UNITED NATIONS

ECONOMIC AND SOCIAL COUNCIL

Distr.
GENERAL

E/CN.3/475
26 February 1976

ORIGINAL: ENGLISH

STATISTICAL COMMISSION
Nineteenth session
New Delhi, 8-19 November 1976
Item 5 (a) of the provisional agenda

ECONOMIC STATISTICS

PRICE AND QUANTITY STATISTICS

Draft guidelines on principles of a system of price and quantity statistics

Report of the Secretary-General

SUMMARY

Work on an integrated system of price and quantity statistics was initiated by the Statistical Commission at its fifteenth session in resolution 1 (XV), paragraph 7. The work in progress was considered by the Commission at its sixteenth and seventeenth sessions and also at various regional meetings. Most recently, it was discussed by the Expert Group on Price and Quantity Statistics.

This paper is addressed to problems of collection of data and compilation of indexes for prices and quantities. Action which the Commission may wish to take is suggested in chapter I. The uses of price and quantity statistics (paras. 6-10) and the need for guidelines (paras. 11-13) are discussed in chapter II. Chapter III shows the over-all structure of the proposed comprehensive system of price and quantity statistics (paras. 14-22) and how the various kinds of indexes that are needed fit into it (paras. 23-31). The strategy of data collection is considered in chapter IV: choice of units of observation (paras. 33-68), the design of the data collection programme (paras. 69-82), and problems arising in specific areas (paras. 83-107). The actual compilation of the indexes is discussed in chapter V, which deals with the types and characteristics of formulae (paras. 108-126) and the choice of formulae and weighting methods (paras. 127-130). Lastly, questions of publication and other forms of retrieval and dissemination are discussed in chapter VI.

The structure of the system of price and quantity statistics proposed is based upon the national accounts and balances, and it makes use of the various standard international classification systems. This is not intended to imply, however, that all index computations should be subordinated to the needs of the national accounts and balances. Price and quantity statistics are multipurpose tools, servicing the needs of Governments and enterprises in their day-to-day decision-making, on the one hand, and providing the basis for understanding the behaviour of prices, output and employment, and their relation to economic policy, on the other. The system proposed is designed to serve all of these varied kinds of needs, and at the same time to be ordered and consistent and a true reflection of the underlying economic interrelationships.

This paper contains draft international guidelines. The Commission may wish to recommend their use by Member States and to request the preparation of a publication on guidelines, together with technical manuals on specific aspects of the sources and methodologies for gathering price and quantity statistics.

CONTENTS

INTRODUCTION

1. Work on an integrated system of price and quantity statistics, covering both index numbers and the series of data on prices and quantities required for compiling them, was initiated at the request of the Statistical Commission at its fifteenth session. 1/ It stems from the discussion of price and quantity comparisons in the revised System of National Accounts. 2/ A first draft of the proposed system was presented to the Commission at its sixteenth session in two documents "A draft system of quantity and price index numbers" (E/CN.3/401) and "The collection and compilation of price and quantity series" (E/CN.3/402). These papers were also submitted to various regional meetings. At its seventeenth session, the Commission considered revised versions of the two documents "A system of price and quantity statistics" (E/CN.3/427) and "The collection and compilation of price and quantity statistics" (E/CN.3/428). These revised papers were also considered at a regional meeting in Europe. They were then revised and consolidated in a Secretariat document "A system of quantity and price statistics" (ST/ESA/STAT.73), which was considered by an Expert Group on Price and Quantity Statistics and also distributed for country comments. The Expert Group report is available as ST/ESA/STAT.81 (June 1975). Information on national practices has been compiled and reported in two documents, "Country practices in national accounting at constant prices" (E/CN.3/464) and "National practices in compiling price and quantity index numbers" (ST/ESA/STAT.74/Rev.1). Special problems of price measurement in external trade were considered at a regional meeting in Europe, reported in document CES/AC.45/3.

2. The present document reflects all of the work that had been done earlier, and it takes into account the comments received from countries as well as other research in the field of price and quantity index numbers. In this respect, it is somewhat more comprehensive in coverage than the earlier documents. At the same time, however, the discussion has been shortened and simplified in some areas. A more extensive technical discussion is available in document ST/ESA/STAT.73/Rev.1.

3. This document, therefore, reflects some seven years' effort. It is believed that the guidelines now proposed have reached the stage where they may be considered for adoption by the Statistical Commission. The proposed system is intended as a framework within which developments in the collection and compilation of elementary series, aggregates and index number of prices and quantities may take place. Statistics in this field are at different stages of development in the various countries; while some countries already compile a large part of the statistics covered by the guidelines, or may expect to do so in the relatively near future, for many other countries the implementation of the recommendations obviously constitutes a much longer term objective.

1/ Official Records of the Economic and Social Council, Forty-fourth Session, Supplement No. 10 (E/CN.3/390), para. 159 (7).

2/ United Nations publication, Sales No. E.69.XVII.3.

4. Although much progress has been made in clarifying the nature of both the theoretical problems and the practical difficulties in this field of statistics, the guidelines in the present document must still be regarded as provisional. Problems still remain in several important areas. Some of these problems are inherent in the nature of index numbers, which do not allow of best or unique solutions. Others arise from practical limitations of the data, some of which may be expected to be reduced in time.

I. ACTION BY THE COMMISSION

5. The Statistical Commission may wish to:

(a) Recommend the draft international guidelines in this paper, modified in the light of the discussions and conclusions of the Commission, for the use of States Members of the United Nations in developing and improving their price and quantity statistics;

(b) Request the Secretary-General to:

(i) Prepare, issue and circulate a publication on guidelines on price and quantity statistics;

(ii) Prepare technical manuals on specific aspects of the sources and methodologies of gathering and compiling statistics of prices and quantities, in particular on the design of appropriate samples and on the composition of appropriate indices for specific areas, such as producers' prices, external trade prices and consumers' prices.

II. THE PURPOSE OF GUIDELINES ON PRICE AND QUANTITY STATISTICS

A. Uses of price and quantity statistics

6. Price and quantity statistics are used for a wide variety of purposes, relating both to the current operation of the economic system and to the formulation of longer-range economic policies, as well as to the analysis of economic behaviour. A review of some aspects of the more important uses will be helpful in identifying the characteristics that price and quantity statistics must have in order to serve these purposes.

7. In operational terms, price indexes are increasingly being used for adjusting contracts, wage rates, pensions, taxes and a variety of other transaction flows in the system. In this context, it is apparent that different indexes are needed for different uses. Businessmen making long-term contracts may protect themselves from future rises in materials costs by including in their contracts a provision for adjusting sales prices as materials prices change. For this type of indexing, highly detailed commodity price indexes are required. On a broader level, consumer price indexes are widely used in wage adjustments and collective bargaining

negotiations, as well as for adjusting various fixed income flows such as pensions and rents. For certain other transaction flows, a more general index relating to the economy as a whole is needed. A few countries are already making use of price indexes for such general adjustments, and it is not unlikely that their use will become more widespread, for such purposes as adjusting accounting flows used in computing profits and returns on fixed obligations and equity, and for adjusting depreciation and other fixed charges to a current price basis.

8. Apart from the uses in which price indexes are actually incorporated into administrative procedures, both price and quantity indexes are used in the short run by businessmen as an ingredient in their day-to-day decisions, and by Governments in monitoring the current performance of the economy. In this context, the interrelationships among the price data, the transactions data and the quantity data are clear: integrated price and quantity statistics and value data are essential to a consistent evaluation of current economic developments. The need for immediacy of reporting, however, precludes comprehensive and representative coverage of the economy as a whole in indexes of this type.

9. On a longer range basis, price and quantity statistics and constant price estimates of the components of the national accounts are extremely important in the analysis of the behaviour of the economic system. For this use, what is needed is a more comprehensive system of price and quantity statistics that can be fully integrated with the national economic accounts and balances. The choice of economic policy by Governments depends heavily upon their understanding of the economic processes that are taking place. Thus a judgement as to whether an expansionary fiscal and monetary policy will exacerbate an inflationary process or lead to increasing output and employment will be an important factor in determining whether or not such a policy is adopted. Knowledge about where price increases are occurring and how they are transmitted is basic to an understanding of the effects of different economic policies. Knowledge of how quantities are changing is crucial to analysis of growth and of cyclical and seasonal fluctuations, and of productivity, capital/output ratios and other technical coefficients. These uses of price and quantity data require a formal and complete system of statistics, not only in terms of coverage of the whole economy but also in terms of the interrelations among the parts.

10. It is apparent, thus, that price and quantity statistics are multipurpose tools, on the one hand serving the needs of Government and enterprises in their day-to-day decision-making, and on the other providing the basis for understanding the behaviour of prices, output and employment and their relation to economic policy. These uses need not be incompatible, although the detailed information on specific industries and commodities needed at frequent intervals may not be required for the more general analytic purposes, and conversely complete coverage of all sectors of the economy, including those where measurement is difficult, may not be necessary for short-run decision making.

B. The need for guidelines

11. This document is addressed to the problem of developing a system of price and quantity statistics that will serve all of these varied kinds of needs, but will at

the same time be ordered and consistent and a true reflection of the underlying economic interrelationships. At the present time, most countries collect and issue price and quantity series for many individual commodities, and compile a number of different aggregates and index numbers from these data. However, because of differences in the ways in which the various series on prices and quantities originated and were developed, they are often incompatible with one another and cannot easily be used for analytical purposes. The different types of indexes - for consumer prices, for wholesale prices, for industrial production, for imports and exports - were for the most part developed quite independently, even in those instances where one administrative organization was responsible for all of them. In addition, despite the very long history of interest in index number theory, it is only recently that its application to economic analysis has developed much beyond the stage reached by Irving Fisher soon after the turn of the century. Fisher was seeking to identify "the" price level, which he thought of as the central tendency for all prices. He did not consider the possibility of systematic shifts in the structure of prices. He thus did not regard the choice of prices to be observed as of great importance, so long as there were enough of them to eliminate random variations. This historical interest in collecting all of the available prices without much regard for their relation to one another still influences, in particular, the wholesale price indexes of many countries. It was not until the development of a consistent set of national economic accounts and balances, which led to still another new set of indexes that differed in a number of important ways from the traditional indexes, that concern over the nature of the indexes became focused.

12. The problems most frequently encountered in using the price and quantity indexes commonly available today include: (a) different results from indexes answering the same, or virtually the same, question; (b) inconsistent results from indexes that should be logically related to one another; (c) inability to trace changes in prices and quantities through the stages of production owing to inconsistent classifications; and (d) lack of balance between supply and disposition, both of particular commodities or in particular industries and for the gross product as a whole. Although some of these problems arise from the necessary limitations of index numbers, it is possible to eliminate or at least reduce many of them through attention to consistency of definition, classification, sources, formulae, etc. But beyond these precepts, which are essentially those common to good statistical practice in any area, these guidelines are also designed to set out an approach to organizing price and quantity statistics and the indexes based upon them that will lead to an ordered and coherent structure.

13. There are various means for co-ordinating price and quantity statistics, but there are obvious advantages in using the national accounts and balances for this purpose. The System of National Accounts (SNA) and the System of Balances of the National Economy (MPS) are used in general as a framework for integrating economic statistics, and they are particularly well adapted to serving that function in this area. This is not intended to imply, however, that all index computations should be subordinated to the needs of the national accounts and balances. The accounts are used as an integrating device, but the system proposed has room for the traditional varieties of indexes as well, and it will accommodate most of the existing special purpose indexes. In this use, it does not appear that the differences between the accounts of the SNA and those of the MPS are of crucial importance. For simplicity, most of the discussion will be couched in terms of the structure and classifications of the SNA, with references to the MPS where needed.

