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THE COLLECTION AND COMPILATION OF PRICE AND QUANTITY SERIES

Report of the Secretary-General

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I.   INTRODUCTION

1.   This paper deals with the principles and techniques of gathering and using elementary series of data for purposes of compiling the index numbers discussed in document E/CN.3/401. This paper and document E/CN.3/401, taken together, describe the results of the work that has been carried out since the Fifteenth Session of the Statistical Commission on the drafting of international guide-lines in respect of an integrated system of price and quantity statistics. The Working Group on Statistics and Indices of Prices and Quanta, Conference of European Statisticians, which discussed the earlier version of document E/CN.3/401, did not have time to consider the earlier version of this paper.

2.   Discussed first in this paper are the required characteristics of elementary series of quantity and price indicators and the types of indicators which are suitable for measuring the various flows in respect of which series of index numbers are to be compiled. Considered next are the methods of choosing, gathering and compiling representative and comparable elementary series of data in respect of these flows. Dealt with last are the approaches to, and the techniques of, compiling the proposed series of index numbers from the available elementary series. In discussing these topics, attention is focused on the special problems which arise in respect of certain types of commodities and industries and some of the flows which are the subject of measurement.

II.   THE SERIES OF INDICATORS

A.   General character

3.   Ideally, the indicators used in compiling quantity and price index numbers in respect of a flow should be the quantities and the prices, respectively, of comparable, homogeneous units of the flow. Thus, for example, the indicators in respect of the quantity of gross output of a given kind of business establish-ment should relate to the quantity of the various goods and services they produce, measured in units which are comparable and homogeneous from one period of account to another and, preferably, from one establishment to another in

respect of embodied quantity of production and quality. The correlative indicators in respect of prices should be the prices of spot or earliest delivery sales as of specific dates spread over the period of account of identical units of the goods and services. Prices in respect of spot or earliest delivery sales are the appropriate indicators in respect of the gross output or sales of goods and services In the case of goods which take a long time to fabricate and which are usually produced to order, price series in respect of the contracts currently being signed are also wanted for purposes of looking forward.

4. The quantity and price indexes should, in principle, be based on independent elementary series of data. Checks of prices and quantities against values, and one against the other, could then be made. In practice, however, it may be necessary to derive either series of indexes from the value indexes of the flow divided by the other series of indexes. Quantity indexes may need to be derived from price and value indexes, for example, if the practical units of measurement for purposes of gathering figures of quantity are so imprecise that considerable variation could occur from one period to another in the mix of items covered. The circumstances under which this is likely to be the case are discussed later in this paper.

5. The conjunction desired between the series of elementary indicators and index numbers of flows may be illustrated by using the case of value added during a period of time. In order to derive quantity and price index numbers of value added, elementary series of quantities and prices of the non-durable goods and services used up in production during the period in question must be available, in addition to the quantity and price indicators in respect of gross output. The quantity indicators of intermediate consumption should refer to homogeneous units which are comparable throughout the period, and, preferably, from one establishment to another, of the goods and services which have actually been used up in producing the gross output. The corresponding price indicators should relate to prices on delivery at the establishments, as of several dates

during the period when the items are used up, of comparable, homogeneous elements of the intermediate goods and services. The elementary quantity series in respect of the gross output of the establishments should measure the amount of goods and services they produce during the period in comparable, homogenous units; and the price series should relate to sales of these units of goods and services at points of time spread over the period. As we shall see later in this paper, difficulties are encountered in matching series of data on intermediate consumption and gross output in the case of agriculture and in gathering suitable elementary series in respect of the intermediate consumption of some other kinds of industries because of the range of items used, the intermittence of deliveries and the inadequacies of producers' records. The gathering of suitable indicators of gross fixed capital formation not only presents these difficulties, but also raises serious problems of defining appropriate units of measurement of quantities and prices because the goods involved are often complex and unstandardized. Measuring the gross output of these complex, unstandardized capital goods is also difficult.

B. Specifications and units of measurement

7. Thus, a fundamental aspect of gathering series of indicators in respect of quantity and price of flows of goods and services 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 of uniform content and quality from the point of view of both producers and users of the good or service. Defining the standardized indicators 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 type and value of benefits in the second case) are reconciled, 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 indicators also contributes to maintaining the national accounting consistencies between the indexes of the supply and disposition of goods and services.

