Unclassified **CCNM/STD(98)32**

Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development

OLIS : 07-Apr-1998
Dist. : 16-Apr-1998

English text only

CENTRE FOR CO-OPERATION WITH NON-MEMBERS
STATISTICS DIRECTORATE

Issues in the Compilation of Short-Term Economic Statistics in Transition Economies

64044

CCNM/STD(98)32
Unclassified
English text only

FOREWORD

The development of reliable statistics, oriented towards the requirements of policy-making in a market economy, is a key component in the programme of the Centre for Co-operation with Non-Members (CCNM). Activities on statistics include the provision of advice on the practical implementation of Western statistical systems, focusing on those areas where the OECD possesses internationally recognised expertise, e.g. national accounts, prices and volume measures, short-term economic indicators and business surveys.

Since the commencement of the transition process, countries in transition have been gradually implementing international recommendations and guidelines with respect to short-term economic statistics. As a result, over the last five years there have been significant improvement in the comparability of the methodologies used by these countries to compile short-term economic statistics and those of OECD Member countries. However, there are still a number of instances where transition economies continue to use practices that were developed under the previous centrally planned economic systems and which are incompatible with the needs of a market economy.

The aims of this document are to: highlight key statistical methodological practices that are incompatible with the requirements of a market economy; and to provide examples of best practice based on existing international recommendations and guidelines. The overall objective is to enable users of short-term economic indicators compiled in transition economies to analyse and evaluate current national practices. Although the document focuses on methodologies used to compile indices of industrial production and retail volume indices, most of the practices highlighted are relevant to many other short-term economic indicators compiled in transition economies.

Specific country practices are contained in the OECD publication, *Short-term Economic Indicators: Transition Economies - Sources and Definitions* (April 1997). Furthermore, a number of the issues discussed in the current document, particularly those relating to coverage, non-response and misreporting are also important in relation to the systematic measurement of unrecorded economic activities. These and other issues relating to the measurement of the informal economy are discussed in greater detail in another OECD publication, *Framework for the Measurement of Unrecorded Economic Activities in Transition Economies* (November 1997).

This document is published on the responsibility of the Secretary-General of the OECD.

TABLE OF CONTENTS

INTRODUCTION

Short-term economic statistics are used for the analysis of seasonal and cyclical fluctuations in key branches of the economy. The main reason for compiling high frequency statistics such as the monthly indices of industrial production or retail volume indices is to develop an understanding of changes taking place in an economy over time in terms of both direction and magnitude. These changes may be short-term (i.e. subannual) or long-term (i.e. extending over one or many years). Such information about the recent past is often used as the basis for predictions about the near future.

The long-term trend in key economic indicators is of particular importance for transition economies where there is a need to measure the impact, extending over a number of years, of structural adjustment on output, sales, etc..

AIMS OF THIS DOCUMENT

The main aims of this document are:

- provide a framework that will enable staff at all levels in transition countries, and international organisations to critically analyse and evaluate current national practices used in the collection and compilation of key short-term economic indicators in the light of international practice;

- to discuss issues relating to methodologies used in the collection of basic statistics and the compilation of short-term economic indicators in transition economies, in particular, in relation to the compilation of indices of industrial production and retail volume indices; and

- to provide examples of best practice in the collection of basic statistics and in the compilation of short-term economic indicators.

Through the provision of an overview of current collection and compilation practices common in many transition economies the purpose of this document is to assist staff in transition economies to develop short-term economic indicators in conformity with international practice. Current practices are discussed in the context of recommendations and guidelines, where available, that are set out by the OECD and other international organisations, and best practice of OECD Member countries.

In particular, the document also highlights a number of statistical compilation methodologies and procedures still commonly used by transition countries that are not in conformity with international practice. Although technical assistance has been provided in these areas by a number of international organisations and individual OECD Member countries many issues and problems still have to be overcome by transition countries in the collection of basic statistics used in

the compilation of short-term economic indicators. These include issues relating to coverage, non-response, misreporting, collection of data from the emerging private sector and problems associated with the continued use of cumulative collection methodology, etc.

In addition to these fundamental collection issues, some of the methodologies currently used by many transition countries in the actual compilation of key indices occasionally result in statistical series that provide an incorrect picture of the events they purport to measure. Some of these practices are the remains of procedures developed under previous centrally planned economic systems.

Some transition countries even produce two sets of short-term indicators, an "official" series based on old methodologies that are still requested by government agencies (finance departments, national banks, economic policy ministries, etc.) and which are released in statistical bulletins published by national statistical offices, and unofficial series compiled at the behest of international organisations for use in the compilation of national accounts based on the 1993 System of National Accounts (SNA). Some countries compromise by publishing both series in their bulletins.

The intended audience of this paper are both branch statisticians and senior staff of statistical agencies responsible for policy decision-making on broader issues associated with the introduction of new statistical and compilation methodologies.

This paper is based on the knowledge gained by OECD staff over the last six years from missions to transition countries and from short-term economic indicator data provided by transition countries for inclusion in the Organisation's quarterly publication *Short-term Economic Indicators: Transition Economies*. Extensive use has also been made of reports, working papers, etc., produced by other international organisations such as the International Monetary Fund (IMF), the Statistical Office of the European Communities (EUROSTAT), the World Bank and the United Nations Statistical Division.

For a more detailed outline of the methodologies used by individual transition economies in the compilation of specific key statistical series readers are referred to OECD publication, *Short-term Economic Indicators: Transition Economies - Sources and Definitions* (April 1997).

FRAMEWORK FOR ASSESSING WHETHER OR NOT SHORT-TERM ECONOMIC INDICATORS CONFORM TO INTERNATIONAL PRACTICES

As mentioned above this document discusses some of the main underlying issues that impact on the reliability of the basic data used in the compilation of short-term economic indicators, and on practices involved in the actual compilation and presentation of those indicators. Whilst some of the issues discussed are relevant to short-term economic indicators compiled by a number of OECD Member countries, they are particularly relevant to those compiled in many transition countries. Many of the practices described below are <u>still</u> used by a number of transition countries and continue to produce data which is <u>not</u> in conformity with existing international standards.

Because of their overall impact on the quality of the statistical series compiled, the issues discussed in respect to basic data in Sections 1 and 2 and in Section 7 in respect to volume indices may be used as a framework for a qualitative assessment on the degree to which the current practices of individual transition countries conform to international standards. These issues comprise:

Collection of Basic Statistics

1. Coverage
2. Classifications used
3. Branch scope
4. Collection units
5. Treatment of non-response
6. Identification and treatment of misreporting
7. Data collection methodology
8. Collection of comparable price data
9. Cumulative collection of data

Data Presentation Issues

1. Presentation of indices
2. Presentation of metadata
3. Presentation of revisions to data
4. Presentation of breaks in time series

Index Compilation Issues

1. Derivation of indices
2. Correspondence between classifications and nomenclatures
3. Use of appropriate index formula
4. Frequency of weight changes during periods of rapid structural change

A number of these issues, particularly those relating to coverage, non-response and misreporting are also important in relation to the systematic measurement of unrecorded economic activity. These and other issues relating to the measurement of the informal economy are discussed in greater detail, primarily in the context of annual and quarterly data, in the OECD publication, *Framework for the Measurement of Unrecorded Economic Activity in Transition Economies* (1997) - OCDE/GD(97)177. By providing a detailed description of statistical issues associated with the compilation of short-term economic indicators the current document complements the document referred to previously whose focus is on activities that are not adequately captured by existing statistical (in the main, annual) collections

SYSTEM OF NATIONAL ACCOUNTS FRAMEWORK

Much of the discussion of short-term economic indicators in this document is provided in the context of the 1993 System of National Accounts (SNA) which provides a suitable framework for the compilation of basic statistics. The primary advantage of using such a framework is that it

enhances the possibility of the compilation of consistent statistical series across branches, etc., and series comparable with those produced by other countries.

At a conceptual level the use of the SNA framework requires the consistent specification of collection units, activities, commodities, variable definitions, etc., used in different statistical series.

SHORT-TERM ECONOMIC INDICATORS COVERED

All transition economies compile a number of short-term economic indicators. These include indices of retail sales (volume), production indices, price indices, average earnings, foreign trade, unemployment and gross capital formation. Many of the issues discussed in the following Sections are relevant to most of these indicators. However, for reasons of brevity the examples cited below are generally restricted to retail sales volume indices and indices of industrial production. Issues relating to the compilation of a number of other statistical series are provided in the OECD publication, *Framework for the Measurement of Unrecorded Economic Activity in Transition Economies*, referred to above.

In general terms the retail volume indices compiled in most OECD Member countries reflect monthly or quarterly changes in the volume of total turnover (or total retail sales) of retail businesses. Indices of industrial production measure monthly or quarterly changes in the physical or quantity output of industry.

Although many OECD Member countries compile annual volume indices this paper will focus on the compilation of sub-annual, i.e. monthly and quarterly indices.

BROAD OUTLINE

This document is divided into seven Sections. Section 1 outlines the major issues and problems in the collection of basic statistics in transition countries that are used in the compilation of short-term economic indicators in general, in particular, for industrial production and retail volume indices. Section 2 describes a number of data presentation issues that impact on the accuracy of the indicator series published and on the ability of users to interpret the data. Section 3 provides a brief outline of two methodologies used by OECD Member countries to adjust the basic data, thereby enhancing its usefulness to users and their ability to interpret the series. Sections 5 to 7 focus on issues specifically relating to the compilation of indices of industrial production and retail volume indices.

For illustrative purposes this document contains examples of suitable practices used in some OECD Member countries and by some transition countries. These were obtained from recent OECD publications or publications produced by other international organisations.

SECTION 1: BASIC STATISTICS COLLECTION ISSUES

1.1. COVERAGE

In the past, statistics for transition countries only covered state enterprises and co-operatives. Until the late 1980's this accounted for the whole of legal production. At varying dates from 1989 onwards, the establishment of private enterprises became legal and the number of enterprises grew dramatically in many countries.

Recording private sector activity is one of the largest problems faced by statistical offices in many transition countries. Prior to the commencement of the transition process the register of legal enterprises maintained in many countries was relatively small and clearly defined. Statistical inquiries tended to be censuses with mandatory reporting requirements. However, many transition countries have experienced large increases in the number of enterprises monitored by their statistical organisations. In Hungary for example, the number of enterprises monitored by the Central Statistical Office in 1994 comprised 187 000 public enterprises and over 500 000 private enterprises.

The explosion in the number of enterprises means that establishing and updating the business register is now a major task and one that has been unfamiliar to the national statistical offices. As a result private sector economic activity in key branches may not be well reported. Furthermore, the comprehensive reporting of even public sector economic activity is also under stress due to budget constraints placed on statistical agencies.

A parallel problem experienced in transition countries (and in a number of OECD Member countries) is the large number of dead or inactive units recorded on the statistical business register. These may amount to as much as 40 per cent in some countries, particularly for smaller enterprises. Given the stability of the population of enterprises in the past, mechanisms to identify and delete inactive units are not in place. The use of such register frames may lead to overestimates in surveys if they are used uncritically to derive counts for grossing up estimates.

Overcoming these difficulties requires the continuation of major changes in the statistical systems of transition economies which will take time to implement fully and effectively. In the meantime, therefore, some of the basic statistics used in the compilation of key short-term economic indicators (especially monthly and quarterly series) still cover only the state and co-operative sectors. The private sector is simply missing or is restricted to official registrations located on a countries statistical business register. The extent of omission varies over time from country to country; from sector to sector; and between annual, quarterly and monthly collections for the same series. However, coverage tends to be particularly deficient in the fastest growing branches of many transition economies, i.e. domestic trade and services. Also, whilst unregistered enterprises may only contribute a small percentage of total output their impact at the sub-branch level could be significant, e.g. in food processing activities in the industry branch.

It is therefore essential for many transition countries to critically analyse the significance of the activity of unregistered enterprises and other units to total branch activity for each statistical collection used in the compilation of key economic indicator series.

The coverage practices adopted by OECD Member countries are generally trade-offs between the resources available in the statistical collection agency to collect and process the data, the need to minimise respondent load, whilst at the same time enabling the collection of sufficient basic data to allow compilation of reliable indicator series.

The coverage practices used by OECD Member countries also reflect the structure and composition of the branches being surveyed. For example, the domination of the domestic trade and industry branches in many Member countries by a relatively small number of large enterprises often permits the collection of monthly and quarterly data from a restricted number of enterprises. Size cut-offs are generally determined on the basis of employment or turnover. This methodology is frequently supplemented by information collected from a random sample of small to medium sized enterprises, where such enterprises contribute a significant proportion of total turnover, output, etc.

The coverage within each in-scope branch may also vary. In branches where units are typically large coverage may be almost complete. For those where it comprises very small establishments it may not be as high as 50 per cent. Overall, countries try to collect monthly data for about 70 per cent of gross value of production/sales, etc..

It is difficult to recommend a precise percentage cut-off for each branch. The main point is to ensure that there is sufficient coverage to enable the indicators to adequately reflect period to period changes in levels.

In the example of indices of industrial production and retail sales volume indices there is considerable variation in the coverage practices used by OECD Member countries in the collection of the basic statistics used for the compilation of these indices. The primary aim is to ensure that sufficient data is collected from enterprises to enable the indices, etc., compiled to reflect changes in volumes from period to period.

Coverage practices for some OECD Member countries (as at May 1996) are provided in the following two tables.

Table 1: Coverage Practices for Indices of Industrial Production Compiled in OECD Member Countries

Country	Coverage Practices
Austria	Data are collected in a monthly survey of all establishments belonging to the industry section of the Austrian Chamber of Commerce.
Canada	All large establishments are surveyed monthly. Small and medium enterprises sampled. The sample is revised annually in accordance with the Annual Survey of Manufactures.
Czech Republic	All enterprises with 100 or more employees are surveyed monthly. Quarterly estimates of enterprises not on the business register and estimates of the production of small enterprises (i.e. less than 25 employees) are also made.
Denmark	Survey covers all enterprises employing more than 200 persons and a selection of enterprises employing 21-200 persons. For small enterprises the probability of selection in the sample is proportional to the size in terms of employment but may also depend on the industry group to which the enterprise belongs.
Finland	Data are collected in a sample survey of establishments of enterprises employing more than 5 persons. Index covers 80 per cent of the gross value added in industry in the whole country.
Greece	All establishments with more than 20 persons employed and 50 per cent of establishments employing 10-20 persons are covered. Establishments with the highest value added are selected so that 80 per cent of the industrial value added is represented by the sample.
Ireland	Data are collected in a monthly survey of establishments of 20 or more persons engaged. The existing sample accounts for over 92 per cent of total net output and 90 per cent of persons engaged in all industries.
Italy	Data are collected by means of surveys of enterprises and directly from administrative sources. About 8 000 enterprises with more than 20 persons are surveyed each month. In some branches the threshold for inclusion in the sample is set lower than 20.
Mexico	Very small firms (i.e. those that employ less than 5 persons) are excluded. The establishments included are those which ranked from largest to smallest add up to 80 per cent of the gross output of the industry, except for industries which are very dispersed. In this case, given the need for a large sample a maximum of 140 establishments are selected even when they do not cover 80 per cent of the gross output of the given industry.
Sweden	The reference population is local units of enterprises with 10 or more employees.
Turkey	Quarterly production data cover all public sector enterprises and large scale manufacturing industrial establishments in the private sector. This represents 89 per cent of the value added of all establishments in the manufacturing industry with 10 or more employees.
United States	Data on physical products are obtained from private trade associations. Data on hours worked collected in monthly establishment survey.

