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International Recommendations for the Index of Industrial Production

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Preface

Comparison of economic performance over time is a key factor in economic analysis and a fundamental requirement for policy-making. Short-term indicators play an important role in this context by providing such comparison indicators. Among these short-term indicators, the index of industrial production has historically been one of the most well-known and well-used indicators. The index of industrial production measures volume changes in the production of an economy, and therefore provides a measurement that is free of influences of price changes, making it an indicator of choice for many applications. While being an important indicator in its own right, the index of industrial production also plays an important role in the System of National Accounts, since it reflects temporal changes in the value added for individual industries, as well as having a strong relationship with the performance of the economy as a whole.

This publication is a revision of the original manual on *Index Numbers of Industrial Production*, published by the United Nations in 1950. It takes into account methodological developments in the field of index number calculation that emerged over the past decades and describes new recommended methodological standards for the compilation of index numbers of industrial production.

The development of these standards has taken into account other recently revised statistical standards and recommendations and contributes to a coherent set of international guidelines that include the *System of National Accounts 2008*, the *International Standard Industrial Classification of All Economic Activities (ISIC) Rev.4*, the *Central Product Classification (CPC) Ver.2*, the *International Recommendations for Industrial Statistics (IRIS) 2008*, the *Producer Price Index (PPI) manual* and the *Consumer Price Index (CPI) manual*.

The updated methodology described in this publication, used with the *Manual for an index of services production*, published by the OECD, now provides assistance to data producers in the compilation of volume indices for the majority of goods- and services-producing industries.

In addition to outlining the standard methodology, this publication also provides practical guidance for actual steps in the index number calculation and presents recommended methods for each industry in its scope to assist countries in producing high-quality short-term economic indicators that are also internationally comparable.

Acknowledgements

This publication draws from or makes direct use of text from a number of sources, in particular the OECD's *Manual for an index of services production*; various Eurostat manuals; the International Monetary Fund's *Producer Price Index (PPI) manual* and the International Labour Office's *Consumer Price Index (CPI) manual*. The United Nations Statistics Division acknowledges the contributions by these organizations in allowing the use of the above mentioned documents in the preparation of this publication.

The standards presented in this publication are closely aligned with the OECD's *Manual for an index of services production*. The OECD manual details concepts and methodology related to the compilation of index numbers for the services sector of the economy. Where possible, the structure, concepts and terminology of the two documents have been harmonized.

The UNSD could not have completed this work without the cooperation and input of the members of the United Nations Expert Group on Industrial Statistics. This topic was discussed at the 2005 and 2007 Expert Group meetings and this publication was reviewed in detail at the 2008 meeting. Expert Group members at the 2008 meeting were: Mr. Cristiano Santos (Brazil), Ms. Teofana Genova (Bulgaria), Mr. Peter Lys (Canada), Mr. Michel Girard (Canada), Mr. Jean-Francois Loue (France), Mr. Norbert Herbel (Germany), Mr. Anthony Kofi Krakah (Ghana), Mr. S.K. Nath (India), Mr. Masato Hisatake (Japan), Ms. Mika Sawai (Japan), Ms. Violeta Kunigeliene (Lithuania), Mr. Eduardo Romero (Mexico), Mr. Leenhert Hoven (Netherlands), Ms. Esther Foo (Singapore), Ms. Wai San Cheng (Singapore), Ms. Wai Yee Yen (Singapore), Mr. Norman Morin (United States), Mr. Robert Yuskavage (United States), Mr. Eun-Pyo Hong (OECD) and Mr. Shyam Upadhyaya (UNIDO).

In addition, Mr. Richard McKenzie (OECD), Mr. Brian Newson (Eurostat), Ms. Isabelle Remond-Tiedrez (Eurostat) and Mr. Marius Reitsema (Netherlands) provided additional input or have reviewed earlier drafts of this publication.

The initial text for this publication was drafted by Mr. Marcel van Kints (UNSD) with guidance and review provided by Mr. Ralf Becker (UNSD) and Mr. Ivo Havinga (UNSD). Additional drafting and editing was carried out by Mr. Becker and Mr. Thierno Aliou Balde (UNSD).

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Abbreviations

CPC	Central Product Classification
CPI	Consumer Price Index
EPI	Export price index
Eurostat	Statistical office of the European Communities
GDP	Gross Domestic Product
IIP	Index of Industrial Production
ILO	International Labour Organisation
IMF	International Monetary Fund
IRIS	International Recommendations for Industrial Statistics
ISIC	International Standard Industrial Classification of All Economic Activities
MPI	Import price index
OECD	Organisation for Economic Co-operation and Development
PPI	Producer Price Index
QNA	Quarterly National Accounts
2008 SNA	System of National Accounts 2008
UNSD	United Nations Statistics Division

Chapter 1: Introduction

1.1 The index of industrial production

1.1. The Index of Industrial Production (IIP) describes the change of the volume of goods and/or services produced over time. Its main purpose is to provide a measure of the short-term changes in value added over a given reference period. However, since it is difficult to collect high-frequency data to accurately measure value added, gross output measures such as value of production or turnover data are more commonly used.1 The IIP being a volume index means the index is not influenced by price fluctuations.

1.2. The IIP is an important short-term economic indicator in official statistics. It is an important indicator in its own right as well as being used in comparison to or conjunction with other short-term indicators to assess the performance of an economy. The IIP is also, in some countries, a key input for calculating volume measures as part of the compilation of the quarterly national accounts.

1.3. Production indices for the industrial sector are used as a main short-term economic indicator because of the impact that fluctuations in the level of industrial activity have on the remainder of the economy in many countries. The availability of production indices on a monthly basis and the strong relationship between changes in the level of industrial production and economic cycles facilitates the use of production indices as a reference series in determining or forecasting turning points in business cycles. Therefore an advantage of the production index compared to other indicators is its combination of high frequency, fast availability (relative to GDP for example) and its detailed activity breakdown.

1.4. IIP data are most commonly published for the hierarchical levels of the industry classification. However, some countries also publish IIP data for other groupings, such as by 'stage of processing[2]' or by 'use[3]' groupings. These data provide additional insight into the monthly movements of the IIP and further assist users in carrying out business cycle analysis.

1.5. While the IIP provides important information in its own right, it is also common for the IIP to be used in comparison to or conjunction with a number of other economic

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[1] Since the purpose of the index is to be a measure of short-term change in value added, output measures (or other substitutes) have to be chosen carefully to reflect this purpose. This is also discussed in sections 4.1.1 and 5.4.2. In addition, since typically for a particular industry volumes of value added move at similar rates to volumes of output in the short run, the IIP can be regarded as a measure of short-term movements in value-added.

[2] In this case the goods and services are classified according to their position in the chain of production. Goods and services are classified either as primary products, intermediate products, or finished products.

[3] In this case IIPs are produced for intermediate goods, energy, consumer goods and capital goods.

statistics in order to assess the current state of a national, regional or the global economy. Some of these complementary indicators include capacity utilization, new orders and inventories. In addition, the IIP is also a data source that can be used as part of the compilation of quarterly Gross Domestic Product (GDP), which is discussed in detail in section 2.5 of this publication.

1.6. The IIP has a wide range of users who assess the most recent economic situation of countries, regions and the global economy, and undertake international comparisons among these countries and regions.

1.2 Historical background

1.7. The Index of Industrial Production (IIP) has traditionally been used to provide insight into short-term changes in economic activity. The compilation of such indices dates back to at least the 1920's.

1.8. The United Nations has a long history of collecting and publishing industrial statistics and related information. The index of industrial production is one of the most well known of these statistics. The collection of these index numbers started in the 1950's following the recommendations of the Statistical Commission at its fifth Session in 1950[4] which outlined the methods to be used in compiling index numbers of industrial production.

1.9. A United Nations publication detailing the production index methodology, namely *Index Numbers of Industrial Production,*[5] was published in 1950. This is the first and only United Nations publication on this topic. While the United Nations has published material on related topics, such as the *Guidelines on Principles of a System of Price and Quantity Statistics*[6] in *1977* or the *Manual on Producers' Price Indices for Industrial Goods*[7] in 1979, no revision of the methodology published in the original version of the index number manual has been released.

1.10. Since its publication in 1950, many changes have taken place that require an updated version of the index number publication. This includes, on one hand, country experiences compiling index numbers over the past decades. This has resulted in more economical and reliable methods of compilation that better respond to the need for fast, descriptive indicators of economic growth. On the other hand, a number of underlying and related statistical standards and recommendations have changed, particularly in recent years, and the concepts and methodology applied in the original index number manual needed to be updated. These updated standards and recommendations include:

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[4] *Statistical Commission, Report of the Fifth Session*, 1950 (E/CN.3/113/Rev.1), page 8.
[5] Statistical Papers, Series F, No.1 (United Nations publication, Sales No. 1950.XVII.4)
[6] Statistical Papers, Series M, No. 59 (United Nations publication, Sales No. E.77.XVII.9)
[7] Statistical Papers, Series M, No. 66 (United Nations publication, Sales No. E.79.XVII.11)

- The *System of National Accounts 2008,*[8] whose compilation of quarterly national accounts is linked to the IIP calculation (see section 2.5 of this publication);
- The *International Recommendations for Industrial Statistics (IRIS) 2008,*[9] which describe the standards for industrial statistics, including its scope, and include the IIP as one of the recommended indicators;
- The International Monetary Fund's *Producer Price Index Manual,*[10] which describes the calculation of producer price indices (PPIs) that are used in the calculation of the IIP when the deflation method is applied (see section 4.2 of this publication).
- The *International Standard Industrial Classification of All Economic Activities (ISIC), Revision 4,*[11] whose high-level categories define the scope of the IIP calculation and whose detailed categories are used to define the aggregation and publication levels of the IIP; and
- The *Central Product Classification (CPC), Version 2,*[12] whose categories are used to define products and product groups used in the IIP calculation.

1.11. The abovementioned standards and guidelines have led to changes in some aspects of the IIP compilation when compared to the 1950 index manual. These changes are reflected in the present publication and include:

- *The scope of the IIP*. The current scope is defined in terms of ISIC Rev. 4, i.e. the scope of the industrial sector is defined to cover section B (mining and quarrying), section C (manufacturing), section D (electricity, gas, steam and air conditioning supply) and section E (water collection, treatment and supply, sewerage, waste collection and remediation activities). This reflects a change from the original 1950 scope which included Mining and quarrying, Manufacturing and Electricity and gas; and
- *Calculation methods, Index weighting practices, linking and re-basing issues*. Historically the production indices for the industrial sector were compiled using a fixed weight approach with weights updated at five-year intervals. However, new methods and approaches over the last several decades have been developed to address deficiencies of these types of indices. Therefore the chain-linked approach with annually updated weights has become more preferred in recent years and is the recommended method presented in this publication.

1.12. This revision of the publication on *Index Numbers of Industrial Production* has been carried out at the request of the United Nations Statistical Commission.[13] Draft text and

[8] Statistical Papers, Series F, No. 2, Rev.5 (United Nations publication, Sales No. E.08.XVII.29)
[9] Statistical Papers, Series M, No.90 ((United Nations publication, Sales No. E.08.XVII.8)
[10] IMF et al, *Producer Price Index Manual: Theory and Practice,* Washington, IMF, 2004
[11] Statistical Papers, Series M, No.4, Rev.4 (United Nations publication, Sales No. E.08.XVII.25)
[12] Statistical Papers, Series M, No.77, Ver.2 (United Nations publication, Sales No. E.08.XVII.26)

issues of this publication have been discussed at United Nations Expert Group meetings in 2005, 2007 and 2008 and the issues and draft version of this publication have been the subject of a worldwide consultation in early 2009.

1.3 Purpose and scope of this publication

1.13. This publication draws on a wide range of experience and expertise, based on consultations with a large number of potential users of this publication. It outlines practical and suitable measurement methods and issues and benefits from recent theoretical and practical work in the area.

1.14. It is intended for compilers and users of indices of industrial production. It assists compilers to produce index numbers in comparable ways so that they can serve as reliable international comparisons of economic performance and behavior using the best international practices. This publication also assists countries that plan to set up a more comprehensive system of volume measures by providing not only the methodological foundations for the index number compilation, but also by giving practical guidance on individual steps and elements of the compilation process.

1.15. It is recognized that due to practical constraints, some of the recommendations in this publication may not be immediately attainable by all national statistical offices and, therefore, should serve as guideposts for agencies as they revise and improve their IIP programs.

1.16. The publication also serves the needs of users by making them aware of the methods employed by national statistical offices to compile the indices. In addition, the publication discusses potential IIP calculation errors, biases and incompatibilities between different approaches that may be employed, so that users can properly interpret the results. Users are therefore encouraged to consult metadata information on index number calculation methods used in different countries to make a better judgment of the comparability of the indices. The United Nations Statistics Division has issued a publication on *Country practices for the collection and calculation of the Index of Industrial Production*[14] that can be used in this regard.

1.17. This publication addresses the standards for the compilation of an index of industrial production, which is defined to cover activities in sections B through E of ISIC Rev.4, i.e. Mining and quarrying; Manufacturing; Electricity, gas, steam and air-conditioning supply; as well as water supply, sewerage, waste management and remediation activities.

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[13] The revision of the IIP publication was placed on the work program of the UNSD in 2004 (See E/CN.3/2006/3, paragraph 14). Work commenced in 2005 and the Statistical Commission endorsed the work undertaken on the IIP by the UNSD in 2006 (E/CN.3/2006/32, page 7, 37/101 part c).

[14] Working Papers, ESA/STAT/2008/8

1.18. This scope coincides with the scope of the International Recommendations for Industrial Statistics (IRIS) 2008, which includes the index numbers of industrial production in its list of recommended indicators.

1.19. Readers familiar with the 1950 IIP publication will note that the present publication has been developed with a slightly different approach. While the present publication outlines key IIP theory and concepts, which did also occur in the 1950 IIP publication, it also goes a step further and provides practical guidance via the use of data examples to demonstrate statistical practice. In addition, chapter 7 provides guidance on methods and approaches at a detailed industry level.

1.20. This publication can be used in conjunction with the OECD's *Manual for an index of services production.*[15] The two publications, when used side-by-side, now provide compilation guidance to produce indices for the majority of goods- and services-producing industries.

1.4 Organization of this publication

1.21. This publication on index numbers of industrial production is organized into two parts.

1.22. Part I includes a description of the international recommendations on index numbers of industrial production, covering the scope of industrial production, fundamental concepts, data sources and compilation methods. It also includes recommendations for the presentation and dissemination of the compiled indices. It is encouraged that countries fully comply with the recommendations set out in Part I.

1.23. Part II includes international guidance to assist countries in implementing the international recommendations presented in Part I. It presents a set of methods (categorized as 'preferred', 'alternative' and 'other') and variables for each ISIC Rev. 4 class in scope of this publication for the compilation of an IIP. This information is based on current country practices that have been surveyed for this purpose and is intended to provide guidance to countries in setting up or revising their IIP calculation.

1.24. In detail, the two parts of the present publication are organized as follows:

PART I: International Recommendations

- Chapter 2 details the fundamental concepts needed to compile an index of industrial production. This includes defining industrial production, volume measures and index numbers and discussing the uses of the IIP;

[15] Organisation for Economic Co-operation and Development (OECD), *Manual for an index of services production,* Paris 2006

- Chapter 3 details the various units and classifications in use internationally and recommends the most appropriate type of unit and classification in the compilation of an IIP. Guidance is also provided for classifying units in the context of 'outsourcing'. The chapter concludes with a discussion of business registers;

- Chapter 4 outlines the various methods and types of data items from which an IIP can be compiled. The sources of data to compile the IIP are also presented;

- Chapter 5 presents key IIP compilation concepts and provides a step-by-step guide to the compilation process; and

- Chapter 6 outlines key presentation and dissemination principles.

PART II: International Guidance

- Chapter 7 presents a framework and associated criteria to assess the quality of the variables to be used for an IIP. This chapter also utilizes country practices to provide recommended approaches and variables for each in-scope ISIC class to produce an index of industrial production.

1.5 Summary list of recommendations in this publication

1.25. This section provides a list of all the recommendations presented in this publication. The recommendations are categorized by topic and reflect the following chapters of this publication. The recommendations are presented here to facilitate quick reference.

1.5.1 Statistical units, classifications and the business register

i. *Statistical unit to compile the IIP*
The recommended statistical unit for data collection to compile the IIP is the establishment. (See para. 3.6)

ii. *Classification of products and industries for data collection, compilation and dissemination*
The international reference classification for economic activities, the International Standard Industrial Classification of All Economic Activities (ISIC) Rev.4, is the most suitable classification for industries in the context of the IIP.
The Central Product Classification (CPC) Ver.2 is to be used to assign products to product groups. (See para. 3.12f)

iii. *Business register and statistical surveys*
It is recommended that, where the IIP is compiled from statistical surveys:
- a business register provide the basis from which a sampling frame is identified;

- the business register be maintained to ensure it remains as representative as possible and contains current information on its constituents; and
- a sample of reporting units be used as a way of minimizing response burden and lowering operational cost;
- the sample selection is updated each year to coincide with the update of index weights.

(See para. 3.33f.)

iv. *Data sources – administrative sources*
It is recommended that countries examine opportunities to utilize administrative sources for the purposes of developing and maintaining a sampling frame and as a data source to reduce response burden. (See para. 4.61ff.)

1.5.2 Scope and frequency

v. *Scope of industrial production indices*
The Index of Industrial Production to be compiled for activities in ISIC Rev. 4 Sections B, C, D and E, i.e. Mining and quarrying; Manufacturing; Electricity, gas steam and air-conditioning supply; as well as Water supply, sewerage, waste management and remediation activities. (See para. 2.6)

vi. *IIP compilation frequency*
It is recommended that the IIP be compiled monthly, so that turning points in economic development can be identified at the earliest possible point in time. (See para. 2.23)

1.5.3 Sources and methods

vii. *Method to compile volume measures for the IIP*
In general, the deflation process with the use of an appropriate price index is recommended. (See para. 4.57)

viii. *Deflator to be used to compile volume measures from value data*
The Producer Price Index (PPI) is recommended as the price index to be used by countries when current price values are deflated to compile volume measures of output for the IIP. (See para. 4.44)

ix. *Level at which to apply deflator*
It is recommended that the deflator be applied to the value data at the lowest level possible, but not higher than the ISIC class (4-digit) level in order to obtain a volume estimate for use in the compilation of the IIP. The detailed PPI used for deflation should be defined as closely as possible (in terms of scope, valuation and timing) to the respective product groups for which it is being used as a deflator. (See para. 4.46)

x. *Variables to be used to approximate industrial production for the IIP*
In general, measures of output (value of output, physical quantity of output) are preferred over input (labor and materials consumed) measures. (See para. 4.54)

1.5.4 Index compilation

xi. *Type of index formula to be used*
The Laspeyres-type index formula is recommended to compile the IIP. (See para. 5.18)

xii. *Missing data*
Missing data are to be estimated using imputation techniques or an administrative data replacement strategy so that the data matrix is complete. (See para. 5.37ff.)

xiii. *Data adjustments – quality change*
Quality changes should be incorporated into the calculation of the IIP either via the use of the price index when deflation methods are employed, or by adjusting input data when volume extrapolation methods are used. (See para. 5.48)

xiv. *Weighting variable – product and product group level of the index*
Value of output is recommended as the weight variable to compile the IIP at the product and product group levels of the index. (See para. 5.56f.)

xv. *Weighting variable – industry level of the index*
Gross value added at basic prices data is recommended as the weight variable to compile the IIP for the different levels of the ISIC structure. (See para. 5.58)

xvi. *Frequency of weight update – product group level of the index*
Product group weights should be updated at least every 5 years. (See para. 5.67)

xvii. *Frequency of weight update – industry level of the index*
Industry level weights of the IIP should be updated annually. (See para. 5.66)

xviii. *Chain linking of the IIP on weight change*
The chain linking method should be used when weights are updated, i.e. the new series should be linked to the old series to produce a continuous series. (See para. 5.89)

xix. *Aggregation of the IIP*
Aggregation from basic data items (products or product groups) should be done directly to industries, without an intermediate step of calculating indexes for establishments. Aggregations to higher level industries should be done in steps, in the case of ISIC through each level of ISIC, using the existing ISIC structure, i.e. index numbers at the ISIC class (4-digit) level should be aggregated first to the ISIC group (3-digit) level, then to the ISIC division (2-digit) level and finally

section (1-digit) level. (See para. 5.24, 5.31)

xx. *Data adjustments – seasonal adjustment*
Seasonal adjustment should be applied to the IIP data at the lowest level of aggregation for which reliable estimates can be obtained and in every period the IIP is calculated. (See para. 5.208)

xxi. *Benchmarking of IIP data*
Benchmarking of the IIP should be considered to reconcile high-frequency with low-frequency series, as well as other sources, like the annual national accounts. (See para. 5.239)

xxii. *Quality review*
A quality review of the IIP should be undertaken every four or five years, or more frequently if significant new data sources become available. (See para. 7.7)

1.5.5 Presentation and dissemination

xxiii. *Presentation of the IIP – data*
The following key presentation principles should be followed for an index of industrial production:

- Both, unadjusted data series and seasonally adjusted data series should be published;
- Index numbers rather than monetary values should be used to present industrial production volume measures;
- Index numbers should be presented to one decimal place;
- Changes from month-to-month and change from the same month one year earlier should be presented;
- A reference period needs to be determined and convention is that this period is set to an index number of one hundred (100.0). Index numbers for all subsequent periods are percentages of the value of the reference period; and
- The main contributors to change should be presented to users, i.e. those product groups or industries that are primarily responsible for the monthly movement in the IIP.

(See para. 6.19)

xxiv. *Presentation of the IIP – metadata*
The following metadata should be provided:

- Precise definitions of the underlying economic concepts the indices intend to measure;
- Specific mention of any limitations in the use or application of the indices;
- Descriptions of the methodologies used in the compilation of the index, with particular reference to the index calculation methods entailing the choice of index formula and the strategy for constructing the index series;

- Weighting system used, weight revision practices and frequency of weight revision;
- Computation at various aggregation levels, selection of base year (weight reference period), frequency of re-basing and procedures for linking indices;
- Treatment of changes in the composition of commodities in the market as well as changes in quality; and
- Comparison of the methodologies applied with underlying index concepts and a description of the impact of departures.

(See para. 6.20)

xxv. *Dissemination of the IIP*

The dissemination of IIP data should follow standard dissemination criteria, which include:

- Data should be released as soon as possible (noting the trade-off between timeliness and quality);
- Data should be released according to a preannounced release calendar;
- Confidentiality of individual survey respondents has to be maintained;
- Data should be made available to all users at the same time;
- Presentation and reporting practices should be consistent over time;
- Weights by industry should be made available to users;
- Data should be accompanied by the methodological explanation and advice;
- Data should be accompanied by commentary that assists users in making their own judgments about the economic implications, i.e. the commentary should not make any assessment of current government policies;
- Contact details of relevant statisticians who can answer questions by users should be included with the release of data.

(See para. 6.2ff.)

xxvi. *Data Revisions*

It is recommended that the following revision practices should be followed by countries:

- A statement by the national statistical office about the reasons and scheduled revisions should be made public and be readily accessible to users;
- The revision cycle should be relatively stable from year to year;
- Major conceptual and methodological revisions should be introduced as required, balancing need for change and users' concerns;
- Revisions should be carried back several years to create consistent time series;
- Details of revisions should be documented and made available to users. The basic documentation should identify data in the statistical publications that are preliminary (or provisional) and revised, explaining the reasons of revisions, and explaining breaks in series when consistent series can not be constructed;
- Users should be reminded of the size of the forthcoming revisions based on past history.

(See para. 6.35)

xxvii. *International data reporting*

International reporting of IIP data should occur (a) at monthly frequency at the 1-digit level of ISIC Rev.4 with a lag of no more than 6 weeks after the reference month and (b) at quarterly frequency at the 2-digit level of ISIC Revision 4 with a lag of no more than 6 weeks after the reference quarter. (See para. 6.39)

PART I

INTERNATIONAL RECOMMENDATIONS

Chapter 2: Fundamental Concepts and Uses of the IIP

2.1. This chapter presents the fundamental concepts underlying the compilation of an index of industrial production. These key concepts are introduced in this chapter to provide the reader with a broad understanding of the IIP prior to addressing these and related concepts in greater detail in later chapters. This chapter defines industrial production and discusses how industrial production is measured, the presentation of these measures as index numbers as well as the frequency at which the IIP should be compiled. The chapter concludes by discussing the uses of the IIP, with particular focus on the IIP in the context of the compilation of the Quarterly National Accounts (QNA).

2.1 Industrial production

2.2. The System of National Accounts (SNA) describes production as "an activity, carried out under the responsibility, control and management of an institutional unit, that uses inputs of labor, capital, and goods and services to produce outputs of goods and services. The economic analysis of production is mainly concerned with activities that produce outputs of a kind that can be delivered or provided to other institutional units."[16]

2.3. Of interest is the additional value created by the process of production, known as *value added.* Value added can be measured either gross or net,[17] that is, before or after deducting consumption of fixed capital:

- Gross value added is the value of output less the value of intermediate consumption, such as materials and purchased business services;

- Net value added is the value of output less the values of both intermediate consumption and consumption of fixed capital.

2.4. "As value added is intended to measure the value created by a process of production, it ought to be measured net, since the consumption of fixed capital is a cost of production. However, consumption of fixed capital can be difficult to measure in practice and it may not always be possible to make a satisfactory estimate of its value and hence of net value added. Provision has therefore to be made for value added to be measured gross as well as net. It follows that provision has also to be made for the balancing items in subsequent accounts of the System to be measured either gross or net of the consumption of fixed capital."[18]

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[16] 2008 SNA, paragraphs 6.2 and 6.10
[17] "Census value added", is another concept of value added that was used in the 1950 publication on index numbers of industrial production. However, the national accounts concept of value added, as defined in the System of National Accounts 2008, should be used in the context of the IIP.
[18] 2008 SNA, paragraphs 6.8 and 6.9

2.5. The above definition of production covers all sectors of the economy. However it is commonly accepted that *industrial production* refers to production with a more narrowly defined scope. When constructing an IIP only production by units classified to selected activities within this more narrowly defined scope are of interest. For the purposes of precision and practicality, an industry classification is used to identify these in-scope units. In the case of this publication, the International Standard Industrial Classification of all Economic Activities (ISIC) Rev.4 is the classification (and version) that is used to define industrial production.

2.6. The International Recommendations for Industrial Statistics (IRIS) 2008 defines the scope of industrial production as ISIC Rev.4 sections B (Mining and quarrying), C (Manufacturing), D (Electricity, gas, steam and air conditioning supply), and E (Water supply, sewerage, waste management and remediation activities).

2.7. Traditionally the index of industrial production is commonly understood to be limited to the production of non-agricultural commodities and to exclude construction output. The 1950 publication states that water and sanitary services should be omitted because they involve a considerable non-industrial element. However, it is generally accepted that the scope of industrial production should be defined in terms of ISIC and must be consistent with the scope as stated in the IRIS 2008. The inclusion of sewerage, waste management and remediation activities to the traditional scope of industrial production activities, that have been relatively unchanged since the 1950 publication, is a significant change.

2.8. The scope of the index of industrial production under ISIC Rev. 3.1 included sections C (Mining and quarrying), D (Manufacturing) and E (Electricity, gas and water supply). As part of the revision to ISIC, i.e. the development of ISIC Rev. 4, an element of the revision was to ensure similar activities were grouped together. One example of this was the suggestion to group the activities of ISIC Rev. 3.1 section O, division 90 (*Sewage and refuse disposal, sanitation and similar activities)* with water supply activities in ISIC Rev. 4 section E (*Water supply; sewerage, waste management and remediation activities)*. This was based on the observation that water production and waste water treatment activities were performed by the same business unit in many countries. This change, i.e. moving division 90 in ISIC Rev. 3.1 to section E in ISIC Rev. 4, was therefore implemented in ISIC Rev. 4.

2.9. The International Recommendations for Industrial Statistics (IRIS) 2008 were also being developed around the same time as the revision to ISIC. These international recommendations state the internationally agreed scope for industrial statistics. As part of the development of the IRIS it was agreed that the scope of industrial statistics should be in terms of the newly revised ISIC, namely ISIC Rev. 4, and that the scope should be defined at the section level of the ISIC hierarchy. This resulted in the scope of industrial production including ISIC Rev. 4 Sections B, C, D and E. This is therefore the scope for industrial production used in this publication.

2.2 Measuring industrial production

2.10. Having defined industrial production, it is now necessary to discuss how industrial production is measured, as well as to explain the differences between current price and volume measures of industrial production.

2.11. The aim of the index of industrial production is to reflect the volume developments in value added over time. Value added is measured by the amount the outputs produced (by the establishment, industry, etc) exceed the intermediate inputs consumed. It may be measured in current price or volume terms.

2.12. The current price value is made up of the current period quantities and the current period prices. In contrast, the volume measure describes the economic situation of a particular period but in the prices of another period. Estimates valued at current prices or in volume terms are therefore fundamentally different.

2.13. A volume estimate of value added is obtained from a current price value via a process of price deflation. The current price value is *deflated*[19] by the use of a price index in order to obtain the volume measure. Change over time of the volume measure is referred to as *volume change*.[20]

2.14. Ideally, therefore, the volume measurement of value added for the industrial sector is achieved by subtracting a volume measure of intermediate consumption from a volume measure of output. This ideal approach to the volume measurement of value added is achieved by the so called *double deflation* approach. That is:

- obtain current price values of output and intermediate consumption;
- deflate the current price values of output and intermediate consumption using appropriate price indices to obtain volume measures; and
- subtract the volume measures of intermediate consumption from the volume measure of output to obtain the volume measure of value added.

2.15. However, this ideal approach to measuring value added at high frequency is difficult to achieve in practice in most countries because the necessary data, in particular to calculate intermediate consumption, are generally not available at the required detail and/or frequency. Therefore the challenge for compilers of an IIP is to obtain the most readily available data that provides the best approximation of short term movements in value added.

