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STRATEGIES FOR PRICE AND QUANTITY MEASUREMENT IN EXTERNAL TRADE

A technical report

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NOTE

Symbols of United Nations documents are composed of capital letters combined with figures. Mention of such a symbol indicates a reference to a United Nations document.

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PREFACE

The present publication is part of a continuing effort by the United Nations Statistical Office to develop comprehensive recommendations for national work on price and quantity statistics. It stems from the discussion of price and quantity comparisons in A System of National Accounts (SNA) and from the elaboration of that discussion which will be found in Guidelines on Principles of a System of Price and Quantity Statistics. 1/ It is directly related to the series of manuals now being prepared on the practical aspects of collecting and compiling price and quantity statistics within the framework of these guide-lines.

The basic purpose of the present report is to examine and assess alternative strategies for the measurement of price and quantity in external trade. Given the special institutional arrangements under which such work is normally carried out, this is regarded as a necessary preliminary to the detailed discussion of methods. The main content of the report is made up of a review of the character of alternative approaches to measurement, an assessment of their advantages and disadvantages in terms of the statistical problems normally encountered and a prescription on how an overall strategy might be formulated and developed in the light of these considerations and the resources available. The report is intended as a self-contained discussion of the alternatives and, as a consequence, overlaps at a number of points the more general discussion of price and quantity measurement in the publications mentioned above. Appropriate references are, however, given to guide the reader in each case.

Problems in this area arise not only from the existence of independent administrative arrangements for the collection of external trade data but also from the special character of the transactions flows involved. In this context, the balance of advantage between alternative strategies is seldom clear and a diversity of views on the subject persists at the national level. In the present report, a major effort is made to identify areas where a consensus exists on the statistical merits of alternative procedures and to assess the feasibility of the alternatives in the light of the costs involved.

The manual which is planned as a supplement will provide detailed practical guidance on the development and implementation of the two main approaches to measurement. In contrast with the present document, it will look at the separate development and refinement of each of these approaches leaving aside the issues relating to the adoption and application of a specific strategy. Together, the two publications should be of direct assistance both to those countries considering the initiation of work on price and quantity indexes and to those which are planning the systematic development and improvement of their existing work.

The present report has been prepared by the United Nations Statistical Office with the help of Mr. Jacob Ryten, formerly of Statistics Canada, acting as

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1/ United Nations publications, Sales Nos. E.69.XVII.3 and E.77.XVII.9, respectively.

consultant to the Organization. It has been distributed in draft form for comments to the regional commissions, interested international organizations and a number of national statistical services. Thanks are due for the contributions received from these sources and, in particular, to the Governments and agencies which supplied special information on their work in this area. Responsibility for the report as a whole rests with the United Nations Statistical Office.

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INTRODUCTION

1. According to recent statistics, the total value of international transactions in goods and services corresponds to close to one half of the aggregate economic activity as measured by the gross product and the value of international transactions in goods alone to about 80 per cent of the goods and services total. 1/ The discussion in the present report centres on the decomposition into prices and quantities of transactions in goods only. It takes place within the conceptual framework provided by (a) A System of National Accounts, (b) Guidelines on Principles of a System of Price and Quantity Statistics and (c) International Trade Statistics: Concepts and Definitions. 2/

2. Because comparatively little has been published nationally and internationally on the sources and limitations of external trade statistics, the discussion of these subjects is longer than would otherwise have been appropriate, It is included as a backdrop to the major issues addressed in the chapters that follow. Broadly, these issues are: the identification of the uses of index numbers of price and quantity in external trade; the theoretical and practical problems that occur in the construction of such index numbers; the net balance of advantages for each course of action open to statistical agencies in the light of theoretical, operational and budgetary considerations; and some guidelines on preferred options, albeit qualified by the recognition that index numbers of price and quantity may exist already and may not be amenable to sudden or radical change. 3/

3. Several papers submitted at earlier dates to United Nations working parties and conferences were extensively used in the discussion that follows. A general acknowledgement is made here particularly of the material in document CES/AC.45/2 submitted to the Meeting on Price Measurement in External Trade, Conference of European Statisticians, Geneva, 1975; "A system of quantity and price statistics", ST/ESA/Stat.73, United Nations, New York, 1975; and "International trade statistics: a review of concepts and definitions, report of the Secretary-General", E/CN.3/506, United Nations, New York, 1978.

1/ The first ratio was measured for 60 countries from data in the United Nations Yearbook of National Accounts Statistics, 1977 (United Nations publication, Sales No. E.78.XVII.2) and the second ratio was measured for 32 countries from data from the same source.

2/ Studies in Methods, Series F, No. 2, Rev.3 (United Nations publication, Sales No. E.69.XVII.3). Subsequently referred to as SNA.

Statistical Papers, Series M, No. 59 (United Nations publication, Sales No. E.77.XVII.9). Subsequently referred to as Guidelines.

Statistical Papers, Series M, No. 52 (United Nations publication, Sales No. E.70.XVII.16). Subsequently referred to as ITSCD. A revised version is being prepared and is expected to be published in 1981.

3/ See the annex to the present report for an overview of the number of countries compiling such index numbers and of the diversity of methods of calculation employed.

4. The present report is primarily a text on descriptive statistics in that it discusses and recommends ways to collect and summarize certain kinds of data. It is in no way designed to advise users on what inferences should be drawn from price data in external trade nor how such inferences can be drawn. But the opportunity provided by the review of data sources and methods is used to describe some of the circumstances in which external trade takes place and how these circumstances affect measures of price. In the report, there are no new departures from traditional means of constructing index numbers of price and quantity in external trade, but a new look is taken at the traditional opposition between alternative sources of data. It is assumed that there are several and not always compatible demands on statistical agencies to produce measures of price change in external trade for entirely different purposes. One such demand requires price measures to be integrated with other index numbers of price and quantity within a standard accounting framework. Other demands effectively run against efforts to integrate and it is not always clear how the different pressures should be ranked. 4/

5. In planning national strategies for the measurement of price change in external trade, it should be borne in mind that the basic record and structure of imports are generally quite different from the record and structure of exports. Exports and imports differ with respect to their commodity make-up, geographic distribution of trading partners, incidence of error, detail of record, interest on the part of users and, at times, even commodity classification. Accordingly, the operations that lead to the factoring of export and import flows need not be the result of a single strategy, except in those cases where the differences noted above are of little consequence to statistical measurement. The desire to achieve symmetry in the design of statistical operations should not play a dominant role. It should be realized that the objective is to produce, subject to the usual budgetary constraints, the "best" measures possible for both kinds of flow and, given that one of the important uses is to place them within the same accounting framework, for the results to be consistent and integrable.

6. It is also relevant to note that while external trade statistics have been collected in many countries for more than a century, studies of their shortcomings by statistical agencies are still very few. The present report attempts to provide guidance for statistical agencies in the selection of areas where more empirical research and more publication of the results thereof are necessary if the caveats that apply to the index numbers of prices and quantity in external trade are to become more meaningful and widely known.

7. The statistician in this area should also keep in mind the value of co-operating with national statistical agencies in partner trading countries, either directly or through the statistical services of the international organizations. In few other statistical domains can international co-operation be as fruitful, particularly as it is beyond the resources of any one country to marshal all the evidence for the precise determination of the weaknesses of its raw data. But with the assistance of trading partners, relying both directly and indirectly on the evidence that they have assembled, statistical agencies will find that improvements in the quality of their price and quantity data in external trade can be achieved more readily.

8. Because the change over time measured in terms of current value is in itself

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4/ This point is elaborated in paras. 10-12 below.

not very telling, the United Nations System of National Accounts (SNA) comprises measures of price and quantity for most of its real flows. Many applications of, and questions addressed to, national-accounts data require a decomposition of measures of value into price and quantity. Conversely, information on how price and quantity have changed is improved if partial measures are related to current flows and integrated within the standard national accounting framework. Such integration can be carried back to the methods of collection and classification of the raw data.

9. The decomposition of external trade flows into prices and quantities within the national accounting framework is required for general macro-economic forecasting and model-building as well as for analyses of the balance of payments. The merchandise-trade component of the current account is by far its dominant element in most countries and forecasting it is usually carried out in real terms.

10. At all times, but particularly when price change accelerates or relative prices show substantial shifts, public attention concentrates on the measures of price change and on the factors that transform prices at the factory gate into prices at the retail counter. However, it is not easy to trace through, stage by stage, the impact of the change in the price of an imported commodity on domestic industry and retail prices. In most countries, there is less than complete compatibility between the coverage, methods, classification and adjustments of price index numbers in external trade and domestic indexes. And yet, these indexes must be related if the mechanism of transmission of inflation across national boundaries and the way in which domestic prices are set are to be properly understood.

11. The requirement to have price indexes available at a relatively fine level of commodity detail is not confined to imports. A similar requirement, albeit motivated by different factors, exists for exports. In particular, Governments as well as the business community show considerable interest in monitoring the performance of their country vis-à-vis its commercial competitors in markets abroad. While changes in a country's competitive position may be gauged from an analysis of its market shares, one of the key explanatory variables of the change in such shares is the measure of the prices of the exporting country vis-à-vis those of its competitors. For this reason, it is necessary to have available (in terms of a common currency) both measures of price for the commodities exported and matching detail from the statistics of major competitors. This presupposes the existence of an internationally agreed commodity classification, a requirement which is met by and large by the Standard International Trade Classification (SITC). It also presupposes the possibility of tracing back to industry selling-prices and costs any change in the price of exported commodities.

12. The conceptual framework within which prices are measured and price indexes constructed is not necessarily the same for all purposes for which the index numbers are used. For example, the decisions of tariff policy require some measure of the elasticity of demand for imports. For the determination of the elasticity, the relevant prices should include both the transport margins all the way to the importer's gate and the protective duties applicable to the commodities under study. Studies that serve tariff-policy discussions also require the availability of highly disaggregated prices to a point that could go well beyond the most detailed level of a purely statistical commodity classification.

13. These examples show that there is a demand that exceeds in its requirement for detail what is strictly necessary for the purposes of integration into a standard national accounting framework and that the balancing of requirements in relation to those of the national accounting system can only be undertaken by national statistical agencies. By and large, however, it would appear that the basic requirements for micro-economic as well as macro-economic analysis can be most successfully met by developing the information on prices and quantities as an integral and co-ordinated part of the national accounting system. 5/

5/ The over-all relationship with the national accounting system is developed in Guidelines, op. cit.

I. SOURCES OF DATA

1.1 Differences in the statistical treatment of exports and imports are imposed by legal, administrative and organizational arrangements as well as by definitional and structural factors. The requirements of users also contribute to the application of different measurement techniques. This is particularly evident when the data are subject to the kind of analysis required to factor them into price and quantity components. The present chapter examines the character of the flows and reviews the nature of the available data in each case.

A. General character of export and import data

1.2 In the majority of countries, the flows of goods that enter and leave are recorded at the point of entry or exit by the Customs administration. There are instances, typically in the centrally planned economies, in which other records are kept. The importing and exporting enterprises keep such records and provide the Government's central administration with the corresponding statistical returns. In a large number of cases, countries place the administrative and regulatory accent of their Customs work on imported goods. It is upon these goods that protective duties are imposed; in addition, they may be subject to health, agricultural and consumer-protection controls. But there are important exceptions to this norm. Some countries impose strict standards on outgoing merchandise so that the esteem in which their exports is held abroad is not jeopardized by inferior quality or workmanship. Other countries impose strict controls on outward flows of merchandise for reasons of national security. Accordingly, the statement that imports are scrutinized more methodically and in greater detail than exports should be taken as an approximation, albeit one that is sufficiently accurate to reflect the practice in most developed market economies.

1.3 As a result of the greater scrutiny of imports, the descriptions of imported merchandise tend to be more specific than the corresponding descriptions of exported merchandise. Furthermore, the amount of supporting evidence that is normally attached to an import declaration outweighs by far what is required to accept an export declaration. And in many countries, the commodity classification in use is either expanded for the purpose of applying customs duties to imported merchandise or else supplemented by a separate commodity classification conceived specifically for this purpose. The finer the information provided by either commodity classification, the greater the potential for statistical work, particularly work of the kind discussed in the present report.

1.4 The commodity structures of import and export flows also tend to have little in common. For many countries, exports are concentrated in a few of the classification categories whereas imports span virtually the entire commodity spectrum. In many countries importers as a group do not constitute a very stable population nor one which is particularly well defined in terms of industrial activity. But this is not so with exporters. The capacity to export goods requires much more know-how and, as a result, exports tend to be concentrated in the hands of a far smaller number of enterprises.

1.5 There is evidence to suggest that the incidence of statistical error, if it were possible to measure it with any rigour, is not the same for exports and imports. For example, very often the commodity coding of exports is deficient either because there is not enough descriptive information to justify the code or because the code is not sufficiently scrutinized by those responsible for the coding operation. The probability of "non-response" is greater with exports than with imports and the measures of value and quantity attached to an export declaration tend to be more suspect than those attached to an import declaration.

B. Custom documents as a source of data

1.6 Data on external trade are among the oldest and largest collections of economic statistics. Some 150 countries and territories reported to the United Nations on their external trade by partner country and by commodity in 1976, making it also one of the more universal kinds of statistics. A very large proportion of these data are derived directly from administrative records kept by Customs. When an exporter is asked to send merchandise across national boundaries or an importer decides to have merchandise from abroad sent to him, the ensuing transaction is recorded in declarations filed with the Customs administrations of the countries whose borders are crossed. Normally, such declarations require a description of the principal characteristics of the merchandise, the value of the transaction, the number of units involved and other appropriate measures of its physical dimensions. Finally, the declaration contains a name or an identification of the country of origin or destination or of consignment. Other kinds of information may be requested because of additional administrative and regulatory functions carried out by Customs.

1.7 The declarations filed with Customs may not be available to the statistical agency, unless the latter, at least for purposes of compiling external trade statistics, is part of Customs. Normally, the declarations are filed with Customs and protected from disclosure by statute. But practice on access to these declarations varies. In some countries, access by the statistical agency takes place on a selective basis; in others, particularly where the statistical agency forms part of Customs, access may be unrestricted. There are countries where access is only granted to a primary statistical compilation carried out under the responsibility of Customs. The nature and extent of access are of considerable importance because the cost of constructing related index numbers of price and quantity and the quality of these index numbers depend on it in a direct way.

1.8 The commodity descriptions and codes requested on each declaration are the subject of international standards and classifications. Today, these standards are in almost universal use. The statistical classification that has come to be accepted for international reporting purposes by most countries with market economies is the Standard International Trade Classification (SITC), now in its third version. The counterpart classification used by the centrally planned economies that form the Council of Mutual Economic Assistance (CMEA) is the Standard Foreign Trade Classification (SFTC), which has approximate convertibility to SITC. Some country groupings have agreed on more detailed systems of classification because it suited the special nature of their trade. For example, the European Economic Community (EEC) reports on its trade on the basis of a very detailed classification (NIMEXE) which is entirely convertible into SITC. In the case of imports, over 100 countries have adopted the Customs Co-operation

Council Nomenclature (CCCN) as an internationally-agreed tariff nomenclature. Some of these countries have expanded CCCN into classifications of finer detail to take account of local conditions and particular national aspects of tariff policy. The NIMEXE is one example of CCCN expansion. Unfortunately there are few documented cases of export classifications that match the detail of some national commodity-tariff systems. And while the universality of systems such as SITC makes it possible to match flows of trade between countries as reported by each, the fact that exports seldom exist classified in the same detail as imports is one of the elements that makes such matching difficult. These considerations play a role in the discussion of alternative sources of information for the construction of index numbers of price and quantity. 6/

1.9 The commodity classification is only one, albeit the most complex, of the classifications involved in the full description of an external trade transaction. It is almost as important to classify the transaction by country of origin or destination. But after almost half a century of international attempts at systematizing and standardizing definitions, there is still some confusion about which partner country should be described as "the partner". Some countries classify as such the country of consignment; others do so for the country of purchase (or sale); and others yet select the country of production (or consumption). 7/

1.10 There are several countries, particularly countries with a federal structure of government and countries which pursue intensive policies of regional development that include in the description of the transaction the region or locality from which the export originated or to which the import is presumed to be destined for ultimate consumption. Where this is done, the physical route of a transaction is completely described. In conjunction with the counterpart identification in the partner country, these features can play an important part in the estimation of transport margins.

1.11 In addition to these classifications, the Customs declaration normally includes an identification of the importer or the exporter. Such an identification can be matched with a register of importers and exporters in which their essential characteristics, such as location, principal activity and size pattern of imports are recorded. A link with a register of this kind can play a crucial role in the construction of price and quantity index numbers. At several stages in the present report, the discussion will come back to the existence of registers and to the possibility of using them as frames for direct-price surveys.

1.12 Even if there is no register of importers or exporters as such, there may be a more broadly based register of businesses from which those that engage in external trade operations may be identified. Once identified, the possibility of linking them with the external trade record should not be forgone. One of the considerations to bear in mind at all times is that such a link is the most

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6/ For the structure of SITC and CCCN see Standard International Trade Classification, Revision 2, Statistical Papers, Series M, No. 34/Rev.2 (United Nations publication, Sales No. 75.XVII.6).

7/ The problems of partner-country definition and country classification are discussed in ITSCD, op. cit.

convenient way to trace the changes in external trade prices to the industrial activities of origin or destination. Without such a link, there is no convincing way in which to answer detailed questions on price formation or on the transmission of inflation.

1.13 Because of the obvious affinity in commercial interests and regulatory objectives between trade and transport, many countries record the mode of transport employed for each particular transaction. Although this is not as critical in the definition of a transaction as the classifications described above, it is of some consequence particularly for the subsequent matching of Customs documents with accompanying transport documents. The purpose of such a match is to estimate more precisely the transport margins for each country-commodity combination. The classification into mode of transport normally distinguishes between air, inland waterways, ocean, road, rail, pipeline and others. There is, as yet, no established international standard for the classification.

1.14 The Customs source normally records all transactions in goods flowing across national boundaries. 8/ Some countries, however, have realized that in the case of transactions of very low value, the effort to record them outweighs the usefulness of the information for statistical purposes or for the purposes of Customs administration. Other countries have realized that certain kinds of high value, small-volume goods, such as diamonds, escape the surveillance of Customs to such an extent that their formal inclusion in the statistics may be misleading. There are countries that exclude from normal recording a variety of special transactions, in particular those that if disclosed might affect adversely the interests of national security. Examples are shipments of arms and ammunition and transactions in radioactive materials. There are also countries that exclude transactions involving ships or oil-drilling platforms largely because the conventional definitions of country of origin and country of destination tend to break down when applied to such transactions.

