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STATISTICS OF PRICES AND QUANTITIES AND NATIONAL ACCOUNTING IN CONSTANT PRICES

The collection and compilation of price and quantity statistics

Report of the Secretary-General

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INTRODUCTION

1. This paper deals with the principles and methods of gathering and using elementary series of indicators for purposes of the system of price and quantity statistics that are set out in document E/CN.3/427. In discussing how the elementary series may be used, the major techniques of compiling the aggregated index numbers and absolute figures of the proposed system are reviewed. As is pointed out in document E/CN.3/427, this paper reflects the comments of the sixteenth session of the Statistical Commission and of meetings in the various regions of the world in respect of its earlier version, document E/CN.3/402, "The collection and compilation of price and quantity statistics".

2. Discussed first in this paper are the nature and characteristics of the elementary indicators which are suitable for purposes of measuring the price and quantity components of the various flows that are dealt with in the index numbers and aggregates listed in table 2 of document E/CN.3/427. Considered next are the methods of choosing, gathering and compiling representative and comparable elementary series of indicators in respect of these flows. Dealt with last are the approaches to, and the methods of, compiling the index numbers and aggregates from the available elementary series. In discussing these topics, attention is focused on the special problems which arise in gathering and compiling price and quantity statistics in respect of certain of the flows and in respect of certain commodities and industries.

I. THE SERIES OF INDICATORS

A. General considerations

3. Ideally, the elementary series of indicators that are used in the system should measure the quantities and the prices of comparable, homogeneous units of flows. For example, the indicators in respect of the quantity of gross output of a business establishment during a period of account should relate to the quantity of each commodity it produces during the period, measured in units which from period to period and, preferably, from establishment to establishment, are comparable and homogeneous in respect of the dimensions of its quantity and of its embodied quality. The corresponding indicators in respect of prices should be the prices of actual sales during the given period for immediate or early delivery of identical units of each of the commodities; the prices should refer to sales made during specific dates that are spread over the period. Sales for earliest delivery should not be considered to include contracts for delayed delivery of goods because they will take a long time to produce. In these instances the prices of the goods delivered during the period of account should be used. In the case of goods which take a long time to fabricate and are usually produced to order, price series are also wanted in respect of the contracts signed during the period of account.

4. Quantity and price index numbers and aggregates should, in principle, be based on independent elementary series of indicators. Checks may then be made of the price and quantity of commodities against their value. In practice, however, it may be necessary to derive data on either quantities or prices from data on values. For example, not infrequently, figures of prices and values must be resorted to in order to derive measures of quantities because the practical units of measurement for purposes of gathering data on quantities are so imprecise that the mix of items covered may vary significantly from one period to another. The circumstances in which this may occur are discussed later in this paper.

5. The conjunction that is desired between quantity and price series - elementary indicators and aggregated index numbers and absolute figures - may be illustrated by using the case of the value added of a group of establishments during a period of account. In order to derive quantity and price index numbers or aggregates of their value added, ideally, data should be available on elementary series of quantities and prices for the period in respect of the non-durable goods and services that they used up in production during the period and in respect of the gross output that they produced during that time. While the quantity indicators of intermediate consumption should relate to the commodities that the establishments used up in producing the gross output, the corresponding price indicators should relate to the average purchasers' prices of these commodities that were delivered to them during the period. The quantity indicators in respect of the gross output of the establishments should measure the amount of goods and services they produced during the period but the corresponding average producers' price indicators should relate to their sales of the commodities.

6. As will be indicated later in this paper, serious difficulties are encountered in practice in attempting to follow the ideal approach outlined above and practical approximations to it must be adopted. For example, it is often not feasible to match data on intermediate consumption and data on gross output in the case of agriculture because of the time that elapses between the use of seed, fertilizer, etc. and the harvest of the crop. It may not be practicable to gather adequate elementary series in respect of intermediate consumption directly from certain kinds of establishments. They use too wide a range of raw materials; they purchase a number of these items intermittently only; and their records may be too scanty. The appropriate measurement of the prices or quantities of the gross output of, and capital formation in, construction or other heavy goods raises serious problems because of the complex and unstandardized character of these goods.

B. Specification and units of measurement

7. It should be clear from the discussion above that a fundamental aspect of gathering series of indicators in respect of the quantity and the price of flows of commodities is the specification of standard elementary units of measurement. The elementary units of measurement should, in principle, not only measure the precise events dealt with in the given flow of goods or services, but should also be uniform in composition and quality from the point of view of both the average producers and the average users. Defining the standardized elementary series so that the assessments of content and quality made by producers and users (essentially in terms of the costs of production in the first case and the kind and value of benefits in the second case) are reconciled and equated, simulates the factors which enter into determining the price of the item on the market. Taking account of both producers and users in defining the elementary indicators also contributes to maintaining the national accounting consistencies between index numbers and aggregates of the supply of commodities and their disposition.

8. While, in principle, the units of measurement should be identical for quantity and price indicators, in practice it is often feasible to use more precisely defined, and therefore more desirable, units of measurement in the case of the elementary price series than in the case of the elementary quantity series. For example, while

it may be feasible to gather prices in respect of the sales, exports and domestic purchases of given varieties and circumstances of sale of goods and services, it is usually impractical to gather quantities, or even values, in respect of items specified in such detail. In these circumstances the elementary series of prices might be combined into averages, roughly weighted if feasible, in order to use them in conjunction with the corresponding elementary series of quantity.

1. Commodities

9. In the case of commodities, that is goods or services sold on the market, the relationships between their characteristics and the prices at which they are sold furnish a basis for standardizing the unit of measurement, that is standardizing the varieties of each commodity. In general, items of a good or a service are identical in quality from the point of view of producers and users if they fetch the same price when sold at the same time on the same or closely interrelated markets. The markets may be considered to be the same or closely interrelated if they are accessible to substantial numbers of the same sellers and/or buyers. In that case, the values that roughly the same sellers and/or buyers assign to commodities are brought to bear on the prices set. And differences in price between items of the same commodity point to differences in their characteristics to which sellers and/or buyers assign value and which should be taken into account in specifying the various varieties of a commodity. On the other hand, no differences in price between items of the same commodity, despite some variation in certain characteristics, may be ignored in distinguishing the varieties of a commodity as sellers and/or buyers apparently do not assign value to these differences.