III. OVER-ALL DESCRIPTION OF THE SYSTEM

14. The national accounts and balances deal with flows of transactions and stocks of assets. The flows and stocks are value figures. In most instances these value figures, at least in principle, may be decomposed into a quantity - a number of units - multiplied by a price per unit. It is upon this relationship that the proposed system of price and quantity statistics rests.

15. The output of the economic system (whether gross domestic product in the SNA or net material product in the MPS) may be viewed as composed of commodities and other goods and services, which in turn may be looked at either in terms of the industries in which they are produced or in terms of the users to whom they go. Price and quantity statistics are relevant both to the origin (commodity and industry) and disposition (final use) sides of the accounts. The basic data that need to be collected on values, prices and quantities can be fitted into a classification framework drawn up in these terms, and from the basic data indexes can be computed that will serve the needs outlined above. The level of detail, the frequency, the coverage, the type of data collected and the type of index may vary according to use, but if the basic data are consistently defined and classified the indexes constructed from them can also be made consistent. Indexes designed for different purposes will differ intentionally, in predictable, meaningful ways, and those designed for the same purpose will fit together into an integrated system.

A. The role of input-output relationships

16. Producing entities in the economic system make use of inputs - materials and factor services - to produce outputs. Some of the inputs may be purchased from other producers; some (factor services) constitute value added within the producing unit. The outputs, in turn, may be disposed of either to other producing units or to final users - consumers, government, etc. These relationships may conveniently be displayed in the form of an input-output table, which traces the flow of commodities and other goods and services through the economic system. Input-output relationships may relate either to what is produced (commodities and other goods and services) or where it is produced (industries and other activities). If each product were produced only in one industry, these two classifications would be identical. The difference arises because this is frequently not the case, producers often produce outputs that are typical of several different industries. The SNA therefore makes provision for classification both by commodity (what) and by industry (where). Table 2 of the SNA 3/ shows the supply and disposition of commodities, and table 3 the gross output and input of industries. Because interest often attaches specifically to production that occurs outside the typical industry, data are needed on both types of classification.

17. It is, of course, obvious that any actual data collected on prices and quantities will relate to commodities (or other goods and services). It

---

3/ Op. cit., annex 8.3.

is not possible to observe either the price or the quantity of an industry's activity, and indexes computed for industries or any larger groups must be some sort of aggregation of commodity data. In order to preserve the record of the input-output relationships, each item of data collected should ideally be specified in all three ways: what it is (commodity), where it was produced (producing industry or other activity), and where it was used (purchasing industry or final use).

18. A standard classification framework embodying this three-way specification of the basic data can be based upon existing standard classification systems. This report is framed in terms of international standard classifications. Some countries may employ their own versions of standard classifications. For internal use, what is important is the use of the same systems throughout, although of course for purposes of international comparability adherence to the international standards is desirable. Standard classifications are available for all of the required breakdowns, and it is one of the most important features of the proposed integrated data system that these standard classifications should be employed, in order to ensure that common definitions are used throughout. It is only if such standardization is maintained that the various parts of the system can be expected to fit together. This point will be discussed more fully, but it should be pointed out that this is a minimum level of price and quantity specification, and there will be other types of specification that are needed in particular uses. There may, for instance, be interest in the region where the commodity is produced or sold, in the size of establishment producing or using it or in various other additional specifications.

19. This does not, of course, mean that data should be collected or indexes computed for all possible categories of the standard classifications. Rather, what it does mean is that the specifications of whatever data are collected should be designed to fit into the standard classifications, and whatever indexes are computed should respect the standard classification boundaries.

20. The standard classifications which it proposed should be used are, for commodities, the International Standard Classification of All Goods and Services (ICGS) (E/CN.3/493); for industries, the International Standard Industrial Classification of All Economic Activities (ISIC); 4/ and for final uses of gross product, the classifications specified in A System of National Accounts. ISIC classifies economic activities according to a telescoping four-digit scheme: the first digit identifies the major division; the first and second, the division; the first three, the major group; and all four, the group. Thus it is possible to move easily from quite detailed classifications to very broad ones. ICGS adds four more digits to the industry codes to obtain a classification of goods and services by classes (six digits) and subclasses (eight digits). ISIC is intended to classify the activities of entire establishments or enterprises into the most appropriate industry. ICGS, on the other hand, classifies goods and services into those industries where they are typically produced (without regard to where they are actually produced). The greater detail in ICGS reflects a greater need; interest in commodities is frequently focused at a much more specific level.

4/ United Nations publication, Sales No. E.68.XVII.8.

The final use breakdowns are specified in tables 5.3, 5.4, 6.1, 6.2 and 6.3 of the SNA. Since these last classifications are insufficiently detailed for some uses, they will need to be supplemented by ISIC, ICGS or other classifications. In particular, this will be necessary for imports and exports, where in some cases the Standard International Trade Classification (SITC) 5/ will also be useful.

21. The level of classification chosen for the basic data of the system should be at least as detailed as the most detailed indexes desired. This is an obvious consideration, but one that in practice it is easy to neglect, and failure to take it into account in advance will lead to unnecessary duplication of collection effort, as well as unintentional and unnecessary inconsistency.

22. Though the classification schemes used are somewhat different, most of what has been said above also applies to the MPS. The classifications explicitly included in the MPS are on a somewhat less detailed level. As a consequence, no distinction is made between commodity classifications and activity classifications, since at the level specified they are much more likely to coincide than is true for the SNA. This tendency may also arise from a higher degree of enterprise specialization in countries using the MPS. In practice, however, more detailed classifications are frequently used, and when this is done the distinction between commodity and activity classification is frequently made. Similarly, although the production boundary in the MPS is restricted to the material product, flows relating to non-material services are identified in the system, and price and quantity indexes relating to them are needed and in fact often compiled.

B. The design of price and quantity indexes

23. Given the basic data arranged in a standard classification framework, it is conceptually possible to construct indexes for any desired aggregation of either transactions or transactors, as long as it is not more detailed than the classes for which the basic data are available. Furthermore, many different kinds of indexes are possible. This section will consider what aggregations are useful, and what kinds of indexes are appropriate. The discussion will be limited to the structure of the system of indexes, excluding considerations of the nature of the data (which will be covered in chapter IV), index formulae (chapter V) and recommendations for implementation (chapter VI).

24. The SNA provides for the recording of flows both at market prices and at approximate basic values. Approximate basic values differ from market prices in that they exclude commodity taxes. They are thus designed to reflect the producer's costs (including profits). Market prices may be either those paid by the purchaser or those received by the seller; the difference is, of course, the trade margin and transport cost. Both price and quantity indexes may be constructed on any of these valuation bases, and the system has room for all.

25. In any integrated system of indexes, the fact of integration means that not all of the index values are independent. Where price times quantity equals value,

---

5/ United Nations publication, Sales No. E.75.XVII.6.

one of the three variables is redundant, and it is necessary to collect independent data for only two of them. Similarly, where intermediate product plus value added equals gross output, one of the three can be derived from the other two. Owing to the exigencies of index number compilation, both of these statements are subject to some qualifications; these are discussed, in chapter V below. What is intended here is only to point out the interrelatedness of the system. When the parts fit together, this not only imposes consistency requirements but also permits a significant economy of statistical effort.

26. Utilizing the concept of the flow of commodities through the economic system, where the output of one industry becomes the input of another until it eventually reaches some final use, it is now possible to outline the kinds of indexes it would be desirable to have. At the simplest level, price and quantity indexes are needed for the gross output of commodities. The commodity data are also the basic building blocks for constructing indexes for industries.

27. For industries, however, it is not only gross output that is of interest. In order to be able to combine industries into larger groups - four-digit industries into three or two digit industries, and eventually into gross product for the economy as a whole - indexes are also needed for value added. To obtain value added, intermediate inputs are needed. The input-output relationships define, for each industry, the commodities that enter into intermediate input and gross output. Value added, on the other hand, is by definition a concept that is not directly measurable, since it is the difference between gross output and inputs purchased from other producers. Value added in current prices is obtained by performing this subtraction. Consequently, to obtain a measure of deflated value added, gross output and purchased inputs must each be deflated separately. This "double deflation" is required because there is no single deflator that is relevant. A price index that is appropriate for the gross output of the industry will include the effects not only of what has happened within the industry, but also of changes in the prices of purchased inputs. A rise in agricultural prices, for instance, will probably affect the prices of the output of the food processing industry, so that observing the change in the price of processed food will not by itself provide any information on changes in the price of food processing. The same, of course, is true of quantity relationships. Observing the quantity of processed food produced gives no information on whether the processing content has increased or decreased relative to the content of raw agricultural inputs. For this reason, it is necessary to approach the measurement of both the price and the quantity of value added in a more indirect way, by constructing separate measures for gross output and intermediate input, each of which consists of an identifiable bundle of commodities. If intermediate input, deflated by an index appropriate to it, is subtracted from gross output, similarly deflated by its own index, the result will be what is known as double-deflated value added. This may then, in turn, be divided into current price value added to derive a price index for value added, but this price index is a derived figure; there is no way that it can be observed directly. The deflated value added figures thus obtained are additive, in that they may simply be summed to obtain aggregations for

larger industrial groups or for the economy as a whole. To aggregate the price and quantity indexes of value added, appropriate weights are needed, but again the relationships are additive.

28. An alternative approach to measuring output is what has been variously referred to as the net sector output index or the ring fence index. For any given industry or sector, this is defined as gross output less what is disposed of to users within that industry or sector. Thus, it is a measure of what that industry passes on to the rest of the economy. It should be noted that the word "net", in this context, does not have its usual national accounting meaning. What is netted out is not capital consumption, but rather own-product consumption. Unlike value added, the net sector output index is not an additive measure. As the sector being considered becomes more inclusive (from four to three or two-digit, for instance), the proportion of output that is disposed of within the industry also becomes more inclusive. At a highly disaggregated level, "net sector output" will be very close to gross output. For larger aggregations, it will approach more and more closely to value added, becoming identical with it for the economy as a whole. The concept of net sector output is thus primarily interesting for intermediate levels of aggregation - the whole of manufacturing, for instance, where it may usefully serve in analysing sector terms of trade. As a practical measure, its lack of additivity is a severe drawback, since component indexes cannot be combined to derive indexes for larger aggregates.

29. The indexes that have been considered so far relate to output, classified by producing sector; the next group will relate to uses of output. These would include various indexes relating to household consumption by type of goods and services, and for various groups of consumers, with corresponding quantity indexes; indexes for government final consumption expenditure by purpose; and by type of government entity; indexes for final consumption expenditures of private non-profit institutions by type of services; indexes of fixed capital formation, both by type of asset and by purchasing industry; indexes of changes in stocks, by type of commodity and by industry where held; and indexes for imports and exports by type of commodity. Once again, this breakdown is additive; deflated current values or properly weighted quantity indexes for detailed groups can be added to obtain more summary groups, and the total for the economy as a whole should equal (aside from index number problems and statistical discrepancies) the total derived by summing value added by industrial origin.