2.16. Various approaches to approximate short-term movements in value added for the industrial sector have been developed, given the measurement difficulties associated with the application of the ideal approach. These approximation approaches require the measurement of output or inputs of the production process to obtain a proxy volume

[19] See section 4.2.1 for a simple demonstration of the deflation process for a single good.
[20] The term volume change is preferred to 'quantity' change because the change in quantities must be adjusted to reflect the changes in quality.

measure of industrial production. Specifically, output approaches include measuring physical output quantities and values of output, while input measures include measuring materials consumed and labor input used in the production process. These approximate approaches assume a fixed relationship between the variable being measured and value added.

2.17. Various approximate approaches are used to measure industrial production because the most accurate proxy measure of industrial production will depend on the specific industrial activity being measured. It is practically not possible to identify a single recommended approach to measuring industrial production for all industrial activities.

2.18. Chapter 4, *Sources and Methods,* of this publication provides a detailed discussion of these various approaches to approximate short-term measures of industrial production. In addition, chapter 7 utilizes country practices to provide a set of variables and approaches, by each ISIC activity, to produce an index of industrial production.

2.3 Presenting industrial production volume measures as index numbers

2.19. Volume measures of industrial production can be presented in either monetary terms or index numbers. Often the choice of presentation is linked to historical preferences as both presentation forms possess advantages and disadvantages.

2.20. An index is a numerical scale that is derived from observed facts and is used to describe relative changes over time. It can be used to describe how variables including prices, costs or quantities change over time. An index is typically expressed as per cent of a base value, which by convention is one hundred (100.0).

2.21. The presentation of industrial production volume data in monetary terms does have some advantages. For example, non-additivity[21] due to chain linking and the relative size of the industrial aggregates are explicitly shown.

2.22. This publication, however, recommends using index numbers to present industrial production volume measures to aid international comparison and analysis.

2.4 IIP compilation frequency

2.23. The purpose of the IIP is, in particular, to identify turning points in economic development at an early stage. It is therefore necessary that the IIP be compiled at high frequency. Two reasonable options for IIP compilation frequency are therefore monthly or quarterly compilation. This publication recommends the IIP be compiled monthly.

[21] See 5.4.3 of this publication for a discussion of non-additivity.

2.5 Uses of the IIP

2.24. The IIP is a key indicator of economic performance in most countries. This section explains why IIPs are compiled and how they are used.

2.25. Index numbers compress many facts into a few simple figures. In conjunction with other data, index numbers summarize past developments, facilitate forecasting of future trends and assist with evidence based policy decisions. In addition, index numbers facilitate international comparisons.

2.26. In micro-economic analysis, an index number of production shown with an industrial grouping enables comparisons of industry performance to be made, particularly when other data such as employment, wages and earnings are also used. A specific example is the analysis of relative changes in productivity, measured as output per hour worked. In macro-economic analysis, the production index serves to assess the significance for the economy as a whole of changes in the volume of industrial output and the relationship of IIP changes with changes in population, national income, foreign trade, prices and other aggregates. Indeed, the index has a particular importance in any analysis of economic changes since industrial production is one of the more dynamic and fluctuating elements in the economy.

2.27. The IIP therefore plays an important role in both national micro- and macro-economic spheres. For the indices to be useful in an international context, it is also important that the index numbers be compiled on a comparable basis. The indices can then be compared one with another and aggregated to show changes in total production, and in the main industrial groups, both for important regions and for the world as a whole. Comparisons are made with similar aggregates of population, national income etc.

2.28. The IIP also has, in some countries, an important role in the compilation of the Quarterly National Accounts (QNA).

2.29. QNA constitute a system of integrated quarterly time series of macro-economic aggregates, coordinated through an accounting framework. QNA adopt the same principles, definitions, and structure as the annual national accounts. In principle, QNA cover the entire sequence of accounts and balance sheets in the *System of National Accounts 2008*; in practice, the constraints of data availability, time, and resources mean that QNA are usually less complete than annual accounts.

2.30. Quarterly national accounts are compiled to obtain:

- a more timely view of current economic conditions than what is available from the annual national accounts; and
- a more comprehensive view of current economic conditions than what is available from individual short-term indicators.

2.31. While the integration of the three main approaches to measuring Gross Domestic Product (production, expenditure and income approach) in the supply and use tables is the recommended approach for the compilation of the QNA, the production approach is the most common method used for measuring GDP on a quarterly basis. This is because many countries have developed short term statistics related to production and these short-term statistics can be used in the compilation of the QNA.

2.32. The compilation of the production approach of GDP involves calculating output, intermediate consumption and value added at current prices as well as in volume terms by industry. However, observed data on intermediate consumption is generally not available on a quarterly basis and therefore alternate methods for estimating quarterly GDP are required.

2.33. An alternate method utilizes short-term statistics to move forward the annual benchmarks to produce the quarterly estimates of production. One of these short term indicators that can be used to compile the QNA is the IIP.

2.34. The IIP is used for the compilation of quarterly volume estimates for the industrial sector in some countries by using the quarterly movement of the IIP to extrapolate forward volume measures of value added from the previous quarter. The IIP may have gaps in coverage that may need supplementary sources, for example, particular industries, goods that are not easily quantified and repair services. Therefore it is preferable to compile QNA estimates from IIP components at the disaggregated level, rather than from total IIP. The more detailed compilation allows for any differences in coverage and concepts to be identified and resolved.

2.35. Readers should refer to the IMF *Quarterly National Accounts Manual – Concepts, data sources and compilation, 2001* for a detailed description of the compilation of the QNA. In particular, chapter III provides relevant information on the data sources for GDP and its components.

Chapter 3: Statistical Units, Classifications and Business Registers

3.1. Statistical units, classifications and business registers all play a prominent role in the collection and compilation of high quality statistics. This chapter presents the various *statistical units* and *classifications* in use internationally and recommends the most appropriate type of unit and classification for the purpose of the compilation of an IIP. Classifying units in the case of outsourcing is also discussed in this chapter. The key principles of a business register, in the context of the IIP, are also presented.

3.1 Statistical units

3.1.1 Statistical unit definitions

3.2. A statistical unit is an entity about which information is sought and for which statistics are ultimately compiled. These statistical units vary from small entities engaged in one or very few activities undertaken at or from one geographical location to large and complex entities engaged in many different activities that may be undertaken at or from many geographical locations.

3.3. A brief description of the statistical units as detailed in IRIS 2008 follows.[22] The statistical units comprise:

- Institutional Unit: An institutional unit is the core unit of the System of National Accounts. All subsequent definitions embody the definition of this basic unit. An institutional unit is defined as an economic entity that is capable, in its own right, of owning assets, incurring liabilities and engaging in economic activities and in transactions with other entities.

- Enterprise Group: An enterprise group consists of all the enterprises under the control or influence of the same owner. A group of enterprises can have more than one decision-making center, especially for the policy on production, sales and profits. It may centralize certain aspects of financial management and taxation. It constitutes an economic entity which is empowered to make choices, particularly concerning the units which it comprises;

- Enterprise: An enterprise is an economic transactor with autonomy in respect of financial and investment decision-making, as well as authority and responsibility for allocating resources for the production of goods and services. It may be engaged in one or more economic activities at one or more locations. An enterprise may be a sole legal unit;

[22] IRIS 2008, Chapter II.D.

- Local Unit: An enterprise often engages in productive activity at more than one location, and for some purposes it may be useful to partition it accordingly. Thus, a local unit is defined as an enterprise, or a part of an enterprise (for example, a workshop, factory, warehouse, office, mine or depot), which engages in productive activity at or from one location;

- Kind-of-Activity Unit: A kind-of-activity unit (KAU) is an enterprise or part of an enterprise which engages in only one kind of productive activity or in which the principal productive activity accounts for most of the value added. As compared to the establishment, in the case of such a unit, there is no restriction on the geographic area in which the activity is carried out; and

- Establishment: 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.

3.4. As an aside, it is necessary to make a distinction between *collection units* and *observation units* as these are terms that are often used when discussing statistical units. A *collection unit* is the unit *from which* data are obtained and by which questionnaire survey forms are completed. In fact, it is more a contact address than a unit. Sometimes the questionnaire is completed by a central administrative office or an accountancy firm who provides this service to its client. Such information-providing entities are collection units.

3.5. *Observation units* are entities for which information is collected and statistics are compiled. Such units have a legal and administrative existence and are able, actually or potentially, to report data about their activities (directly statistically observable units).

3.1.2 The recommended statistical unit

3.6. The establishment[23] is recommended as the statistical unit for the purposes of compiling an IIP because it is the most detailed unit for which the range of data required is normally available. The data gathered, in order to be analytically useful in an IIP context, need to be grouped according to such characteristics as kind of activity, geographical area[24] and size, and this is facilitated by the use of the establishment as a statistical unit.

[23] The establishment is also recommended as the preferred statistical unit for the collection of the range of industrial statistics in IRIS 2008.
[24] It is noted that in circumstances where no geographical dimension of the IIP is planned then the Kind-of-Activity Unit (KAU) may be suitable.

3.2 Classifications

3.7. In the context of calculating IIPs, classifications of activity (industry) and products are required to categorize economic information about statistical units and their inputs and outputs.

3.8. There are various activity and product classifications in use throughout United Nations member countries, often tailored to specific country needs. However, many of the national activity classifications are either derived[25] from or related[26] to the International Standard Industrial Classification of All Economic Activities (ISIC), which is the international reference classification[27] for activities and is being maintained by the United Nations. Similarly, many national product classifications are derived from or related to the Central Product Classification (CPC), which is the international reference classification for products and is also being maintained by the United Nations. The latest versions of these classifications are ISIC Rev.4 and CPC Ver.2.

3.9. The compilation of an IIP requires data on products or product groups (see chapter 5 for details). In this case a product classification has to be used and the CPC Ver.2 can serve as an appropriate and internationally accepted standard.

3.10. All goods produced through industrial activities are classified in sections 2 (Food products, beverages and tobacco; textiles, apparel and leather products), 3 (Other transportable goods, except metal products, machinery and equipment), and 4 (Metal products, machinery and equipment) of the CPC Ver.2, while the relevant services are classified in divisions 69 (Electricity, gas and water distribution (on own account)), 88 (Manufacturing services on physical inputs owned by others), 89 (Other manufacturing services; publishing, printing and reproduction services; materials recovery services) and 94 (Sewage and waste collection, treatment and disposal and other environmental protection services). Each of the detailed categories (subclasses) of the CPC Ver.2 is in general linked to a single ISIC Rev.4 class.

3.11. The dissemination of IIPs, as well as the compilation at higher levels of aggregation, is carried out by type of economic activity, thus requiring an activity classification.

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[25] Derived classifications are based upon reference classifications by either adopting the reference classification structure and categories and then possibly providing additional detail, or through rearrangement or aggregation of items from one or more reference classification. Derived classifications are often tailored for use at the national or multi-national level. One example is the Statistical Classification of Economic Activities in the European Community (NACE).

[26] Related classifications partially refer to reference classifications, or are associated with the reference classification at specific levels of the structure only. Special correspondence tables are needed to compare data between the related classification and the reference classification. One example is the North American Industry Classification System (NAICS).

[27] Reference classifications are those economic and social classifications that are a product of international agreements approved by the United Nations Statistical Commission or another competent intergovernmental board. Reference classifications have been approved and recommended as international standards, are used for international comparison and serve as guidelines for the preparation of other classifications.

3.2.1 The recommended classifications

3.12. To produce an internationally comparable IIP, a classification for the compilation has to be chosen that can be applied to as many countries as possible around the world. The international reference classification for economic activities, ISIC Rev.4, is the most suitable classification for this purpose. In addition, the International Recommendations for Industrial Statistics (IRIS 2008) defines the scope of industrial statistics in terms of ISIC Rev. 4.

3.13. It is recommended that the CPC Ver.2 should be used to assign products to product groups.

3.2.2 Classification of statistical units – a special case: Outsourcing / activities on a fee or contract basis

3.14. Units are allocated to the industry classification according to their principal activity. Ideally, the principal activity of the unit should be determined with reference to the value added of goods and services produced. The process of classifying units in the case of outsourcing is somewhat more complex. This section provides guidance on the correct classification of these units and therefore determines whether they are in scope for the purposes of the IIP.

3.15. Outsourcing or activities carried out on a fee or contract basis in the industrial sector has become more prevalent in recent times.

3.16. In some cases, units sell goods or services under their own name but the actual production, such as the physical transformation process in the case of manufacturing, is carried out fully or in part by others through specific contractual arrangements. This section describes how units involved in such arrangements should be classified in ISIC.

3.17. In this section, the following terminology is applied:

- The *principal*[28] is a unit that enters in a contractual relationship with another unit (here called contractor) to require the contractor to carry out some part (or all) of the production process;

- The *contractor*[29] is a unit that carries out a specific production process based on a contractual relationship with a principal. The activities performed by the contractor are denominated "on a fee or contract basis"; and

[28] Elsewhere sometimes referred to as "contractor" or "converter".
[29] Elsewhere sometimes referred to as the "subcontractor".

- *Outsourcing* is a contractual agreement according to which the principal requires the contractor to carry out a specific production process. The term "subcontracting" is sometimes used as well. In this context, the production process also includes supporting activities.

3.18. The principal and the contractor may be located in the same economic territory or in different economic territories. The actual location does not affect the classification of either one of these units.[30]

Classification of the contractor

3.19. Contractors, i.e., units carrying out an activity on a fee or contract basis, are usually classified in the same ISIC category as units producing the same goods or services for their own account. Exceptions to this rule exist for trade activities, for which separate categories for such outsourced activities exist.

Classification of the principal

Outsourcing of parts of the production process

3.20. If only part of the production process is outsourced, the principal is classified to the ISIC class that corresponds to the activity representing the complete production process, i.e., it is classified as if it were carrying out the complete process, including the contracted work, itself.

3.21. This applies not only to the outsourcing of support functions in the production process, such as accounting or computing activities, but also to the outsourcing of parts of the core production process, such as parts of a manufacturing process.

Outsourcing of the complete production process

3.22. In general, if the principal outsources the complete production process of a good or service, it is classified as if it were carrying out the production process itself. This applies in particular to all service-producing activities, including construction.

3.23. In the case of manufacturing, however, the following special considerations apply. In manufacturing, the principal provides the contractor with the technical specifications of the manufacturing activity to be carried out on the input materials. The input materials (raw materials or intermediate goods) can either be provided (owned) by the principal or not.

[30] Elsewhere, the terminology of "insourcing" and "outsourcing" (referring to relationships between units involved) or "offshoring" (referring to transactions between economic territories) may be used; those distinctions have no bearing on the guidelines in this section and are not used here.

3.24. A principal who completely outsources the transformation process should be classified into manufacturing if and only if it owns the input materials to the production process – and therefore owns the final output.

3.25. A principal who completely outsources the transformation process but does not own the input materials is in fact buying the completed good from the contractor with the intention to re-sell it. Such an activity is classified in section G (Wholesale and retail trade), specifically according to the type of sale and the specific type of good sold.[31]

3.3 The business register and the IIP

3.26. The statistical business register is an essential tool for data collection. A statistical business register is a register of business units engaged in production of goods and/or services. The business unit of the business register is usually the enterprise and has identifiable links to their establishments and is classified by economic activity.

3.27. In an IIP context, the business register provides the basis from which a sampling frame is identified i.e. a list of all economic units in the industrial sector is selected from the business register to form the sampling frame. The sampling frame should include:

- all accurate and up to date data items associated with units that are required for stratification, sample selection and contact purposes, for example, industrial and geographical classifications, size variables (in terms of number of persons employed, turnover etc.), name, postal and location address and description of the unit, telephone number and preferably a contact name; and
- all the active units, without omission or duplication, that are in the survey target population.

3.28. A selection of units from the sample frame is then made and it is from these units that data required for the compilation of the IIP are requested. This is referred to as the sample selection. A sample survey normally provides an efficient method for obtaining statistical information from large populations without the enormous costs and large human resource requirements of census-type enumerations.

3.29. To keep the coverage of the business register as representative as possible, it must contain current information on its constituents. This means the register is maintained over time to take note of the changes in the enterprise dynamics. For example, an enterprise may merge or split up, change production activities, or move location, while new enterprises may be created (births) and existing enterprises may cease to exist (deaths). Unless the business register is regularly maintained, it will quickly loose its value as the source of sample frames/selections.

3.30. Administrative data sources can also be used for statistical purposes. Data and information from government administrative record keeping operations are increasingly

[31] The final classification of the principal may also depend on other activities that are carried out in the same unit.

becoming one of the major sources from which economic statistics can be compiled in many countries. These data are the result of government operations which require respondents to furnish information due to legislative provisions. As a result the administrative data generally has a complete or near complete coverage of the administrative target population. A by-product of this process of data collection is its use for statistical purposes.

3.31. Administrative data can be used as a primary data source, or a complementary source to complete existing statistics, to confront statistical output and to also provide a frame for sampling. The administrative data is likely to also be an important source of survey frame maintenance by reflecting timely changes to the business unit population.

3.32. The use of administrative data sources should therefore be considered in the context of the IIP. However, some potential disadvantages do exist. These include differences in concepts, definitions and units between the administrative source and statistical standards. See section 4.4 of this publication for more details on administrative data sources in the context of the IIP.

3.3.1 The recommended approach

3.33. Where the IIP is compiled from statistical surveys, it is recommended that:

- a business register provide the basis from which a sampling frame is identified;
- the business register be maintained to ensure it remains as representative as possible and contains current information on its constituents; and
- a sample survey be used as a way of minimizing response burden and lowering operational cost;
- the sample selection be updated each year to coincide with the update of index weights.

3.34. It is also recommended that countries examine opportunities to utilize administrative data sources for the purposes of developing and maintaining a sampling frame and as a data source to reduce response burden.

Chapter 4: Sources and Methods

4.1. This chapter outlines the sources and methods from which an IIP can be compiled. Section 4.1 presents the variables used to approximate industrial production and section 4.2 presents the methods to obtain volume measures. Having outlined the variables and methods, section 4.3 presents the recommended variables and methods to obtain industrial production volumes. The chapter concludes with a discussion on sources of data.

4.2. There is not one single correct method that, if followed, will produce an accurate IIP. The preferred variable and resulting method (the variables and methods used are related) will depend on the industrial production activity that the measure is representing as well as data availability. Therefore, it is common for a single country to utilize a range of variables and methods for different economic activities in the construction of a total IIP.

4.3. Chapter 7 of this publication provides a full list of preferred variables and methods, by industry, to compile an IIP. This list not only provides guidance to countries to compile an IIP but also seeks to achieve a greater degree of international comparability of industrial production indices as, over time, more countries implement the preferred approaches.

4.1 Approaches used to measure industrial production

4.4. The aim of the IIP is to reflect the volume developments in value added over time. However the measurement of value added for the purposes of the IIP is difficult to achieve in practice as it is generally not possible to calculate value added at high frequency in most countries. This is because the required data, in particular to calculate intermediate consumption, are generally not available at the required detail and/or frequency. Therefore the challenge for compilers of an IIP is to obtain the best approximation of short-term movements in value added. These approximate measures of value added center on measuring the output of production and, in some cases, the inputs used in the production process.

4.1.1 Measures of output to measure industrial production

4.5. Output, as presented in the 2008 SNA, is defined as the set of goods and services (products) produced by an establishment, excluding the value of any goods and services used in an activity for which the establishment does not assume the risk of using the products in production, and excluding the value of goods and services consumed by the same establishment except for goods and services used for capital formation (fixed capital or changes in inventories) or own final consumption.[32] Whenever a production

[32] See 2008 SNA, para. 6.89.

process extends over two or more accounting periods, it is necessary to calculate the work-in-progress completed within each of the periods in order to be able to measure how much output is produced in each period.

4.6. The measurement of output is, however, undertaken in a number of ways for the purpose of constructing an IIP. Output can be measured in monetary terms (values) or in physical quantities. In addition, a simplified definition of output known as 'value of output sold in the reference period' is also sometimes used to represent industrial production for an IIP. These three alternatives to measuring output for the purposes of constructing the IIP are discussed below.

(a) Value of output

4.7. The 'value of output' includes products produced whether they are sold, otherwise used or entered into inventories for sale or constitute "work-in-progress" inventories. Output should be recorded at the time it is produced and valued at the basic price[33] prevailing at that time.

4.8. The most accurate output information on products is obtained via the conduct of production surveys. For the purpose of compiling the IIP it is likely that a representative monthly survey is required. It should be noted that the *value of output* may not always be easily available within a statistical unit's records.

4.9. For the purpose of compiling the IIP, all output within the reference period should be included. A statistical unit is in general able to easily provide the *value of output sold* in the reference period. It is often more difficult for units to provide data relating to output entering into inventories of finished goods, goods retained for further processing or work-in-progress. There is likely to be a significant difference between the true value of output and the reported output when inventories are not reported.

4.10. The value of finished goods entering into inventories should be valued at the basic price prevailing at the time the output is produced. It is a little more difficult for work-in-progress. When the basic price of the finished product is known, the work-in-progress can be valued in proportion to total production cost. If the basic price of the finished product is not known, the value of work-in-progress should be based on the total production cost incurred during the reference period plus a mark up.

4.11. Bearing in mind that the intention of the index is to measure short-term changes in value added, the suitability of using the value of output (or other indicators) may be a concern. While in general the ratio of value added over output does not change significantly over short periods, and therefore justifies the use of changes in output to approximate changes in value added, adjustments are necessary when this ratio is

[33] Basic price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable, and plus any subsidy receivable, by the producer as a consequence of its production or sale. It excludes any transport charges invoiced separately by the producer. (2008 SNA, para. 6.51)

distorted by events during the observation period that affect value added and value of output in different ways, such as in the case of changing production patterns including outsourcing.[34]

4.12. Where value of output is used, the volume measure is obtained through the use of an appropriate price deflator. The price deflation process (which is discussed in detail in section 4.2.1) will ensure that any quality changes of the products are reflected in the production volume.

4.13. It is important to note that the deflation process only yields reasonable results if an "appropriate" price deflator is chosen. This price deflator should be specific for the group of products to which it is applied and should take into account specific circumstances that may alter the overall price and value structure of the products produced. For instance, goods or services produced for the domestic market may be priced at different levels than the same goods or services produced for export. A simple shift between these market destinations would create a change in the value of output, while the volume of goods produced has not changed. Separate price deflators may be necessary to handle the two types of products (for domestic market versus for export market). If deflation takes place at the industry level, similar distinctions have to be made for instance between a conventional manufacturer of goods and a provider of manufacturing services (contractor), similar to the example above.

4.14. The availability of an appropriate deflator (or lack thereof) will often determine the suitability of the deflation method for a specific industry or part thereof. This should be taken into account in the application of the recommended methods shown in section 7.3 of this publication.

(b) Physical quantity of output

4.15. Physical quantity of output is also a data variable used to approximate industrial production. Physical quantity of output data are, in general, also obtained via the use of production surveys. This approach measures product output in terms of the number of items, tonnes, liters, etc in order to track the development of production. These data are often used in the context of an IIP when the products are homogeneous.

4.16. The physical quantity of output approach also aims to include goods and services produced whether they are sold, entered into inventories of finished goods or constitute "work-in-progress" inventories. The inclusion of work-in-progress can be more difficult to achieve with this method when compared to value of output methods.

4.17. It is important to emphasize the issue of quality changes in regard to physical quantities. Quality is a term used to refer to characteristics of goods or services that make them distinguishable from each other from an economic point of view. These characteristics can change over time, which is referred to as *quality change*. Quality changes to products should be included in the changes in volumes and therefore

[34] See also section 5.4.2 regarding the use of value added for establishing weights.

contribute to the compilation of the IIP. Misleading IIP results can occur where quality changes are not included in the change in volumes.

4.18. Changes in quality can be incorporated into this approach via data adjustments (see section *5.3.2 Quality adjustment* for a detailed discussion of quality adjustment issues).

4.19. The physical quantity of output approach to measuring industrial production is most suited to those industries that produce homogenous goods where quality remains constant over time. An example being the measurement of output of the coal industry. This is because coal of a specific grade is a homogeneous good, can be easily measured (in tonnes) and whose quality will remain constant over time.

4.20. An aspect of using this output approach is that no deflation process is required, i.e. this approach is an example of the volume extrapolation method which is discussed in detail in section 4.2.2.

(c) Value of output sold

4.21. The value of output sold is another approximate measure of industrial production for the purpose of compiling an IIP.

4.22. The value of output sold is synonymous with such terms as turnover, sales or shipments and refers to goods or services sold by the statistical unit during the reference period.

4.23. There are some important methodological differences when compiling the IIP using 'value of output sold' when compared to 'value of output' or 'physical quantity of output'. These differences can adversely affect the quality of the IIP. The differences include:

- Value of output sold measures production sold rather than measuring the output of the production process in the reference period. This is because goods can be otherwise used (i.e. for barter or own use) or entered into inventories for sale or other use. Goods can also be sold from inventories;
- Work-in-progress is also excluded when the value of output sold is used to compile the IIP; and
- Countries are unable to produce IIP statistics at the product level because traditionally, the 'value of output sold' data are collected at a higher level of aggregation. This higher level normally corresponds to the industry class (say ISIC class) level for an observation unit.

4.24. It is possible to overcome some of the concerns of using value of output sold data to compile the IIP by adjusting the data, e.g. by using changes in inventories, including changes in work-in-progress. However timely and reliable data would be needed to allow these adjustments to take place and this is rarely the case.[35]

[35] Obtaining the timely and reliable data presents particular difficulties in terms of valuation, accuracy and availability. Businesses tend to use a variety of inventory measurement and valuation methods. In addition,

4.25. While the use of value of output sold data to compile the IIP is not ideal, it does have some advantages:

- Value of output sold data are generally available in a more timely fashion than product level data; and
- Data collection is less costly due to the higher level of aggregation compared to product data.

4.26. Finally, in order to obtain volume data from value of output sold data a process to exclude price effects is needed. This is referred to as deflation and is discussed in detail in section 4.2.1.

4.1.2 Measures of input to approximate industrial production

4.27. Measures of input to approximate industrial production are generally used in circumstances where reliable or accurate measures of output cannot be obtained.[36] In practice, the main input variables used to approximate industrial production are: (a) labor input; and (b) materials consumed.

4.28. In practice it is also possible to use a combination of these two variables to approximate the value of output on a cost basis.

<u>(a) Labor input</u>

4.29. Labor input can be measured in the form of *number of hours worked, full-time equivalent jobs* or *numbers of persons engaged* and is used in a volume extrapolation method.

4.30. Number of hours worked is preferable to number of employees as an indicator of labor input. Output is affected by changes in standard weekly working hours, the proportions of part-time employees, and hours of overtime. Hours worked takes these effects into account, while number of employees does not.[37] It is preferable that actual hours worked be covered, rather than paid hours, which include sick leave, vacations, and public holidays but exclude unpaid work. The labor input measure should include working proprietors and the self-employed as well as employees.

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these data are rarely available on a monthly basis. For additional details see the IMF (2001) Quarterly National Accounts, paragraphs 3.134 – 3.144.

[36] When accurate measures of output become available only with a lag, measures of input may be used temporarily to approximate industrial production. For example, the estimate for a given month in an industry might be input-based for its initial release, but be based on an output measure when revised in a subsequent release.

[37] Hours worked is still an imperfect measure of labor input, since ideally, labor input measures should take into account different types of labor (e.g., disaggregating by occupation or skill level), weighted by their different rates of remuneration or other means reflecting their contribution to the production process and to value added in particular. However, such measures may be difficult to obtain with high frequency.

4.31. Caution is advised when using these variables for the purpose of compiling the IIP. This is due to the potential for producing misleading IIP results because of the stability of these variables and the difficulty in incorporating productivity changes and changes in the composition of the labor force into the index.

4.32. If the production process becomes more efficient because of an increase in labor skills or the use of more or better capital equipment, the employment-based indicator will tend to underestimate the increase in value added. Furthermore, employers tend not to adjust their skilled labor force in response to short-term fluctuations in operating surplus, which means that labor input may be steady whereas value added is in fact changing.

4.33. Ideally, adjustments need to be made to the labor input data whenever the relationship between labor input and value added changes. This is rather difficult to accurately achieve in practice but may be attempted by applying productivity factors.[38] However, productivity factors should only be applied when sufficient information is available about the development of the productivity trend which therefore allows for the estimation of such adjustments.

(b) Material consumed

4.34. Material consumption is also used to approximate industrial production for use in the IIP. Material consumption is only useful when there is a clear relationship between material use and production. The process here is to either obtain a *value* of the material that is consumed in the production process or measure the *quantity* of material consumed and monitor the value or quantity of these materials over time. Where the value of material consumed is monitored, a volume measure is obtained through deflation. In circumstances where the quantity of raw materials is monitored, a process of volume extrapolation is used to compile the IIP. If several input materials are considered in the calculation, the price deflator should reflect the mix of these materials (in case of material value being used), while the quantities have to be combined using appropriate weights, such as unit price in the base period (in case of material volumes being used).

4.35. Energy use is a variable that has historically been used for particular industries, especially capital intensive industries, to compile an IIP. The variable of interest may be kilowatt hours of electricity used in the production process. An obvious difficulty with this variable is the need to constantly monitor the relationship between energy use and the production process/output. Where this relationship does change, say due to implementing new technology that leads to reduced energy consumption, it is necessary to adjust the IIP to take account of this change in the input/output relationship. However, in practice, energy use has proven to be a poor quality variable for compiling the IIP and should no longer be used.

[38] Labor productivity factors are usually calculated on the basis of annual production and hours worked data. These annual data are then transformed to monthly data (with the constraint that the monthly average of the transformed data is the same as the annual data).

4.2 Methods to obtain industrial production volumes

4.36. The index of industrial production (IIP) is intended to measure the change in the volume of value added over time. Therefore any change from price effects should be eliminated.

4.37. As discussed in section 4.1 above, the data items used to approximate industrial production vary. Following the collection of these data items, a process to isolate the volume component of the data is required as it is from these volumes that the IIP is calculated. Volume measures are obtained through a process of *deflation* or *volume extrapolation*. This section details these two methods.

4.2.1 Deflation

4.38. Deflation is defined as isolating the volume component (that is quantity and quality) from variables that have price and volume elements.

4.39. Box 1 illustrates the process of deflation for a single good. The volume measure is obtained by dividing the current period value by an appropriate price index.[39]

[39] In this section discussion will center on the use of price indices to obtain volume measures of output or production. This publication is not a guide to the construction of price indices (both PPI and CPI). For this, refer to the IMF and ILO manuals on these topics (*Producer Price Index Manual*, 2004 and *Consumer Price Index Manual*, 2004).