(a) Standard goods and services

10. This criterion is immediately applicable in specifying series of indicators in the case of commodities which are not the subject of marked changes in character and circumstances of sale from one transaction to another. In the case of the goods, the units of measurement (that is, the varieties) which ideally should be used in gathering price and quantity data may be specified in terms of physical composition, components, size, style, packaging, operating characteristics, for example capacity, power, speed, durability, etc., and circumstances of sale, for example quantity, customer services and terms of payment. In the case of services which are sold on the market, specifications in respect of the units of measurement should relate to such attributes as the activities and treatments constituting the services, the conditions under which the services are rendered, the levels of skill and training of the persons rendering the services and, if feasible, the benefits generally expected from the services.

11. In practice, it is usually feasible to specify the elementary units of measurement in such detail in the case of the prices of commodities but not in the case of their quantities. Producers or sellers and users or purchasers of commodities do not generally keep their accounts in respect of the quantity and value of these items in sufficient detail so as to be able to distinguish between differing circumstances of sale, or even between important aspects of the intrinsic characteristics of varieties of given commodities. However, they should be able to use their sales or purchase documents in order to furnish data on the prices of transactions in specific varieties of commodities.

(b) Highly fabricated unique goods

12. In the case of highly fabricated goods which are often produced to order, such as heavy machinery, large-scale or intricate equipment or construction projects, it is not feasible to define suitable standardized indicators like those discussed above. In general, reliable direct series on the quantity or prices of these items cannot be gathered. Instead, composite price index numbers or averages that simulate prices in the market must be constructed in respect of representative, standardized models of these items.

13. The models might be defined in terms of strategic, well-specified components and/or steps in fabrication in respect of which it is feasible to gather comparable elementary series of prices. These elementary price series are then combined into the index numbers or averages, using weights that are proportional to the value during the base period of the various components of the model and/or of the various steps in fabricating the model. Or, the representative, standardized models might be defined in terms of measurable characteristics, such as size, performance, durability and circumstances of sale which, in addition to physical composition, are strategic in determining its market price. The prices of these models are then estimated from the regressions of the value of the goods on their characteristics that are defined from data in respect of market transactions in a range of their variants. This is the "principal factors of quality" or "hedonic" approach to decomposing values. The approaches to constructing price series discussed in this paragraph are also dealt with in the section of this paper on adjusting for differences in the quality of commodities.

14. In practice, the pricing of representative, standard models as a whole is more common than building up these prices from constituent standardized elements. Producers are often relied on to estimate the cost of producing the model, or to indicate the price at which they would be willing to supply it. Price indexes for construction projects, and sometimes heavy machinery, are also compiled from price series for estimated inputs of materials and labour into given models. This approach has the disadvantages of not taking account of changes in the efficiency of using materials, changes in the productivity of labour, or alterations in the margin of gross profit. In some instances, adjustments are attempted for changes in the productivity of labour. Use is even made of price indicators in respect of less highly fabricated items which are similar in general character to the heavy machinery or equipment under discussion. Whether trends in the two sets of prices may be expected to be the same is questionable.

15. Basic series of quantity in the case of heavy machinery, equipment, construction projects or similar goods must, in general, be derived from series of current values (for example, at producers' values in the case of gross output or purchasers' values in the case of fixed capital formation) divided by the corresponding fabricated price series. The simple elementary quantity series which it is usually practicable to gather and to combine in respect of these items, such as the floor space of structures of a given type or the capacity of heavy machinery, either concern too few of the strategic elements in respect of their worth to users and in respect of their cost of production and/or encompass a range of differences in qualities. For purposes of devising suitable quantity indicators it would be necessary to follow essentially the same procedure as in the case of the price indicators discussed above. This is more difficult to do in the case of quantities than in the case of prices.

16. Alternatively, series of proxy indicators are frequently used in compiling quantity indexes relating to highly fabricated unique goods, especially in the case of monthly and quarterly index numbers. For example, use is made of data on employment in order to extrapolate base-period values in the case of index numbers of production (value added) of the machinery or construction industries. The employment may be measured in terms of man-hours worked or in terms of the number of persons engaged. The latter series furnishes an imprecise measure of labour input and either series requires unknown adjustments for changes in the productivity of the personnel employed. The proxy series in the case of the gross output of, or capital formation in, highly fabricated goods, are often quantities of commodities used up in intermediate consumption, for example, the quantity of cement, lumber and other building materials consumed in representative types of construction projects. The applicability of these proxy series is questionable because of variation from one time to another and from one project to another, in the input-output coefficients in respect of a specified kind of construction or in respect of a given kind of heavy capital goods.

(c) Complex services

17. As in the case of highly fabricated, unique goods, it should be useful and probably feasible to employ fabricated series of price indicators in order to partition the current value of complex services that are sold on the market, for example medical or hospital care, into components of price and quantity. The fabricated series should be based on representative models of the major varieties of the services. The procedures of pricing these models would be similar to those discussed above in the case of highly fabricated unique goods. The elements of the representative models to be priced would, in the case of the services, be kinds of activity and forms of treatment, including, if possible, specifications as to the level of skill - training, experience, certification of the persons - carrying out the activities. The skill of the persons performing the elements of a complex service and the prices attached to each of the elements, are probably the best proxy measures of the relative quality of, that is the expected benefits from, these activities that it would be feasible to use. While, conceptually, these prices may not be fully satisfactory indicators of relative quality in the case of services such as medical care, they are the best available objective measures of the values that users attach to the services. The problems of pricing the elements of representative models will increase as the detail of their decomposition into elements increases. Serious difficulties may also be encountered in finding suitable base-period values for purposes of fabricating price index numbers in respect of representative models from the price data on their elements and for purposes of combining these index numbers into price series in respect of the total complex service. None the less, the use of representative models that are decomposed in as much detail as is feasible would be preferable to using the prices of incomparable examples of the complex services.

18. In national practice, the latter type of price series are used in order to compile price and quantity data in respect of household consumption expenditure on such services as medical and hospital care. Statistics of employment, coupled with base-year period values, are frequently the basis for estimating the value added in constant prices, of the service industries.

(d) Financial services

19. Gathering and compiling series of price and quantity indicators in respect of the gross output and disposition of, and value added in, banking and similar financial services raises difficult problems in addition to those in the case of complex services. The new problems relate to services to be measured, the element into which these services might be decomposed and the prices to be assigned to each of these elements. For example banks grant loans, invest depositors' funds, provide means of payment and liquidity, safe-keep funds and perform trust functions. The content of each of these functions, for instance the magnitude, work of investigation and risk of loans or the type and amount of deposits varies from one period to another and from one bank to another. Furthermore, the prices attached to certain of these services, for example value per unit of currency in a given type of deposit, must be imputed.