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, i.e. goods or services sold on the market, the
relationship between their characteristics and the price at which they are
sold furnishes a basis for standardizing the unit of measurement. Varieties
of a good or service are of identical 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 interrelated markets.

a. Standard goods and services

10. This criterion is immediately applicable in specifying series of indicators
in the case of commodities which in fact are not subject to marked changes in
character and circumstances of sale from one transaction to another. In the
case of the goods, the units of measurement (i.e., 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, such as capacity, power, speed, durability, etc., and
quantity, market, type of customer and customer services, terms of payment
and other circumstances of sale. In the case of services which are sold on
the market, specifications of indicators should relate to such attributes as

constituent elements, levels of skill and training of the renderer of the services, and the conditions under which the service is rendered.

11. In practice, it is usually feasible to specify the elementary units of measurement in such detail in the case of prices but not quantities. Producers or sellers and users or purchasers of goods or services do not generally keep their accounts in respect of the quantity and value of these items in sufficient detail to distinguish between circumstances of sale, or even between some aspects of the intrinsic characteristics of the varieties of the goods or services. However, they should be able to use their sales or purchase documents in order to furnish data on the prices of transactions conducted on given dates in well-specified 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, construction projects or complex services, 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 indexes or averages 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 construction in respect of which it is feasible to gather comparable elementary series of prices in respect of contracts. These elementary price series are then combined into the index numbers or averages, using weights which are proportional to the value during a base period of the various components of the model and/or of steps in fabricating it. 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 price of these models are then estimated from the regression of the value of the good on the characteristics, determined from data in respect of market transactions in a range of its varients. This is the "principal factors of

quality" or "hedonic" approach to decomposing values. The characteristics which are in fact strategic, as well as the relative contribution each makes to the price of the standard models, are of course determined from the fitted function.

14. In practice, the pricing of representative, standard models as a whole is more common than building up these prices from constituent standardized elements. In this case, producers are generally requested 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 disadvantage of not taking account of changes in the efficiency of using materials, in the productivity of labour, or in the margin of gross profit. In some instances, adjustments are attempted for changes in the productivity of labour. Use is 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 complex services need, in general, to be derived from series of the appropriate current values (e.g., at producers' values in the case of gross output or purchasers' values in the case of fixed capital formation) divided by the corresponding price data. The quantity series which it is practicable to collect for these items, such as the floor space of dwellings or office buildings of a given type, either relate to much too few of the strategic elements in their worth to users and in their cost of production and/or encompass a wide range of qualities.

16. Alternatively, series of proxy indicators are used in compiling quantity indexes relating to these goods and services, especially in the case of monthly and quarterly index numbers. In the case of the value added in the production

of complex goods or services, or the gross output and household consumption
of complex services, series on the personnel employed in producing the goods
or services are often used. The employment is measured in terms of man-hours
worked or average 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 inter-
mediate 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
over time, and from one project to another, in the input-output coefficients
in respect of a given type of construction or heavy capital good.

c. Financial services

17. The compilation of quantity indexes of the gross output and value added
of banks and other financial services raises the question of the character
of the service(s) to be measured, as well as problems similar to those discussed
below for government and private non-profit services. An eclectic enumeration
of these services would include at least granting loans, investing depositors'
funds, providing means of payment and liquidity and safe-keeping funds.
While quantity series in the case of some functions would be such physical
measures as number of checks cleared or number of deposits made, the quantity
series in the case of other functions seem to require expressing the value
of deposits or loans in constant units of a given currency.

2. Services of government and private non-profit bodies

18. The definition of meaningful and reliable quantity indicators in respect
of the gross output, and value added in the production, of services which in
the main are not marketed, such as the services of government and private
non-profit bodies is extremely difficult. Annual series of quantity index
numbers only are therefore included for these services in the proposed system
of index numbers. In place of series of price index numbers in respect of

the gross output and value added of these services, it may be of interest to compile index numbers of unit costs.

a. Measuring elements of gross output

19. At best, the quantity of the gross output and final consumption 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 service rendered. Each of these elements should be highly correlated with the cost of furnishing the service and the benefits received from it. The indexes of the quantity of the gross output and final consumption 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 of employees and consumption of fixed capital should be taken into account. 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.

20. 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. In the case of general administration or the legislature, the way in which the services rendered might be meaningfully decomposed into measurable elements is not apparent.

b. Measuring elements of gross input

21. In view of these difficulties, recourse is often taken to measuring the quantity of gross output and final consumption 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 should 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.

22. 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.

C. Types of indicators

23. 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 is 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.3/401.

1. Gross output of commodities and industries

a. Quantity

24. 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 materials, (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 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.

25. 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), it is found more practical to use quantity series in respect of intermediate consumption than 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. While it may be necessary to use the proxy indicators in the case of monthly series, it should be feasible to use quantity indicators of the gross output of the various commodities in the case of annual series.