1.15 In spite of these and other exclusions and the undoubted proportion of transactions that are not reported, it is virtually impossible to rival the coverage of the Customs source in countries with market economies. In addition to their coverage, the Customs data are updated on a continuous basis, making it possible to have frequent compilations derived from them. Virtually all developed market economies and most developing market economies now compile external trade statistics on a monthly basis and publish them in considerable detail with the same frequency.

1.16 These records constitute the basis upon which statistical agencies must decide how they wish to decompose external trade flows into price and quantity elements. One choice is whether the statistical agency should rely entirely on the Customs source and if so, whether it should attempt to access the individual declarations or merely the statistical compilations to which they give rise. The implications of these two options are quite different. Resorting to compilations implies that the statistical agency will commission the Customs administration to provide, at agreed intervals, a statement of what has been exported and imported over a specified time period. Such a statement will usually group all transactions that fall within the same commodity classification and

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8/ For the international recommendation on coverage see ITSCD, op. cit.

country of origin and will provide figures for the total value and quantity trade for each commodity-country combination.

1.17 Access to compilations can take several forms. For example, it is common to specify compilations a good deal more elaborate than the one described above. Other variables are recorded for each transaction and some are of considerable usefulness in factoring the value flows. The size of the transaction is a case in point. Large-size transactions may be traded at prices that behave differently from those of average or small size (because of bulk-purchase discounts, for example). Accordingly, a useful compilation will stratify transactions by size within each commodity-country combination. Especially in the case of imports, there may be supplementary documentation designed perhaps for a more accurate assessment of the duties payable but useful, nevertheless, for a better determination of the nature of the commodity. Such information, too, can be included in the compilation requested from Customs. This is by no means an exhaustive analysis of all the variables that may be used for supplementary stratifications. Other variables depend more directly on the circumstances of a particular country and may include the mode of transport and the point of entry or exit.

1.18 In addition to a compilation which may range from the summary to the very detailed, the statistical agency may be given access to individual records. This may take several forms. The statistical agency may be provided with a statement that includes a list of all individual transactions. The availability of such a list opens a new range of options. It makes it possible to sample individual transactions, to exclude from the calculations specific transactions as a result of the application of explicit criteria of "normal" behaviour or to adjust individual records on the basis of knowledge derived from other sources. Moreover, the availability of a list of individual transactions makes it possible to calculate statistical measures for each commodity or commodity-country combination and to use the results of such calculations for analytical or editing purposes. A second form of access to individual records consists in allowing the statistical agency to consult the actual declarations filed with the Customs administration. These variants may be the result of long-standing institutional arrangements or else the result of a legal framework which specifies the administrative records to which the Government's statistical agency has access.

1.19 In terms of access, one extreme is represented by those countries that have unfettered access to all documents resulting from trade transactions. 9/ In such cases, the statistical agency will only be inhibited by the detail contained in the available documentation. Otherwise, it is free to design the procedures to follow in order to refine the measurement of price for these transactions. Free access of this kind, however, is not common nor, whenever granted, is it convenient. Customs records may be crushingly voluminous and to handle them with the care required for tolerably precise price measurements may be a task beyond the resources of most statistical agencies.

1.20 Using trade compilations or a mixture of such compilations together with Customs documents for the purposes of constructing index numbers of price and quantity is the basis of what is commonly known as the measurement of price change

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9/ In addition to the declarations, there may be copies of commercial invoices or adaptations of these invoices for Customs purposes.

by means of "unit values". Of the 160 countries and territories with market economies that currently report their external trade flows to the United Nations Statistical Office, rather less than one half report related index numbers of price and quantity. Of these, about two thirds appear to calculate these index numbers exclusively on the basis of Customs records and by means of aggregations of unit values. 10/

1.21 The sources of data which exist in addition to the administrative records of Customs may be classified as "direct" and "indirect". "Direct" are those sources which result from a price survey, that is, from a measurement process requiring contact by mail or in person with reporting units on the basis of questionnaires and procedures under the control of the statistical agency. "Indirect" procedures are those under the control of the statistical agency but designed with a different purpose in mind or those that reflect a measurement process under the control of some other agency which merely provides the results therefrom. Records of foreign-exchange transactions, for example, may in some countries be a useful source for updating and checking Customs-based value data and may also provide relevant information for the compilation of price and quantity indexes. Other examples of "indirect" procedures are mentioned later.

C. Export and import-price surveys

1.22 Procedures classified as "direct" involve two distinct operations. The first is the compilation of a list of all entities within the country that regularly engage in external trade. Such a list normally includes a number of details on the characteristics of each entity and is kept up to date in a reasonably efficient manner. The list need not be held by the statistical agency nor need it be designed as a single integrated file. In several countries, there are institutional arrangements that make the constitution and maintenance of such a list easier. For example, there may be associations of exporters either on a national or an industrial basis and such associations may have virtually full coverage as well as workable systems to keep their membership lists up to date. Voluntary associations of this kind usually request members to supply details on their size, activity, commodities traded and geographical areas of interest, location, form of organization, foreign affiliation if any etc. Where these lists exist, and the statistical agency has access to them, the basis upon which to create a survey frame for export price measurement is ready-made.

1.23 In market economies, such a situation rarely holds for imports, mainly because the population of importers tends to be larger and more unstable than the population of exporters. Besides, whereas there are many obvious benefits to be derived by exporters from pooling their experience and know-how and jointly promoting their products, the same incentives are seldom present in the case of importers. In spite of this, there are often institutional arrangements that make it possible to secure usable lists of importers, particularly in countries where some form of licensing is required.

10/ Summary descriptions of methods will be found in 1977 Supplement to the Statistical Yearbook and the Monthly Bulletin of Statistics (United Nations publication, Sales No. E.78.XVII.10). See also the annex to the present report.

1.24 Whether lists of importers and exporters are derived from records held by the statistical agency or whether they are made available through the good offices of trade or similar associations, such lists normally relate only to those businesses that engage in regular export and import operations. This is a tolerable restriction in the case of exports, as in most countries the casual exporter is of little significance to the over-all export flows. It may, however, be a more serious limitation in the case of imports where casual importers sometimes account for a sizeable fraction of total trade.

1.25 Lists of importers and exporters are used as survey frames from which to draw samples unless, of course, trade is so concentrated that the statistical agency finds it possible to survey all the business entities engaged in trade at regular and frequent intervals. Where full coverage is not possible, businesses are related to the commodities that they import or export in view of the fact that each commodity flow must have a suitable deflator or else must be directly estimated in volume terms. The problems that arise in relating each business to the corresponding commodity flows in trade may be complex if there are inconsistencies in the classifications used, or else, as could be the case with imports, the importer loses track of the individual commodities imported. The problems may be overcome by combining the information recorded on the Customs declarations with what is gathered from direct interviews of importers and exporters.

1.26 As part of a direct survey, the statistical agency normally discusses with each business the particular items which should be selected for pricing purposes. While such discussions can take place by mail, they usually take place by interview. This is so because in addition to selecting items and drawing up their respective specifications, the time at which the price reading should be taken and upon whom the responsibility for quality adjustment should lie are matters that also require discussion.

1.27 As a rule, the objective of direct-price surveys is not so much to provide for the compilation of external trade deflators as to provide indicators of price development which are more relevant for analysis and policy-making than unit-value measures. National priorities in this connexion are reflected in the character of the approach taken to survey pricing, particularly the efforts made to bring the survey into line with domestic-price surveys and to combine the results of all such inquiries within a general framework. Some of the distinguishing features of current national work on direct price surveys are outlined in the following paragraphs. 11/

1.28 The valuation of exports and imports in these surveys is normally in terms of values at the national border, corresponding essentially to the Customs f.o.b. (free on board) or c.i.f. (cost of insurance and freight) requirement. In some cases, this implies an adjustment to the values immediately available to reporters to allow for transport costs to and from the national border. In addition, an effort may be made to estimate freight and insurance margins on imports both for the intrinsic value of this information and as a step towards the valuation of imports f.o.b. the exporting countries.

11/ Detailed information on national work in the Federal Republic of Germany, Japan and the United States will be found in the references given at the end of the present report.

1.29 Generally, the prices collected from reporters relate to contract prices over a specified period such as the preceding month. This provides for a relatively up-to-date valuation even though it may differ significantly, because of delays in delivery, from the contemporaneous valuation of comparable goods at the border. As part of the data collection, information on duties and other levies on exports and imports (and on subsidies where applicable) may be obtained from the reporters.

1.30 Countries employing the survey approach may also collect detailed information on the terms of the contracts entered into during the reporting period. This allows more accurate comparisons to be made of the context within which price changes have taken place and of the significance of the price changes themselves. In assessing competitiveness, delays in delivery, for example, can be as significant as the price factor. Detailed knowledge of the terms of the contracts is also helpful in converting the values of contracts negotiated in foreign currencies into national currencies for pricing purposes.

1.31 While the commodity classifications of export and import-price indexes prepared in this way start with the national external trade classifications, special emphasis is normally directed to the formation of classifications more closely related to those of the domestic-price indexes. The industry-based classification may be dominant in this connexion with a view to integrating the results with those of producer price surveys and it may be supplemented by special classifications for broad economic categories related to end-use or stage-of-processing. Limited regional or area breakdowns may be provided for in the design of the price sample.

II. APPROACHES TO MEASUREMENT

2.1 The purpose of the present chapter is threefold. First, it briefly discusses the different requirements for price information in external trade and suggests that these requirements give rise to different strategies for the measurement and compilation of such prices. Next, there is a systematic review of the weaknesses, both theoretical and practical, of attempts to measures prices by computing unit values - the latter are rigorously defined - derived from administrative sources. This is followed by an equally systematic review of the operational difficulties that at times make the measurement of external trade prices by direct survey less than ideal. And finally, there is a discussion of why traditional comparisons of the two approaches tend to miss the point because they fail to acknowledge the information potential of administrative records.

2.2 In earlier paragraphs, some examples were given of the uses to which statistics on prices and quantities in external trade are put. Some of these uses are linked to macro-economic concerns and underscore the need to have aggregate measures which are consistent with the other components of the standard national accounting presentation. Uses which have to do with the transmission of price change across national boundaries and within those boundaries, from one sector to another, place more emphasis on disaggregated measures of price change. For some uses, no detailed information on the price changes of individual commodities is required; for other purposes, the usefulness of the price statistics depends entirely on the commodity breakdown that can be made available. Some uses require that the measure of price change be as "pure" as possible; for others, the measure of price change must be congruent with the value flow which is to be deflated with respect to timing, coverage, definition and scope.

2.3 In this complex situation, a statistical agency must choose among the various strategies open to it, strategies that have to do with sources of data and methods of calculation. One strategy is to accept the need for multiple measures of price change in external trade, to publish them all and to make clear to users that different objectives require measures based on different conceptual frameworks and on different sources. A handful of countries do this, accepting the fact that alternative measures normally show different results and that at critical points in the business cycle, such differences may give rise to contradictions.

2.4 Another strategy is to select a particular measure of price which, without being ideal for any of the stated purposes, is nevertheless usable for all of them. Only a statistical agency in its national context may gauge which option it can adopt, taking all its obligations and constraints into account. A statistical agency about to review its work programme in this field may find it useful to consult with counterpart agencies in countries where multiple measurement is conducted regularly in order to find out what, in their experience, is the trend and cyclical pattern of differences. 12/ An exchange of this kind may be of great help in interpreting and improving the national series.

12/ Such countries include the Federal Republic of Germany, Japan, Sweden and the United States of America.

2.5 The main options are to exploit the Customs source, to institute an independent survey of exporters and importers and to rely on established domestic-price surveys. Some countries may contact all exporters as part of a more general survey of producer prices and in such a case, may find it comparatively easy to expand it so as to take external trade requirements into account. 13/ If a census or large-scale survey of industry is in place, reporting establishments may be persuaded to report separately on imported inputs classified in a manner consistent with other external trade data. The identification of these imports may not poee too many problems for manufactured goods but for bulk intermediate or primary goods, it may require information which the the reporting establishments do not have.

A. Limitations of unit values

2.6. Customs records, or compilations based on Customs records, include information on value and quantity for each commodity, commodity-country combination or possibly longer chains of identifying variables. "Commodity" may be defined at any level, according to whether, in addition to the major international classifications (CCCN or SITC) or their national equivalent, the statistical agency or the Customs administration has adopted supplementary digits to refine the classification scheme. Usually the units of quantity for a particular item of the classification are consistent. In other words, transactions that concern imports of photographic film, for example, are not reported on one declaration in pounds and on another in square yards. 14/ Accordingly, for each item i of the classification, for a specified period of time, it is possible to aggregate the values of all m transactions so classified and to do the same for the corresponding quantities. The ratio

$$(a) \qquad \frac{\sum_{i=1}^{m} V_{it}}{\sum_{i=1}^{m} q_{it}} = \frac{\sum_{i=1}^{m} p_{it}\, q_{it}}{\sum_{i=1}^{m} q_{it}}$$

where v = value, q = quantity and p = price is the unit value uv_{jt} of all transactions for the particular classification item j at time t. Dividing this ratio by a similar ratio constructed for a period of reference o yields a unit value relative o which in turn may be weighted to form an aggregate index of unit values. Thus

$$(b) \qquad \sum_{i=1}^{n} W_{jn} \cdot \frac{UV_{jt}}{UV_{jo}} = I^{k}_{ot}$$

13/ This approach has particular merit from the point of view of statistical integration.

14/ In the case of textile piecegoods, weight and surface-area measures very often alternate with each other in Customs declarations, particularly when the Customs tariff acknowledges both forms of invoicing.

states that the sum of unit-value relatives weighted with appropriate weights derived from the structure of trade in some period k over the n commodity categories that comprise the trade flow yields an aggregate index of unit value I. The superscript and subscripts show that the weights are for period k but the measure of change compares periods t with 0, one of which may or may not be the same as k.

2.7 The aggregation of the quantities reported for a group of transactions classified into a given commodity category can only be achieved if the quantity units employed are comparatively coarse. If, for example, the commodity classification is "domestic refrigerators, electrical" which in SITC terms corresponds to a five-digit item, the unit of quantity is likely to be the simplest of all, namely, numbers of domestic electrical refrigerators. It follows that no allowance is made for the fact that the capacity, trim and utility options of domestic refrigerators may vary just as much as the options with which passenger-cars are endowed. They may include frost-free freezers, automatic ice-cube makers, soft drink dispensers, eight-day meat compartments, butter-consistency regulators, door courtesy lights and other consumer conveniences. All these options may vary with each brand name and model size. No empirical evidence suggests that once a flow of trade in refrigerators is established, its composition remains stable over time. On the contrary, there are empirical indications that, at the opening of trade, the importer tries to determine by some market strategy which are the most popular options and adjusts his future orders accordingly, After a time, the price-utility relationship changes and, while certain options decline in popularity, others see their market share expanded.

2.8 Let us assume that the trend is towards the more costly and more elaborate varieties. The following could be the effect of measuring price by unit value assuming that the only variable characteristic is size. Let there be three kinds of refrigerators of capacity a, 2a and 3a respectively. Assume that opening prices are proportional to size so that the price of the largest refrigerator is three times that of the smallest, which will be equated to 1. Assume also that in some base period, refrigerators sell in proportions 5,3 and 2 going from the smallest to the largest. Imagine now that all prices double but that tastes change so that new sales are in proportions 2,3 and 5 going from the smallest to the largest:

	Size of refrigerator											
	Small			Medium			Large			All sizes		
Period	q	p	v	q	p	v	q	p	v	Q	UV	V
Now ...	2	2	4	3	4	12	5	6	30	10	4.6	46
Then ..	5	1	5	3	2	6	2	3	6	10	1.7	17

The price change equals $\Sigma w.p/p_o$ so that, irrespective of the nature of the weights, given that all $p/p_o=2$, over-all prices have doubled. But the change in unit value is $4.6/1.7=2.71$. The relative difference between the two measures is $(2.71 - 2)/2$ or 36 per cent. In other words, the failure to distinguish among the various refrigerator sizes gives rise to an overstatement of 36 per cent in the price increase.

2.9 It is not too difficult to provide other examples to show that measures of this kind fail because they use very coarse units of quantity and that when major shifts within such units occur, they give rise to spurious movements in the indicator of price change. Algebraically, the relative difference between a measure of unit value as defined above and a "true" measure of price can be analysed into an expression involving the correlation coefficient between quantity relatives and prices and the coefficients of variation of each. 15/ For the change in unit value to be equal to the change in prices as measured by a base-weighted index either:

(a) There is no variance of base-period prices within the category (this is the state of complete homogeneity);

(b) There is no variance of quantity relatives for the period (this indicates no shift in the composition of the category); or

(c) There is no correlation between base-period prices and quantity relatives.

2.10 The above expression for the unit-value bias is usually the centre-piece of the arguments put forward to alert producers and users of the statistics to the limitations of unit values as proxy measures of price change. In the absence of information on the internal structure of individual commodity categories and the nature of its variation, it is impossible to give an objective assessment of the practical effects of using unit values. There are presumptions about the sign of the bias in different circumstances. For example, for bias to exist there must exist covariance between base-period prices and quantity relatives. Such covariance is expected to be negative if the only effect at work is substitution. But is the income effect is sufficiently large to offset it, the correlation coefficient could turn out to be positive. In all likelihood, the relative size of the two effects differs by commodity market and between exports and imports.

2.11 There are other problems in the use of unit values which are only briefly mentioned here. For example, not all transactions include a measure of quantity. Several commodity-classification categories, particularly those related to capital equipment, machine tools and several varieties of consumer goods often have no meaningful unit of quantity. Accordingly, there are gaps, sometimes of considerable importance, in the array of transactions that can be decomposed into price and quantity elements on the basis of Customs records.

B. Limitations of survey prices

2.12 In the case of survey pricing, the statistical agency is free within its budgetary constraints to be as elaborate as it wishes in defining the characteristics of the commodities to be priced. Adopting very elaborate definitions makes it possible for the statistical agency to monitor any variation in these characteristics and to take appropriate measures when such variations

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15/ For the derivation of this expression and a detailed discussion of the impact of disaggregation on the unit-value bias, see Parniczky G., "Some problems of price measurement in external trade statistics", Acta Oeconomica, vol. 12, No. 2, (1974), pp. 229-240.

occur. In this fashion, there is greater control at all times over the commodities sampled and no shifts in their characteristics can take place without being reported and presumably reflected in the statistics to which they give rise.