20. In view of the absence of explicit market prices in the case of elements of banking and of certain other financial services, it seems best to use elementary series of quantities in order to partition current values of their gross output, value added, etc. The quantity series should relate to various dimensions of the elements that make up the services in question. It will probably be possible to make rough estimates only of the weights to be assigned to each dimension of an element, and even to each element, into which banking and certain other financial services are decomposed.

2. Services of government and private non-profit bodies

21. As compared to the complex services rendered by industries, gathering and compiling quantity and price series are more complicated in the case of the services of government and private non-profit bodies than in the case of similar services of industries because the former bodies do not sell their services in the market. The data that may be available on the unit costs of the government and private non-profit services are a poor substitute for prices as the unit costs do not necessarily reflect the relative values (benefits) of the services to consumers. It is therefore desirable to focus on series in respect of quantities in order to partition current values in respect of those services.

(a) Measuring elements of gross output

22. At best, the quantity of each kind of government and private non-profit service might be decomposed into quantities of the constituent standardized elements which are found to be strategic to the quantity and quality of the services rendered. As in the case of the complex services, each of the elements should be highly correlated with the cost of furnishing the service and the benefits received from it. The index numbers of the quantity of each kind of services would be derived by combining the quantity indicators of each standardized element of the service, weighted in proportion to its relative unit cost during a base period. The cost of the input of commodities, compensation or employees and consumption of fixed capital should be taken into account in computing the unit cost. If data are available on the relative benefits that may be expected from the various elements, the unit costs of the elements might be adjusted in terms of these data. Alternatively, quantity indexes of the

gross output and final consumption of a service might be derived from value indexes of the cost of the service divided by corresponding standardized unit-cost indexes. In general, the direct (first) approach to measuring the quantity of gross output and final consumption is more practicable than the indirect (second) approach because it is less difficult to gather current data on quantities than on unit costs in respect of standardized elements of government or private non-profit services.

23. The techniques outlined above will be recognized as part of programme and performance budgeting. It has been found feasible to approximate these methods of measurement in the case of such government services as post offices, employment exchanges or sanitary services. In these instances, the services may be meaningfully decomposed and data may be gathered on the quantity and unit costs of each constituent task. However, as the services become more complex in character, the number of elements (dimensions) which need to be taken into account increase substantially. Moreover, the significance of the skill (quality) with which the elementary tasks are performed grows and the difficulties of calibrating quality markedly increase. For instance, it hardly seems adequate to evaluate the gross output of school services in terms of student-hours taught, grade and type of institution; or to measure hospital services rendered in terms of number of patient bed-days, out-patient visits and operations by type. It is necessary to decompose these services into much more detail in order to standardize the elements which are the units of measurement of the service in question. In the case of general administration or the legislature, the way in which the services rendered might be meaningfully decomposed into comparable measurable elements is not apparent.

(b) Measuring elements of gross input

24. In view of these difficulties, recourse is often taken to measuring the quantity of government and private non-profit services in terms of inputs, i.e., the quantity of commodities purchased, employment and sometimes consumption of fixed assets. The quantity indexes are of course to be compiled from quantity indicators in respect of the various inputs, each weighted by their share in the costs of production of the service in question. In this approach, it is extremely difficult to take account of changes in the productivity with which commodities, labour and capital are employed. However, if the quantity indexes of gross output and final consumption are compiled from a detailed classification of services and detailed data on the inputs into each kind of service, it may be feasible to measure the effects on these quantity indexes of changes in the distribution of inputs over the various services and in the character of inputs into each service. For example, in the case of employment, it is desirable to use number of man-days of employment classified according to project and occupation, grade and perhaps level of pay. However, adjustments for changes in the productivity of inputs into each detailed service per unit of standardized input are necessarily based on assumptions and are, to some extent, arbitrary when quantity indexes of gross output are not available.

25. Quantity indexes of the value added of government and private non-profit services are also generally based on data in respect of inputs, primarily of employment. In principle, consumption of fixed capital should also be taken into account. If independent estimates of gross output and of commodities purchased on current account are available, double deflation may of course be used to compile quantity index numbers of value added.

C. Types of indicators

26. As we have seen above, while it is desirable that the quantity or price indicators in respect of a flow should relate to units of the flow itself, it is not infrequently necessary to resort to indicators of proxy flows or other indirect means of measurement. This section of the paper consists of a discussion of the quantity and price indicators which it may be practical to use in compiling annual, monthly and quarterly index numbers of the various flows. The discussion roughly follows the order in which flows are listed in table 2 of document E/CN.3/427.

1. Gross output of commodities and industries

(a) Quantity

27. Monthly and annual figures of the quantity of gross output of individual commodities should not be too difficult to gather from establishments engaged in producing raw material, (e.g., agricultural and mining products), semi-finished manufactures and electricity, gas and transport services. The products of these units are not too diverse and are of relatively constant quality. While establishments manufacturing consumers' goods and standardized kinds of capital goods and parts should be able to supply data on the quantity of the gross output of individual commodities annually, they may find it more practicable to provide figures of the quantity of shipments, or of sales, of these items monthly. This is due to the range of commodities they produce and their lack of suitable monthly, or even quarterly, figures of stocks. The indicators of shipments, or sales, will of course deviate from those of gross output to the extent that stocks are being built up or run down.

28. Where a wide assortment of commodities are produced by establishments from a less diverse range of raw materials (e.g., in the manufacture of pharmaceuticals or other household chemical products), use is frequently made of quantity series in respect of intermediate consumption as a proxy for quantity indicators of gross output. This technique of measurement has disadvantages not only because changes occur in input-output coefficients, but also because differing types of indicators are then used in respect of the production of the items, on the one hand, and the import and disposition of the items, on the other. It may therefore be preferable to base the desired series of the deflated value of gross output.

29. As was indicated above, indirect or proxy approaches to measuring gross output are in general required in the case of the gross output of heavy machinery, equipment or construction. The deflated value of work put in place on these items appears to be the preferable measure, but monthly, or even annual, data on the value of the work put in place and suitable series of price indexes may not always be available. Countries have therefore resorted to the less satisfactory proxy measures of the intermediate inputs of selected commodities or of employment.

30. Because of the diversity or complexity of gross output, the deflated value of sales appears to be the most suitable and practicable measure of the quantity of gross output in the case of the distributive trades, restaurants and the services, except transport, and a number of recreational services. In the case of retail trade only, series of quantity indexes classified according to categories of commodities are called for monthly and annually in table 2 of document E/CN.3/427. This proposal is due to the usefulness of figures of retail sales in compiling indexes of final consumption expenditure.