26. 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.

27. 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 the distributive trades only, series of quantity indexes classified according to individual commodity are called for monthly and annually in the suggested series of table 2 in document E/CN 3/401. This proposal is in part due to the usefulness of figures of the sales of the distributive trades in compiling indexes of final consumption expenditure and gross fixed capital formation.

28. It is difficult to decide on suitable quantity indicators in respect of insurance service charges. Account should probably be taken not only of the number of policies in force and the number of claims made in respect of each form and category of insurance, but also of the deflated face value of the policies. It is not clear how the face value should be deflated or how the three elements should be combined into a single index. It appears to be desirable to derive the annual price indexes from the value indexes of the insurance service charges for each type of insurance divided by the corresponding quantity indexes.

b. Prices

29. In the case of most commodities except heavy capital goods, it should be
feasible to gather series of producers' prices in respect of sales as of a
given date for spot or early delivery of varieties of the commodities direct-
ly from the 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 series
of prices and quantities, as well as the corresponding series of producers'
values, as much as is possible.

30. 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, suit and dress 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 possible.

31. As was indicated earlier, in the case of heavy machinery and
equipment and construction projects usually made on individual order, indexes of
producers' prices in respect of representative models should be built up
from the producers' prices of standardized components or other aspects of
these models gathered from the producers in respect of contracts which are
currently being made. It may be necessary to resort to the prices of the
standardized constituents of the models in bids for contracts or to respondents'
estimates of the value of the models in the light of the bids or contracts made.
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

32. 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, and to use a different classification. 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, but preferably more often for 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.

33. Annually, it will be necessary to compile quantity and value series for the imports of significant amounts of transport services and insurance service charges in respect of items other than imports of merchandise, and for the exports of transport services and insurance service charges. While the quantity series of imports and exports of passenger transport services can be compiled from base weighted passenger-miles during a year in respect of each type and category of service , more detailed data will probably be required in order to compile the price series since the prices of a given category of passenger transport service may vary over the year. It may be necessary to use average monthly, or less frequent, prices, weighted according to the current-year values during the month or other period selected. In the case of the export of freight transport services, it may be sufficient to use the annual amount of ton-miles and unweighted average annual price series in respect of each type of freight. The problems of constructing appropriate indicators for insurance service charges were discussed in paragraph 28 above.

3. Intermediate consumption of commodities and industries

34. Because of the difficulties of gathering suitable figures, table 2 of document E/CN.3/401 calls for the annual compilation only of indexes of quantity of the actual intermediate consumption of goods and services classified

according to type of commodity or according to kind of activity of the consuming
establishments. The monthly series in table 2 in respect of quantities of
goods which are customarily used in intermediate consumption, can be derived
from monthly data on the gross output of commodities classified according to
customary end-use.

35. However, because of the variability of prices, it is desirable to compile
monthly series of actual 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 inter-
mediate commodities to producers.

36. 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 encount-
ered in laying down detailed specifications, at least in the case of important
intermediate goods. The average prices obtained directly from these reports
or by dividing quantities into values, on the one hand, and the averages of the
purchasers' and producers' prices gathered monthly, on the other, should be
reconciled, one with the other. The annual data on the quantity of the
intermediate consumption of various commodities derived from these reports
should also be reconciled with the annual data on the gross output and import
of these commodities.

37. 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

38. 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
or type of commodity, might be derived from figures of the value and average
current-weighted monthly prices of the retail sales of the relevant commodities.
39. While the same approach can 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.3/401, 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 can 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 averages of monthly
prices gathered in respect of retail sales.

5. Gross fixed capital formation in commodities and by industries

40. The gathering of suitable indicators of quantity and price in respect
of the gross fixed capital formation of the various industries and the govern-
ment 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.
Nonetheless, because of the significance of gross fixed capital formation
for economic conditions and growth, quarterly as well as annual series are
are suggested in table 2 of document E/CN.3/401. The monthly series of quantity
and producers' price indexes in respect of gross fixed capital formation by
type suggested in the table are to be derived from monthly series on the
customary use to which various commodities are put.

41   It is probably necessary to use indirect approaches in compiling most
of the quarterly and annual purchasers' price series in respect of the fixed
assets acquired by producers. Purchasers' prices in respect of these goods
can 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. For some of these items, the purchases of large-
scale producers may be regular enough to make it feasible to gather purchasers'
prices from them. In the case of other capital goods, it will be necessary
to compile indexes of producers' prices for representative models of the items.