30. Table 1 below summarizes the structure of the proposed system of price and quantity statistics. This table is intended only to display the structure and does not contain any detailed specifications of types of indexes, levels of classification, priorities, frequencies, etc. These questions are dealt with later, and shown in detail in chapter VI. As will be readily apparent, table 1 is merely a skeleton national accounting framework. The skeleton is, however, selectively chosen, to display those elements to which the price and quantity data relate.

Table 1. Structure of the system of price and quantity statistics

(Basic data and compiled indexes at various levels of aggregation)

I. Gross output of commodities and activities

Commodities and activities by ISIC and ICGS classifications	Purchased inputs (intermediate consumption) of activities		Gross output of (a) commodities and (b) activities		Value added of activities	
	Market prices	Approximate basic values	Market prices	Approximate basic values	Market prices	Approximate basic values
1. Agriculture						
2. Mining						
3. Manufacturing						
4. Electricity, gas and water						
5. Construction						
6. Distributive trades						
7. Transport and communications						
8. Finance etc.						
9. Services						
Gross domestic product						

II. Final uses of output

Final uses by SNA Classifications	Purchasers' values
1. Consumption of households, by type	
2. Government consumption, by purpose	
3. Consumption of non-profit institutions, by type	
4. Gross fixed capital formation	
(a) by type	
(b) by purchaser	
5. Increase in stocks	
(a) by type	
(b) by industry	
6. Exports, by type	
7. Imports, by type	
Gross domestic product	

31. There remains one group of indexes not covered in the structure discussed above. These are indexes for factor payments and other components of the disposition of gross product. Indexes of wage cost and wage income are frequently computed, and there is increasing interest in indexes for other components of income - profits, interest - as well as capital consumption and indirect taxes. The present guidelines do not include recommendations in this area, however. They have been excluded on the ground that there is, as yet, insufficient international consensus on appropriate methodology. Work in this area will continue, and as a consensus is reached the guidelines will be extended to include this breakdown.

IV. THE STRATEGY OF DATA COLLECTION

32. Translating the theoretical structure of the system of price and quantity statistics into a programme for implementation requires substantial elaboration of the discussion above. This chapter will deal with some of the more important considerations that arise in designing and executing a programme of data collection upon which to base price and quantity indexes. It will discuss, first, the choice of the units for which data are to be collected; second, the design of a programme of data collection; and finally, special problems that arise in particular instances.

A. The choice of units of observation

1. The definition of the unit

33. The precise specification of the elementary units of measurement is a fundamental aspect of the selection of price and quantity indicators used to compute indexes of price and quantity. The definition of "q" and "p" units affects not only the representativeness of the units selected but also the boundary between the quantity and price components, i.e., between those factors that will be reflected in the quantity index and those that will be reflected in the price index.

34. If, for example, the units are defined as automobiles, without any further specification, then the quantity index of automobiles will be proportional to the number of automobiles. In this case, all changes in the quality of the cars that lead to differences in their market value, or in the mix of cars of different quality, will be regarded as changes in price and reflected in the price index. If, alternatively, the unit is defined as a car with a specific engine capacity (but without any other specification of the quality) then quality changes involving changes in engine capacity will also be treated as quantity changes - an automobile with a larger engine will be counted as more quantity of automobile rather than as a higher priced automobile - but all other quality changes will still be reflected in the price index. The addition of other specifications, such as weight, optional extras, etc., will, similarly, shift the effect of changes in these elements from price to quantity.

35. The treatment of quality changes will be discussed below, beginning with paragraph 45. First, however, some of the other questions that may arise in the specification of units of measurement will be discussed.

(a) Regional differences

36. In many countries, there are regional differences in the prices of certain products. Some differences reflect climate or transport cost. Quite often, also, there are considerable differences between cities, towns, and villages, or between tourist resorts and industrial regions. In these cases the question arises,

assuming that there are no other differences in the products, whether the products sold in the different regions at different prices should be considered, for the computation of indexes, as one single product representing the same quantity wherever it is sold, or as different products representing different quantities. Is an orange consumed in a subtropical region the same as an orange consumed in a colder climate? Is the orange the unit, or are these two oranges in different places different products?

37. This question involves the fixing of the borderline between the quantity component and the price component of value. Suppose the same total number of oranges is consumed as in the previous year, but there is a shift in consumption from the warmer to the colder regions; since in the colder regions oranges are more expensive, the value of all oranges consumed in the country would increase. Is this a quantity increase or a price increase? If the unit is "an orange", the answer is that the increase was in prices (since the same quantity was consumed in the two years); but if the orange in warm regions and the orange in cold regions are two different products, then it is quantities that have increased, not prices. For most intertemporal comparisons, the latter treatment is more appropriate, since the trade and transport activities that lead to the increase in cold-climate oranges do represent real output.

38. This question becomes especially important in the case of food consumed on farms and similar non-marketed output. Treating food consumed on farms as a separate product from marketed food will, of course, result in an increase in quantity as the share that is marketed increases.

39. The application of this rule in practice would require that national price indexes be compiled as averages of regional price indexes, and not as indexes of national average prices. This is done in many countries for consumer or retail price indexes, which are compiled from a large and geographically well-distributed sample of prices. The index for the country is obtained as a weighted average of these separate price relatives or regional indexes. In some countries, however, separate indexes can be compiled only for large regions, and in a number of countries the national price indexes are computed on the basis of the national average prices without any regional breakdown. These indexes may sufficiently well approximate those compiled taking regional differences into account if the regional price differences are not large or if the changes in the proportions between the regions are unimportant. It should be noted, also, that there are some special purposes, for example interregional quantity and price comparisons, for which it is preferable to treat the product consumed in the different regions as the same product. To compare per capita consumption of oranges in warm and cold regions, for instance, the concept that is needed relates to oranges meeting physical specifications, not to oranges-plus-transport. For these purposes, national average prices and not regional prices should be used.

(b) Seasonal differences

40. This problem is very similar to that of the preceding subsection, the only important difference being that the dimension here is time and not space. Seasonal variation is often connected with some other characteristic, for

example, the origin of the product (imported or domestic) or differences in the production process (hothouse or field grown). Here again, the question arises whether a strawberry consumed in winter is the same product as a strawberry consumed in summer. On the basis of similar considerations, the conclusion seems to be that theoretically strawberries in different seasons should be treated as different products.

41. Treating the product in different seasons as a different product means that the effect of the shifts in the proportions consumed in the various seasons is to be considered a quantity change and not a price change. The calculation of the index therefore requires in principle that the annual average price index be computed as a weighted average of the price indexes for the various seasons, and not as an index based on annual average prices. The problem of seasonal variation has been widely studied, and a number of highly technical methods of treating it have been developed. This is not the place for a detailed discussion of these methods; it is sufficient to point out their objective.

(c) Price discrimination

42. The sort of problem considered in sections (a) and (b) above may be generalized to include any situation in which different prices are charged for the same product sold in different markets, however the different markets are distinguished. Thus, a product sold in a small independent shop may be priced differently from the same product sold in a chain supermarket. Or a product sold in small quantities may cost more than the same product sold in large quantities. Products sold individually to consumers may differ in price from the same product sold as intermediate input to producers, for instance, household appliances sold to consumers, as opposed to the same products sold to builders. In other cases, there may be differences related to the characteristics of the purchasers - lower prices for children, the elderly, the disabled; or for certain categories of employees, licensed members of a profession, members of a club. In these cases, as in the cases of regional and seasonal variation, the question arises as to what the appropriate unit is. Should it be the product, irrespective of the market in which it is sold, or should it be the product sold in a given market? In the first case, the changes in value caused by the shifts between the markets are considered price changes; in the second case, they are treated as quantity changes. The answer, in the general case, is not as clear-cut as it is in the simpler regional and seasonal variation cases, however.

43. There are arguments for both solutions under certain circumstances. For measuring production, there are strong arguments for treating these differences as price and not quantity. Selling identical items to different customers at different prices does not involve a change in the quantity or volume of the items produced, and for such purposes as productivity analysis it is the quantity of goods produced that is important. Moreover, at the moment when production is measured it may not yet be known in which market the goods will be sold. On the other hand, when measuring the disposition of production - the volume of exports and of domestic consumption, for instance - it is more appropriate to use

the prices at which the products were actually sold. If these prices are different in the two markets this means that the products sold in different markets should be treated as different products.

44. This gives rise to a conflict, to which there is no ideal solution. If the most appropriate method is to be used for the computation of each type of index, there will be two output indexes that differ because they treat price discrimination differently, the choice between them depending upon the use contemplated. This, in turn, will mean that some method of reconciliation will be needed if the national accounts in constant prices are to balance. One possible method is to introduce a special balancing item into the accounts. This balancing item would not be the same as the balancing item in the account at current prices that allows for the effect of statistical errors in the component series, but rather it would have an economic meaning. Another solution sometimes proposed is the absorption of the difference in the trade sector. In many of the instances where this problem arises, the trade sector is interposed between the producer and the final purchaser, so that it is possible to consider that the trade sector buys a single product which it then, as a part of its function, turns into multiple products. Such a treatment, however, merely obscures the problem, without solving it.

(d) Quality differences

45. Quality differences raise fewer questions of principle than does price discrimination, but in practice they are more difficult to deal with. In view of the purposes for which price and quantity indexes are needed, it is clear that quality differences ought to be treated as differences in quantity, not in price. In measuring consumption, for example, a better suit should be counted as more quantity of clothing than a poorer one, not as a higher price of the same quantity as a poorer suit. But the application of this principle presents a great many practical problems.

46. In the case of goods, all differences in physical composition, components, size, style, packaging, operating characteristics (for example, capacity, power, speed, durability, etc.), should be considered quality differences. Circumstances of sale, such as the net weight or volume of the item bought, customer services, guarantees and terms of payment are also quality characteristics from this point of view; differences of this sort merge by imperceptible degrees into the price discrimination case discussed above. In the case of services, quality characteristics relate to such attributes as the activities constituting the services, the conditions under which the services are rendered, the levels of skill and training of the persons rendering the services and, if feasible, the benefits generally expected from the services.

47. Quality differences are generally accompanied by price differences when products are sold in the same period in the same market. In fact, in general, it is through these price differences that it is easiest to identify and quantify the quality differences. It should be noted, however, that though the

correlation between the quality differences and price differences at a given place and time is relatively very strong, not all quality differences are necessarily accompanied by price differences and not all price differences necessarily correspond to quality differences.

48. Quality differences should be judged generally from the point of view of the utilization of the goods or services, excluding differences in the circumstances of production that do not lead to differences in utilization. For example, electric energy having exactly the same utilization characteristics should not be considered of different quality simply because of differences in the production process (thermal energy, hydro-energy, or nuclear energy), although, as will be noted below, for some purposes it may be necessary to consider them different products.

49. While quality differences existing at a single point of time cause some problems, it is in taking account of the changes in quality over time that the most difficult questions arise. From the point of view of index computation, there is no substantial difference between the treatment of quality change and that of new products, and in this section no distinction will be made between them. The problem of quality change is encountered in all kinds of quantity and price indexes. For the sake of simplicity, the discussion here will concentrate on consumption.

50. When a new product replaces an old one, two questions arise: (a) how will the continuity of the indexes be preserved, and (b) how will the accuracy of the index be affected? When a new product is clearly identifiable as a replacement for a specific old product, the usual method of maintaining continuity is by linking or splicing: the new product is substituted for the old using the ratio between their prices that is actually observed in the market. In many cases, however, old products disappear and new ones appear in circumstances where it is not possible to establish an unambiguous link, so that some element of judgement will always come into play. Often the substitution is not complete; the new product simply adds to the spectrum of choices available, but in doing so it may lead to major changes in the function of the old product. An example is the advent of television. While it is clear that the introduction of television had a major impact on both the radio and the motion picture industries, greatly changing the character of both, it is not at all clear that television can be considered a direct substitute for either. The usual practice, in such cases, is to introduce the new product at what is essentially an arbitrary point, after it is well established in the market. Similarly, disappearing old products for which there is no obvious replacement are simply dropped.