Source: OECD, Paris, *Main Economic Indicators: Sources and Definitions*, May 1996

Table 2: Coverage Practices for Retail Volume Indices Compiled in OECD Member Countries

Country	Coverage Practices
Australia	Excludes retailers with no employees.
Belgium	Enterprises with a turnover of more than FB2.5 million (FB4.5 million for the food sector) are covered by the index.
Canada	Retail trade estimates do not include any form of direct selling which bypasses the retail store, except mail-order and catalogue sales activities of department store businesses.
Czech Republic	From 1992 organisations with 25 or more employees are covered. From 1991 monthly data takes account of an estimate for sales of units which are not subject to the statistical survey.
France	The index measures monthly changes in the value of total sales of department stores, chain stores, hypermarkets and mail order businesses.
Ireland	Data cover the retail sales of businesses whose main activity is retail trade and the sales of retail outlets of non-distribution enterprises. The direct retail sales from non-distribution establishments are excluded as well as sales by hawkers, street stalls, newspaper vendors and other retailing activities not conducted from permanent business premises.
Mexico	Establishments covered are selected from a list organised by decreasing turnover in each sampled city. The sample represents at least 50 per cent of the total sales in each city according to a 1994 commercial census.

Source: OECD, Paris, *Main Economic Indicators: Sources and Definitions*, May 1996

An important coverage issue for many transition countries is whether or not to include estimates for enterprises and private entrepreneurs operating in the informal economy. Such units include small-scale businesses that operate from private homes, in streets or markets, or without a fixed base of operations. Informal activity tends to be focused in retail trade, service activities, small-scale construction, small-scale transport and agricultural activity.

A more detailed discussion of the measurement of the informal economy is provided in the OECD publication, *Framework for the Measurement of Unrecorded Economic Activity in Transition Economies* (1997).

1.2. CLASSIFICATIONS USED

The branch scope of short-term economic indicators such as volume indices should be defined in terms of existing standard international classifications such as the *International Standard Industrial Classification (ISIC)* or the equivalent European Union classification, the *Statistical Classification of Economic Activities in the European Community (NACE).* Some countries may opt to use their own versions of these classifications, however these should at least be comparable with international classifications.

The gross output of individual commodities should also be defined in terms of equivalent standard classifications such as the *Central Product Classification (CPC)* or the European Union equivalent, the *Classification of Products by Activity (CPA).* These commodity data are also the basic building blocks for constructing indices for industries.

The importance of linking commodity classifications with activity (branch) arises from the fact that branch activity can be defined in terms of the products characteristic of that activity.

The level of classification chosen for the basic data used in the calculation of key indices should also be as detailed as that of the most detailed indices desired. In other words it is necessary to use as detailed a product classification as possible so that each product identified has maximum homogeneity regardless of the level of detail used in the presentation of results. These are obvious considerations, but are often neglected in practice. Failure to take sufficient consideration of this point, when for example, production indices are being designed will lead to unnecessary duplication of collection effort and unintentional inconsistency between different volume indices compiled. Such inconsistency can impact on the usefulness of the indices in the compilation of national accounts.

The presentation of individual consumption expenditure of households should be made on the basis of the *Classification of Individual Consumption by Purpose* (COICOP).

1.3. BRANCH SCOPE OF INDICATOR SERIES

As mentioned above the branch scope of short-term economic indicator series compiled should be defined in terms of existing standard international classifications. The industrial production and retail volume indices described in this document refer to activities classified to one of the major international branch classifications. The branches (defined in terms of ISIC) included by most OECD Member countries for these two series are summarised in the following table.

Table 3: Branch Scope of Industry and Retail Volume Indices Compiled by OECD Member Countries

Type of Index	Branches Included	ISIC, Rev 3
Indices of Industrial Production	Mining and quarrying	Divisions 10-14
	Manufacturing	Divisions 15-37
	Electricity, gas and water supply	Divisions 40,41
Retail Sales Volume Indices	Retail trade*	Division 52

* excluding sale of motor vehicles and motor cycles and repair of personal and household goods

The inclusion of mining and quarrying; manufacturing; and electricity, gas and water branches in indices of industrial production is recommended by the United Nations and EUROSTAT. Almost all OECD Member countries follow this recommendation. Those not adhering to the recommendation generally only include mining and manufacturing, manufacturing and energy, or in some cases, construction.

In the case of retail volume indices there is greater homogeneity in terms of branch scope of the indices. Whilst most OECD Member countries collect monthly information for enterprises or establishments whose predominant activity is retail trade, many exclude a specific number of retail trade activities. Such exclusions include motor vehicle sales, eating and drinking places, service stations, etc. A small number of Member countries compile their volume indices using value added tax (VAT) data.

1.4. COLLECTION UNITS

Many of the statistical series compiled in transition countries are based on the collection of activity data, whereby information is collected from a variety of unit types. Furthermore, information is collected from units irrespective of whether or not the activity details collected are primary or secondary activities. The primary aim has been to collect as much activity data relevant to the indicator being compiled as possible.

Prior to the commencement of the transition process the emphasis of enterprise based statistics was to record the level of output/production against enterprise and national production targets. Emphasis was therefore given to the compilation of product based (or activity) statistics.

Whilst activity based statistics still have a role, the development of a market economy requires information that sheds light on considerations such as the efficiency of the production process, the efficient utilisation of resources, studies on vertical and horizontal integration, etc. Analyses of these issues may be carried out at both the macro and micro levels. The latter requires the availability of information on both the output(s) of enterprises, and inputs to the production process.

As many enterprises make more than one product, a basic choice has to be made as to whether one is measuring the output of the entire enterprise, or only of its main product. In the manufacturing industry for example, non-principal production of other manufactured products would still be included in the total output of manufactured goods. It is also not uncommon for manufacturing enterprises to produce goods or provide services that are not manufactured products. These could include for example, construction output or transport services. For OECD Member countries, the situation often varies between monthly and annual collections. For the former it is frequently assumed that the output of the main product is representative of the output of the entire enterprise. In the case of annual collections information for both principal and non-principal production are often collected explicitly.

The SNA recommends the use of the United Nations ISIC system, though national accounts may also be compiled using other industry classifications including the Classification of Branches of the National Economy (CBNE). The central problem is how the unit is defined. The Council for Mutual Economic Assistance (CMEA) approach was to create artificial units that were lined up with activities. ISIC recognises that whilst this is theoretically desirable, in practice the heterogeneous nature of activities conducted by many units makes it difficult to define units on the basis of a single activity. For the example cited above, under the United Nations classification system, these other activities may still be included in the unit classified to manufacturing.

ISIC is thought to offer the best practical response to the desire for units of homogeneous production or activity in normal market situations. As a result, much of the structural data (i.e. income, cost/expenditure items) produced by OECD Member countries is based on the predominant activity of the unit and includes income and cost information on secondary activities conducted by that unit. Predominant activity is determined on one of a number of alternative basis. Both ISIC Rev. 3 and the SNA recommend the use of value added to determine the main activity. However, ISIC Rev 3 states that employment might be used if no other information is available. In the case of vertical integration, ISIC Rev 3 recommends that proportional weight should be given to kind of activity or establishment in each portion of the chain.

The SNA recommends the use of the establishment as the basic statistical unit for the production and generation of income accounts. An establishment is defined as an enterprise, or part of

an enterprise, that is situated in a single location and in which only a single productive activity is carried out, or in which the principal productive activity accounts for most of the value added. This term is equivalent to the local kind-of-activity unit (KAU) defined in the ESA. Whilst both the establishment unit and the KAU strive for homogeneity in terms of the activity of the units from which information is collected, both accept the reality of secondary activity by some units.

Over the last two years a number of transition countries, particularly those in Central and Eastern Europe have also introduced collections using this methodology. This has followed the introduction by those countries of activity classifications compatible with either/or ISIC or NACE. An example of the introduction of the new collection methodology is the PHARE distributive trade pilot study project. However, it is not certain at this stage whether or not such new collections replace the old methodology, or have been implemented by some transition countries in addition to the old methodology.

Whilst the ideal situation would be to observe the activities of homogeneous production units engaged in only a single activity reality generally dictates a choice between one of the following options for the collection of information:

- collect only enterprise data;
- collect combined information in respect of all activities (principal and secondary) from the establishment; or
- collect data from establishments only in respect of principal production.

A decision as to which option to use depends on the degree of homogeneity of activity of the collection unit, the availability of data disaggregated by activity from respondents, the data requirements of users and the type of information being collected. Where users require detailed financial/structural data (in particular, detailed expenditure information) data availability will dictate the enterprise as being the observation unit. Where such needs are restricted to income and limited financial data (such as income, wages and salaries, employment, etc.) the collection of information in respect of all activities from the establishment might be possible. If only commodity data is required it would generally be possible to collect information from establishments only in respect of principal production.

1.5. TREATMENT OF NON-RESPONSE

The response rate for the private sector component of many of the enterprise collections conducted in many transition countries used to compile short-term economic indicators is often between 40-60 per cent for collections such as domestic trade where there is a high proportion of new small private enterprises. Response rates for branches dominated by state enterprises, former state enterprises and other larger registered private enterprises are still very high. However, even in these branches transition countries still need to develop strategies to maintain high levels of co-operation from respondents. In the longer-term it is reasonable to expect that issues of response burden will become important for these respondents.

This relatively low response rates for some branches is due to a combination of factors. These include:

- the requirement (particularly for small enterprises) to provide excessive information; poor form design. This includes the collection of very detailed information for business register coverage purposes;

- unrecorded enterprise deaths;

- the assumed association of the statistical office with taxation authorities, etc.

It has become even more imperative for the national statistical agencies in transition countries to introduce compilation practices and forms that elicit voluntary response rather than response based primarily on compulsion.

The first task in dealing with non-response is to analyse non-responding units. Many transition countries do not currently undertake any analysis of the impact or bias introduced into statistical output produced from collections with a high non-response rate.

There is a need for transition countries to maintain on-going measures of non-response in their statistical collections. Data should be maintained in respect of overall non-response, and more importantly, in respect of different types of ownership and size categories of non-responding enterprises.

Non-responding units can broadly be divided into two main types. The first type comprises non-response due the fact that enterprises are no longer active or in fact, may no longer exist. Furthermore, it is quite common for the officially “registered” activity actually undertaken to be very small scale and not necessarily the main source of income for the entrepreneur concerned. The identification and deletion of dead units from business registers is often considerably more difficult than their initial registration.

Measures of the proportion of “dead” units on the statistical register could be derived through periodic quality assessments of the register by taking a randomly selected sub-sample of units to identify the proportion the units that are dead or non-active. This component of non-response could then be deducted from the adjustments that are made for non-responding enterprises. Failure to make such adjustments would tend to inflate estimates as they would be included in the estimates for non-responding enterprises. Such an assessment of the number of dead units on the register need only be taken periodically. In other words, at least once every year or so.

The second type of non-responding unit comprises those enterprises that, for a number of reasons, chose not to respond, but which are still in operation at some stage during the reference period. Efforts for dealing with non-responding enterprises that are still active but for which a response has not been received can be broken down into long-term and short-term solutions.

Short-term solutions

The short-term solutions essentially involve the use of one of a number of techniques for estimating the production, sales, etc., of non-responding enterprises. Although not a viable long-term solution to the problem of unacceptably high levels of non-response these methodologies are used extensively by OECD Member countries.

Adjustment for non-response involves the creation of data for those enterprises, etc., that for some reason did not respond to a collection, but where the enterprise was active during the reference period. Imputed data will not always be the true values but they need only be good enough for the purpose of providing outputs of acceptable quality.

A dataset that has a large amount of imputation performed can be used as though it were a complete dataset. The results however can be misleading if the imputation used distorts the distribution of the data. As a check on the quality of the final estimates there should be a report on how great a contribution the imputed data made to the final estimates.

If too much of a final estimate is derived from imputed values then the quality of that estimate is questionable and there is a clear need to revise collection procedures or methodology in some way using the procedures discussed below.

Imputation will usually involve the creation of data that are consistent with ideas about how the data should behave. This requires extensive knowledge about the behaviour of enterprises, etc., under study.

When imputing data for units in a sample survey it is particularly desirable to have some idea of the effect of the imputation on the final estimate. A change in value from 15 to 100 will have a much greater effect than another change from 0 to 500 if the estimation weight in the former case is 63 but only 2 in the latter.

Imputation can be carried out either clerically (using the knowledge of staff concerned) or through some automated process. An automated process is preferable unless imputation is rare or the need for human judgement is clear. Clerical imputation can be expensive in terms of resources required and can lead to inconsistent treatment.

There are a number of different imputation methodologies. Some of these are listed below. A more detailed discussion of the alternative methodologies is however beyond the scope of this document. Broadly speaking imputation methods fall into three broad categories:

- the derivation of data based on information provided by the unit either for the current period or in previous periods;

- the use of information provided by other similar units that is modified to achieve a closer approximation of the data for the missing enterprise;

- the use of information provided by other similar units that is not modified to achieve a closer approximation of the data for the missing enterprise.

Long-term solutions

Longer-term solutions involve the adoption of procedures to improve the response rate for statistical collections. Such solutions include:

- The improvement of questionnaire design. Many transition countries continue to use questionnaires designed when information was collected primarily for central planning and control purposes, and only covered the activities of state enterprises and co-operatives. Many of these forms collect very detailed information, and their continued use is a significant cause for poor response from private sector enterprises, particularly for small units. Modification of existing questionnaires involves improvement of lay-out; significant reductions in the number of questions asked; ensuring that information required by national statistical offices is readily available from the records maintained by enterprises. These aspects require a careful program of questionnaire development and testing.

- The training of staff involved in statistical collections to obtain the co-operation of non-responding enterprises, etc. This entails, for example, ensuring that staff are fully conversant with the purposes of the statistical collection and the uses to which the data will be put.

- Another technique involves the priority allocation of non-response resources to those enterprises that are sufficiently large and where non-response would have an influence on the quality of the results. Such enterprises would be given priority follow-up. A sub-sample of the smaller units would be followed-up on some sort of rotation basis. For a monthly collection, this would mean that a certain number of the smaller enterprises are followed-up each month so that all followed-up over an acceptable time frame, e.g. a twelve month period. This would ensure that dead units are identified and removed from further consideration.

1.6. IDENTIFICATION AND TREATMENT OF MISREPORTING

Units that respond to statistical collections also contain an element of incorrect data, i.e. that part of response which is under-enumerated or misreported. This could take the form of the understatement of income, the overstatement of costs, undertaking a range of hidden activities in order to survive. Causes can be attributed a number of reasons, e.g. fear of disclosure of information by national statistical office to taxation authorities.

Misreporting could also be due to the inability of respondents to understand the questions or the non-availability of the information sought. An example of the latter is the request for inordinate detail, particularly from small enterprises.

It is very difficult to obtain accurate objective indicators of the extent of misreporting by units in a specific collection by direct measurement. Methodologies most commonly used by OECD Member countries generally involve the confrontation and reconciliation of different data sources. This approach, which is also used in the measurement of unrecorded economic activity is described in detail in the OECD publication, *Framework for the Measurement of Unrecorded Economic Activity in Transition Economies* (November 1997).

The process of validating data obtained from statistical collections through comparisons and reconciliation with other data sources as a means of determining the quality and reliability of the series is one that should be undertaken in respect of each collection and is the responsibility of branch statisticians.

An outline of the short-term and long-term methodologies/solutions for dealing with misreporting follows.

Short-term solutions

Short-term solutions to misreporting involves adjusting reported to derive "correct" aggregated information. Such adjustments could be made to unit record information or to preliminary aggregates. The first step is to try to obtain some measure of the extent of incorrect reporting. Procedures for doing this include identifying averages for large and small enterprises for key variables that are being measured. These could include output per employee, value added per employee, etc. By identifying an industry average it is possible to focus available resources for editing to large enterprises reporting data well below or above these averages. This information would be used by staff to query enterprises whose information is simply not believable or that is inconsistent with the bulk of the enterprise information received.

The underlying assumption in the use of such of averages is of course that there is no systematic under or incorrect reporting across all or most of the enterprises in the collections. Such an assumption may be incorrect for transition economies where large scale misreporting is quite common. Overcoming this problem necessitates the use of case study data obtained from alternative sources. These include taxation authority data; private audit firms; informal contacts within the industry; etc. This information would be used to arrive at "correct" averages and ratios.

Use of ratios

The first step in trying to impute for under-reporting by enterprises (in particular, the private sector) involves checking the information supplied by all private enterprises irrespective of whether or not they are in the formal or informal sector. This entails making various comparisons between:

- data provided by different organisations within the same branch and type of ownership to determine the variation in reporting;
- private sector and state enterprises;
- data supplied on enterprise returns with external sources such as tax statistics, anecdotal information from accountants and different organisations of private entrepreneurs.