42. In general, it is best to derive the quarterly and annual series of quantities
in respect of gross fixed capital formation from series of values in respect of
detailed categories of fixed assets divided by series of the corresponding
current-weighted average purchasers' prices. The series of values should be
gathered quarterly and annually from the producers who acquire the capital goods,
and should cover both own-account production and purchases. These data should
be reconciled with figures of purchasers' values of each category of capital
goods derived from data on gross output, imports and exports.

6. Value added of producers

43. 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, but may be available monthly only if the series are used as proxies
for monthly series on gross output. In some cases it may be necessary to use
measures of man-hours worked, or other aspects of employment, instead of
data on gross output, in compiling monthly indexes of value added. As has
already been mentioned, 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.

D. Gathering representative series of indicators

1. The Problem

44. This section of the paper concerns the principles and methods of selecting respondents, commodities and varieties of commodities for purposes of gathering representative quantity and price indicators. 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.

45. While it is desirable and feasible to gather data in respect of the total value of gross output, intermediate consumption, gross fixed capital formation etc. of practically all 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 each variety of the commodities, included in these flows. In order to keep the inquiries manage- able, the number of individual commodities in respect of which figures of the various types of transactions are sought must be restircted. 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 product- ion, 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 representative units and commodities each year from among the new, and perhaps the very rapidly growing, establishments and commodities, and other varieties of commodities, or even commodities, must be substituted for the items which they have replaced in the market.

46. 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.

47. 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 consumed by, or in the gross fixed capital
formation of, these services. 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 sample of house-
holds, irrespective of the frequency with which these inquiries are taken.

2. Methods of selection

a. Industries

48. In the case of business establishments, it may be best to select res-
pondents 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.

49. 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 estab-
lishments is classified according to kind of economic activity, each group
of establishments is likely to produce or sell, use, and engage in fixed
capital formation in, similar commodities. Classifying establishments in
this fashion also tends to group together the gross output of commodities
which are joint products or substitutes and which are correlated in respect
of the uses to which they dispose of their products and the trends in the
price and quantity of their products. 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 can then be gathered from the same establishments.

50. For efficient selection of respondents and items, the business estab-
lishments in each category (stratum) of kind of activity and, perhaps, locat-
ion should be arrayed in the order of magnitude of a relevant attribute.
For example, value of gross output or of shipments, value added or employ-
ment during a base year might be used. 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 esti-
mates and of the base-year results in making the annual estimates.

51. It may however not be practicable to use probability samples, particu-
larly 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 expect-
ed 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, i.e. 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 includ-
ed in the sample. Sufficient 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.

b. Other units

52. 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, e.g. countries or districts and villages, municipilities 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.

53. 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.

3. Criteria of selection

54. 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 selected from each stratum into which the 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 year, relative to the average magnitude for all strata; (ii) the relative degree of correlation between quantity and price changes in the flows to be measured; and (iii) the relative variation over time in these

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.

4. Frequency of collection

55. Though reliable data on the quantity or value of an item can, in most instances, be gathered once a year, a quarter, or a month in respect of the entire period which 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 can be expected to vary during the period and the relative magnitude of the involved flow. For example, price quotations in respect of transactions during one day of a quarter only may be sufficient to establish a representative quarterly price in a few instances, while price quotations in respect of transactions during one day of each week of the quarter may be needed for this prupose 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.

5. Maintaining the representativeness of indicators

56. In order to maintain the representativeness of the various quantity and price series 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 in the case of each kind of economic activity. 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 while
other added commodities and varieties of commodities will represent enlargements
in the quantity of goods and 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 quanti-
ty indexes so as to show increases in quantity. Series which represent the activi-
ties of new establishments should in general be considered to represent increases
in quantity.

57. 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 auto-
matically omitted from the sample. On the other hand, positive steps must be
taken in order to identify and add new establishments, commodities or varieties of
commodities which should be represented in the sample. Information might be gath-
ered in respect of new establishments and commodities as part of the collection
of basic data for the annual series of index numbers; and units and items repre-
sentative of them might be added to the samples for the annual, quarterly, and
monthly inquiries 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 and data might be gathered on the value, quantity and prices of
the gross output and intermediate consumption of, and the fixed capital formation
in detailed categories of commodities from samples of new producing units. Arrange
ments 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.

58. 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 (i.e. specifications) of the commodities for which they report in their replies to 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.

E. Adjusting series for differences in quality

1. The problem

59. In order to introduce series of new commodities, or differing varieties of the same commodity, into a quantity or price index, 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 and 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 the source of supply and disposition and in technology and cost structure of production as is possible. 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. New price series would in general be linked to, or substituted for, the price series of the cognate item in an index.