Box 1: Deflation process

	Period T_0			Period T_1		
	Current value	Price index	Volume measure	Current value	Price index	Volume measure
Good A	$110.00	100.0	$110.00	$120.00	107.2	$111.94

The volume measure is obtained by dividing the current period value by a price index. (The price index is obtained/compiled from a separate source/survey.) In the base period T_0 a volume measure of $110.00 is the outcome of the calculation (i.e. $110.00/100.0*100.0). In period T_1 the volume measure is $111.94 (i.e. $120.00/107.2*100.0). It is these volume measures that are of interest in an IIP context.

The IIP for good A is calculated in period T_1 by obtaining the volume relative of the volume measures (i.e. $111.94/$110.00 = 1.0176) and then applying the volume relative to the IIP in the base period T_0 (i.e. 1.0176*100.0 = 101.8).

	Period T_0		Period T_1		
	Volume measure	IIP	Volume measure	Volume relative	IIP
Good A	$110.00	100.0	$111.94	1.0176	101.8

4.40. The output variables "value of output" and "value of output sold" and the input variable "value of material consumed" use the deflation method to compile the IIP.

4.41. Countries currently compile a range of price indices as part of their broader system of price statistics. These price indices relate to different economic transactions and are constructed for different purposes.

4.42. There are generally four main price indices compiled by countries in the area of economic statistics. These are Producer Price Indices (PPI), Consumer Price Indices (CPI), Export Price Indices (EPI) and Import Price Indices (MPI). IIP compilers therefore need to determine which price index is to be used to achieve volume measures for the IIP.

4.43. The CPI measures the rate of price change experienced by households in their role as consumers and is valued at purchasers' prices. The EPI and MPI measure the changes in prices of internationally traded goods and services while the PPI is an index designed to measure the average change in the price of goods and services either as they leave the place of production or as they enter the production process.

4.44. The PPI is recommended as the price index to be used by countries when current price values are deflated to achieve volume measures of output for the IIP. This is because the PPI directly measures product prices from the producer (both input and output product prices of the production process) and quality changes are usually taken into account. Also, price changes of items selected for the PPI for a product group are more likely to be similar to price changes of items not selected, than would be the case for volume changes. However, IIP compilers should first examine the details of the PPI indices available to ensure that: (i) they are representative of the value aggregate to be deflated (the price survey may differ from the survey used for the value aggregates); and (ii) quality changes do not significantly taint the PPI component measures.

4.45. In circumstances where PPIs are unavailable, alternative deflators could include:

- The CPI adjusted for changes in taxes and trade and transport margins. However the CPI, even when so adjusted, is less appropriate as an IIP deflator because CPIs relate to consumer products rather than producer products; and
- The EPI in circumstances where a product or group of products are produced primarily for export.

4.46. The detailed PPI used for deflation should be defined as closely as possible (in terms of scope, valuation and timing) to the respective product groups for which it is being used as a deflator and should be applied at the lowest level possible but not higher than the ISIC class (4-digit) level. The quality and application of the PPI is of great importance for the calculation and resulting quality of the IIP.

4.2.2 Volume extrapolation

4.47. The volume extrapolation method utilizes the movements in volumes directly to calculate an IIP. The volume measure in the current period is compared to the volume measure in the base period and the resulting volume relative is used to calculate the IIP. This process has been illustrated with the example in Box 2.

Box 2: Volume extrapolation process

	Period T_0		Period T_1	
	Volume (Tonnes of coal)	IIP	Volume (Tonnes of coal)	IIP
Coal	20,000	100.0	22,000	110.0

Data relating to volume/quantity (tonnes) of coal are collected in periods T_0 and T_1 as part of a monthly IIP survey. This single data item of physical quantity of output (tonnes of coal) is used to calculate a volume index. The IIP volume index in period T_1 is calculated by:
tonnes (T_1)/tonnes(T_0) * 100, i.e.: (22,000/20,000 * 100.0) = 110.0.

4.48. The volume extrapolation method does not require the collection of value data or the use of price indices to obtain volume measures.

4.49. The output variable “physical quantity of output” and the input variables “labor input” and “materials consumed” use the volume extrapolation method to compile the IIP.

4.50. The volume extrapolation method is, for example, used in the mining and quarrying industries because the products being measured are generally homogenous, the quality of the products tends to remain constant over time and it is often possible to obtain almost a complete observation of all production volumes. With regard to the manufacturing service industries, volume extrapolation of hours worked is the preferred method due to the fact that there is no production of a good that can be measured.

4.51. The volume extrapolation method is also used to measure industrial production volumes in manufacturing industries where production of a single product can extend over many months (reference periods). These industries include 'Building of ships', 'Manufacture of railway locomotives and rolling stock' and 'Manufacture of air and spacecraft'. The volume extrapolation of hours worked is the preferred method in these industries as the value of work-in-progress can be difficult to measure. It is recommended that whenever 'hours worked' data are used, it should ideally be adjusted for changes in productivity to reflect the change in the relationship between hours worked and output of the production process over time.

4.3 Recommended variables and methods to obtain industrial production volumes

4.52. Sections 4.1 and 4.2 of this publication have outlined various approaches and methods to obtain industrial production volumes for the purpose of compiling an IIP. The issue for IIP compilers is to determine which approach to use.

4.53. As mentioned earlier in this publication, it is not possible to recommend a single approach to obtain industrial production volumes as the most appropriate methods and variables used will depend on the industrial activity of interest. However, general recommendations can be provided both in terms of methods and variables.

4.54. In general, measures of output are preferred to input measures. This is primarily due to (i) the difficulty in identifying changes in the relationship between input variables and the value added of the production process; and (ii) the need to consequently make adjustments to the data to take account of these changes. Of the output measures, the use of 'value of output' or 'physical quantities of output' are preferred to 'value of output sold' from a theoretical point of view. This is because, by definition, 'value of output' and 'physical quantity of output' are more accurate proxy measures of the volume of output of the statistical unit in the reference period. Nevertheless, there are practical advantages to the use of value of output sold to compile the IIP that center on the timely availability of data. Further, the 'value of output' is preferred to the 'physical quantity of output' for reasons indicated in section 4.1.1. However, as discussed in that section, quantity indicators prove to be valid alternatives in measuring the industrial production especially in cases of industries producing homogenous goods where quality remains constant over time.[40]

4.55. In practice the two alternate methods, deflation and volume extrapolation, for achieving volume measures of industrial production are *not* considered to be equivalent. In general, the deflation process with the use of an appropriate price index is recommended. It is, however, acknowledged that for deflation to be carried out a comprehensive suite of both value and price data need to be available.

4.56. The main reasons for recommending deflation are:

- Deflation better accommodates a heterogeneous product mix due to the relative stability of prices;

- Price relatives for a representative sample of goods and services can be used as representative for all goods and services in the same group in a way that volume measures can not provide; and

- The quality changes associated with changing, new and disappearing products can be properly reflected when current values are deflated by price indices. It is more difficult to account for quality changes in a volume extrapolation approach. Price indices are generally constructed with a fixed basket approach that holds quality constant over time. The price index therefore measures pure price change, ensuring any quality changes are reflected in the volume component. In a volume extrapolation process, there is no guarantee that the quality of two products is the same between two periods.

4.57. While general recommendations for deflation and volume extrapolation are presented in this chapter, chapter 7 of this publication presents the set of 'preferred', 'alternative' and 'other' methods and variables for each ISIC Revision 4 industry class for the compilation of an IIP as well as the framework used to make these assessments. The detailed table in chapter 7 demonstrates that the preferred method is almost exclusively the deflation approach i.e. specifically the value of output deflated by an appropriate PPI.

[40] A good practice on the use of quantity indicators could include discussions with establishments on selecting "representative" items, that is, items that are likely to be representative of volume change in the majority of output, that are significant in terms of value added, and that are likely to be longer lasting and produced in successive periods. Detailed specifications should be recorded during this "initiation" of the representative products, including the terms of sale (bulk discounts, warranties etc) and price-determining characteristics. Then the volume of output of the same item can be requested and recorded each month. The manufacturer can be asked if any quality dimensions (from a checklist of specs) have changed and, if so, to say what features have changed and whether they are important in a price-determining sense. If not important, then the (changed) replacement can be classified as a comparable one and volume measurement continued. If the difference is substantial, say for a replacement model, then the establishment should be asked for details of representative replacements and the volume changes of the new replacement can be linked to the old. The quantities for the new replacement can be requested from the establishment for the previous overlap period or, if not available, some estimate be made.

4.58. However, the detailed table in chapter 7 also shows that the volume extrapolation method may be employed by statistical agencies in specialized cases as the preferred method because it produces sound results.

4.4 Sources of data

4.59. The purpose of this section is to define the various types of data sources that could be used for data collection required for the compilation of the IIP.

4.60. To produce statistics, basic data are collected and transformed from the institutional units – corporations, government units, households and non-profit institutions serving households – in their roles as producers, consumers and investors, income earners, etc. There are two primary data sources for collecting economic data: (a) surveys by the statistical office, and (b) use of administrative data sources. In either case, however, the original providers of the data are the same, namely the production unit, and the original sources of the data are the same, namely the records kept by these units.

4.61. These two primary data sources are characterized as follows:

- Surveys: The required information to compile an IIP can be collected by the statistical office directly from the units concerned or obtained from secondary sources.[41] When data are directly collected from units by the statistical office, data collection could be carried out by either enumerating all the units in the population (census) or eliciting response only from representative units scientifically selected from the population (sample survey). The sample survey technique is a less costly way of data collection for compiling accurate industrial statistics at high frequency when compared to a 'census' approach. It should be noted that various approaches to sample surveys are currently implemented by countries. This includes only surveying those businesses above a size threshold (e.g. employment or contribution to production); a simple sample drawn from the whole population; or a stratified sample. The stratified sample approach is recommended with complete enumeration above a threshold (i.e. 100% coverage of the biggest businesses) and samples of businesses below the threshold (i.e. partial coverage of smaller businesses). The survey approach does, however, possess some significant disadvantages, since surveys are relatively resource intensive (both financial and manpower), require additional respondent burden and may result in sampling errors and higher non-response rates than administrative data.

- Administrative data sources: Administrative processes are set up in response to government legislation and regulation in areas such as taxation, employment registration, building permits etc. Each regulation (or related group of regulations) results in a register of the institutional units – enterprises,

[41] In some countries high quality survey data that can be used in the compilation of the IIP are available from other government agencies, from industry associations and market research firms.

persons, etc. – bound by that regulation and in data resulting from application of the regulation. The register and data are referred to collectively by the statistical office as an *administrative data source*. The administrative authorities keep records of the units in response to legislated administrative requirements or simply for internal purposes to assist the units in managing their operations. The data emanating from the administrative source can often be used by the statistical offices. The advantages of this approach are lower response burden and higher cost efficiency for the statistical agency when compared to statistical surveys. However, discrepancies between administrative concepts and statistical concepts often occur.

4.62. The possibility of using administrative data sources for statistical purposes has received increased attention in recent years. Statistical agencies worldwide have been examining the possibilities and issues associated with these sources of data. There are a number of reasons for the increased focus on administrative data sources for statistical purposes. These include:

- Statistical producers are attempting to expand the range and depth of their statistics programmes while at the same time coming under increasing pressure to reduce their costs as well as the burden statistical surveys place on the respondents;

- Smaller sized businesses are large in number, generally have simple organizational structures, but are a relatively expensive source from which to collect data in a traditional survey setting. Their characteristics also suggest that they are well suited to the proposition of utilizing administrative data, particularly tax data (if such units are registered with tax authorities), in lieu of survey data; and

- Continuing advances in information technology have made the large administrative sources much easier to handle and have opened up new possibilities for linking different statistical and administrative databases.

4.63. It is clear, however, that the use of administrative data sources for statistical purposes comes with some issues and problems. Some of these problems include different coverage, different timeliness, different definitions, different activity classifications and data quality issues. Nevertheless, concerted attempts are constantly being made to mitigate or accommodate these problems.[42]

4.64. The weaknesses inherent in administrative data concerning concept and coverage of the statistical units and the target population are overcome in adopting the sample survey as the means for data collection. This is because the planning, execution of the sample

[42] The OECD Administrative Data Framework outlines good practice in the use of administrative data sources to compile short-term statistics such as the IIP. See:
http://www.oecd.org/document/18/0,3343,en_2649_34257_36239186_1_1_1_1,00.html

surveys, data collection and the processing procedures are under the control of the statistical office.

4.65. The choice of data source by countries will often depend on availability of resources (financial, staff and time resources), availability of data by source and the burden placed on data providers by statistical data requests. It is suggested that the data sources for the IIP be reviewed at regular intervals to ensure that new opportunities, especially via use of administrative data sources, are examined and exploited where appropriate.

Chapter 5: Index Compilation

5.1. When constructing an index of industrial production, the objective is to measure short-term volume changes in value added. This is achieved, in practice, by first identifying variables (or indicators) and determining methods, along with an agreed scope and classification system, to collect these data variables from the appropriate business population. Techniques are then required to obtain volume measures from the collected data. These topics have been covered in detail in chapters 2 to 4 of this publication.

5.2. This chapter describes the recommended method and process of producing an IIP where detailed measures are combined to arrive at an aggregate or summary measure of volume change of industrial production.

5.3. A step-by-step guide demonstrates the recommended compilation process and is one of the practical aspects of this publication that aims to assist countries in developing or refining the compilation of an IIP.

5.4. This chapter comprises six sections, each addressing issues relevant to the production of an IIP. Section 5.1 presents the most used index formula types; section 5.2 discusses the aggregation of the IIP from the lowest level to higher aggregations; section 5.3 looks at managing of input data; section 5.4 deals with the topic of weights used for the index calculation; while section 5.5 provides step-by-step guides to compiling the index and section 5.6 examines a number of additional compilation topics. This chapter concludes with a set of appendices providing more theoretical background to the IIP calculation, with appendix 5(a) discussing index number theory in an economic context and providing historical information on IIP calculation, while appendix 5(b) shows common criteria for index numbers and how they apply to the index types discussed in this publication. Finally, appendix 5(c) provides a numerical example demonstrating the difference between chain index and fixed base index calculation.

5.1 Index types to compile an IIP

5.5. A volume index is a weighted average of the proportionate changes in the quantities of a specified set of goods or services between two periods of time. The quantities compared over time must be those for homogeneous items and the resulting quantity changes for different goods and services must be weighted by their economic importance, as measured by their relative values in one or the other period.[43] In this context “volume” is a more correct and appropriate term than “quantity” in order to emphasize that quantities must be adjusted to reflect changes in quality.

[43] It should be noted however, that in practice the IIP formulas from the Lowe family do not use weights that are measures of economic importance, especially when the weight reference period precedes the price reference period. These weights are hybrid ones where the prices refer to the price reference period and quantities to the weight reference period.

5.6. A volume index can be calculated between two periods of time, say a reference period 0 and current period t. Numerous index number formulae have been proposed in the rather abundant literature on index number theory, differing from each other mainly in the weights which they attach to the individual quantity relatives and the particular form of average used, whether it is arithmetic, geometric, harmonic, etc.

5.1.1 Laspeyres, Paasche and Fisher volume indices

5.7. While numerous types of indices exist, there are three main types that are used internationally when aggregating quantities over time. For the Laspeyres index, the weights of some fixed base period are used. For the Paasche index, the weights of the current period are used. Finally, the Fisher index is defined as the geometric mean of the Laspeyres and Paasche indices.[44]

5.8. The three types of indices are expressed mathematically below. The Laspeyres volume index can be defined as the change in quantities (or volumes) of a specified basket of goods and services valued at the prices of the reference period 0. The Laspeyres volume index for period t can be obtained directly from the Lowe formula[45] by taking $b=0$. Thus, it can be expressed as:

Formula 1: Laspeyres index formula

$$L_t = \frac{\sum_i p_{i,0} q_{i,t}}{\sum_i p_{i,0} q_{i,0}} = \sum_i w_{i,0} \frac{q_{i,t}}{q_{i,0}} \quad ; \qquad w_{i,0} = \frac{p_{i,0} q_{i,0}}{\sum_j p_{j,0} q_{j,0}}$$

where: $p_{i,0}$: prices for product, product group or industry i at the base period 0

$q_{i,0}$: quantity for product, product group or industry i at the base period 0

$q_{i,t}$: quantity for product, product group or industry i at period t

$w_{i,0}$: relative share (of "value of output") for product/product group or industry i in the base period 0

i: products, product groups or industries to be aggregated (i=1,2,…,n)

5.9. The Paasche index differs from the Laspeyres index in two respects. It uses a harmonic mean of quantity changes instead of an arithmetic average and the fixed period volumes are those of the current period t. The Paasche-type volume index can be obtained directly from the Lowe formula by taking $b=t$. Thus, it can be written as:[46]

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[44] See appendix 5(b) for a comparison of the index types.
[45] See appendix 5(a) for a definition and discussion of the Lowe index.
[46] Note that the weights in Laspeyres and Paasche formulas denote the true relative shares as opposed to the hybrid weights encountered in the general Lowe formula.

Formula 2: Paasche index formula

$$P_t = \frac{\sum_i p_{i,t} q_{i,t}}{\sum_i p_{i,t} q_{i,0}} = \frac{1}{\sum_i w_{i,t} \frac{q_{i,0}}{q_{i,t}}} \quad ; \qquad w_{i,t} = \frac{p_{i,t} q_{i,t}}{\sum_j p_{j,t} q_{j,t}}$$

where: $p_{i,t}$: prices for product, product group or industry i at period t

$q_{i,0}$: quantity for product, product group or industry i at the base period 0

$q_{i,t}$: quantity for product, product group or industry i at period t

$w_{i,t}$: relative share (of "value of output") for product/product group or industry i at period t

i,j: products, product groups or industries to be aggregated (i=1,2,…,n)

5.10. Before considering other possible formulae, it is useful to establish the behavior of Laspeyres and Paasche indices vis-à-vis each other.

5.11. In general, a Laspeyres index tends to register a larger period-to-period increase over time than a Paasche index. It can be shown that this relationship holds whenever the price and quantity relatives (weighted by values) are negatively correlated, that is, as prices go up the quantities purchased go down or vice versa. Such negative correlation is to be expected for price takers, including consumers and firms purchasing intermediate inputs, which react to changes in relative prices by substituting goods and services that have become relatively less expensive for those that have become relatively more expensive. A positive correlation would be expected for price setting firms that substitute output towards goods and services that have become relatively more expensive. In such circumstances the inequalities expressed above would be reversed.

5.12. Laspeyres and Paasche volume indices are members of the Lowe family of index numbers. Their formulas differ in that Laspeyres holds the basket fixed in the reference period and Paasche in the current period. If the objective is simply to measure the volume change between the two periods considered in isolation, there is no reason to prefer the basket of the earlier period to that of the later period, or vice versa. Both baskets are equally justifiable from a conceptual point of view. Thus neither formula can be judged superior to the other, yet they can yield different results. In practice however, as IIPs are calculated for a succession of time periods, a time series of monthly Laspeyres IIPs based on period 0 benefits from requiring only a single set of prices (or revenues), those of period 0, so that only the quantities have to be collected on a regular monthly basis. A time series of Paasche IIPs, on the other hand, requires data on both quantities and prices (or revenues) in each successive period. Thus, it is much less costly and time consuming to calculate a time series of Laspeyres indices than a time series of Paasche indices. This is a decisive practical advantage of Laspeyres indices over Paasche indices and explains why Laspeyres and more generally Lowe indices (with $b \leq 0$) are used much more extensively than Paasche indices. A monthly Laspeyres or Lowe IPP can be published as soon as the quantity information has been collected and processed, since the base-period weights are already available.

5.13. An important common weakness of Laspeyres and Paasche indices stems from the fact that these indices do not treat equally the information from the two periods under consideration. Laspeyres indices use the price (or revenue) information of the reference period while Paasche indices use the current period information. A compromise solution for the volume index is to use a formula that makes symmetric use of the reference period and current period information. Two approaches have been proposed in the literature for this purpose. The first approach considers the quantity weights of the two periods priced at an average of the prices pertaining to the two situations under consideration. In this case, taking the geometric mean as the average for the prices leads to the so called Walsh quantity index[47]. The second approach consists in an evenhanded average of the primary 'fixed-basket' indices, the Laspeyres and Paasche indices. Taking the geometric mean as an average for these two indices leads to the so called Fisher ideal volume index, which is generally considered as the best evenly weighted average of the Paasche and Laspeyres indices. In fact, it is proven that the Fisher index is the only homogeneous symmetric average of the Laspeyres and Paasche indices.

5.14. A Fisher-type volume index is thus obtained for each period by taking a geometric mean of the Laspeyres-type index and Paasche-type index for the same period. It is expressed mathematically as follows:

<u>Formula 3: Fisher index formula</u>

$$F_t = \left(L_t \cdot P_t\right)^{1/2}$$

5.1.2 The recommended index type

5.15. Determining which index type should be used to compile the IIP is not necessarily simple, though the selection of an appropriate index formula should be made on both theoretical and practical grounds.

5.16. The detailed criteria used to select an index type (as in the axiomatic approach) can be found in appendix (b) of this chapter. In short, all index types possess characteristics that make each of them more or less desirable in certain circumstances. The Fisher index for example, possesses several theoretically desirable characteristics (like factor reversal and time reversal)[48] but is considered difficult to produce in a timely and cost effective manner due to its use of the Paasche index (current information on price and quantity

[47] The corresponding Walsh price index chooses the geometric mean of the base and current period quantities as the Lowe fixed basket quantity and then, prices out this average basket at the prices pertaining to the two situations under consideration.

[48] See Appendix 5(b).

may not be readily available). On the other hand, the Laspeyres type index can be produced in a timely and cost effective manner and benefits from taking practical compilation constraints into consideration. However, the main theoretical concern with both Laspeyres and Paasche is that the weights are not a symmetric average of current and reference period price and quantity information. There is a further concern, based on the economic theory outlined, for the need to update the weights and then have a chained series of superlative indices. The ultimate aim would be to end up with an index that incorporates all the available historical information (path dependent) to track the dynamic changes in industrial production.

5.17. In summary, the selection of the index type to be used to compile the IIP should take into consideration:

- the purpose of the index (to provide a short-term indicator of production and, where required, for use in the compilation of the QNA);
- theoretical considerations (i.e. including an up-to-date weighting structure, time and factor reversal, etc.); and
- practical considerations (i.e. what can be practically achieved due to resource constraints and data availability).

5.18. An overall assessment of both theoretical and practical issues has resulted in the Laspeyres-type volume index being widely used by national statistical agencies. This publication also recommends a Laspeyres-type volume index for the compilation of the IIP.[49]

5.19. More specifically, the recommended index is the arithmetic version of the so called Young index[50] which considers a weighted average of the individual quantity relatives $\frac{q_{i,t}}{q_{i,0}}$ using the weights $w_{i,b}$ of period b (with $b \le 0$).[51] These weights correspond to the true revenue shares of period b as opposed to the hybrid shares considered in the general case of the Lowe family. When the weight base period and the index reference period are the same (that is b=0) then, the Young index is equal to the Laspeyres index. The choice of holding constant the revenue shares has a particular importance in the context of weight updating[52] and chain linking of the IIP where the weight reference period usually precedes the quantity reference period. In the practical compilation of the IIP, the weight reference period b is typically much longer than periods 0 and t. The weights usually refer to expenditures over a period of a year, or longer, while the quantity reference period is usually a month in some later year. For example, the weight reference period

[49] The Laspeyres-type index is used in place of the Fisher 'ideal' approach when timeliness is important. However, when possible, it is advised to also calculate retrospective Fisher IIPs so that users are informed of the extent of the substitution bias.
[50] A detailed description of the Young index and its properties can be found in: IMF et al, *Producer Price Index Manual: Theory and Practice,* Washington, IMF, 2004.
[51] See paragraphs 5.260-5.263 of this publication on the Lowe family of index numbers.
[52] Volume updating may, when the dispersion in relative volume changes is very high, give counterintuitive weights to quantity changes. Such volume changes can be of a very high order as new establishments are set up or old ones close.

will be a survey period of say 1998, while the quantity reference period commences in say 2000, since it will take time to compile the results and get the weights.

5.20. The characteristics of the Young index usually differ slightly from those of a true Laspeyres index although it suffers from the common drawback related to the fact that the weights do not symmetrically reflect current and reference period price and quantity information. For example, in the case of monthly indices with annual weight structure, it has been shown that the Young index is equal to the Laspeyres index plus the covariance between the difference of annual shares pertaining to year *b* and month 0 shares, and the deviations in relative quantities from their mean. Normally, the weight base period precedes the quantity reference period. In this case, if the elasticity of substitution is larger than 1 (for example, the proportionate decline in quantity is greater than the proportionate increase in prices), the covariance will be positive and the Young index will then exceed the Laspeyres index. Alternatively, if the elasticity of substitution is less than 1, the covariance will be negative and the Young index will be less than the Laspeyres index.

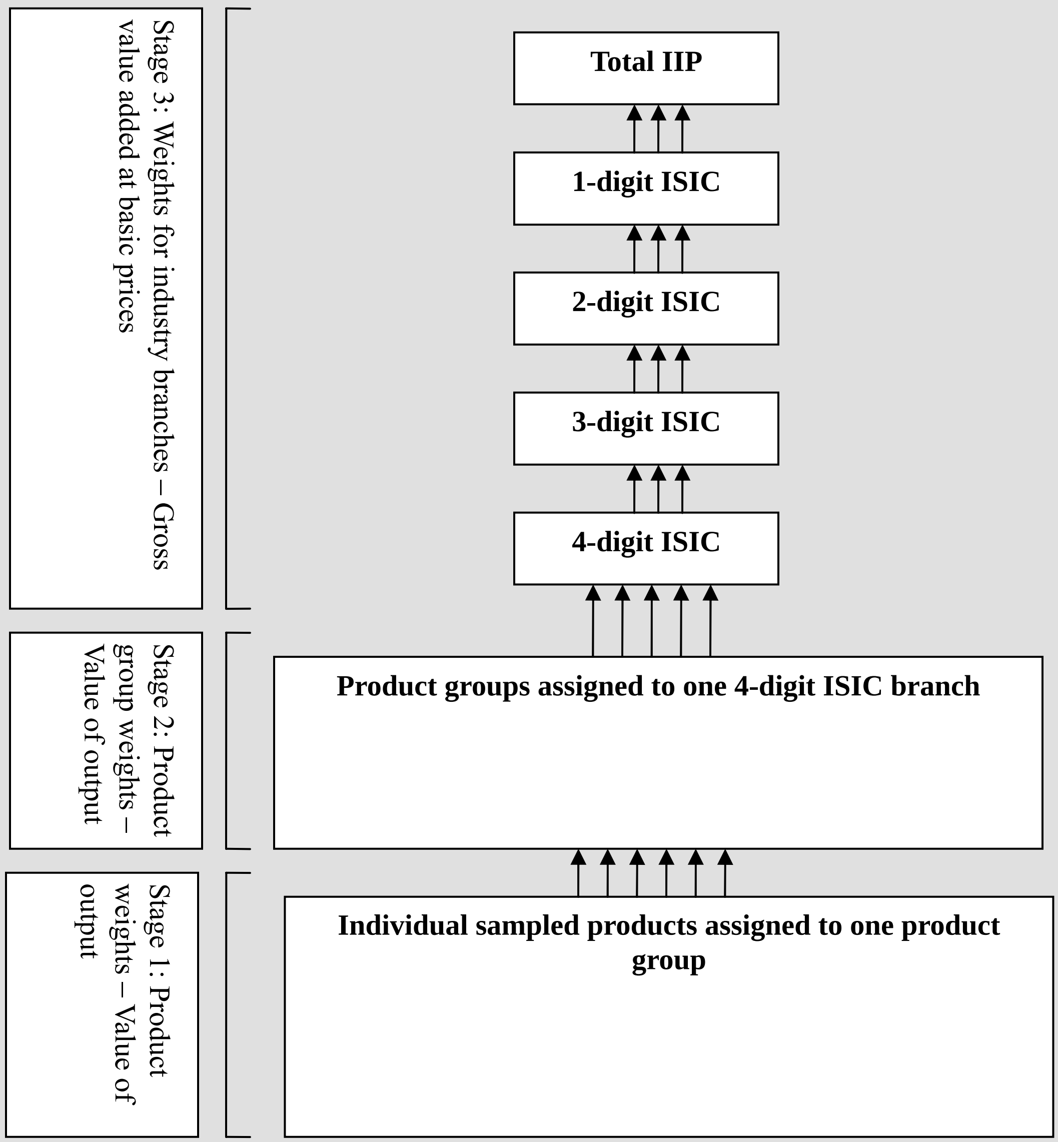
5.21. Finally, it should be noted that the geometric form of the Young index (weighted geometric average of the quantity relatives using the revenue shares of period *b* as weights) offers many attractive theoretical features.[53] However, this type of indices cannot be expressed as the ratios of value aggregates in which the prices are fixed. They are not fixed basket indices and as such, they are not easy to explain or justify to users.

5.2 Index structure by stage

5.22. The IIP is typically constructed at three fundamental stages. At the first stage, product data are collected and each product is assigned to a product group. Product data are then combined using weights to produce data for the product groups. At the second stage, industry data are produced by assigning product groups to industry classes and combining product group data using weights. Each product group is assigned to just one industry (e.g. ISIC Rev.4 class). At the third stage, upper level indices are calculated in line with the industry classification structure. Diagram 1 demonstrates the three stages of the IIP index structure.

[53] For example, if revenue shares are constant, then a geometric Young index is equivalent to a Törnqvist index, which is a superlative index.

Diagram 1: Index structure and weights - by stage



5.2.1 Building the IIP from the lowest stage

5.23. The calculation of the Total IIP starts with the measurement of indicators at the product level. Sampled products are assigned to product groups using the Central Product Classification (CPC) Ver.2 which serves as an appropriate and internationally accepted standard. These product groups contain fairly homogeneous products, and via the use of weights, the sampled products are combined to produce data for the product groups.

