it may be desirable to wait some time after the reappearance of the item to replace the "dummy" price quotation. In some cases, countries utilize price data for cognate series to bridge the gap between the disappearance and reappearance of seasonal items. This approach is taken when previous experience indicates that price trends between periods when the seasonal item is on the market are similar for the seasonal item and cognate series. In a few instances, prices for seasonal items have not been included in compiling price data relating to the months or quarters in which these items are not on the market. If this practice is followed, included in annual aggregates on prices would be the average of the prices of seasonal items for only part of the year during which these varieties are on the market. It would be useful, in any case, if countries in publishing price data indicated the conventions that they adopted in dealing with prices for seasonal items.

63. Countries do not seem to encounter many problems on the weighting and comparison base for seasonal items. In incorporating prices for seasonal items into much broader price aggregates, it is generally easiest and common practice to utilize a year as the weighting base. Some countries are, however, considering the use of varying weights for seasonal items in monthly or quarterly price data in order to avoid over-weighting the significance of these items when they are not on the market in volume. If prices for seasonal items are dropped from monthly or quarterly aggregates, this would, of course, involve adjusting weights. Price series which consist mainly of seasonal items or are materially

influenced by the prices of these items are usually published only for periods when the items are on the market. Although there may be advantages, when issuing monthly or quarterly price data of this type, to utilizing the comparative month or quarter of the base year as the weighting and comparison base, few, if any, countries find this approach feasible. They generally utilize the entire base year for this purpose.



VIII. SUGGESTED ACTION BY THE STATISTICAL COMMISSION

64. The foregoing survey of problems and practice in gathering representative and comparable wholesale price series indicates the significance of meaningful and useful wholesale price statistics. It also emphasizes the considerable interest in and increasing amount of work on these questions on the part of national statistical offices. Further, the review of the problems of gathering representative and comparable price series and of the alternatives for dealing with these questions suggests the need for revising and extending the recommendations that the Statistical Commission made, at its seventh session, on the collection of wholesale price statistics. The Commission may, therefore, wish to invite the Secretary-General:

- (i) To prepare and publish a technical report on the subject of gathering and compiling representative and comparable wholesale price series, based on this paper modified in the light of the Commission's discussion of this topic and additional information on national experience and practice that may be made available.
- (ii) To formulate a set of guiding principles on the collection and compilation of representative wholesale price series for the consideration of the Commission, including a revision and extension of the recommendations on this subject made by the Commission at its seventh session.
- (iii) To consult, on the foregoing work with national statistical offices and experts and with regional and other international bodies, where necessary.

ANNEX I

THE STATISTICAL ANALYSIS OF MERCHANDISE QUALITY STRUCTURE<sup>1/</sup>

The Commercial Quality Control Institute (KERMI) of the Ministry of Internal Trade carries out regular quality analyses of products circulating in domestic trade. It issues a comprehensive quarterly report giving the results of laboratory analyses of some of the technical characteristics involved in quality structure, e.g.

"Goldsol" Silks

Characteristic		Laboratory analysis results	
		1st quarter, 1955	1st quarter, 1954
Thickness of weave (10 x 10 cm)	Along the warp	627	625
	Along the woof	298	265
Weight, sq. metre		115	113
Tensile strength per kg. (200 x 50 mm)	Along the warp	22.4	28.0
	Along the woof	20.8	20.8
Colour fastness		8.0	7.5

These qualitative criteria do not give a complete picture of the quality structure of the products, some of the values for these criteria having been higher and some lower than in the base period.

In order to express the relative quality structure of a particular product by means of a single indicator, it is necessary to construct an index expressing changes in a number of qualitative criteria. This article is concerned with the solution of that problem.

<sup>1/</sup> Translated and extracted from an article in Hungarian in Statisztikal Szemle, XXXIII, 8-9 August-September 1955, pp. 799-803.



## 1. This individual qualitative index

For the purpose of calculating an index-number expressing quality changes in individual commodities (hereinafter called the individual qualitative index), three categories are established. The first consists of commodities whose quality is determined by a single technical characteristic; the second of commodities whose quality is determined by a number of technical characteristics, a change in the values of those characteristics being in a linear relationship to a change in quality. The third category consists of commodities whose quality is determined by a number of technical characteristics, a change in the values of those characteristics not being in a linear relationship to a change in quality.

The individual qualitative index is established by different methods according to the category.

(A) In the case of commodities whose quality can be determined by a single technical characteristic, it is derived from the ratio of the values of the technical characteristic concerned, e.g.

## Copper Sulphate

Technical characteristic	1955	1954
	First quarter	
Percentage copper sulphate content	97.31	98.0

Individual qualitative index:  $M = \frac{97.31}{98.0} = 0.993$ . The average fall in quality of the copper sulphate was therefore 0.7 per cent.