60 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 indexes than in the case of quantity indexes. However, since 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 differences 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.

2.   The use of overlapping prices

61.   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 efficeintly, while the old item, even if it is being replaced in the market will not have yet become obsolete.

62.   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, or in components (e.g. with or without certain accessories) etc. 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.

63.   When the market does not provide a direct measure of the relative economic worth in question, it becomes necessary to simulate the process of pricing in the market in order to evaluate it. This involves balancing the probable relative sellers' supply price (relative costs plus profits) and the probable relative buyers' offering price (relative utilities), one against the other. In practice, the best that can be done is to evaluate, from the point of view of both sellers and buyers, the economic worth of the pertinent differences between the two items, i.e. the value of the differences in characteristics which are considered to be correlated with differences in price in the market. It may often not be feasible to evaluate the economic worth of these differences in terms of both sellers and buyers. The evaluation is then most commonly carried out in terms of supply or cost price in the case of the producers' prices. More emphasis, even exclusive attention, is given to buyers' evaluation in the case of purchasers' prices of retail sales to households.

3.   Quantifying technico-physical characteristics

64.   Measurerable differences in technico-physical characteristics have often been used in order to evaluate the relative economic worth of differing 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.

65. The "hedonic" or "principal factors of quality" approach which was outlined earlier in this paper, has also been used in evaluating the relative economic worth of varieties of a commodity. This approach represents a statistical analysis of the degree of relationship, and parameters of the function, between selected technico-physical characteristics and prices in the market. It has been experimented with in the case of the prices of such items as automobiles, kinds of power equipment, and dwellings. The analysis may be applied to data during the period when either the new or the old variety of the commodity in question is on the market. The results obtained for the two periods may differ because of changes in the relative consumer preferences and conditions of supply.

66. In employing the "principal factors of quality" approach, as well as other techniques of estimating relative economic worth of two items, a basic assumption is that the factors of price determination have not changed significantly in the interval of time between the disappearance of an old item and the introduction of a new item. The shorter this interval of time, the more likely is this assumption to 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 of course relate to various periods of time, and 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 over-all level of prices.

4. Cost and supply price data from producers

67. 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 over-lapping price

data are not available in respect of paired items or it is not clear that there
are not available in respect of paired items or 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.

68. 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. Focussing 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.

F. Discontinuities in series

69. 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.

1 Irregular discontinuities

70. 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.

71. 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.

72. 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.

2. Seasonal discontinuities

73 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.

74. 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.

III. METHODS OF COMPILING INDEXES

75. This part of the paper concerns the compilation of the annual and less
frequent, quarterly and monthly index numbers listed in table 2 of document
E/CN.3/401 from the elementary series of quantity and price dealt with above.

A. Commodity flows and input-output tables

1. The role of commodities

76. The elementary series of quantity and price in respect of individual commo-
dities furnish not only the building blocks for, but also the links between,
the various series of quantity and price indexes. The identical commodities
of course enter into the supply of goods and services from gross domestic

output and imports, on the one hand, and into the disposition of goods and services to domestic uses and exports, on the other. In the system of index numbers proposed in document E/CN 3/401, the identical commodities are also covered in the annual and less frequent and quarterly or monthly indexes of the quantity and price of a given flow, for example the annual and monthly indexes of the gross output of goods by the food manufacturing industries or the annual and less frequent, quarterly and monthly indexes of household consumption expenditure on food. In order to tie together all the inquiries in respect of the various series of indexes, in operations as well as in concept, it has been suggested that the samples of commodities and respondents in the smaller-scale, frequent inquiries should be sub samples of the samples in the corresponding less frequent inquiries. The links between the data in respect of the supply and disposition of goods and services and between the indexes of differing frequency in respect of the same flows, make cross checks possible. Moreover, the available figures in respect of one series can be re-inforced with figures available in respect of the other series.

2 The commodity classification

77 For purposes of building up series of index numbers which can be linked together, it is essential to classify all series according to categories of an identical commodity classification, as well as according to the scheme of classification used in the published index numbers. For example, the identical commodity classification should be used in compiling all series of the gross output, intermediate consumption and gross fixed capital formation of industries classified according to kind of activity and series of household consumption expenditure classified according to object.