2.13 In actual practice, matters are less simple. If the statistical agency goes to extremes in elaborating specifications, it runs the risk of not being able to match the original specifications over time. In order to avoid too many cases where no match is possible, some leeway must be given to pricing agents or to the reporting unit itself. Of course, the amount of flexibility that should be granted varies a great deal over the spectrum of commodities. For primary and even for a certain number of intermediate products, specifications may be reasonably tight, as the chances of rapid evolution are small. For others, however, where suppliers vary characteristics continually, leeway is necessary if the price survey is to be at all feasible. This is particularly important in the case of imports where there may be sudden shifts between supplying countries, with resulting changes of characteristics in seemingly identical products.

2.14 There are also difficulties in determining which particular variety or item within a commodity category should be priced. To sample varieties or items on a probability basis would require knowledge if not of the universe, at least of some frame from which the selected varieties can be drawn by a probability sampling process. In many cases, it may be best to rely on judgement or on intensive interviewing of business people to determine those varieties that are sold in greatest volume and the stability of their characteristics.

2.15 As part of the requirements for a direct-price survey there must be a procedure to identify importers and exporters. If their identity is systematically filed with licensing bodies or with trade associations, the identification process need not be too cumbersome. Better still, if all Customs documents contain an identification of the exporter or the importer and such an identification can be matched with the more important details of the business through the device of a directory or register, for statistical purposes nothing more need be added to the identification procedure. This method only breaks down when the number of casual importers (it seldom applies to exporters) is large. Such importers can often account for a sizeable fraction of total imports or of individual categories of imports.

2.16 There are two more aspects of survey pricing that ought to be noted as potential sources of error. The first is the time-reference of the price. Imports and exports are transactions that take place in a world with friction. International carriers, particularly of the ocean-going type, do not arrive and depart like clockwork. The regulatory and administrative procedures at border crossings of the importing countries do not always take up the same amount of time. Not only are such procedures tied to the processing of documents, but they may also involve lengthy physical inspections of the commodities imported. In the case of primary products such as sugar, there are physio-chemical tests for the determination of the proper Customs tariff. For a variety of ores, there are assays to determine the extent of their metal content. In the case of imports of several kinds of foods and beverages, health and agricultural precautions demand bacterial counts etc. Such controls go beyond primary products. Equally complex tests exist for manufactures such as pharmaceuticals or clothing, tests which are dictated by policies of consumer protection or policies designed to shelter domestic industries from competition from abroad. Finally, there are lags in domestic transportation and distribution. Similar considerations apply to exports.

2.17 For these reasons, it is difficult to synchronize the timing of prices reported by direct survey with the timing of the trade flows to which they ought to refer. As it is, the timing of the latter as recorded in the documents filed with Customs is often suspect. For example, it is not well known whether, on balance, declarations precede or follow physical movements nor is it well known how both relate to financial settlements or changes in ownership. 16/

2.18 The difficulties that exist with timing are to some extent compounded by difficulties relating to the transactions themselves. In normal price surveys, the individual observations apply to purchases or sales carried out in virtually the same circumstances. In the case of external trade, such rigidity could cause a breakdown in the survey since the total number of transactions per trader per period of time may be relatively small. Accordingly, reporting units may have to be asked to average prices over longer periods of time. Moreover, greater variation in the terms and conditions of each sale may force frequent adjustments of the prices of actual transactions.

C. Unit values and survey prices compared

2.19 The considerations mentioned earlier in the present chapter suggest that the traditional opposition between survey prices and unit values may be over-emphasized. There are undeniable and serious differences particularly when the two are compared in their extreme forms. In such comparisons, prices are specified to the point where each virtually corresponds to a unique transaction while unit values are calculated on the basis of crudely defined commodity aggregations within which shifts of all types are likely. In the practice that is recommended in the present report, the opposition is much reduced. In a direct price survey, compromises must be made in so far as the commodities to be priced have to be matched with similar commodities over time. This implies a fair degree of flexibility in the specifications and also that the reporting unit must calculate some of the reported prices as averages. This is particularly so when the seller finds that each transaction is accompanied by different terms of settlement, which imply variable deviations from set or list prices for each transaction. Also, as the statistical agency strives for greater precision of the sample of prices, it will find that wider margins for specifications are required.

2.20 At the other extreme, practice with respect to unit values is not quite as described in traditional comparisons. Careful handling has made it possible to narrow down definitions of commodities to such an extent that they approximate closely the lists of specifications that a statistical agency would find workable. Such ways include the use of all the relevant cross-classifications of the Customs record. 17/

2.21 One of the ways of arriving at distributions with smaller variances is to sort transactions by size and to consider that size ranges are extensions of the commodity description. This is justified by the fact that trade practices may include discounts or other concessions for bulk purchases. Accordingly, to measure

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16/ See also para. 6.25 below.

17/ See chapter V for a step-by-step presentation of recommended procedures for manipulating unit values.

unit values for a mix of different size shipments, where the mix is subject to variation, will normally increase the unit-value bias. Moreover, size may be a pointer to different characteristics within a commodity category, so that by keeping the unit values for different size groups separate, the risks of imputing shifts in quality mix to the price factor are lessened. Not too much work along these lines has been reported, but agencies that are in a position to introduce these distinctions should do so. The marginal cost is small in comparison to the manual work of analysing distributions of individual unit values.

2.22 Another way of narrowing down the aggregations of values and quantities is to group them by their origin or destination. The different country origins for a given commodity category often spell different varieties, or even more commonly, different products altogether. Under normal circumstances, this should be readily apparent from the distributions of unit values. In the case of exports, it is generally of less importance what the destination of the exported commodity is, at least as a key for distinguishing between different varieties or different products. Rather, it is the identity of the manufacturers or producers that is the principal key. Where countries can identify the producers of their exports by inspection of Customs records, they should take advantage of this in the stratification of unit values. Where such information is not available, certain proxies could be introduced, such as the Customs point where the exports declaration tends to be filed and the name of the carrier.

2.23 In the study of distributions of the unit values of industrial imports, special attention should be paid to those distributions that appear to have more than one mode. They are fairly common in standard commodity classifications and generally indicate the existence of several varieties of the same produce ranging from the "top of the line" variety with high mean price to the "stripped down" variety at the other end of the scale. Multi-modal distributions can also indicate that the commodity category or the stratum within the category shelters more than one product. Such information is essential for several purposes. First, it provides a basis for refining the classification. While a classification scheme cannot aim at covering every single product that is marketed, it nevertheless should be designed so as to avoid unwarranted heterogeneity. Secondly, it is important for editing purposes, as a possible indication that respondents, the Customs administration or even the statistical agency may be systematically misinterpreting the classification and ascribing to one particular category two distinct products. Finally, and more importantly for the purposes immediately at hand, it helps to identify shifts in the product mix giving rise to spurious indications of price change.

2.24 The separation of unit values into different strata as described above should be adopted whenever there is a presumption that the variance of the unit values within strata is smaller than between them. Most such work is of an empirical nature and should be guided by the accumulated knowledge and experience of the circumstances in which external trade takes place. Intuition may play a large role in this process. But not all statistical agencies have the same opportunities to introduce stratification. In some cases, there is access to each individual record by computerized means and experimentation along the lines suggested above is feasible at reasonable cost. Where such facilities have not yet been developed, it may not be possible to manipulate unit values in the ways indicated.

2.25 There are legal and logistical considerations that may make the remarks above inapplicable. It may happen that the Customs administration is precluded by law from allowing the statistical agency access to commercial invoices, individual declaration forms or even the individual record as transcribed for computer or manual processing. There may also be cases where access is granted but the logistics are such that no advantage is gained as a result. This may occur because of difficulties in the storage and retrieval of forms or because the resources of the statistical agency do not allow it to pursue down to the level of the individual transaction any editing or analytical queries which it may have. In such cases, little alternative may exist to the calculation of crude unit values or, if the constraints are legal rather than budgetary, to the institution of direct surveys.

2.26 The difference between the techniques discussed in connexion with unit values and survey prices is that with unit values there is lack of control over what is being priced. Even if, for a particular flow of trade, the stratifications suggested are helpful in the sense that they reduce variance and show distributions similar to the distributions derived from a price survey, movements in the parameters of the distribution over time cannot be readily explained. Obviously from a simple inspection of the distributions nothing can be learnt about the commodity mix and its change over time. This is the major drawback of a procedure that relies entirely on empirical and indirect techniques to assess price change.

2.27 This drawback is reduced in importance if the statistical agency has access to commercial invoices, or extracts thereof, provided they accompany the file of each trade transaction. Such invoices or extracts might show standard commodity descriptions, conditions of delivery, form of settlement, conditional rebates etc. But this information may or may not be there depending on the transactors and, to a certain extent, on the size of the transaction. It may also vary with the nature of the commodity involved. None the less, most invoices contain a wealth of descriptive material that a statistician interested in accurate commodity classification will find irreplaceable. Accordingly, regular and well-established procedures to assess the quality of the data by means of studies of the invoices filed with Customs are an important adjunct to pricing by means of unit values. They should also be incorporated into the monitoring work that in a well-organized system should precede the compilation of index numbers.

2.28 If these conditions are present and the statistical agency is equipped to review invoices and to pursue inquiries with exporters and importers in order to supplement its knowledge of the underlying transactions, it is not that far from conducting a price survey. The invoices and the commodity detail that they provide in combination with the ingenuity of commodity specialists may provide comparable control over the characteristics of the commodities priced. These considerations only hold for commodities which do not exceed a certain level of technical complexity. Even if a statistical agency is properly equipped with trade journals, directories, technical dictionaries, trade catalogues etc., there are commodities the nature of which cannot be ascertained by a study of a file kept with Customs. Such commodities, a proper description of which can only be derived from a study of the relevant technical documentation, are beyond the methods described above.

2.29 It is clear that at some point the further refinement of the unit value approach along the lines indicated above will give rise to diminishing returns and that more cost-effective ways of improving price measures can be found through the introduction or elaboration of independent price surveys. In those countries where

a dual approach has been systematically developed, emphasis has been progressively directed to the extension of these surveys to meet expanding needs for more reliable information on price changes on a disaggregated basis. The use of the approach for the compilation of Paasche-type indexes for the deflation of trade flows, though initially looked on as of secondary interest, is increasingly regarded as an important objective for the shaping of future work. Recommendations for comprehensive development strategies are outlined in chapter VI below.

2.30 The preceding analysis of the advantages and disadvantages of alternative sources of price information is predicated upon the existence of certain administrative and regulatory procedures. In other words, the balance could shift towards survey pricing if, as a result of tariff-reduction agreements, Customs controls were for all intents and purposes abolished. As it is, the movement towards trade facilitation has precipitated a reassessment of the current balance of advantages.

2.31 The movement away from the traditional functions of Customs can take place in either of two forms. One affects mostly imports and comes about through the institution and broadening of Customs unions. The abolition of an internal tariff in such unions is normally accompanied by the simplification or even outright suppression of standard Customs declarations for intra-trade shipments. This, in turn, may lead to the loss of virtually all intelligence that has been described in previous paragraphs as essential to the calculation of usable unit values. The replacement of Customs declarations, in whole or in part, by transport documents (a development that should be expected in such circumstances), could provide a pis-aller for the estimation of trade flows in value terms; but it is unlikely that such documents would contain the necessary details for the estimation of prices. Even if the replacement of Customs declarations on such a scale were not to take place, statistical agencies should plan for any move by the Customs administrations to relax their procedures to inspect and monitor the declarations related to intra-trade.

2.32 For exports, it is the facilitation of trade procedures by means of document simplification, and possibly the elimination of such documents, that may suppress documentary evidence for pricing purposes. This should not be taken to imply that all trends towards simplification affect statistical operations adversely. Some result in greater standardization and even provide a basis for the integration of related kinds of statistics. In at least one case, there has been a drive towards the institution of a single master document with all the necessary transport, financial, insurance, trade and tariff information from which partial carbon copies may be drawn. Since the movement towards simplification also stresses modern communications and data processing, it promotes the use of standard coding and, indirectly, greater congruence between import and export reports of trading partners. Notwithstanding these positive features, statistical agencies should keep a watchful eye in case the simplified documentation reaches the point where all information that is not strictly necessary to identify the merchandise physically and load it onto the right carrier is abolished. Bearing these considerations in mind, statistical agencies depending on the exploitation of administrative records should be aware that this option may not be too long-lived.

III. MAJOR PROBLEMS OF PRICING

3.1 The purpose of the present chapter is to review the major problems involved in pricing commodities in external trade and to identify the strengths and weaknesses of the two main approaches in dealing with them.

A. Quality change

3.2 Changes in the characteristics of commodities over time span a wide spectrum. At one extreme, there is the trivial change in characteristics that, however treated, does not affect the resulting price measures, at least not above the level of precision at which they are used. At the other extreme, there is the new commodity or the unique commodity for which no precedent can be found and for which there may never be a successor. There are the commodities that move in and out of trade at regular intervals, almost in all cases seasonally, that is, at intervals that do not exceed one year in length. There are also the commodities that enter and leave external trade flows at irregular intervals. These two varieties do not pose so much a problem of pricing as they pose difficulties for the construction of time series of price relatives.

3.3 Significant changes in the characteristics of the commodities selected for pricing purposes pose conceptual and practical problems. Empirical research suggests that these changes in characteristics may constitute an important source of error in the construction of measures of price change. Any commodity that enters the market can be represented by a number of characteristics. Even a "simple" good like an egg may be represented by such characteristics as size and colour of shell. Intermediate goods used for manufacturing purposes can be described by much longer lists of characteristics. As for complex goods such as passenger cars, aircraft, computers and guidance systems, entire volumes are required to describe all their characteristics. For the prices of these commodities to be compared over time or across space, each price once it is established should be preceded by a full enumeration of characteristics. In this way, another price may be pronounced comparable if its accompanying list matches the first. If in some respects it does not, it is the role of the price statistician to estimate the price that would have obtained if there were no differences in the list of characteristics.

3.4 But it is not always clear whether changes in characteristics should be accepted unquestioningly as subjects for statistical adjustment nor is it always clear when a change in characteristics has taken place. This last point is easy to grasp if it is borne in mind that no list of characteristics, no matter how carefully prepared, is exhaustive. All such lists are selective and are quite likely to miss important features of the commodities sampled for pricing.

3.5 The problem of quality change as described theoretically has no ready practical solution that a statistical agency may adopt, especially if the agency has to deal with tens if not hundreds of such problems at every moment in time. Essentially, there are two ways of coping with the problem. The first, which is the most widely adopted, will be called the "commodity expert" approach. The

second, largely experimental for the time being, is called the "hedonic" approach. 18/

3.6 The "commodity expert" approach, even though applied with different intensities, is one of the most common features of the price programmes of statistical agencies. Broadly, the approach consists in employing a variety of experts who, as a result of their training, knowledge of the market and knowledge of the industry and individual manufacturers, are in a favoured position to draw up a list of characteristics for each of the commodities under observation. They are in an equally favoured position to estimate costs every time there is a change in one of the characteristics specified as relevant. 19/ The techniques used to arrive at such estimates vary but, more often than not, consist in ascertaining through contacts with the manufacturer the cost of the new characteristic. Such contacts may be very formal and well established. For example, some countries such as the United States, in which the passenger car represents an important item of consumer expenditure and where, annually, new models are introduced featuring significant changes from the previous year, devote considerable expert resources to establishing what the quality adjustment should be. For the statistics of external trade, such a procedure could have two consequences. On the one hand, countries that trade intensively in passenger cars with the United States could reap the benefits of this exercise by applying the same adjustments in the case of their imports of cars manufactured in the United States. Secondly, if the adjustments by the exporting country are compatible with the conceptual framework of the price series of the importing countries, the adoption of these adjustments by the latter would provide a welcome measure of statistical integration.

3.7 The drawing up of a list of characteristics and the annual valuation of changes are often decried as too subjective. There are countries that prefer to delegate to the actual reporting unit some part of the task of adjusting for quality. Indeed, it may be that some form of intermediate delegation (to a trade association, for example) would prove workable in special cases. But the arguments of response burden and the failure of reporting units to comply faithfully with the complex requirements of the statistical agency suggest that delegation is not a widely applicable solution. Other criticisms of subjective adjustments hinge on examples for which no obvious alternative adjustments exist. In particular, there are changes in "performance" characteristics interwoven with changes that are more of a social or psychological nature.

3.8 The argument is not limited to consumer durable goods. It applies even more forcefully to capital goods. Little alternative exists to pricing by reference to commodity experts and manufacturers. To ensure adequate coverage, an expensive establishment of experts, supporting industrial and commercial intelligence and a network of contacts with manufacturers may have to be maintained.

3.9 The "hedonic" approach starts from the premise that each commodity is a combination of characteristics each of which has an implicit price. This price is

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18/ See Evi Griliches, ed., Price Indexes and Quality Change (Cambridge, Mass., Harvard University Press, 1971) for an extensive bibliography on the measurement of quality change by the "hedonic" approach.

19/ References to other functions of commodity officers will be made below in connexion with unique goods, new goods and the splicing of index numbers.

set by the market and is reflected in the over-all prices at which different combinations of these characteristics sell whenever different varieties of the same commodity, each with its own peculiar combination of characteristics, coexist. The model for which this type of analysis was developed was the passenger car but it can be applied to a wide variety of consumer durables, to selected items of machinery and equipment and to construction. Algebraically, if p is the price at which some complex good y is sold then $p = \sum_{i=1}^{n} \lambda_i x_i$ that is, the price is a linear combination of the values of n characteristics x_i each with its own implied price. If a sufficient number of observations of p and x_i can be found, it should be possible to explain the variation in p by a multiple regression of p on x_i. The results of such a regression not only show how the market priced each characteristic but also serve as a basis for adjustments for comparability over time. This is essential in cases where p_t differs from p_o by relating to a variety with a substantially different configuration of characteristics.

3.10 The problems that must be solved in the wake of this approach to quality adjustment range from purely technical problems in econometrics, mostly related to the collinearity of the characteristics, to problems of technology and engineering related to the commodities for which this approach is taken. An adequate resolution of the problems requires that the statistical agency have access to trained econometricians as well as to competent commodity specialists. A significant amount of spade work has been carried out and published and could be taken as a guide by agencies interested in experimenting with this approach.

3.11 If the resources for the application of these techniques are not within the budgetary reach of a statistical agency and it does not have access to the statistical agencies of trading partners where careful examination of quality variation takes place, the question becomes one of whether limited judgemental adjustments should be made. The balance of experience suggests that for those commodities for which quality change is a serious issue, judgemental adjustments are conducive to aggregate measures superior to the ones obtained with no adjustments. If such a course of action is adopted, procedures should be documented and public discussion of them encouraged to the extent possible.