51. If no attempt is made to maintain continuity either by splicing or by substitution, it is obvious that the representativeness of the index is reduced. Whether this is a serious danger depends upon the relative importance of the item in question (and the number of items involved). Where there are many comparable products, the disappearance of a few old ones may not matter, but in other cases the reduction in representativeness may be more important.

52. There is, furthermore, a second source of inaccuracy arising from the changing product mix that is likely to be much more serious than any reduction in representativeness that is the concealed price change that may be introduced. In all cases where the price difference between the old product and the new is not proportional to the quality difference, the replacement of the old product by the new has the same effect for the consumer as a change in the price. The change may of course be in either direction. Where it occurs in response to demand - i.e., where the new product drives the old out - there is a prima facie case that the new product represents more quality for the money. But where the shift reflects supply conditions - i.e., where the old product can no longer be obtained - there is a strong likelihood that quality relative to price will decline. To the extent that such differences in quality can be measured, appropriate adjustments must be made if the price indexes are to be an accurate measure of price change. But the possibilities of measuring quality differences are limited, and it must be recognized that such adjustments are often incomplete and to some extent arbitrary.

53. Even in cases where the market prices of the old and new products at a given point in time are used for splicing, there is still a large element of arbitrariness. This arises in the timing of the substitution, since new products often have higher prices when first introduced and falling prices as their production increases. Conversely, the product being phased out is likely to have a rising price, since it will not benefit to the same degree from technological advances. Thus, throughout the period when both products are on the market the ratio between their prices is likely to be continually shifting, so that the choice of the exact moment for making the splice will affect the outcome. One approach to this problem calls for very early introduction of the new product, with a small weight at first but an increasing weight as its use increases. Correspondingly, the old product would be phased out by gradually decreasing its weight. This method would capture the price change, but it introduces other problems relating to shifting weights, which are discussed below.

54. Where shifts are not voluntary but are forced by the disappearance of a product formerly available, an additional consideration enters. Even if it is assumed that the difference in price between the old and new products is an accurate reflection of their relative quality, the consumer will have lost something through having been forced to make the change. This, for instance is the case with mandatory installation of safety equipment or anti-pollution devices in automobiles. The increase in price may accurately reflect the increase in quality, but if consumers would rather not have the new equipment they are worse off. Nevertheless, it is still appropriate to treat the required improvements as increases in quantity, not price. The system of price and quantity statistics is intented to provide an objective measure (in so far as that is possible) of what has happened to output and its price. Measuring the utility or welfare that output yields is beyond its scope. It is, of course, true that the very concept of "output" involves some assumptions about utility, but certain conventions have been adopted for use in national accounting, and it seems preferable to maintain the same conventions here.

55. These difficulties in determining the appropriate level at which to introduce a new product (or similarly, in valuing a change in quality) have attracted much attention, and various methods have been developed of handling them. Four of the methods commonly proposed will be discussed briefly here.

56. Much attention has been attracted in recent years by the "hedonic" approach. This method is based upon the existence of a correlation between the various quality characteristics of a product and its price. If observations for a number of different models of a product, each displaying different combinations of quality attributes and correspondingly different prices, are available, it is possible to estimate regression equation of price as a function of the various quality indicators. For this method to be effective, a number of conditions must be met. It can be applied only for commodities like automobiles and houses that are available in a number of variants. But it is precisely in these cases that it is difficult to determine which aspects of the different variants are important, and which are not. Furthermore, the importance of a given characteristic may vary from time to time depending upon factors that are not within the set being considered. Thus, for instance, the importance of fuel consumption as a component of the quality of an automobile is highly dependent upon the cost of fuel but the cost of fuel is not a quality characteristic and will not enter into the regression equation. More importantly, this method does not solve the basic timing problem. It is still necessary to base the link upon the price relationships among different variants of a product existing at one particular moment of time, and very different results may be obtained depending upon the moment chosen.

57. A second approach relies upon cost to serve as the indicator of quality. A product that costs the producer 10 per cent more to make is assumed to represent 10 per cent more quantity. For cost to be an accurate reflector of differences in quality, productivity must of course have remained constant. Since technological change is one of the major reasons for the introduction of new products, considerable caution is needed in applying this method. Although there are many cases where it will give quite satisfactory results, it is not universally applicable. In particular, it entirely omits cost-free improvements, which occur rather frequently.

58. In some cases, a foreign market can provide some help in determining the relative qualities of two products, if both the old and new products are present and competing in, for example, a neighbouring country. This method may introduce some foreign influence into the national indexes, and the result may differ depending on which foreign country is used. Nevertheless, in some situations it may prove useful.

59. Because of the difficulties with all of these essentially market-determined methods of measuring quality differences, some countries employ estimates made by commodity experts. But this method is not entirely free from the same difficulties, since the commodity experts may base their conclusions on a primitive form of hedonic estimate, or on the cost relationships, or the price relationships in foreign markets, or on some combination of all of these. Subjective judgements may also play a role. Nevertheless, the depth of the commodity expert's specialized knowledge and the flexibility of the method may sometimes make its use advantageous.

60. There is thus no completely satisfactory method of measuring changes in quality, or of pricing new products. Relatively arbitrary splicing and substitution are, therefore, likely to continue to be the methods generally employed for dealing with changes in the product mix. For this reason, it is especially important that attention be given to the method of splicing, and that it not be left to casual decision-making of the price collectors. Replacement of the price index of the old product by the price index of the new product should take place at a time when the assumption that the price differences between the two products are proportional to the quality differences is most likely to be true. Too early replacement will underestimate the price change, and too late replacement will overestimate it.

(e) Unique products

61. There are some fields in which the new products problem is so severe that it takes on an entirely different dimension. In most construction and in some branches of the heavy machinery industry, virtually all products are new, in that each product is unique. In some fields of services the problems are similar: most of the product consists of unique services. Various techniques have been developed to deal with this problem. In some instances, the hedonic approach can be used. Measurements are often based on price movements of inputs of materials and labour, although the implicit assumption of constant productivity inherent in this approach is unlikely to be true over any extended period. In spite of the fact that comparable products are rare, it may be that a price index based on a small number of observations can serve as an adequate indicator for a wider group of products. A variant of this approach is the "standard product" method, where a specific item (house, ship, machine) is specified in great detail, and the price of the standard product is then estimated in each period by industry experts, although here again the "standard" is likely to become obsolete rather quickly. Alternatively, it is often possible to identify relatively homogeneous components of a unique product (the propulsion machinery of a ship, the walls of a house) for which price and quantity data can be obtained. Subject to the limitation of the assumption of fixed technology pointed out above, it may then be possible to combine the component indexes into over-all indexes.

(f) Specification versus functional definitions

62. One final question that needs to be considered in this context is that of how commodities are to be identified. At one extreme, "specification" pricing identifies commodities by listing in great detail all of their physical characteristics. Thus, an article made of metal would not be classed with a similar article made of wood. At the other extreme, only the function of the commodity is considered. A wooden table and a metal table would be classed together if both were used for the same purpose. This question becomes particularly important in the consideration of capital goods, where the only use is for further production, and where the physical specifications of products seldom remain unchanged for long. Technological changes which involve altered

specifications for a machine would, with specification pricing, lead to the new machine being considered a different product, which in turn, as pointed out above, would lead to the change in its value being classed as a quantity change rather than a price change. But functional pricing would consider the new machine the same product as the old as long as it performed the same function, and so would class its change in value as a change in price. Specification pricing of capital goods which leads to treatment of improvements in technical characteristics as increases in the quantity of capital goods produced will locate productivity increases in the capital-goods-producing industries. But functional pricing will treat such improvements as price increases, and the measured quantity of capital goods will remain unchanged. Thus the productivity of the capital goods will appear as increased productivity of the capital-goods-using industries. The decision made on this score will thus determine whether productivity change is measured as occurring in the industries where the capital goods are produced or in the industries where the capital goods are used.

2. The selection of units

63. One of the constraints of a consistent system of price and quantity statistics and indexes is that the various parts must fit together. This is, however, also one of its great advantages, since it means that it is not necessary to make separate computations or collect separate data for all the indexes needed.

64. It is common practice to take either the price or the quantity index as the primary measurement, and to derive the other from the primary measure together with expenditure data. There are some commodities for which quantities are the natural primary measures; these are found especially in primary industries - agriculture and mining - but they may also occur in some branches of manufacturing and in some services. On the expenditure side and at higher levels of aggregation, however, prices are usually the only feasible measurement. No general recommendation can be made in this respect. The choice will depend in each case upon the possibilities of data collection.

(a) Derivations and approximations

65. Various other kinds of derivations are also possible. Among the most important are:

(a) Activity-type indexes from commodity-type indexes;

(b) Appropriate basic value indexes from market price indexes combined with information on taxes;

(c) Disposition-type indexes from supply-type indexes or vice versa, taking advantage of input-output relationships.

66. The term "derivation" is used here in a relatively broad sense, to mean that in the calculation of some indexes entire or partial use can be made of the calculations of other indexes. In some cases, the derivation may mean identity

(e.g., some activity-type price indexes may be considered to be the same as the corresponding commodity-type indexes); in other cases, the derivation consists of a simple arithmetical operation (dividing price into value to obtain quantity); in still other cases, some reweighting will be needed, to yield indexes for different purposes.

(b) Kinds of prices

67. In the discussion to this point, it has been tacitly assumed that once a commodity has been identified, an unambiguous price can be observed for it. In many cases, however, this is an extreme over-simplification. Quite apart from the problems of sampling variation discussed below, there are many different kinds of prices, and it is necessary to make a choice among them. Order prices reflect the current market, but they relate to output that will be delivered at some time in the future. Contract prices relate to current deliveries, but they reflect market conditions at some time in the past. Spot prices relate both to the current market and to current deliveries, but they often reflect only a minute proportion of total production, and they could be expected to be quite different if their share of the market were larger. Prices may vary by size of order. Where production extends over a long period of time, particularly for capital goods, there may be progress payments. There are conflicting aims to be met in choosing among this welter of available pricing information. For the purpose of deflating the national accounts, the objective should be to relate the price to the current value aggregate. In other words, that price should be chosen that most nearly reflects what was paid for the current period's output. This may entail choosing long-term contract prices, even where these are not relevant to current market conditions. These prices, however, are quite inappropriate for forward-looking or predictive uses. For these purposes, order prices will be more generally useful, and occasionally spot prices are important. It is clear, thus, that it may frequently be necessary to consider more than one price for a given commodity.

68. One special case that presents difficulty is that of internal transfer prices. When a producer obtains inputs from a related enterprise - a corporate affiliate or another branch of the same enterprise - the prices that are set may be quite arbitrary. It is, for instance, frequently advantageous for a parent company to concentrate its profits either in a particular industry or in a particular location, often for reasons of tax advantage. Steel manufacturers may shift their profits back to their wholly owned coal-producing subsidiaries, where tax treatment is more favourable, by setting unrealistic purchase prices for the coal they use. Profits may be kept in foreign subsidiaries, or alternatively transferred home, by manipulating the prices at which the subsidiaries' products are purchased. These problems can be ignored where such internal transfer prices are infrequent, but there are some commodities and some activities where they may account for a significant proportion of the total. In these cases, an attempt must be made to determine what the equivalent market price would have been.