78. It is desirable that the commodity classification should have several levels, ranging from categories of individual commodities to moderately detailed categories of the kinds of activity where the goods and services in question are characteristically produced. The multi-level scheme of classification is

needed so that trends in items included in sample inquiries might be imputed to correlated items not included in these inquiries. It may be sufficient to have two levels of classification of commodities, one of which would be the categories of individual commodities, in addition to the categories based on the kind of activities where the items are characteristically produced. The correlation in price and quantity trends should be much greater between members of the last two categories of the proposed classification than between members of the detailed categories in respect of the characteristic kind of activity where the items are produced.

79. In order to compile price series for an individual commodity, it will be necessary to average the prices gathered in respect of the transactions as of given dates of various respondents (markets) in varieties of the commodity. It is desirable that current-weighted averages be used. While this should be feasible annually in the case of the various respondents, but not necessarily the differing varieties, it may not be possible monthly or quarterly. The last available annual series of weights might be used in the latter case.

3. The use of input-output tables

80. Uniform classifications of data in respect of the various sources of supply and disposition of goods and services according to intermeshing categories of commodities and industries and the balancing of this supply and disposition, one against the other, are called for by the input-output tables which it is suggested be compiled at least once every five years in document E/CN.3/401. These and related features of input-output tables make them invaluable frames for purposes of determining the weights, base-year and current-year, of the system of index numbers, selecting interrelated samples for collecting integrated series of quantity, price and value indicators, and compiling linked and consistent series of index numbers of price, quantity and value. Though adequate basic data may not be available to compile the suggested input-output tables of index-number series completely each year, it would be desirable to

carry this work forward as far as is possible. In any event, it will be be advantageous to use the input-output tables as the frame for purposes of compiling annual, and even quarterly, series of index numbers and for purposes of selecting samples and weighting in the case of all types of inquiries. The compilation of annual series of index numbers within the framework of input output tables will, among other things, furnish relatively current weights for price series and the basis for compiling monthly series of index numbers on the disposition of goods and services to domestic sources.

81. The use of input-output tables as a frame for compiling the system of index numbers should also be of assistance in filling in gaps in the available series of indicators. Examples of this practice may be cited from national experience in compiling constant-price estimates of fixed capital formation and value added.

82. The proposed system includes the collection of quarterly and annual series from producers on the value and prices of gross fixed capital formation, classified according to important commodities and kind of economic activity. However, these series are difficult to gather, and in any event, part of the data collected will relate to a miscellaneous category of capital goods. Figures gathered in respect of the value and prices of the gross output and imports of various capital goods, coupled with the same type of data in respect of exports and the proportion of these items usually disposed of to consumption, have been used to estimate the missing series in respect of gross fixed capital formation. In making these estimates, the past ratio of distributive trade and transport margins to the producers' values of the capital goods also must be taken into account.

83. Relatively complete annual quantity and value data on intermediate consumption, cross-classified by type of commodity and kind of activity of consuming industries, are also difficult and burdensome to gather. Countries have used past input output coefficients, coupled with quantity and value data on the

gross output of the consuming industries, and data on the supply, measured in purchasers' values, of the pertinent commodities in order to estimate the intermediate consumption of various kinds of business establishments.

84. As has already been mentioned in document E/CN.3/401, it is necessary to introduce certain modifications in the tables of the SNA on basic input-output data [1]/, for purposes of using them as an integral part of the proposed system of index numbers. For instance, the detail in table 11 of the SNA should be increased by adding the required cross-classifications of data according to categories of commodities and categories of kind of activity, object or purpose in the case of domestic dispositions. It also appears to be advantageous to cross-classify distributive-trade and transport margins by type of commodity and source of disposition instead of classifying them by source of disposition only. The cross-classified series are required in order to cross-check series in respect of the supply of goods valued in producers' prices, and their disposition valued in purchasers' prices. A similar cross classification of distributive trade and transport margins is needed in making estimates of items of domestic expenditure from data on the supply and export of given commodities.

85. The proposed system of index numbers includes the compilation of annual indexes of producers' and purchasers' prices in respect of categories of commodities by type of disposition These series, coupled with quantity indexes of the supply of commodities, also classified by category of commodity and type of disposition, and valued at either producers' or purchasers' values, would furnish the basis for estimating cross classified price and quantity indexes for distributive-trade and transport margins. However, the producers' prices of certain items which are disposed of to more than one type of domestic use may differ from one use to the other; and it may not be feasible to differentiate between the dispositions in gathering prices from producers. In these circumstances, the comparisons would be limited to weighted averages of producers' and purchasers' prices and the series in respect of distributive-trade and

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1/ See tables 11 and 12, annex 8.3, A System of National Accounts, United Nations, New York, 1968.