(b) Prices

31. In the case of most commodities except heavy capital goods, it should be feasible to gather series of producers' prices in respect of sales for spot or early delivery of varieties of the commodities directly from producers. While it may be necessary to gather price series more frequently than quantity series, for example at least once a month or at even shorter intervals, it is advantageous to combine the collection of corresponding series of prices, quantities and producers' values when they relate to the same interval of time.

32. Where the sales of individual producers are too intermittent and small to make it feasible to gather the required price series from them, for example in the case of small-scale farmers or in the case of clothing manufacturers, prices are frequently gathered from wholesalers who purchase the commodities directly from the producers. When this practice is followed, the prices should still be valued at the establishments of the producers of the items, if feasible.

33. As is indicated earlier in this paper, in the case of heavy machinery and equipment and construction projects usually built on individual order, indexes of producers' prices in respect of representative models should be fabricated from the producers' prices of standardized components of, or steps in the production of, these models. Except for relatively standard machinery or equipment which is made to order, for example, large-scale electric generators, turbines, boilers, cranes, the use of proxy price series in respect of similar, much smaller-scale standard items is questionable.

2. Imports and exports of commodities

34. Statistics of imports and exports of merchandise are, in general, the best source of quantity and price indicators in respect of these flows. It may be necessary to compile quantity data of imports and exports in greater detail than is common in external trade statistics. Since the values and prices recorded on external trade documents are not infrequently set with customs duties, foreign exchange regulations, etc. in view, it may be desirable to add queries concerning actual transaction values and prices in respect of imports (c.i.f. values plus import duties) and exports (f.o.b. values). Alternatively, price series might be gathered from wholesalers who are primarily importers or exporters, at least once a month and preferably more often in the case of major imports and exports. In collecting these price series, care should be taken to obtain figures excluding the costs of any warehousing, transport, insurance, etc. within the country in the case of imports and including these costs to the customs frontier of the country in the case of exports.

3. Intermediate consumption of commodities and industries

35. Because of the difficulties of gathering suitable figures, table 2 of document E/CN.3/427 calls for the annual compilation only of indexes of quantity of the intermediate consumption of goods and services classified according to categories of commodities or according to kind of activities of the consuming establishments. The monthly series in table 2 in respect of quantities of goods which are customarily used in intermediate consumption, may be derived from monthly data on the gross output of commodities classified according to customary end-use.

36. However, because of the variability of prices, it is desirable to compile monthly series of purchasers' prices in respect of the important intermediate commodities. Except in the case of commodities which individual producers consume in large amounts, even the purchases of intermediate commodities by large establishments may be too intermittent to make these establishments appropriate sources for monthly price quotations. Where this is so, monthly purchasers' price indexes might be compiled from monthly, or more frequent, price series gathered from wholesalers who sell the intermediate commodities to producers.

37. Annually, figures should be gathered from producers of the values, quantities and, perhaps, average prices of their intermediate consumption of well-specified commodities or varieties of the commodities. Since the major part of the intermediate consumption of producers will consist of raw materials, semi-finished goods and standardized parts, difficulties should not be encountered in laying down detailed specifications, at least in the case of important intermediate goods.

38. The methods outlined in the preceding paragraph should also be useful in gathering quantity and price data in respect of the consumption of commodities by government and private non-profit services.

4. Final consumption expenditure of households

39. Monthly purchasers' price series in respect of household consumption expenditure by object should be compiled from price series for the retail sales of the various goods gathered from retail trade units and price series for the various services gathered from their producers. Quarterly quantity indicators in respect of household consumption expenditure classified according to object might be derived from figures of the value and average current-weighted monthly prices of the retail sales of the relevant commodities.

40. While the same approach may be used in compiling the annual quantity and price series in respect of household consumption expenditure which are suggested in table 2 of document E/CN.3/427, it would be advantageous to collect annual data on these expenditures directly from a sample of households. These data should furnish more complete measures of household consumption expenditure than the figures of retail sales since production for own-account consumption and purchases from government and private non-profit services should be included. Moreover, the two series of data may be checked, one against the other. The desired quantity series may be derived by dividing the value series gathered from households by the corresponding current-weighted average of monthly prices gathered in respect of retail sales.

5. Gross fixed capital formation in commodities and by industries

41. The gathering of suitable indicators of quantity and price in respect of the gross fixed capital formation of the various industries and the government and private non-profit services is a difficult task. Not only are the additions which producers make to their stocks of fixed assets intermittent and variable, but capital goods are also highly fabricated and unstandardized. In view of these difficulties, table 2 of document E/CN.3/427 calls for annual series only in the case of gross fixed capital formation.

42. It is probably necessary to use indirect approaches in compiling most of the series of purchasers' values in the case of the fixed assets. Purchasers' prices in respect of these goods may be derived from producers' prices plus unit distributive-trade and transport margins or, at best, sales prices of wholesalers plus unit transport margins. It is likely to be feasible to gather these price series directly from producers or wholesalers in respect of the less complex and more standardized machinery and equipment only. In the case of other capital goods, it will be necessary to compile indexes of producers' prices for representative models of the items.

43. In general, it is best to derive the annual series of quantities in respect of gross fixed capital formation from values in respect of detailed categories of fixed assets divided by the corresponding current-weighted average purchasers' prices. The series of values should be gathered from the producers who acquire the capital goods; the series should cover both own-account production and purchases.

6. Value added of producers

44. It should be feasible to compile quantity indexes of the value added of various kinds of producers by means of double deflation annually, but not monthly. Series in respect of intermediate consumption should be available annually; and may be available monthly as well if used as proxies for monthly series on gross output. In some cases it may be necessary to use measures of man-hours worked or of other aspects of employment, instead of data on gross output, in compiling monthly indexes of value added. As is indicated earlier in this paper, there are serious disadvantages in basing the compilation of annual quantity indexes of value added on indicators in respect of gross output or intermediate consumption only because of changes in the efficiency with which primary and intermediate inputs are used.

II. GATHERING REPRESENTATIVE SERIES OF INDICATORS

A. The problem

45. This section of the paper concerns the principles and methods of selecting respondents, commodities and varieties of commodities for purposes of gathering representative elementary series of prices and quantities. It also deals with the question of maintaining the representativeness of the series in the face of the changing universe of respondents, commodities and types of transactions.

46. While it is desirable and should be feasible to gather data in respect of the total value of gross output, intermediate consumption, gross fixed capital formation, etc. of practically all the establishments of industries once every five years, it is impracticable to seek detailed figures of the value, quantity and average price of each commodity, or of each variety of the commodities, included in these flows. In order to keep the inquiries manageable, the number of individual commodities in respect of which figures of the various types of transactions are sought must be restricted. In the case of the annual, quarterly and monthly collection of data, the number of respondent establishments, as well as the number of individual commodities and varieties of commodities, in respect of which data are sought must be progressively reduced in order to gather the information promptly and economically. Because of the birth and death, and changing scale of production, of establishments and individual commodities, the units and items which are to be surveyed can not be kept

unchanged. Provision should be made to add represenatative units and commodities each year from among the new, and perhaps the very rapidly growing, establishments and commodities; other varieties of commodities, or even commodities, must also be substituted for the items which they have replaced in the market.