B. The design of the data collection programme

1. Over-all considerations

69. As was pointed out above in the discussion of the uses of price and quantity statistics, different data are needed for different purposes, and it is neither feasible nor desirable to ignore these differences. The forward-looking, monitoring or predictive uses require immediacy. Data must be available as soon as possible after the period to which they refer, and they must be compiled frequently - for maximum usefulness, monthly, or in some cases weekly. Since interest in these indexes often centres on particular commodities, especially when the price indexes are used for indexing contracts and similar purposes, very detailed and highly specified data are needed. It is not feasible to expect indexes with comprehensive coverage to be compiled either as frequently or as quickly, nor is there any need for this to be done. There are some parts of the economic system, like the service industries and government, where separation of price and quantity is conceptually obscure and measurement provides an approximation at best. The available methods of estimation in these areas are not likely to cast very much light upon short-period variations. Yet for some purposes the need for comprehensive coverage is sufficient to make even approximations acceptable. These sorts of uses - deflation of the national accounts, longer run analysis of price and output behaviour - are not those where either frequency or immediacy are especially important, and less frequent periodicity and a longer delay in compilation do not seriously reduce their usefulness. For other parts of the system, a periodicity more frequent than the length of the production period is of doubtful utility. This is true, for instance, of output indexes for field crops in agriculture, and to some extent that of heavy capital goods with a long gestation period.

70. The strategy of data collection must make allowance for these differences in needs, while at the same time endeavouring to maintain as much representativeness as possible. The sample design must take into account the prices and quantities for which there is a demand for frequent and quickly available reports, as well as those for which less frequent reporting is acceptable. The choice of the specific commodities for which frequent observations are to be made will depend upon a number of factors, including the competing demands of potential users, the ease of collection, and the resources available. The relative importance of such factors will necessarily differ from country to country. It is usually easier, in a market economy, to collect prices of relatively homogeneous products for which there are established markets; these tend to be products at early stages of the production process. This is even truer of data on quantities: tons of steel produced in a given week is a relatively easy statistic to collect, whereas determining the quantity of computers or airplanes produced takes much analysis. Such price and quantity information on basic materials and other standardized products is widely collected and widely used for monitoring and forecasting. Beyond this, the priorities must reflect the most urgent demands, the frequency of observation decreasing as the complexity increases. They may be expected to emphasize the most important components of a country's commodity output, where

an effort should be made to supplement the data gathered to meet the monitoring demands of users of detailed indexes (which may shift from time to time) with enough data gathered on a probability sampling basis to ensure adequate over-all representativeness. They will often include at least quantity indicators of trade and transport, if these are easily available (as they may be either from an administrative source like the tax collection apparatus or from the industry's own records). Finally, they may be expected to include some parts of the final use data, especially consumer prices.

71. But this sort of balancing of response to short-term demand with difficulty and cost is an insufficient basis upon which to rest a longer range collection programme. The collection programme should take into account the nature of price and quantity observations. Probability sampling is based upon the assumption that the observations collected are independent (at least within strata). This, however, is far from a valid assumption for prices, where whole groups may be expected to move in much the same way. Although we no longer expect (as Irving Fisher did) that the behaviour of all prices is similar, the theory of price and value does suggest that there will be groups of prices subject to the same influences that will behave in the same way. Where groups of prices move together, it is not necessary to observe all of them with the same frequency. Some can be checked much less frequently, and others used as proxies in the interval. The determination of what prices are redundant in a particular economy is an empirical question, which depends upon the analysis of past behaviour.

72. Beyond the data needed at frequent intervals, and the more comprehensive data needed on a quarterly or annual basis, the design of an adequate data collection programme requires intensive (or benchmark) study at less frequent intervals. Such a benchmark study should endeavour to cover the total value of gross output, in terms of both its origin and its disposition, in as much detail as possible. What is "possible", both in terms of frequency and in terms of detail of coverage, is a question of the resources available; a relatively complete benchmark study once every five years is a reasonable objective. Apart from its intrinsic usefulness as an analytical tool, such a benchmark study is needed to test the validity of the samples used in inter-benchmark periods.

2. Sampling problems

73. Even on the most comprehensive benchmark basis, all collection of price and quantity data inevitably involves the selection of a sample out of all of the commodities and respondents in the economy. This is not the place to discuss technical considerations of sample design, but some of the questions that arise will be briefly noted.

74. Prices may move differently in different areas (cities, villages, rural areas), in different establishments producing the same goods or services, for different commodities and for different specifications of the same commodity. The sample design should capture all of these differences. The example of consumer price indexes may illustrate the complexity of the sampling problems involved. First, a sample of areas is needed, within which to conduct

expenditure surveys and price collection. Within each area, a sample of families or consumer units must be selected from whom data on which to base expenditure weights can be obtained, and samples of outlets are needed at each sampling point from which price quotations can be obtained. Furthermore, since it is impossible to price all the thousands of items that consumers buy, it is necessary to select a sample of items for pricing. Finally, pricing is usually done at a specific time of the month or quarter, so there is, in effect, a sampling of time.

(a) The selection of areas

75. The selection of cities, villages and rural areas in which the prices will be observed depends on the extent to which price changes differ for different types of agglomerations or different regions, and upon the resources available. The kinds of strata that need to be distinguished depend on the types of agglomerations that exist and on the extent of differences in price trends between regions. Where regional price trends do not differ substantially, it is sufficient to distinguish metropolitan areas, other large cities, small cities, villages and rural areas. Where regional differences are important, a good geographic dispersion is also desirable. The relatively high cost of price collection does not always allow these principles to be followed; in many countries the collection of data is restricted to the capital and a relatively small number of other cities. Even where resources are limited, however, some attention should be given to this problem, since ignoring it can lead to quite misleading results where a substantial part of the population lives in rural areas. There are some prices that tend to behave more or less similarly throughout even large countries, whereas others, like rent, may behave quite differently from place to place. A distinction needs to be made also between price levels and price changes. Even where levels differ regionally, changes over time may be similar, or move in predictable ways.

(b) The selection of commodities

76. The problem of selection of commodities arises in connexion with most types of price indexes, since it is never possible to observe the whole universe. There are certain principles that can be used in making this choice. First, as much advantage as possible should be taken of stratification, since this will reduce the sampling error if the dispersion within the strata is smaller than the dispersion in the whole universe. Secondly, although there are strong arguments in favour of using probability selection, this method is not always to be preferred. Commodities differ both in importance and in the accuracy with which they can be observed. A departure from probability sampling to include items selected according to other criteria, such as ease of measurement, does not necessarily involve a bias. The crucial question is whether the items selected measure the price movement as well as those that would have appeared in a probability sample. This is a question that can only be answered by empirical testing, using comprehensive benchmark data.

77. It is expedient to make the commodity selection in three stages. The first stage is the commodity group level. For the consumer price index, examples of this level are bakery products, meat, fish, fruit, etc. Weights, in the form of money

expenditures, can be obtained from consumer expenditure surveys for all of these groups. At this level, coverage should be exhaustive (i.e., all groups should be covered). The second stage is the identification of the commodity or item; this consists of more homogeneous categories within a commodity group, like bananas, apples, oranges. Weights are not always available at the commodity level, but they can usually be estimated. At this level, a combination of purposive selection with probability sampling is appropriate, such that the more important items are included in the sample with certainty. The third stage is the specification level, which gives the detailed identification of the particular items to which the prices collected relate, for instance, "banana, yellow variety, best quality, full-sized fruit, such as Cavendish or Gros Michel; fruit should be at least five times as long as it is broad". At this level, weights are seldom available, so that purposive selection is necessary, taking into account the relative importance of the item, the possibility of defining and measuring its quality, the expected stability of its characteristics and other similar aspects.

78. Building up index numbers from the elementary series involves imputing variations in the sampled items to other items. If the sample is efficiently selected, most of the non-sampled commodities should be similar in price movement to the sampled commodities; the degree of similarity can be tested and the amount of error introduced by imputation can be measured by making use of the periodic benchmark data. In general, the imputation of the price trends of sampled commodities to other commodities is to be preferred to the imputation of quantity trends, since in most instances the prices of substitutable commodities with similar production processes are more highly correlated than the quantities of these commodities.

(c) Selection of respondents

79. Methods of selecting respondents (establishments, sales outlets, households) will differ from field to field and also from country to country. In some instances - for example, the various producer price indexes - it is expedient to select the respondents before selecting commodities, since the classification of establishments may constitute a valuable first step in the selection of commodities and at the same time facilitate the collection of co-ordinated figures on value, quantity, and price. In some countries the production and sale of certain products are highly concentrated in a relatively small number of establishments, so that coverage of establishments can be nearly exhaustive. Some kinds of goods are sold by a variety of types of sales outlets where the prices may move differently; other kinds of goods are sold only by one type of outlet.

80. In the case of business establishments, a basic condition for making the selection is a list of all establishments or outlets producing and/or selling a given group of commodities. The establishments should be divided into strata by kind of activity, location, and possibly other characteristics such as kind of sales outlet (e.g., small shop or supermarket), and by size, determined by some indicator such as gross output or employment. Within strata, probability sampling would yield a given level of accuracy at minimum cost, if the observations were independent and the cost of collecting all data items were the same. Since

neither of these conditions is normally met, however, some modification of strict probability sampling is usually advantageous. Larger establishments can usually furnish more reliable figures more quickly, so they are likely to be the best source of data for the more frequently compiled indexes. Smaller proportions of smaller establishments can be added to improve representativeness over longer intervals and as resources permit. Provision must also be made for taking into account changes in the mix of producers, such as shifts from smaller to larger firms, and the effect which this has on the average price paid by purchasers. Finally, consideration also must be given to the amount of information that any one respondent is asked to supply, in order to keep the burden on respondents within acceptable limits.

81. The problems arising in selecting household samples are somewhat different. Here, probability sampling is appropriate within strata defined according to geographic location, size of place and socio-economic characteristics.

3. Methods of reporting

82. There are a number of widely differing approaches to the actual collecting of price and quantity data, and the different methods are likely to have both substantially different costs and substantially different validity. The basic different is between methods which employ direct collection in the market by agents of the statistical office, and those that rely upon reporting (sometimes entirely voluntary) by enterprises or by trade associations or other groups. Direct observation is usual for consumer prices, but it is much less generally employed for obtaining data from producers. Where reporting is voluntary, it depends essentially upon the goodwill or self-interest of the reporting units. To keep the results statistically valid, it is necessary to secure the co-operation of at least the major part of the respondents. This, in turn, often necessitates shaping the content of the data collected so that it meets the needs of the respondents being asked to supply it.

C. Problems arising in specific areas

83. The discussion to this point has been concerned mainly with the problems of price and quantity data in the areas where the separation of price and quantity components of value is relatively straightforward. These areas - agriculture, mining, manufacturing and many commodities purchased by consumers - constitute the bulk of traditional index measurement. But extending price and quantity measurement to other sectors leads to new problems. For the most part, the problems arise because output is hard to identify, or because it is difficult to separate out a price and quantity component. Some of these special problems will be discussed in this section.