The types of ratios used include:

- the ratio of intermediate consumption to output by branches and sub-branches. A private enterprise is not likely to be competitive with state enterprises if the ratio of its costs to output are higher. An assumption that could be made where this occurs is that the value of intermediate consumption is overstated by the private sector enterprise to minimise tax on profits. It is also possible that output could be understated;

- the average compensation of an employee in the private sector is compared with the average compensation of an employee in the state sector and if necessary brought up to at least a comparable level;

- the average mixed income of the owner of a private firm is compared with the average compensation of employees in the same industry.

Imputation of number of unregistered enterprises by branch

A useful source of information on the number of unregistered enterprises that would be excluded from on-going statistical collections involves the matching of name and address information of place of employment obtained from respondents in household based labour force surveys against coverage on the statistical business register.

Imputation techniques involving the use of indirect indicators

A number of transition countries have adopted imputation/adjustment methodologies involving the use of indirect indicators. Examples of some of these are provided below.

- estimation of private construction by individuals on the basis of information on new housing and facilities registered by local authorities. In the Russian Federation physical (floor space) indicators are converted to value terms using average construction cost per square metre of residential space in each given region. These computations are checked against household budget survey data and sales of building materials to households through retail trade;

- the adjustment for market services provided by the private sector. In the Russian Federation the adjustment is based on both indirect indicators and information from taxation records. The former includes:

  - number of private cars used as taxis;

  - number of private dentists, lawyers, etc. and their average remuneration as shown by special labour force surveys;

  - adjustments for services provided by private pre-school institutions based on the total number of enrolments and fees charged per child.

Long-term solutions

Long-term methods for overcoming the problem of misreporting is to overcome the problem at source, i.e. to try to obtain accurate information from responding enterprises. Techniques for achieving this are similar to those discussed above for reducing non-response in the long term, plus the use of more systematic editing techniques.

1.7. DATA COLLECTION METHODOLOGY

The very large expansion in the number of small private sector enterprises, particularly in the emerging domestic trade and services branches, has made the need to use sampling procedures essential. However, a number of transition countries are reluctant to use sample surveys and continue to try to collect data on a census basis (i.e. by exhaustive enumeration of all enterprises). The basic principles of sampling are not widely understood, and sampling is seen in many quarters as an extremely poor second-best alternative to complete enumeration.

The continued use of exhaustive methods for the collection of data will become even less viable than it is now due to the imposition of increased resource constraints by governments on national statistical offices, who as a result will be forced to adopt alternative methodologies in order to free up capacity within the organisation to deal with other statistical issues and priorities such as the measurement of the informal economy.

The derivation of reliable information using sample survey methodology reinforces the need for transition countries to introduce practices to improve the accuracy and quality of the information collected, and the development of on-going procedures to measure existing quality standards. It is not uncommon for greater attention to be given to sampling error than non-sampling errors (arising from bad form design, non-response bias, coverage bias, processing errors, etc.) even though the latter may have a much greater negative impact on the quality of the data produced. The reason for concentrating on sample error is that is often easier to quantify.

Transition countries therefore need to review the collection methodologies currently used for each key statistical collection, particularly those that require significant staff resource input, and more particularly those where exhaustive enumeration is currently used.

The choice of the appropriate methodology to use in the collection of the basic statistics required for the compilation of short-term economic indicators is again made by achieving appropriate trade-offs between:

- respondent load;
- the required level of accuracy of the indicators with respect to considerations such as branch scope and the coverage of the units from which data are collected; and
- resources available for the collection, processing and compilation of the basic statistics.

A number of transition countries have introduced enterprise cut-offs (particularly for quarterly and monthly collections) as a means of dealing with the rapid growth in the number of enterprises. In some instances these cut-offs have been modified at very frequent intervals, sometimes to the detriment of time series continuity. A number of different approaches are used including the selection of units ranked in size until an “acceptable” proportion of sales/turnover is included in the “sample”. Whilst such an approach is feasible care need to be taken to ensure that it does not bias the resulting sample of selected units through the automatic exclusion of smaller private enterprises. To reduce the risk of this stratification of the population by branch (and if possible, size) should be undertaken.

OECD Member countries use a number of alternative methodologies in the collection of the basic data required for the compilation of monthly and quarterly data for short-term economic

indicators. Most commonly, exhaustive enumeration is used only in the collection of data from the most significant units in both the private and public sectors. This data is often supplemented from data obtained from a randomly selected sample of small and medium sized enterprises. Some OECD Member countries exclude units that do not employ staff from the coverage of their subannual collections for some branches.

Whichever methodology is chosen the goal is to ensure that the survey frame (i.e. the list of enterprises, etc. that forms the potential respondents for a particular survey) should comprise a large proportion of the relevant characteristics, e.g. production, employment, turnover, etc., in a given ISIC class, group or division at the national level. Some countries aim at 90 per cent, others for a lower percentage.

As mentioned earlier, the process of determining the appropriate collection methodology is largely one of balancing the accuracy of output against the cost of collecting the data. This process requires access to branch enterprise concentration data compiled from annual or less frequently collected census data to enable an objective decision to be made as to the appropriate collection methodology. An example of such a table is provided below.

Table 4: Branch Concentration Table: Industry, 1987

Employment Size Categories	No. of Establishments	Employment (No.)	% of Total Employment	Value added ($ m)	% of Total Value Added
4-49	25 301	322 900	32.2	11 546	25.3
50-99	1 718	132 200	13.2	6 227	13.7
100-199	1 079	164 600	16.4	7 903	17.4
200-499	558	180 500	18.0	8 899	19.5
500-999	142	104 400	10.4	5 670	12.4
1 000 or more	48	99 500	9.9	5 302	11.6
Total	28 846	1 004 100	100.0	45 547	100.0

The monthly or quarterly data collection options available for a branch with the above characteristics include those summarised in the following table:

Table 5: Analysis of collection methodology options

	Percentage of Total Branch Employment	Percentage of Total Branch Value Added
Option 1: Exhaustive enumeration of all units (3 545) with employment of 50 or more persons.	68	77
Option 2: Exhaustive enumeration of all units (750) with employment of 200 or more persons.	38	44
Option 3: Exhaustive enumeration of all units (750) with employment of 200 or more persons, plus a sample selected from each of the three smaller employment size strata.	100	100

In a situation of really scarce resources Option 1 could provide the required level of information on changes in level for monthly and quarterly series if linked to either annual or biennial benchmark data derived from complete enumeration of all enterprises. Option 3 on the other hand might be more suitable if smaller units contribute a disproportionately large share of monthly or quarterly changes in level. The precise number of units in the sample component will depend on the level of accuracy required and the level of disaggregation in the required output tables. The more detail required the larger the sample.

Because the above characteristics vary considerably between branches similar tables are required for each branch for which an appropriate collection methodology is being identified. Furthermore, because these characteristics vary over time there is a need for such an analysis to be undertaken at regular intervals in order to arrive at the optimum methodology for the level of resources available to collect and process the data.

Programme of Rotating Branch Collections

In an ideal world data covering the whole economy could be collected by exhaustive enumeration of enterprises (of all sizes and ownership) every year. The reality however is that most countries do not have sufficient resources to conduct detailed collections covering all branches of their economy in any one year. Furthermore, it is debatable as to whether the collection of detailed information each year would be an optimal use of resources.

As an alternative, many OECD Member countries determine the appropriate collection methodology for individual branch collections in the context of an overall on-going programme for the rotation of a number of branch collections. For example, some Member countries have developed an on-going programme of branch censuses or large-scale surveys that are used to collect benchmark data for sub-annual indicator-type collections.

Benchmark collections perform functions that distinguish them from the more frequent enquiries these include:

- to establish a detailed profile of the structure of the branch; and

- to provide a broader or more accurate array of information on activity than would normally be feasible on an annual or sub-annual basis.

Current indicator collections involve the collection of information from higher level statistical units (e.g. the entire enterprise instead of each location) and may also entail the collection of a more restricted range of data than benchmark collections. Some countries use indicator data to extrapolate other benchmark data.

Given the amount of detail collected, benchmark enquiries can supply the framework needed for undertaking special surveys and provide the basic information required for the evaluation and adjustment of current indicators.

Such an on-going (or rolling) programme enables countries to allocate resources towards the more frequent enumeration (e.g. annual) of those branches that are either undergoing rapid structural

change and/or are statistically significant in respect of total employment, contribution to GDP, exports, etc. Censuses for those branches that are deemed to have a lower priority might only be held every two, three or even five years. Some countries supplement these large scale collections with more frequent (e.g. annual or sub-annual) collections which collect less detailed information and with more restricted coverage.

1.8. COLLECTION OF COMPARABLE PRICE DATA

Comparable price data describes a situation in which all items are expressed in the same prices in the two periods being compared. This is different to constant price data (discussed in greater detail in Section 4.3 below) which refers to aggregate data for several periods where all items are expressed in their respective prices of the base period.

In transition countries enterprises are requested to provide monthly data on their production, sales, etc., at comparable prices (e.g. the prices existing at January each year) and at current prices.

There are three types of comparable price concepts applied in transition countries, where enterprises are requested to provide:

- the prices of the first of the two periods being compared, which depending on the type of comparisons being made can be:
  - prices of the same period of the previous year on a cumulative basis;
  - prices of the same period of the previous year on a discrete basis;
  - the prices of the previous period;
- the prices of the current period;
- the fixed prices of a particular period (e.g. 1 January, December of the previous year, etc.).

Different versions of comparable prices are often used in different countries and in different periods of time. This obviously leads to confusion about the precise meaning of the term.

In general terms, the main problem is that enterprises themselves are required to make the calculation of value of output, sales, etc., at comparable prices. This calculation becomes uncertain in an economy in transition when the range of products produced, sold, during any given period may be significantly different from the range of the same period of the preceding period. It is difficult to say whether this leads to over or under statement of comparable price values.

More specifically, the problems associated with this methodology are:

- The assumption that the quality of the comparable price information provided by the hundreds of reporting enterprises is at least satisfactory and consistent. There is an underlying assumption that the products, etc., priced by the enterprise each month are comparable in terms of quality, etc. In periods of high inflation and rapid changes in the composition of a particular product the reporting by enterprises of comparable price data

is a difficult and intricate task. The compilation of indices based on such data is hampered by major changes in the selection and assortment of goods produced by the enterprise, in part influenced by problems in obtaining reliable material inputs.

– The assumption that the monthly data of comparable prices over two or more consecutive years provides a consistent indicator of the volume of industrial production when compared to the previous year. In periods of high inflation experienced by many transition countries this is often not the case.

The original system was designed to compare the current year to date period to the same year to date period of the previous year in order to check whether or not an enterprise (or industry) was meeting the production objectives of planned targets. The system was not intended to build a consistent subannual time series.

For these reasons many commentators in transition countries believe that comparable price data received from enterprises is not always reliable. As a result there may be considerable differences between indices compiled from such data and volume indices calculated by one of the methodologies described in Sections 5 and 6 below.

For example, the Interstate Statistical Commission of the CIS states that some member countries of the CIS publish separate indices using both comparable price and one of the other methodologies discussed in Sections 5 and 6. The differences in the indices calculated on the basis of these differing methodologies may be as much as 10-15 points for any one period. Such differences limit the usefulness of the data for economic analysis.

It is therefore recommended that the comparable price methodology be discontinued and replaced by methodologies in conformity with international practice. Some of these methodologies are discussed in Sections 5 and 6.

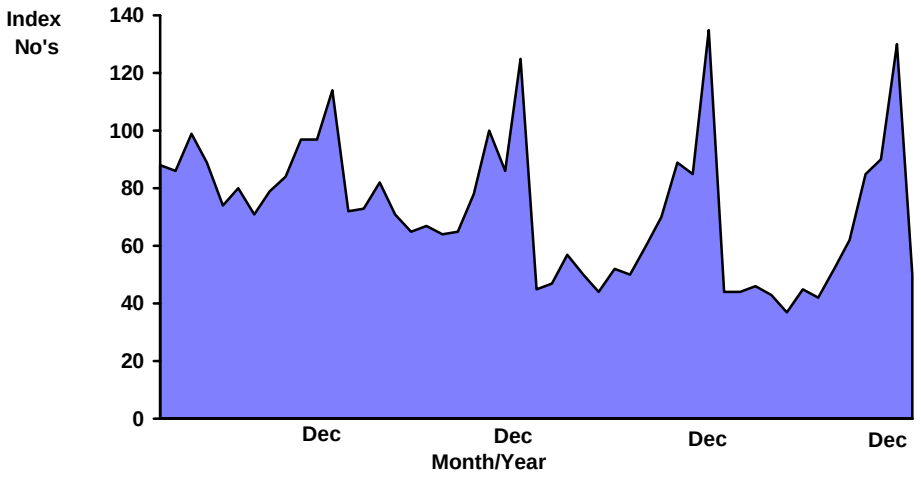
1.9. CUMULATIVE COLLECTION OF DATA

In OECD Member countries it is common practice to ask firms to report subannual financial and other data for discrete monthly or quarterly periods, and to allocate data revisions to the month or quarter where they actually occurred. However, in transition countries a major function of production statistics in the past was to provide data for monitoring total production, sales, etc., against targets. For this reason a common practice was to obtain sales or output data, etc., for the year to date, and to derive monthly or quarterly data by subtracting the previously reported figure.

Presenting data in this form constitutes a crude procedure for making comparisons that removes the problems of seasonal variation. However, the timing of changes is also obscured. In effect, cumulative estimates are annual estimates calculated more frequently. In OECD Member countries the issue of seasonal variation is treated by adjusting the data for recurring seasonal patterns thereby permitting the observation of changes from one sub-annual period to the next.

The collection of year-to-date, or cumulative data, often led to errors in the month or quarter during which activity was recorded because errors and revisions in previously reported data would not be inserted in the appropriate time period but simply incorporated in a new cumulative total.

The practice of cumulative reporting which has continued in many transition countries introduces distortions in subannual data as many series show a larger than usual entry in March, June and September, and an exceptionally large one in December. Because of very tight publication deadlines and the compilation of statistics very soon after the end of the reference period reporting often lags behind schedule. Due to a reluctance to revise the data for earlier periods unreported production often falls through to subsequent periods resulting in a seemingly large seasonal component in some series. A typical index series produced this way is shown in the following graph.



Whilst cumulative reporting has minimal impact on annual production data it can significantly impact on the accurate distribution of monthly and quarterly production throughout the year. This limits the reliability of a series to reflect short-term movements. It can also limit the usefulness of the data for use in the compilation of price and volume indices.

Theoretically, it is always possible to de-cumulate year-to-year sub-annual data by subtracting current from previous period cumulative data. This will only work if there are no retrospective revisions to the data.

Priority therefore needs to be given to the collection of sub-annual information (physical quantity and value data) on a discrete monthly basis. Many transition countries have in fact revised their forms and have adopted OECD Member country practice in the collection of discrete monthly and quarterly value data. A number of countries have compromised and now collect both cumulative and discrete period data. However, many enterprises still derive the latter by subtracting current cumulative period information from the previously reported cumulative period figure.

Further recommendations on data revision strategies are provided below in Section 2.3.

Summing up, the continued collection of basic statistics from enterprises on a cumulative basis is one of the most significant issues impacting on the quality of many of the monthly and quarterly indices produced by statistical agencies in transition countries. The output produced using this methodology is clearly incompatible with that produced by OECD Member countries. It is therefore strongly recommended that this methodology be phased out as a matter of urgency, and that new questionnaires to collect only discrete monthly and quarterly data from enterprises be introduced.

Allied to this issue is the need to introduce a strategy for data revisions that facilitates the revision of data in the appropriate month/quarter in lieu of the current practice of carrying revisions forward to subsequent periods.