47. Although external trade and related statistics furnish monthly or quarterly, as well as annual, figures in respect of the main components of imports and exports of goods and services, it is usually feasible to compile quantity and price indicators for a selection of goods only. In particular, in the case of imports and exports of complex capital goods, it is practicable to undertake the pricing of a small number of representative items only.

48. In the case of government services, it should be possible to compile annual data on the total value of all transactions covered in the proposed system of quantity and price indexes, but not on the quantity and price of all the individual commodities they consume or of all their gross fixed capital formation. Here too, a manageable number of representative individual commodities must be chosen and kept up to date. In the case of households, it will be essential to restrict direct field inquiries into consumption expenditure classified according to object to samples of households.

B. Methods of selection

1. Industries

49. In the case of business establishments, it may be best to select respondents from whom data are to be sought annually, quarterly or monthly, first; the individual commodities in respect of which figures of values, quantities and, perhaps, unit values are to be requested, second; and the varieties of these individual commodities in respect of which price series are to be gathered, third. This order of selection has a number of advantages.

50. The identifying and other information required in respect of the universe from which the selection is to be made, is usually more readily available and less voluminous for establishments than for commodities and for commodities than for varieties of commodities. When the universe of establishments is classified according to kind of economic activity, each group of establishments is likely to produce or sell and use similar commodities. Classifying establishments in this fashion also tends to group together the gross output of commodities which are joint products or substitutes. Thus, the selection of respondents is a valuable first step in the direction of selecting individual commodities. For this purpose it would also be advantageous to classify the universe of establishments according to area, as well as kind of sales outlet, in the case of retail trade units and other kinds of highly localized industries. Moreover, selecting sample establishments first, facilitates the collection of co-ordinated figures of values, quantities and prices. All the data to be gathered in respect of the sample commodities and varieties of these commodities may then be gathered from the same establishments.

51. For efficient selection of respondents and items, the business establishments in each category (stratum) of kind of activity and, perhaps, location should be

arrayed in the order of magnitude of a relevant attribute. Use might be made of gross output or shipments, of value added or of employment during a base year for this purpose. In order to gather data of a given level of accuracy at minimum costs, it is best to use the techniques of probability sampling in selecting the respondents, individual commodities, etc. to be surveyed. The monthly and quarterly samples should be sub-samples of the annual samples and the annual samples should in turn be sub-samples of the base-year samples. This intermeshing of samples will lay the basis for effective use of the annual results in making the monthly and quarterly estimates and of the base-year results in making the annual estimates.

52. It may however not be practicable to use probability samples, particularly in the monthly and quarterly inquiries, in view of the difficulties of obtaining rapid and reliable response in the case of certain establishments. Instead, many countries use purposive samples in their monthly and quarterly surveys. They attempt to select representative respondents who can be expected to furnish useable figures quickly. A common way of making this selection is to choose all units above a given size from each stratum of establishments. The size cut-off point chosen reflects the number of establishments to be included in the sample and the distribution of establishments according to size. A preferable approach is to limit the number of establishments which are selected with certainty, that is to raise the size cut-off point, and to include representative units of the smaller establishments. In general, the most efficient size cut-off point is equivalent to the total value of the measure of size adopted, divided by the number of establishments to be included in the sample. A sufficient number of sample units are then chosen from among the smaller establishments so that their total in respect of the measure of size adopted is equivalent to this size cut-off.

2. Other units of observation

53. In the case of surveys of household consumption expenditure, it is efficient to use multi-stage sampling. The first two stages might consist of successively smaller areas of location of household, for example counties or districts and villages, municipalities or towns and blocks. The third stage sample units are then households. The areas of location should, at each stage, be stratified according to size of population. The areas of each stratum might be listed in order of size of population and geographic location, and might be selected with probability proportional to size of population. The number of areas selected from each stratum should depend on the relative magnitude of the population included in the stratum and the variance of its members in size of population.

54. In order to select commodities and varieties for purposes of gathering series in respect of the consumption and capital formation of government services, the commodities involved in the case of each service should be arrayed in order of their value during a base year. Commodities grouped according to the kind of activity where they are characteristically produced and listed in order of value, should also be used in selecting items for purposes of gathering price series in respect of imports and exports.

C. Criteria of selection

55. Irrespective of the methods applied in choosing respondents, individual commodities, etc. the use of criteria such as the following in order to determine the relative size of the sample to be selcted from each of the strata into which respondents or items are divided, will contribute to the efficiency of the sample: (i) the amount of the item of major interest, for example value added, value of gross output or value of imports or exports during the base period relative to the average magnitude in the case of all strata; (ii) the relative degree of correlation between quantity and price changes in the case of the flows to be measured; and (iii) the relative variation over time in the quantity and price series. The first criterion, which is based on the fact that the larger the value, the smaller should the sampling error be, is frequently used in selecting respondents and items for gathering indicators of quantity and price. The last two criteria, which are based on the fact that the greater the variance, the larger should the sample be, are the subject of much less attention. This may be due to the difficulties of measuring intra-class correlations and variances.

D. Frequency of collection

56. Though reliable data on the quantity or value of an item can, in most instances, be gathered in respect of the entire period that is of interest, this is not so in the case of data on prices. The frequency with which price quotations must be gathered during a period in order to estimate representative average prices for the period, should depend on the extent to which the prices in question may be expected to vary during the period and the relative magnitude of the flow. For example, price quotations in respect of the transactions during a given day only of a quarter may be sufficient to establish a representative quarterly price in a few instances while price quotations in respect of the transactions during one day of each week of the quarter may be needed in other instances. In the case of most flows, it is likely to be sufficient to collect price quotations in respect of the transactions during one day of each month. In the case of most countries, gathering price quotations more frequently than once a month is feasible only where organized exchanges or trade associations are the source of this information.