1. Retail and wholesale trade

84. In the SNA, the gross output of distributive trade is defined as the gross margin, i.e., the difference between the sales value and the purchase cost

of goods sold. Value added is defined as this gross margin minus intermediate consumption, the latter being composed of such items as rent, heat, light and office supplies but excluding the cost of goods sold. The decomposition of the gross output of distributive trade into separate price and quantity components is, in principle, similar to its decomposition for any other activity, but since in this case gross output is expressed in terms of a monetary margin and not in terms of a physical quantity of goods produced it is difficult to find a suitable physical measure of the quantity of services rendered. It is, however, possible to make use of double deflation to solve this problem, deflating sales value and purchase cost separately.

85. In actual practice, the quantity index of the gross output of trade is often computed as a weighted average of the percentage changes in quantities of different goods sold weighted by the gross margins of these different goods in the base year. This method is satisfactory if margins are stable.

86. In a technical sense, this approach has the advantage that it provides constant price estimates and indexes for trade flows that are consistent with those for corresponding aggregates in producers' and purchasers' values. However, it does not provide direct measures of the quantity component of the value of services rendered by trade. The implicit assumption is that the relative trade margins during the base period reflect the amount of trade services involved in the handling of the goods. This assumption often is not valid for individual commodities, since trade margins may vary significantly from product to product for reasons unconnected with the amount of trade services supplied. The method described is, therefore, more acceptable at a somewhat more aggregated level. On the other hand, care should be taken to ensure that important differences in margins that correspond to real differences in the amount of trade services required to handle the goods are taken into account. Stores that deliver, for instance, are performing more service than those that do not. The level of aggregation at which the computations are made will determine the extent to which shifts in sales between goods with different gross margins and between types of shop will appear as quantity or price changes.

2. Transport

87. In the transport industry, the fact that prices are often controlled or regulated simplifies access to the information needed to compile price and quantity indexes. But this advantage is offset by the complexity of transport services, which gives rise to exceptional difficulties in specifying output.

88. The traditional units of measurement of transport performance are the ton-kilometre and the passenger-kilometre. Restricting the measurement to these dimensions, however, omits such characteristics as mode of transport, kind of goods transported, speed, handling of goods, average distance and size of shipment, area and direction, and quality of service. The methodological aspects of this problem have been dealt with above in the discussions of price discrimination and quality differences. The conclusion there drawn was that most of these differences should be regarded as differences in quantities and not in

prices. In practice, however, taking all of these differences into account would require a degree of detail that is likely to raise serious problems, and some simplification is necessary. This limitation has important consequences. Changes in prices and quantities will only be measured adequately if the groups for which the measurements are made do not differ significantly with respect to the characteristics not measured.

89. It was pointed out above that there are some instances in which it is preferable to regard price indexes as the primary information, and others in which quantities are easier to collect directly. In the case of transport, quantity indexes compiled directly in terms of ton-kilometres or passenger-kilometres may, at least for some modes of transport, be easily obtainable. But it will not generally be possible to obtain a sufficiently detailed breakdown to ensure that the groups combined are fully homogeneous, and if there are changes over time in their composition the quantity index will not accurately reflect the volume of transport services rendered. Whether preference is given, therefore, to the direct computation of price or of quantity indexes will vary according to circumstance, between countries, between modes of transport, and from one situation to another.

3. The service industries

90. Problems arising in the service industries are of two types. One, which applies to a broad spectrum of both services sold in the market and those provided by Governments and the non-profit sector, again reflects the difficulty of identifying the unit of output. The second is an additional problem in the case of those services not sold in the market: not only is the quantity of output not readily observable, but even its value is difficult to determine.

91. Services of Governments and non-profit institutions not sold in the market are valued in the national accounts at cost, i.e., the total of intermediate consumption, compensation of employees and consumption of fixed capital spent for these services, and this procedure is usually followed also in the construction of output indexes. Questions can be raised about this procedure both on the ground that it is not symmetrical with the treatment of marketed services (for which operating surplus and indirect taxes are included) and on the ground that cost does not necessarily represent the users' valuation of the services. Despite these objections, however, there does not seem to be any reasonable alternative to the use of cost values.

92. The problem of identification of output is in many ways more difficult. In many fields, services are essentially unique, or at any rate not sufficiently standard so that there is a meaningful unit of output that can be counted. Although there are some service fields, like dry cleaning and hotel rooms, where a good measure of output can be found, there are many others, such as medical care, education and public administration, where there is no obvious unit. In such cases, attempts are usually made to calculate an index with indicators that can be regarded as proxies for movements in the quantity of output.

93. The most frequent solution is to use movements in inputs as a proxy. This, of course, involves the assumption that productivity does not change, an assumption that frequently cannot be defended. The simplest input indicator is number of persons employed. Another indicator sometimes proposed is wages and salaries; this assumes that average wages and average productivity move together, an assumption that is sometimes preferable to assuming zero productivity change; however, it also implicitly assumes that output price does not change, which does make its use for measuring this price change dubious. Sometimes explicit attempts are made to adjust input-type indexes for estimated productivity changes. Various methods are used, and to assume some productivity change is in most cases probably better than to assume none, but at this time there appears to be no sound basis for making the estimates.

94. In some cases, indicators are used that are neither of the input type nor the output type. They may attempt to measure the benefit of a given service, as for instance the number of students achieving a given qualification, or they may show use, as number of hospital bed-days. The crucial question in all these cases is the extent to which the indicator is correlated with what is supposed to be the output of the industry.

95. Whatever indicator is selected, substantial improvements can be achieved by stratification, determining independently the changes in the indicators for each stratum and computing the quantity index for the industry as a weighted average. Health services, for example, could be divided according to place of delivery (hospital, clinic, doctor's office, home), or according to type of service (nursing, laboratory services, physician's services). Instead of assuming that there is no productivity change at all, this implies that there are no changes within the categories distinguished. Productivity changes that are due to changes in the relative proportions of the different categories are taken into account. This is especially important where employment is used as a proxy, since it is only in this way that any allowance can be made for changes in the mix of labour employed.

4. Construction

96. The main source of difficulty in compiling indexes for the construction industry lies in the fact that construction products as a general rule are unique. This basic difficulty is aggravated by the fact that the production process is relatively long, so that at the end of each accounting period the proportion of work in process is high.

97. The variety of methods used by different countries for compiling construction indexes is striking. They may be classified roughly into three types, those based on output, those based on input, and those based on components.

98. The main difficulty in applying indexes of the output type springs from the uniqueness of products in this industry. If really comparable products are selected, there is a danger that the sample will be too small and not sufficiently representative, whereas attempts to increase the size of the sample will make

quality differences more important and begin to distort the results. One of the subvariants of this method involves the selection of a standard building or buildings whose quality characteristics are described in great detail. Then for each consecutive period an estimate is made of the cost or price of the same type of building, using the technology of the base period but current wages, materials costs, etc. The difficulties with this method are once again low representativeness and the assumption of unchanged technology.

99. A more promising development in output-type indexes is the hedonic approach. The basic principles of this method were described above. So far experience with this method is too restricted to evaluate its applicability to the construction industry in detail, but there can be no doubt that it deserves further attention.

100. Inputs into construction activities can be measured much more easily than outputs, and input-based indexes were widely used at one time. There are various variants of this method. The most common practice is to compile total input indexes covering wages, materials, and often also capital consumption. It is difficult to judge to what extent productivity changes distort these indexes, but it is clear that the effect may vary from country to country and from period to period. Most countries that use this method seem to consider the effect of productivity changes to be important, and efforts have been made to reduce their distorting effect by means of various types of adjustment.

101. Measurements based on the components of production occupy an intermediate position between the output-type and input-type indexes. Construction products have a number of components that are not end-products, but are more than simple inputs. It is often possible to specify these components quite exactly, as for instance interior wall panels of a particular type. The quantities and prices of these components may be much more readily measurable than those of the finished product as a whole. The component method has a number of advantages. It is less subject to inadequate coverage and to changes in quality than methods based on output measurement. It is less affected by distortion due to changes in productivity than input-type measures. If no adjustments are made for changes in productivity, the input method is distorted by both intra- and inter-component productivity changes, while the component method is only distorted by intra-component productivity changes.

102. Reviewing the relative advantages and disadvantages of the various possibilities, the hedonic approach and the methods based on components of production are the most promising. Combinations of the various procedures may also be very useful; it is not expedient to try to unify the methods and to apply the same procedure in all parts of the construction industry.

5. Exports and imports

103. Unit value and quantum indexes of imports and exports have been compiled for many years in practically all countries, but not too many countries are in a position to take full advantage of the detail available in customs records. Often it is only aggregations of these records that are used as the primary input for

the compilation of indexes. In such cases, quantities may relate to relatively broad categories, such as the four-digit items of the Standard International Trade Classification. Where this occurs the resulting measures of price are only unit values, at times of insufficiently homogeneous groups of products, the changes in which are affected not only by actual price changes but by changes in the composition of the groups in question. The use of unit values, no matter how carefully computed, raises particular problems for manufactured commodities where the most detailed of customs records may conceal substantial price ranges. Even small changes in the composition of such groups may cause considerable distortion.

104. One way of improving the quality of external trade indexes is to define the elementary categories to which the quantity and unit value data relate so as to increase as far as possible the product homogeneity of these categories. This, however, is not always possible within existing procedures. It is likely, therefore, that radical improvement in the quality of external trade indexes can be achieved only by equally radical changes in methods of handling customs records or perhaps, as is the case in some countries, with the help of additional variables (for example, geographic origin or destination, mode of transport) and by supplementing them with data obtained from special external trade price surveys.

105. The use of data from price surveys in addition to customs records may also have important advantages in obtaining consistency throughout the system of price and quantity statistics. It is desirable that the distinction between the quantity component and the price component in changes in value should be, as far as possible, the same in external trade transactions as in transactions in the same products internally. With methods now generally used, the unit value bias is usually substantially smaller in the latter. However, price surveys are costly, and they may also introduce other kinds of bias in the calculation of trade indexes.

106. Apart from questions of unit value bias, other problems also arise in the compilation of import and export price and quantity indexes. Prices for the same commodity may differ according to the country from which it is imported or to which it is exported. This question was discussed above in the consideration of price discrimination, where it was pointed out that the various requirements of the system of price and quantity statistics are to some extent in conflict. In view of the main functions of the external trade indexes, it seems better to consider that identical goods sold or bought in different markets are, in general, one single product, and consequently that changes in the values caused by shifts from one market to another are price changes and not quantity changes. This does not exclude the possibility, however, that for some special purposes - for example, measuring the quantities of goods available for domestic use - the same kind of changes may be treated as quantity and not price changes.

107. A final consideration on external trade prices relates to exchange rates. Two factors enter into changes in external prices: changes in actual transaction prices, in the currency in which the transaction is made, and changes in exchange rates. Although both clearly are kinds of price change, there are many cases where it is useful to separate them. If the official exchange rates do not coincide with purchasing power ratios of the currencies, some other computed exchange rate may be used, or if such exchange rates cannot be sufficiently well estimated, the best solution is to compile the price index in such a way that the effect of the shifts between the transactions in different currencies is excluded. This can be achieved by compiling separate price indexes for the transactions made in the various currency groups.

V. THE COMPILATION OF INDEXES

A. Types of index formulae

108. In the early history of index number construction, a great deal of effort was expended in the search for a perfect index formula, and a very large number of formulae with different characteristics were devised and analysed. It is now generally recognized, however, that no one index will serve for all purposes. Different indexes, compiled according to different formulae, will be needed in different circumstances. A very large number of formulae are encountered in the literature on index numbers, but most of these are of theoretical interest only. This section will consider only those formulations that are actually fairly widely used by national statistical offices in compiling indexes.