Unfortunately, the problems in this area will not be resolved merely by introducing new questionnaires. Because cumulative collection is so strongly imbedded in the enterprise reporting process, there is also a need to validate the reporting practices by respondents when they complete the new questionnaires to ensure that they are in fact providing discrete monthly data from their records and are not using inappropriate methods of reporting, e.g. by deducting the current cumulative figure from the previous cumulative figure. Such validation needs to be done through field observation of respondents actually completing questionnaires. The process of educating respondents will need to be undertaken with a parallel programme to educate data users, especially with regard to the acceptability of revisions to published data.

Another benefit arising from the introduction of discrete period data collection from enterprises is that data validation for individual reporting units will also be facilitated in respect to both errors and missing items for a particular period.

SECTION 2: DATA PRESENTATION ISSUES

2.1. PRESENTATION OF INDICES

Practices used in the presentation of most statistical data, and indices in particular, are not neutral. Different practices can have a significant impact on both the actual information that is presented to the reader and the conclusions that may be drawn from the data. This Section provides a number of recommendations on the most suitable means of presenting index information in tabular form. Although the Section emphasises tabular presentation, the benefits/advantages of graphical presentation should not be forgotten. Changes in a series over time are often more readily identified in a graph. However, care should be taken to ensure that appropriate graphic presentation standards are used, particularly with respect to breaks in time series (refer Section 2.4).

In transition countries it is still common practice to present sub-annual (i.e. monthly or quarterly) index information:

- as a change from the same period of the previous year on a cumulative basis; and/or
- as a change from the same month or quarter of the previous year.

Neither of these approaches are recommended as they can mislead users by indicating, for example, that an economy is still in recession when in fact economic activity may have actually been recovering for some time. This point is illustrated quite clearly in an IMF Working Paper (refer Table 6 below) which shows that use of annual rates of change based on change between a quarter and the same quarter of the previous year may result in the appearance of turning points in the data only after a substantial delay. Moreover, the IMF Working Paper goes on to say that use of annual growth rates based on cumulative data results in even longer delays in picking the turning points.

These points are illustrated in the following table derived from the IMF publication. The table also demonstrates the recommended approach of recording data and rates of change on a period by period basis, instead of cumulatively or compared to data from a year earlier.

Table 6: Period to Period Change Versus Change from Same Period Previous Year

Quarter	Discrete Data	Cumulative Data	Qtr to Qtr Rate of Change	Change from Period in the the Same Previous Year	
			Discrete Data	Discrete data	Cumulative data
			%	%	%
	(2)	(3)	(4)	(5)	(6)
Q1 1991	100	100			
Q2 1991	94	194	-6.0		
Q3 1991	90	284	-4.3		
Q4 1991	86	370	-4.4		
Q1 1992	90	90	4.7	-10.0	-10.0
Q2 1992	93	183	3.3	-1.1	-5.7
Q3 1992	97	280	4.3	7.8	-1.4
Q4 1992	100	380	3.1	16.3	2.7
Q1 1993	97	97	-3.0	7.8	7.8
Q2 1993	95	192	-2.1	2.2	4.9
Q3 1993	90	282	-5.3	-7.2	0.7
Q4 1993	87	369	-3.3	-13.0	-2.9

Source: IMF, Washington DC, *Working Paper: National Accounts in Transition Countries: Distortions and Biases* - A. Bloem, P. Cotterell, T. Gigantes, November 1997, page 35.

The example contains two turning points, which in this example are defined as the first period where the period to period values change from positive to negative and vice versa. The first turning point occurs in Qtr 1 of 1992 and the second in Qtr 1 of 1993. These turning points are clearly identified in the discrete quarterly data shown in column 2 or in the quarter to quarter rates of change in column 4. The first turning point is illustrated by the change in the quarterly rates of change from a negative rate in Qtr 4 of 1991 to a positive rate in Qtr 1 of 1992. The second turning point is shown in the change from a positive to a negative rate of change between Qtr 4 of 1992 and Qtr 1 of 1993.

In the above table, annual rates of change are presented in column 5 which show the second turning point occurring in Qtr 3 of 1992, two quarters after it actually occurred. If the annual rates are based on cumulative data (illustrated in column 6) the analysis misleadingly conveys the impression that the turning point took place three quarters after it actually occurred.

Therefore, in accordance with accepted international practice it is recommended that the main presentation of indices be in the form of a time series of an annual, chain-linked index with either the average level of one year or a specific quarter of one year as the reference period (i.e. the period equal to 100). The period actually selected as the reference period is of minor importance as it does not affect the period-to-period changes in the index time series.

Changes in a Laspeyres index from the previous period, the same period in the previous year, and the change from the same period of the previous year on a cumulative basis can, if required, be presented in supplementary tables. However, the users can easily derive these growth rates themselves from the published Laspeyres index.

The following set of expressions also derived from IMF working papers reports illustrates the methodology for doing this. Let $I_{0,t}$ be the index level in period *t* of an annual chain linked

Laspeyres volume index with period 0 as reference period. Then the change from the same month of the previous year in this index can be calculated as:

$I_{0,t} / I_{0,t-12}$

the change from the previous month as:

$I_{0,t} / I_{0,t-1}$

the change from for example May to July of the same year as:

$I_{0,July} / I_{0,May}$

and the average change from the first three months of the previous year to the first three months of this year (i.e. the changes from the same period of the previous year on a cumulative basis) as:

$$\sum_{m=1}^{3} I_{0,mA} / \sum_{m=1}^{3} I_{0,mA-1}$$

where *m* represents the months and *A* the year.

The recommended approach which is illustrated in the following table provides users with the opportunity to compare the changes of different periods in an easy, flexible and consistent manner.

Table 7: Illustration of Presentation of Fixed Based Index and Derivation of Same Period of Previous Year Index

Month	Month to Month Growth (Previous month = 100)			Index Based on Chain Linking Month to Month Growth Rates (December 1993 = 100) (Fixed based index)				Change from same period in the previous year (same period of previous year = 100)	
	1994	1995	1996	1993	1994	1995	1996	1995	1996
January	82.2	90.6	93.3		82.2	81.7	77.7	99.4	95.1
February	102.9	99.5	100.1		84.6	81.3	77.8	96.1	95.7
March	107.7	106.2			91.1	86.3		94.8	
April	92.7	91.7			84.4	79.2		93.8	
May	93.6	101.0			79.0	80.0		101.2	
June	103.3	102.3			81.7	81.8		100.2	
July	96.5	98.6			78.8	80.7		102.4	
August	105.8	103.5			83.4	83.5		100.1	
September	99.2	99.1			82.7	82.7		100.0	
October	106.0	103.6			87.7	85.7		97.8	
November	99.5	96.2			87.2	82.5		94.5	
December	103.4	101.1		100.0	90.2	83.3		92.4	

Sources: Russian Federation State Committee on Statistics, *Monthly Indicators Which Characterise Economic and Social Processes in the Russian Federation, March 1996*; International Monetary Fund

2.2. PRESENTATION OF METADATA

Most statistical publications produced by national statistical agencies include some metadata describing the methodology used in the collection of the basic statistics and in the compilation of the data. The descriptions provided by both OECD Member countries and transition countries, however, often lack the degree of detail required to enable users to understand what a series includes (and as important, excludes), the extent of bias caused by non-response or misreporting, etc. Such information is essential for users as changes in the methodology used to compile the data they use may necessitate changes to their interpretation/analyses of developments in the economy.

It is particularly important for transition countries to provide comprehensive descriptions of the methodologies underlying the statistical series presented in their publications. Such information is essential to users (both within and external to the agency responsible for collecting and compiling the data) in an environment where the statistical system is undergoing rapid change as transition countries bring their information systems into line with those of market economies. Unfortunately, most transition countries provide only minimal information on the methodologies used to compile their statistics.

Adequate metadata should be regarded as an essential part of all data presentation. In recent years the importance of good and comprehensive metadata has been given greater emphasis in OECD Member countries and work on the improvement of metadata is now underway in many statistical agencies.

User surveys conducted in OECD Member countries indicate that many clients of statistical agencies consider improvements in timeliness important. However, timeliness is not the only and perhaps not even the most important concern of users of short-term economic indicator data. At a meeting of users and producers of short-term economic statistics organised by the OECD in 1995, clients placed heavy emphasis on completeness, referring specifically to completeness with respect to time (availability of long time series), documentation (availability of statistical metadata) and coverage (availability of statistics on relevant new areas).

To enable the user to ascertain the relevance of the data to the purpose on hand it is important for statistical agencies to develop and adhere to a set of common metadata standards for all statistical series. These standards focus not only on what is included in the statistics presented but also on what the data does not include. For example, the user may want to determine the relevance of a series of enterprise statistics to the activities of units operating in the informal economy, or need to know more about the rebasing of an index.

At a minimum information should be provided on:

- coverage - units that are included and what is excluded (e.g. small enterprises, specific types of ownership) , especially where these relate to unrecorded economic activities that fall within the production boundary of the SNA;
- level of non-response and an indication of any bias;
- time series breaks (refer Section 2.4 below);
- any systematic misreporting by enterprises that complete questionnaires, etc.

The provision of such metadata by branch statisticians requires the adoption of a more systematic approach by branch statisticians in the information they provide about their statistical collections to users both within their own organisation and to external users. The paucity of information currently provided stems largely from fear of criticism about the statistics they produce. However, in reality the opposite is true. By being more open about both the strengths and weaknesses of existing data not only will users be in a better position to correctly analyse the statistical tabulations provided but there is greater likelihood that a wider understanding of the problems/issues of data collection throughout the user community (especially in key government ministries) will help bring about the required change/improvements.

Elements of metadata

An outline of the elements of metadata required for key statistical collections is provided below.

1. Broad definition of collection		
2. Coverage	Master list	The register, etc., from which units in the collection are drawn
	Geographical coverage of collection and publication	Country, region, cities, urban/rural
	Statistical population	Enterprises, establishments, households
	Coverage exclusions	This describes: - types of unit ownership excluded - whether or not small units, etc., are excluded; - types of activities excluded. An indicator is required of the magnitude of these exclusions based on objective analyses.
3. Non-response	Non-response rate	As percentage of total enterprises in collection. Also required are indications of non-response bias (e.g. response rates by size of enterprise, type of ownership, predominant activity, etc.)
	Methodology for imputing data for non-responding units	
4. Collection	Frequency of data collection	Monthly, quarterly, annually
	Reporting units	For example, households/enterprises in x regions of the whole country
	Reporting method	Complete enumeration, sample survey, use of employment/turnover cut-offs, etc.

	Survey items	Description of questionnaire (how long questionnaire has remained unchanged, brief description of what is collected)
	Data item collection	Whether monthly/quarterly items are collected on a cumulative or discrete basis
	Sample survey frame	Sample frame used (e.g. whether centralised statistical business register, or branch specific register) Sample stratification Method for selecting sample units Method for updating sample frame Method for rotating sampled units out of survey Sample size
5. Data Manipulation	Aggregations/grossing up	Methodology used Aggregated items/targets Calculation of weights Who does this (regional office, head office)
	Seasonal adjustment	Methodology/program used (X11, X12, etc.)
	Other adjustments	Trading days, etc.
6. Data quality	Sampling errors and their corrections	
	Indications of reporting bias	Systematic under-reporting
	Other errors and their corrections	
	Missing data in time series	
	Breaks in time series	
	Timeliness and release dates	
	Preliminary data	
	Revision strategy once data is published	
	Data verification strategy	
7. Classification standards	Standard classifications/nomenclatures	
	International comparability	
	Departures from international standards	

Source: derived from: OECD Paris, *List of Metadata Items for OECD's Main Economic Indicators, October 1996, G. Petit, P. Beziz, R. van Eck*

2.3. PRESENTATION OF REVISIONS TO DATA

It is standard practice for statistical agencies in OECD Member countries to revise published data from time to time. There are several causes of such revisions, though the most important is the need to revise previously compiled and published data as new, more accurate, more final and more comprehensive data becomes available. In transition countries new information with better coverage and quality continuously becomes available which enables statistical offices to make revisions and further improvements to previously published series. For example, it is likely that emerging economic activities may not be captured through the traditional methods of data collection. The introduction of new surveys which are more likely to capture such activities may necessitate the revision of previously published data.

Unfortunately, as mentioned in Section 1.8 above in the discussion on the cumulative method of collecting basic sub-annual statistics, the practice many transition countries is not to revise previously published data once they have been published but instead to carry revisions through to subsequent periods in the same year. This practice results in the substantial diminution of the ability of monthly and quarterly series to accurately reflect actual changes that occurred in each monthly and quarterly time period.

Therefore, as a matter of priority, it is the function of the statistical agencies in these countries to educate users of the international practice to periodically revise economic statistics that have been previously released or published.

To achieve credibility for its revision policy it is necessary for statistical agencies to:

- adopt and publicise beforehand a timetable for the publication and revision of monthly, quarterly and annual series, reconciliation of estimates, etc.;

- in the metadata and/or any analytical text accompanying published data draw users attention to the fact that index numbers for the current and previous month (period) should be regarded as preliminary and subject to revision;

- advise users when revisions are made to data for a particular month, etc., by clearly indicating which items have been altered. A practice adopted by some countries is to place the letter “r” beside the revised series.

2.4. PRESENTATION OF BREAKS IN TIME SERIES

As mentioned in the introduction to this document, the primary reason for the compilation of short-term economic indicators is to analyse seasonal and cyclical fluctuations in key branches of the economy. The purpose is to develop an understanding of changes taking place in an economy over time in terms of both magnitude and direction. Such changes may be short-term or long-term (i.e. extending over one or many years).

The essential element of the above description are the words “over time”. Obviously, in order for appropriate conclusions to be drawn from changes in levels of the series over time it is essential for the underlying data to be comparable in terms of collection and compilation methodologies over the whole period of the analysis. In fact, a series where these conditions of

underlying comparability do not exist cannot be called a valid time series and should not be presented as such in publications, etc.

Analyses of short-term economic statistics such as indices of industrial production and retail sales volume indices are usually undertaken in the context of a time series where often the need is for information reaching back to the commencement of the transition process. Because of significant changes in their statistical systems over this period most transition countries have had difficulties maintaining a consistent time series for many of the key short-term economic indicator series over the whole transition period. Changes that have occurred in these series include changes in coverage (especially with the introduction of private sector organisations), the introduction of and frequent alteration of size cut-offs, introduction of new classifications, and changes in compilation compilation/calculation methodologies. It is not unusual for some series to be significantly altered on an annual basis.

What constitutes a break in a series is largely a matter of judgement. However, international practice is to provide users with detailed information about the impact of changes to the series to the continuity of the series. This enables users to formulate their own judgement of the significance of the series break on any analyses that may have been undertaken using the data. Finally, care should be taken to ensure that the series breaks are clearly presented as series breaks in published graphs and tables.

Allied to the issue of inadequate metadata discussed in Section 2.2 above, the main problem with the introduction of series breaks in transition countries is that often users are provided with scant information in the metadata about the significance of these changes on the consistency of the underlying series over time. There are frequent instances of unreported changes in the compilation practices which lead to data for successive time periods not being strictly comparable. Furthermore it is not unknown for a continuous series to be graphed regardless of series breaks.

In accordance with international practice, series breaks should be identified and clearly presented in data provided to both internal and external users.

The statistical agencies of OECD Member countries go to great lengths to maintain comparability of data in a series over time. This is done by ensuring comparability in terms of data item definitions, classifications, coverage and definition of collection units, compilation methodologies, etc. However, situations occur where it is not possible to maintain such comparability. Where this occurs the following practices are implemented:

- sufficiently detailed information is provided in the metadata about changes in underlying methodologies to give users a clear and unambiguous understanding of the magnitude of the break in the time series;

- the statistical data is presented in such a way that the break in series is again drawn to the attention of users. Common practice is to show the break by drawing a line between the old and new series and inserting appropriate footnotes at the foot of the table;

- where possible historical data is revised on the basis of the new methodology. Where this is done by imputation clear indication (for example in footnotes) of the fact that data prior to implementation of the new methodology is estimated should be provided;

– where it is not possible to revise all (or significant parts) of earlier data effort should be made to overlap the old and new series for as long as necessary to give users an indication of the magnitude of the changes in level resulting from the new methodology. Because of resource constraints such overlap is often restricted to only one or two time period (i.e. months or quarters).