E. Maintaining the representativeness of indicators

57. In order to maintain the representativeness of the various quantity and price series that are gathered, it is generally necessary to re-examine and revamp the samples of respondents, individual commodities and varieties of commodities used each time the base year for the series is changed. This should be carried out once every five or ten years. In addition, between these thorough reviews and revisions, it is essential to keep the samples used in the various inquiries up to date by adding representative series in respect of the newly founded establishments and the newly produced or imported, important commodities and varieties of commodities. These additions should be made at least annually. Some of the added commodities, or varieties of commodities, will be substitutes or replacements for items which have drastically decreased in importance or disappeared from the market; other added commodities, or varieties of commodities, will reflect growth in the quantity of goods or services supplied. In the former case, the new series should be linked

into quantity indexes by tying these series to the old series they replace; in the latter case, the new series should be added to quantity index numbers so as to show increases in quantity. Series which represent the activities of new establishments should in general be considered to represent increases in quantity.

58. When establishments which are in a sample inquiry go out of business, or when included commodities disappear from the market, they will of course be automatically omitted from the sample. On the other hand, positive steps must be taken in order to identify and add new establishments, commodities or varieties or commodities which should be included in the sample. Information might be gathered in respect of new establishments and commodities as part of the collection of basic data for the annual series of index numbers; units and items representing them might be added to the samples for the annual and more frequent surveys in connexion with the compilation of the annual series. Lists of producers classified according to kind of economic activity might be reviewed and revised annually; data might be gathered on the value, quantity and prices of the gross output, intermediate consumption and the fixed capital formation in respect of relatively detailed categories of commodities from the samples of new producing units. Arrangements are also required so that establishments continuing in the annual sample will furnish information concerning new and important commodities produced which have not been covered before. Similarly, annual external trade statistics should be reviewed in order to detect individual commodities which have become important in imports or exports.

59. Substitutions for, or replacements of, varieties of commodities being priced will often be required more frequently than once a year. For this purpose, respondents might be asked to indicate any changes that have taken place in the important varieties (for example, specifications) of the commodities for which they report in monthly and quarterly inquiries. Countries have often detected such changes as a result of querying marked monthly increases, or decreases, in the series of prices which establishments report.

III. ADJUSTING SERIES FOR DIFFERENCES IN QUALITY

A. The problem

60. In order to introduce series of new commodities, or differing varieties of the same commodity, into an index number of quantity or price, it is necessary to have a measure of the quality, that is the economic worth, of the new item relative to that of a cognate item included in the index. If the new item replaces an old item of the index which is now of little or no importance in the supply of goods or services, the old item should be used as the cognate item. If an item is entirely new, its cognate item might be the good or service already included in the sample which is as similar to the new entry in source of supply and disposition and in technology and cost structure of production as is feasible. The relative economic worth of two items is considered to be equivalent to the ratio between their prices when traded on the same market at the same time. This ratio furnishes the means of expressing the "pure" price or quantity of a standardized unit of the cognate item to be introduced into an index in terms of the "pure" price or quantity of a standardized unit of the cognate item. The quantity data in respect of the new item, measured in units of the cognate item can then be added to, or linked into, the index number. New price series would, in general, be linked to, or substituted for, the price series of the cognate item in an index number.

61. More attention has been paid to the necessity of making adjustments for changes in the quality of the items covered in a series in the case of price index numbers than in the case of quantity index numbers. However, as it is necessary to assign a nominal average base period price to new items which are introduced into quantity indexes without replacing other items, attention has been given to evaluating the relative quality of the new items in these instances. The techniques employed to evaluate the relative economic worth of items necessarily depend on a number of considerations. The avenues of information and the resources that are available for this work set practical limits to what might be done. Whether or not items introduced into the sample replace old items, the circumstances under which replacement takes place in the market, and the similarities and differnces in characteristics between the added items and the cognate old items are important factors in determining the appropriate methods of measuring their relative economic worth.

B. The use of overlapping prices

62. When prices in respect of a new commodity, or variety of a commodity, and the cognate item included in a sample inquiry are available in the market simultaneously, the ratio of these prices furnish a reliable and direct measure of the relative economic worth of the two items. This situation occurs most frequently when the new item is a replacement or substitute for the old item or when shifts take place in the relative importance of the various transactions in a commodity or commodity category. The two items may consist of unlike but related commodities, represent two varieties of the same commodity, or differ in circumstances of sale. In dealing with the addition of a new item, or the substitution of it for an old item, decisions are required on the point when the new item should be introduced. It is advisable to do this when both the new item and its cognate item command a significant portion of the market, for example when the two items have about equivalent shares of the market. At that stage, the new item will have been on the market long enough to be known and to be produced efficiently while the old item, though it is being replaced in the market, will not have yet become obsolete.

63. In view of the advantages of having simultaneous price data for two items where one is replacing the other, statistical authorities have sought this information if they do not already have it. Prices have frequently been gathered which indicate the value that the market sets on the differences in circumstances of sale, in components (for example, with or without certain accessories) or in other measurable characteristics between the two items. In the absence of market information, statistical offices have asked respondents to estimate the market prices that the old variant of a commodity would fetch at present or that the new variant of the commodity would have commanded in the past. Some offices have found it valuable to carry the use of market valuation further by measuring the change in the "pure" price of cognate items during the time elapsing between the disappearance of the old variant and the introduction of the new variant. Either of the last two techniques for adjusting series to a comparable basis are most applicable where the elapsed time between the substitution of one series for the other is short and the change in prices during the interval of time is small.

C. Principal factors of quality

64. When the market does not provide a direct measure of relative economic worth, it becomes necessary to simulate the process of pricing on the market in order to estimate relative economic worth. The "hedonic" or "principal factors of quality" approach, which is briefly described earlier in this paper, is designed to serve this purpose.

65. This approach consists of a statistical analysis of the degree of the relationship, and the parameters of the function, between selected technico-physical characteristics of the marketed varieties of a commodity and their transaction prices. The function may then be used in order to estimate the price of new varieties of the commodity that are supplied to the market after the old varieties have disappeared. The analysis may be applied to data during the period when either the new or the old varieties of the commodities in question are on the market. The parameters of the function derived in respect of each period may differ because of changes in the consumer preferences and in the conditions of supply.

66. The "principal factors of quality" approach has been used in estimating the prices of such items as automobiles, types of power equipment, dwellings and other kinds of highly fabricated unique goods. As is indicated earlier in this paper, the approach may be used in order to evaluate trends in prices in the case of unique goods or services, as well as in the case of abrupt changes in the varieties of a commodity that are supplied to the market. In the former case, the prices of representative models of the goods would be estimated from the fitted function.

67. In employing the "principal factors of quality" approach, as well as other techniques of estimating relative economic worth of items, a basic assumption is that the factors of price determination have not changed significantly in the interval of time between the disappearance of old items and the introduction of new items. The shorter this interval of time, the more likely will this assumption be well founded. An elaboration of the method where the assumption is not made, is the use of time as one of the variables in the fitted function. In this case, the data on prices and the selected attributes that are utilized in the statistical analysis relate to various periods of time; the parameters associated with the variable, time, would reflect not only changes in relative consumer preferences and conditions of supply, but also changes in the level of prices for the commodity in question.