transport margins would be classified according to category of commodity only
The more limited classification would still be of value in cross checking figures
in respect of the total supply and total disposition of goods and services
and in filling in gaps in data in respect of domestic expenditures on specific
commodities from series on the supply of these commodities

86.   Since valuation in the proposed system generally is to be in either producers'
values or purchasers' values, the partitioning of producers' values into
approximate basic values and commodity taxes, net, is generally not necessary.
However, valuation at approximate basic values is wanted for purposes of the
input-output analysis of constant price data

4.   National practice

87.   Series for individual commodities or detailed categories of commodities
always have to be used in practice as the building blocks for price index
numbers, but not necessarily for the corresponding quantity index numbers.
Quantity and price series for detailed categories of commodities are often
employed in compiling index numbers of quantity, but data in respect of much
broader categories of commodities, or even other units of observation, have also
been used   For example, in national accounting at constant prices, the consump-
tion expenditure of households classified according to object of expenditure
is sometimes deflated by consumer price (cost of living) index numbers which are
classified in a similar fashion. The same type of approach has been used in
deflating gross fixed capital formation classified by kind of activity. This
method of deflating current value series for the purposes of estimating quantity
index numbers is questionable in view of such factors as the probable differences
between the current value series and the price index numbers in scope, classifi-
cation and weights implicitly and explicitly assigned to components, and the use
of base weighted aggregative price series. Another example is that in estimating
quantity index numbers of the value added of certain industries and government
and non profit services, use is often made of series on employment classified
by kind of activity. These series of course do not reflect changes in labour

productivity

88. While only a few countries have systematically used an input-output frame-
work in order to compile national accounting data in constant prices, a number
of countries have used the commodity flow method in order to estimate constant
price series of gross fixed capital formation and private consumption
expenditure from figures of gross output, imports and distributive-trade and
transport margins for detailed categories of goods and services. This approach
has also been employed in order to reconcile constant price series in respect
of the supply and disposition of goods and services and in order to estimate
the increase in stocks as a residual.

B. Double deflation and value added

1. The need for double deflation

89. 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.

90. Double deflation is not suggested for the compilation of the more frequent
quantity index numbers because of the difficulties and burdensomeness 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 for gross output
in order to extrapolate the quantity indexes of value added for the last
available year should yield reliable monthly or quarterly indexes.

91. It is, however, unrealistic in the case of most industries 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 be of small importance, 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.

92. 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, the vertical integration of industry, and 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, value added, but not gross output, indexes will show alterations in the quanta of raw materials utilized per unit of gross output.

2 Anomalies in double deflation

93. The use of the double deflation method may sometimes lead to paradoxical results in the case of estimates of value added at constant prices for detailed categories of industry. For instance, if some important input is used in much larger quantities than in the base year because of a considerable fall in its relative price, the quantity index of value added may show a decline, even if 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 could even become negative.

Since such unrealistic results are likely to be caused by one, or a few, major factors, it should, however, be possible to identify the reasons for them. A change of base year may be necessary if a considerable change in the price structure for either output or input is found to be the major reason.

94 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 instance, 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 price or quantity measures may of course result if unrepresentative price indexes are used in respect of, or to deflate, gross output and intermediate input.

3. National practice

95. The use of double deflation in compiling indexes 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 applied for gross input generally do not cover purchased services. For some 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 indicative of 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 other 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.

C. Imputations and quantity, price and value series

96 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 and services is even required in the compilation of index numbers for bench-mark years since 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.

97. 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 activity or fall within the same category at the next more detailed level of the commodity classification. 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 benchmark years.

98. 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 subdivisions of these groups. The imputations should, in most instances, be restricted to the latter categories in the case of benchmark inquiries.

99. 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 in benchmark inquiries, 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.

100. Because of the advantages of imputing trends in prices over imputing trends in quantities, it is suggested that in annual and benchmark inquiries, series should be gathered from establishments on the value of gross output, intermediate consumption and gross fixed capital formation, in total and classified by 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 by categories of commodities. It is not suggested that monthly or quarterly value series are required for any other flow, with the exception of heavy capital goods or other unhomogeneous, detailed categories of commodities, for which it is necessary to derive quantity series from figures on value and price. The gathering of annual value figures for the various flows will, of course, also furnish the data needed for constructing current-weighted price indexes, and for checking the consistency of the annual quantity and price indexes when these indexes have been compiled independently.

101. 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 can be compiled independently for most elements of the various flows.