SECTION 3: ADJUSTMENT OF BASIC DATA

3.1. ADJUSTMENTS FOR WORKING DAYS

Monthly or quarterly short-term economic indicators can be adjusted for the different number of working days in a given month. The correction of working days normally takes account of:

- different lengths of months
- number of Saturdays and Sundays in a month
- official holidays and regional official holidays
- differences in the importance of certain working days (trading day adjustment)

A number of other factors are not included, i.e. holidays of individuals or firms, hours lost due to strikes, overtime or short work weeks, etc.

There are a number of different techniques for undertaking these adjustments. The usual method to calculate indices per working day is based traditionally on adjustments coefficients. These show the relation between the real number of working days of a month and the number of working days of a standard month which results from distributing the total number of yearly working days among 12 equal standard months of the base year.

More sophisticated methods of regression modelling may also be used.

The correction of working days should be done at the individual branch level.

It may be the case that no corrections are necessary if production or sales, etc., run continuously throughout the year.

The yearly average of the corrected production, sales, etc., indicator series should also be identical to the yearly average of the uncorrected series.

3.2. SEASONAL ADJUSTMENT

In order to determine whether changes in the original series reflects real developments or changes in the business cycle it is recommended that seasonal adjustment is undertaken.

The main reason for compiling high frequency statistics such as the monthly indices of industrial production or retail volume indices is to form a time series which may be used for

monitoring short-term fluctuations over a period of less than a year. A time series is a repeated measurement of the same concept over time. Cumulative data is not a time series.

Time series are analysed to understand the developments in an economy over time, that is, the direction and magnitude of changes that have taken place. Trends in the time series for the recent past are often used as the basis of predictions about the most likely in the near future. It is therefore important to be able to identify the underlying trends in a time series so as to be able to identify their direction at any time and to be able to identify turning points, that are changes in the direction. There are a number of provisos, the fluctuations must be real.

A time series is made up of three components:

- the trend cycle (T_t)
- seasonal variations (S_t)
- irregular variations (I_t)

The relationship between the original series and its trend cycle, seasonal variation, and irregular components can be additive or multiplicative. Time series models can be represented as either:

$$X_t = T_t + S_t + I_t$$

or

$$X_t = T_t \cdot S_t \cdot I_t$$

The *trend* is the underlying path or general direction reflected in the data.

The *seasonal variation* includes seasonal effects proper and other systemic effects. A seasonal effect is an effect that is reasonably stable in terms of annual timing, direction and magnitude. Possible causes are natural factors, administrative or legal measures, and social traditions.. Other systemic effects on the time series are due to variations in the number of working or trading days in a period or events that occur at regular intervals such as for example pay days for large groups of employees, pension payments, etc. Both the seasonal and the other systemic effects represent systemic, persistent, predictable calendar-related effects.

An *irregular effect* is an effect that is unpredictable in terms of timing, impact, and duration. It can be caused by sampling errors, non-sampling errors, unseasonable weather changes, natural disasters, strikes, and socio-economic changes.

Seasonal adjustment identifies and removes by means of analytical techniques, the regular within a year pattern to highlight the underlying trends and short-run movements in the series. A seasonally adjusted series consists of the trend plus the irregular component, and if the irregular component is strong, may not represent a smooth easily interpreted series.

To further highlight the trend the underlying trend the irregular component may be removed and the underlying trend estimated by smoothing the seasonally adjusted series using moving

averages or other trend estimation techniques. Some seasonal adjustment packages in addition to seasonal adjustments, separate estimates for the trend component.

The three series are presented below in Chart 3, which shows the decomposition of indices of industrial production for Estonia for the period 1993 to 1996.

Which series (seasonally adjusted or trend) should be published is still the subject of debate between experts in this area. It is recommended that both be presented, preferably in the form of graphs incorporated into the same chart.

It is important to emphasise that seasonal adjustment and trend estimations represent an analytical massaging of the original data. As such, the seasonally adjusted data and the estimated trend component complement the original data but can never replace the original. The nonseasonally adjusted data shows the actual changes that have taken place, while the seasonally adjusted data and the trend estimate represent an analytical elaboration of the data showing the underlying trends.

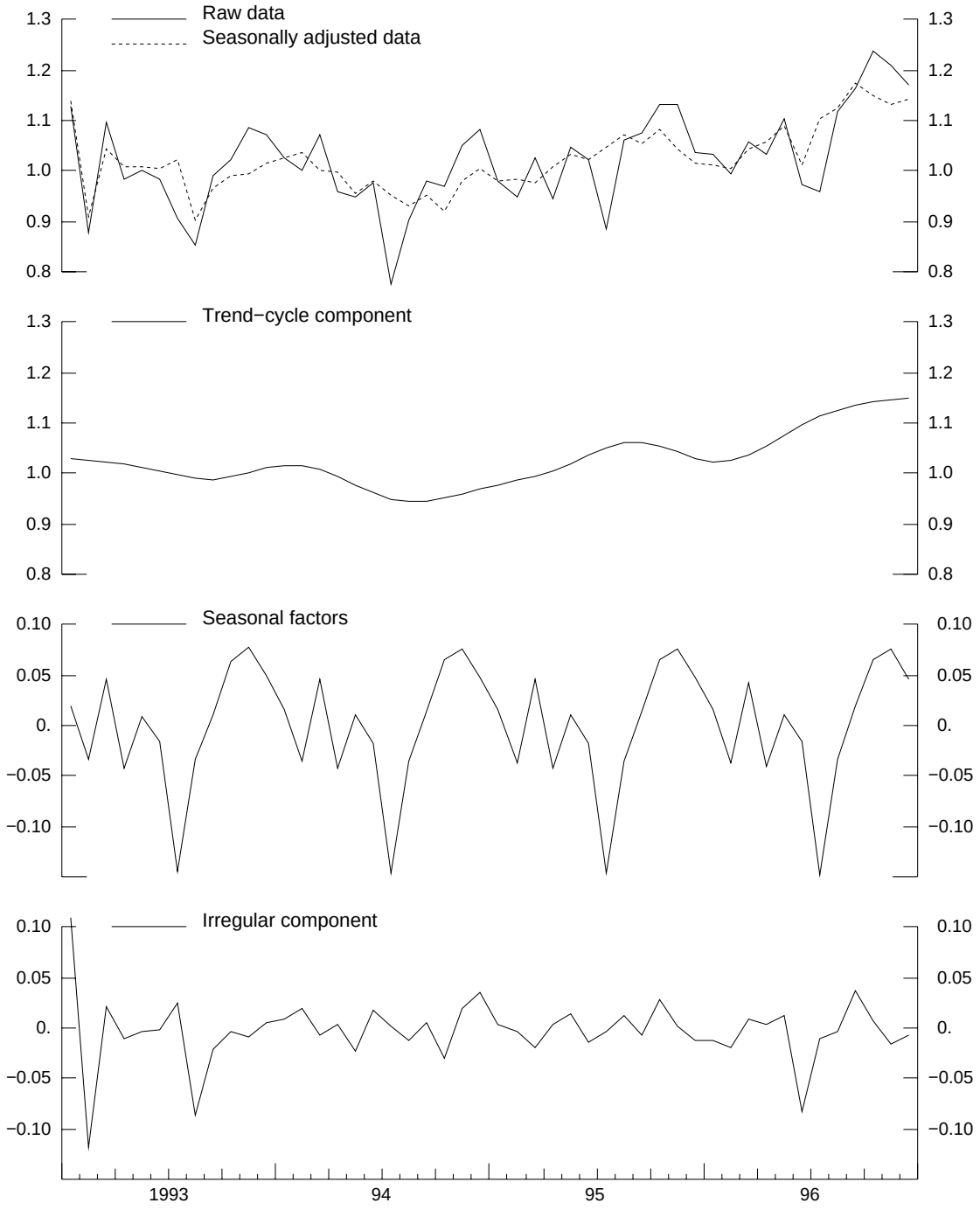
Seasonal adjustments and trend estimates should not be built into the original data compilation process but should be done after the original data has been compiled.

Seasonal adjustment is easy to do with off the shelf programs such as X-11 and X-12 ARIMA developed by the United States Census Bureau, or X11-ARIMA developed by Statistics Canada. These programs include options for adjustment for varying numbers of working days, holidays, irregular events, treatment of extreme values, tests for stable seasonality.

OECD Member countries apply the seasonal adjustment at different levels. Some countries adjust all individual series, while others make the adjustments only at aggregated levels. Most countries obtain seasonally adjusted totals as the sum of the adjusted components whilst others also adjust the totals independently.

A more detailed account of the issues related to the seasonal adjustment of statistical series compiled in transition countries (in particular, indices of industrial production) is provided in the OECD publication *Seasonal Adjustment of Industrial Production in Central and Eastern European Countries and the Russian Federation* (1997) - OCDE/GD(97)142.

CHART 1 DECOMPOSITION OF INDUSTRIAL PRODUCTION
ESTONIA



SECTION 4: DEFINITIONAL ASPECTS OF VOLUME INDICES

4.1. TERMINOLOGY

Before proceeding further on problems and issues specific to the compilation of volume indices currently compiled in transition economies it is necessary first of all to outline key terminology used to describe index components, etc. One of the factors contributing to the continued use of incorrect methodologies in the compilation of indices is the use of often conflicting terminology for the same aspects, components, processes, etc., of index compilation.

The purpose of the list of key terminology provided below is not to provide a definitive set of terms, etc., but to ensure a consistent understanding of the issues discussed in subsequent parts of this document.

Chained index	A chain index consists of a series of successive indices, each linked (or spliced) to its predecessor. Linking consists of multiplying the values of the successor index by the value of its predecessor in an overlap period, so that the index base period of the successor becomes the same as for the predecessor index.
Comparable prices	Is used to describe a situation in which all items are expressed in the same prices (either reported or estimated) in the two periods being compared.
Constant prices	Is used to describe aggregate data for several periods where all items are expressed in their respective prices of the base period.
Corresponding period index	Is an index where the base is the corresponding period (e.g. month or quarter) of the previous year. The corresponding period may also be a corresponding cumulative period.
Fixed-base index	Is an index which is calculated by comparing the current period to a fixed base period, for all observations.
Fixed-weight index	Is an index in which the weighting pattern is fixed for the life of the index. As explained below the Laspeyres index is the primary example of a fixed-weight index.
Linking	Is the technique used to join a new index series which reflects a changed weighting pattern to the previous index series to form a continuous series. Also referred to as chaining.
Link relatives	Express the unit price of an item in each period as a percent of the item's unit price in the immediately preceding period. They are useful for studying relative period to period price changes instead of changes from a fixed base period.

Previous period index	Is an index where the base is the previous month, quarter, or year.
Price	The price of a product or service is defined as the value of one unit of a product for which the quantities are perfectly homogeneous not only in a physical sense but also in respect of location, time, conditions of sale, etc.
Quantity relative	Is the ratio of the total quantities in the two periods.

4.2. TYPES OF INDICES

As further discussed in Sections 5 and 6 below, a number of different methodologies are used to compile quantity and volume indices. To a large extent the choice of methodology used by any one country is dictated by the availability of different types of data. However, before proceeding further it is necessary to have a clear understanding of what is meant by the terms "quantity" and "volume" indices, and although not specifically covered in detail, "price" and "value" indices as well.

As mentioned in the introduction to this document a major aim of economic analysis is to develop an understanding of changes taking place in an economy over time. This includes the measurement of economic growth (or decline) in volume terms between different periods. To achieve this for key economic value aggregates it is necessary to distinguish between changes arising solely from price changes from the remaining influences, i.e. quantity and quality, which are referred to as changes in "volume".

The creation of a system of price and volume indices is based on the assumption that at the level of a single homogeneous good or service *i* at time *t,* value (V_{it}) is equal to price per unit of quantity (P_i) in time *t* multiplied by the number of quantity units (Q_i), i.e. :

$$V_{it} = P_{it} \times Q_{it}$$

Price indices

Hold item composition, quality, and quantities constant to measure changes in price relatives over time.

Quantity indices

Quantity indices measure relative changes in activities such as industrial production, dwelling unit construction, etc., only through relative changes in physical units, e.g. tonnes of coal, number of dwelling units, kilowatt hours of electricity, etc.

For transactions in goods it is relatively easy in many cases to define the physical unit involved in the transaction and therefore the price per unit. In a number of cases, e.g. unique capital or "complex" goods, it is more difficult.

Even at fine levels of detail, physical quantity based series may only provide crude measures of changes as they do not properly reflect changes that may occur in the mix of different qualities. For example, a constant number of physical units recorded for a certain flow may understate the volume change if the composition has changed in favour of units with higher quality.

Quantity indexes have no meaning from an economic point of view if they involve adding quantities that are not commensurate, i.e. where the quantity data are non-homogeneous. The change in the quality of different products is regarded not as a change in price but as a part of the change in the "volume" of the product. At the aggregated level the term "volume" is preferred to the term "quantity". For this reason the 1993 SNA uses the term "volume increase" rather than "quantity increase" because in some situations the quantities remain unchanged but the quality may change.

It is not legitimate to add together quantities that are not identical with each other even though they may be expressed in the same physical units (e.g. tonnes of coal to tonnes of beef).

Volume indices

Price and volume indices of aggregates are always compiled from price and volume indices of individual goods and services. It may not be possible to compile a quantity index due to:

- the non-availability of physical unit information for many items of production, sale, etc.;
- problems of quality changes;
- changes in the composition of items included in the index; and
- the problems of aggregating different units of quantities.

As mentioned above, if every production/transaction value is the product of the quantity and price, volume movements can be determined by holding the price constant. Nearly all items used in the compilation of volume indices are aggregates or aggregates of aggregates. By keeping the prices on each item fixed, period to period changes in the constant price estimates for aggregates of items reflect changes in the quantities (and/or quality) of the different products. Such indices are aggregated using prices as the weights.

The SNA defines a volume index as an index that measures the average of the proportionate changes in the quantities of a specified set of goods or services between two periods of time. The quantities compared must be homogeneous while the changes for different goods or services must be weighted by their economic importance as measured by their values in one or other, or both, periods.

Values of production, sales, etc., may be used in the compilation of volume indices. In analysing trends in capital investment for example, movements in expenditure on capital goods are considered rather than the numbers of items of equipment purchased. If every transaction value in such an expenditure aggregate is considered as a product of the volume of goods sold and the unit price, it is apparent that attention can be concentrated on volume movements. This is done by holding the price terms constant in deriving the overall movement.

Both the SNA and the European System of Accounts (ESA 1995, page 235) states that in general the best method of estimating volume changes for flows of goods or services is deflating

value data with price indices. However, in periods of high inflation there is greater difficulty in measuring both current price data and in compiling price indices. In these circumstances it may be more appropriate to estimate volumes directly.

Value indices

Value indices deal with variables that have elements of change in both the price and quantity. Since a measure of value is obtained by multiplying price by quantity, an index showing changes in retail sales could be the result of changes in either or both price and quantity sold. Similarly, changes in the level of income received could result from changes in the rate of pay, from changes in the level of output, or from changes in both.

Summing up

There is particular confusion when different terms are used to describe fundamentally the same set of indices compiled in transition countries. For example, quantity indices are sometimes referred to as physical volume indices, and in some instances people talk of volume indices when describing quantity indices. When is an index of industrial production a quantity index and not a value index, or when is an index of retail sales a volume index or a value index? Part of the problem is that many indices use combinations of quantity and value data in their compilation. Very few indices are "pure" quantity or volume as defined above.

Indices of some items, such as value added, cannot be treated as the product of a price and a volume components since value added is only derived as a balancing item. In such instances an index derived by dividing current price data by a price index is described as being "in real terms" rather than "at constant prices".

4.3. CONSTANT PRICES

The expression "constant prices" is often used interchangeably with "quantum", "volume", "quantity", and "in real terms". However, measures at constant prices are not the same as volume series described above. They are in fact value series that are adjusted to remove the effects of price changes. More specifically, the term constant prices is used to describe aggregate data for several periods where all items are expressed in their respective prices of the base period. These are generally the average prices of the base year, which is recommended by the 1993 SNA. These may be changed every year resulting in annual chain-linked Laspeyres volume indices.