3.12 Like most other matters in external trade, the issue of quality adjustment does not affect a country's imports and exports in the same fashion. First, as noted above, the variety of commodities exported is on average far smaller than the variety imported. 20/ In such cases, the span to be covered by commodity expertise will vary according to whether it is used for exports or for imports. Secondly, while in the case of exports it is usually possible to locate the exporters and gather from them the relevant intelligence on quality change, this is less easy in the case of imports. Importers may be intermediaries with no direct knowledge of the characteristics of the commodities, or, alternatively, as ultimate consumers of the commodities, they may be too fragmented and dispersed to be easily located and consulted. 21/ Finally, in the case of many countries, particularly developing

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20/ See annex below.

21/ The situation is not quite the same in countries where the Government or other public bodies are major interpreters of a wide variety of goods. If this is the case, it is easier to locate the ultimate consumer, although it may be just as difficult to gather intelligence about the characteristics of the goods.

countries, exports may be concentrated in primary resources or products for intermediate consumption where the rate of technical change is comparatively slow. But these same countries are very likely to import those commodities for which technical change proceeds at a quick pace and for which trading patterns may not yet be firmly set.

B. Unique goods

3.13 The situation with regard to quality adjustment reaches the height of complexity in the case of "unique" goods. These are goods which, because of their novel characteristics, cannot be matched over time with similar goods. Trade in them is not likely to be repeated, at least not with characteristics that are sufficiently similar for the construction of index numbers. Unique goods tend to be capital goods such as ships and items of industrial machinery and equipment made to order. There are major theoretical and practical difficulties in attempting to describe these goods for pricing purposes. First, there is the matter of enumerating the components of the goods, without which a proper list of characteristics may not be possible. This may entail a review of all the functions of the equipment and of its operating characteristics. Secondly, there is the matter of imputing a value to the particular configuration of components; this may turn out to be a subjective imputation and yet one of considerable significance. For purposes of statistical recording, there must be a factoring of total price into the price of the components and the price of the assembly. In practice, many of the individual components may turn out not to have a market price and decomposing them further may not be a practical possibility. In the end, such cases are normally dealt with by the use of proxies such as a combination of indexes of employee compensation in the manufacture of the components in question and of the prices of the materials used. It becomes a matter of judgement by the national statistical agency which particular indirect indicator, or combination of indicators, gives the best approximation.

3.14 Exports and imports are not affected in the same way by the difficulties involved in pricing unique goods. Under normal circumstances, it is easier to have access to the individual exporter, who may actually provide guidance on the characteristics and pricing of his unique good. Guidance may also be given on the components which are likely to reappear as components of other unique goods susceptible to be exported at later dates. From the point of view of the price statistician, this is indispensable intelligence. But in the case of imports, no such information may be forthcoming. The importer may depend on foreign technicians who have no rapport with the statistical agency and who, accordingly, may not supply the required technical information. Alternatively, while all parties to the transaction may know the characteristics of the equipment, they may not know enough for pricing purposes about the way it was produced, assembled and costed.

3.15 There are various circumstances of this kind in which the statistical agency may experience difficulty in obtaining the required detailed information on the import of a unique good. In such circumstances, the statistical agency should establish communication with the counterpart agencies of exporting countries. From them, it should attempt to gather enough relevant knowledge, directly through their measures of export prices or indirectly through their measures of domestic-price change, to assess how it should handle such transactions. It is important to keep in mind that such indirect measures may give a better indication of the notional movement over time than the assumption that the price has moved at the same rate as the price index for a related aggregate.

C. Seasonal and other discontinuities

3.16 Sharing some of the characteristics of "unique" goods are those goods that move in and out of trade at regular or irregular intervals. This may be for different reasons. In the case of repetitive patterns, seasonal weather or institutional factors may be the cause. The examples normally given are drawn from the categories of food and beverages and clothing. Fresh fruit and vegetables are not always in season and imports or exports may alternate with those of frozen produce. Garments usually differ in component material, weight and configuration by season; summer garments tend to be imported in winter and winter garments in summer.

3.17 There are several ways in which seasonal products can be treated. Neither conceptually nor practically are the forms of treatment as difficult to implement as in the case of complex goods. One way of dealing with these commodities is to consider them as different according to the season in which they are available. This poses no problem in the case of fresh and frozen produce available in season or out of season. While there is no easy way of distinguishing their characteristics in trade, the difficulty is obviated by the fact that the country of origin is unlikely to be the same for "in" and "out of" season produce. Accordingly, combining the origin with a description of the commodity is an easy and efficient means of distinguishing between varieties. There are also variants of the manner in which a current price should be related to the "base" price for purposes of constructing a price relative. 22/

3.18 It is more difficult to deal with products that enter and leave trade flows at unpredictable intervals. If prices in external trade are measured by a sample of commodities, too many disappearances that fortuitously coincide in time may seriously affect the representativeness of the sample, however derived. Such commodities create further problems when they reappear in trade, in that a price must be imputed for the time when they were not traded. In this sense, the problem is no different from that discussed for seasonal commodities. However, in the case of the latter, measures can be taken to smooth them in and out of the aggregates to which they belong, in order not to cause spurious changes in time series. In the case of commodities that move in and out unpredictably, such arrangements can only be made ex post at greater cost and with more difficulty.

3.19 For imports, such movements may reflect the commercial "demise" of one supplier and the quest for a replacement. They may also be the reflection of the fluctuating state of commercial relations between two countries or of corporate decisions taken by a transnational company importing from its subsidiaries and shifting its sources of supply.

D. The problem of valuation

3.20 Problems of valuation are less severe than the ones discussed so far from the point of view of finding satisfactory solutions. But they may have a considerable impact on the accuracy of the over-all figures and should, therefore, be discussed at length. The problem of valuation in the case of the transactions of transnational corporations is used here to illustrate the kind of issues which arise in practice.

22/ Cf. Guidelines, op. cit., paras. 37-39.

3.21 Transnational corporations may be vertically integrated with constituent plants, each corresponding to a different stage of processing and distribution, located in different countries. Such corporations trade with themselves, that is to say, export and import goods from one of the countries where they are located to another. For example, transnational A, engaged in the production of television receivers, may produce labour-intensive components in a low labour-cost country X, assemble the receiver in a medium labour-cost country Y, and market the receiver in a high labour-cost country Z. This means that before something is actually marketed, which may only happen from country Z onwards, trade takes place between X and Y and Y and Z. Four transaction records are created, none of which may indicate the true market value of the goods traded. Countries may deal with this practice in two ways. In one way, they may accept whatever valuation the corporation attaches to the commodities traded between the countries where it has its establishments. In these circumstances, the recording country knows that what has been entered into its merchandise trade account is likely to be consistent with the financial statistics it gathers from enterprises. In the second way, the statistical agency may prefer to replace the corporation's valuation by its own. The statistical valuation is likely to be an estimate of the price at which the commodities concerned would have been exchanged if only the transaction were between unrelated business entities.

3.22 By accepting at face value the valuation reported by a transnational corporation, a statistical agency may gain a measure of consistency at the risk of committing two errors. The first is an error of level which in certain cases may be sufficiently important to affect the weighting scheme adopted for aggregation purposes. The second is an error of movement over time. A corporation may have an internal pricing policy that simulates the open market and is reflected in the way in which it prices these international transactions. Alternatively, the valuation may be the result of other considerations of a corporate nature, taxation being the most common. If the latter is the case, the considerations that bring about a change in valuation over time will differ from the interplay of supply and demand in the market. In certain cases, the outcomes may be perverse in the light of general cost and price movements in the countries involved in the transactions.

3.23 In order to determine whether or not there is an issue of valuation, the importing country must know about the range of commercial affiliations between itself and its trading partners. This is not always possible and even in those countries where there is extensive documentation on intercorporate ownership and control, it is difficult to maintain the information up to date in view of the frequent shifts in corporate ownership. Consequently, the statistical agency may find that if it wants to single out those transactions that are not at arm's length, it is only capable of intercepting part of them, the others being hidden by changes in name or by intercorporate relationships that are too indirect to be detected.

3.24 The assumption that it is up to the statistical agency to determine which course of action it wishes to pursue does not hold universally. In many countries, much depends on the procedures adopted by the Customs administration. The reasons why the latter chooses one course of action or another may have little to do with statistical requirements. By and large, if a Customs administration adopts the new General Agreement on Tariffs and Trade (GATT) definition of value, it will value goods at their "transaction value". 23/ The statistical agency may not have the

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23/ See para. 3.26 below.

means - either in terms of manpower or access - to challenge an estimate made by Customs on this basis and may, therefore, be forced to accept valuations that rely partly on judgement and partly on administrative rules and that in any case are likely to be inconsistent with the rest of the balance of payments.

3.25 In addition, not all Customs administrations have the means, the experience and the knowledge to estimate tolerably well the "transaction value" as defined by the GATT rules of valuation. When such knowledge is not readily available, local rules may be established to prevent excessive and inconsistent use of administrative discretion. As a result, it may sometimes be found that the time series produced by the application of such rules is a good deal further from a true series of transaction values than the values reported to Customs in the first place. It may not be easy for a country to weigh all these factors in order to come to a decision on how to handle the valuation of transactions internal to a transnational corporation. The relations between the statistical agency and the Customs administration must be assessed and so must the experience of the latter in dealing with valuation problems, its capacity to detect those transactions that are not conducted at arm's length and its ability to estimate open-market prices. The importance of the decision depends on the degree of penetration of the national economy by transnational corporations and the extent to which transactions within these corporations have an impact on over-all trade. Ideally, there should be an arrangement between the Customs administration and the statistical agency to report both values.

3.26 The discussion applies equally to other types of adjustment made to reported values by the Customs administration. Article 1 of the new international agreement on this matter states:

> "1. The customs value of imported goods shall be the transaction value, that is the price actually paid or payable for the goods when sold for export to the country of importation ... provided:
>
> (a) that there are no restrictions as to the disposition or use of the goods by the buyer other than restrictions which (i) are imposed or required by law or by the public authorities in the country of importation, (ii) limit the geographical area in which the goods may be resold, or (iii) do not substantially affect the value of the goods;
>
> (b) that the sale or price is not subject to some condition or consideration for which a value cannot be determined with respect to the goods being valued;
>
> (c) that no part of the proceeds of any subsequent resale, disposal or use of the goods by the buyer will accrue directly or indirectly to the seller ...; and
>
> (d) that the buyer and seller are not related, or where the buyer and seller are related, that the transaction value is acceptable for Customs purposes ...".

The primary basis for Customs value under the new agreement is "transaction value" as defined above, adjusted as explained in a subsequent article of the agreement for any elements of value which are not included in the price actually paid or payable. Articles 2 to 7 of the agreement indicate the nature of the valuation

options to be implemented when the conditions of article 1 are not met, including the situation where the buyer and seller are related. Essentially, these valuation options provide for the estimation of "transaction value" in terms of the basic concept underlying article 1. 24/

E. Valuation for national accounting

3.27 Customs practice with respect to f.o.b. and c.i.f. valuation is not uniform from country to country. It is, however, common in a wide majority of countries to value exports f.o.b. (free on board) and imports c.i.f. (that is, including the cost of insurance and freight). There are some important exceptions to this norm. 25/ Moreover, the meaning of f.o.b. is by no means the same from one country to another. And even if a single valuation norm were adopted by all and interpreted in a consistent fashion, it would still not yield a set of prices fully integrable with the other components of the national accounting system. Nor would it yield a set of prices that would meet all the uses to which external trade statistics are put.

3.28 It follows that in ideal circumstances, countries should collect several prices per transaction. In other words, for exports there should be a price for the commodities at the factory gate, a price for their transport to the national border, a price for vessel transshipment or for initial loading if no transshipment occurs, and so on up to the c.i.f. measure. For imports, the concept c.i.f. should be similarly broadened to distinguish freight and insurance margins to the national border and to provide for protective duties and other indirect taxes that may be levied on entry. But while this may be desirable in practice, it may not be a feasible programme. It appears that there are at least two sources of difficulty for an explicit collection of freight and insurance margins. First, many sales are priced from specific suppliers to specific purchasers. In such cases, the price quoted tends to be all inclusive, that is, it comprises freight and insurance even when quoted by the exporter. 26/ If, on the import side, the commodities in question are admitted free of duty and any other charge, there is no administrative reason to have the reported price broken down into its constituents. And even if there were, it would reflect no more than a crude estimate arrived at to comply with a Customs requirement. Such cases may be more common than suspected.

3.29 A second source of difficulty lies in the fact that transport may be assumed by the exporting company's own fleet. In this case, any breakdown of price into commodity proper and transport margins may be as devoid of significance as some of the prices reported in transactions internal to transnational corporations. It is

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24/ For full text of agreement and explanatory matter, see Customs Valuation: Agreement on Implementation of Article VII of GATT (document 25.800 of 14 December 1979) Customs Co-operation Council, Brussels. The latest international recommendations on valuation in external trade statistics, incorporating the new GATT definition, will be found in the revised version of ITSCD, op. cit.

25/ The United States, for example, compiles and publishes import statistics on the basis of three different valuations, including the c.i.f. valuation.

26/ See The Reconciliation of United States-Canada Trade Statistics (Ottawa, United States-Canada Trade Statistics Committee, 1973) for an indication of the Canadian situation.

possible that these situations only exist for a narrow group of commodities and across an equally narrowly defined group of trading lanes. In this case as well as in the case described in the previous paragraph, it is up to the statistical agency to weigh, in the light of the evidence it has, whether more harm is done by requesting a notional breakdown of the full price into its commodity component and transport margin than by making the appropriate assumptions on the basis of related indicators. One consideration that militates against too many assumptions by the statistical agency is that commodities that fall into these situations are mostly primary commodities and transport is typically an important component of the full cost of the shipment. Accordingly, the leverage of any systematic error in estimation is much greater than in the case of the average shipment in external trade.

3.30 For certain purposes, values of imports are required after the application of protective taxes. But here, too, it is not always easy to compile such values. For example, there are standard techniques for calculating the landed values of imported merchandise starting from the Customs record of the transaction. In the majority of cases, this record includes a reference to the tariff as well as to the commodity code and, therefore, a straight mechanical conversion makes it possible to go from the c.i.f. value to a value that includes whatever taxes are applicable to the commodity and to its particular country of origin. There are cases, though, when the application of Customs duties is contested either because certain exemptions were not properly taken into account or because the codes - tariff and commodity - are not thought by the importer to be appropriate. When this is the case, it is rare for the outcome of the resulting litigation to be reflected in the published statistics. It follows that the sum of the duties that should have been collected by a de jure application of the Customs tariff seldom equals the de facto collection. Normally, the differences are of negligible proportions in countries whose tariff nomenclature is based on the Customs Co-operation Council Nomenclature. But they could attain significant levels in other cases. Systematic differences should show up once the data are fitted into the standard national accounting framework.

F. Alternative approaches compared

3.31 Little discussion has taken place so far on the difficulties in pricing experienced by the reporting unit itself. In fact, the reporting unit may not be in a position to report the price as it relates to the specifications laid down by the statistical agency or else may not wish to do so because of the excess burden placed upon it. It may also balk at the notion of reporting in much detail what it feels to be the heart of commercial intelligence, even to a statistical agency. The tendency to do this affects exports and imports differently. In the case of exports, the collection of prices if derived directly from exporters by a survey would probably be as good or as bad as the collection of domestic producer prices. In the case of imports, it would be much more difficult to find out how terms and conditions of sales that need not be reported to Customs - or for that matter directly to a statistical agency - actually affect prices.

3.32 In the case of both exports and imports, there may be practical difficulties in establishing definitively what the prices, including those terms and conditions that appear to be the most volatile, actually are. Economic theory would lead to the presumption that as the pressure on capacity changes with the business cycle, this should reflect itself in the pricing policy adopted by enterprises. Indeed,

the way such a policy operates may be to have a normal price with a set of standard terms and conditions attached to it for each particular product. The terms and conditions, though, may constitute a band within which there are fluctuations that correspond to corporate competitive policy, pressure on capacity etc. If such a model fits well certain corporate pricing policies, it is unlikely that all countries that undertake price surveys succeed as a result of their tight statistical controls or because of the responsiveness of their reporting units to capture the fluctuations within the band. As examples of what the terms and conditions include, the following may suffice: delivery period, after-sales service, terms of payment including interest-free period and parts warranty. These seldom form part of any documentation presented to Customs, and statistical agencies would find it onerous to inquire systematically into them for every commodity in their price surveys.

3.33 The factors discussed in the previous paragraphs do not affect exports and imports, nor prices collected from different sources, in the same way. It is not possible to draw up a table of export and import - price data broken down by source and to impute to each cell an estimate of the likely error caused by each of the difficulties discussed so far. Nonetheless, it is important for national statistical agencies to develop an intuitive grasp of these possible errors in order to decide upon the strategy that best suits their circumstances.

3.34 For the pricing of unique goods, there is no significant difference in terms of the source from which the price information is collected, provided the statistical agency has access to individual import and export declarations filed with Customs. In other words, once the statistical agency finds out through access to individual records that a unique good has either been imported or exported, from then on it must carry out a detailed inquiry in order to decide how the good in question will be treated. Obviously, Customs documents alone are not going to solve the matter. But a straightforward price survey or the use of indirect evidence collected from the domestic market or from abroad will not solve it either. The options are to exclude the unique good from the compilation of the current measures of price and quantity or to attempt to include it in the best way possible.

3.35 The problem of changes in quality is often cited as the one which an approach <u>via</u> unit values calculated from Customs documents cannot solve. Indeed, the traditional techniques that were used in conjunction with unit values were inadequate to deal sensibly with changes in quality. But then, they were developed at a time when the bulk of external trade consisted of crude and semi-manufactured products, the quality of which was unlikely to change fast. A few general points on this issue may make matters clearer. First, any approach to measure changes in quality requires ample budgetary means. Should a statistical agency that is conducting a pricing survey of any breadth wish to engage in periodic reviews of the characteristics of the commodities sampled, it will find it more onerous than the actual survey. For most statistical agencies, the choice is to be very selective or to integrate the external trade sample with that for the domestic market and hope that efforts to adjust qualitatively commodities selected for the latter will be sufficient for the external trade indexes.

3.36 If the approach followed is to be very selective, there is no incompatibility between the two major sources of information on prices in external trade. 27/ A well-managed programme that relies on Customs unit values does not preclude periodic consultation with, or even visits to, important exporters and importers. In the case of direct pricing, some prior knowledge of the commodity structure of external trade would allow the statistical agency to identify those commodities for which it is presumed that rapid quality change does occur. The importers and exporters of such commodities would also be identified and a programme of regular consultation would be mounted allowing for the possibility of making certain quality adjustments retroactively. Something almost identical would take place if the approach were via Customs unit values. In either case, the statistical agency would have to rely heavily on the commodity expertise that it had managed to secure. 28/

3.37 For the purpose of statistical integration, there is no great difference in the results of quality adjustment derived from the two approaches. Rather, it is a matter of internal organization and internal lines of communication within the statistical agency. To the extent that imported and exported goods are but a subset of the goods bought and sold by domestic producers, it should be easier to integrate inquiries into quality that arise from domestic surveys with those that arise from external trade if the latter are based on a direct price survey.