5.24. Product group data are then aggregated to produce industry data by assigning each of these product groups to just one ISIC 4-digit industry class and by using weights.[54] Aggregation from basic data items (products or product groups) should be done directly to industries, without an intermediate step of calculating indexes for establishments. Upper levels of the industry classification are then produced by combining industry class data and by using weights.

5.25. It should be noted that the product data (i.e. from stage 1 in diagram 1) is used to compile the various stages of the index and may be available in the form of *quantities* or *values*. Where values of production are collected, deflation[55] is needed to obtain industrial production volumes. Deflation of the value data to produce volume measures should occur at the most detailed level of the index structure but not higher than the 4-digit ISIC level. This is recommended as relevant price indices (deflators) would be expected to be available at this level. Deflation is undertaken by dividing the current period value of production/output at the 4-digit ISIC level, after aggregating the product and product group data, by a price index. To ensure that the deflated output relatives are always 100.0 in the base year, it is required to undertake the deflation of the output values at the 4-digit ISIC level first and then calculate the deflated (volume) 4-digit output relatives.[56] This is demonstrated in the sequence of steps in section 5.5.

5.26. The recommendation of the Laspeyres-type index for the calculation of the IIP implies that in circumstances where price deflators are used to obtain volume indices from current period values, the deflator should be of the Paasche-type. This is because the variation of an aggregate at current prices is equal to the product of the Laspeyres volume index and the Paasche price index, as shown in Box 3.

Box 3: Relationship between volume changes, volume index and price deflator

$$\frac{V_t}{V_0} = \frac{\sum_i p_{i,t} q_{i,t}}{\sum_i p_{i,0} q_{i,0}} = \frac{\sum_i p_{i,0} q_{i,t}}{\sum_i p_{i,0} q_{i,0}} \cdot \frac{\sum_i p_{i,t} q_{i,t}}{\sum_i p_{i,0} q_{i,t}} = {}_{Vol}I_t^{Laspeyres} \cdot {}_{Price}I_t^{Paasche}$$

Where: V_t = value of output in period *t*

$p_{i,t}$ = price of product i in period *t*

$q_{i,t}$ = quantity of product i in period *t*

${}_{Vol}I_t^{Laspeyres}$ = Laspeyres volume index in period *t*

${}_{Price}I_t^{Paasche}$ = Paasche price index in period *t*

i: products to be aggregated (i=1,2,…,n)

[54] A detailed discussion of weights used to compile the IIP can be found in section 5.4 of this publication.
[55] See section 4.2.1 of this publication for a discussion of deflation.
[56] The rule "100" in the base year (as average of the 12 months in the base year) can only be applied to the original, unadjusted series. Seasonally adjusted series are usually not equal to 100.0 regarding the 12-month-average in the base year.

5.27. In practice, however, it is virtually impossible to calculate Paasche price indices for all detailed levels of industrial production because of the very detailed data, both prices and quantities, which would be required for every period. The compromise solution used for many years in most countries has been to deflate current price values using Laspeyres deflators. The outcome is an approximation of the results which would be achieved by using Paasche deflators. This is because where the current and reference periods are close, the difference between the two deflator types, and hence the difference between the resulting deflated values will be acceptably small.

5.28. The basic compilation of the IIP at the lower levels is described using the value of gross production as the basic information, which makes the IIP at this level essentially a gross output index. The IIP, at least at the lower levels of aggregation, i.e. at the 4-digit ISIC level and below, is a measure of the development of the volume of gross output, which is a key economic variable in itself. Only with the aggregation of the index across industries, i.e. by aggregating to higher levels of ISIC, does the net aspect play a part using value added data for weighting. The use of value added for these weights allows the meaningful aggregation of data across heterogeneous industry groupings, having a distinct advantage over the use of output.

5.29. It is important to be aware of both the conceptual and the theoretical approach, i.e. the theoretical IIP as an index of value added (net output) on one hand and the practical outcome, i.e. the IIP mainly as a gross output index on the other hand.

5.2.2 Upper stage aggregation of the IIP

5.30. The upper stages of the IIP are compiled following the calculations of the IIP at the lower stages. Volume relatives are calculated and then weights are used to produce IIP data for all levels of the ISIC structure.[57]

5.31. Aggregations to higher level industries should be done in steps, in the case of ISIC through each level of ISIC, using the existing ISIC structure, i.e. index numbers at the ISIC class (4-digit) level should be aggregated first to the ISIC group (3-digit) level, then index numbers at the ISIC group level are aggregated to the ISIC division (2-digit) level and so on.

5.32. Section 5.5 of this publication provides a detailed discussion of the process to compile an IIP from the lowest stage to the upper stage of the index structure. In short, for monthly indices, the indices for the upper stage are obtained by comparing the current month quantities to the quantities in the quantity reference period (i.e. the denominator of the production index is always the average quantity of the base year). Weights are then applied to the volume relatives to enable the IIP at the various levels of the ISIC structure to be produced. The weights are updated every year with the latest available weighting data.

[57] See section 5.4 for a discussion of the weights to be used.

5.3 Managing input data

5.33. This section discusses input data and adjustments that can be applied so that IIP compilers produce an accurate industrial production index.

5.34. Input data are collected on a regular basis (by survey from respondents, or from administrative sources) by survey statisticians who edit, impute, aggregate and use the data in the compilation and production of statistics. However, the raw input data are rarely available in a form that is ready for compilation, i.e. some of the data may be missing or require quality adjustment. These topics are discussed below.

5.3.1 Managing non-response / missing data

5.35. Missing data are encountered in most statistical surveys, creating problems when attempting to compile estimates. The IIP is no different in this respect. Missing data may be the result of partial completion of the questionnaire (item non-response) or a selected unit may not have returned a questionnaire at all (unit non-response).

5.36. There are two general strategies to deal with *item non-response*:

a) Ignore all forms with missing values and confine analysis to the fully completed forms; *or*

b) Missing data are estimated so that the data matrix is complete. This is called imputation.

5.37. Strategy (b), imputation,[58] is recommended because adopting the first strategy leads to discarding the valid data contained in the partially complete forms. There are a variety of imputation methods, ranging from simple and intuitive to rather complicated statistical procedures. Some of the more common methods are; (i) *Mean/modal value imputation*: impute the mean value of a variable for missing data; (ii) *Post stratification*: divide the sample into strata and then impute stratum mean, mode or median; (iii) *Carry forward* the value for the reporting unit from the same survey occasion in the previous period, adjusted to reflect the average increase (decrease) of the data item in the stratum; and (iv) *Regression imputation*: use regression techniques to impute the missing data. It should be noted that the carry forward approach can induce undue stability and should be advised against, except in exceptional circumstances when it is known that production will remain constant. Also, the post-stratification should be preferred to the mean/modal imputation in most cases since the imputation is targeted. Although a statistically advanced method, the regression imputation method needs a significant amount of available data in the historical part of the series and also in the independent variables used to explain the dependent variable at hand. The choice of method for imputation in an

[58] It should be noted that in the case of the IIP, imputation should be advised only for temporarily missing values – for example, a maximum of three months of data for monthly series.

IIP context depends on the local statistical environment of the country concerned and is best handled on a case-by-case basis. Depending on the situation, some of these methods may yield very similar results.

5.38. The case of *unit non-response* can also be dealt with by using the imputation approaches listed above. This is particularly relevant when the missing unit has traditionally had a significant impact on the IIP.

5.39. Another way to manage non-response/missing data is to use administrative data as a replacement strategy. When available, administrative data can be modeled or substituted directly to fill data gaps.

5.40. There are also non-statistical ways to minimize both forms of non-response. These include (i) impressing upon respondents the importance of providing the requested data; (ii) sending reminders to non-respondents; and (iii) resorting to the enforcement measures laid down in national legislation.

5.3.2 Quality Adjustment

5.41. The IIP is concerned only with measuring volume changes. Price changes are to be excluded while quantity and also quality changes are considered changes in volumes and should be reflected in the IIP.

5.42. The term *quality*[59] refers to all those characteristics of a good or service that are sufficiently different to make them distinguishable from each other from an economic point of view. Accurately reflecting quality changes in the IIP calculation is important and can occur in a couple of ways - either via deflation when using a price index that is constructed to hold constant quality or by adjusting the source data when the volume extrapolation method is employed. Without such quality adjustments, the IIP would potentially misrepresent the actual changes in volume.

5.43. In the first method, the production value data used to calculate an IIP are deflated using a price index. Price indices are almost universally constructed to represent price changes at constant quality. Therefore, when a value measure is deflated by a price index the resulting volume measure reflects changes in quality. However, any deficiencies in the price index will carry over to the estimates of volume change. IIP compilers need to be aware of the extent and nature of methods used by price index compilers to take account of such quality changes if the price indices are to be used effectively as IIP deflators.[60]

[59] See 2008 SNA, chapter 15, Section B parts 4 and 5 for a detailed discussion of the 'quality' topic.
[60] There are a variety of methods currently used by price statisticians to take account of quality change during the construction of a price index. These methods include, among others, matched model pricing and hedonics. Quality change and methods relating to price indices are discussed in detail in 2008 SNA, Chapter 15, section B part 5; as well as the PPI and CPI manuals.

5.44. In the second method, when an IIP is compiled using volume extrapolation, including quality changes in the IIP calculation is more complex.

5.45. Ideally the volume extrapolation method should be avoided if the products selected to compile the IIP are subject to quality change. There are, however, situations where quantity data (specifically labor input data) are the only data available.

5.46. As noted in chapter 4, labor input is seldom preferred as a volume measure because the relationship of labor to output is variable. Because of the delays and costs associated with hiring and firing, employment tends to be less responsive to output changes than some other inputs into the production process. The relationship between labor input and production output also changes as a result of changes in capital intensity and total factor productivity, further illustrating the difficulties of quality adjustment when the volume extrapolation method is employed.

5.47. Other variables where quality adjustments are required include output variables like physical quantity and input variables like materials consumed.

5.48. In summary, it is recommended that quality changes be incorporated into the calculation of the IIP. The method used to incorporate quality change into the IIP will, however, depend on the data sources and methods used to compile the index. A price index is used to incorporate quality when deflation methods are employed, while adjusting input data is employed when volume extrapolation methods are used. In practice, the deflation method is preferred due to the reasons outlined above.[61]

5.4 Weighting

5.49. Weights allow the lower level indices to be ‘put together’ or combined to produce aggregate measures at higher levels once all the necessary input variables have been collected, imputed, and adjusted as required.

5.4.1 The role of weights in an index

5.50. Weights are a key element in the construction of any index as they provide a measure of the relative importance of each index component. In the case of the IIP, weights reflect the relative importance of a product, product group or industry within the overall scope of industrial production. To arrive at the aggregate index figure, data for products, product groups or industries are multiplied by these weights to derive a weighted average aggregate index.

[61] Few countries currently make adjustments for quality when using the volume extrapolation method because it is difficult to implement. Compilers of the IIP using the volume extrapolation method need to assess the extent to which quality adjusted volume data impact the IIP results. This impact will vary by industry and by country.

5.51. Box 4 provides a simple example to illustrate the important role weights play when compiling an index. The weight attached to each product determines the impact the volume change of that product will have on the overall index. For simplicity, this example uses only two products. Product A is more important than product B and this is reflected by the weights in panel (i). The resulting index for panel (i) is *115.3*. Panel (ii) illustrates the situation when products A and B are used in the calculation without reflecting their different importance. The resulting index for panel (ii) is *116.7*.

Box 4: Using weights to compile indices

Panel (i)

	Base period			Current period t		
	Weight (%)	Quantity	Index	Quantity	Index	
Product A	0.7	150	100.0	170	113.3	(= 100*170/150)
Product B	0.3	100	100.0	120	120.0	(= 100*120/100)
Total			*100.0*		*115.3*	*(= 0.7*113.3+0.3*120.0)*

Panel (ii)

	Base period			Current period t		
	Weight (%)	Quantity	Index	Quantity	Index	
Product A	0.5	150	100.0	170	113.3	(= 100*170/150)
Product B	0.5	100	100.0	120	120.0	(= 100*120/100)
Total			*100.0*		*116.7*	*(= 0.5*113.3+0.5*120.0)*

5.52. The index result in panel (i) is preferred due to the reflection of the different importance of the products. More generally, this shows that accurate weights have an important impact on the index results and are therefore critical to the compilation of any index.

5.4.2 IIP weighting data

5.53. Weighting data to construct an IIP are required at three fundamental levels. These are (i) weights for products; (ii) weights for product groups; and (iii) weights for industry branches. Weights at these three levels are obtained from different sources and use different data variables. Diagram 1 in section 5.2 illustrates the three levels of the index.

5.54. Formula 4 presents the calculation of weights in the base period of the IIP. This formula applies to the calculation of the weight of a product in a product group; product group in an ISIC class; and the weight of an ISIC class in an ISIC group etc.

Formula 4: Calculating weights

$$w_{i,0} = \frac{W_{i,0}}{\sum_{j \in K} W_{j,0}}$$

where: $W_{i,0}$: Absolute weight (value) of product, product group or industry i in the weight reference period T_0

$w_{i,0}$: Relative weight of product, product group or industry i in the weight reference period T_0

K : Set of all products, product groups or industries within the next higher aggregation to be calculated

By consequence: $\sum_{i \in K} w_{i,0} = 1$.

Note: In the different steps of the calculation in chapter 5.5 ${}^{p}W_{j,0}$, ${}^{pg}W_{j,0}$ and ${}^{ind}W_{j,0}$ are used to replace $W_{j,0}$ in the above formula, reflecting the different weighting variables used. The actual calculation in section 5.5 then uses the relative weights $w_{j,0}$.

5.55. (i) Product weights: The aggregation of the index starts with a sample of specific products. Product data are combined using weights that reflect their relative importance to form product groups. Note that only the relative importance among the products selected is of concern, not the explicit share of the products within the product group.

5.56. *Value of output*[62] should be used to establish the weight of each product selected in the product group. The information for these product weights is generally obtained via the conduct of product censuses or surveys. As indicated in paragraph 4.11, the use of value of output may be a concern, given the fact that the intention of the index is to measure changes in value added. This applies in particular to the establishments of the weights in the case of outsourcing. When a manufacturing unit outsources part of its production process to another unit, using the total value of output for establishing the weight of this product may overstate the units' real contribution to the product concerned within the measured economy. Similar situations can arise when units merge or split (resulting in or breaking vertical integration patterns). In such cases a careful adjustment of the weights of the products affected is necessary to avoid distortions in the index compilation.

[62] See section 4.1.1 of this publication for a detailed discussion of value of output.

5.57. (ii) Product group weights in the base period are obtained by determining the share of *value of output* (or proxies thereof) by product group within its ISIC class. These values of output reflect the relative importance of each product group considered within an ISIC class and are used to aggregate data for these product groups. The product group weights are generally obtained via the conduct of product censuses or surveys. Each product group is assigned to just one ISIC 4-digit industry.

5.58. (iii) Weights for industries (i.e. weights at the 1-, 2-, 3- and 4-digit levels of ISIC) in the base period are obtained by determining the share of gross *value added*[63] *at basic prices* by industry of all industries in-scope of industrial production. Such information is available as a result of annual national accounts compilation. However, for some countries, it requires the use of other comprehensive data sources to obtain weights for lower levels of ISIC.

5.59. Taking into account that the purpose of the index is to measure short-term changes in value added, in the aggregation of indices of different industries value added should be used for the corresponding weights to reflect the relative importance of each industry in higher-level aggregations. Weights using the value of output are not suitable in this context, as this would give any industry using intermediate goods and services produced by other (or even the same) industries a higher weight and essentially introduce a distortion due to a double counting effect in the final aggregations.

5.60. While it could therefore also be desirable to use a value added-type concept at all levels of the IIP aggregation, this is limited by theoretical and practical circumstances. The concept of value added is applicable only to activities (and therefore industries), but not to products. In addition, detailed data that could be used to approximate such a concept are often not available in the frequency or timeliness required for the IIP compilation. Value added should be used for the aggregation of the IIP from the lowest level at which it is available, i.e. typically starting from the 4-digit level of ISIC.

5.61. Value added may be measured either gross or net. The rationale for selecting gross value added as the weighting value for the industry level of the IIP is based mainly on two considerations. Firstly, gross value added refers more to supply side considerations to meet the final demand, including gross capital formation, while net value added is more meaningful for an income approach in measuring welfare and living standards. Secondly, the measurement of consumption of fixed capital, as required for net value added, is quite difficult to observe, as described in the 2008 SNA.

5.62. Also of interest is the concept of gross value added at factor cost. This concept is mentioned here as several countries currently weight the industry level of their IIP using this variable. However it is recommended that this variable no longer be used to weight the IIP because gross value added at factor cost is not strictly a measure of value added; it is essentially a measure of income and not output.[64]

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[63] See 2008 SNA, para. 6.8.

[64] 2008 SNA, para. 6.80 – 6.81, provides a detailed description of this concept, including why gross value added at factor cost is not a concept used explicitly in the SNA.

5.4.3 Updating the weights

5.63. The weights of an index need to be periodically updated in order to reflect the changing structure of the economy. Over time production levels shift in response to economic conditions. Some products and industries become more important while others become less important. In extreme cases products can disappear completely or entirely new products can enter the market. The two key issues to consider when updating index weights are (a) the frequency of weight updates; and (b) the method used to incorporate new weights into the index structure.

Frequency of weight updates

5.64. The frequency at which IIP weights are updated for the products/product groups and industry branches of the IIP can be linked to (i) the need to accurately reflect the current relative importance of product groups and industries; (ii) data availability; and (iii) the index type used to compile the index.

5.65. The need to accurately reflect the current relative importance of product groups and industries in the IIP is an important consideration when determining the frequency at which to update IIP weights. This is because the prices of products change over time and therefore weights change. As the current period gets further and further away from the base period, the weights become more and more irrelevant because the substitution of less expensive products for more expensive products over time is not taken into account.[65] Therefore the credibility of the IIP is undermined.

5.66. It is recommended that the industry level weights of the IIP be updated annually with the latest weights available as this will ensure that the IIP is an accurate indicator of volume growth. The latest weights available are likely to be from year t-2 or t-3. The frequent updating of weights may mitigate the substitution bias/changing weights problem. Reliable and timely annual weighting data for the industry levels of the index need to be available for inclusion into the IIP compilation process. Delays in the availability of annual weighting data will cause revisions to the IIP when the weights do become available and recalculations are made.

5.67. It is also recommended that the product group weights be updated frequently (e.g. at least every 5 years) as this provides an opportunity to incorporate new products (see section 5.6.2) as well as reflect the changing relative importance of product groups within the industrial sector.

5.68. Therefore the weights for different levels of the IIP are updated at different frequencies. Due to resource and data constraints, it is more practical to update weights for the industry levels more frequently than those for product levels. This is, in fact, the current approach in most countries.

[65] The bias arising from the tendency to purchase inexpensive substitutes for expensive items when prices change is referred to as substitution bias.

5.69. The index type chosen to compile the IIP is also an important consideration when determining the frequency at which to update the IIP weights. This publication, in section 5.1.2, recommends that the IIP be compiled using the Young index. The use of this Laspeyres-type index formula provides some flexibility in regard to the frequency of weight updates as the weights are not derived from the current period. This is in contrast to the Paasche or Fisher indices which, by definition, require new weights each time the index is compiled.

5.70. The Laspeyres-type index formula requires a base period (or reference period) to be selected, as the weights are derived from this period. However, before discussing the issue of selecting the base period, some clarification of the term "base period" is required. The base period, usually a year, is generally understood to be the period against which other periods are compared and whose values provide the weights for an index. However, the concept of the "base period" is not a precise one and may be used to mean rather different things. Three types of base periods may be distinguished:

- the *quantity reference period*, that is, the period whose volumes appear in the denominators of the volume relatives used to calculate the index ($q_{i,o}$ in formulas 1 and 2), or
- the *weight reference period*, that is, the period, usually a year, whose values serve as weights for the index ($w_{i,0}$ in formula 1); or
- the *index reference period*, that is, the period for which the index is set equal to 100.

5.71. The three types of base periods may coincide, but frequently do not.

5.72. A consequence of implementing the recommended approach, i.e. Laspeyres-type volume index with weights updated annually, is that the selection of a weight reference period is no longer arbitrary. The weight reference period will always be the most recent period (year) for which weights are available.[66]

5.73. Some countries, however, update their 'weight reference period' less frequently, such as every 5 years, due to a variety of reasons including resource and data availability constraints. In circumstances of less frequent weight updates, it is important to carefully select the weight reference period to ensure the resulting IIP is fit for purpose. The weight reference period should therefore possess the following characteristics: (a) reasonably normal/stable (i.e. typical of recent and likely future years); (b) not too distant from the

[66] In practice, the calculation of the IIP is likely to use industry weights from period t-2 (i.e. the year 2005 index is likely to be compiled using industry weights from 2003). This is because the necessary weighting data for the industry level are not normally available until at least 18 months after the reference period. Further, in some countries, for the first few months of a new year (i.e. year 2006 in this example), the index may need to be compiled using the 'old' weights (i.e. from 2003) because the 'new' weights (i.e. from 2004) are not yet available. In these situations, the IIP should be recalculated (revised) on the basis of the new weights once they become available (i.e. the January 2006 IIP should be calculated using the weights from 2003 but be recalculated on the basis of 2004 weights when they become available).

reference period; and (c) clearly identified when analyzing and comparing the index results.

5.74. In summary, it is recommended to update industry level weights annually and product group weights frequently, at least every 5 years.

5.4.4 Fixed weights versus chained index

5.75. The simplest case of an index time series is obtained by considering one of the standard types of index in a series of separate binary comparisons between each year *t* and the base year 0. This usually means a series of a Laspeyres, Paasche or a Fisher index. The case is not only the simplest, but also the natural procedure when a particular index is to be computed and published regularly over time. Apart from routine revisions, an index once published remains unchanged, and all that normally happens is that the next index number for the following month, quarter or year is computed and added to the series.

5.76. There are however, serious limitations to this approach from an economic point of view. In a series of binary comparisons, the index for year *t* depends only on quantities/prices of year t and the fixed base year, while the course of prices/quantities between years 0 and *t* is completely ignored. Yet, economic common sense would suggest that a production quantity index or a producer price index would be influenced by prices before year t as well as those achieved in that year. Furthermore, from the statistical point of view, the series of binary comparisons is inefficient in that it does not make full use of all the data as they unfold over time.

5.77. An index using all the historical price/quantity data provides a rolling comparison of year *t* back to year 0 using the whole data as cumulated to the current year. The main concept of chaining is to consider only short series of a traditional index (Laspeyres, Paasche, etc.) and link them together into longer series. This can be achieved, for example, by changing the base year of the weight period at intervals of about five years to yield a five-yearly chain of Laspeyres or Paasche indices. Indeed, the process can be accelerated to yield annual chaining or even more frequent chaining. In fact, the more frequently weights are updated, the more representative will the resulting index series be.

5.78. Irving Fisher (1911), who gave the chain system its name, noted that the chain system is invariant to changes in the base period and he also saw the advantage of the method in dealing with the new good problem as the following quotation indicates:

> It may be said that the cardinal virtue of the successive base or chain system is the facility it affords for the introduction of new commodities, the dropping out of obsolete commodities, and the continued readjustment of the system of weighting to new commodities.[67]

5.79. In the case of more elaborated and complex index numbers such as the IIP, the above issue translates into the more general issue of updating or incorporating new

[67] Fisher, I., *The Purchasing Power of Money*, London 1911 (Macmillan), p.204.

weights into the index structure at the various levels of aggregation. The methods used to incorporate new weights into fixed weight and chain linked indices are fundamentally different. IIP compilers therefore need to determine which approach to use. But it is necessary to firstly define the terms *fixed weight* and *chain linked* indices prior to addressing the issue of methods of weight updates.

- *Fixed weight indices* have their weight structure fixed at a particular point in time. These weights represent the relative worth of different products/industries at that point in time and are used to compute indices over an extended period. A fixed-weight volume or quantity index compares volume (or quantity) in period *t* relative to some fixed base period (which is why fixed-weight indices are also known as fixed-base indices). The weights are traditionally updated every 5 years and at this time the entire time series is re-calculated based on the new set of weights;

- The term *chain linked indices* refers to the updating of the weights and linking two index series together to produce a time series. Unlike the fixed weight approach, the chain approach does not re-calculate the entire historical series whenever the weights are updated, but rather links or splices together the two index series to produce a coherent time series. For example, a chained quantity index compares quantities between two periods taking into account information on weight changes in the intervening period or periods.

5.80. In a fixed-weight setting, when changing the base year and index weights, values for all periods are recalculated using the weights from a new base year. In this case, the entire historical series will be revised as the weights for the whole series are expressed in terms of the economic situation in the new base year. Strictly speaking, a fixed-weight Laspeyres index would never have its weights updated, as by definition they must relate to the starting point of the time series which therefore becomes less and less relevant the longer the length of the time series. In practice, the weighting reference period generally refers to some point within the time series assigned by a pre-determined weight updating strategy. For example, weights might be updated for a fixed weight index every 5 years based on data from censuses or structural surveys generally available with a considerable lag.

5.81. A theoretical justification of the chain system can be derived from the continuous time approach to index numbers. This approach, introduced by the French economist Divisia (1926),[68] is based on the assumption that price and quantity data are available as continuous functions of time. The theory of mathematical differentiation is used then to decompose the rate of change of a continuous time value aggregate into two components that reflect price and quantity change. In this case, chaining can be interpreted as the discrete approximation to the continuous functional form proposed by Divisia. It is important to note however, that although Divisia's approach offers some insights, it does

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[68] Divisia, F. 1926. *L'indice monétaire et la théorie de la monnaie* (Paris: Société anonyme du Recueil Sirey).

not offer much guidance to statistical agencies in terms of leading to a definite choice of the index number formula.

5.82. In a general chain-link setting, the index time series is not revised for its entire history when the base year and index weights are changed – as is the case for fixed weight indices. It is therefore necessary that discrete intervals (e.g. 1 year, 5 years, etc.) of the component indexes are aggregated by using weights derived from the economic situations for periods near to these intervals. To achieve this, each time the weights and base year for the index are updated, data are only compiled with the new weights for periods close to the reference period for these weights, and the series is then linked to the historical portion. Therefore, the index is compiled for a succession of different segments while keeping the original weights for each past segment fixed.

5.83. The weighting methodology for the segments will depend on the type of index used, e.g. chained Laspeyres, chained Paasche, or chained Fisher.[69] For example in the case of a 5-year chained Laspeyres index with a time series starting in 1990, the portion of the index from 1990 – 1994 would be compiled using weights from 1990, linked to the portion of the index from 1995 – 1999 compiled using weights from 1995, then linked to the portion of the index from 2000-2004, and so on. In general, the more frequently weights are updated the more representative will the resulting volume or quantity index series be. For an annual chained-linked Laspeyres volume index where the weights are updated each year, the links are combined by successive multiplication to form the complete time series, according to the following general formula:

$$L_t = \sum_i (w_{i,t-1} \frac{q_{i,t}}{q_{i,t-1}}) \times \sum_i (w_{i,t-2} \frac{q_{i,t-1}}{q_{i,t-2}}) \times \ldots \times \sum_i (w_{i,0} \frac{q_{i,1}}{q_{i,0}}) \times 100$$

where $w_{i,t}$ is the relative share of value added of industry *i* at time *t*, and $q_{i,t}$ is the volume measure for industry i at time *t*.

5.84. From an economic point of view, if the price of a particular good rises relative to all other goods in an economy because of an increase in demand, then price taking firms will tend to produce more of this good relative to other goods. Alternatively, consumers will tend to substitute goods that have become relatively more expensive with less expensive goods. Over time, the pattern of relative prices in the base period tends to become progressively less relevant to the economic situations of later periods to the point where it becomes inappropriate to continue using them to measure volume changes from one period to the next. Hence, with long time series, it is as inappropriate to use the most current weights for a date long in the past as it is to use the weights from a long time in the past for the current period.

[69] Other chain-linked indexes can be considered where the weights refer to some mid point of the index segment to which they are applied. For example, if a new base year of 2005 was introduced, an index could be calculated with the new weights back until 2003, and then be linked to the segment from 1998 – 2002 based on weights from 2000 and so on. Such an index is called a 'midyear index', belonging to the class of 'Lowe' indexes (IMF PPI manual, 2004).

5.85. Using a fixed-weight index to measure quantity changes in the presence of relative price changes will introduce substitution bias into the quantity index because information on relative price changes is not taken into account when measuring quantity changes. Moreover, the substitution bias usually becomes larger over time, as the fixed weights become more unrepresentative of those faced by agents when measuring quantity changes in more recent periods. Chaining fixed-weight indices helps to alleviate the substitution bias. A different way to express the same phenomenon is to say that using chain indices instead of fixed-weight indices reduces the spread between Laspeyres and Paasche types of indices. In fact, it can be shown that if individual prices and quantities tend to increase or decrease steadily over time, chaining will significantly reduce the index number spread, possibly almost eliminating it.

5.86. One of the main drawbacks of the chain-linking approach refers to the lack of the *additivity characteristic*. In short, additivity is a property whereby a total aggregate is defined as the sum of its components. By direct result of the chaining process the aggregate is no longer the sum of the components and is said to be 'non-additive'.[70] In an IIP context this means the lower level volume measures of say, ISIC 4-digit classes, do not sum to upper levels of the ISIC structure (3-digit ISIC level and so on).

5.87. Non-additivity is most evident to users when chain volume measures are published in monetary terms rather than index numbers. The impact of non-additivity can be reduced by choosing a reference period that is close to the current period. It should be noted that the annually chained Laspeyres approach *is* additive in the year after the weight reference period but additivity breaks down in periods significantly before or after the reference period. It is for this reason that some statistical agencies update both the *weight reference period* and *index reference period*[71] on an annual basis.

5.88. Another drawback of the chain-linking approach comes from the fact that in cases where individual prices and quantities fluctuate so that the relative price and quantity changes occurring in earlier periods are reversed in later periods, chaining will produce worse results than a simple fixed-weight index. Szulc (1983)[72] made the point that when prices or quantities oscillate ('bounce'), chaining can lead to considerable index drift, that is, if after several periods of bouncing, prices and quantities return to their original levels, a chained index will not normally return to unity. It should be noted however that on balance, situations favorable to the use of chain indices over time seem more likely than those that are unfavorable, as the underlying economic forces that are responsible for the observed long-term changes in relative prices and quantities, such as technological progress and increasing incomes, do not often go into reverse.