In terms of the above notation, measuring a product at constant prices involves the compilation of a time series where all the transactions for that product are expressed in the price of a selected base period *0*.

$$CP_{it} = P_{i0} \times Q_{it}$$

As mentioned above, the term comparable prices is used to describe a series in which all items are expressed in the same prices in the two periods being compared.

Constant price data are additive which constitutes a convenient method of compiling aggregate volume measurements.

The adjustment of current price value series by a suitable price index simply provides artificial proxies for quantity aggregates that cannot be directly measured and aggregated because of their diversity.

Aggregates at constant prices for each period are obtained by summing constant price values for the transactions covered. The average prices of the base period in effect act as weights to combine the quantities of the individual commodities involved in the transaction. Thus, for a given base period constant price measures in theory will vary only with changes in the quantities of the goods and services transacted.

This process of substituting base year prices can only be applied to the values of goods and services consumed. It cannot for example be applied to incomes (e.g. pensions, interest and dividends) which cannot be disaggregated into price and quantity components.

As mentioned above, the starting point for constant price estimation is the basic relationship that value equals price times quantity. Such a relationship is not as obvious at an aggregated level.

In some cases direct and independent data can be collected for each element of the relationship (i.e. value, price and quantity) and corresponding price and volume indices can be constructed directly from collected price and quantity data. Alternatively, this relationship can be used to derive one of the three items indirectly. For example, an implicit price deflator can be derived as the value at current price divided by the value at constant prices, or an estimate at constant prices can be derived by deflating current value data with an appropriate price index.

It is not possible to treat some items, such as value added, as the product of a price and a volume component since it is only derived as a balancing item.

SECTION 5: TYPOLOGY OF METHODOLOGIES AND TYPES OF INFORMATION USED TO COMPILE INDICES OF INDUSTRIAL PRODUCTION

The methodologies used in each individual country in the compilation of volume indices is largely dependent on the types of data that are available. This Section and the following Section provide a general outline of the methodologies used to compile indices of industrial production and retail sales volume indices respectively.

Indices of industrial production can be compiled using either one or combinations of two broad types of information[1].

Input data

- consumption of typical raw materials (in quantities)
- employment or hours worked

Output data

- use of production data of selected products in physical quantity terms
- deflated values of products

5.1. METHODOLOGIES INVOLVING USE OF INPUT DATA

The assumption underlying the use of input data in the compilation of volume indices is that net output is constant per unit of input item used. Such an assumption may not be realistic where many different inputs are used. It may only be acceptable for a branch where one homogeneous input (or at best a few) accounts for the bulk of the inputs used.

This methodology entails the use of inputs in physical units actually consumed (i.e. not just those purchased). Examples include the consumption of paper (in tonnes) in the printing industry, etc.. If several major inputs are used periodic adjustments need to be made to take account of changes in the proportions used, e.g. in the case of construction materials.

The main types of input data used and key issues relevant to each are discussed below.

1. derived from EUROSTAT, Luxembourg, *Manual: Methodology of Industrial Short-Term Indicators,* September 1994 and *Methodology of Industrial Indicators: Rules and Recommendations*, 1996

Consumption of raw materials

- There may be considerable difference in timing as to when the materials were purchased and when they were actually used in the production process.

- Materials input is also an imperfect proxy for work done when there are changes in the amount of processing applied to materials for a given product. This could for example arise if less processed materials are purchased and further processing is undertaken on the materials and components in the industry itself. As a result more work is done and less materials are used for given output. Therefore, when work done is increasing it might be found that an output series remains unchanged and a series of materials input actually declines.

- A materials input series could ignore technical substitution of minor for major materials if it is confined to a few of the more important materials.

- Changes in the amount of wastage of materials may not be adequately allowed for in a series of materials recorded as used or consumed.

Employment or hours worked

- Labour statistics are generally available in most countries. These comprise number of employees and hours worked.

- Irrespective of the labour series used there is a need for adjustments in output in certain industries as a result of the employment of males, females, juveniles.

- The main advantage of using labour input series is that they are fairly direct approximations of work done. Furthermore, the timing of labour input and work done agrees.

- The main difficulty is that they do not take account of changes in labour productivity. Labour series can only be used as an approximation to a series of work done if it is known that productivity changes in a particular industry are small. This is a major consideration as one of the major uses of an index derived from this type of data is to assess changes in the productivity of labour.

5.2. METHODOLOGIES INVOLVING THE USE OF OUTPUT DATA

The hypothetical data in the following table contains current price values and price indices used in examples in the discussion of methodologies in this and in the following Sections. These examples are drawn largely from material prepared for a national accounts workshop for transition countries held at the OECD in Paris in December 1996.

Table 8: Calculation of Values in Current Prices

	Item	Period 1	Period 2	Period 3	Period 4	Period 5
Price (P_n)						
	A	11	12	14	16	18
	B	6	5	4	4	3
Quantity (Q_n)						
	A	7	6	6	5	5
	B	14	16	18	20	22
Values (P_n,Q_n) at current prices						
	A	77	72	84	80	90
	B	84	80	72	80	66
	Total	161	152	156	160	156
Price Index (Period 3 =100) (P_n/P_3) . 100						
	A	78.6	85.7	100.0	114.3	128.6
	B	150.0	125.0	100.0	100.0	75.0
Laspeyres Price Index (Period 3=100)						
$\Sigma(P_nQ_3)$		174	162	156	168	162
$\Sigma(P_3Q_3)$		156	156	156	156	156
Index = $[\Sigma(P_nQ_3)/\Sigma(P_3Q_3)]*100$	Total	111.5	103.8	100.0	107.7	103.8
Paasche Price Index (Period 3=100)						
$\Sigma(P_nQ_n)$		161	152	156	160	156
$\Sigma(P_3Q_n)$		154	148	156	150	158
Index = $[\Sigma(P_nQ_1)/\Sigma(P_3Q_n)]*100$	Total	104.5	102.7	100.0	106.7	98.7

Source: OECD, Paris, National Accounts Workshop, December 1996

Use of production data of selected products in physical quantity terms

This approach entails the selection of a number of representative individual commodities expressed solely in physical quantity terms. The number of commodities chosen by countries can vary from a few hundred to several thousand, the aim being to ensure that in total the number selected account for a high proportion of total output, sales, etc. This proportion generally ranges from between 70 per cent to 90 per cent.

Branches and the commodities representing them are normally chosen with reference to their importance to total industry output in the base year, and on the availability of the required data. This is generally undertaken using annual or less frequent branch census data. The list of commodities should be reviewed regularly in the light of census results.

Generally a basket of representative products (or product groups) is observed for each branch to calculate a reliable index. The products are identified and defined with the aid of one of the international product classifications described in Section 1.2 above. The products chosen are representative of the output of the branch and their share in respect of total branch output is able to be determined.

Each individual commodity is also chosen for its suitability to represent a smaller number of product groups each of which can be further attributed to a branch class. This is done to ensure that any particular branch class is adequately represented by one or more of its main products.

At the two-digit ISIC or NACE levels the selected products should on average account for about 70 per cent of the total branch output. However, the basic aim is to compile an index that accurately shows period to period movements, not absolute levels. It is therefore not necessary to be over comprehensive.

Physical quantity data is still commonly used to compile indices of industrial production in both OECD Member and transition countries. The latter make use of it due to the high concentration of industry output by a small number of large enterprises which (still) makes the collection of such information relatively easy. With the privatisation and break-up of these larger enterprises this may not be the case in future.

Where available, physical quantity data is the preferred data for the calculation of production type indices. Their advantage over value estimates in calculating volume indices arises because price factors are often difficult to discount, especially in periods of high inflation. However, physical quantity data is seldom available at the required level of classificatory detail for “complex” items such as machinery and other engineering industry output.

Also, at the moment physical quantity data may be the more reliable source data to use than value data in transition countries because of the cumulative collection methodology outlined in Section 1.9 above. There is still the need however to verify the precise methodology used for the collection of quantity data each month or quarter. For example, it must be discrete period data, and revisions where applied retrospectively must be applied to the period to which they relate.

If quantity indicators are compiled care must also be taken to ensure that the quantities refer to products that are as homogeneous as possible. Physical and other characteristics should be taken into consideration when identifying products where there may be differences in quality. For many goods and services intended for a specific purpose there may exist several varieties of differing qualities each with its own price.

Differences in quality are reflected by:

- physical characteristics;
- deliveries in different locations;
- deliveries at different times of the year;
- differences in conditions of sale or the circumstances or environment in which the goods or services are supplied.

With given physical characteristics the differences in other factors imply that the physical units are not identical in an economic sense and that the value differs amongst the units. These differences in unit values are considered to be differences in volume and not as difference in price.

Two main methodologies are used in the initial index aggregation process of physical quantity data for the calculation of quantity indices.

Calculation of quantity relatives by commodity

At the elementary indices level this methodology entails the calculation of the ratio of the quantity produced each month or quarter over the corresponding base period figure. These indices are then aggregated to higher levels.

Quantity revaluation

This methodology involves the calculation of ratios of values of output at constant prices. For each commodity, the sum of quantities reported by all enterprises is multiplied by the statistical agency by the average price in the base year.

If the current price value of a transaction in period *n* is expressed as:

$V_n = P_n \times Q_n$ (where P_n and Q_n are the price and quantity respectively of the transaction in period *n*), then the corresponding constant price value is calculated by substituting the base period price (P_o) for the current period price (P_n) in the above relationship, i.e.:

$$VK_n = P_o \times Q_n$$

Where more than one commodity is involved, the total value at constant prices is obtained by summing the constant price values of the individual items, i.e. total:

$$VK_n = \Sigma(P_{io} \times Q_{in})$$

This methodology is illustrated in the following table.

Table 9: Quantity Revaluation Methodology

	Item	Period 1	Period 2	Period 3	Period 4	Period 5
Base period 1 (P_1*Q_n)	A	77	66	66	55	55
	B	84	96	108	120	132
$\Sigma(P_1*Q_n)$	Total	161	162	174	175	187
Index = $[\Sigma(P_1Q_n)/\Sigma(P_1Q_1)]*100$		100.0	100.6	108.1	108.7	116.1
Base period 2 (P_2*Q_n)	A	84	72	72	60	60
	B	70	80	90	100	110
$\Sigma(P_2*Q_n)$	Total	154	152	162	160	170
Index = $[\Sigma(P_2Q_n)/\Sigma(P_2Q_2)]*100$		101.3	100.0	106.6	105.3	111.8
Base period 3 (P_3*Q_n)	A	98	84	84	70	70
	B	56	64	72	80	88
$\Sigma(P_3*Q_n)$	Total	154	148	156	150	158
Index = $[\Sigma(P_3Q_n)/\Sigma(P_3Q_3)]*100$		98.7	94.9	100.0	96.2	101.3
Base period 4 (P_4*Q_n)	A	112	96	96	80	80
	B	56	64	72	80	88
$\Sigma(P_4*Q_n)$	Total	168	160	168	160	168
Index = $[\Sigma(P_4Q_n)/\Sigma(P_4Q_4)]*100$		105.0	100.0	105.0	100.0	105.0
Base period 5 (P_5*Q_n)	A	126	108	108	90	90
	B	42	48	54	60	66
$\Sigma(P_5*Q_n)$	Total	168	156	162	150	156
Index = $[\Sigma(P_5Q_n)/\Sigma(P_5Q_5)]*100$		107.7	100.0	103.8	96.2	100.0

Source: OECD, Paris, National Accounts Workshop, December 1996

This methodology is equivalent to compiling a Laspeyres index using prices as the weights to enable quantity comparisons. Summation across individual commodities then yields total values of output at base year prices for product groups. Ratios of these totals to corresponding monthly average monthly vales for the base year are then taken.

For quantity indices to be valid (irrespective of which of the above variants is used) the individual commodities selected (expressed in either quantities or revalued quantities) must be homogeneous, not subject to quality change (since a change in quality is equivalent to a change in quantum), and quantity data must be available in each period. For this reason in many transition countries and OECD Member countries revaluation is used mainly for agricultural products and for goods produced for own final use. The methodology is also used for less complex industrial goods produced where it is supplemented by the use of other methodologies for more complex items.

In practice, the homogeneity of commodities depends on the degree of detail to which they are classified. For example, it may not be satisfactory to apply the quantity revaluation methodology to the total number of television sets produced, especially when there is wide diversity in the types

and value of television sets produced. However, reasonably useful results could be obtained if the numbers were classified by size of screen, and provision of extras such as remote control, etc.

Value Deflation

This method which is discussed in more detail in Section 6 in respect of volume indices of retail sales, entails the calculation of product values at base year prices. For each product, the sum of the current values reported by all enterprises from which data is collected is deflated by an appropriate producer price index. Summation across products yields product values at base year prices for industry groups. Ratios to corresponding average monthly product values are then taken.

The following table summarises the methods used in 1995 and 1996 by OECD member countries to compile indices of industrial production.

Table 10: Summary of Methodologies Used by Most OECD Member Countries to Compile Industrial Production Indices

Country	Main Type of Basic Information	Second Main Type of Basic Information
Australia	deflated sales	
Austria	quantities	
Belgium	quantities	
Czech Republic		
Denmark	deflated sales	
Finland	quantities	hours worked
France	quantities	
Germany	deflated product values	
Greece	quantities	
Ireland	quantities	deflated sales
Italy	quantities	
Japan	quantities	
Luxembourg	quantities	deflated product values
Netherlands	deflated sales	quantities
Norway	quantities	
Portugal	quantities	
Spain	quantities	
Sweden	hours worked	quantities
Turkey	quantities	
United Kingdom	deflated sales	quantities
United States	electricity consumption	quantities

Sources: EUROSTAT, *Methodology of Industrial Short-term Indicators: Rules and Recommendations*, 1996, p. 45
OECD, *Main Economic Indicators: Sources and Methods*, 1996

SECTION 6: METHODOLOGIES USED TO COMPILE RETAIL SALES VOLUME INDICES

The methodology most commonly used in the compilation of retail sales volume indices in OECD Member countries is value deflation. Broadly, this method entails the calculation of product values at base year prices. For each product the sum of the current values reported by all enterprises from which data is collected is deflated by an appropriate price index. Summation across products yields product values at base year prices for industry groups. Ratios to corresponding average monthly product values are then taken.

This methodology is illustrated in the following table where period 3 is used as the base period. The example also uses the current price values and the Laspeyres and Paasche indices provided in Table 8 above.

Table 11: Value Deflation Methodology

	Period 1	Period 2	Period 3	Period 4	Period 5
Current Price Values $\Sigma(P_n*Q_n)$	161	152	156	160	156
Constant Price Estimates (Laspeyres) Index = $[\Sigma(P_nQ_3)/\Sigma(P_3Q_3)]*100$	111.5	103.8	100.0	107.7	103.8
Constant Price Estimate $\Sigma(P_nQ_n)/[\Sigma(P_nQ_3)/\Sigma(P_3Q_3)]$	144.4	146.4	156.0	148.6	150.3
Constant Price Estimate (Paasche) Index = $[\Sigma(P_nQ_n)/\Sigma(P_3Q_n)]*100$	104.5	102.7	100.0	106.7	98.7
Constant Price Estimate $\Sigma(P_nQ_n)/[\Sigma(P_nQ_n)/\Sigma(P_3Q_n)]$	154.1	148.0	100.0	150.0	158.1

Source: OECD, Paris, National Accounts Workshop, December 1996

Deflation of current price values using a Paasche price index gives the same result as the quantity revaluation methodology discussed earlier.

OECD Member countries tend to use a Laspeyres (fixed weight) price index, at least at the detailed level of aggregation.

Value deflation methodology tends to be used for more complex, heterogeneous products such as machinery, precision instruments, etc.

There are also two variants of this method:

- the first entails the use of values for a select number of specific products; whilst

- the second uses the values of almost all products produced.

Whichever variant is used care must be taken to ensure that an appropriate price index is used (as discussed in Section 7.2 below). For example, where there are considerable differences in the prices for products sold domestically and those exported, separate producer price and export price indices should be used.