3.38 Direct pricing, moreover, is a trigger for inquiries into quality change to take place. The regular confrontation of commodities as they are sold, bought, imported or exported with the description of the commodity as it was initially entered into the price collection, shows whether a change in characteristics occurred. There is nothing to trigger a similar inquiry if the statistics are derived from Customs records, whether or not access to individual invoices is granted. An invoice description, no matter how detailed, is not sufficient to provide evidence of a change in characteristics. This is perhaps the key weakness of a pricing programme entirely based on Customs records. Several requirements must be met before quality changes are detected. First, the list of specifications accepted by reporting units must be sufficiently tight. Secondly, the reporting unit must be sufficiently alert and co-operative to signal departures from the list of specifications. And thirdly, once a departure from specification has been signalled, the statistical agency must have the resources and expertise to act on it.

3.39 A pricing programme that relies on unit values should provide for the study of trade directories and trade periodicals as these provide important clues to changes in the performance characteristics of a wide range of commodities, particularly of industrial equipment. Accordingly, if commodity experts are available and their services are sensibly tied to the monitoring of the raw data for the index numbers, some additional insurance against drift in quality is gained. Further remarks on the way these various services should be combined and integrated are made in the last chapter of the present report.

27/ Throughout this discussion, it is assumed that the statistical agency has access to individual records and invoices filed with Customs.

28/ In the later discussion of overall strategy (chapter VI below), more will be said of the ways in which a network of consultative arrangements should be built up and maintained.

3.40 Irrespective of the approach adopted, it is not easy to gain access to importers in order to consult with them on matters of quality change. As noted in earlier chapters, they are more difficult to locate, less aware of the characteristics of their products and responsible for a wider variety of commodities. Against this, in many countries, imports of sophisticated manufactured products come accompanied by equally sophisticated descriptions of their characteristics.

3.41 There is no major difference in the way new products or seasonal products are dealt with as a result of adopting either approach. Once these commodities are identified, the issue is more one of index-number construction than of raw quotes to be used for purposes of constructing it. But there is a difference in the way that such commodities are identified according to the source used. The process that goes on, on a continuous basis, in Customs is one of identification of the characteristics of imported goods for purposes of assigning them to the right category of the Customs tariff. This process, therefore, is a trigger that signals new products. There are several ways in which this may become known to the statistical agency. In certain countries, there are periodic Customs bulletins that show the latest set of new commodities that have been assigned to a particular category in the Customs tariff. Often such bulletins contain the trade name of the commodity and a description of its most important functions. In other countries, where the coding is carried out by a statistical unit within Customs, the trigger may be a difficulty experienced in applying the existing commodity classification to a new product.

3.42 For exports, matters are reversed. In a large number of countries, there is little attention paid by Customs to the accuracy of the assignment of commodities to classification categories. Even in countries where care is taken, it is unlikely that Customs will rule on assignments involving new products. If the classification process is in the hands of the statistical agency or of a statistical unit within Customs, the probability of detecting a new line of exports may depend on the quality of the descriptions that are supplied with the export declarations. Since these are likely to be condensed, the chances of detection are correspondingly reduced. Conversely, a direct-pricing process by relying on a network of correspondents and by confronting them regularly with a set list of specifications, may be more successful at detecting new products or important quality changes. Moreover, if such a survey is closely linked to surveys of domestic prices, the detection of emerging new products should be even more probable.

3.43 There are two features of the direct-pricing approach and of the approach via Customs documents that must be carefully compared. Both features give rise to biases, albeit different ones, and their effect on imports and exports are not the same. In the case of imports, as a crude generalization, no importer can escape the administrative control of Customs. In addition, if an importer is less than candid in describing the circumstances of his purchase and the nature of his commercial relations with the exporter, he may have committed an indictable offence. Moreover, he is dealing with an arm of Government that is experienced in the valuation of different commodities and to whom a value report must, at the very least, be sensible for it to be accepted. In other words, the Customs source ensures coverage, high-quality reporting and consistency in valuation. Against this, the very nature of the fiscal control by Customs may be a source of bias; the control exerted by Customs may only apply to those commodities which are not admitted duty free; and the nature of the documentation submitted to Customs may

be inadequate for a proper determination of price. In addition, the rules adopted by Customs for valuation purposes may be the source of greater distortions than any of the biases listed so far.

3.44 In the case of the direct pricing of imports, the following advantages and disadvantages should be listed. First, a statistical agency is commonly perceived to be neutral and price reports to the agency should be relatively free of bias. Secondly, in mounting its inquiry, a statistical agency can ensure that it conforms to the requirements dictated by the co-ordination and integration of price statistics rather than having to do so ex post by adjustment. And thirdly, through judicious sampling, a statistical agency may overcome the problem of coverage which it otherwise would experience. Against these advantages, non-response or incomplete or incorrect response to a statistical agency could be an important cause of bias. Secondly, the dispersion and instability of importers might make it difficult to design a workable sample. Thirdly, because of considerations of response burden, a statistical agency may hesitate to go as far as the Customs administration in its attempts to determine the precise nature of affiliation between exporter and importer. And finally, the sample size required to provide usable data for all the variables of interest in external trade could turn out to be an excessive budgetary commitment.

3.45 In the case of exports, the balance of advantages and disadvantages is almost the exact opposite. Reporting to Customs on exports, except in those countries where for special reasons there are export controls, is generally simpler and free of sanction. Reporting of values is likely to be neutral in that seldom does Customs have a fiscal objective when inspecting export reports. The provision of descriptive material to accompany Customs declarations is easier to secure because in so far as the exporter is the producer, he is generally more knowledgeable about the commodities he exports, and there tend to be substantially fewer exporters than importers. But it should be noted that non-response or incomplete response in the case of values does occur if the documents are very lightly monitored by Customs. 29/ Even when a report is filed, the valuation used need not be sensible. Whereas descriptive material may be available, in practice it may be difficult to secure, particularly if there are policies to promote exports and to facilitate them in every possible way. Finally, the exporter may challenge the authority of Customs to engage in data collection more easily than the importer.

3.46 The situation is not all that different for the survey pricing of exports by the statistical agency, except that its degree of success with response will be as high or as low for exporters as for any other segment of the business population. In other words, there is no reason to suppose that exporters are more or less co-operative than any other group of businessmen. Also, since it is easier for the statistical agency to link a direct inquiry into export prices with its inquiry into producer prices, the advantages of consistent quality adjustment, research and possibly technique of aggregation can be more readily attained.

29/ Cf. The Reconciliation of United States- Canada Trade Statistics, op. cit. This study found that about 5 per cent of United States exports to Canada was not reported. Subsequent inquiries indicated that the proportion was increasing.

IV. THE PROBLEM OF AGGREGATION

4.1 So far, the discussion has turned on the characteristics of the basic data and on the advantages and disadvantages of the two main approaches to deriving price information. In the present chapter, the discussion centres on how the raw data should be summarized for the purpose of compiling index numbers of price and quantity. The paragraphs that follow deal with the price index number concept and how it relates to the uses to which the indexes are put; to how different estimation techniques serve to measure the concept; and to the difficulties that arise in practice when constructing index numbers. 30/

A. Types of index-number formulae

4.2 The formulae most commonly used in compiling price and quantity indexes are the base-weighted Laspeyres, the current-weighted Paasche and, occasionally, the cross-weighted Fisher formula. The algebraic definitions of these formulae are set out below. The symbols p and q refer, respectively, to the price and 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; this has 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 ratios of aggregates of prices multiplied by base period quantities or as arithmetic means of price relatives weighted by base-period values. Paasche price index numbers may be expressed either as ratios of aggregates of prices multiplied by current period quantities or as harmonic means of price relatives weighted by current-period values. Quantity indexes similarly may be viewed in either way. Fisher indexes are simply geometric means of Laspeyres and Paasche indexes.

30/ See R. G. D. Allen Index Numbers in Theory and Practice (Chicago, Aldine Publishing Company, 1975) for an extensive bibliography on index numbers, their interpretation and their theoretical foundations. International recommendations for price and quantity index numbers will be found in SNA (chap. IV) and Guidelines (chaps. IV and V).

Alternative index-number formulae

Type of formula	Formula
Laspeyres	$P^L = \frac{\sum p_1 q_0}{\sum p_0 q_0} = \frac{\sum p_0 q_0 \left(p_1/p_0\right)}{\sum p_0 q_0}$
	$Q^L = \frac{\sum p_0 q_1}{\sum p_0 q_0} = \frac{\sum p_0 q_0 \left(q_1/q_0\right)}{\sum p_0 q_0}$
Paasche	$P^P = \frac{\sum p_1 q_1}{\sum p_0 q_1} = \frac{\sum p_1 q_1}{\sum p_1 q_1 \left(p_0/p_1\right)}$
	$Q^P = \frac{\sum p_1 q_1}{\sum p_1 q_0} = \frac{\sum p_1 q_1}{\sum p_1 q_1 \left(q_0/q_1\right)}$
Fisher	$P^F = \sqrt{P^L \cdot P^P} = \sqrt{\frac{\sum p_1 q_0}{\sum p_0 q_0} \cdot \frac{\sum p_1 q_1}{\sum p_0 q_1}}$
	$Q^F = \sqrt{Q^L \cdot Q^P} = \sqrt{\frac{\sum p_0 q_1}{\sum p_0 q_0} \cdot \frac{\sum p_1 q_1}{\sum p_1 q_0}}$

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

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	$\frac{\sum p_1 q_0}{\sum p_0 q_0}$	$\frac{\sum p_2 q_0}{\sum p_1 q_0}$	$\frac{\sum p_2 q_0}{\sum p_0 q_0}$
II. Moving weights, without chaining	$\frac{\sum p_1 q_0}{\sum p_0 q_0}$	$\frac{\sum p_2 q_1}{\sum p_1 q_1}$	$\frac{\sum p_2 q_0}{\sum p_0 q_0}$
III. Moving weights, with chaining	$\frac{\sum p_1 q_0}{\sum p_0 q_0}$	$\frac{\sum p_2 q_1}{\sum p_1 q_1}$	$\frac{\sum p_1 q_0}{\sum p_0 q_0} \cdot \frac{\sum p_2 q_1}{\sum p_1 q_1}$

4.4 The relationship between these indexes of price and quantity and the corresponding index of value can be readily established. If the index of value is defined as:

$$V = \frac{v_1}{v_0} = \frac{\sum p_1 q_1}{\sum p_0 q_0}$$

then it is clear that it is equal to:

$$\frac{\sum p_1 q_1}{\sum p_1 q_0} \times \frac{\sum p_1 q_0}{\sum p_0 q_0}, \text{ that is, to } Q^P \cdot P^L,$$

and also to

$$\frac{\sum p_1 q_1}{\sum p_0 q_1} \times \frac{\sum p_0 q_1}{\sum p_0 q_0}, \text{ that is, to } P^P \cdot Q^L$$

In other words, the index of value is equal to the product of (a) the Paasche index of quantity and the Laspeyres index of price or (b) the Laspeyres index of quantity and the Paasche index of price. It can be similarly shown that it is equal to the product of the respective Fisher indexes.

4.5 The position taken in the present report is that matrices of prices or quantities and current values should be compiled routinely to ensure that an appropriate data-base is available for the preparation of indexes of price and quantity in any of the forms indicated above. Following the Guidelines, the Laspeyres form of the price index should be given preference in monitoring and reporting on price developments over a given period and the Paasche form of the price index for the derivation of the related quantity measures. The Paasche form of the price index is also recommended for use in supplementing the Laspeyres form as an indicator of the impact of structural changes over the period in the commodity flow. 31/

B. Calculation of Paasche and Laspeyres indexes

4.6 To derive the Paasche and Laspeyres combination in either form, it is a matter of choice for the statistical agency whether it seeks to measure a price index directly and derive the index number of quantity implicitly or whether it wishes to do the converse. But is is not self-evident which one of the two should be chosen. If the statistical agency relies on Customs documents or on compilations thereof as most do, these documents normally provide for each transaction both a value and quantity. From these two, unit value can be derived and it is only then that the choice arises as to how to derive the index numbers. From a strict algebraic point of view, there is no difference between the two approaches but in practice, there are differences often sufficiently significant to affect the over-all measures. In fact, there are good reasons to weigh carefully the choice between calculating directly price or quantity relatives. The array of prices and quantities for any two different periods seldom allows a complete one-to-one correspondence in the commodities to which these prices and quantities refer. In such a situation, the statistical agency has to impute price or quantity changes to the unmatched commodities and it is not a matter of indifference how these imputations are established.

31/ See Guidelines, op. cit., chaps. IV and V, for an elaboration of this position and a discussion of the possible role of Fisher indexes and chained indexes.

4.7 One obvious criterion to decide on which is the most efficient imputation, in the sense of the imputation which for the same information minimizes error, is that of least variance in movements over time. Traditionally, the dispersion of price movements in external trade has been less than that of the corresponding quantities. Nonetheless, from 1973 onwards, even if energy products or those manufactures which have a high energy or energy-related content are excluded, the dispersion of price changes for a number of commodities has attained comparable magnitude to that for quantities. Moreover, before engaging in comparisons of this type, the span over which the rates of change are calculated ought to be defined. It is possible that for annual and longer spans, the dispersion in the rate of change of prices exceeds that of quantities.

4.8 It is also possible that the measures of dispersion of the rates of change in prices differ significantly between exports and imports. If this is the case, there must exist situations where it is appropriate to select different strategies of index-number construction for the two flows.

C. Aggregation into a hierarchy of index numbers

4.9 In practice, index-number makers calculate, store and manipulate price and quantity "relatives" rather than prices and quantities. These are normally selected according to some criteria and, after critical review, are used as raw data for the purposes of aggregation. The selection criteria will vary a great deal depending on the access that the statistical agency has to individual records, the integration that may exist between its editing procedures and the calculation of the index numbers, the nature of the data themselves and, of course, the precision to which the working-out of the index and its principal subaggregates is required. In order to keep the ensuing discussion simple and at a fairly general level, two assumptions are made. The first is that the statistical agency collects unit values or prices for purposes of constructing price relatives, and the second is that it ends up with a base-weighted price index of the Laspeyres type.

4.10 Assume that the construction of a weighting diagram and the choice of a base period are over and that out of the application of the selection criteria for price relatives, the array of prices that will enter the calculation is specified. Moreover, assume that there is an efficient signalling device that notes any change in quality. The statistical agency has to deal on a current basis with (a) the collection of prices; (b) the identification of the commodities to which they refer so that the matching with comparable commodities in the base period may take place; and (c) the calculation of price relatives R^{p}_{ot} where t is the current period. Once R is calculated it requires to have a weight attached to it so that it may enter any necessary intermediate or final aggregation.

4.11 The weight W_o is of the form $p_o q_o / \Sigma p_o q_o$ or, in other words, it is the share of the commodity under review in the total base-period value of the flow (aggregate or subaggregate). More often than not, the particular relative corresponds to a price selected to represent a broader ensemble of products. Accordingly, the weight ascribed to R refers to the base-period value of all the commodities it represents. The product $W_o R^{p}_{ot}$ is stored for accumulation with other products until all the components of the aggregate index are calculated and ready to be added together.

4.12 Many countries extend the publication of their index numbers of price and quantity to cover important components as well as the total and, therefore, carry out several subaggregations. Accordingly, W_o is not expressed as a share of total value in the base period but rather as a share of total value in that segment of the classification which constitutes the first level of aggregation. If there is a hierarchy of levels of aggregation, there must be a corresponding hierarchy of weights which should be matched level for level with the part of the classification to which they are specifically related.

4.13 In certain circumstances, the statistical agency may find that, for a particular commodity, it has several price relatives but no weight for some of them. While this is unlikely if the index number is derived exclusively from Customs sources, in cases where it is directly derived or in the so-called hybrid cases, which will be discussed at a later stage, there may be instances of such a situation. The question arises how these relatives should be weighted particularly if they are considered important in the context of the index-number calculation. One satisfactory procedure would be to calculate the geometric average of the relatives in order to avoid giving excessive weight to extreme price observations. Another procedure would be to weight each quote by the reciprocal of its standard error or, in the absence of such knowledge, by a factor denoting the reliability, even if subjective, attached to the statistic. 32/ The point about such a procedure is that whatever information exists and is deemed to be relevant to the construction of the index number, should be incorporated in an explicit fashion.

D. New products

4.14 There are problems that arise in the construction of index numbers because the commodity universe is not stable over time. In fact, new products are devised and marketed, old products are withdrawn, and products are changed with respect to their price-determining characteristics. Whether the index is based on total coverage or on a sample of relatives, matching commodities remains one of the most difficult day-to-day problems to solve. Import prices are probably more vulnerable to what could be called product innovation than other price collections such as consumer prices. With the latter, there is a built-in inertia in the collection procedures that allows for the gentle phasing out of certain products and the phasing in of others, a convenient feature both from the point of view of the price interviewer and the price index-number maker.

4.15 In the case of consumer prices, generally collected at retail outlets, it may take some time before a commodity that is no longer sold or is hardly ever sold actually leaves the shelves of the outlet and with it, any evidence of the price at which it would be sold if only someone wished to buy it. Likewise, the introduction of new products is often done piecemeal, at selected outlets at first, so that they may coexist with the products they are slated to replace. In the case of imports, the chances are that, if a product is felt to be rapidly losing in popularity, trade in the product will stop literally overnight. When a new product is introduced, it will be brought in when the inventories of its predecessors are judged adequate for the period of coexistence. But, unlike the situation with

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32/ Cf. R. Stone, Quantity and Price Indexes in National Accounts (Paris, The Organisation for European Economic Co-operation, 1956), p. 105.

retail prices, the inventory of previous models is neither visible to the Customs officer nor to the statistician. For this reason, there may be no time or opportunity to smooth products in or out in the same fashion and price movements may have to be imputed from those observed in the case of similar products with an appropriate measure of continuity and price homogeneity. 33/

E. Choice of base period

4.16 There are several aspects to the choice of base period in constructing price and quantity index numbers. First, there is the choice itself. Are there any set criteria to guide it? Secondly, there is the question of how often this base should be reviewed in order to be brought up to date. Thirdly, there is the question of how index number runs, established on different base periods, can be put together for the purpose of creating a synthetic run appropriate for long-term comparisons.