5.89. As a general recommendation, the chain-linking approach and more specifically the chained Laspeyres-type volume index, is the recommended one for the compilation of the

[70] See the IMF (2001) Quarterly National Accounts, pg 163 for a detailed discussion of the non-additivity issue.
[71] See the 'frequency of weight updates' in section 5.4.3 for definitions of these terms.
[72] Szulc, Bohdan J. (1983); "Linking Price Index Numbers"; in Erwin Diewert and Claude Montmarquette (eds.), *Price Level Measurement*, Statistics Canada.

IIP. In this way, when re-weighting occurs, the index is compiled with weights only for those periods to which they relate. In addition, industry level weights should be updated annually and product group weights should be updated frequently, at least every 5 years. It is important however, that the issue of non-additivity as a result of chaining is carefully explained and presented to users. Moreover, as the price and volume components of monthly and quarterly data are usually subject to much greater variation than their annual counterparts due to seasonality and short-term irregularities, the advantages of chaining at these higher frequencies are less and chaining should definitely not be applied to seasonal data that are not adjusted for seasonal fluctuations. Also of note is that the presentation of percentage point contributions to the percent change of an index is a way to decompose the growth rate of a chain index into additive components.

5.5 Compilation procedures

5.90. This section is a practical guide to the compilation of a raw data/original terms IIP in line with the recommended approach. It leads the reader through the compilation process in a step-by-step manner. This section draws heavily on the published work of Eurostat in its *Methodology of short-term business statistics* (2002); the OECD's *Manual for an index of services production* (2006) and the IMF's *Producer Price Index Manual: Theory and Practice* (2004).

5.5.1 A step-by-step guide to compiling the index using the deflation method

Introduction of the example

5.91. This example demonstrates the process to compile a monthly Laspeyres IIP using the deflation approach. It shows the calculation of the first two months of the IIP.

5.92. Each step of this example to compile an IIP includes a description of the process/step, the presentation of relevant formulas as well as illustration of the process with the use of data. The steps follow the recommended approach described in section 5.2 of the present publication and illustrated in diagram 1.

5.93. The compilation of the IIP commences with the collection of basic data (also known as micro data) relating to products. The basic data are combined (using weights) to produce indices for product groups, which are then combined (using weights) to the lowest level of the industry classification, namely the 4-digit level of ISIC.

5.94. The upper levels of the IIP, above the 4-digit level of ISIC, are compiled by combining (with the use of weights) the lower level indices. Here, ISIC classes are combined to form ISIC groups; ISIC groups are combined to form ISIC divisions and so on.

5.95. Box 5 panel (i) shows the products, product groups and corresponding industries used in the example, illustrating the steps involved in the IIP compilation. Box 5 panels (ii) and (iii) show the basic data that are used throughout the example.

5.96. Of interest is that the IIP is compiled from value data in this example. Deflation is undertaken to produce volume measures at the industry level. Alternatively the volume extrapolation method can be used to compile the IIP if suitable volume indicator data exist. The compilation process when using the volume extrapolation method is similar to the process presented in this step-by-step example, with the major difference being that the volume extrapolation method *does not* require deflation to occur.[73]

5.97. The calculation of the index in this example covers the following steps:

- Preparing product data (preprocessing)
- Calculating value relatives at product level
- Calculating value indices at product group level
- Calculating value indices at industry (4-digit ISIC) level
- Deflation
- Calculating volume indices (IIP) at 3-digit and 2-digit ISIC level

5.98. For the purposes of simplified illustration, this is a raw data case. Topics such as seasonal adjustment, re-weighting and linking of indices are covered in greater detail in section 5.6 of this publication.

Step 1: Preparing product data (preprocessing)

5.99. The first step is to obtain and organize the necessary data from which an IIP can be constructed. This step, often referred to as pre-processing, requires the preparation of all data including variables, deflators and weights. In addition, while not explicitly presented in this example, the imputation of any missing data also occurs at this stage.[74]

5.100. The 'value of output' data presented below in Box 5 panel (ii) represent monthly data for nine products (P_1, … , P_9) representative of six product groups (G_1, …, G_6). The data are collected through 15 observations. Each observation is a measurement of one product by one establishment. A single establishment could also report on multiple products, i.e. multiple observations, but that does not affect the calculation.

5.101. The product groups are representative of ISIC classes, in our example 1511, 1512 and 1520. These ISIC classes are then aggregated in line with the ISIC classification (i.e. the ISIC classes are combined to form ISIC groups 151 and 152 and then ISIC division 15). Box 5, panel (i) provides a possible interpretation of the products and product groups used in this example.

[73] Section 5.5.2 of this publication demonstrates the process to produce the IIP using the volume extrapolation method.

[74] The basic data for this example (from a current survey, a price survey, the national accounts or other sources) are introduced in panels (ii), (iii), (iv), (xi) and (xiv) of Box 5.

5.102. The categories are just for purposes of illustration of the aggregation of products to product groups etc. It should be noted that for each product group, just a number of representative (not necessarily exhaustive) products is chosen, etc. Depending on local needs and the structure of individual industries, a more narrow definition of product groups or products may need to be chosen (e.g. identifying brand names or models) to ensure that the data collected for these categories remains representative of volume changes.

Box 5 Panel (i): Products, product groups and ISIC classes considered

ISIC class	Product group	Product
1511 – Tanning and dressing of leather; dressing and dyeing of fur	G1 – Leather	P1 – Chamois leather
	G2 – Furskins	P2 – Dressed furskins
1512 – Manufacture of luggage, handbags and the like, saddlery and harness	G3 - Luggage	P3 – Leather suitcases
1520 – Manufacture of footwear	G4 – Leather footwear	P4 – Men's shoes with leather uppers P5 – Women's shoes with leather uppers
	G5 – Textile footwear	P6 – Shoes with textile uppers
	G6 – Sports footwear	P7 – Ski boots P8 – Tennis shoes P9 – Men's running shoes

5.103. The periods T_0, T_1 and T_2 considered in the example are defined as:

- T_0 is the *quantity* reference period (i.e. the period whose volumes appear in the denominators of the volume relatives used to calculate the index) and is calculated as the monthly average of the base year. T_0 is also the *index* reference period (the period for which the index is set to 100.0);
- T_1 and T_2 are single-month periods for which data has been recorded and for which the IIP will be compiled. (For our purposes we assume that T_1 and T_2 are months immediately following the year of the reference period.)

Box 5 Panel (ii): The raw data

Observation	Product	Product group	ISIC class	Value of output in period		
				T_0	T_1	T_2
1	P_1	G_1	1511	124	161	178
2	P_3	G_3	1512	306	284	306
3	P_4	G_4	1520	101	125	132
4	P_7	G_6	1520	86	106	81
5	P_4	G_4	1520	89	98	103
6	P_4	G_4	1520	75	92	100
7	P_9	G_6	1520	62	71	72
8	P_2	G_2	1511	144	165	180
9	P_5	G_4	1520	51	64	65
10	P_5	G_4	1520	22	30	28
11	P_6	G_5	1520	40	45	47
12	P_8	G_6	1520	47	36	33
13	P_5	G_4	1520	32	38	42
14	P_9	G_6	1520	32	41	39
15	P_5	G_4	1520	101	96	99

5.104. It should be noted that the "products" and "product groups" that are used in the calculation of an IIP can include the manufacturing services of CPC Ver.2 divisions 88 and 89 (in the case of outsourcing), that is, not only the goods figure into this calculation process, but relevant services do as well.

5.105. After obtaining the raw data from a set of observations, i.e. measurements of one product by one establishment, a preprocessing step aggregates the information collected into unique values for each product used in the calculation. This aggregation simply adds up the values for all observations of product P_i to arrive at the total value for P_i that will be used in the following steps.[75]

5.106. Box 5 panel (iii) shows the data for each product calculated in this step.

[75] To obtain comparable data, the same set of observations has to be used for each period considered (possibly completed through imputation procedures).

Box 5 Panel (iii): Data at product level

Product	Product group	ISIC class	Value of output in period		
			T_0	T_1	T_2
P_1	G_1	1511	124	161	178
P_2	G_2	1511	144	165	180
P_3	G_3	1512	306	284	306
P_4	G_4	1520	265	315	335
P_5	G_4	1520	206	228	234
P_6	G_5	1520	40	45	47
P_7	G_6	1520	86	106	81
P_8	G_6	1520	47	36	33
P_9	G_6	1520	94	112	111

5.107. Box 5 panel (iv) contains the individual product weights and product group weights. These weights are used to combine the product data to produce data for the product groups. In this example, the weight reference period is also chosen to be T_0. Therefore the product weight represents the relative share of the total value of product P_i among the representative products selected for the product group to which P_i belongs.

5.108. Following the recommendations in section 5.4.2, we use value of output for the weights of individual products in this example.

5.109. It should be noted that the absolute weight of a product group may be larger than the sum of the absolute weights of the representative products in our calculation. This is due to the fact that the products are really just "representative" for the product group and do not necessarily include all products of that group. The absolute weight for the product group will therefore include weights for products not selected for the calculation. Similarly, the weight for an individual product may be larger than the base period value for this product in panel (iii). This is due to the fact that panel (iii) includes only the weight of the selected observations for product P_i, while data in panel (iv) reflects the total weight of product P_i. The weights in panel (iv) are obtained separately from other sources, like structural business surveys, and not from the collection of data in panel (iii).

Box 5 Panel (iv): Product and product group weights

Product	Product group	Absolute weight ${}^{p}W_{j,0}$	Relative weight ${}^{p}w_{j,0}$
P_1	G_1	124	1.0000
P_2	G_2	144	1.0000
P_3	G_3	340	1.0000
P_4	G_4	295	0.5598
P_5		232	0.4402
P_6	G_5	40	1.0000
P_7	G_6	86	0.3539
P_8		55	0.2263
P_9		102	0.4198

Product group	ISIC class	Absolute weight ${}^{pg}W_{j,0}$	Relative weight ${}^{pg}w_{j,0}$
G_1	1511	145	0.5017
G_2		144	0.4983
G_3	1512	510	1.0000
G_4	1520	550	0.6166
G_5		40	0.0448
G_6		302	0.3386

Step 2: Calculating value relatives at product level

5.110. Value relatives for each period are calculated in panel (v) for each product using the data from panel (i). Formula 5 presents the method of calculation for the value relatives for products.

Formula 5: Calculating value relatives

$$
{}^{p}R_{j,i} = \frac{{}^{p}_{VAL}V_{j,i}}{{}^{p}_{VAL}V_{j,0}}
$$

Where: $^{P}R_{j,i}$ = value relative of product j in period T_i

$^{P}_{VAL}V_{j,i}$ = value data of product j in period T_i (i = 0,1,2)

Box 5 Panel (v): Product value relatives by period

Product	Product value for period T_0 $^{P}_{VAL}V_{j,0}$ [1]	Product value for period T_1 $^{P}_{VAL}V_{j,1}$ [2]	Product value relative for period T_1 $^{P}R_{j,1}$ [3]=[2]/[1]	Product value for period T_2 $^{P}_{VAL}V_{j,2}$ [4]	Product value relative for period T_2 $^{P}R_{j,2}$ [5]=[4]/[1]
P_1	124	161	1.2984	178	1.4355
P_2	144	165	1.1458	180	1.2500
P_3	306	284	0.9281	306	1.0000
P_4	265	315	1.1887	335	1.2641
P_5	206	228	1.1068	234	1.1359
P_6	40	45	1.1250	47	1.1750
P_7	86	106	1.2326	81	0.9418
P_8	47	36	0.7660	33	0.7021
P_9	94	112	1.1915	111	1.1809

Note – Data for columns [1], [2] and [4] are sourced from Panel (iii).

Note – Even though values are shown here only with a limited number of decimals, the full value should be carried over into following calculations. In other words, no rounding should be applied in any of these steps (apart from final results). Any current software application (database, spreadsheet) handles a sufficient number of significant digits for these calculations.

Step 3: Calculating value indices at product group level

5.111. Box 5 panel (vi) demonstrates the process of combining products, using product weights, to produce data for product groups. The product value relatives from panel (v) are combined with product weights from panel (iv) to produce product group data.

5.112. These aggregates are obtained by multiplying the product value relative for each product with the weight for this product, and subsequently add the resulting values for each product group.

5.113. Since the product value relatives can be considered "value indices" at the product level, the aggregation procedure produces a "value index" at the product group level:

${}^{pg}_{VAL}I_{k,t} = \sum_j {}^{p}w_{j,0} \cdot {}^{p}R_{j,t}$, where the summation runs over all products P_j in product group G_k.

Box 5 Panel (vi): Combining product data to produce product group data

Product group	Product	Product weight ${}^{p}w_{j,0}$ [1]	Product value relative ${}^{p}R_{j,1}$ [2]	Weighted product value relative [3]=[1]*[2]	Product group value index ${}^{pg}_{VAL}I_{j,1}$ [4]=Sum([3])	Product value relative ${}^{p}R_{j,2}$ [5]	Weighted product value relative [6]=[1]*[5]	Product group value index ${}^{pg}_{VAL}I_{j,2}$ [7]=Sum([6])
	P_1	1.0000	1.2984	1.2984		1.4355	1.4355	
G_1					1.2984			1.4355
	P_2	1.0000	1.1458	1.1458		1.2500	1.2500	
G_2					1.1458			1.2500
	P_3	1.0000	0.9281	0.9281		1.0000	1.0000	
G_3					0.9281			1.0000
	P_4	0.5598	1.1887	0.6654		1.2642	0.7076	
	P_5	0.4402	1.1068	0.4872		1.1359	0.5001	
G_4					1.1526			1.2077
	P_6	1.0000	1.1250	1.1250		1.1750	1.1750	
G_5					1.1250			1.1750
	P_7	0.3539	1.2325	0.4362		0.9419	0.3333	
	P_8	0.2263	0.7660	0.1734		0.7021	0.1589	
	P_9	0.4198	1.1915	0.5001		1.1809	0.4957	
G_6					1.1097			0.9879

Note – Data for columns [2] and [5] are sourced from Panel (v), data for column [1] from Panel (iv).
Note – By design, the value index for the product groups for base period T_0 will always yield 1 and a separate calculation is therefore not shown above.

5.114. Box 5 panel (vii) provides a summary of the product group data results obtained in panel (vi).

Box 5 Panel (vii): Aggregated product group value indices

Product Group	Assigned ISIC class	Product group value index		
		${}^{pg}_{VAL}I_{j,0}$	${}^{pg}_{VAL}I_{j,1}$	${}^{pg}_{VAL}I_{j,2}$
G_1	1511	100.0	129.8	143.6
G_2	1511	100.0	114.6	125.0
G_3	1512	100.0	92.8	100.0
G_4	1520	100.0	115.3	120.8
G_5	1520	100.0	112.5	117.5
G_6	1520	100.0	111.0	98.8

Note – The "value indices" have been multiplied by 100 solely to conform to the standard way of presenting index numbers. This is not necessary for the calculation itself.

Step 4: Calculating value indices at industry (4-digit ISIC) level

5.115. The IIP compiler then needs to combine the product group data to produce data for industry classes. First, the product group weights have to be established, and then the calculation and aggregation procedure is carried out.

5.116. Box 5 Panel (iv) above shows the product group weights used for this example, taking into consideration the remarks made in para. 5.109 above.

5.117. Box 5 Panel (viii) shows the calculation for this step, which is similar to the previous one that constructed the value indices at the product group level.

5.118. In this case, the value relatives are identical to the calculated "value indices", due to the fact that the "value indices" in the base period are always 1 (or 100 %). We therefore do not show a separate calculation of these relatives.

Box 5 Panel (viii): Combining product group data to produce industry data

ISIC class	Product group	Product group weight $^{pg}w_{j,0}$ [1]	Product group value relative $^{pg}R_{j,1}$ [2]	Weighted product group value relative [3]=[1]*[2]	ISIC class value index $^{c}_{VAL}I_{j,1}$ [4]=Sum([3])	Product group value relative $^{pg}R_{j,2}$ [5]	Weighted product group value relative [6]=[1]*[5]	ISIC class value index $^{c}_{VAL}I_{j,2}$ [7]=Sum([5])
	G_1	0.5017	1.2984	0.6514		1.4355	0.7202	
	G_2	0.4983	1.1458	0.5709		1.2500	0.6228	
1511					1.2224			1.3431
	G_3	1.0000	0.9281	0.9281		1.0000	1.0000	
1512					0.9281			1.000
	G_4	0.6166	1.1526	0.7107		1.2077	0.7447	
	G_5	0.0448	1.1250	0.0504		1.1750	0.0527	
	G_6	0.3386	1.1097	0.3757		0.9879	0.3345	
1520					1.1369			1.1369

Note – Data for columns [2] and [5] are sourced from Panel (vii), data for column [1] from Panel (iv).
Note – By design, the value index for the ISIC classes for base period T_0 will always yield 1 and a separate calculation is therefore not shown above.

5.119. Box 5 panel (ix) provides a summary of the ISIC class data results obtained in panel (viii).

Box 5 Panel (ix): Aggregated ISIC class value indices

ISIC class	ISIC class value index		
	$^{c}_{VAL}I_{j,0}$	$^{c}_{VAL}I_{j,1}$	$^{c}_{VAL}I_{j,2}$
1511	100.0	122.2	134.3
1512	100.0	92.8	100.0
1520	100.0	113.7	113.2

Note – The "value indices" have been multiplied by 100 solely to conform to the standard way of presenting index numbers. This is not necessary for the calculation itself.

Step 5: Deflation

5.120. Deflation of the values in this example is carried out at the 4-digit level of the ISIC industry structure. Deflation is undertaken by dividing the current value by the appropriate price index. Section 4.2.1 of this publication recommends that the producer price index (PPI) at the corresponding level of aggregation be used as the deflator.

5.121. Box 5 panel (x) contains the set of producer price indices in this example that will be used as deflators to isolate the volume component from the value data.

Box 5 Panel (x): Producer price index data

ISIC class	Producer Price indices		
	${}_{P}I_{j,0}$	${}_{P}I_{j,1}$	${}_{P}I_{j,2}$
1511	100.0	102.1	104.2
1512	100.0	102.4	103.6
1520	100.0	101.9	104.0

Note: The data in this panel are obtained from a separate producer price index data collection programme. In this example we assume that the base period for the producer price index and for the IIP are identical (T_0).

5.122. Box 5 panel (xi) presents the deflation calculation to obtain the volume indices (IIP) by ISIC class. The volume indices are calculated using formula 6.

Formula 6: Calculating volume indices through deflation

$$ {}_{VOL}^{c}I_{j,i} = \frac{{}_{VAL}^{c}I_{j,i}}{{}_{P}I_{j,i}} $$

Where: ${}_{VOL}^{c}I_{j,i}$ = volume index in period T_i for ISIC class j

${}_{VAL}^{c}I_{j,i}$ = value index in period T_i for ISIC class j

${}_{P}I_{j,i}$ = deflator (price index) in period T_i for ISIC class j

Box 5 Panel (xi): Deflation of value data by ISIC class

ISIC class	Value index ${}_{VAL}^{c}I_{j,1}$ [1]	PPI ${}_{P}I_{j,1}$ [2]	Volume index ${}_{VOL}^{c}I_{j,1}$ [3]=[1]/[2]	Value index ${}_{VAL}^{c}I_{j,2}$ [4]	PPI ${}_{P}I_{j,2}$ [5]	Volume index ${}_{VOL}^{c}I_{j,2}$ [6]=[4]/[5]
1511	122.2	102.1	119.7	134.3	104.2	128.9
1512	92.8	102.4	90.6	100.0	103.6	96.5
1520	113.7	101.9	111.6	113.2	104.0	108.8

Note – Data for columns [1] and [4] are sourced from Panel (ix), data for columns [2] and [5] from Panel (x).
Note – By design, the value index for the ISIC classes for base period T_0 will always yield 100 and a separate calculation is therefore not shown above.

5.123. Box 5 panel (xii) presents the volumes by ISIC class that were calculated in panel (xi). For ease of notation, we will use $I_{j,i} = {}_{VOL}^{c}I_{j,i}$ from now on. The index *j* will denote the ISIC class, group, division or section in those cases.

Box 5 Panel (xii): Summary table of IIP by ISIC class

ISIC class	IIP at ISIC class level		
	$I_{j,0}$	$I_{j,1}$	$I_{j,2}$
1511	100.0	119.7	128.9
1512	100.0	90.6	96.5
1520	100.0	111.6	108.8

5.124. Panel (xii) concludes the calculation of the IIP at the industry level, producing the desired index at the lowest industry level.

Step 3: Calculating volume indices at 3-digit and 2-digit ISIC level

5.125. The aggregation to higher levels of ISIC uses a weighted average of these industry-level data. No deflation is required in further steps, since the price component has been removed already.

5.126. In order to compile the IIP for the upper levels of the classification, the lower levels must be combined using weights. The recommended variable from which weights are derived for the upper levels of the IIP is *gross value added at basic prices* (see section

5.4.2), which can be obtained from national accounts data. Box 5 panel (xiii) shows the weights that are being used in this example for the aggregation to higher-level indices.

Box 5 Panel (xiii): Gross value added at basic prices

ISIC	GVA (base period weight values) $W_{j,0}$	Relative weight (in next higher ISIC level) $w_{j,0}$
1511	95	0.3585
1512	170	0.6415
1520	298	1.0000
151	265	0.4707
152	298	0.5293

Note: *j* corresponds to the ISIC class or group, e.g. $w_{151,0} = 0.4707$.

5.127. Ideally, value added-type weights should have been used already in earlier stages of the calculation to reflect the desired nature of the index as a measure of changes in value added. However, since value added is usually not available at the product or product group level, output figures have been used instead. (See section 5.4.2 for a discussion of this.)

5.128. Unlike the weights at the product and product group level, the weights (absolute value added figures) at the detailed industry level should add up to the weights at the higher level. This is due to the fact that the lower-level industries entirely compose the higher-level industries and are not just representative components as in the case of products and product groups.

5.129. Box 5 panels (xiv) and (xv) show the calculation for the IIP at the next higher ISIC levels, i.e. at group and division level. The process of calculation is identical in both cases. The calculation for the IIP at ISIC-section level and for the total IIP is carried out in the same way. (The calculation is not shown here since data for this example have been restricted to just one ISIC division for sake of clarity.)

Box 5 Panel (xiv): Aggregating to higher levels of ISIC – ISIC groups (3-digit)

ISIC group (k)	ISIC class (j)	ISIC class weight $w_{j,0}$ [1]	ISIC class index $I_{j,1}$ [2]	Weighted ISIC class index [3]=[1]*[2]	ISIC group index $I_{k,1}$ [4]=Sum([3])	ISIC class index $I_{j,1}$ [5]	Weighted ISIC class index [6]=[1]*[5]	ISIC group index $I_{k,2}$ [7]=Sum([6])
	1511	0.3585	1.1972	0.4292		1.2889	0.4621	
	1512	0.6415	0.9064	0.5814		0.9653	0.6192	
151					1.0106			1.0813
	1520	1.0000	1.1157	1.1157		1.0883	1.0883	
152					1.1157			1.0883

Box 5 Panel (xv): Aggregating to higher levels of ISIC – ISIC division (2-digit)

ISIC division (k)	ISIC group (j)	ISIC group weight $w_{j,0}$ [1]	ISIC group index $I_{j,1}$ [2]	Weighted ISIC group index [3]=[1]*[2]	ISIC division index $I_{k,1}$ Sum([3])	ISIC group index $I_{j,1}$ [4]	Weighted ISIC group index [5]=[1]*[4]	ISIC division index $I_{k,2}$ Sum([5])
	151	0.4707	1.0106	0.4757		1.0813	0.5090	
	152	0.5293	1.1157	0.5905		1.0883	0.5760	
15					1.0662			1.0850

5.130. Box 5 panel (xvi) presents a summary of the data results for this example.[76]

[76] Refer to chapter 6 of this publication for guiding principles and recommendations for the presentation and dissemination of these statistics.

Box 5 Panel (xvi): Summary of data results

ISIC	Index of Industrial Production (IIP)		
	T_0	T_1	T_2
1511	100.0	119.7	128.9
1512	100.0	90.6	96.5
1520	100.0	111.6	108.8
151	100.0	101.1	108.1
152	100.0	111.6	108.8
15	100.0	106.6	108.5

5.5.2 Using the volume extrapolation method to calculate the IIP

5.131. This section illustrates the calculation of the IIP when volume (quantity) data are used as the basic data. This example follows the step-by-step approach used in section 5.5.1 of this publication. Of particular note is that the volume extrapolation method does not require the process of deflation to construct the IIP, since the basic data used for the calculation do not contain a price component.

5.132. Overall, the calculation follows a similar path as in the deflation method shown in section 5.5.1. We will therefore keep the explanations to a minimum and focus on differences in the two approaches.

5.133. Similar to the deflation method, the calculation is carried out in several steps, namely:

- Preparing product data (preprocessing)
- Calculating volume relatives at product level
- Calculating volume indices at product group level
- Calculating volume indices (IIP) at industry (4-digit ISIC) level
- Calculating volume indices (IIP) at 3-digit and 2-digit ISIC level

Step 1: Preparing product data (preprocessing)

5.134. As in the example in section 5.5.1, the first step is to obtain and organize the necessary data from which an IIP can be constructed. This step, often referred to as pre-processing, requires the preparation of all data including variables and weights. In addition, while not explicitly presented in this example, the imputation of any missing data also occurs at this stage.[77]

5.135. The 'quantity of output' data presented below in Box 6 panel (ii) represent monthly data for fifteen products (P_1, … , P_{15}) representative of six product groups (G_1, …, G_6).

5.136. The categories are just for purposes of illustration of the aggregation of products to product groups etc. For each product group, just a number of representative (not necessarily exhaustive) products is chosen, etc. Depending on local needs and the structure of individual industries, a more narrow definition of product groups or products may need to be chosen to ensure that the data collected for these categories remains representative of overall volume changes. Compared to the example in section 5.5.1, it should be noted that in the case of volume aggregation, often a more detailed selection of products is necessary to ensure that aggregation of quantities is still meaningful. For example, simply adding up the number of shoes with completely different prices or other characteristics would not produce a reliable volume index.

5.137. The product groups are representative of ISIC classes, in our example 1511, 1512 and 1520. These ISIC classes are then aggregated in line with the ISIC classification (i.e. the ISIC classes are combined to form ISIC groups 151 and 152 and then ISIC division 15). Box 6, panel (i) provides a possible interpretation of the products and product groups used in this example.

[77] The basic data for this example (from a current survey, a price survey, the national accounts or other sources) are introduced in panels (ii) and (iii) of Box 6.

Box 6 Panel (i): Products, product groups and ISIC classes considered

ISIC class	Product group	Product
1511 – Tanning and dressing of leather; dressing and dyeing of fur	G1 – Leather	P1 – Chamois leather
	G2 – Furskins	P2 – Dressed furskins
1512 – Manufacture of luggage, handbags and the like, saddlery and harness	G3 - Luggage	P3 – Leather suitcase, Model A P4 – Leather suitcase, Model B P5 – Handbags, Model A
1520 – Manufacture of footwear	G4 – Leather footwear	P6 – Men's shoes, Model A P7 – Men's shoes, Model B P8 – Men's shoes, Model C P9 – Women's shoes, Model A P10 – Women's shoes, Model B P11 – Women's shoes, Model C
	G5 – Textile footwear	P12 – Textile shoes, Model A
	G6 – Sports footwear	P13 – Ski boots, Model A P14 – Tennis shoes, Model A P15 – Men's running shoes, Model A

5.138. Similar to the example in section 5.5.1, a first aggregation of individual observations to the product level has to be carried out. For the sake of this example, we show only the aggregated product data in panel (ii).

5.139. It should be noted that the quantity / volume data can either be observed directly as the quantity of output of the given product or it could be calculated from the value of production (if available) by using a unit price as deflator. This requires also a certain degree of homogeneity of the actual products observed within each category.

Box 6 Panel (ii): Data at product level

Product	Product group	ISIC class	Unit	Quantity (volume) of output in period		
				T_0	T_1	T_2
P_1	G_1	1511	Sq. meters	240	303	340
P_2	G_2	1511	Sq. meters	288	326	334
P_3	G_3	1512	Number	32	24	29
P_4	G_3	1512	Number	36	36	35
P_5	G_3	1512	Number	103	102	113
P_6	G_4	1520	Pairs	40	43	44
P_7	G_4	1520	Pairs	42	45	41
P_8	G_4	1520	Pairs	52	55	48
P_9	G_4	1520	Pairs	41	45	44
P_{10}	G_4	1520	Pairs	42	47	44
P_{11}	G_4	1520	Pairs	56	62	62
P_{12}	G_5	1520	Pairs	80	92	96
P_{13}	G_6	1520	Pairs	34	35	37
P_{14}	G_6	1520	Pairs	28	31	31
P_{15}	G_6	1520	Pairs	16	21	20

5.140. Box 6 panel (iii) contains the weight data used in this example. The relationships between the product and product group weights are similar to the example in section 5.5.1, as explained in para. 5.109. The weight data represents gross output figures for these products and product groups.

Box 6 Panel (iii): Product and product group weights

Product	Product group	Absolute weight $^{p}W_{j,0}$	Relative product weight $^{p}w_{j,0}$
P_1	G_1	130	1.0000
P_2	G_2	144	1.0000
P_3	G_3	86	0.3691
P_4		115	0.4936
P_5		32	0.1373
P_6	G_4	100	0.2062
P_7		140	0.2887
P_8		33	0.0680
P_9		81	0.1670
P_{10}		72	0.1485
P_{11}		59	0.1216
P_{12}	G_5	40	1.0000
P_{13}	G_6	64	0.3832
P_{14}		33	0.1976
P_{15}		70	0.4192

Product group	ISIC class	Absolute weight $^{pg}W_{j,0}$	Relative product group weight $^{pg}w_{j,0}$
G_1	1511	145	0.5017
G_2		144	0.4983
G_3	1512	510	1.0000
G_4	1520	550	0.6166
G_5		40	0.0448
G_6		302	0.3386

Step 2: Calculating volume relatives at product level

5.141. Volume relatives for each period are calculated in panel (iv) for each product using the data from panel (ii). The calculation is similar to formula 5 in section 5.5.1, only that volumes (quantities) are used instead of values.