(B) In the case of commodities whose quality can be determined only by a number of technical characteristics, a change in the values of these qualitative characteristics being in a linear relationship to the change in quality, the individual qualitative index is established as follows:

The laboratory analysis results in respect of the individual qualitative characteristics are available for individual commodities both for the period covered by the report and for the base period.

If we know the weights corresponding to the relative importance of these characteristics in the formation of quality, these weights can be applied to the ratio  $\frac{IQ_{55}}{IQ_{54}}$ . The weighted average of the ratio gives the individual qualitative index, e.g.

Lignite

Technical characteristic	Qualitative weight*	Laboratory analysis results		Ratio	Weighting operation
		1955 1st quarter	1954		
Calorific value, by kg.	0.7	3600	3600	1.000	(0.7) 1.000 = 0.700
Percentage gangue content	0.3	4	5	0.800	0.3 $\frac{1}{0.800^{**}}$ = 0.375

Individual qualitative index:  $M = \frac{0.700 + 0.375}{1.000} = 1.075$ , which means

that there was an average improvement of 7.5 per cent in the quality of the lignite.

(C) In the case of the overwhelming majority of commodities, changes in quality are not in a linear relationship to changes in the values of their technical characteristics. The individual qualitative index for such commodities will not be equivalent to the average of the ratios for the individual technical characteristics but will deviate from it in accordance with functional relationships of higher degree. The individual qualitative index may in this case be calculated as follows:

(a) Industrial and commercial experts in the Commercial Quality Control Institute have worked out a system of points corresponding to possible values (those likely to be encountered in practice) for the individual technical characteristics, e.g.:

\* In technical practice, the weights of the individual qualitative criteria in the structure of quality are generally known, or they can be calculated for commodities for which they are not yet available.

\*\* Since a numerical rise in the ratio of the values for the laboratory analysis results reflects a fall in quality, it must be taken into account in the reciprocal.



Serge  
 (rayon, 90 cm wide)

Thickness of weave, 10 cm	Along the warp	Analysis value	596-600	601-605	606-613	614-620
		Points	70	80	96	105
	Along the woof	Analysis value	360-365	366-370	371-375	376-380
		Points	78	96	101	102
Weight per sq. metre, in gr.		Analysis value	96-97	98	99-100	101-105
		Points	35	36	39	41
Tensile strength in kg.	Along the warp	Analysis value	32-33	34-35	36-38	39-45
		Points	81	90	95	99
	Along the woof	Analysis value	15-17	18-19	20	20-25
		Points	88	91	97	100

(b) The analysis values are known and the corresponding points can be ascertained from the table. The total number of points expressing the quality of the commodity are calculated both for the period covered by the report and for the base period, e.g.:

Serge  
 (rayon, 90 cm wide)

Technical characteristics		Analysis value	Points	Analysis value	Points
		1955, First quarter		1954, First quarter	
Thickness of weave, 10 cm	Along the warp	609.9	96	614.0	105
	Along the woof	365.0	78	370.0	96
Weight per sq. metre, in gr.		102.0	41	100.0	39
Tensile strength in kg	Along the warp	45.0	99	38.0	95
	Along the woof	24.2	100	21.0	100
Total		-	414	-	435

/...

(c) The individual qualitative index is obtained by relating the points for the two periods.

Individual qualitative index:  $M = \frac{414}{435} = 0.952$ , which means that the quality of the serge has declined by 4.8 per cent.

The individual price indexes can be corrected on the basis of the individual qualitative indexes calculated by this method.

2. The individual price index adjusted for changes in quality

We know the unit prices of the following commodities and their ratios (individual price index).

The data in the table show that the price of lignite rose by 22.7 per cent, that of serge decreased by 2.5 per cent and that of copper sulphate remained unchanged.

The Individual Price Index of Certain Commodities

Commodity	Unit price		Individual price index $\left( \frac{P^1}{P^2} \right)$
	1955	1954	
	First quarter Forint-quantity unit		
Copper sulphate	5.80	5.80	1.000
Lignite	27.---	22.---	1.227
Serge (rayon, 90 cm wide)	71.40	73.20	0.975

If, in addition to price changes (laid down in decrees and orders) i.e., the individual price indexes, changes in quality are also taken into account, an individual price index is obtained which expresses both changes in quality and in unit price, e.g.:

/...