4.17 It makes intuitive sense that the period chosen as base should be a period when all the commodities covered are in rough supply-and-demand equilibrium and no price level or particular set of price levels appears to be badly out of step with the others. In actual practice, there is frequently no one period that meets all these conditions in the strict sense of the word. There are always relative prices that by one criterion or another can be said to deviate abnormally from their historical norm. Accordingly, the choice of a base period has to proceed in a negative rather than in a positive fashion and consists in avoiding those periods when massive shifts of demand or supply caused large changes in the relative prices of a particular set of commodities. Typically, periods of war, severe drought or other natural disasters and periods of boom in particular commodities should be avoided. But these are not all the considerations that enter into play. For example, a statistical agency may seek to calculate all its price indexes on the same base period and because domestic circumstances may not be entirely reflected in external circumstances, one of the two sets of indexes may actually suffer. Alternatively, a statistical agency may find it has no choice of base period left. Having planned well in advance a major census from which a wide range of weights are to be derived, if the year of census turns out to be an abnormal year, it may be too late to do anything about it. Nonetheless, the requirement for integrable data may suggest that very same year as the common base period for all price-index numbers. A statistical agency may also select a year in order to conform to the year recommended by international statistical agencies and this year may not always turn out to be an appropriate choice from the national point of view.

4.18 There should be no confusion between "base" period and "reference" period. Base period is an expression traditionally reserved for the period to which the weights relate, and it need not be the same as the reference period. For the aggregate as well as for all the subaggregates, in an index number of Laspeyres form, the additive relationships and the changes over time remain invariant when the reference period is shifted from t to $t+k$.

33/ Cf. Guidelines, op.cit., paras. 49-59.

4.19 In the case of external trade, the choice of a base period is not constrained by the availability of data from Customs because these are produced currently. It is more a matter of integration of national statistics, of co-ordination with international statistical agencies and of the avoidance of years which are definitely unacceptable. The problem recurs often in the case of external trade because the configuration of the weighting scheme may change faster than for other components of expenditure on gross national product. In general, relatively frequent updates are indicated for external trade but they require computing resources and skills to link the new estimates to the old and to explain satisfactorily the mechanics and the purpose of the operation.

F. Change of base period

4.20 While there are no set criteria to determine when a change of weights is required, there are several manipulations of the data which can provide evidence for this purpose. In addition to the manipulations which are discussed below, the mortality of the original sample of products is likely to increase with time and the substitute products may start to differ from their predecessors functionally as well as qualitatively. There is no objective ceiling beyond which the number of replacements becomes unacceptable, but a practicing statistician does acquire with experience the feel that the figures are no longer under control. The following paragraphs deal with two simple issues: the first concerns the precise nature of the manipulations that a statistical agency should undertake prior to deciding whether a base revision is required. The second has to do with the techniques that may be used to link runs of index numbers calculated according to different weighting schemes.

4.21 So far, reference has been made to the dual calculation of index numbers of Laspeyres and Paasche form in the context of selecting one for price and the other for quantity so that their product equals the change in value. Since Laspeyres and Paasche can be calculated for the same component, the relationship between the two at any point in time is measurable so long as the required weights are available. This relationship is an element upon which the decision to review the weights can be based.

4.22 If the statistical agency is in a position to calculate the difference at appropriate intervals and if after a sufficiently long period of time it detects a significant increase in its value, it should take steps to replace the weighting scheme by a new one. There is more flexibility, it should be added, in revising weights in the case of external trade indexes, than say, in the case of the consumer price index. Considerations of integration apart, the domestic spotlight on these indexes is unlikely to be as intense and decisions on base changes may more easily be taken on their technical merits.

G. Linking index numbers with different base periods

4.23 As a matter of prudence, a statistical agency will wish to monitor very closely the behaviour of an index number calculated on a new base year. In fact, it is considered judicious to provide a period of overlap for this purpose whenever such a change takes place. Whether this is done currently by producing for every period two sets of indexes and subjecting to analysis the differences between them, or ex-post facto by producing the new version so that it overlaps the old, is an

operational matter for the national statistical agency to decide. In addition to providing an overlap, the statistical agency is also expected to provide guidance on how to link the two series. Imagine the following situation for two Laspeyres price indexes:

Period	t-k,	...	t-2,	t-1,	t,	t+1,	..., t+k
Old version .	I_{t-k},	...	I_{t-2},	I_{t-1},	I_t,	I_{t+1}	
New version .				I'_{t-1},	I'_t,	I'_{t+1},	..., I'_{t+k}

Assume that a run of measures extending from t+k back to t-k is required. One simple solution is akin to the splicing that was briefly discussed in connexion with the introduction of new goods or of goods with substantially changed qualities. The solution consists in extending backwards the relationship between the two indexes in the overlap period. In the example, there are three periods of overlap so that a choice is possible. Since it can be argued that with the passage of time, the representativeness or characteristicity of the index deteriorates, the "true" relationship can be best estimated at the time when the old index is closest to its base, provided that this is not offset by the choice of a period too remote from the point of view of the new index. 34/

H. Alternative forms of index numbers

4.24 In external trade, unlike most other expenditure components of the national accounts, shifts in trading patterns as a result of shifts in supply and demand seem to occur relatively fast. Accordingly, it is wise to ask the question whether the traditional forms of index number used for the factoring of values into price and quantity should be replaced by more appropriate even though less well-known forms. Since, in the case of external trade, weights are available on a current basis and virtually any combination of weights and relatives is possible, the question takes on obvious practical significance. An examination of country practice as shown in the annex to the present report, reveals that a fair number of countries compile index numbers of the Fisher-type or chain-linked indexes.

4.25 Chain-linked index numbers derive their name from the fact that, while their base shifts over time, there is a device to link the index for each period to the two adjacent ones. The following form is developed for a Laspeyres-type price index.

34/ More elaborate procedures for the development of long-run series are discussed in SNA, op.cit., paras. 4.46-4.47. See also the discussion of alternative forms of index numbers in paras. 4.24-4.25 below.

Period	1,	2,	.....,	n-1,	n
Index	$\frac{\sum p_1 q_0}{\sum p_0 q_0}$,	$\frac{\sum p_2 q_1}{\sum p_1 q_1}$, ...,	$\frac{\sum p_{n-1} q_{n-2}}{\sum p_{n-2} q_{n-2}}$,	$\frac{\sum p_n q_{n-1}}{\sum p_{n-1} q_{n-1}}$	

The run of indexes as a time series, designating each term as I_t and the original links as I'_t (for t=1,...,n), has the form:

Period	Index
1	$I_1 = I'_1$
2	$I_2 = I'_2 \times I_1 = I'_2 \times I'_1$
⋮	⋮
n	$I_n = I'_n \times I_{n-1} = I'_n \times I'_{n-1} \times \ldots I'_1 = \prod_{t=1}^{n} I'_t$

This form has an obvious advantage from the point of view of the practical index-number maker in that the number of "births", "deaths", and changes in quality which have to be dealt with at any one time is smaller than in the case of the more traditional forms of index number. Since all direct comparisons are within the neighbourhood of the base period, the instability of individual components is minimized. 35/

I. The exchange-rate problem

4.26 So far, the analysis of the problems of measuring prices in external trade has proceeded on the assumption that the relationship of the national currency to the currencies of the principal trading partners does not change. Alternatively, the assumption is that there is an international numéraire to which the national currency as well as everyone else's has a fixed relationship. It is time to relax this assumption, particularly as recent years have witnessed massive realignment of currencies. From the point of view of a country interested in measuring changes in its prices abroad as a gauge of its competitive position, it is of little consequence to determine that its prices expressed in the national currency have remained stable, if this has been accompanied by a large revaluation vis-à-vis the currencies of its major competitors. Accordingly, it is of greater importance for this particular purpose to determine the price change in terms of a numéraire than to adhere to the nominal prices in national currency that are reflected in the Customs documents or are reported directly to the statistical agency.

4.27 In order to calculate index numbers expressed in an international currency or in the currency of the market abroad, certain assumptions must be made about the way exporters behave when they report values to the Customs administration. Normally, the value reported to Customs is computed in the national currency. But this may be a notional value if the real price at which merchandise is sold was initially

35/ Cf. SNA, op. cit., paras. 4.44-4.47 and Guidelines, op. cit., chap. IV.

calculated in some third currency and the reported value is merely the result of conversion of the negotiated value at current exchange rates. Alternatively, the price in national currency reported to Customs may already include the effects of exchange-rate alignment. In most cases, the documentation submitted to Customs does not shed light on the behaviour adopted by the exporter nor how the settlement by the importer abroad is to be made. It, therefore, remains an area of export price indexes where there may be substantial advantages in carrying out a direct price survey.

4.28 Even more pitfalls exist in the case of import prices expressed in other-than-national currencies. The documents that accompany the Customs declarations may be expressed in virtually any currency and little is known how, in reality, payment is to be made. The convention calls for Customs to convert a price denominated in foreign currency by applying the prevailing spot rate of the day on which the merchandize is to be cleared. The importing country may wish to analyse the observed changes in its import prices into those changes that are due to changes in the price charged by the exporter in his own currency and those changes that result from changes in the exchange rates. If so, the calculations are similar to those discussed in the case of exports and are based on critical assumptions about the way in which prices are established in the reports to Customs.

V. SOME TENTATIVE SOLUTIONS

5.1 So far, the discussion has consisted of an examination of the sources available, the limitations of each, the major problems that arise in the pricing of commodities and how those problems are likely to affect the broader measures of export and import prices. There has also been an examination of techniques for the aggregation of individual price series into summary measures. In the course of the review of these issues, recommendations have been made with the purpose of either suggesting to statistical agencies ways of overcoming the difficulties described or showing how to take advantage of the special features of the raw data. In the present chapter, these recommendations are brought together in a systematic fashion.

5.2 It is important to bear in mind that, in accessing the Customs records, a statistician is accessing a census of all commodity transactions between his country and the rest of the world. Admittedly, the information contained in these records is not always spelt out in the right form. Often, the information is recorded using non-standard expressions which make it difficult for the statistician to reconcile the record for one period with any previous record. To overcome this, the external trade statistician has an important tool available in the form of equipment for high-speed data processing. With the help of the computer, data can be aggregated, re-aggregated, sorted and merged. Few other economic statistics in any country tend to be as automated as those for external trade. Another asset that the statistician should utilize fully is the availability of current weights. This means that in order to study the decay of a particular index number, no new survey designed to obtain the basic statistics for weight estimation is required. Finally, Customs documents do normally identify both the exporter and the importer. Accordingly, if the statistician wishes to measure prices by a direct survey, the Customs records can be expected to provide the raw material necessary to construct a list of reporting units.

A. Estimating reliability

5.3 Assume a situation where the statistical agency has the following assets: access to individual Customs declarations, a list of all importers and exporters, and a description of the principal activity of each one of those importers and exporters. Assume also that the statistical agency has access to expertise on commodities and maintains contacts with the country's principal manufacturing industries. How can such an agency go about estimating the reliability of its price measures with a view to improving them? The question can be re-phrased as follows: given that the over-all precision or reliability of the price measures is the joint effect of many factors, what criteria should a statistical agency use to allocate its existing resources and additional expenditures if the objective is to ensure a steady stream of improvements in the index?

5.4 The following aspects of the data must be considered. First, there is the accuracy of the flows themselves. This accuracy can be gauged by systematic comparisons with counterpart reports of the same trade flows and is best measured by a country-by-country analysis, at least for those countries that are important trading partners. For those countries that are important exporters of a small

number of primary resources, one quick way to analyse the quality of the statistics on their exports is by reference to the trade matrix by commodity that comprises the bulk of volume II of the United Nations Yearbook of International Trade Statistics. 36/ The unexplained gap as a proportion of the flow of trade to which it refers and, in particular, the direction of its change over time, provide a basis for a numerical measure of precision. Next, there is the quality of the commodity classifications applied to the individual transactions. An assessment of this quality can only be made by periodic sampling of individual declarations and accompanying documents - invoices for example - and recoding them ab initio. The recoding exercise can be used to derive a formal measure of accuracy.

5.5 It is difficult to specify ways of estimating valuation errors without introducing a special inquiry on the subject. A record could be kept of all changes in a given valuation as a result of either a finding by Customs or by the statistical agency itself and the size of the changes could be expressed as a proportion of the original declared value. But nothing is known about the complete population and, in particular, whether the set of transactions that has its values changed is representative.

B. Measuring unit-value bias

5.6 If the statistical agency relies on Customs documents, or compilations from these documents, for the calculation of its price index numbers, it will have to estimate what the unit-value bias is likely to be, commodity by commodity. Possibly, for commodities in the initial stages of transformation and for primary commodities, not too much effort should be spent on this. But for the more advanced manufactures there should be an attempt to calculate changes in the product mix. Seasonal changes are of comparatively little interest in that they are readily detectable and can be adjusted for in simple ways. But more permanent changes in mix are all important, as failure to record them could lead to the permanent distortion of the price and quantity measures. The following are some of the ways in which a statistical agency can protect itself against this. First, through its editing procedures it should keep under continuing scrutiny the distribution of unit values within each category of the classification. Secondly, it should keep under some form of cyclical review the commodity categories that are likely to be the object of variation in mix and, through inspection of invoices and other documentation, gauge the impact of such variation. Finally, the statistical agency should institute a system of periodic consultation with the principal importing and exporting industries in order to ascertain current commodity trends and how they are reflected in the pattern of commodity imports and exports.

5.7 It is not likely that resources will permit a statistical agency to carefully review all the commodity categories it is concerned with at once. It may, therefore, be forced to adopt step-by-step procedures on the basis of which it should be able to estimate the "potential unit-value bias" for the commodities that are not being currently reviewed. There is also the error caused by incomplete coverage. This can come about in several ways. First, not all Customs declarations have a meaningful measure of quantity. Gaps may be accepted or else dealt with by imputation, but the imputed quantities may themselves be the result of an imputed price. Secondly, there may be unit values which show movements over time of such an erratic nature that they can only be interpreted as the result of rapid but

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36/ United Nations publication, Sales No. E.79.XVII.8.

undetectable changes in product mix. In the light of this, the statistical agency may decide to exclude these unit values from its calculations of price index numbers. Thirdly, the statistical agency may have decided to opt for a restricted selection of time series but one that it can define narrowly in terms of commodities and that it can follow through time rather than to opt for a more ambitious selection to which attention cannot be devoted as intensively.

5.8 If these last reasons prevail, the statistical agency will, in fact, have a sample of prices or near-prices and should seek to measure the sampling error. This would complete its measure of over-all reliability. But seldom will the sample have been chose by random selection with explicit chances of selection attached to each of the observations. The likelihood is for the sample to result in part from a set of circumstances beyond the control of the price index-number maker. Examples ard the presence or absence of units of quantity or the proportion of "unique" goods in the trade flows which, with or without a measure of quantity, are not susceptible to comparison over time. In addition, there are the subjective judgements made by the statistician about which particular series of unit values behaves in what is thought to be an appropriate way. The latter could be a dangerous criterion of selection because the index-number maker may unwittingly bias his selection towards those time series that show high auto-correlation coefficients and, therefore, look more like what one has come to expect from a price series. But even if the results of these procedures do not lead to the constitution of a "representative" sample, one could still pretend it had been chosen at random and use the variance to estimate the possible error caused by partial coverage.

C. Developing sampling frames

5.9 However a statistical agency decides to calculate the required measures of price in external trade, it is important that at the outset it compile a directory of importers and exporters. The most natural way of doing this, if there are no existing registers of business, is to derive such a list from the Customs documents themselves. In most cases, the declarations filed with Customs disclose the identity of the principals to the transaction. There is an important distinction to be made in that at the level of Customs and in connexion with the payment of duties, unloading, clearing etc. only an agent or a broker may be involved, without any knowledge of what the transaction is about or for. But because of legal considerations, normally the agent is obliged to reveal to Customs the identity of the principal.

5.10 Of course, names and addresses obtained in this fashion are not good enough to constitute a directory. They may conceal a severe degree of duplication, particularly when the businesses involved are multi-company and may act through a variety of affiliates. It may thus take some time before a near-complete register of active traders can be compiled.

5.11 For such a directory to be of analytical interest, it must include a description of the principal activity of the exporter or importer. To secure a meaningful description of activity there are three main options depending on availability of the raw data. If the agency has a general business register, a match between the main register and the list of businesses in external trade is required. The efficiency of such a match depends on whether the statistical agency has the facility to match alphabetic lists (unless there is a universal numerical designation for businesses). The match may also be conducted manually, but this poses a limit on the number of records if the costs of the operation are not to

become prohibitively high. Finally, there may be no list, in which case the statistical agency will depend on direct inquiry, perhaps assisted by telephone directories and trade journals.

5.12 A statistical agency may be helped by trade associations if these request that their members identify themselves as a condition of membership and the associations are prepared to make this knowledge available. Such aid is particularly valuable in the case of exports, where Customs records may be deficient or even non-existent. The trade associations may also be a better source for list maintenance than the Customs records. The latter can only suggest that a particular business is no longer active, at least not in external trade. But they may be of no assistance to determine whether this is because of a name change, a merger or takeover, bankruptcy or a change in the nature of its activity. Not only must the statistical agency have a procedure to interrogate businesses that are seemingly inactive but they must establish whether, in fact, they have duplication in their records. A trade association on the other hand, even if it cannot ensure full coverage, may be in a position to reply to all these questions without inflicting further burdens on the respondent.

5.13 Notwithstanding the difficulties of maintenance, a list of names and addresses is an essential tool which, once compiled, can be used for two major purposes. The first is to contact, on a regular basis, representative exporters and importers in any one particular line of business. The reasons for such contacts may range from attempts to further commodity intelligence, so important for quality adjustments, to the need to establish which products are about to become obsolete and which others are slated for introduction. A second reason is to use the list as a sampling frame, if prices are to be measured by direct survey or if special studies are to be made of the Customs documents which involve sampling them. Bearing in mind that a list of names and addresses drawn from Customs records associates with each name the commodities imported or exported, the sample can be designed in such a way that each dollar in trade stands a known probability of being selected. Sampling of this kind is limited by the detail in which commodities are described to Customs. If the descriptions are vaguely worded and cover a wide range of varities - if not products - little can be done about it. 37/

5.14 A statistical agency should develop contacts with counterpart agencies in partner countries to request assistance in the interpretation of the details of a transaction. While this is not a course of action that all countries feel is open to them, it none the less constitutes an important asset for some. Bilateral contacts may eventually lead to an exchange of reports whereby the two statistical agencies agree that the import records of one will normally become the export records of the other. The feasibility of such an exchange will depend on such factors as the existence of contiguous borders, relatively-large trade flows and good political relations between the two countries. 38/

5.15 While useful for assistance on the details of a transaction, the average level of international statistical co-operation is not such that a country can use foreign sources as the basis for a sampling frame for its imported commodities.