Box 6 Panel (iv): Product volume relatives by period

Product	Product volume for period T_0 ${}^{p}_{VOL}V_{j,0}$ [1]	Product volume for period T_1 ${}^{p}_{VOL}V_{j,1}$ [2]	Product volume relative for period T_1 ${}^{p}R_{j,1}$ [3]=[2]/[1]	Product volume for period T_2 ${}^{p}_{VOL}V_{j,2}$ [4]	Product volume relative for period T_2 ${}^{p}R_{j,2}$ [5]=[4]/[1]
P_1	240	303	1.2625	340	1.4167
P_2	288	326	1.1319	334	1.1597
P_3	32	24	0.7500	29	0.9062
P_4	36	36	1.0000	35	0.9722
P_5	103	102	0.9903	113	1.0971
P_6	40	43	1.0750	44	1.1000
P_7	42	45	1.0714	41	0.9762
P_8	52	55	1.0577	48	0.9231
P_9	41	45	1.0976	44	1.0732
P_{10}	42	47	1.1191	44	1.0476
P_{11}	56	62	1.1071	62	1.1071
P_{12}	80	92	1.1500	96	1.2000
P_{13}	34	35	1.0294	37	1.0882
P_{14}	28	31	1.1071	31	1.1071
P_{15}	16	21	1.3125	20	1.2500

Note – Data for columns [1], [2] and [4] are sourced from Panel (ii).

Step 3: Calculating volume indices at product group level

5.142. Box 6 panel (v) demonstrates the process of combining products, using product weights, to produce data for product groups. The product volume relatives from panel (iv) are combined with product weights from panel (iii) to produce product group data.

5.143. This aggregation is similar to the one shown in section 5.5.1. Since the product volume relatives can be considered "volume indices" at the product level, the aggregation procedure produces a "volume index" at the product group level: ${}^{pg}_{VOL}I_{k,t} = \sum_j {}^{p}w_{j,0} \cdot {}^{p}R_{j,t}$, where the summation runs over all products P_j in product group G_k.

Box 6 Panel (v): Combining product data to produce product group data

Product group	Product	Product weight $^{p}w_{j,0}$ [1]	Product volume relative $^{p}R_{j,1}$ [2]	Weighted product volume relative [3]=[1]*[2]	Product group volume index $^{pg}_{VOL}I_{j,1}$ [4]=Sum([3])	Product volume relative $^{p}R_{j,2}$ [5]	Weighted product volume relative [6]=[1]*[5]	Product group volume index $^{pg}_{VOL}I_{j,2}$ [7]=Sum([6])
	P_1	1.0000	1.2625	1.2625		1.4167	1.4167	
G_1					1.2625			1.4167
	P_2	1.0000	1.1319	1.1319		1.1597	1.1597	
G_2					1.1319			1.1597
	P_3	0.3691	0.7500	0.2768		0.9062	0.3345	
	P_4	0.4936	1.0000	0.4936		0.9722	0.4799	
	P_5	0.1373	0.9903	0.1360		1.0971	0.1507	
G_3					0.9064			0.9650
	P_6	0.2062	1.0750	0.2216		1.1000	0.2268	
	P_7	0.2887	1.0714	0.3093		0.9762	0.2818	
	P_8	0.0680	1.0577	0.0720		0.9423	0.0628	
	P_9	0.1670	1.0976	0.1833		1.0732	0.1792	
	P_{10}	0.1485	1.1191	0.1661		1.0476	0.1555	
	P_{11}	0.1216	1.1071	0.1347		1.1250	0.1347	
G_4					1.0870			1.0408
	P_{12}	1.0000	1.1500	1.1500		1.2000	1.2000	
G_5					1.1500			1.2000
	P_{13}	0.3832	1.0294	0.3945		1.0882	0.4170	
	P_{14}	0.1976	1.1071	0.2188		1.1071	0.2188	
	P_{15}	0.4192	1.3125	0.5502		1.2500	0.5240	
G_6					1.1634			1.1598

Note – Data for columns [2] and [5] are sourced from Panel (iv), data for column [1] from Panel (iii).
Note – By design, the value index for the product groups for base period T_0 will always yield 1 and a separate calculation is therefore not shown above.

5.144. Box 6 panel (vi) provides a summary of the product group data results obtained in panel (v).

Box 6 Panel (vi): Aggregated product group volume indices

Product Group	Assigned ISIC class	Product group volume index		
		${}^{pg}_{VOL}I_{j,0}$	${}^{pg}_{VOL}I_{j,1}$	${}^{pg}_{VOL}I_{j,2}$
G_1	1511	100.0	126.2	141.7
G_2	1511	100.0	113.2	116.0
G_3	1512	100.0	90.6	96.5
G_4	1520	100.0	108.7	104.1
G_5	1520	100.0	115.0	120.0
G_6	1520	100.0	116.3	116.0

Note – The "value indices" have been multiplied by 100 solely to conform to the standard way of presenting index numbers. This is not necessary for the calculation itself.

Step 4: Calculating volume indices (IIP) at industry (4-digit ISIC) level

5.145. In this step, the product group data is combined, using the appropriate product group weights, to produce a volume index at the industry level. The calculation is similar to step 4 in the example in section 5.5.1, with the exception of course, that the product group indices here are volume instead of value indices.

5.146. Box 6 panel (vii) shows the calculation for this step. Note that for this example the weights at the product group level are the same as in the example of section 5.5.1, while the product group indices differ (being volume instead of value indices).

Box 6 Panel (vii): Combining product group data to produce industry data

ISIC class	Product group	Product group weight $^{pg}w_{j,0}$ [1]	Product group volume relative $^{pg}R_{j,1}$ [2]	Weighted product group volume relative [3]=[1]*[2]	ISIC class volume index $_{VOL}^{c}I_{j,1}$ [4]=Sum([3])	Product group volume relative $^{pg}R_{j,2}$ [5]	Weighted product group volume relative [6]=[1]*[5]	ISIC class volume index $_{VOL}^{c}I_{j,2}$ [7]=Sum([6])
	G1	0.5017	1.2625	0.6334		1.4167	0.7108	
	G2	0.4983	1.1319	0.5640		1.1597	0.5779	
1511					1.1974			1.2886
	G3	1.0000	0.9064	0.9064		0.9650	0.9650	
1512					0.9064			0.9650
	G4	0.6166	1.0870	0.6097		1.0408	0.6418	
	G5	0.0448	1.1500	0.0272		1.2000	0.0538	
	G6	0.3386	1.1634	0.4794		1.1598	0.3927	
1520					1.1157			1.0882

Note – Data for columns [2] and [5] are sourced from Panel (vi), data for column [1] from Panel (iii).

5.147. Box 6 panel (viii) provides a summary of the ISIC class data results obtained in panel (vii).

Box 6 Panel (viii): Aggregated ISIC class volume indices

ISIC class	ISIC class volume index		
	$_{VOL}^{c}I_{j,0}$	$_{VOL}^{c}I_{j,1}$	$_{VOL}^{c}I_{j,2}$
1511	100.0	119.7	128.9
1512	100.0	90.6	96.5
1520	100.0	111.6	108.8

Note – The indices have been multiplied by 100 solely to conform to the standard way of presenting index numbers. This is not necessary for the calculation itself.

5.148. Since the calculation of these indices was done using volume information only, no separation of a price component, i.e. no deflation step, is required. The volume indices therefore constitute the sought IIP at the ISIC class level.

Step 5: Calculating volume indices (IIP) at higher industry levels

5.149. The aggregation of indices at the ISIC class level to higher levels of ISIC is carried out in exactly the same way as shown in the example in chapter 5.5.1, since in both cases volume indices at the ISIC class level are now available. Panels (xiii) to (xvi) of Box 5 in section 5.5.1 show the exact calculation (using the same data). The detailed calculation is therefore not repeated here.

5.6 Additional compilation issues

5.150. This section aims to provide additional technical detail for specific topics relevant to the construction of an IIP.

5.6.1 Re-weighting, linking and re-referencing the index

5.151. Section 5.4 discussed the role of weights in the compilation of an IIP as well as the reasons behind periodically updating these weights. This section provides an example of how to carry out the *re-weighting* process (i.e. introducing new weights into the index structure). Following that, the processes of *linking* (which is a numerical operation requiring data for an overlapping period of the index using both the old and new weights) and *re-referencing* (updating the reference period to equal 100.0) are outlined.

5.152. It is desirable to maintain a continuous index series whenever new weights are incorporated into an index. Therefore this publication recommends that the chain linking method be used when weights are updated, i.e. the new series should be linked to the old series producing the continuous series and, unlike the fixed-weight approach, the entire historical series should not be recalculated from basic data each time the weights are updated.

5.153. To achieve this, each time the weights and base year for the index are updated, data are only compiled with the new weights for periods close to the reference period and the series is then linked to the historical portion. This is called a *chain-linked index* as it is compiled for a succession of different segments while keeping the original weights for each past segment fixed. The QNA manual[78] discusses three linking methods, the *one-quarter overlap* (a link factor is derived by dividing the index of the first quarter of year t by the index for the same quarter using the weights of year t-1), the *annual overlap* technique (a link factor is derived by dividing the index for year t by the index for year t using the weights of year t-1) and the *over-the-year* technique (a link factor is determined based on the same period in the previous year).

5.154. "While, in many cases, all three linking techniques give similar results, in situations with strong changes in relative quantities and relative prices, the over-the-year technique can result in distorted seasonal patterns in the linked series. While standard price statistics compilation exclusively uses the one-quarter overlap technique, the annual

[78] The IMF Quarterly National Accounts manual (2001), chapter IX, provides a detailed discussion of various linking methods, one of which is the one quarter overlap approach.

overlap technique may be more practical for Laspeyres-type volume measures because it results in data that aggregate exactly to the corresponding direct annual index. In contrast, the one-quarter overlap technique and the over-the-year technique do not result in data that aggregate exactly to the corresponding direct annual index. The one-quarter overlap provides the smoothest transition between each link, while the annual overlap technique may introduce a step between each link".[79]

5.155. The linking method presented below is the 'annual overlap' approach and is used solely for presentation purposes.[80] Individual countries need to determine the most appropriate linking method for their own circumstances.

5.156. Often when weights of an index are updated, the new weight reference period is traditionally set to "100.0". This is achieved by dividing all values of the index series by the old index of the new weight reference period and multiplying by 100. This process is known as *re-referencing*.

5.157. Box 7 illustrates the calculation for the linking process, including re-weighting and re-referencing.

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[79] IMF QNA (2001), paragraph 9.39.

[80] An important issue here is the feasibility of IIP compilers to, each year for each link, compile annual overlaps for their monthly series using both the old and the new weights while producing a real time index. In many aspects, the one-quarter overlap can be most useful in this regard. For example, when considering the linking in of new products, the annual overlap method becomes more difficult.

Box 7: Re-weighting, linking and re-referencing an index

Quarterly Laspeyres volume index with annual chain-linking, using the annual overlap method

						At constant prices of:						Chain-linked index
						2005		2006		2007		
Basic data	Quantities a	Quantities b	Prices a	Prices b	Total at current prices	Level	Index 2005 = 100	Level	Index 2006 = 100	Level	Index 2007 = 100	2005 = 100
2005	**270**	**244**	**10.0**	**5.0**	**3920.00**	**3920.00**	**100.00**					**100.00**
2006-q1	74.2	63.6	9.8	5.2	1057.88	1060.00	108.16					108.16
2006-q2	72.8	64.2	9.3	5.8	1049.40	1049.00	107.04					107.04
2006-q3	75.3	65.6	8.6	6.1	104774	1081.00	110.31					110.31
2006-q4	76.7	67.6	8.3	6.5	1076.01	1105.00	112.76					112.76
2006	**299**	**261**	**9.0**	**5.9**	**4230.90**	**4295.00**	**109.57**	**4230.90**	**100.00**			**109.57**
2007-q1	77.1	65.5	8.1	6.7	1063.36			1080.35	102.14			111.91
2007-q2	76.3	66.2	7.8	6.9	1051.92			1077.28	101.85			111.59
2007-q3	77.8	68.2	7.6	7.3	1089.14			1102.58	104.24			114.21
2007-q4	78.8	69.1	7.3	7.5	1093.49			1116.89	105.59			115.70
2007	**310**	**269**	**7.7**	**7.1**	**4296.90**			**4377.10**	**103.46**	**4296.90**	**100.00**	**113.35**
2008-q1	80.1	70.2	7.1	7.9	1123.29					1115.19	103.81	117.68
2008-q2	79.5	72.2	6.9	8.2	1140.59					1124.77	104.71	118.69
2008-q3	81.1	71.9	6.5	8.8	1159.87					1134.96	105.65	119.76
2008-q4	83.3	72.7	6.3	9.1	1186.36					1157.58	107.76	122.15
2008	**324**	**287**	**6.7**	**8.5**	**4610.30**					**4532.50**	**105.48**	**119.57**
Independently chain-linked annual indices												
2005						3920.00						**100.00**
2006						4295.00	109.57	4230.90				**109.57**
2007								4377.10	103.46	4296.90		**113.35**
2008										4532.50	105.48	**119.57**

5.158. The indices in box 7 are calculated in the following way:

Step 1: Compile constant price estimates for each quarter at the annual average prices of the previous year, with the annual data being the sum of the four quarters.
e.g.:

2006-q1 10.0*74.2 + 5.0*63.6 = 1060.00
2006-q2 10.0*72.8 + 5.0*64.2 = 1049.00
2006-q3 10.0*75.3 + 5.0*65.6 = 1081.00
2006-q4 10.0*76.7 + 5.0*67.6 = 1105.00
2006 1060.00 + 1049.00 + 1081.00 + 1105.00 = 4295.00

Step 2: Convert the constant price estimates for each quarter into a volume index with the average of last year = 100. Note: The denominator is the average of the quarters of the previous year.

e.g.:

2006-q1	[1060.00 / (3920.00/4)] * 100 = 108.16
2006-q2	[1049.00 / (3920.00/4)] * 100 = 107.04
2006-q3	[1081.00 / (3920.00/4)] * 100 = 110.31
2006-q4	[1105.00 / (3920.00/4)] * 100 = 112.76
2006	4295.00 / 3920.00 * 100 = 109.57

Step 3: Link the quarterly volume indices with shifting base and reference year using the annual indices as linking factors (using 2005 as the reference period for the chain-linked index).

e.g.:

2007-q1	102.14 * 109.57/100 = 111.91
2007-q2	101.85 * 109.57/100 = 111.59
2007-q3	104.24 * 109.57/100 = 114.21
2007-q4	105.59 * 109.57/100 = 115.70
2007	103.46 * 109.57/100 = 113.35

The indices for 2008 have to be calculated using the linking factors based on the 2006 and 2007 indices.[81]

2008-q1	103.81 * 103.46/100 * 109.57/100 = 117.68
2008-q2	104.71 * 103.46/100 * 109.57/100 = 118.69
…	

Note that the unweighted annual average of the derived chain-linked quarterly index series is equal to the independently derived chain-linked annual data.

e.g.:

2007	(111.91 + 111.59 + 114.21 + 115.70) / 4 = 113.35
…	

5.159. Box 7 shows that the products are initially compiled using weights (prices) from year 2005. These 2005 weights are used to compile indices for the periods until the fourth quarter of 2006. New weights (prices) from 2006 are then implemented. The two series of indices are then linked together. To link the old and the new series, an overlapping period (in this example an annual overlap period) is needed in which the index has to be calculated using both the old and the new set of weights.

[81] Note that the calculations above show only a limited number of digits, i.e. rounded figures. The calculation itself was however carried out using the full precision of data available, which explains some apparent discrepancies in the results.

5.160. A linking coefficient can be calculated between the old and new series during the overlap period and this coefficient is applied to the new index series to bring the index up to the level of the old series.[82] The linking coefficient in this example between 2005 and 2006 is 1.0957. Therefore the index number for the first quarter of 2007 is 111.91. This is obtained by:

(A) Calculating the 'link factor' for the annual overlap period:

$$\text{Link factor} = \frac{Index_{oldbase}}{Index_{newbase}}, \quad \text{which is } \frac{109.57}{100.00} = 1.0957$$

(B) Multiplying the indices calculated using 2006 prices by the linking factor, e.g. for 2007-q1: 102.14 * 1.0957 = 111.91

5.161. Often, when weights are updated and linking occurs, the reference period is also updated. It is convention that the base reference period is expressed as 100.0. This process of updating the base reference period to equal 100.0 is called *re-referencing*.

5.162. Re-referencing is a simple process of applying the re-reference factor to the historical series. The re-reference factor is defined as:

$$\text{Re-reference factor} = \frac{Index_{newbase}}{Index_{oldbase}}, \quad \text{which is } \frac{100.00}{109.57} = 0.9127 \text{ in this example.}$$

5.6.2 Introducing new products

5.163. The emergence of new products and the disappearance of old products is a usual phenomenon in economies. The inclusion of these new products, where their production is significant, and the removal of old products are important for the compilation of an accurate IIP.

5.164. The introduction of new products into the IIP has posed difficulties for index compilers in the past because of the IIP compilation method and frequency of weight updates. A fixed weight approach with weights updated every five years has traditionally been used. The problem is that as the period of interest moves further from the base period the number of products that are present in both the base period and the current period becomes progressively smaller and estimates are needed for those missing products. In addition, the quality of products changes over time and may become so significantly different that they can no longer be considered the same product and direct comparisons to the base period are no longer possible. This results in fewer and fewer actual product comparisons from which to compile the IIP.

[82] For a detailed description of linking using coefficients, please see the PPI Manual (2004), p238

5.165. The annual updating of weights, as recommended in this publication, provides the opportunity to incorporate new products more often. This is because the new product can be added to the basket of products in the (new) base period and quantity comparisons between the current period and the base period can now occur for this new product. It is important that appropriate weighting data are available for these products before they can be incorporated into the index.

5.166. Box 8 illustrates the process of incorporating new products into an index at the time of re-weighting. Assume there is an index that is compiled from three components (A, B and C). The weights are initially from 2003. Component A had 50 percent share, B had 35 percent share and C had 15 percent share. Assume that new weights for these components are available in 2004. As part of the process to collect new weighting data, a new component (D) is found and has a significant weight share (15%). The new weights are for 2004: A (45%), B (30%), C (10%) and D (15%).

5.167. The total index is derived from products A, B and C in periods proceeding Jan 05 and from products A, B, C and D in periods from Jan 05 onwards. Calculation of the chained and re-referenced indices is as per the discussion in Box 7 above.

Box 8: Incorporating new products into an index

Index	Weight 2003	2003	Dec 04	2004 Annual Index	Weight 2004	2004	Jan05	Feb05	Mar05
		2003 = 100				2004 = 100			
Panel (i) Product level indices									
A	0.50	100.0	110.2	108.3	0.45	100.0	102.9	102.3	102.3
B	0.35	100.0	112.4	110.3	0.30	100.0	100.4	100.9	101.5
C	0.15	100.0	107.7	105.8	0.10	100.0	102.1	102.5	102.7
D	. .	. .	. .		0.15	100.0	103.0	103.1	104.0
Panel (ii) Aggregation to higher level indices									
Total		100.0	110.6	108.6		100.0	102.1	102.0	102.4
Panel (iii) Chaining of the higher level indices									
Total		100.0	110.6			108.6	110.9	110.8	111.2
Panel (iv) Re-referencing the 4-digit ISIC index to period = 2004									
Total		92.1	101.8	100.0		100.0	102.1	102.0	102.4

Note: The 2004 annual index is used to calculate the link factor for the total index and is equal to [108.6/100] = 1.086. The total index for Jan05 is then calculated as: [102.1 * (108.6/100)] = 110.9.

5.168. However, the process of incorporating new products at the time of re-weighting doesn't address the situation where the product disappears or the quality of a product changes significantly between weight updates. This is particularly the case in product markets with a rapid turnover of products. Index compilers can use a short-run formulation (formula 7) to cope with these situations. A data example using the formula is presented in Box 9 below.

Formula 7: Incorporating replacement products into an index between re-weights

$$L_t = \sum_i q_{i,0}\, p_{i,0} \left(\frac{q_{i,s_i}}{q_{i,0}}\right)\left(\frac{q'_{i,t}}{q'_{i,s_i}}\right) \Big/ \sum_i q_{i,0}\, p_{i,0}$$

where: $p_{i,0}$: prices of product i at base period 0

$q_{i,t}$: quantity of original product i at period t

$q'_{i,t}$: quantity of replacement product i at period t

s_i : period starting in which product i is being substituted

Note that $q'_{i,k} = q_{i,k}\,(\forall k)$ for all products I that are not substituted.

5.169. Box 9 uses formula 7 to present the situation where a product disappears or significantly changes in T_1 and a new product appears. Note that the next re-weight is not scheduled to be implemented for several periods.

5.170. Assume that, for simplicity of the example, two products (A and B) have been selected to represent a product group or industry for the purposes of compiling an IIP. Price and quantity data are collected in the base period for products A and B. Quantity data are also collected in period T_1 for product A and are used to compile the IIP. However, product A is replaced by product B in T_2 as product A no longer exists.

5.171. This approach for replacing products in an index is possible because data are available for both products A and C in period T_1. This method is referred to as the overlap method[83] for incorporating replacement products into an index. In this example the overlap period is T_1.

5.172. Panel (i) of Box 9 provides the data for products A, B and C while panel (ii) presents the method of calculation and index results. It should be noted that additional weighting information may be required to augment the initial weighting given to product

[83] A detailed account of all the methods to incorporate products into an index are available in chapters 7 and 8 of the CPI and PPI manuals.

A within the wider product group. However, a chain formulation in which weights are regularly updated would be a better mechanism to achieve this.

Box 9: Incorporating replacement products into an index between re-weights

Panel (i): Observed data

Product i	Product prices in the base period $p_{i,0}$ [1]	Product quantities in the base period $q_{i,0}$ [2]	Product quantities in period T_1 $q_{i,1}$ [4]	Product quantities in period T_2 $q_{i,2}$ [5]
A	2.00	10	11	..
B	3.00	8	9	10
C	…	…	7	12

Panel (ii): Index compilation

We use formula 7 for calculating the index for the product group consisting of products A, B and C.

For period T_1, no special considerations are necessary. Note that in formula 7 we have $q'_{A,t} = q_{A,t}$ and $q'_{B,t} = q_{B,t}$ for t=0,1,2, which means that the formula reduces to the following simple form:

$$L_1 = (q_{A,1} p_{A,0} + q_{B,1} p_{B,0}) / (q_{A,0} p_{A,0} + q_{B,0} p_{B,0})$$
$$= (11 \cdot 2 + 9 \cdot 3) / (10 \cdot 2 + 8 \cdot 3)$$
$$= 1.114$$
$$= 111.4\%$$

For the calculation for period T_2, we need to consider that product A is not available in the current period and has been replaced by product C since period T_1. This gives us s_A=1 and we use the values for product C as replacement for A, i.e. $q'_{A,t} = q_{C,t}$ for i=1,2. Since product B is not replaced in the periods covered in the calculation, we have $q'_{B,t} = q_{B,t}$ for t=0,1,2. Note that due to the replacement, we essentially consider only two products in our formula, namely A and B.

With this we obtain:

$$L_2 = (q_{A,0} p_{A,0} \left(\frac{q_{A,1}}{q_{A,0}}\right)\left(\frac{q'_{A,2}}{q'_{A,1}}\right) + q_{B,0} p_{B,0} \left(\frac{q_{B,1}}{q_{B,0}}\right)\left(\frac{q'_{B,2}}{q'_{B,1}}\right)) / (q_{A,0} p_{A,0} + q_{B,0} p_{B,0})$$
$$= (q_{A,0} p_{A,0} \left(\frac{q_{A,1}}{q_{A,0}}\right)\left(\frac{q_{C,2}}{q_{C,1}}\right) + q_{B,0} p_{B,0} \left(\frac{q_{B,1}}{q_{B,0}}\right)\left(\frac{q_{B,2}}{q_{B,1}}\right)) / (q_{A,0} p_{A,0} + q_{B,0} p_{B,0})$$
$$= (10 \cdot 2 \cdot \frac{11}{10} \cdot \frac{12}{7} + 8 \cdot 3 \cdot \frac{9}{8} \cdot \frac{10}{9}) / (10 \cdot 2 + 8 \cdot 3)$$
$$= 1.539$$
$$= 153.9\%$$

5.6.3 Seasonal adjustment

5.173. High frequency time series data on economic statistics in general and industrial production in particular, including the IIP, are often characterized by seasonal fluctuations and other calendar related effects that mask relevant short- and long-term movements of these series and impede a clear understanding of the underlying economic phenomena. A proven and well-known solution is to identify and remove these effects, thus relying on seasonally adjusted data.

5.174. The main aim of seasonal adjustment is to filter out seasonal fluctuations and typical calendar effects within the movements of the time series under review in order to uncover the important features of the series in relation to its evolution (trajectory), i.e. the direction and magnitude of the changes that have taken place. In this way the seasonally adjusted results do not show "normal" and repeating events, rather they provide an estimate for what is new in the series (change in the trend, the business cycle or the irregular component). Therefore, seasonally adjusted data help to reveal the "news" contained in the time series, which is the ultimate goal of seasonal adjustment.

5.175. Usual seasonal fluctuations mean those movements which recur with similar intensity in the same season each year and which, on the basis of the past movements of the time series in question, can under normal circumstances be expected to recur. For example, in the case of the IIP, annual summer holidays have a negative impact on industrial production although the level of this impact varies from one country to another. Calendar effects are those effects associated with the composition of the calendar. The most important calendar effects are the working/trading day effects which represent the "within-month" effects, and the moving holiday's effects which are associated to holidays that occur at the same time each year based on various calendars other than the Gregorian calendar. Therefore, their exact timing shifts systematically each Gregorian calendar year.

5.176. A trivial solution to get around seasonal patterns would be the same-month comparisons in the original series, that is to look at rates of change compared to the same month (or quarter) of the previous year. While this process can remove some part of the seasonality, it cannot remove the working/trading day variations or the moving-holiday effect. These comparisons reflect movements in the trend only if the series contains no working/trading day variation and no moving holidays.

5.177. The seasonally adjusted data and the estimated trend/trend-cycle complement the original data, but they cannot replace the original data for the following reasons: i) unadjusted data are useful in their own right. While the non-seasonally adjusted data show the actual economic events that have occurred, the seasonally adjusted data and the trend-cycle estimate represent an analytical elaboration of the data designed to show the underlying movements that may be hidden by the seasonal variations. Thus, compilation of seasonally adjusted data, exclusively, represents a loss of information; ii) no unique solution exists on how to conduct seasonal adjustment and; iii) seasonally adjusted data are subject to revisions as future data become available, even when the original data are not revised.

5.178. *Advantages of seasonal adjustment.* Seasonal adjustment supplies users and analysts with the necessary inputs for business cycle analysis, trend-cycle decomposition and turning points detection. It provides a more smooth and understandable series hence revealing the “news” contained in the time series of interest. Seasonal adjustment facilitates the comparison of long-term and short-term movements among industries, sectors and countries. Also, by applying statistical quality control procedures through both input and output series, it allows for better comparability with other series and methods.

5.179. *Disadvantages of seasonal adjustment*. Seasonal adjustment suffer from various drawbacks including:

- Subjectivity: as seasonality is not precisely defined, seasonal adjustment depends on 'a priori' hypotheses about the components of the time series and the overall data generation process. These hypothesized components are non observable and can only be estimated. In particular, the seasonal and the seasonally adjusted components may vary from one software to another, and upon options chosen within the software;
- Burden: seasonal adjustment is time consuming and significant computer and human resources must be dedicated to this task;
- Risks: inappropriate or low-quality seasonal adjustment can generate misleading results and increase the probability of false signals. Also, the presence of residual seasonality as well as over-smoothing can negatively affect the interpretation of seasonally adjusted data.

5.180. *General recommendation*. Countries should consider producing and disseminating seasonally adjusted series as an integral part of their long-term programme of quality enhancement of their industrial production statistics. However, countries should consider all advantages and disadvantages of seasonal adjustment before starting the seasonal adjustment process. Seasonal adjustment must be performed only when there is clear statistical evidence and economic interpretation of the seasonal/calendar effects. Making any seasonal and/or calendar adjustment on time series which do not show any evidence of such effects is an inappropriate statistical treatment.

5.181. It must also be noted that some time series can only be characterized by calendar effects without seasonal ones; in this case, only the calendar adjustment will be appropriate. Moreover, other series can be characterized only by seasonal effects without significant calendar ones; in this case only the seasonal adjustment filtering must be applied.

5.6.3.1 Basic concepts of seasonal adjustment

5.182. *Time series.* When statistical data are collected at regular intervals of time they form a time series. Production of new motor vehicles for each sub-period (week, month, quarter) of the year in a given country is a good example of a time series. For a time series to be useful (or even meaningful), the data must be comparable over time, that is, consistent over time in concepts and measurement. The reporting periods have also to be discrete (i.e. every month, quarter, year, etc.), identical and without overlapping. In contrast, data collected irregularly or only once do not represent a time series. There are two types of time series - stock and flow. Stock series are measures of activity *at a point* in time while the flow series measure the level of activity *over* a time interval. For example, IIP is a flow series, whereas the level of inventories represents a stock series. Different techniques are used when seasonally adjusting stock and flow series.

5.183. *Components of time series.* For the purpose of seasonal adjustment, a time series is generally considered to be made up of the following four main components – the trend component, the cycle component, the seasonal component and the irregular component:

(a) *The trend component* (T_t) which reflects long term movements lasting many years. It is generally associated with structural causes, for example, institutional events, demographic and technological changes, new ways of organization, general economic development, etc. In many series such as those on the production of goods and services, this may be termed the growth element.