68. In practice, use is made of a number of other approaches to measuring the relative economic worth of varieties of a commodity when the market does not directly furnish this information. These approaches all attempt to evaluate the economic worth, from the point of view of both sellers and buyers, of differences in characteristics which are considered to be correlated with differences in prices. When this is not feasible, evaluation is frequently carried out in terms of the supply or cost price of producers. However, in the case of the prices of retail sales to households, buyers' evaluations or relative economic worth are frequently emphasized.

D. Quantifying technico-physical characteristics

69. A simplification of the "hedonic" approach to measuring the value of differences in technico-physical characteristics has often been used in the case of different varieties of the same commodity, or very similar substitutes, when a simple linear relationship exists between the economic worth and one, or a few, of these characteristics. For example, use has been made for this purpose of such characteristics as the weight of bread or soap, the alcoholic content of beer, the metal content per unit of ore, the purity and specific gravity of sulphuric or nitric acid, the power potential of electric generators. The use of the correlation between technico-physical characteristics and values in comparing the economic worth of items has been extended to more complex situations by assigning point values (weights) to each of a number of attributes which are considered to be relevant and defining relationships which are not necessarily linear between the technico-physical characteristics and economic worth. This approach has, for example, been applied in laboratory and engineering evaluation of a number of commodities in the case of Hungary and in the engineering and road evaluation of various types of automobiles in the case of Sweden.

E. Cost and supply price data from producers

70. The techniques described in the preceding section are used to a limited extent only. Official statistical authorities make more use of data on supply or cost prices in adjusting series to a comparable basis when overlapping price data are not available in respect of paired items or when it is not clear that there are no differences in quality between the items. Data are usually gathered from respondents on (i) the cost, supply or estimated market price of the components or materials that account for the difference between the new and old varieties of an item, (ii) the cost or supply price for the new variety when the former variety was on the market or vice versa, or (iii) the parts of the difference in price between the new and old varieties that are due to changes in "pure" price and alterations in specified characteristics. Supply (asking) prices are preferable to cost prices, because they include an estimate of profits. Since the estimates of profits by major suppliers will frequently be based on assumptions about the prices that buyers are willing to pay, supply prices may approximate market prices closely. In particular, supply prices may be expected to approximate market prices in the case of industrial machinery and equipment and highly fabricated consumer goods, if averaged for major suppliers.

71. In gathering these data from respondents, it is desirable to be as specific as is feasible with respect to (i) the difference in attributes between the two varieties that are to be valued, (ii) the type of valuation sought, and (iii) the period of reference for valuation. Focusing the attention of the respondents on the difference in characteristics to be valued should assist in gathering more pertinent and objective estimates. As supply or cost prices may differ from one period to another, it is essential to indicate whether the data are wanted for the period that the old or the new variety was on the market. Seeking information for the more recent period may yield more reliable data.

IV. DISCONTINUITIES IN SERIES

72. Transactions in items included in a sample may be discontinued temporarily because of seasonal patterns in their demand or supply, or because of unforeseen events. Seasonal discontinuities often occur for food products or wearing apparel. Suspended imports of articles because of special quotas or duties are examples of irregular discontinuities. The discontinuities may result in distortions in a price index if the price quotations for an item are simply excluded when the item temporarily is not available, particularly if the item has a significant weight in the index. Ways of avoiding these distortions in price indexes, both in respect of short-run changes and long-run trends, must therefore be devised.

A. Irregular discontinuities

73. The appropriate method for dealing with irregular discontinuities in price series depends to a great extent on the weight a discontinued transaction carries in a price index and on whether it has regularly exhibited significant fluctuations in price. If the temporarily discontinued quotations have negligible weight and have shown little fluctuation in the past, it is appropriate to omit the series temporarily from the index; or, better, to carry forward the last available prices. The second alternative is easier to do and is less likely to result in illusory changes in the index.

74. Where the aforementioned conditions do not hold, it is common practice to estimate the missing prices, based on price series for cognate items or groups of items. Use should be made of the most similar cognate variety or commodity, the price trend of which exhibited the greatest correlation with that of a discontinued item. Where cognate items are not available, some countries carry forward the last available price for discontinued items, while other countries impute the price trends in the class of commodities closest to the discontinued items.

75. When the discontinued items again appear in the market and their actual prices are reintroduced in compiling the price indexes, the index number may register sharp illusory changes. These changes might be eliminated by proportioning the change in the price of an item over each month during which it was not for sale. However, this can be a laborious procedure which probably should not be resorted to except where reintroducing the actual prices gives rise to marked distortions in published price data.

B. Seasonal discontinuities

76. A common national practice in dealing with seasonal discontinuities in priced items is to carry forward the last acceptable price of an item during the period it is not available on the market in sufficient quantities. The last acceptable price should refer to some time before the disappearance of the item from the market, because of the atypical price situation at the time of its disappearance. Similarly, it may be desirable to wait some time after the reappearance of the item to replace the "dummy" price.

77. In some cases, price data for cognate series are used in bridging the gap between the disappearance and reappearance of seasonal items. This approach might be taken when the price trends of the seasonal and cognate items are similar during the periods when both items are available on the market. In a few instances, prices for seasonal items are excluded in compiling price indexes relating to the months or quarters during which these items are not on the market. If this practice is followed, the annual price statistics should include the prices of the seasonal items for only that part of the year when these items are on the market.

V. SELECTED ASPECTS OF COMPILING INDEX NUMBERS

78. This part of the paper concerns selected questions in the compilation of the annual and more frequent, index numbers listed in table 2 of document E/CN.3/427 from the elementary series of quantity and price dealt with above.

A. Imputations in respect of quantity, price and value series

79. Building up the annual and more frequent quantity and price index numbers from elementary series in respect of samples of commodities of course involves imputing trends in the sample commodities to other commodities. Imputation of trends in prices and quantities to some goods or services is even required in the compilation of index numbers for base periods as it is impracticable to seek quantity and price series for the innumerable, relatively unimportant items which are produced or imported and disposed of to intermediate and final uses.

80. If the sample is efficiently selected, most of the non-sampled commodities should be similar in character to the sample commodities. They should, for example, be the characteristic products of the same detailed kind of activities. However, less important non-sampled commodities are likely to differ more substantially from the sample commodities. The extent to which items from relatively detailed, unimportant categories of commodities will not appear at all in the samples will be greater in monthly and quarterly inquiries than in annual inquiries. In practice, figures are however often sought for the total value of these miscellaneous items, at least in base-period years.