109. The formulae most commonly used in compiling price and quantity indexes are the fixed base-weighted Laspeyres and the moving current-weighted Paasche, and occasionally the cross-weighted Fisher formula. The algebraic definitions of these formulae are set out in the table below. The symbols p and q refer, respectively, to the price and the quantity of individual commodities, and P and Q to price and quantity indexes. The subscripts 0 and 1 refer, respectively, to the base period and the current period. A subscript i should also be shown for the individual commodities 1 through n; these have been omitted in order to simplify the presentation. Two versions have been shown for each formula. Laspeyres price index numbers may be expressed either as aggregated indexes of prices weighted by base period quantities or as arithmetic means of base-period-value weighted price relatives. Paasche price index numbers may be expressed either as aggregated prices weighted by current period quantities or as harmonic means of current-period-value weighted price relatives. Quantity indexes similarly may be viewed in either way. Fisher indexes are simply geometric means of Laspeyres and Paasche indexes. As a general rule, it is the second version of the formulae, with value weights, that is more convenient to use.

Table 2. Alternative index number formulae

Type of formula					
Laspeyres	P^L	=	$\frac{\Sigma(p_1q_0)}{\Sigma(p_0q_0)}$	=	$\frac{\Sigma(p_0q_0(p_1/p_0))}{\Sigma(p_0q_0)}$
	Q^L	=	$\frac{\Sigma(p_0q_1)}{\Sigma(p_0q_0)}$	=	$\frac{\Sigma(p_0q_0(q_1/q_0))}{\Sigma(p_0q_0)}$
Paasche	P^P	=	$\frac{\Sigma(p_1q_1)}{\Sigma(p_0q_1)}$	=	$\frac{\Sigma(p_1q_1)}{\Sigma(p_1q_1(p_0/p_1))}$
	Q^P	=	$\frac{\Sigma(p_1q_1)}{\Sigma(p_1q_0)}$	=	$\frac{\Sigma(p_1q_1)}{\Sigma(p_1q_1(q_0/q_1))}$
Fisher	P^F	=	$(P^LP^P)^{\frac{1}{2}}$	=	$(\frac{\Sigma(p_1q_0)}{\Sigma(p_0q_0)} \cdot \frac{\Sigma(p_1q_1)}{\Sigma(p_0q_1)})^{\frac{1}{2}}$
	Q^F	=	$(Q^LQ^P)^{\frac{1}{2}}$	=	$(\frac{\Sigma(p_0q_1)}{\Sigma(p_0q_0)} \cdot \frac{\Sigma(p_1q_1)}{\Sigma(p_1q_0)})^{\frac{1}{2}}$

110. Laspeyres indexes, in the form given above, depend on fixed, base period weights which in time can become unrepresentative. Alternatively, Laspeyres-type indexes may be evaluated using moving anterior weights with or without chaining. The appropriate formulae, for price indexes, are set out in the table below. Symmetrical indexes can be constructed for quantities. In like manner, Paasche weights may also be used with or without chaining.

Table 3. Laspeyres price indexes

Basis	Comparison of period 1 with period 0	Comparison of period 2 with period 1	Comparison of period 2 with period 0
I. Fixed weights	$\frac{\Sigma(p_1q_0)}{\Sigma(p_0q_0)}$	$\frac{\Sigma(p_2q_0)}{\Sigma(p_1q_0)}$	$\frac{\Sigma(p_2q_0)}{\Sigma(p_0q_0)}$
II. Moving weights, with chaining	$\frac{\Sigma(p_1q_0)}{\Sigma(p_0q_0)}$	$\frac{\Sigma(p_2q_1)}{\Sigma(p_1q_1)}$	$\frac{\Sigma(p_1q_0)}{\Sigma(p_0q_0)} \cdot \frac{\Sigma(p_2q_1)}{\Sigma(p_1q_1)}$
III. Moving weights, without chaining	$\frac{\Sigma(p_1q_0)}{\Sigma(p_0q_0)}$	$\frac{\Sigma(p_2q_1)}{\Sigma(p_1q_1)}$	$\frac{\Sigma(p_2q_0)}{\Sigma(p_0q_0)}$

111. Apart from the question of the time period to which they refer, the choice of weights is ordinarily a relatively simple matter that does not raise special complications. In general, the weights are determined by the phenomena to be measured. For example, to construct gross output quantity or price indexes, gross output values should be used as weights. The weights should, of course, relate to the entire class for which a particular observation is standing as proxy, not just to the item specified.

112. A question will sometimes arise as to whether the weights should include imputed values. For example, should the weights of an agricultural production quantity or price index include the imputed values of home-consumed produce? The answer to this question must depend upon the purpose for which the index is to be used. In an agricultural output quantity index, where by definition non-marketed output is included, the weights should also include these non-marketed values. In a quantity index of sales of agricultural products, on the other hand, the weights should be restricted to products actually sold. In a price index intended for deflation of agricultural output, imputed values should be included in the weights, since they are included in the current value figures that are to be deflated. On the other hand, a price index intended for the analysis of market conditions would be better without the imputed values in the weights. The essential criterion is to match the content of the weights to the content of the value figures being deflated.

B. Characteristics of the formulae

113. The characteristics of different index formulae are discussed at great length in the literature on index numbers; nevertheless, it seems expedient to examine here those aspects that have some relevance in determining the formulae and weighting systems in actual use.

1. Characteristicity of the weights

114. Weights should be characteristic of the periods being compared. Fixed weight indexes tend to become obsolete as the period for which the same weights are used lengthens. Moreover, where fixed weight indexes are used to make comparisons between periods neither of which is the base period, the weights may be uncharacteristic of either of the periods being compared. As will be pointed out below, there are some important advantages in keeping the weights constant over some period of time. Nevertheless, in order to avoid a substantial obsolescence the weight base must be revised periodically.

2. Bias

115. The concept of bias implies divergence from some expected value. In periods of rising prices, a Laspeyres price index will usually be higher than a Paasche price index, and this is sometimes expressed as an upward bias in the Laspeyres index and a downward bias in the Paasche index. The difference between the Laspeyres and Paasche formulae is in general greater the more remote the two periods compared are from each other, since as the time lengthens the differences in quantity and price structures may be expected to increase.

116. There is no general rule as to whether using moving-average chained indexes will reduce this difference. If the structural changes are smoothly continuous in one direction, the difference between Laspeyres and Paasche chained indexes will be smaller than the difference between the directly compiled Laspeyres and Paasche indexes. However, in many areas (e.g. fruit, vegetables) the effect of fluctuations is greater than that of continuous trends, and in these cases the moving-weighted chained indexes will show a larger difference than the directly compiled indexes.

117. The difference between the Laspeyres and Paasche indexes depends upon the dispersion of the price relatives, the dispersion of the quantity relatives and the correlation between movements in individual prices and the corresponding quantities. The absence of dispersion between individual relatives is unlikely, but it is often moderate, especially in centrally planned economies where many prices are controlled. Where, as economic theory would lead us to expect, there is a negative correlation between changes in relative prices and changes in relative quantities, a Laspeyres index will show a larger change than a Paasche index.

118. It cannot be assumed that the difference between the Laspeyres and Paasche indexes will be negligible. Special attention should be paid to the magnitude of the difference in the cases of consumer price indexes (where price and quantity changes are strongly inversely correlated), to certain agricultural products (where dispersion of quantity changes may be considerable), and to periods when structural changes in the economy are important.

3. Circularity

119. The circularity or transitivity test requires consistency between the indexes for a succession of periods. For example, for three successive periods, the index

for the change from the first to the second multiplied by the index for the change from the second to the third must equal the index for the change from the first to the third. Very great importance is, in general, attached to this requirement, and failure to meet it will considerably reduce the usefulness of an index.

120. Whether or not a system of index numbers is circular depends primarily upon whether the weights are fixed or moving, and whether the indexes for non-adjacent periods are compiled directly or chained. Fixed-weight indexes (i.e., Laspeyres) always satisfy the circularity test, as do chained indexes. But moving-weight indexes without chaining do not.

4. Internal (structural) consistency

121. Although this requirement is often overlooked, there are some purposes for which its importance is overriding. In terms of constant price aggregates, consistency means that the parts should add up to the totals. Self-evident though this requirement seems, some of the methods in practice do not meet it. In terms of index numbers, a necessary but not sufficient requirement for consistency may be phrased in terms of the average test: an index of an ensemble must not be higher than the highest or lower than the lowest sub-index. Any index with moving weights will fail to meet the internal consistency test. So, also, will the Fisher formula, since additivity is inconsistent with geometric averaging.

122. Where interest is only in over-all indexes, without any breakdown, the fact that the method applied does not meet the consistency requirement may be of little importance. But where the analysis of changes in structure is important, as for instance where continuous percentage distributions are published, the violation of the consistency requirement may be very troublesome. In particular, additivity is an essential requirement in the calculation of constant price national accounts aggregates.

123. It should be noted that there is an inherent conflict between the requirements of characteristicity, circularity and internal consistency; each set of indexes can satisfy only two of these three requirements. For circularity, fixed weights are best, but these lead to difficulty with characteristicity. Circularity can be obtained with moving weights without losing characteristicity by chaining, but in this case the internal consistency requirement is not met. Finally, indexes can be constructed which are characteristic and at the same time internally consistent, but in this case circularity must be abandoned.

5. Factor relations

124. This test (often called the factor reversal test) requires that the product of quantity and price indexes be equal to the ratio of values in current prices. Of the indexes discussed here, only the Fisher type meets this condition. Neither the Laspeyres nor the Paasche index, by itself, will do so.

125. If the quantity index is a fixed-weight Laspeyres index, it must be combined with a Paasche price index to meet the factor relations test. This is shown in the following formula:

Ratio of values		Laspeyres quantity index		Paasche price index
$\frac{\Sigma p_1 q_2}{\Sigma p_0 q_0}$	=	$\frac{\Sigma p_0 q_1}{\Sigma p_0 q_0}$	.	$\frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}$

Thus, to obtain constant-price national accounting aggregates of Laspeyres form, the deflators used in deriving them from current price value figures must be of Paasche form. This will result in price and quantity estimates that meet the factor reversal test for all comparisons involving the base period. For comparisons that do not include the base period, the factor reversal test still will not be met. A chained Laspeyres quantity index combined with a chained Paasche price index, however, will always meet the factor relations test.

6. Simplicity of computation and interpretation

126. An additional property worth mentioning is simplicity. Ease of interpretation for the users and ease of computation for the producers are not irrelevant, although in some cases they may be of secondary importance. The Laspeyres and Paasche form formulae are relatively easy to interpret, while the economic content of cross-weighted formulae and of chained indexes is less readily apparent. At the same time, cross-weighted, chained, and moving-weight indexes are more costly, since they require the determination of new weights for every period.

C. The choice of index formulae and weighting methods

127. Since no one index formula can satisfy all the requirements of characteristicity, bias, circularity, internal consistency, factor relations and simplicity, different formulae and weighting systems will be needed for different purposes and in different circumstances. Still, it is desirable that differences that give rise to inconsistencies in the system of price and quantity indexes should be avoided unless there are good reasons for them.