Accepted practice is to use fixed-weighted (Laspeyres) price indices to deflate current price estimates at the most detailed level possible and then to sum these revalued components. This method is equivalent to using current period weights for combining the intermediate components, while fixed base period weights are used within each component. A more detailed discussion on index formulae is provided below in Section 7.3.

With the exception of countries experiencing very high rates of inflation similar to those experienced by many transition economies in the early stages of transition, constant price estimates derived through deflation can in general produce more accurate results than other methods because:

- price competition causes prices of identical commodities produced by different firms to move in similar ways and therefore reasonably accurate estimates of price change can be obtained using small samples. On the other hand value and quantity changes cannot be measured accurately without collecting a large amount of data;

- in the compilation of price indices specific attention can be given more readily to excluding changes that are attributable to differences in quality, thereby ensuring that any such quality changes are automatically reflected as quantum changes; and

- if directly relevant price or quantity data are not available to revalue a current price value, then the proxy price movements of related commodities will almost certainly be more accurate indicators than any proxy quantity movements. For example the changes in the prices underlying the cost of running a real estate office is likely to be similar to that for a stock broker's office, but the quantum of output for the two are unlikely to be related.

The justification for these is that price relatives (P_t/P_0) generally display less variation than quantity relatives (Q_t/Q_0). The main underlying assumption is of course the availability of suitable price indices compiled to international standards.

Where it is possible to obtain direct and independent estimates for both price and quantity components in addition to the current price value the basic relationship between them referred to earlier can be used as a means of undertaking a consistency check on the value, price and volume measures.

Finally, apart from the issue of the availability of a suitable price index another major issue to consider when determining whether or not to use the value deflation methodology is whether to use gross production value or sales data. The suitability of either series is very much dependent on the branch for which the index is being compiled.

Production value data

In the case of industry, the output series used should represent production of completed items at the end of a stage of production. The data needs to represent the result of production during the reference period, whether for sale or stock. Sales on the other hand can be made from either current production or from stocks.

Sales value data

Sales value data can be used to calculate an index where changes in the quality of goods occur or if the combination of products included change. This methodology is useful for the compilation of a volume index for retail sales.

An example of the deflation of a current value retail sales series is shown in the following table. Column 2 shows annual current value retail sales between 1994 and 1997. A price index for the selling prices of the same range of goods is shown in Column 3. In Column 4, sales are expressed at constant 1994 prices. For example, 1995 sales of $43 538 are equivalent to sales of $43 538/1.03 = $42 270 at 1994 prices.

Columns 5 and 6 respectively present link relatives and percent relatives for the constant-dollars sales in Column 3. These relatives reflect changes in the quantity of products sold, since prices are constant. The link relatives show that the quantity of merchandise sold increased by about 10 per cent per year during the period. The percent relatives show, in turn, that by 1997 the quantity sold was about 133 percent as great as in 1994.

Table 12: Example of Calculation of Constant Value Series

Year	Annual Retail Sales	CPI (1994=100)	Retail Sales at 1994 Prices	Relatives for Column 3	
				Link Relative	Percent Relative (1994=100)
(1)	(2)	(3)	(4)	(5)	(6)
1994	38 500	100	38 500	-	100.0
1995	43 538	103	42 270	109.8	109.8
1996	49 050	105	46 714	110.5	121.3
1997	54 950	107	51 355	109.9	133.4

On the other hand, when sales data is used for the compilation of an index for industry a major consideration is the need to ensure that an appropriate price index is used where sales occur in different markets with different prices (e.g. domestic versus export markets).

Other disadvantages of using this methodology for industry production indices are:

- the time-lag between production and sales;
- the inclusion of sales from stocks, and the exclusion of production for stocks; and

- the exclusion of intermediate production of finished or semi-finished goods for subsequent processing in the same enterprise.

There is less considerably less variation in the basic methodology used by OECD Member countries to compile retail sales volume indices than for indices of industrial production (refer Table 10 in Section 5 above). The primary method is the deflation of current value sales data by an appropriate CPI (refer Section 7.4 below).

Finally, it should be emphasised again that enterprises should not be expected to report data at constant prices or at comparable prices. The three main methods for deriving constant prices (revaluation, deflation and extrapolation) should be undertaken by the statistical agency itself at the most disaggregated level possible. This reduces the risk of using an inappropriate index formula and weighting pattern in manipulating the basic source data obtained from enterprises.

SECTION 7: INDEX COMPILATION ISSUES

7.1. DERIVATION OF INDICES

In transition countries it is still common practice to present indices as ratios based on the same month of the previous year *(t/t-12)* or on the same period of the previous year (e.g. January to June 1996 compared to the same period of 1995). A monthly index so compiled over a twelve month is in fact twelve separate indices and must not be presented as an index showing month on month movements. In some transition countries however such an index is occasionally derived from such a series and incorrectly presented and graphed as a time series that purports to show month on month movements.

The first step in the incorrect derivation of an index involves the calculation of monthly ratios to the average of the base year annual level (column 1). This is done by relating monthly absolute comparable price data (discussed in Section 1.8 above) to the absolute indicator of base year average monthly output.

Following that, indices of production volume for each month in subsequent years are chained to the corresponding month of the previous year (columns 2-4).

Table 13: Example of Incorrect Calculation of Fixed Base and Previous Period Indices

Month	1990 as % to average monthly level	As % to corresponding period of previous year			As % to average monthly level in 1990		
		1991	1992	1993	1991	1992	1993
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
					(2) x (1)/100	(5) x (3)/100	(6) x (4)/100
Jan	101.1	95.7	84.4	80.2	96.8	81.7	65.5
Feb	97.4	95.3	87.6	82.6	92.8	81.3	67.2
Mar	108.2	94.0	87.5	84.9	101.7	89.0	75.6
Apr	100.7	93.4	88.5	85.3	94.1	83.3	71.1
May	98.3	93.4	85.0	85.4	91.8	78.0	66.6
June	100.8	91.0	84.8	85.5	91.7	77.8	66.5
July	91.5	94.0	77.2	85.7	86.0	66.4	56.9
Aug	96.2	92.0	72.2	88.2	88.5	63.9	56.4
Sept	98.5	93.8	76.2	88.3	92.4	70.4	62.2
Oct	103.8	90.1	78.4	86.1	93.5	73.3	63.1
Nov	98.8	88.7	78.9	86.3	87.6	69.1	59.6
Dec	104.9	88.1	80.7	86.5	92.4	74.6	64.5

The third step involves the derivation of an index of industrial volume expressed in percentage terms of each average monthly level in the base year (columns 5-7).

Having done this a number of transition countries then derive a previous period index series by chaining the separate monthly indices derived from the previous step. For example a PP=100 for June 1993 is 99.8, i.e. June 1993/May 1993 x 100 (66.5:66.6 x 100 = 99.8). This methodology is clearly wrong and produces results incompatible with those produced by OECD Member countries. It is not possible to derive a previous period series from a series that has previously been calculated on the basis of same period previous year.

Where there is a need to present corresponding period previous year data the recommended practice is to first present the data in the form of a time series with a fixed base period. Users, if they so wish, may then recalculate this information into a corresponding period series. The recommended approach is illustrated in Table 7 in Section 2.1 above.

7.2. CORRESPONDENCE BETWEEN PRICE INDICES AND COLLECTION CLASSIFICATIONS AND NOMENCLATURES

When using volume indices compiled by the deflation of current values by a price index care needs to be taken to ensure correspondence between the classifications and nomenclatures used in different statistical surveys, so that producer prices, consumer prices, etc., are available for the same product or group of products.

For example, as discussed in Section 6 above most OECD Member countries compile retail volume indices through the deflation of current value retail sales data by a suitable price index. The price index most commonly used is the CPI which is the main source of comprehensive data on changes in purchaser's prices on consumer goods and services. The consumption basket used for constructing the CPI often differs from the definition and coverage of items in the current value retail trade collection. It is therefore important not to deflate current value data by the total CPI but instead to use a price index that has been specifically constructed to ensure that the items included in the price index correspond with those in the current price value of retail sales data. In some transition countries the required correspondence is not attained. For example the value of retail sales data at current prices might exclude estimates of the informal economy whereas the CPI used to deflate this series might include price data from such components of the economy.

To help identify any possible inconsistencies between the price index and the current value data it is preferable to compile constant price estimates at the most disaggregated level possible using the relevant components of the price index. The price data covered by the CPI should be supplemented with additional price data for flows not properly covered by price index.

Therefore, in converting current value series into constant values the price index used must also be relevant to the series. Thus, a general food price index could not be used to adjust the series on car sales, or the overall CPI (which could include services, etc.) to adjust overall current value retail sales aggregates that excluded services.

7.3. USE OF APPROPRIATE INDEX FORMULA

Inappropriate use of Sauerbeck formula

A common problem in the compilation of volume indices is the continued use of the Sauerbeck formula in the compilation of the price indices (particularly producer price indices (PPIs) used to deflate current value data. The situation is further complicated by the fact that many cases the price indices used are incorrectly described as Laspeyres indices.

The essential feature of the Sauerbeck formula is that price relatives are calculated as a ratio of current period price to previous period price. These are combined using base period weights. This formula differs from the more internationally accepted Laspeyres in that in the Sauerbeck formula the base period prices are changing and do not match the base periods of the weights.

The essential difference between a Laspeyres and a Sauerbeck index is that the former maintains a link back to the base period which enters into each monthly calculation. The Sauerbeck on the other hand is solely a measure of month on month movements.

The Sauerbeck is algebraically written as:

$$\Sigma \frac{P_n}{P_{n-1}} \times P_o Q_o$$

Sauerbeck indices do not behave in the regular way of Laspeyres price indices. For example, if after a certain period of time production or sales return to their original value, the index does not return to its original value. Furthermore, cumulated monthly figures are inconsistent with the corresponding twelve-monthly figures, and monthly figures cannot be chained and averaged to derive a valid quarterly or annual estimate. In addition, the compilation task is unnecessarily increased by having to calculate two indices each month (*t/t-1* and *t/t-12)*.

Whilst there is no generally agreed conclusion on the bias introduced by use of the Sauerbeck formula it is recognised that they generally result in overestimates of inflation price indices calculated from Laspeyres formula. For this reason transition countries should initiate procedures to identify and replace any inappropriate index formulae currently in use.

The use of Sauerbeck formula is still common statistical practice in many transition countries. In some instances Sauerbeck indices are incorrectly presented as Laspeyres. Proper identification of which formula has actually been used may require reference to the actual working papers used in the calculation of the index. Use of the Sauerbeck formula may be identified by the omission of any reference base period prices in the calculation of price relatives.

An example of the differences between price indices compiled using the Laspeyres and Sauerbeck formulae is shown in Table 13 below. The basic data used in the table is derived from information provided above in Table 8.

The weights for each of items A and B for the Sauerbeck index are derived as the ratio of their values to the total values in the base period (period 1). Therefore the weights are:

Item A	0.478
Item B	0.522

Table 14: Comparison of Laspeyres and Sauerbeck Indices

	Item	Period 1	Period 2	Period 3	Period 4	Period 5
Laspeyres price index (period 1 = 100) Index = $[\Sigma(P_nQ_1)/\Sigma(P_1Q_1)]*100$		100.0	95.7	95.7	104.3	104.3
Sauerbeck price index						
Price relatives (P_n/P_{n-1})	A		1.091	1.167	1.143	1.125
	B		0.833	0.800	1.000	0.750
Weighted price relatives $\Sigma(W_{io})*(P_n/P_{n-1})$	Total		0.957	0.975	1.068	0.929
Final spliced Sauerbeck index $\Sigma[W_{io}*(P_2/P_1)*...*(P_5/P_4)\}$	Total	100.0	95.7	93.3	99.7	92.6

Source: OECD, Paris, National Accounts Workshop, December 1996

As mentioned earlier the main feature that distinguishes the Sauerbeck index is that the price relatives are based on the previous period only. The reason why the Sauerbeck index is often confused with the Laspeyres is that in the former the weighted price relatives are based on a fixed base. In the Laspeyres the price relatives are based on a fixed base.

Index formulae used by OECD Member countries

The pre-transition era in transition economies was typified by relatively slow changes in the price and product structure in industry. This resulted in volume indices that in statistical terms were stable over time. These indices did not vary significantly whichever index formula was applied. However, with the onset of high inflation, particularly in the early period of transition, an important issue in the compilation of volume indices was the mechanism by which price and volume changes of individual goods were added to price and volume changes of aggregates. There were also changes to the price structure brought about by changes in the relative prices of goods and services.

There is a wide choice of index formulae available to solve this problem. This Section provides a brief description of the formulae commonly used. For completeness this overview includes a description of the Paasche formula even though it is used only for a very small number of indices compiled by OECD Member countries.

Most OECD Member countries use a Laspeyres fixed-weight formula in the compilation of their volume indices. A smaller number use the Laspeyres chain-index formula.

Laspeyres

The Laspeyres formula is the main index formula used in both transition and market economies for index compilation. In algebraic terms it is commonly written as:

$$\frac{\Sigma P_o Q_n}{\Sigma P_o Q_o} \times 100$$

where P_o is the price in the base period, Q_n the quantity in the current period and Q_o the quantity in the base period.

The essential element of the Laspeyres formula is that the index is constantly linked back to the base period in the calculation of quantity relatives. The weights are derived from a single year in the past.

A Laspeyres index may not require frequent updating of the index weights, since they come from the base rather than the current period. In countries and branches where structural changes are taking place slowly weighting information is collected less frequently with less respondent burden, etc.

There is a choice between two methods for calculating a Laspeyres volume index. These involve the use of base year quantities as weights. These entail the use of physical quantity data to calculate the volume index. The other method entails the use of base year expenditures or output/sales value data as weights. These require the use of value, etc., relatives to calculate the index. It is more usual to use expenditure or value data as weights as they are generally easier to obtain (through annual value of output/sales collections). Also, it may be difficult to define "quantities" for some expenditure, sales, output items.

The next issue in the application of the Laspeyres volume index formula, where volume changes are weighted with the values in a base year, is determining which year should be chosen as the base year. Generally speaking this involves the choice between a fixed base year (described above) and a changing base year. The latter method is called a chained Laspeyres and is described in the next Section.

An advantage of using fixed weights for a series of years is that in longer series of values in constant prices deflated parts of aggregates exactly add up to the deflated aggregate.

Chained Laspeyres

One of the major problems with using a fixed weight formula is that volume changes of aggregates are calculated with outdated weights. As discussed in Section 1.9 above, the more remote the base period the less representative the quantity relatives represented in the weights of a fixed weighted volume index will become. It is similar to the weighting issue in relation to the compilation of price indices. Over time, the production or retail sales expenditure pattern reflected in the fixed weights used in the derivation of such quantity and volume indices will become less representative of actual production/expenditure patterns currently occurring. The process of change in structure and

composition of production or sales will be gradual in some branches of the economy and rapid in others.

It is in the dynamic areas of an economy where growth is most significant that quantity and volume relatives are likely to be subject to most change, and where a fixed weighted volume index will perform poorly in measuring real growth in aggregate volume. For this reason chain linked Laspeyres are used.

An index in the form:

$$\frac{\Sigma P_{n-1} Q_n}{\Sigma P_{n-1} Q_{n-1}} \times 100$$

will compare the volume movement between the period under consideration (period *n)* and the preceding period *n-1*.

Each term in a time series of such indices will measure change since the previous period, with the component volume movements being weighted together using the price relatives of the previous period. That is, a changing series of weighting base periods is used, each reflecting the recent situation in respect of price relationships. Application of the chained Laspeyres volume index means that the weights change every year and are derived from the previous year. Because the weights are more up-to-date a better approximation of the real world volume changes is obtained than with fixed weights.

When derived as described by this format, the terms of the series are each Laspeyres volume indices but since each has a different base period, they do not form a time series of directly comparable terms.