(b) *The cycle component* (C_t) indicates the fluctuation around the trend characterized by alternating periods of expansion and contraction, usually referred to as business cycle. In much analytical work, the trend and the cycle components are combined, since for series covering a short period of time the long-term trend cannot be adequately estimated. In this case, the trend-cycle component (TC_t) describes the underlying path or general direction reflected in the data, that is, the combined long-term trend and the business-cycle movements in the data.[84]

(c) *The seasonal component* (S_t) is a movement within the year with a characteristic shape for each time series that represents the effect of climatic and institutional events that repeat more or less regularly each year. This component includes seasonal effects narrowly defined and calendar related systematic effects that are not stable in annual timing, such as trading day effects and moving holiday effects. The seasonal effect narrowly defined is an effect that is reasonably stable in terms of magnitude. Possible causes for this effect are natural factors, administrative or legal measures, social/cultural traditions, and calendar-related events that are stable in annual timing (e.g., public holidays such as Christmas).

(d) *The irregular component* (I_t) represents unforeseeable movements related to events of all kinds. It is the residual variations due to developments or to momentous occurrences such as wars or national catastrophes, which affect a

[84] This approach is used in the discussion of composition models in section 5.6.3.2.

number of series simultaneously. In general, the irregular component has a stable random appearance and it captures effects that are unpredictable unless additional information is available in terms of timing, impact and duration. The irregular component includes the following: i) irregular effects narrowly defined; ii) outlier effects; iii) other irregular effects such as the effects of unseasonable weather, natural disasters, strikes, irregular sales campaigns, etc. The irregular effect narrowly defined is assumed to behave as a stochastic variable that is symmetrically distributed around its expected value.

5.184. *The concept of seasonality*. The impact of seasonality in socioeconomic activities has long been recognized. For example, low level of winter construction, high pre-Christmas retail sales, and seasonal variations in agriculture are well known phenomena. Seasonality represents the composite effect of climate and institutional events which repeat more or less regularly every year. Major causes of seasonality include weather, composition of the calendar, timing decisions and expectations. These causes are mainly exogenous to economic systems but human intervention can modify their extent and nature.

5.185. Another characteristic of seasonal variations is that although they repeat annually with certain regularity, they may evolve. Many causes can produce an evolving seasonality, for example, changes in technology alter the importance of climatic factors; customs and habits are affected by different distributions of income and thus, can modify the seasonal demand pattern for certain goods. For most time series, moving seasonality is more the rule than the exception. Depending on the main causes of the seasonal variations, these can change slowly or rapidly, in a deterministic or a stochastic manner or a mixture of both.

5.186. *Calendar effects.* High frequency economic statistics data are often strongly affected by calendar composition issues. For example, there may be close connections between industrial production and the hours worked or between retail sales and the number of trading days. Variations associated with the composition of the calendar play an important role in the analysis of economic statistics in general and industrial production statistics in particular. They should be identified and removed from the original series in order to ensure comparability of these statistics across time (months or quarters).

5.187. The most common calendar effects are the moving holidays effects, the working/trading day effects, which represent the within-month variations, the length-of-month/quarter effect and the leap-year effect. These variations are usually treated as seasonal in character and should be removed together with the other seasonal variations when producing a seasonally adjusted series.

5.188. *Moving holidays.* Moving holidays are holidays that occur at the same time each year based on the different calendars other than Gregorian calendar, which is widely used as a world standard for statistical time series. Therefore, their exact timing shifts systematically each Gregorian calendar year. The influence of these moving holidays can include the loss of working days and changes in economic and social behavior. Such effects are usually country specific, making it difficult to build them into standard routines about the holiday. Examples of moving holidays include Easter, Chinese New year, Korean Thanksgiving day and Ramadan.

5.189. Easter generally falls in April but can also fall in late March and can affect a wide range of economic time series including those on the industrial production. The Easter effect is the variation due to the displacement from April to March of the volume of activity when Easter falls in March instead of the usual April occurrence. *Chinese New Year* affects in a similar way industrial production activities and has a predictable magnitude and direction. It is important to note that statistical packages have built-in options and default calendars for the detection and treatment of moving holiday's effects.

5.190. *Working/trading day.* Working/trading day effect is due to the number of times each day of the week occurs in a given month/quarter and the length of the month/quarter. The number of trading days may differ not only from period to period, but it may also vary between the same time periods in different years. The concept of working/trading day is dependent on specific national characteristics, in particular where calendars and holidays differ from one country to another. It depends also on the indicator series under consideration. For example, a month with five weekends is a priori a poor month in terms of working days for the IIP, while it is a good month in terms of trading days for retail trade indicators, given that Saturday is an important day for retail sales.

5.191. Working/trading day effect is present when the level of activity varies with the days of the week, implying the existence of an underlying daily pattern of activity defined over the week. This daily pattern states the relative importance of each day of the week. For example, five Sundays in a month impacts industrial production series because Sunday is not a business day and thus, marks a low point in the economic activity. Working/trading day effect needs to be accounted for because it may lead to apparent changes in level of activity when the underlying level is in fact unchanged**.**

5.192. The adjustment for working/trading day can be carried out using two main approaches - the proportional method approach and the regression based approach. Under the first approach, the effect of trading days is estimated by using their proportion in the month/quarter while under the second approach it is estimated in a regression framework. In general, the regression based approach should be preferred by countries as a method of trading day adjustment. In fact, built-in options provided by statistical packages are mostly based on the regression approach. However**,** it is recommended that countries use country-specific calendars as they ensure more accurate results.

5.193. *Length of month/quarter effect.* The different months of the year have different lengths - 28, 29, 30 or 31 days. Hence, if June and July have the same levels of activity on the respective days of the week, the total level of activity for July may still be greater than that for June purely because July has an extra day. This effect is called the *length of month effect.* If a series does not have a working/trading day correction, then the length of month effect will be accounted for automatically in the seasonal factors. If the series have a trading day correction, the length of month can still be accounted for in the seasonal factors or alternatively in the trading day factors. Length of month correction can also be done using prior factors. In this case, the monthly weights obtained in the trading day regression routine are divided by the average number of days in a month (i.e. 30.4735). Alternatively, to allow for the length of month in the trading day correction, the monthly weights are divided by the number of days in the respective month.

5.194. *Outliers*. Outliers are abnormal values in the time series, usually caused by one-off economic or social events. Their detection and correction prior to implementation of the adjustment process is an important precondition for the quality of seasonal adjustment. It is essential to distinguish between different types of outliers because their treatment differs. Outliers are divided into two groups (i) errors in the data; and (ii) the "true" special events. The first step of any outlier analysis should be the detection and correction of plain data errors and after that, the detection and correction of "true" outliers. The most important "true" outliers include impulse outliers (abnormal values in isolated points of the series), transitory changes (series of outliers with transitory effects on the level of the series), and level shifts (series of innovation outliers with a constant and permanent effect on the level of the series).

5.195. *Seasonal adjustment*. Seasonal adjustment is the process of estimating and removing, by means of statistical techniques, the overall seasonal component from the time series under review. It removes altogether the systematic variations related to the seasonal effects narrowly defined, and the variations that are calendar related. Thus, the impact of the regular within-a-year seasonal pattern, the influences of moving holidays such as Easter and Ramadan, and the effects of working/trading days and the weekday composition in each period (month or quarter) are removed to highlight the underlying features (trend and short-run movements) of the series and hence provide a better understanding of the series.

5.6.3.2 Main principles of seasonal adjustment

5.196. As a general rule, the seasonal adjustment process should be performed at the end of a survey cycle when the survey has been designed and conducted; data has been collected, processed and edited; and estimates are produced. The seasonal adjustment process starts once the original estimates are available and the original time series of data are formed. Seasonally adjusted series are derived by removing the seasonal effects and the systematic calendar effects, from the original series. A trend (or trend-cycle) is then derived by removing irregular influences from the seasonally adjusted series.

5.197. *Basic principles of seasonal adjustment.* In order to remove the seasonal component from a time series it should first be decomposed into its constituting components - the trend, the cycle, the seasonal component and the irregular component. The seasonal variations can be distinguished from the trend by their oscillatory character, from the business cycle by having annual periodicity and from irregulars by being systematic. These components can be combined in a number of ways. The most commonly used types of decomposition models are the following: the additive decomposition model, the multiplicative decomposition model and the pseudo-additive decomposition model.

5.198. *Additive decomposition model.* The additive model assumes that the components of the time series behave independently of the other. In particular, the size of the seasonal oscillations is independent of the level of the series. For example, an increase in the trend-cycle will not cause an increase in the seasonal component. This model is used if the irregular and the seasonal effects are independent of the trend behavior, i.e. if the seasonal effects are the same from year to year.

$$X_t = TC_t + S_t + I_t$$

5.199. *Multiplicative decomposition model.* The multiplicative model is generally taken as the default model in most seasonal adjustment software packages. This model assumes that the components of the series are interdependent and thus the seasonal variation's size increases and decreases with the level of series, a characteristic of most seasonal economic time series. For example, an increase in the trend will cause an increase in the magnitude of the seasonal component.

$$X_t = TC_t \cdot S_t \cdot I_t$$

5.200. The multiplicative model can also be written in the following form by taking logarithms (log-additive). For time series with trends in both the mean and the variance (presence of heteroskedasticity) the log-additive decomposition seems to be the most appropriate one; whereas when only trend in the mean is present, the multiplicative decomposition is generally used. Clearly, the multiplicative or log additive models cannot be used when the original series contain zero values. In this case a pseudo-additive decomposition model (see next paragraph) can be used.

$$\log(X_t) = \log(TC_t) + \log(S_t) + \log(I_t) .$$

5.201. *Pseudo-additive model.* The pseudo-additive decomposition model combines elements of both the additive and the multiplicative models. It assumes that the seasonal pattern and the irregular component are both dependent of the level of the trend cycle but independent of each other. Removing the multiplicative link between the seasonal and the irregular components is particularly useful if the series contains one or more zero values. This is because the additive relationship between the seasonal and irregular components allows either one of them to absorb the zero values without disturbing the trend-cycle behavior of the series. In this way the method can accommodate one-off zero values, as well as regular zero values occurring as the result of a consistent seasonal pattern.

$$X_t = TC_t \cdot (S_t + I_t - 1)$$

5.202. *Quality of seasonal adjustment*. The most fundamental requirement of seasonal adjustment quality is that there is no estimable seasonal effect still present in the seasonally adjusted series. The presence of estimable seasonal effects in either the seasonally adjusted series or the de-trended seasonally adjusted series (i.e. the irregular component) is generally what is referred to as *residual seasonality*. To detect whether the seasonally adjusted time series contains residual seasonality or trading day effects, a special "spectral diagnostic" should be carried out for monthly data or for sufficiently long quarterly series. Depending upon the package used for seasonal adjustment, there are other diagnostics that can be used to assess the presence of residual seasonality.

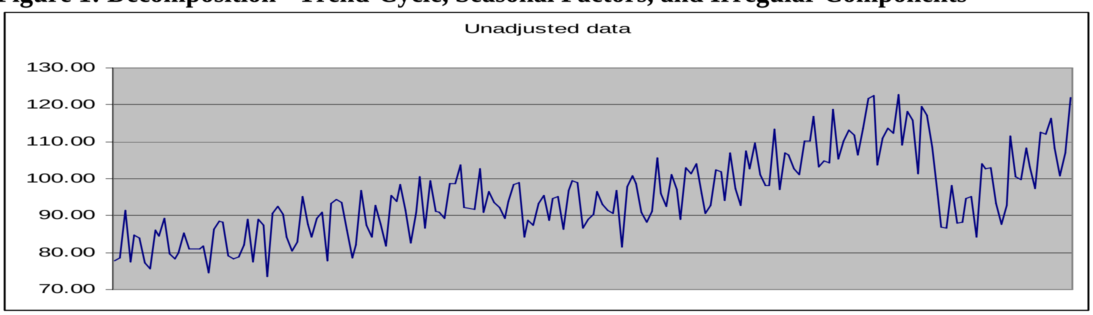
5.203. Other important requirements of a good seasonal adjustment are lack of bias in the level of the series and the stability of the estimates. A lack of bias in the level means that the level of the series will be similar for both the original series and the seasonally adjusted series. Stability of the estimates means that as new data become available and are incorporated into the estimation procedure, the revisions to the past estimates are small. Large revisions can indicate that the estimates are misleading or even meaningless.

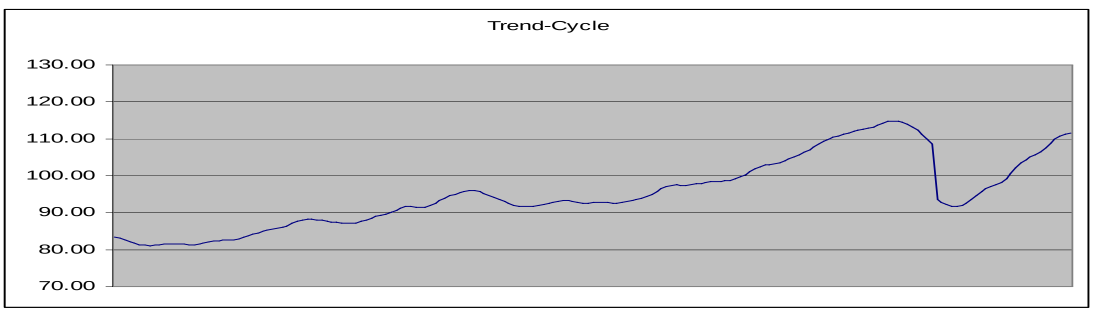
5.204. Box 10 shows an example of the decomposition of an IIP data series into its three components and the resulting adjusted IIP time series.

Box 10: Example of seasonal adjustment

Data series: Germany, IIP total industry, Jan 1995 – Mar 2011, base year = 2005
Software: X-12-ARIMA
Model: Multiplicative model

Figure 1: Decomposition - Trend-Cycle, Seasonal Factors, and Irregular Components





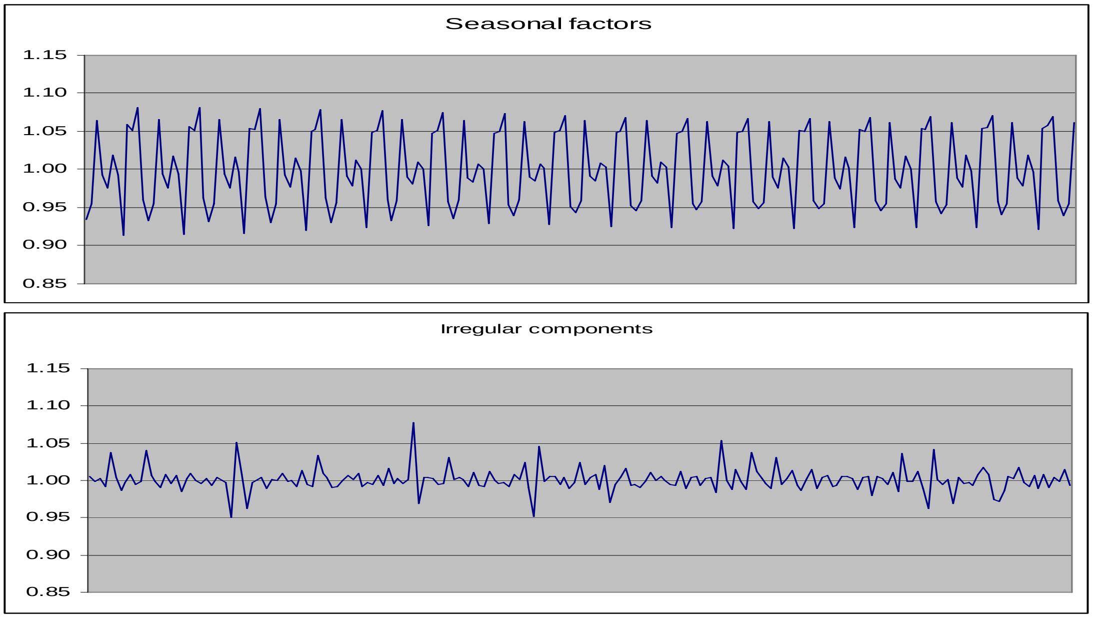
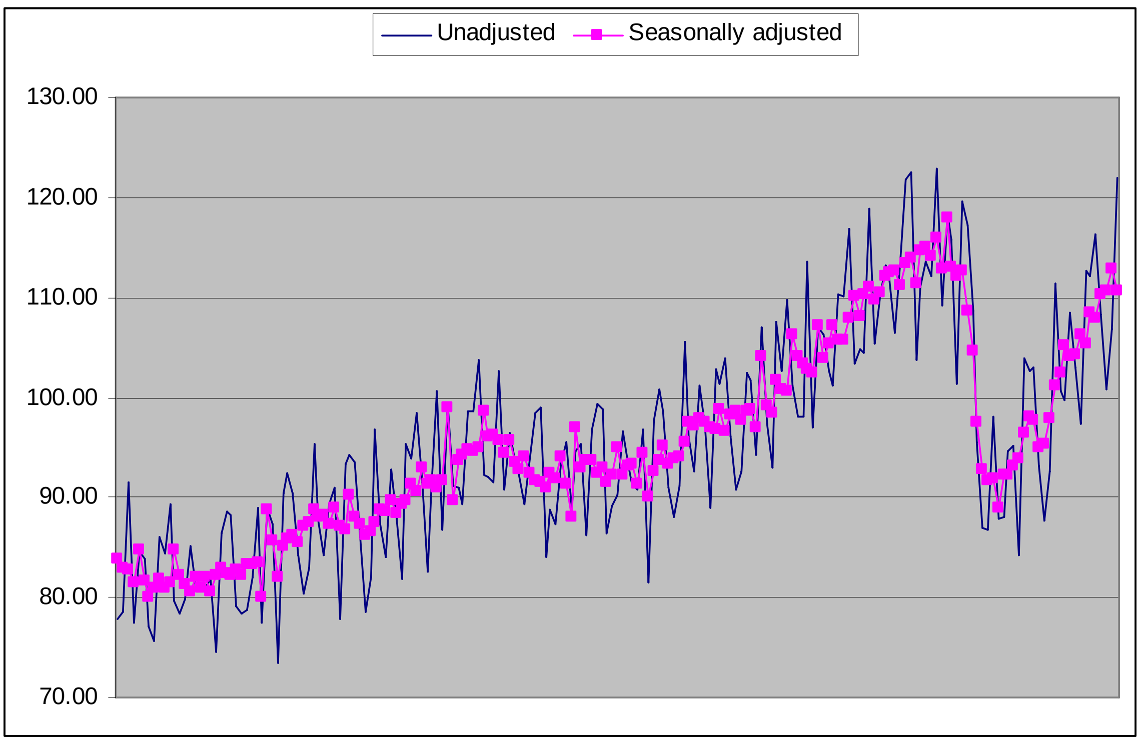


Figure 2: Unadjusted and seasonally adjusted series



Source: United Nations Statistics Division, IIP database

5.6.3.3 Seasonal adjustment software packages

5.205. The most commonly used seasonal adjustment packages can be grouped into two main categories: the first category of methods is based on moving average techniques, while the second category is based on explicit models with a small number of parameters for each component.

5.206. *Seasonal adjustment packages based on moving average methods*. The majority of seasonal adjustments methods used by statistical offices belong to the class of moving averages. The methods in this category are mainly descriptive and non-parametric procedures in the sense that they lack explicit parametric models for each unobserved component. Major computational differences between the various approaches of this class are related to different procedures for pre-adjustment and different techniques used at the ends of time series. Some methods use asymmetric filters at the ends while others extend the series using ARIMA models and apply symmetric filters to the extended series. The general procedure in this class of models follows an iterative estimation procedure, the core of which is based on a series of moving averages. Census X-11, X-11-ARIMA and X-12-ARIMA are the main seasonal adjustment software packages based on moving average methods.

5.207. *Seasonal adjustment packages based on model methods*. The model-based approach requires the components of the original time series, such as the trend, seasonal and irregular to be modeled separately. This approach, assumes the irregular component is “white noise”. Major computational differences between various methods in the model based approach are usually due to model specification. In some cases, the components are modeled directly. In other cases, the original series is modeled and the component models are derived from that model. Model based seasonal adjustment programs include, among others, TRAMO-SEATS, STAMP, and BV4.

5.6.3.4 Issues in seasonal adjustment

5.208. *Level of adjustment*. The industry level of the estimates at which to apply seasonal adjustment will depend on the level at which IIP compilers are able to produce reliable seasonal adjustment estimates. The lowest level of aggregation is likely to be at the 3-digit or 4-digit ISIC level but will vary by country. It is generally recommended to perform seasonal and working day adjustments at the lowest level, provided that the data have sufficient accuracy to enable reliable adjustments to be performed. If this is not possible due to resource constraints and/or lack of accuracy in the data, countries may determine the most suitable level according to their assessment of the best balance between practicality and homogeneity of the data.

5.209. *Minimum length of time series*. Five years of data and relatively stable seasonality are required in general as minimum length to obtain properly seasonally adjusted estimates. For series that show particularly strong and stable seasonal movements, it may be possible to obtain seasonally adjusted estimates based on only three years of data. A longer time series, however, is required to identify more precisely the seasonal pattern and to adjust the series for calendar variations (i.e. working/trading days and moving holidays), breaks in the series, outliers, and particular events that may have affected the series and may cause difficulties in properly identifying the seasonal pattern of the series. In particular, the detection and isolation of working/trading day effect is difficult as around seven years of data are needed to have enough examples of the different types of months (there are seven types of 31-day months, seven types of 30-day months, seven types of 29-day months, and one type of 28-day month). Working/trading day is usually not analyzed in series with less than five years of data. Moreover, if a time series has gone through severe structural changes resulting in radical changes in the seasonal patterns, it may not be possible to seasonally adjust the data until several years after the break in the series. In such cases, it may be necessary to seasonally adjust the pre-break and post-break part of the series separately.

5.210. *Consistency between raw and seasonally adjusted data.* Seasonally adjusting a monthly or quarterly time series can cause discrepancies between the yearly sums of the raw series and the corresponding yearly sums of the seasonally adjusted series, especially for series with significant calendar-related effects or moving seasonality. Forcing the sum (or average) of seasonally adjusted data over each year to equal the sum (or average) of the raw data brings consistency over the year between the adjusted and non adjusted data, although there is no justification from a theoretical point of view for such practice. This can be of particular interest in cases where low-frequency benchmarking figures officially exist and users' needs for time consistency are stronger, especially in National Accounts.

5.211. Most seasonal adjustment software packages provide for the consistency option between the seasonally adjusted and the raw data. In X-12-ARIMA for example this task is handled by the "force = totals" option which uses a Denton-type benchmarking method (see section 5.6.4) to modify the seasonally adjusted series and force the yearly totals of the seasonally adjusted and the raw series to be equal. The procedure is done in such a way that the monthly (or quarterly) changes in the seasonally adjusted series are roughly preserved. It should be noted however, that forcing equality over the year, between the seasonally adjusted data and the raw data (e.g. sum or average) can have several disadvantages, including:

- The presence of bias in the seasonally adjusted data, especially in cases where calendar and other non-linear effects are significantly relevant;
- The non-optimality of the final seasonally adjusted series;
- The need of additional post-processing calculations.

5.212. *Direct and indirect seasonal adjustments*. A seasonally adjusted value of an aggregate series can be derived either as seasonally adjusting the series itself (direct adjustment), or as summing (or combining) the seasonally adjusted values of its component series (indirect adjustment). Under most circumstances, the direct and indirect adjustments for an aggregate series are not identical. There are some very limited situations in which the two types of adjustment coincide, particularly if the adjustments are additive.

5.213. Whether direct or indirect adjustment is more appropriate for a given set of series will to a great extent depend on the set of series in question. Because neither theoretical nor empirical evidence uniformly favors one approach over the other, countries are advised to deal with this issue on a case by case manner, after a thorough analysis based on the characteristics of the series in question, the aggregation constraints imposed by the context (national accounts, geographical breakdown, etc.), and the user demand for consistent and coherent outputs, especially where they are additively related. The following is a practical guidance on how to deal with direct/indirect seasonal adjustment in some particular cases:

(a) Indirect seasonal adjustment should be preferred when the component series that make up the aggregate series have quite distinctively different seasonal patterns and have adjustments of good quality. The indirect seasonal adjustment in this case is of better quality than the direct adjustment.

(b) Direct seasonal adjustment should be preferred when the component series have similar seasonal patterns and summing the series may result in noise cancellation.

5.214. *Outliers in seasonal adjustment.* Outliers need to be detected and corrected in order to improve the estimations of the components of the time series (trend, cycle, seasonal and irregular). In particular, the correction of outliers aims at preventing the trend path from distortion. The trend path is intended to measure the long-term growth of time series and it is not desirable for it to respond to a one-off irregular movement. It should be noted that all seasonal adjustment packages have built-in options for the detection and the treatment of outliers, at least for the historical part of the series. For the most recent values, however, a sophisticated automatic correction is not possible. In this case subject-matter knowledge must be used along with a thorough descriptive analysis of the time series under review.

5.215. *Revisions.* Revision of seasonally adjusted data takes place for two main reasons. First, seasonally adjusted data may be revised due to a revision of the unadjusted (raw) data. These revisions of unadjusted data may be the result of improved information sets (in terms of coverage and/or reliability). Second, revisions of seasonally adjusted data can also take place because of a better estimate of the seasonal pattern due to new information provided by new unadjusted data and also to the characteristics of the filters and procedures used to estimate and remove seasonal and calendar components.

5.216. Generally, when data revisions are solely based on new information, they are relevant and relatively easy to handle. However, in seasonal adjustment it may be the case that just one more observation results in revisions of the seasonally adjusted data for several years, which sometimes confuses users. The challenge is to find a balance between the need for the best possible seasonally adjusted data, especially at the end of the series, and the need to avoid unimportant revisions that may later be reversed, that is to find a trade-off between the precision of seasonally adjusted data and their stability over time.

5.217. In the development of a revision policy, consideration needs to be given to the needs of users and resources available to implement the policy. A sound revision policy should address at least the following issues: (i) the frequency and relative size of revisions due to seasonal adjustment; (ii) the precision of the seasonally adjusted data, (iii) the time period over which the raw data have been revised; and (iv) the relationship between the timing of the publication of revisions to the seasonally adjusted data and the publication of the revisions to the raw data. It is important that the revision policy is as coherent and transparent as possible and that it not lead to the publication of sub-optimal seasonally adjusted data, which could mislead users in interpreting the underlying economic picture.

5.218. *Concurrent versus extrapolated seasonal factors*. For the current year, seasonally adjusted data can be computed either by running every month/quarter the seasonal adjustment procedure (concurrent approach) or by using extrapolated coefficients computed once a year. In the first case, data are revised every month/quarter. In the second case, data are not revised within the year but only once a year. In terms of accuracy of seasonally adjusted series the concurrent approach is the recommended one. It allows producing up-to-date seasonally adjusted data by recalculating the values every time new data become available. The use of extrapolated seasonal factors, although preferred by some users, can lead to biased results especially when unexpected events occur during the year. It is recommended that countries schedule the revisions of seasonally adjusted series in a regular manner, preferably in accordance with the established common revision policy.

5.219. *Validation of the seasonal adjustment results.* Seasonal adjustment is a complex statistical data treatment which needs accurate monitoring before the results are accepted. In order to ensure that seasonally adjusted data are of good quality they have to be validated using a wide range of quality measures. Among others, the absence of residual seasonal and/or calendar effects, as well as the stability of the seasonally adjusted pattern has to be carefully assessed. The validation of seasonally adjusted data can be performed by means of several graphical, descriptive, non-parametric and parametric criteria included in the output of the seasonal adjustment program. If possible this could be complemented with graphical diagnostics and additional statistical tests obtained from external statistical packages. Both TRAMO-SEATS and X-12-ARIMA provide a wide range of quality measures, together with graphical and spectral analysis. The measures reflect, to an extent, the different underlying philosophies on which the two approaches are based; nevertheless they include a number of common measures.

5.220. The full model-based structure of TRAMO-SEATS implies that diagnostics on the appropriateness of the model are particularly important. Furthermore, the model-based structure can also be exploited to provide additional insights into the quality of the decomposition achieved (for example, size of the innovation in the seasonal component, seasonally adjusted series estimation error, standard error of the revision and of the growth rates, significance of seasonality, etc.), which extend in a natural way to forecasts of the components. The output of TRAMO-SEATS also provides summary tables which contain diagnostics and quality measures. These tables can be read and abnormal values or errors can be picked up. In this way, identification of problematic series can be fully automatic.

5.221. X-12-ARIMA supplies a large set of quality measures reflecting the particular structure of the method with an essentially parametric pre-treatment part and a fully non-parametric seasonal adjustment part. These quality diagnostics have to be used to assess the result of each step of the seasonal adjustment process. Diagnostic checking of the regARIMA model, performed through various analyses of the residuals from model estimation, and diagnostic checking of the seasonal adjustment are included in the output.

5.6.4 Comparing sub-annual index numbers to other data

5.222. National statistical organizations conduct a number of surveys aimed at producing volume estimates of value added. These include the IIP as well as the quarterly and annual national accounts. It therefore seems sensible that the data obtained from the various sources be examined to determine if they present a consistent message about the economy to users.

5.223. The process of comparing data that has generally been derived from different surveys or other sources, especially those of different frequencies, in order to assess their coherence and the reasons for any differences is referred to as data confrontation.

5.224. It is recommended that the sub-annual IIP be compared to other data sources essentially in an attempt to identify any significant quality issues with the IIP. These comparisons could then result in improvements to the production of the index in future periods, for example by improving or changing IIP data sources.

5.225. The comparison of the IIP to, for example, the annual surveys that measure value added is suggested as annual data are available and are collected to obtain a measurement of both output and intermediate consumption – the difference being value added. Volume measures are then obtained using the double deflation approach. This approach to measuring value added is rarely possible with the monthly IIP and therefore various variables to approximate value added are collected.

5.226. It is acknowledged that the methods used to measure value added at annual and sub-annual frequencies are likely to produce some discrepancy in the results due to conceptual and practical issues. However, further examination of the data results (both sub-annual and annual) are required where the discrepancies cannot be explained by these conceptual or practical issues.

5.227. Some countries take this data confrontation process a step further and implement *benchmarking* of the monthly IIP to the annual national accounts.

5.228. *Benchmarking* is a statistical technique belonging to the family of *temporal aggregation/disaggregation techniques*, which are aimed at combining two or more sources of measurement in order to obtain reliable high frequency estimates of the series under investigation. These techniques play a central role in improving key dimensions of data quality such as timeliness, accuracy and coherence. Such techniques have been used widely by statistical agencies for many years, although they were generally concentrated in the areas of national accounts and reconciliation of censuses with survey data. Nowadays, a broader application of benchmarking techniques in the production of short-term economic statistics (e.g. industrial production, wholesale and retail trade, etc.) has taken place in statistical agencies worldwide.