128. Indexes compiled for purposes other than national accounting, to meet the short-term kinds of needs outlined in chapter II, are usually, for practical reasons, of the Laspeyres type, since moving weights are not feasible over short intervals. Since characteristicity is of great importance for these uses, however, increasing attention is being given to the advantages of chained indexes, with weights changed as often as is feasible. There is an inevitable conflict between short-term analysis requiring up-to-date weights and longer-run analysis requiring additivity. If resources permit, one possible solution is the provision of two indexes, one with changing weights for short-period comparisons and one with fixed weights for comparisons over longer periods of years.

129. For national accounting purposes, the need is to express changes in aggregates over a period of years in constant and current prices, so that the quantity indexes and deflated aggregates must meet additivity and circularity requirements, and the corresponding price indexes must meet the factor reversal test. For a comparison of only two years, these requirements would be met by fixed-weight Laspeyres quantity indexes and the associated Paasche price indexes. It would be possible to move from Laspeyres to Paasche price indexes by a detailed reweighting of the basic price data if the necessary weights were available. As a general rule, detailed weights are available only for benchmark years, however. Furthermore, problems would still arise in comparisons of periods not including the Laspeyres base period. A compromise solution is, therefore, necessary. Laspeyres price indexes are used to deflate current values at the most detailed level available. The deflated elements are then added together, thus effectively using Paasche-type weights at an intermediate level. An implicit deflator is then obtained by dividing the current price value by the deflated value. Thus both the price and the quantity indexes obtained are of a hybrid nature, but they satisfy all of the required conditions. They are additive and circular, and they meet the factor reversal test.

130. Marked differences between Laspeyres and Paasche indexes, or between Laspeyres indexes and implicit deflators, point to the need for shifting the weight base of the Laspeyres index to a later year. The frequency with which the base should be changed depends somewhat upon how fast structural changes are occurring. Complete reweighting requires benchmark data, for which a five-year interval was recommended above. At shorter intervals, a number of countries apply an intermediate solution, reweighting the indexes at some intermediate level of classification. Care should be taken, of course, not to select a weight base period marked by unusual economic conditions.

VI. DISSEMINATION OF PRICE AND QUANTITY INFORMATION

131. The discussion to this point has been mainly concerned with the design of a programme of data collection and storage, and with methods of compiling the data into indexes. There has been little consideration of priorities, and none of publication. It is the purpose of this chapter to draw a distinction between collection activities and a publication programme and to suggest priorities for each.

132. In the collection of data, it is important that the organization of the data base be such as to provide a place for all price and quantity data for which a need is anticipated. To serve this purpose, the framework for the data base must be formally complete, and it must accommodate data at the level of detail or disaggregation at which it is collected, as well as at various levels of aggregation. It must illuminate the interconnexion among the various parts of the data and the various types of index.

A. The framework of the data base

133. A general explanation of the structure of such a framework was given in chapter III above. It is now possible, in view of the further discussion of data

collection and index compilation in chapters IV and V, to set out the formal structure in tabular form; this is done in table 4. It must be emphasized that this is neither a proposed programme for data collection nor a proposed publication programme. It is a presentation of the structure of the data system. What part of it countries will find it possible or useful to implement will depend upon their individual circumstances.

134. Table 4, like table 1 above, is divided into two major sections, dealing respectively with the origin of gross output and its disposition. Part I is further divided into a section based on commodity-type classifications and a section based on activity-type classifications. Within each of these classifications, provision is made for both market price and approximate basic value valuations. The classification by activity includes places for purchased inputs (intermediate consumption), gross output and value added. Where appropriate, provision is made for different types of indexes for different purposes - i.e., Laspeyres price indexes for monitoring, implicit deflators for deflation. The system includes price indexes, quantity indexes and deflated national product components, as well as the basic data used in compiling them.

135. Part II of table 4 is subdivided by final use of gross domestic product, into consumption, government and non-profit services, capital formation, and exports and imports. Again, provision is made for inclusion of various types of index and various valuation bases.

136. For both parts of the structure, table 4 suggests appropriate classification systems, and indicates the levels of disaggregation at which subtotals might be appropriate. Given the basic framework of the system, indexes and deflated values at higher levels of aggregation may be built up easily from the elementary components at the most disaggregated level.

137. As noted in chapter II, the system does not include indexes for factor costs or returns, or other components of income. Further work is required before this breakdown can be added.

B. Content of the publication programme

138. A programme of dissemination of price and quantity statistics should include more than printed publications. At the most detailed level, it is not necessary to publish all of the input and output indexes for all commodity and activity classes, or all of the detailed import and export categories. While such micro-components are necessary ingredients in the compilation of more aggregative indexes, in most cases, very few users wish to have all of the very detailed results. Selected indexes at the most basic level are needed for monitoring purposes, and their publication will evoke widespread interest. But the number of indexes needed for this purpose is limited: general users do not want and cannot assimilate large volumes of data. On the other hand, individual users will want a large variety of specific detailed indexes. To meet this need, channels must be established to allow access by individual users to the detail in the data base, within the limits of any restrictions that may be imposed by confidentiality requirements.

Table 4. A framework for the collection and storage of price and quantity data

	Classification system, levels, subtotals	Valuation base	Basic data	Types of index	
				Prices	Quantities
Part I. Product originating					
A. Commodities and other goods and services	ICGS classes or ISIC groups	Market prices and approximate basic values	Current price values; producers' prices; purchasers' prices; in some cases physical quantities. All basic data to he identified by commodity and producing industry, and purchasing industry where possible; benchmark weights	Laspeyres fixed and chained	Laspeyres fixed
B. Activities 1. Purchased inputs (intermediate consumption) 2. Gross output 3. Value added	ISIC groups (for trade, ICGS classes); subtotals for major groups, divisions, and major divisions; total GDP	Market prices and approximate basic values	As above	Laspeyres indexes, implicit deflators	Laspeyres indexes, deflated national product components
Part II. Final use of product					
A. Consumption of households	SNA categories, and possibly income groups; subtotals by level and durability; total consumption	Market prices	Current price values; market prices; benchmark weights	Laspeyres indexes; implicit deflators	Deflated national product components
B. Government and non-profit institution consumption	SNA categories; subtotals by level; total government and total non-profit	Market prices (cost in most cases)	Current price values; physical output indicators; some purchasers' prices	Implicit deflators	Deflated national product components
C. Gross fixed capital formation	SNA classifieations of asset types; ISIC group for purchasing industry; subtotals by asset type and purchasing industry; total gross capital formation	Market prices	Current price values; purchasers' prices. Basic data should identify asset type and purchasing industry; benchmark weights	Laspeyres indexes; implicit deflators	Deflated national product components
D. Change in stocks	SNA categories cross-classified by industry in which held	Market prices	Current price values; prices from part I, section A	Implicit deflators	Deflated national product components
E. Exports and imports	ICGS classes; subtotals by ISIC and SITC levels	Exports f.o.b.; imports c.i.f. and c.i.f. plus import duties	Current price values; prices; units	Laspeyres indexes; possibly unit values	Laspeyres; deflated national product components
F. Total GDP by final use		Market		Implicit deflator	Deflated national accounts total

139. The choice of indexes for publication and the decision on the frequency with which they are published must reflect a balance between the interest of users and the resources available. In detail and at the margin, this will vary from country to country. There are, however, some common elements of a publication programme that nearly all countries will find desirable. On the output, or product originating, side, first priority should undoubtedly be given to indexes of producers' prices (replacing the traditional wholesale price index). The industries for which indexes should be published should be those important to the country; in most cases they might be expected to include agriculture, industry (including manufacturing, mining, electricity and gas), construction, transport, trade and services. Primary interest, from the point of view of publication, is likely to attach to the indexes of gross output. In addition to price indexes, there is also much interest in quantity indexes in certain of these areas, notably agriculture and industry. For the distributive trades, there is interest in turnover as well as in margins. For gross domestic product as a whole, what is needed is of course value added, and interest will attach primarily to deflator-type price indexes and to constant-price estimates of the components of gross domestic product originating by industry.

140. In terms of the uses of gross domestic product, first priority will go to the consumer price index. To the extent that resources are available, variants of this index applicable to specific socio-economic groups or to specific regions will also be of interest, as will its components by type of commodity. Great interest will also attach to price and quantity indexes for imports and exports. For all of the final uses of gross domestic product, deflator-type price indexes and estimates of the components of the final uses of gross domestic product in constant prices will be needed.

141. Table 5 sets out such a publication programme in tabular form. It suggests appropriate frequencies of publication and appropriate classifications and levels of detail. The table does not contain priorities, but the whole table is, in a sense, a list of priority concerns. Nevertheless, it should be emphasized that the system as a whole is an integrated structure. Valid indexes at the aggregative levels suggested for publication cannot be derived without the underpinning of collection of data on a much more detailed level. To obtain the greatest benefit from the effort put into data collection, attention must be devoted to uses beyond the compilation of the indexes that are published. Methods of storing and retrieving the basic data must be devised that will lend the greatest possible flexibility to its use.

Table 5. A proposed publication programme for price and quantity indexes

	Price			Quantity		
	Type of index	Classifications	Frequency	Type of index	Classifications	Frequency
I. Key commodities						
Selected commodities	Laspeyres	Selected ICGS subclasses	M	Laspeyres	Selected ICGS subclasses	M
II. Gross output						
A. Agriculture	Laspeyres	ISIC major groups	M	Laspeyres	ISIC major groups	A
B. Industry	Laspeyres	ISIC groups	M	Laspeyres	ISIC groups	M
1. Manufacturing 2. Mining 3. Electricity, water, gas Total						
C. Construction	Laspeyres	ISIC major groups	M	Laspeyres	ISIC major groups	M
D. Transport	Laspeyres	ISIC groups	A			
E. Trade	Laspeyres	ISIC major groups	A	Laspeyres	Turnover, by ICGS classes, type of outlet	M
F. Services	Laspeyres	ISIC major groups	A			
III. Gross domestic product originating (value added)						
A. Agriculture	Implicit deflator	ISIC major groups	Q	Deflated value	ISIC major groups	Q
B. Industry	Implicit deflator	ISIC major groups	Q	Deflated value	ISIC major groups	Q
C. Construction	Implicit deflator	ISIC major division	Q	Deflated value	ISIC major division	Q
D. Transport	Implicit deflator	ISIC major groups	Q	Deflated value	ISIC major groups	Q
E. Trade	Implicit deflator	ISIC divisions	Q	Deflated value	ISIC divisions	Q
F. Services	Implicit deflator	ISIC major groups	Q	Deflated value	ISIC major groups	Q
Total GDP originating	Implicit deflator		Q	Deflated value		Q
IV. Final uses of gross domestic product						
A. Household consumption	Laspeyres; also implicit deflator	SNA categories; possibly socio-economic groups	M Q	Deflated value; also Laspeyres	SNA categories	Q
B. Government consumption	Implicit deflator	SNA purposes	Q	Deflated value	SNA categories	Q
C. Non-profit consumption	Implicit deflator	SNA categories	Q	Deflated value	SNA categories	Q
D. Gross fixed capital formation	Implicit deflator	SNA categories	Q	Deflated value	SNA categories	Q
E. Change in stocks	Implicit deflator	SNA categories	Q	Deflated value	SNA categories	Q
F. Exports and imports	Laspeyres; also implicit deflator	ICGS; also SNA categories	Q Q	Deflated value	SNA categories	Q
Total final uses of GDP	Implicit deflator		Q	Deflated value		Q

A = annual; M = monthly; Q = quarterly.