37/ Cf. United States Department of Labor, United States Bureau of Labor Statistics, 1976, Handbook of Methods (Washington, 1976), chap. 17.

38/ See K. H. Schlüter, Aussenhandel und Statistik (Mainz, W. Kohlhammer Verlag-Deutscher Gemeindeverlag, 1967), pp. 88-92, for illustrations of the discrepancies which may arise between partner-country records.

But on its own, a country may find that the cost of establishing and maintaining lists of traders and the commodities they trade in are beyond its budgetary possibilities. Accordingly, if for other reasons the statistical agency feels that it must sample commodities, it is forced to do so by applying judgement to the universe of commodities. This can be done in a variety of ways and it is not necessary that it be consistant among commodities.

D. Refining unit values

5.16 The possibilities of extracting more information from Customs records are by no means fully exhausted. This applies particularly to statistical agencies which have access to files of individual transactions recorded in ways appropriate for computer processing and which have the ability and the resources to manipulate such files extensively. The basic obstacles to overcome are the coarseness of the commodity classification and of the units of quantity reported for each category of the classification. The means of overcoming such obstacles included, among others, the progressive narrowing down of the categories into which transactions are classified, in order to increase the homogeneity of the resulting sets. This can be done either directly, through the drawing up of tight lists of specifications or else indrectly, by using subsidiary breakdowns and verifying empirically whether these breakdowns appear to have a positive effect on the homogeneity of the resulting selections. Thus, the indirect approach consists in supplementing the commodity classification by country of origin or destination, size of transaction, mode of transport, identity of importer or exporter and tariff classification if it is a classification or an expansion of a classification in its own right.

5.17 There is a distinction to be made between exports and imports on the grounds that the diversity of product in the case of imports, particularly manufactured products, is normally substantially greater than for exports. If each product in each reporting country has an equal chance of being changed by quality improvement over a period of time, the probability of such a change taking place for a given period in the case of imports would exceed that for exports by an amount proportional to the number of supply countries and the ratio of the number of imported to the number of exported products. The difference between exports and imports in respect of complexity of commodity classification, number of varieties and probabilities of quality change, provides the statistical agency with an important indicator of how it should deploy its resources and, if it wants to make rapid progress, which of the two flows is most likely to yield positive results in the short run.

5.18 The analysis of data reliability could provide the statistical agency with yet another set of important indicators on how to allocate its resources between alternative means of breaking down and re-grouping the raw data. For example, if research into reliability shows that coding of commodity categories tends to incur a proportionately higher rate of error than other variables, it is more efficient to concentrate on those breakdowns which assist in detecting the wrong codes. Importer identification and size of transaction usually constitute two good examples; the point of entry at which the merchandise is cleared could constitute another. But the country of origin may not be of any assistance in detecting this kind of error. Straight comparisons between importers may indicate unsuspected problems in valuation, due perhaps to transactions between seemingly independent firms that turn out to be related by some form of ownership or control.

If the imputation of transactions to their country of origin is suspect, the analysis of means of transportation plus any details on the ships or aircraft used, available from related administrative files, may provide better indications on the source of error than further work on the details of the commodity classification. In short, the way in which a statistical agency can maximize the effectiveness of auxiliary breakdowns for the derivation of prices is to study the raw data in conjunction with its research into the reliability of the data.

5.19 For each of the selected breakdowns in each of its possible combinations, the statistical agency will have to compare the distribution of unit values with that of the unit values for the commodity category as a whole. In the first instance, it is a matter of application of standard statistical tests to determine whether the "narrowed down" distrubutions are significantly different from the over-all distribution and whether the variances of the disaggregated sets are smaller than the over-all variance. There may be a number of computational difficulties resulting from known peculiarities of the data or, more importantly, from the fact that in certain cases, the number of transactions on which to conduct the tests is too small. Nevertheless, the statistical agency should mobilize adequate computing facilities so that the parameters for measuring significant differences are explicit and the complete procuedure is as automatic as possible. The parameters are, in effect, the criteria upon which it will be decided whether the unit-value relative is to be calcualated on the over-all commodity category or on a segment thereof.

5.20 This approach to index-number construction presupposes a very intimate link between the way in which incoming information cn the value of transactions is edited and the way in which it is subsequently incorporated in the index. Such a link should be used for the systematic interrogation of importers and exporters on the nature of transactions whose prices appear to deviate from the mean for their cell by more than some amount fixed as a result of historical experience. This may be an important lead to changes in quality or to shifts in product mix undetected even after inspection of individual Customs declarations.

E. Combining sources of data

5.21 The discussion above leads to a set of recommendations for those statistical agencies that meet the conditions assumed at the outset. These are that the statistical agency has established co-operative arrangements with Customs, that the statistical agency has access to computing equipment and that it employs commodity experts. It has also been assumed that the agency has some experience in the field of price inquiries and that it has developed means to contact and co-operate with the statistical agencies of its principal trading partners. Finally, it has been assumed that a research group has been formed whose major task is to keep the index, both in terms of individual constituents and in terms of aggregate comparisons, under steady review. The discussion suggests that, in such situations, the over-all measurement of price changes in external trade could be improved by combining the Customs-based data with information drawn from a variety of sources. These would include export and import direct price surveys, surveys of domestic prices and the results of related inquiries made by the statistical agencies of trading partners.

5.22 In previous chapters, reference was made to the fact that data obtained from each of these sources had their own unique combination of advantages and disadvantages. In other words, given the range of possible errors, each source

produced data with a unique combination of errors. Some of these errors could not be estimated with sufficient reliability and as a result, it was not possible to engage in direct comparisions of the quality of the data produced. In spite of this, it was possible to identify which source was the most appropriate to meet a particular objective. As for the advantages, they were mostly related to cost in its widest sense, that is, including the monetary and real resources required to provide commodity expertise, maintenance of directories, control of specifications etc.

5.23 When a choice is made for individual commodities in this context, it is mostly between direct surveys and unit values. For commodities subject to little or no transformation, there may be little difference in the characteristics of time series of unit values and series of prices derived by direct survey. In the case of commodities subject to considerable transformation, however, the two sets of data frequently show different results and, particularly in those cases where there is rapid quality change, the error incurred in using unit values is likely to exceed significantly that of direct price surveys. 39/ If the statistical agency has tried out all the devices suggested in previous chapters to make the best use of Customs information and there still remains the suspicion that there are substantial changes in the product mix, a direct price survey should be launched for those commodities. As resources become available, the scope of this survey should be progressively extended in consonance with the general guidelines for national work on the development of a comprehensive price statistics system.

5.24 If a direct price survey is not immediately possible, or if resources will not allow more than a token survey restricted to a very small number of highly critical commodities, for which no unit values are derivable anyway, other alternatives should be pursued. In particular, domestic producer prices may be used to supplement unit values, and the survey from which the former are derived may be amended to include, if at all possible, questions to establish if the varieties sold abroad differ in price, quality or both, from those sold in the domestic market. Failing attempts to gather intelligence from domestic sources, related data available from partner countries should be examined and utilized.

39/ Comparisons of unit-value and specification price series will be found in Measurement of Price Changes in External Trade, op. cit., and in the related country paper contributed by Canada. For the United States, see I. B. Kravis and R. E. Lipsey, Price Competitiveness in World Trade, volume XXVII, (New York, National Bureau of Economic Research, 1971).

VI. STRATEGIES FOR COMPILING INDEX NUMBERS

6.1 The present chapter contains descriptions of three strategies for the compilation of index numbers in external trade which might be considered for adoption by statistical agencies in tight, average and relaxed budgetary circumstances, respectively. These strategies may also be regarded as providing a framework within which the development of work in a given country may be systematically planned. From this perspective, the recommendations for statistical agencies in tight budgetary circumstances may be looked at as directly relevant to most developing countries, especially to those about to begin work in this area. In specific situations, individual cost-benefit considerations may suggest significant modifications in the implied priorities.

6.2 It is assumed that, at this stage, that is, by the time a statistical agency is considering which is the most appropriate strategy to adopt for the compilation of index numbers, it has defined its objectives. It is also assumed that these objectives include the preparations of (a) suitable deflators for estimating the values of sales and purchases of goods to and from the rest of the world within the national accounting framework and (b) summary measures of external trade prices, for which the question of consistency with flows measured at constant prices is of secondary importance. The statistical agency will have balanced these two demands and decided on the nature of the compromise to be made in each case.

6.3 The assumption that there are different purposes to serve in compiling price index numbers carries with it a number of implications for the measurement of the freight and insurance margins which are normally included in the value of imports. It is unlikely that agencies inclined to adopt the first strategy will have the resources to do much about disentangling payments for these services in the Customs valuation. Other countries may feel that they are in a position to do so. Typically, countries in the second tier of the budgetary classification may decide to sample Customs documents in order to compile a matrix of commodity-origin/destination values for freight and insurance margins. This is an exercise whose precision is strictly a function of the size of the sample and of the quality of the files that the Customs administration keeps on each transaction. As for countries in a well-endowed situation, the statistical agency may pursue the matter of estimating these margins in the course of direct consultation with the reporting units established for its price surveys.

A. Strategy for a tight budget

6.4 Under tight budgetary conditions and if the country's commodity structure of trade is simple, the statistical agency should not attempt to go much beyond measures of unit values derived from Customs sources for both exports and imports. Such measures should be derived from compilations rather than from individual records. In this way, the statistical agency can see itself as the beneficiary of a Customs administrative process, assuming that it is the Customs administration that prepares the compilation of raw data. The statistical agency should be prudent in the detail that it requests from Customs. For each item, there should

be a value/quantity ratio. "Item" should be defined in the narrowest sense possible (for example, the fifth digit of SITC) but where there is a separate tariff classification for imports, it should not be necessary to request tabulations involving the two. Initially, the statistical agency should limit its activity of inspection to a comparison of the item V/Q ratios with each of their constituent item/country of origin or destination ratios in order to detect cases where the differences are significant. Such an inspection may be visual and based on arbitrary parameters, perhaps not even explicit. Item/country combinations that exhibit markedly different ratios from the item average over a certain period, say one year, should be candidates for separate treatment in the index.

6.5 A selection should be made of all the unit values that display stable characteristics in terms of patterns of period-to-period change. For example, only those items or item/countries whose quarter-to-quarter change in unit value, disregarding sign, does not exceed twice the standard deviation of the unweighted changes may be considered as candidates for inclusion in the index. 40/ This selection should be tempered by the need to achieve broad representation, that is to say that all SITC groupings at a certain level (say, three-digit) should be represented by a measure covering not less than one half of their value. An exception, however, can be made for certain groupings. In fact, virtually the entire section 7 of SITC ("Machinery and transport equipment") as well as most of section 8 ("Miscellaneous manufactures") should be the object of special treatment because of the incidence of unique and complex goods, particularly in the case of imports. The rationale behind these recommendations is not difficult to understand. Series of relatives that exhibit sizable irregular movements are suspected of doing so because of shifts in product mix which are not detected by the analysis of the item/country breakdown. Accordingly, they should be excluded from the calculations. Broad representation is important if the over-all series is to be used in the context of the national accounts and in conjunction with an estimate of the flow of constant prices. And finally, the exclusion of portions of sections 7 and 8 is justified on the grounds that their inclusion could on balance produce over-all estimates of price change of poorer quality. In practice, the statistician will have to trade considerations of representativeness against those of irregularities and shifts in product mix.

6.6 Once the price indicators are selected, each one should be linked to the weight it represents in the over-all calculation. Thereafter, it becomes a matter of straight statistical compilation. Weights should be stored in such a way that they can be retrieved in conjunction with unit values and as each new observation is added, it should be divided by the base-period unit value and multiplied by the weight as a matter of routine calculation. Obvious adjustments stemming from quality changes, appearance or disappearance of products etc., should be made manually before the phase of automatic calculation.

6.7 If computing resources permit, the statistical agency should keep a separate record of each time series of relatives for future research and analysis. For that reason, it should first store and then proceed to aggregate the cross-products of relatives by weights. The aggregation can take one of two forms. It can

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40/ In doing this, it is important to note and treat separately all items whose period-to-period change is of a seasonal nature.

generate a number of separate accumulations, each corresponding to a particular sub-aggregate and one to the over-all total, or it can be sequential, so as to provide the statistician with time to intervene, inspect the behaviour of the sub-aggregates and, if necessary, apply corrections to the elementary data.

6.8 The publication of an index compiled on this basis can take several forms as discussed in chapter IV. If the statistical agency has good reason to believe that the estimates of the sub-aggregates are not firm, either because of underlying error in the value data or else because the individual unit values are stretched to cover too broad a span of commodities, it should limit publication to the aggregates.

B. Strategy for the average budget

6.9 The following are the assumptions underlying this strategy. The statistical agency has access to the individual documents filed with Customs and has the means to store and retrieve the corresponding records individually. The statistical agency has the computing capacity to manipulate those records in the form required and can move back and forth from a record in computer-readable form to the corresponding declaration and invoice. Finally, the statistical agency has a nucleus of officers who are by experience, training and current occupation, capable of following the major developments in the manufacture and marketing of the products of the industries in which they specialize. The statistical agency relies essentially on the contents of the Customs declaration and on any analytical conclusions it may draw from the intensive processing of the information in those declarations. 41/

6.10 Given these assumptions, the statistical agency should make sure that it either receives or creates a complete file in which each individual transaction is recorded together with all the relevant variables. 42/ At this point, the variables in question include all those that were discussed at length in chapter III above. Such a file should be used both for the compilation of the trade statistics in value terms - after each transaction or subtotal has been subjected to the usual editing tests - and as raw input for the compilation of price and quantity index numbers.

6.11 Assuming that indicators have been selected along lines similar to those described for the first strategy (but with the possibility of more complex stratifications), the input file should provide the statistician with three key items of information for each selected category. The first is the simple arithmetic average of all the unit values within the category; the second is the unit value for the category calculated in the standard manner; the third is a measure of dispersion of the component unit values within the category. In addition, there could be a number of auxiliary indications such as the number of transactions, their modal size etc. The measure of dispersion becomes a good deal more useful if there is a capability to attach to it a plot of the individual unit

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41/ An example of national practice following broadly the lines indicated here will be found in S. Brenna, "Revision of indices of foreign trades", Artikler fra Statistisk Sentralbyra, No. 57 (1973), (mimeographed in English).

42/ There may, however, be a cut-off point in the range of transaction values below which nothing is recorded or only a sample of transactions is recorded.

values. An examination of these three elements, with the help of explicit criteria of selection, should precede any calculation of the index.

6.12 One example of such criteria is that the mean unit value as determined by the simple arithmetic average should not deviate by more than a pre-specified percentage from the last period mean or, in the case of seasonal commodities, from the mean 12 months earlier. All cases of reversal in the direction of change should be looked at; changes in the measure of dispersion in excess of a pre-specified value should be questioned; and finally, any gap between the category unit value and the simple arithmetic average of its components greater than a pre-specified value should also be questioned. These criteria are based on the presumption that prices and the structure of prices within a certain framework (a classification category or any of the finer combinations of variables alluded to in various paragraphs above) do not move abruptly. In other words, large movements in the same direction are suspect and reversals of direction of change of any size are even more suspect. These are comfortable assumptions to make for stable products in non-inflationary times. At times of rapid price change or of currency instability and for products that are still undergoing appreciable technical innovation, these assumptions may be misleading. It is up to the price statistician to review them regularly in order to determine whether, in the light of the general economic climate, they continue to be relevant.

6.13 The explicit editing criteria referred to above are empirical and can be introduced with varying degrees of sophistication. One way is to apply an extrapolation formula to the summary measures calculated for each category. The extrapolation can be simply linear, on the basis of the latest change, or the result of exponential smoothing or for more sophisticated systems, the result of auto-regressive moving averages. 43/ The permissible gaps or changes should be determined in a fashion such that, on balance, the number of monthly interrogations does not exceed the capacity of the statistical agency to handle them.

6.14 Having chosen the breakdowns and applied to each set of transactions the criteria of allowable variation, the statistician is in a position to propose an aggregation formula and to follow up on any particular transactions or groups of transactions which appear not to meet the editing tests. The procedures for aggregation are those that have been described in earlier chapters and also in the discussion of the first strategy. The difference, in this case, lies in the volume of interrogations and in the methods used to detect transactions in need of further study. There is one more difference. If the statistical agency is prepared to calculate the index numbers on the basis of data collected from a variety of sources, it may fill the gaps created by unavailable unit values with domestic or partner-country price indicators.

6.15 The statistical agency will store a matrix of weights, that is to say, a conveniently arranged array of the values of exports and imports by category for each period. This matrix will be accessed for the purpose of calculating the standard index as well as a number of other index forms for analytical purposes.

43/ Cf. G. E. P. Box and G. M. Jenkins, Time Series Analysis, Forecasting and Control, Volume XIX (San Francisco, Holden Day, 1970), chaps. 5 and 6.

As a matter of routine, it is sensible to tabulate Laspeyres, Paasche, and Fisher aggregations in order to detect anomalies at the aggregate and subaggregate levels, that is, beyond any anomalies detected in the manipulation of individual relatives.

6.16 If the statistical agency decides to publish its index numbers of prices in Paasche as well as Laspeyres form, it should take pains to explain the significance of the period-to-period changes in the Paasche series and emphasize that this can be as much a result of shifts in weights as in prices. Similarly, if the agency opts for a chain index, which in the case of external trade is a defensible option, it should provide readers with a measure of drift on a regular basis. 44/

6.17 The treatment of new products, quality changes and reappearing products, should follow the lines laid down in chapter III above. All staff with expertise in commodity analysis should be carefully organized so that they can be assigned when required to the analysis of quality or to the pricing of unique goods that may be included in the current trade flows. As a matter of day-to-day activity, commodity analysts should inquire into the nature of those transactions that failed the editing screens or the stricter criteria used for index acceptability. For such purposes, it would seem advantageous to consolidate all the commodity expertise available to the statistical agency into a single group. This would allow for the integration of assumptions and methods for all price collection work undertaken by the agency.

6.18 The insertion of relatives derived from foreign sources in the basic file poses no conceptual nor operational problems. All that is required is that the particular relative, converted into local currency if there has been a change in the exchange rate during the period spanned by the relative, be aggregated with the other index relatives. Of course, there is room for other adjustments if enough is known about them. For example, if the relative excludes a transportation margin that all other relatives include, and enough is known about the way the margin has varied over time, the relevant adjustment should be made before adding it to the main file.