81. The trends in quantity or price of sample items should, in most instances, be imputed to other items within the same detailed category of the classification. In practice, the categories in respect of which the trends in sample items are imputed to non-sample items range from the most detailed to the broadest level of classification. It is suggested that for monthly or quarterly series of index numbers, the level of classification equivalent to the major groups of the International Standard Industrial Classification (ISIC) should, in most cases, be the broadest category in respect of which trends in quantities or prices are imputed. In the case of annual series, the broadest categories of classification used in making the imputations might, in most instances, be equivalent to the groups of the ISIC, or even commodity classes or sub-classes of the Draft International Standard Classification of All Goods and Services (ISCC). The imputations should, in most instances, be restricted to the latter categories in the case of benchmark years.

82. In general, the imputation of the price trends of sample commodities to other commodities is to be preferred to the imputation of the quantity trends. This is so because, in most instances, the variation in the prices of similar commodities is more highly correlated than the variation in the quantities of these commodities. Thus, it is often advantageous to compile current-weighted index numbers of prices and divide these series into index numbers of values in order to derive index numbers of quantities. This method of compiling index numbers of quantity is particularly useful, even for benchmark years, when elementary quantity series are gathered for a very small portion of a category of commodities, as for example in the case of relatively unimportant miscellaneous commodities.

83. Because of the advantages of imputing trends in prices over imputing trends in quantities, it is suggested that in annual and less frequent compilations, series should be gathered from establishments on the value of gross output, intermediate consumption and gross fixed capital formation, in total and classified according to categories of commodities. Annual series of values in respect of the total final consumption expenditure of households and the services of government and private non-profit services should also be collected. External trade statistics usually yield monthly and quarterly, as well as annual, figures on the value of imports and exports, in total and classified according to categories of commodities. It is not suggested that value series should be sought in respect of any other flow, excepting non-homogenous categories of commodities, for which it is necessary to derive data on quantities from figures of values and prices. The gathering of annual figures of values in respect of the various flows will, of course, furnish data for purposes of constructing current-weighted price indexes and for purposes of checking the consistency of annual quantity and price index numbers when these indexes have been compiled independently.

84. Except in the case of relatively unimportant miscellaneous commodities, the derivation of quantity indexes from value and price indexes should be carried out for as detailed categories of commodities as is feasible. In order to cover the miscellaneous group of commodities in the quantity index for a given flow, however, the relevant price index might be divided into the total value index for the flow. Provisions should be made so that annual quantity and price indexes may be compiled independently for most elements of the various flows.

B. Double deflation and value added

1. The need for double deflation

85. Quantity and price index numbers of value added for the various kinds of producers should, as far as is possible, be compiled from quantity and price series in respect of aggregates of gross output and intermediate consumption. Such series of aggregates, built up from series for individual commodities, are to be compiled annually, but not monthly or quarterly, in the proposed system. Price indexes of value added are also to be compiled annually only, but it should be noted that quantity indexes of this flow are to be prepared monthly or quarterly, as well as annually.

86. Double deflation is not suggested for the compilation of the more frequent quantity index numbers because of the difficulties of gathering quantity and price data on the intermediate consumption of individual commodities on a monthly or quarterly basis. Since it seems reasonable to assume that the input-output coefficients of a kind of activity will not change significantly during the course of a year or so, the use of quantity series in respect of gross output, or in respect of a proxy flow, in order to extrapolate the quantity indexes of value added for the last available year should yield reliable monthly or quarterly indexes.

87. In the case of most industries, it is however not realistic to assume stable input-output coefficients over a number of years because of technological progress and changes in the relative prices of inputs. For agriculture, changes in intermediate inputs may not be important, but fluctuations in gross output because of weather and related factors will result in significant alterations in input-output relationships from one year to the next.

88. Experience suggests that other important factors contributing to the differences between quantity indexes of gross output and quantity indexes of value added compiled by double deflation, are changes in product mix, in the vertical integration of industry and in the efficiency with which raw materials are utilized. Shifts in the relative importance of products from less to more highly fabricated commodities, or vice versa, will be reflected in the indexes of value added to a considerably greater extent than in the indexes of gross output. With greater diversification in gross output and higher input-output ratios, the difference in sensitivity to changes in product mix between indexes of value added and indexes of gross output increases. While indexes of gross output will not be affected by changes in the degree of fabrication of raw materials consumed if the quantity of gross output of commodities remains unchanged, indexes of value added will reflect these changes. Further, index numbers of value added but not index numbers of gross output, will show alterations in the quanta of raw materials utilized per unit of gross output.

2. Anomalies in double deflation

89. The use of double deflation may sometimes lead to paradoxical results in the case of estimates of value added at constant prices for detailed categories of industry. For example, when, because of a considerable decline in relative price, an important input is used in much larger quantities in the current period than in the base period, the quantity index of value added may show a decline though value added at current prices and the quantity index of gross output increase substantially. If a considerable decrease in the quantity of gross output takes place at the same time, value added at constant prices might even become negative. As such unrealistic results are likely to be caused by one, or a few, major factors, it should, however, be possible to identify these factors. It may be necessary to change the base period if the anomaly is due to substantial alteration on the structure of either outputs or inputs.

90. If the indicators utilized in double deflation are not sufficiently accurate, unrealistic quantity series of value added may also be obtained when input-output coefficients are high. For example, if the quantity indicators utilized in respect of intermediate input and output are not representative, an increase in gross output

which is actually due to a proportionate increase in intermediate input, may be reflected differently in the two indicators and may result in spurious changes in the quantity index of value added. Similar spurious changes in the measures of price or quantity may result if unrepresentative price index numbers are used in respect of, or to deflate, gross output and intermediate input.

3. National practice

91. The use of double deflation in compiling index numbers of value added has been found most suitable, in practice, in the case of agriculture, a number of manufacturing industries and part of transportation. The indicators used in respect of gross intermediate inputs generally do not cover purchased services. For certain other industries, the relatively insignificant ratio of intermediate input to gross output, or the lack of adequate data on intermediate consumption, has led to the use of data on gross output as indicators of the trends in value added. Examples of industries where intermediate consumption is a very small proportion of gross output are logging, distribution and a number of the services. In the case of the chemical and miscellaneous food industries, the wide range of intermediate inputs interferes with the use of double deflation. Because of the difficulties of putting together quantity series for gross output, measures of employment or intermediate inputs have been used as substitutes for double deflation in compiling quantity indexes of value added for industries such as the manufacture of heavy machinery or construction.

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