D. Links between index numbers of differing frequency

102. In view of the integration of concepts, classifications and weighting in the proposed system, valuable use can, and should, be made of the more complete data in respect of the less frequent series of index numbers in compiling the more frequent series of index numbers. The more ample, less frequent data can be used to increase the accuracy of the more frequent series of index numbers and to fill in major gaps in the collected basic data. Benchmark year inquiries should be used for these purposes in compiling annual series of index numbers and the annual data should be used for the same purposes in compiling monthly or quarterly series of index numbers.

1. Benchmark years

103. The most complete and detailed data should be gathered and compiled in respect of weight base (benchmark) years. The compilation should consist of estimates of current values and index numbers of quantity and price in respect of all flows of the production, consumption expenditure and capital formation accounts of the SNA. The data in respect of producers should be cross-classified by categories of commodities and kind of activity; and the data in respect of the _final consumption of households, private non-profit bodies and government services should be cross-classified according to categories of commodities and object or purpose of expenditure. In other words, it is suggested that the extended tables in respect of basic input-output data discussed above should be compiled.

104. These data will serve a number of purposes. They will furnish the basis for selecting samples for the collection of yearly, quarterly and monthly data and weighting and reconciling the index numbers and other series compiled from these samples. The input output coefficients, the patterns in which commodities

are disposed of to intermediate and final uses, and the parameters of other relationships which are indicated by the benchmark data, should be of assistance in estimating missing, needed annual and more frequent series of data. The detail and comprehensiveness of the benchmark figures will also permit the complete cross checking of the series.

2. Annual series

105 The elementary series of quantities, prices and values for years between benchmark years will be gathered for sample commodities, from the domestic producers and users of the commodities and from data on imports and exports. These elementary series should relate to each of the flows included in the series of index numbers. In general, building the annual index numbers from weighted relatives of the annual and base year figures for each sample item should result in a high degree of reliability in the index numbers. This is the ratio method of estimating from sample data. The technique can be used in estimating values in current and constant prices as well as quantity and price index numbers In the case of elements of certain flows which are not, or are very poorly, represented in the annual samples, for instance, some commodities consumed by industries which use a wide range of intermediate commodities, it may be more efficient to use an alternative technique of estimation The required date may be estimated from base year input-output coefficients coupled with figures on the gross output of the consuming industries and the supply of the intermediate commodities during the year in question. This method may also be of value in estimating index numbers on the gross fixed capital formation of industries.

106. Some of the sample commodities, or varieties of commodities, in any given year will replace items included in the benchmark series. In these instances, the substitute or replacement items, adjusted for quality differences, should be used in estimating the relatives which are to be linked into the series compiled. Other sample commodities in a given year may represent commodities not previously produced or imported. In this case, the sample commodities, weighted to cover the full estimate in base year values of all the new items which they represent,

should be added to the series compiled for the year. It may also be necessary to add the gross output and intermediate consumption by new producers of relatively unimportant miscellaneous commodities. These additions should be estimated from data gathered from sample units of newly founded establishments.

107. The suggested annual series of index numbers relate to all the flows to be covered in the benchmark series. These index numbers should also be compiled in the form of input-output tables, but not cross-classified in as much detail as the benchmark data. The type and magnitude of the samples used in gathering annual figures should still be such that it will be possible to cross check the series for the supply and disposition of goods and services and for quantities, prices and values, and to furnish useful annual data in respect of values, quantities and prices for purposes of input-output analysis.

5. Monthly and quarterly series

108. The suggested monthly and quarterly index numbers do not deal with all of the flows included in the annual series. Omitted are series in respect of the intermediate consumption of industries and in respect of most of the activities of government and private non-profit services and, a few key quarterly series only are proposed in respect of gross fixed capital formation. Values series are not required in respect of the included flows, and the monthly and quarterly series of index numbers are to be classified in much less detail than the annual series.

109. Smaller samples of commodities and of business establishments will generally be required for monthly or quarterly series than for annual series. In order to link the elementary series of indicators gathered monthly or quarterly as closely as is possible with the series gathered annually, it is desirable that the monthly or quarterly samples be sub-samples of the annual samples.

110. It seems in general advantageous that the series of monthly or quarterly index numbers should extrapolate the corresponding definitive index numbers for the most recent year. This year might also be the weight and comparison base for series of price indexes with current weights. This approach will facilitate

dealing with the new series introduced and the old series replaced since the base year, and matching elementary series of indicators in compiling relatives. It will also make it possible to reinforce the data available monthly or quarterly with the more complete annual estimates. The extrapolation might best be carried out with index numbers constructed from base or current-weighted relatives, as appropriate, of the monthly or quarterly elementary series and the corresponding annual series, each of course adjusted to the same time span.