The Individual Price Index of Certain Commodities Adjusted for  
 Changes in Quality

Commodity	Unit price		Individual price index (2:3)	Individual qualitative index	Individual price index adjusted for changes in quality (4:5)
	1955 First quarter	1954			
1.	2.	3.	4.	5.	6.
Copper sulphate	5.80	5.80	1.000	0.993	1.007
Lignite	27.--	22.--	1.227	1.075	1.141
Serge (rayon, 90 cm wide)	71.40	73.20	0.975	0.952	1.024

Accordingly, the individual price index corrected by changes in quality

is  $\frac{P_1}{P_0} \cdot \frac{1}{M}$

ANNEX II

EXPERIMENT OF THE DIVISION OF STATISTICS, BOARD OF TRADE, UNITED KINGDOM  
 WITH REGRESSION ANALYSIS FOR PURPOSES OF ADJUSTING PRICE SERIES FOR MOTOR-  
 CARS TO A COMPARABLE BASIS: DESCRIPTION AND CONCLUSIONS REACHED 1/

A. Description

1. Price/specification relationships were examined for thirty-four United Kingdom cars. The aspects of specification most highly correlated with price (£y) were bhp ( $x_1$ ) and weight ( $x_2$  lbs.). The correlation and regression coefficient (with price the dependent variable) are shown in the following table; the figures relate to cars at the Autumn 1957 Motor Show:

Independent variables	Correlation coefficients	Regression coefficients
bhp ( $x_1$ )	0.86	6.67 $x_1$
weight ( $x_2$ )	0.92	0.30 $x_2$
bhp ( $x_1$ ) and weight ( $x_2$ )	0.93	1.22 $x_1$ + 0.26 $x_2$

The following is an analysis of variance:

Source of variance	Sums of squares	Degrees of freedom	Mean square
Variation explained by weight	1132273:	1	1132273
Variation explained by addition of bhp	6507:	1	6507
Total explained variance	1138780:		
Residual variance	185650:	31	5989
Total variance of price	1324430:	33	

1/ Extract from correspondence between the Division of Statistics, Board of Trade, United Kingdom and the Statistical Office of the United Nations.



The variance ratio:  $\frac{\text{Mean square (addition of bhp)}}{\text{Mean square (residual)}} = 1.086$

which with d.f  $n_1 = 1$ ,  $n_2 = 33$  is not significant at the 20 per cent level of significance. For the purpose of estimating the price of a car from its specification therefore, there would have been little point in doing more than using weight as the independent variable; to extend the analysis to the multiple regression of price on weight and brake horsepower would have added very little to the reliability of the estimate. But changes in bhp have been considerable in recent years and would have to be taken into account in any index of quality change.

#### B. Conclusions Reached

2. The Board of Trade has experimented with the use of regression analysis to compile a quality-adjusted price index for motor-cars, taking 1954 as a base year. The parameters relating price to aspects of specification (weight, brake-horsepower (bhp) etc.) have changed since 1954, but not so radically as to present any insuperable difficulty; nor has technical advance been so swift over the period that the price-quality relationships of the base year have been rendered obsolete. Nevertheless, the Board of Trade view is that the relationships between specification and price at a time cannot reliably be used to estimate the effect over time of changes in specification on price. The reasons for taking this view are set out in the following paragraphs.

3. At any one time it may reasonably be assumed that the relative prices of different varieties of a commodity are a measure of the relative qualities of those varieties: the dearer the motor-car, the better its quality. If some characteristic - say weight - is highly correlated with price, then that characteristic will give a reliable measure of the relative quality of motor-cars - again, at any one time. But it does not follow that, because weight, a linear function of price, may be taken as a measure of relative quality in the base year, changes in weight over time are a measure of changes in quality and can be translated into terms of changes in price in the base year.

4. To illustrate the point: at any one time the weight of a motor-car is highly correlated with its price, and it will be possible from the prices and weights of cars in 1954 to derive an equation of the form

$$y = a + b x$$

where Y is the price of a car and X its weight, and b, the parameter attaching to x, is positive. If, between 1954 and 1958, by the use of more expensive materials - e.g., the use of alloy steel in place of mild steel - the weight of cars is reduced (ceteris paribus) then the regression equation would show that, at 1954 prices, 1958 specification cars would be cheaper than 1954 specification cars - i.e. that there had been a reduction in quality between 1954 and 1958. Moreover, this contradictory result would still be obtained even though prices and weights of cars in 1958 were still correlated to the degree that they were in 1954.

5. Statistical techniques do not seem to help in selecting the aspects of specification to be handled. A number of aspects - weight, the wheel base, etc. - are highly correlated with price "at a time" and analysis of variance will show whether the addition to, say, weight of a second (or third, or fourth) variable will add anything significant to the explained variance of price at that time. But changes in quality may take place not only (or indeed, not at all) in the chosen variable or variables, but in other characteristics which may add little to the explained price variance at a time or which are more difficult (or impossible) to handle by regression techniques - design, consumer appeal, and so on. Hence the selection of the characteristics to be used seems to be a subjective matter. If the one chosen (directly correlated with price in the base year) diminishes over time, the regression method will show a fall in quality - as happens if weight is used. If the characteristic shows little change - perhaps for reasons largely outside the control of the industry: the width of cars, for instance - the regression method will show little change in quality; while if a characteristic is chosen which increases over time - bhp in recent years - an improvement in quality will be shown. And intermediate results can be obtained by selecting other variables or using two or more variables in a multiple regression analysis.

6. For these reasons, the Board of Trade has decided that the use of regression methods does not present a valid technique for adjusting motor-car price indices for changes in specification.