C. Strategy for the "well endowed"

6.19 This approach to the measurement of price presupposes that the national statistical agency has substantial resources which it intends to allocate to a price programme in external trade. It also assumes that the objective is to calculate the best possible index numbers to meet the demand from external trade analysts and to integrate the results with the rest of the system of prices and quantities in the framework of the national accounts. There are two variants to this strategy. In the first, call it the "dual" strategy, at the same time as the Customs records are accessed for the calculation of index numbers of unit values, the statistical agency conducts a comprehensive price survey of importers and exporters. In the second variant, the "hybrid" strategy, the two approaches are employed to complement each other and an extensive integration of data collection and compilation takes place.

44/ See paras. 4.24-4.25 above.

6.20 The calculation of an index based on unit values has been discussed in connexion with the first two strategies of compilation. For consideration, therefore, is the matter of conducting an external trade price survey. 45/ In previous chapters, there has been a discussion of how to derive lists of exporters and importers and how to maintain them. To the extent that some exporters are also manufacturers, the range of commodities that they can potentially export can be assessed from surveys of industry. Such an assessment would be independent of Customs sources and it is important that this be so in order to check on the way in which commodities are reported to Customs in export declarations. If the exporters are wholesalers, such a check is unlikely to be possible as hardly a single country mounts a programme to collect detailed commodity statistics from establishments in the distributive trades. In the case of imports, the situation is similar but probably the number of intermediaries is larger. Moreover, the industry statistics will be of less help to the extent that the commodity detail reported for inputs is likely to be considerably less than for outputs. Accordingly, the commodity universe will have to be drawn up by combining Customs records with detailed industry statistics. There could be a cross-check if the Customs documents contain an identification of the manufacturer and his return to the industry survey can be located and compared with his pattern of exports.

6.21 Once the matrix of commodity/source establishment is drawn up, the statistical agency will decide on the precision of the sample and calculate the number of establishments that should be contacted. These establishments should be stratified if there is a presumption that geography, major activity or even major customer (or supplier) abroad all play a role in determining the varieties handled. It is assumed that the matter of designing a sample survey does not constitute a problem for the statistical agency. 46/

6.22 Drawing up a list of specifications should take place after consultation with the reporting units. For reporting units that have a complex corporate structure, there are advantages in contacting the head offices of the corporations rather than plant management. Pricing policy with respect to sales and purchases abroad may involve a number of nuances the nature of which will not be known at the establishment level. In discussion with corporate management, it is necessary to determine the potential deviations from list prices and how these deviations are likely to respond to changes in the pressure of demand and capacity utilization. Credit terms, warranties, and, above all, waiting times may all be as important as the measure of price.

6.23 It may be too difficult to design a sample of commodities within each reporting unit in view of the fact that the number of observations that relate to actual transactions must be maximized. A purposive selection based on such criteria as continuity and ease of replacement may be more appropriate, but it, too, will require the close co-operation of corporate officers. The commodities selected in

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45/ Descriptions of the price surveys of the Federal Republic of Germany and the United States, respectively, will be found in W. Rostin, Indices of Foreign Trade Prices on Base 1970, Studies on Statistics, No. 30, (Wiesbaden, Statistisches Bundesamt, 1974) and in the Bureau of Labor Statistics Handbook of Methods, op. cit.

46/ For details of United States practice, see M. Kasper and R. J. Pratt, "Surveying international prices", 1978 Proceedings of Survey Research Methods Section: American Statistical Association. (Washington D.C., American Statistical Association, 1978), pp. 499-504.

this fashion will constitute the sample and the network of contacts secured through the process of interview and consultation should be used to keep the original specifications under control. Having agreed on the characteristics of the goods to be priced and on the standard conditions of purchase and sale, the statistical agency should ask reporting units to co-operate in signalling any depatures from agreed norms. The statistical agency should be aware of the difficulties that this may pose to reporting units that turn out to be intermediaries and whose knowledge of the commodities is imperfect.

6.24 The systematic comparison of the relatives derived from an inquiry conducted along these lines with the unit-value ratios that most closely correspond to them provides invaluable intelligence on the unit-value bias, on the changes in mix in each commodity category selected for the compilation of the index of unit values and also on the possible shortcomings of the price relatives because of coverage, "wrong" timing or failure to record deviations from list. The merit of this strategy is that it provides the statistical agency with virtually everything required to conduct an extensive programme of comparisons and to measure the limitations of each source in the greatest possible detail.

6.25 The most important results of such a programme of comparisons include estimates of errors in coverage and timing and of changes in the mix of specifications. Very little is known about the leads and lags between a manufacturer's quote and the actual flow of merchandise in and out of the country and less still about the timing of the change in ownership that the conceptual framework of the national accounts calls for. In times of rapid price change, the effects of variable lags could be of significance to the over-all measurement of the external trade flows at constant prices. Of course, once a direct survey is in place, if the statistical agency is not unduly constrained by the fear of overburdening its respondents, it should inquire into these lags in a more systematic fashion. Initially, in the case of experts, they might be measured as the time elapsed between the date on which the price quotation was established for contractual purposes and the date on which Customs returned a copy of the export declaration to the exporter.

6.26 The comparisons between sampled prices and unit values will provide the statistical agency with indicators of the unit-value bias and presumably with a ranking of these problem cases in the Customs-based series which should be looked at more intensively. There is no suggestion of a complex set of statistical techniques to carry out these comparisons. At least initially, the different types of error could be determined by the inspection of graphs of time series. A significant difference in slope may be an indication of inadequate sample design; irregular fluctuations in the series of unit values may indicate shifts in product mix; and lags in turning points of levels or growth rates may give first indications of differences in timing.

6.27 In the second variant of the strategy, the "hybrid" strategy as it has been called, one measure of prices is complemented by the other. The network of contacts with exporters and importers is used for periodic checks on changes in characteristics of those products that are not in the sample commodities used for the direct price survey. These contacts are also used to determine settlement and delivery conditions that are not necessarily reflected in the Customs documents. For the dovetailing of the two methods of collecting data, the commodity universe is divided into two portions. The first includes those commodities which are not susceptible to quality change at all, or only to small variations in quantifiable

price-determining characteristics. These commodities are measured primarily by unit values. The other segment of the commodity universe corresponds to those commodities for which there are no quantity measures to speak of, to those commodities that are unique because of their size and complexity and to those commodities that are the object of significant change in their physical characteristics. This segment is dealt with primarily by direct survey. The overall index is, in effect, derived as a weighted average of the two kinds of indicators. 47/

D. Role of research unit

6.28 Whichever strategy is adopted by a country's statistical agency, it is strongly recommended that it allocate some of its resources to the development of a small research unit. Where resources are scarce, the research unit may not be more than the allocation to priority research projects of a certain percentage of the time of those who actually compile the index numbers. But in no circumstances should it be overlooked that research into prices and their aggregation is essential if progress is to be made, nationally and internationally, in the construction and interpretation of these and other index numbers.

6.29 In the course of the discussion, several subjects that ought to be studied by a research unit have been mentioned. For example, it has been mentioned that, in the case of external trade, analysts and statistical practitioners are fortunate to have at their disposal both quantity and price relatives and the latest configuration of weights. This confers upon them the unique advantage of being able to monitor the evolution of the index numbers under various methods of calculation.

6.30 It is common to present the advantages of progress towards the integration of statistical measures as of benefit to the principal users of statistics. It is less common to discuss the advantages that accrue to the statistical agency. Work on measuring prices in external trade provides a good example of how a common research facility can be instrumental in effecting internal economies. Both measures of domestic prices and measures of external trade prices - however derived - must come to grips with problems such as quality adjustment and the pricing of unique goods. The techniques that have been developed to deal with this problem are demanding in terms of professional attention, knowledge of the products or industries under review and computing effort, not to mention their thirst for extensive arrays of price observations. These requirements suffer unless there are institutional arrangements to pool knowledge, experience and methodology.

6.31 Another function of a research unit is to monitor domestic and international developments in the prices of major trading partners. Notwithstanding the usual difficulties with non-matching classifications, different conceptual frameworks and other impediments to straightforward comparisons, these counterpart measures are very often a source of critical evidence against which one's index can be tested. In addition, there are specific situations that demand close monitoring. There are countries where the bulk of exports may not have a firm value until sold by a commercial intermediary or within the purchasing country. In such cases, it is necessary that any price intelligence be communicated to the exporting country as soon as it becomes available. Unfortunately, the necessary arrangements do not get established automatically and to put them in place and maintain them, requires special care and attention.

47/ With this strategy, the compilation of comprehensive unit-value measures might be continued both for the purposes of comparison and to encourage further methodological development.

Annex

COVERAGE AND STRUCTURE OF INDEX NUMBERS IN EXTERNAL TRADE

1. The tables in the present annex are designed to illustrate the variety of practices adopted by countries in compiling and updating Customs-based index numbers in external trade. The basic data are derived from the United Nations Yearbook of International Trade Statistics, 1978 (hereafter referred to as Yearbook 1978). In the notes to its country chapters, Yearbook 1978 includes brief statements on how the index numbers of unit value and quantum are compiled and on how often the weights on which the index numbers are based have been revised.

2. The tables follow a logical sequence. First, the total trade (1977 exports plus imports) of those countries reporting index numbers is aggregated and expressed as a proportion of total trade by continent, regional grouping, stage of development and economic system. Secondly, a simple classification of index-number formulae into six different categories is used to provide a broad picture of how the trade flows for each of the main groupings are broken down by kind of index. Thirdly, a detailed picture is provided of individual country practice in each region in terms of kind of index and frequency of change of base-period.

3. Several arbitrary conventions have been adopted. For example, those countries reporting index numbers in external trade but reporting no figure later than 1972 are excluded. Regional aggregates differ from those in Yearbook 1978 where the latter are not a sum of the trade reported by the related countries but comprise certain adjustments. The classification by types of index reflects an interpretation of individual countries' descriptions of their practices. Because of the brevity of these descriptions, the interpretations may at times be incorrect. There are countries which use different approaches for exports and imports and there are countries which have changed their techniques more than once. In such cases, the simplest possible conventions have been adopted: countries are classified according to the formula last used and by whichever flow, exports or imports, is larger.

Table 1. World trade coverage of countries that reported index numbers in external trade, 1977

Grouping	Number of countries a/		Value of 1977 trade b/		Proportion (%) (col. 4 ÷ col. 3)
	That reported external trade	Also reporting index numbers	Of reporting countries	Of index-reporting countries	
America	46	13	485	416	86
Developed	2	2	362	362	100
Developing	44	11	123	54	44
LAFTA c/	11	5	81	43	53
CACM d/	5	1	8	2	23
Other America	28	5	34	9	26
Europe (market economies)	21	19	956	955	100
EEC e/	8	8	762	762	100
EFTA f/	8	7	144	143	100
Other Europe	5	4	50	50	100
Europe (centrally-planned economies)	8	7	205	200	97
Africa	46	15	109	52	47
Developed	1	1	12	12	100
Developing	45	14	97	40	41
North Africa	6	5	44	31	70
CEUCA g/	4	1	4	2	37
Other Africa	35	8	49	7	15
Asia (market economies)	36	18	467	354	76
Developed	2	2	157	157	100
Developing	34	16	310	197	61
Middle East	15	6	165	86	52
Other Asia	19	10	145	111	77
Asia (centrally-planned economies)	1	0	1	0	0
Oceania	12	4	36	34	92
Developed	2	2	33	33	100
Developing	10	2	3	1	15
All countries a/	170	76	2 259	2 011	89
Developed	28	26	1 520	1 520	100
Developing	133	43	533	292	55
Centrally-planned	9	7	206	200	97

For country membership of groupings, see Yearbook of International Trade Statistics, 1978.

a/ "Countries" include countries and territories.

b/ Exports plus imports in billions of United States dollars.

c/ Latin American Free Trade Association.

d/ Central American Common Market.

e/ European Economic Community.

f/ European Free Trade Association.

g/ Customs and Economic Union of Central Africa.

Table 2. Proportion of trade (exports plus imports) of index-reporting countries represented by each type of index within each geographic area, 1978 a/

Grouping	Index type 1	2	3	4	5	6	Proportion of trade represented by indexes	Proportion of world trade represented
America	6.0 (6) b/	18.8 (1)	68.2 (2)	6.3 (1)	0.7 (3)	-	85.8 (13)	21.0
Europe (market economies)	50.4 (6)	-	26.5 (5)	6.6 (4)	16.5 (4)	-	100.0 (19)	43.4
Europe (centrally-planned economies)	-	-	6.3 (1)	17.8 (2)	-	75.9 (4)	95.5 (7)	8.9
Africa	34.6 (5)	-	8.3 (3)	24.7 (1)	8.4 (5)	24.0 (1)	50.9 (15)	4.4
Asia	17.1 (6)	6.2 (1)	50.7 (3)	9.3 (2)	16.7 (6)	-	72.5 (18)	20.8
Oceania	78.0 (1)	0.2 (1)	21.8 (2)	-	-	-	90.5	1.5
All	29.5 (24)	5.2 (3)	37.5 (16)	8.8 (10)	11.2 (18)	7.8 (5)		100.0
Developed	31.3	5.3	47.6	6.1	9.7		73.9	
Developing	37.2	7.6	9.3	16.3	23.2	6.4	17.2	
Centrally-planned	-	-	6.3	17.8	-	75.9	8.9	

a/ The index types are defined as follows:

(i) Quantum is base weighted. Unit value is derived implicitly. The two are interdependent;

(ii) Unit value is base weighted. Quantum is derived implicitly. The two are interdependent;

(iii) Both quantum and unit value are Fisher-type indices;

(iv) At least one of quantum and unit-value indexes is an annual Paasche or Laspeyres chain-link index;

(v) Both quantum and unit value indexes are base weighted.

(vi) Other.

b/ The figures in parentheses represent the number of reporting countries in each cell.

Table 2a. Index types and base-year changes (1950-1975) by countries

Country, territory or area	Index type (see Table 2)	Years of period covered by index	Base-year changes	Percentage of trade of the area 1978
AMERICA				100.0
Bolivia	1	13	-	0.2
Brazil	4	26		5.4
Canada	2	26	1968, 1971	16.1
Colombia	1	26	1967	1.0
Dominican Republic	3	16	1972	0.0
Ecuador	1	18	1955, 1970	0.6
El Salvador	1	24	1965	0.3
Guyana	5	16	1969, 1974	0.1
Jamaica	5	26	1954, 1965	0.3
Mexico	1	10	-	2.4
Panama	5	26	1960	0.2
Trinidad and Tobago	1	19	1964	0.7
United States-Puerto Rico	3	26	CHAINED	58.5
EUROPE (market economies)				100.0
Austria	1	26	1961, 1971	2.5
Belgium-Luxembourg	1	26	1953, 1963, 1970	8.2
Denmark	3	26	CHAINED	2.3
Finland	4	26	(CHAINED)	1.4
France	1	26	1956, 1961, 1966, 1973	13.9
Germany, Fed. Rep. of	1	26	1954, 1960, 1962, 1970	23.0
Greece	1	26	1954, 1961, 1970	0.9
Iceland	4	26	(CHAINED)	0.1
Ireland	3	26	1953, 1968	1.1
Italy	3	26	1953, 1960, 1966, 1970	9.8
Malta	5	26	1955, 1965	0.0
Netherlands	3	26	CHAINED	9.2
Norway	1	26	1955, 1961, 1970	1.9
Portugal	5	26	1960	0.6
Spain	5	26	1953, 1960	2.8
Sweden	4	26	(CHAINED)	3.7
Switzerland	3	26	CHAINED	4.1
United Kingdom	5	26	1954, 1961, 1970	13.1
Yugoslavia	4	26	1963	1.4

Table 2a. Index types and base-year changes (1950-1975) by countries (continued)

Country, territory or area	Index type (see Table 2)	Years of period covered by index	Base-year changes	Percentage of trade of the area 1978
EUROPE (centrally-planned economies)				
Bulgaria	4	24		
Czechoslovakia	6 a/	26	1953, 1960, 1970	
German Democratic Republic	6 b/	17	1960, 1970	
Hungary	3	18	CHAINED	
Poland	4	26	(CHAINED)	
Romania	6 a/	16	1970	
USSR	6 a/	26	1970	
AFRICA				100.0
Egypt	1	23	1963, 1965	7.4
Ethiopia	5	21	-	0.7
Guinea-Bissau	5	15	-	0.0
Kenya	3	26	1954, 1964, 1972	2.3
Libyan Arab Jamahiriya	6 c/	6	-	12.2
Malawi	5	12	-	0.5
Morocco	1	26	1955, 1956, 1972	5.6
Southern Africa, Customs Union of	4	26	(CHAINED)	12.6
Sudan	5	23	1953	1.5
Togo	1	23	1963, 1966	0.4
Tunisia	1	26	1964	2.8
Uganda	3	26	1954, 1964	0.8
United Republic of Cameroon	5	22	1956, 1957, d/ 1961, 1968	1.6
United Republic of Tanzania	3	26	1954, 1964, 1971	1.1
Zambia	1	12	-	1.4

Table 2a. Index types and base-year changes (1950-1975) by countries (continued)

Country, territory or area	Index type (see Table 2)	Years of period covered by index	Base-year changes	Percentage of trade of the area 1978
ASIA				100.0
Burma	5	26	1952	0.1
Cyprus	1	26	1962, 1968, 1970	0.2
Hong Kong	2	8	-	4.5
India	1	26	1952/53, 1958, 1968/69	2.5
Indonesia	3	7	-	3.3
Israel	4	26	(CHAINED)	1.7
Japan	3	26	1960, 1965, 1970	31.7
Jordan	5	19	-	0.3
Kuwait	1	6	-	2.7
Pakistan	5	21	1960/61, 1970	0.9
Philippines	1	26	1955, 1965, 1972	1.6
Republic of Korea	4	13	(CHAINED)	5.1
Saudi Arabia	5	6	-	9.9
Singapore	1	4	-	4.2
Sri Lanka	5	26	1958, 1967	0.3
Syrian Arab Republic	5	19	-	0.6
Thailand	3	26	(CHAINED)	1.7
Turkey	1	8	-	1.2
OCEANIA				100.0
Australia	1	26	1959/60, 1966/67	70.6
Fiji	3	16	1965, 1969, 1972	1.4
New Zealand	3	26	CHAINED	18.3
Samoa	2	6	-	0.2

a/ Only quantum (base-weighted).

b/ Only quantum (current-weighted).

c/ Unit value only (base-weighted).

d/ Quantum index only.

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