In order to derive a comparable time series, the individual volume indices need to be compounded by multiplying separately estimated year-to-year volume indices as follows to produce a chain-linked volume index series, in this case a Laspeyres chain-linked volume index.

$$\frac{\Sigma P_o Q_1}{\Sigma P_o Q_o} \times \frac{\Sigma P_1 Q_2}{\Sigma P_1 Q_1} \times \ldots\ldots\ldots\ldots\ldots \times \frac{\Sigma P_n Q_n}{\Sigma P_{n-1} Q_{n-1}} \times 100$$

An example of a chained Laspeyres volume index is provided in the following table. In deriving a Laspeyres based volume index the idea is to produce a Laspeyres based volume between each adjoining period and then link the series together by using the movement in each period's index to move forward the previous period's level. The data for the base periods are obtained from Table 4 above.

It can be seen from the formula used that the (price) weights are changing in each period and the series is being linked together over time.

Chain volume series can also be expressed in value terms. However, the resulting series is not additive in that the deflated parts of an aggregate do not exactly add up to the deflated total. This aspect is also demonstrated in the following table where the chain values for each period has been calculated using the Laspeyres formula with a reference period of 1. The values for items A and B have been derived from Table 8 above.

Table 15: Laspeyres Chain Volume Index

	Item	Period 1	Period 2	Period 3	Period 4	Period 5
Constant price values						
- Base period 1		161	162			
- Base period 2			152	162		
- Base period 3				156	150	
- Base period 4					160	168
- Base period 5						156
Chain Laspeyres volume index	Total	100.0	100.6	107.2	103.1	108.3
Index = $[100.0]*[\Sigma(P_1Q_2)/\Sigma(P_1Q_1)]*$ $[\Sigma(P_2Q_3)/\Sigma(P_2Q_2)]*$ $[\Sigma(P_3Q_4)/\Sigma(P_3Q_3)]*$ $[\Sigma(P_4Q_5)/\Sigma(P_4Q_4)]$						
% change over previous period			0.6	6.6	-3.8	5.0
Chain Laspeyres volume (value)						
- Base period 1	A	77.0	66.0	66.0	55.0	55.0
	B	84.0	96.0	108.0	120.0	132.0
	Total	161.0	162.0	174.0	175.0	187.0
Chain Laspeyres volume (value)	Total	161.0	162.0	172.7	166.0	174.3
% change over previous period			0.6	6.6	-3.8	5.0

Source: OECD, Paris, National Accounts Workshop, December 1996

In period 2 the series are additive because the movement in that period is calculated using period 1 as the base. For subsequent periods it can be seen that the sum of components A and B do not equal the chain volume total. However, the percentage change from one period to the next is identical for both the volume index and the volume (value).

In reality, pure fixed weight methods are almost never used. Even countries that apply fixed weights periodically change those weights and select another base year. In chaining the sub-indices they also have the problem of non-additivity. This of course is based on the assumption that the rebasing is not carried backwards. Long time series therefore almost inevitably involve some form of chain indices. Annual chaining is merely an example of where rebasing is implemented annually instead of every five or ten years.

Paasche

The Paasche formula determines the reference period as the current period and is described algebraically as follows:

$$\frac{\Sigma P_n Q_n}{\Sigma P_n Q_o} \times 100$$

As with the Laspeyres, the Paasche index can be used to construct a chain index by constructing period to period Paasche indices and multiplying then together to obtain the index for the desired period. A year's index would therefore be the product of month-to-month Paasche indices.

The availability of administrative data under central planning made the compilation of Paasche indices feasible since reporting of current information could be successfully mandated by the government from state enterprises. With the transition towards market economies statistical agencies have to rely more on voluntary co-operation from respondents and greater consideration has to be given to the issue of respondent burden.

The reporting of sales and expenditure data used in the compilation of current index weights is particularly onerous to respondents both because of the time involved and because the information requested is considered sensitive and confidential in a competitive business environment.

The main differences between Laspeyres and Paasche formulae used to derive volume indices can be illustrated using, as an example, the calculation of a volume index of production. The base-weighted (Laspeyres) shows the ratio of current production at base-year prices to base-year production valued at base-year prices. The Paasche index shows the ratio of current production at current prices to base-year production valued at current prices.

The relationship between the Laspeyres volume index and the Paasche price index is demonstrated by the fact that the ratio of values in current can be derived by multiplying a Laspeyres volume index by a Paasche price index, i.e.:

$$\frac{\Sigma P_o Q_n}{\Sigma P_o Q_o} \times \frac{\Sigma P_n Q_n}{\Sigma P_o Q_n} = \frac{\Sigma P_n Q_n}{\Sigma P_o Q_o}$$

Another disadvantage of the Paasche index is that while the index number for each period can be compared with the base period, comparisons between two other periods do not accurately reflect the change between the two periods. Because inter-period comparisons are valid with base-weighted indices, these indices used more often by OECD Member countries. Transition countries are increasingly calculating base-weighted indices that can therefore be compared between different periods in the year.

Fisher

For both the 1993 SNA and the 1995 ESA the preferred measure of year to year changes in volume is a Fisher volume index which is defined as the geometric mean of the Laspeyres and the Paasche indices, i.e.

$$F_q = (L_q \ x \ P_q)^{1/2}$$

In periods of low inflation and slow structural change, the preference of both the SNA and the ESA for the Fisher formula is not strongly marked because:

- the computation of genuine Fisher indices is extremely data intensive and would increase the work burden considerably;
- the fact that the index is not additive; and most significantly
- empirical verifications have shown that the approximation by the usual indices (chained Laspeyres/chained Paasche) are quite satisfactory.

Recommendations

In summing up this discussion of index formulae used in the compilation of volume indices both the SNA and the ESA show a strong preference for chain indices. Available empirical results for many OECD Member countries indicate that the biases which are avoided by chaining indices are larger than those that would result from the choice of the index formula. In other words chain Laspeyres and chain Paasche provide satisfactory approximations of Fisher chain indices which constitutes the theoretical reference.

7.4. FREQUENCY OF WEIGHT CHANGES DURING PERIODS OF RAPID STRUCTURAL CHANGE

Despite the occurrence of rapid structural change, some transition countries do not modify the weights used in the derivation of their indices frequently enough. A small number of countries continue to use weights calculated at the commencement of the transition process.

The concept of production weights used in the compilation of Laspeyres volume indices denotes a set of goods and services or production with specified and unchanging relative proportions. This set reflects actual proportions in a certain period, the reference period.

In conditions of rapid economic structural change, in the context for example of an index of industrial production, the composition of production in the industry branch which the reference period weights is supposed to represent do in fact change with time. For example, the absolute decline of heavy industry may lead to a relative increase in the size of industry branches involved in the production of consumer goods or food processing.

The Laspeyres index assumes that the relative composition of production remains the same. For this reason an index of industrial production based on a constant base period is upward biased in

the sense that it tends to overestimate production volume changes. Because of this characteristic of the Laspeyres index it is important to update the weights frequently during periods of rapid economic change.

In the context of a retail volume index which may be derived from the deflation of a current value retail sales index (refer Section 6 above), the expenditure pattern of consumers which the reference period weights for the current value index is supposed to represent also change with time. Not only do tastes and fashions change, but market conditions as well. As a result consumers continuously change their spending habits, normally by spending less on the relatively higher priced goods and services and more on the relatively lower priced goods and services. This has been particularly evident in many transition countries where the composition of expenditure (due for example to increases in imports) has changed significantly over the last five years.

The Laspeyres index assumes that the composition of retail sales remains the same. For this reason a retail volume index based on a constant base period (a Laspeyres index) is also biased upward in the sense that it tends to overestimate retail volume changes. It is therefore similarly (and perhaps even more) important to update the weights frequently during periods of rapid economic change.

Both the 1993 SNA and ESA 1995 recommend that countries should, where possible, use annual chain indices for measuring growth rates in volumes of expenditure or production. Fixed base indices may also be used when the volume measures for components and aggregates have to be additively consistent for purposes of economic analysis and modelling.

The creation of a constant time series links the old series with the new series based on the new base period resulting in a set of chain linked time series. Effectively, two indices using different fixed baskets and covering two different time frames are linked by having a period applicable to both, i.e. month representing the end of one index and the start of another.

It should be noted that the most recent period for which expenditure structures or production patterns are known is not necessarily that chosen as the new base of the index. The computations involved, however, require that the two be identical. If they are not too far apart, the disparity may be acceptable and no adjustment is made for it.

Until now, most OECD Member countries produce infrequently rebased volume series. Rebases are normally held every five years for both volume and price measures. The series are also chained (or linked) to estimates expressed in terms of earlier base years. However, in recent years some OECD Member countries have been compiling and publishing volume series chained more frequently.

The weighting methodology used by a number of OECD Member countries in the calculation of indices of industrial production is summarised in the following table.

Table 16: Weighting Methodology Used By OECD Member Countries in the Compilation of Indices of Industrial Production

Country	Weighting Methodology Used
Austria	Indices are calculated with fixed weights based on the 1990 value of net production.
Denmark	The industry group weights correspond to their value added in 1985.
Finland	Weights refer to the value added at factor cost and are revised every five years.
France	A fixed weight formula is used to calculate the indices using weights for individual indices derived from the 1990 value added of the corresponding industrial branch.
Germany	Indices are calculated using a fixed weight formula with net production as weights. The base period is the second half of 1990.
Greece	The indices are calculated using a fixed weight formula with base year 1980 weights equal to value added at factor cost.
Ireland	The monthly gross output indices are compiled as base weighted chain-linked Laspeyres indices with base 1990=100. The monthly indices are adjusted to ensure that their annual average agrees with the corresponding annual benchmark volume series.
Italy	The weights used to aggregate at product level are based on the value of production, and on value added at factor cost in 1990 for higher levels of aggregation. Data are collected in respect of 530 commodity items. Weights are based on value added by industry obtained mainly from the 1990 Census of Manufactures.
Netherlands	The weights are recalculated every five years and are derived from national accounts data.
Spain	The indices use a fixed weight formula with weights used to aggregate at branch and product level based respectively on value added and production in the 1990 base year.
United Kingdom	The total index is calculated as a weighted arithmetic average of about 280 separate indicators, each of which describes the activity of a small sector of industry using the Laspeyres formula. The basic indices are weighted by value added at factor cost.
United States	Total index is derived from 260 individual series based on the 1987 Standard Industrial Classification. Weights used to derive individual industries are derived from value added of individual industries

Source: OECD, Paris, *Main Economic Indicators: Sources and Definitions*, May 1996

Both factors will lead to increasing inaccuracy in the calculated indices unless both weights and the composition of the basket is reviewed frequently.

At the other extreme however the change of base period and chain linking should not be conducted more frequently than annually. Too frequent chaining can introduce a substantial bias (in most cases upwards) in a chain-linked index. In general, relative prices and relative quantities tend to change only gradually over time and do not return to their original level.

Volume indices are generally calculated in two steps. The first step involves the aggregation of basic information within an ISIC or NACE activity. The second involves aggregating indices between branch activities.

Initial Stage

For indices compiled from physical quantity data such as indices of industrial production, indices of ISIC or NACE at the lowest level are calculated using a Laspeyres formula to baskets of representative products (commodity groups) for each activity.

Where baskets of representative products and fixed weights are used care must be taken to ensure that changes in the structure of industry are taken into account. This is particularly the case where activities show a high degree of product diversification or are affected by rapid changes in product engineering. Baskets of goods that are too old can lead to very fast growing industries being under-represented and declining industries becoming over-represented.

Ideally, the weights applied at this stage consist of value added. In practice this information is generally not available at the product level. As a proxy (on the assumption of a fixed ratio between value added and sales inside a given industry) the weights used at this stage can be obtained from the PRODCOM statistics in the base year or other sales statistics.

For indices of industrial production compiled through the use of physical quantity data the elementary indices comprise quantity relatives by commodity. For each commodity item total quantity produced in the period under review is expressed as a per cent of the corresponding base figure.

The first stage is not necessary if the basic information for the production of volume indices consists of deflated value data of branches.

Second Stage

The next stage of the compilation of composite indices is the aggregation of lower level indices. This aggregation is done by weighting the computed branch indices with the share of the appropriate class according to the value added at factor cost in the base year. The value added at factor cost is derived from annual structural surveys of the base year.

In the Russian Federation the branch indices for the indices of industrial production are compiled by valuing the quantities at the average prices of the preceding year which is equivalent to compiling a Laspeyres index using the average of the previous year as the weight period and as the base period for the quantity comparisons. These branch indices are further aggregated into the total index using value added weights a procedure that conforms with international standards.

BIBLIOGRAPHY

A Dictionary of Statistical Terms, F.H.C. Marriott, fifth ed. Longman Scientific & Technical

Australian Bureau of Statistics, Canberra, *Constant Price Estimates,* seminar prepared for the Treasury, August 1995

Australian Bureau of Statistics, Canberra, *Working Papers in Econometrics and Applied Statistics: Choosing a Price Index Formula*, WP No. 96/1, Leanne Johnson, May 1996

EUROSTAT, Luxembourg, *Manual: Methodology of Industrial Short-term Indicators*, September 1994

EUROSTAT, Luxembourg, *Methodology of Industrial of Industrial Short-term Indicators: Rules and Recommendations*, 1996

EUROSTAT, Luxembourg, *Statistical Classification of Economic Activities in the European Community (NACE, Rev. 1)*, May 1996

EUROSTAT, Luxembourg, *European System of Accounts (ESA 1995)*, 1996

EUROSTAT, Luxembourg, *Report of EUROSTAT Task Force on Volume Measures*, 1997, edited by INSEE, presented at OECD/UNECE/EUROSTAT Meeting of National Accounts Experts held at OECD, Paris, June 1997

International Monetary Fund, Washington DC, *Working Paper: Methodologies of Price Indices in Transition Countries*, K.D. Zieschang, November 1995

International Monetary Fund, Washington DC, *Working Paper: National Accounts in Transition Countries: Distortions and Biases*, A. Bloem, P. Cotterell, T. Gigantes, November 1996

OECD, Paris, *Main Economic Indicators: Sources and Definitions*, May 1996

OECD, Paris, *List of Metadata Items for OECD's Main Economic Indicators*, October 1996, paper by G. Petit, P. Beziz, R van Eck presented at work session on Statistical Metadata

OECD, Paris, *Short-term Economic Indicators: Transition Economies - Sources and Definitions*, April 1997

OECD, Paris, *Short-term Economic Indicators: Transition Economies* - quarterly

OECD, Paris, *Framework for the Measurement of Unrecorded Economic Activity in Transition Economies* (November 1997) - OCDE/GD(97)177

OECD, Paris, *Seasonal Adjustment of Industrial Production in Central and Eastern European Countries and in the Russian Federation* (1997) - OCDE/GD(97)142

OECD, Paris, *Consumer Price Indices: Sources and Methods*, 1994

OECD, Paris, *Producer Price Indices: Sources and Methods*, 1994

OECD/EUROSTAT, Paris/Luxembourg, *Construction Price Indices: Sources and Methods*, 1997

State Committee on Statistics of the Russian Federation, Moscow, *Refinement of Procedures for the Monitoring of Prices for Goods and Services and CPI Calculation in the Russian Federation*, paper prepared for joint ECE/ILO meeting on CPIs, Geneva, 20-24 November 1995

Statistics Netherlands, Voorburg, *Reference Manual on Design and Implementation of Business Surveys*, March 1995 (in Russian)

Statistics Netherlands, Voorburg, *The Use of Chain Indices in the Netherlands*, 1997, S. de Boer, J van Dalen, P. Verbiest. Paper presented at conference on measurement problems, INSTAT, Rome, January 1997

United Nations Statistical Division, New York, *International Recommendations for Construction Statistics*, 1997

United Nations Statistical Division, New York, *International Standard Industrial Classification (ISIC, Rev. 3)*, February 1989

United Nations Statistical Division, New York, *Central Product Classification (CPC)*, February 1989

United Nations Statistical Division, New York, *International Recommendations for Industrial Statistics*, 1983

United Nations Statistical Division, New York, *Guidelines on Principles of a System of Price and Quantity Statistics*, 1977

EEC, IMF, OECD, UN, World Bank, *System of National Accounts 1993 (1993 SNA*), 1993