5.229. The main objective of benchmarking is to combine the relative strengths of low- and high-frequency data while preserving as much as possible the short-term movements in the high-frequency data under the constraints provided by the low-frequency data. The more frequently observed series (monthly or quarterly) are usually less reliable than the less frequently (quarterly or annual) observed ones. For this reason, the latter is generally considered as the benchmark. In national accounting for example, the quarterly accounts are interpolated from many sources to fit the concepts and definitions of the accounts. They are also benchmarked to yearly values provided by the Input-Output Accounts. Quarterly accounts must also satisfy cross-sectional additive constraints, which is a particular case of benchmarking known as reconciliation. The issue of benchmarking arises also with annual data, when a survey is only conducted every few years, and with monthly data, when they should be benchmarked to the quarterly estimates.

5.230. Broadly speaking, benchmarking consists of creating a new high frequency series (the benchmarked series) by adopting the movement of the observed frequent series (the indicator) at the level of the benchmarks. In this way, the annual sums of the benchmarked series are equal to the corresponding benchmarks. The low- and high-frequency data can be derived on the basis of conducted censuses, more accurate sample surveys, administrative data or even some combination of these sources.

5.231. As a general rule, the benchmarking should be performed at the end of a survey cycle when data has been collected, processed and edited and estimates are produced. In most cases, benchmarking is performed before the seasonal adjustment process, to "fine tune" the raw series that will be used as input to the seasonal adjustment process. However, in some cases, especially for geographical or accounting reasons, benchmarking is performed on the seasonally adjusted series within the overall seasonal adjustment process.[85] In this case, the seasonally adjusted sub-annual series is benchmarked to the yearly sums of the raw series, using formal benchmarking methods.

5.232. *Benchmarking methods*. There are two main approaches to benchmarking of time series - a purely numerical approach and a statistical modeling approach. The numerical approach differs from the statistical modeling approach by not specifying a statistical time series model that the series is assumed to follow. The numerical approach encompasses the prorating method and the family of least squares minimization methods known as the Denton family. The statistical modeling approach encompasses ARIMA

[85] See para. 5.210f

model-based methods and a set of various regression models. The most commonly used numerical approach methods are briefly described below.

5.233. *The prorating method*. It is the simplest benchmarking method and consists of multiplying the sub-annual values by the corresponding *annual proportional discrepancies* which are obtained as a ratio of the annual benchmarks over the corresponding sum of original sub-annual (monthly or quarterly) values. For each year, the correction factor is constant. As a result, the prorating method preserves the proportional movement within each year, but produces potentially large and sometimes spurious discontinuities between the last month (or quarter) of a year and the first month (or quarter) of the next year. This drawback is generally known as *the step problem.* The main advantage of the prorating method lies in its simplicity. In fact, it can be easily programmed in spreadsheet applications. However, because of the step problem, the prorating method is not recommended.

5.234. *The Denton family of benchmarking methods*. The Denton family of least squares benchmarking methods is based on *the principle of movement preservation* and the differences between the methods depend on how this principle is made operational. The principle of movement preservation can be expressed as requiring that i) the month-to-month (or quarter-to-quarter) growths in the indicator series and the benchmarked series should be as similar as possible and ii) the adjustment to neighboring months/quarters should be as similar as possible. The month-to-month (or quarter-to-quarter) growths in the two series can be specified as absolute growth or as a rate of growth. The goal is to minimize the absolute or the relative difference between the month-to-month (or quarter-to-quarter) growths of the two series.

5.235. While still imposing the benchmarks onto the sub-annual original series, the Denton family solves the problem of large inter-annual discontinuities observed in the prorating method. Among the Denton family of benchmarking methods, the *proportional Denton method*[86] is usually the most preferred one. The key feature of this particular technique is that through the implementation of the least squares method it minimizes the month-to-month (or quarter-to-quarter) movements in the ratio between the benchmarked series and the indicator (also called BI ratio). It is relatively easy to implement and provides a simple framework for extrapolation which fully takes into account the existence of any systematic bias or lack thereof in the year-to-year rate of change in the original sub-annual series. The practical implementation of the proportional Denton technique, however, requires application of special software.

5.236. *Benchmarking software packages*. Significant developments have occurred in the field of benchmarking in both theory and practical applications, including the development of software packages. However, most of the existing software packages on benchmarking have been developed by countries as 'in-house' programs, mostly based on the Denton family of benchmarking methods.[87]

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[86] See IMF Quarterly National Accounts Manual (2001), chapter VI, for a more detailed description.
[87] Statistics Canada has recently developed a benchmarking program in which three Generalized Least Square (GLS) models have been implemented. Eurostat has also developed recently a Windows-based

5.237. *Benchmarking and revisions.* To avoid introducing distortions in the series, the incorporation of new annual data for one year will generally require revisions of previously published data for several years in order to maximally preserve the short-term movements of the infra-annual series. This is a basic feature of all acceptable benchmarking methods. In practice however, with most benchmarking methods, the impact of new annual data will gradually diminish for sufficiently distant periods. As a practical recommendation, countries may allow at least two to three preceding (or following) years to be revised each time new annual data become available.

5.238. *Benchmarking and quality*. A broader application of benchmarking techniques has a key role to play in improving the quality of the data. In fact, the fundamental characteristics of benchmarking closely relate to the dimensions of quality such as accuracy, timeliness and coherence. When available resources are scarce and the capacity of statistical offices to expand data collection is limited, these techniques often succeed in filling the gaps of missing data and solving potential shortcomings. They can also play an important role in optimizing the use of the data when many sources of data are available and thus need to be reconciled.

5.239. The pros of benchmarking (e.g. ensuring consistency between two data series) and the cons (e.g. frequent revisions to the sub-annual series) need to be considered by countries according to their own circumstances to determine if they should implement benchmarking for their IIP series.

5.6.5 A guide to transition from a fixed weight index to a chain index

5.240. The purpose of this section is to provide guidance on the implementation of the recommended approach – an annually chained IIP of the Laspeyres type.[88] Particular emphasis is placed on procedures to transition from a fixed weight index, which is currently used by many countries.

5.241. A *fixed weight index* has its weight structure fixed at a particular point in time. These weights represent the relative worth of different products at that point in time and are used to compute indices over an extended period. The weights are traditionally updated every 5 years and at this time the entire time series is recalculated based on the new set of weights. For countries that currently compile a fixed weight index, the significant changes that are needed to produce an IIP in line with the new recommendations of this publication are (i) weights need to be updated annually; and (ii) the indices need to be chained. This means increasing the frequency at which this re-weight process occurs and then chaining the indices together rather than recalculating the entire historical series whenever the weights are updated. Of note is that for countries that currently compile a "5-yearly chained index", the significant change is that weights need

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benchmarking software (called ECOTRIM) which supports a range of benchmarking methodologies including the Denton approach, with a user-friendly interface. ECOTRIM is currently freely available through written request to Eurostat.

[88] Relevant material can also be found in Appendix 5(c) of this publication.

to be updated more frequently, i.e. annually. Section 5.6.1 is an important reference in this context.

5.242. The transition to a Laspeyres-type IIP with annual chaining from a fixed weight index can be broken into a number of stages in a project management context. These suggested stages are discussed below.

Stage 1: Set scope and plan the programme of work involved

5.243. In this stage it is important to develop a sound project management framework that ensures that the project is carried out in a way that is efficient, meets the desired objectives, assigns responsibilities and reporting arrangements, identifies risks and lists the set of tasks to be undertaken. There are various project management frameworks available that can assist statistical agencies to undertake this work. Also, it is suggested that planning for the change in methodology begin one to two years prior to the desired change and occur in conjunction with the next re-weight.

Stage 2: Develop detailed methodologies

5.244. This stage of the transition process is aimed at developing detailed methodologies required to calculate the annually chained Laspeyres IIP. The topics should center on methodologies to rebase and link the indices every year, including the source of annual weighting data as well as to produce seasonally adjusted estimates.

Stage 3: Specify and develop necessary computer systems

5.245. The computer systems used to produce the monthly IIP would need to be changed to reflect the new methodology. This will require the specification of necessary methodological changes by the subject matter staff and implementation by computer programmers. An essential part of this process is the testing of the system changes in a test environment to ensure the production of estimates are in line with the specified methodology.

Stage 4: Publish experimental estimates and consult key users

5.246. It is important that key users of the IIP understand the changes that are being made when moving to a new methodology for the index. Communication of these changes to key users should include:

- Release of a special information paper including the presentation of the new methodology to users, reasons for the changes, as well as results of research;
- Conduct of seminars and workshops for key users, as these provide an opportunity for users to gain an understanding of the new methodology, ask questions and provide feedback; and

- Release of experimental estimates to provide an opportunity for users to become accustomed to the changes before the changes are implemented into the official release of the IIP.

Stage 5: Officially release the annually chained Laspeyres IIP

5.247. A date for official release of the IIP as per the new methodology should be set following (i) extensive consultation with users detailing the new methodology, (ii) verification that the computer systems are producing estimates as per the required methodology, and (iii) a sufficiently long period of producing experimental estimates.

Appendix to Chapter 5

Appendix 5(a): Basic elements of index number theory

5.248. The word "index" comes from Latin and means a pointer, sign, indicator, list or register. The concept of index numbers is widely used nowadays to reach various fields and disciplines of scientific measurement, including economics, anthropology, physics, mathematics, astronomy, etc. An index number is essentially a practical construct, and the problem of how to compute it is as much one of economic theory as of statistical technique.

5.249. In economics**,** an index number is generally a ratio that measures changes in key economic variables with the ultimate aim of monitoring the short- and long-term movements in the economy over time by quantifying growths or declines, e.g. in identifying the different phases of the business cycle. A number of index types can be distinguished for that purpose; For example, a volume index, usually presented as a weighted average, measures the proportionate change in the quantities of goods and/or services consumed or produced between two periods of time; similarly, a price index measures the change of prices of many commodities between two periods of time.

5.250. The classical definition of index numbers goes back to Edgeworth in the 1880's.[89] He later gave a concise definition:

> I propose to define an index number as a number adapted by its variations to indicate the increase or decrease of a magnitude not susceptible of accurate measurement.

5.251. Another definition using a more developed form of the same concept was given by Bowley (1926)[90]:

> Index-numbers are used to measure the change in some quantity which we cannot observe directly, which we know to have a definite influence on many other quantities which we can so observe, tending to increase all, or diminish all, while this influence is concealed by the action of many causes affecting the separate quantities in various ways.

5.252. In its simplest form, an index number is typically expressed as per cent of a base value, which is given the value 100 for the variable at hand. This is usually called the *reference base* of the series of index numbers. The next time the value of the variable is measured, the observation is compared to this base period figure. The calculation is based on this formula: *([new observation]/[old observation])*100*. For example, if the price of a 1 kilogramme-packet of sugar at base period (or period 0) is 1.60 dollars and its price goes up to 1.85 dollars when it is measured at period 1, the index for this packet of sugar will be calculated as follows: (1.85/1.60)*100 = 115.6. The price index value 115.6 indicates the magnitude of the percentage change since the base period: the price of the packet of sugar has gone up by 15.6 per cent.

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[89] See *Index Numbers in Economic Theory and Practice* by R.G. D. Allen (1975)

[90] Bowley, A. L., *Elements of Statistics*, 5th ed. (London, 1926)

5.253. While some applications of index numbers are not strictly economic but occur in more or less distantly related domains ranging from demography to medicine or technology, it remains true however, that the main uses of index numbers are in economics and hence that the theory is best developed in an economic context. Through the remainder of this chapter, the index number theory will be presented in an economic context, thus referring to quantity and/or price indices.

Index number theory in economic context

5.254. Economic theory is in part concerned with modeling the demand and supply for *individual* goods and services (products)[91] by *individual* economic agents (producers or consumers).[92] However, due to the truly enormous numbers of both products and agents in real life economies, empirical economics uses data that are always aggregated over products and often aggregated over agents. The main question here is how to accomplish this aggregation.

5.255. In the same vein, the basic index number problem in the context of microeconomic theory can be framed into the problem of aggregating the information involving possibly millions of prices and quantities into a smaller number of price and quantity variables. More specifically, the problem asks how to aggregate or summarize individual microeconomic data on prices into a single aggregate price level, and individual data on quantities into a single aggregate quantity level so that the product of the price level times the quantity level equals the sum of the individual prices times the quantities for the commodities to be aggregated.

5.256. The aggregation problem also encompasses two other aggregation problems: (i) the aggregation over time and (ii) the aggregation over space, as the definition of a product is flexible enough to encompass not only the “physical” characteristics of a good or service, but also its time and spatial characteristics, i.e., the same good sold at a different place or time could be regarded as a distinct commodity. Also, different terms of sale can serve to consider the same physical good as different products.

5.257. For practical measurement purposes, the “fundamental” unit of time or space cannot be too small, since the smaller the unit of time or space within which production or consumption takes place, the less actual production or consumption there will be to observe, and comparisons between these tiny units will become meaningless. Thus for normal economic data, the time period under consideration is usually: (i) a shift (a part of a working day), (ii) a day, (iii) a week, (iv) a month, (v) a quarter, or (vi) a year. A normal “spatial” unit is usually: (i) an enterprise or a household at a specific address or (ii) an aggregate of enterprises or households over a region. The region could be a county or

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[91] The term “products” actually encompasses more than goods and services, although this will have little impact on the calculation of the IIP within the scope of industrial statistics. See the introduction to the CPC Ver.2 for a discussion of this.

[92] See *“Essays in Index Number Theory”*, Volume I, W.E. Diewert and A.O. Nakamura (Editors) 1993 (Elsevier Science Publishers).

municipality, a metropolitan region, a state or province, a country, or a group of countries. For the remainder of this text the aggregation problem refers to the aggregation over goods and services through time.

5.258. Mathematically, the aggregation problem can be formulated as follows: given a series of microeconomic price and quantity data $(p_{i,t}, q_{i,t})$ of *n* products (*i=1, 2,…, n*) for *T* periods (*t=1, 2, …, T*), find *T* aggregate prices $P^1, P^2, ..., P^T$ and *T* aggregate quantities $Q^1, Q^2, ..., Q^T$ such that the aggregate value in period *t*, $P^t Q^t$, equals the total microeconomic value (over all products) for each time period *t*, that is: $\sum_{i=1}^{n} p_{i,t} q_{i,t} = P^t Q^t$ for *t=1, 2,..., T.*

5.259. The aggregate period *t* price P^t is supposed to represent all of the period t microeconomic prices $p_{1,t}, p_{2,t}, ..., p_{n,t}$ in some sense, and similarly, the aggregate period *t* quantity Q^t is supposed to represent all of the period t microeconomic quantities $q_{1,t}, q_{2,t}, ..., q_{n,t}$ in some sense. Thus, the index number problem can be summarized into how exactly these aggregates P^t and Q^t can be constructed? As can be seen from this problem formulation, index numbers come in pairs in economic theory, one price and the other a matching one of quantity. Sometimes one or the other is used alone; but there is almost always a mate to it in the background.

5.260. The earliest approach to index number theory was the *fixed basket approach* pioneered by Joseph Lowe (1823)[93] in the context of the calculation of bilateral price indices. In this approach, an approximate representative product basket is specified that is a representative of purchases made during the two periods under consideration (periods 0 and *t*), and then the level of prices in period *t* relative to period 0 is calculated as the ratio of the period *t* cost of the basket to the period 0 cost of the basket. In principle, any set of goods and services could serve as the reference 'basket' and it does *not* have to be restricted to the basket actually produced in one or other of the two periods compared. There are two natural choices for the reference basket: i) the period 0 product vector $q^0 = (q_{1,0}, q_{2,0}, ..., q_{n,0})$ which leads to the well-known Laspeyres price index; and ii) the period *t* product vector $q^t = (q_{1,t}, q_{2,t}, ..., q_{n,t})$ which leads to the Paasche price index.[94] The corresponding quantity indices are easily obtained by interchanging the role of prices and quantities.

5.261. For practical reasons, the basket of prices/quantities has usually to be based on surveys conducted in an earlier period than either of the two periods whose prices/quantities are compared (that is a period *b* with $b \leq 0 \leq t$). Because it takes a long time to collect and process survey data (i.e. revenue data), there is usually a considerable

[93] Lowe, Joseph, 1823. *The Present State of England in Regard to Agriculture, Trade and Finance*, 2nd ed. (London: Longman, Hurst, Rees, Orme and Brown).
[94] An explicit formulation of the Laspeyres, Paasche and Fisher volume indices is presented in section 5.1.1.

time lag before such data can be introduced into the calculation of the index. This is always the case when the index is first published. For example, a monthly IIP may run from January 2000 onward, with January 2000 = 100 as its quantity reference period, but the prices may be derived from an annual survey made in 1997 or 1998, or even spanning both years. The basket may also refer to a year, whereas the index may be compiled monthly or quarterly.

5.262. The positioning of period *b* is crucial. While period *b* may have to precede period 0 when the index is first published, there is no such restriction on the positioning of period *b* as price and quantity data become available for later periods with the passage of time. Period *b* can then be moved forward. If period *b* is positioned midway between period 0 and period *t*, the quantities are likely to be equirepresentative of both periods, assuming that there is a fairly smooth transition from the relative prices/quantities of period 0 to those of period *t*. In these circumstances, the Lowe index is likely to be close to other indices called "superlative" indices.[95]

5.263. The Lowe volume index is defined as the percentage change, between the periods compared, in the total value of quantities under the fixed price regime. The index can be written, and calculated, in two ways: either as the ratio of two value aggregates or as an arithmetic weighted average of the quantity ratios (or quantity relatives) for the individual products using 'hybrid' expenditure/revenue shares as weights. The weights are described as hybrid because the prices and quantities belong to two different time periods, *b* and 0 respectively. The Lowe index formula for period *t* can be expressed as follows:

Formula 8: Lowe index formula

$$L_t = \frac{\sum_i p_{i,b} q_{i,t}}{\sum_i p_{i,b} q_{i,0}} = \sum_i \left(w_{i,b} \frac{q_{i,t}}{q_{i,0}}\right) \quad ; \quad w_{i,b} = \frac{p_{i,b} q_{i,0}}{\sum_i p_{i,b} q_{i,0}}$$

where: $p_{i,b}$: price for product, product group or industry i at the weight base period *b*

$q_{i,0}$: quantity for product, product group or industry i at the base period 0

$q_{i,t}$: quantity for product, product group or industry i at period t

$w_{i,b}$: hybrid expenditure/revenue share for product, product group or industry i in the weight base period *b*

i: products, product groups or industries to be aggregated (i=1,2,…n)

5.264. As researchers attempted to be more precise about the 'fixed basket', the fixed basket approach led eventually to the so called Fisher and Walsh types of indices which

[95] See para. 5.282ff on the method of exact numbers.

treat both periods symmetrically by considering averages of Laspeyres and Paasche indices (the Fisher case), or averages of the quantities/prices pertaining to the two periods (the Walsh case).

5.265. Ultimately, the fixed basket approach evolved into one of the three main approaches to index number theory namely, the axiomatic approach, which is based on a set of pre-determined desirable properties for an index number. The other two main approach to index number theory are the stochastic approach which treats the observed price or quantity relatives as if they were a random sample drawn from a defined universe, and the economic approach which is based on the microeconomic theory of economic agent's behavior, namely consumers and producers.

The axiomatic approach

5.266. The origins of the axiomatic or test approach are rooted in the more or less casual observations of the early workers in the index number field on their favorite index number formulae or those of their competitors. In this approach various desirable properties for an index are proposed depending on the situation at hand and then it is determined whether any index formula is consistent with these properties or tests. Also, in this approach, the period *t* aggregate price and quantity levels, P^t and Q^t, are regarded as functions of both microeconomic price and quantity vectors, p^t and q^t, and these vectors are both allowed to vary independently.

5.267. An ideal situation would be to have an agreed set of 'standard tests' and to find an index that meets all the proposed criteria. In practice however, the problem is more complex as there is no universal agreement on what the best set of reasonable axioms would be for a given situation: different price statisticians may have different ideas about what tests are important, and alternative sets of axioms can lead to alternative best index number functional forms. Hence, the axiomatic approach, while extremely useful, can lead to more than one best index number formula.

5.268. A broad range of criteria or tests have been proposed in the literature to assess the overall quality of an index. Among these criteria, the following five axiomatic tests are widely used for the construction of bilateral price and quantity index numbers: the commensurability test, the constant quantities test, the constant basket test, the proportionality test and the time reversal test.

- The commensurability test or invariance to changes in the units of measurement, states that the index should not change if the units of measurement for each commodity or price has changed;
- The constant quantities test states that if quantities are identical in two periods, then the quantity index should be the same regardless of what prices are in both periods;
- The constant basket test states that if prices remain unchanged between two periods then the ratio of the quantity indexes between the two periods should be equal to the ratio of values between the two periods;

- The proportionality test requires that when all quantities increase or decrease by a fixed proportion between two periods, then the index should increase or decrease by the same fixed proportion.
- The time reversal test requires the index going from period 0 to period *t* to be the reciprocal (inverse) of the index going from period *t* to period 0, that is, if prices and quantities in period 0 and *t* are interchanged and the index number formula is evaluated, then the new index should be the reciprocal of the original index. In other words, the index number comparison between any two points of time should not depend on the choice of which period is regarded as the base period: if the other period is chosen as the base period, then the new index number should simply equal the reciprocal of the original index.

5.269. Another problem associated with the axiomatic approach stems from the fact that it is not sufficient to know which tests are failed. It is also necessary to know how badly an index fails. Failing badly one major test, such as the commensurability test, might be considered sufficient to rule out an index, whereas failing several minor tests marginally may not be very disadvantageous. It is worth mentioning that the Fisher index passes all five of the above tests, while the Laspeyres and Paasche indexes fail the time reversal test. In fact it has been shown that the Fisher index is the only one of its kind that satisfies more than twenty of such tests or criteria, hence its name "Fisher ideal index".

The stochastic approach

5.270. The stochastic approach to index number theory treats the observed price or quantity relatives as if they were a random sample drawn from a defined universe. Using econometric analysis tools (linear and log-linear regression analysis, etc.), the approach addresses issues such as the appropriate form of average to take and the most efficient way to estimate it from a sample of price relatives or quantity relatives, once the universe has been defined. However, the approach does not help decide on the choice of universe as there are many possible universes that can be defined, depending on which particular sets of industries, products, or transactions the user is interested in. The stochastic approach is particularly useful when the universe is reduced to a single type of product.

5.271. The stochastic approach to index number theory dates back to the work of Jevons (1863)[96] and Edgeworth (1888)[97] with the so-called unweighted approach. In the context of the determination of price indices, the basic idea behind the approach is that each price relative, $\frac{p_{i,t}}{p_{i,0}}$ for $i = 1,2,\dots,n$, can be regarded as an estimate of a common inflation rate between periods 0 and *t*; that is, $\frac{p_{i,t}}{p_{i,0}} = \alpha + \varepsilon_i; i = 1,2,...,n$ where α is the common

[96] Jevons, W.S., 1884, "A Serious Fall in the Value of Gold Ascertained and Its Social Effects Set Forth," reprinted in *Investigations in Currency and Finance* (London: Macmillan), pp. 13–118. Originally published in 1863.
[97] Edgeworth, F.Y., 1888, "Some New Methods of Measuring Variation in General Prices," *Journal of the Royal Statistical Society*, Vol. 51, pp. 346–368.

inflation rate and the ε's are random variables with mean 0 and standard deviation σ. The least squares (OLS) or maximum likelihood estimator (ML) for α yields the so-called Carli index. Using a log-linear model when the random component is multiplicative (instead of being additive as in the above model), leads to the so-called Jevons index as being the OLS and ML estimator of the inflation rate α.

5.272. The unweighted approach encountered severe criticism as both the Jevons and Carli price indices suffer from a serious flaw: each price relative is regarded as being equally important and is given an equal weight in the index. This led to the weighted stochastic approach to index number theory pioneered by the work of Walsh (1901)[98] and later developed by Theil (1967)[99] and other index number theorists. Walsh pointed out that a sensible stochastic approach to measuring price change means that individual price relatives should be weighted according to their economic importance or their transactions' value in the two periods under consideration.

5.273. The weighted stochastic approach assumes that the *n* price relatives $\frac{p_{i,t}}{p_{i,0}}$ or a transformation $f(\frac{p_{i,t}}{p_{i,0}})$ of these price relatives have a discrete statistical distribution where the corresponding probability of selecting the i^{th} price relative is a function of the revenue shares pertaining to product *i* in the two situations under consideration. Different indices can be obtained depending on the choice of the transformation function *f* and the probability functions. For example, when *f* is the natural logarithm and the probability function for product *i* is the simple unweighted arithmetic mean of the revenue shares, then the resulting index is the so-called Theil index.

5.274. Although the stochastic approach to index number theory in itself does not determine the form of the index number (there are several stochastic indices to choose from, just as there are many possible universes), it is worth mentioning that the approach can be very useful, especially in the estimation of elementary prices from which most aggregate price indices are constructed. These elementary prices usually have to be based on samples of prices and the stochastic approach may provide useful guidance on how best to estimate them.

The economic approach

5.275. The economic approach to index number theory relies on the assumption of optimizing behavior on the part of economic agents: utility-maximizing or expenditure-minimizing behavior on the part of consumers and profit-maximizing or cost-minimizing behavior on the part of producers. In this approach, the microeconomic price vectors p^t are regarded as *independent* variables, but the quantity vectors q^t are regarded as dependent variables, i.e., q^t is determined as a solution to some microeconomic optimization problem involving the observed price vector p^t.

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[98] Walsh, C.M., 1901, *The Measurement of General Exchange Value* (New York: Macmillan).
[99] Theil, H., 1967, *Economics and Information Theory* (Amsterdam: North-Holland).

5.276. Suppose that an economic agent facing price vectors p^t has consumer preferences (or a production function) over differing amounts of *n* goods that can be represented by a function *F* (called an aggregator function). Then the economic agent will generally find it useful to minimize the cost of achieving at least a given utility or output level $u^t = F(q^t)$. The associated cost function (or expenditure function) *C*(*u, p*) is thus defined as the solution to this minimization problem: $\min_x \{\sum_{i=1} p_{i,t} x_i : F(x) \geq u^t\}$ for *t=1, 2,..., T.*

5.277. Various forms of the solution to the index number problem can be derived depending on the characteristics of the aggregator function *F.* For example, when *F* is a an increasing linearly homogeneous function, then it can be shown that the above mentioned minimization problem satisfies the following equality: $\min_x \{\sum_{i=1} p_{i,t} x_i : F(x) \geq u^t\} = c(p^t)F(q^t)$ for *t=1, 2,..., T* ; where $c(p^t)$ is the minimum cost of achieving one unit of utility (or output). The solution to the index number problem is thus derived by taking $P^t \equiv c(p^t)$ and $Q^t \equiv F(q^t)$ for *t=1, 2,..., T.*

5.278. The main difficulties in the economic approach lie in the practical implementation of the rather theoretical results derived from the underlying microeconomic theory. There are however, at least three different ways to 'operationalize' the theoretical indices defined from this approach: (i) the econometric estimation; (ii) the use of nonparametric bounds; and (iii) the theory of exact index numbers.

5.279. *The econometric estimation*. Given time series or cross section data on production units or households, the method postulates a functional form for the cost function *C* or the aggregator function *F* and estimates by regression analysis the unknown parameters that appear in the functional form. Typically, functional forms for *C* or *F* that are flexible are chosen, i.e., the functional form has a sufficient number of free parameters so that under appropriate regularity conditions it can provide a second order approximation to an arbitrary cost or aggregator function. The main issue in this econometric method lies in the complexity associated with the number of unknown parameters, especially when the number of products to be aggregated becomes large. In fact, the number of parameters to be estimated grows at a rate approximately equal to *n/2*, where *n* is the total number of products considered.

5.280. *The method of non-parametric bounds*. Owing to the fact that it is practically difficult to determine the exact functional forms of the aggregator and cost functions *F* and *C*, this method aims at developing bounds for the 'true theoretical index' that depend on observable price and quantity data instead of the functional form of *F* and *C*. In practice, these bounds are mostly based on the observable Laspeyres and Paasche indices. They also depend on the way the optimization problem is defined – cost minimization or revenue maximization for producers, and utility maximization for consumers.

Downwards-biased Laspeyres and upwards-biased Paasche indexes are generally observed for revenue maximizing producers, while these bounds are reversed for utility maximizing consumers. In any of these cases, it has been shown that the gap between the Paasche and Laspeyres price indexes will always include the value of a theoretical economic index.[100] This suggests that taking some sort of average or symmetric mean of the Paasche and Laspeyres price indexes should yield an empirically observable price index which is "close" to the unobservable theoretical price index.

5.281. This method gives quite satisfactory results in the time series context as Paasche and Laspeyres price indexes for consecutive time periods will usually differ by a relatively small margin. However, in the cross section context where the observations represent, for example, production data for two producers in the same industry but in different regions, the bounds are often not very useful since the corresponding Laspeyres and Paasche indices can sometimes differ by a large margin.

5.282. *The method of exact index numbers.* This method uses the rationale of microeconomic theory of producers and consumers to seek for explicit solutions to the index number problem based on particular functional forms of the aggregator function *F*. Diewert (1976)[101] introduced the notion of "flexible aggregators" which are functional forms that provide a second-order approximation to an arbitrary, twice differentiable linear homogenous function. Flexible aggregators can be interpreted as functional forms that cover a wide range of utility, production, distance, cost or revenue functions.

5.283. In the same vein, an index number is defined as *superlative* if it is equal to a theoretical index whose functional form is flexible - it can approximate an arbitrary technology to the second order. That is, the technology by which inputs are converted into output quantities and revenues is described in a manner that is likely to be realistic for a wide range of forms. In contrast to the theoretical indices, a superlative index is an actual index number that can be calculated. The practical significance of these results is that they give a theoretical justification for expecting a superlative index to provide a fairly close approximation to the unknown underlying theoretical index in a wide range of circumstances.

5.284. Depending on the particular features of the aggregator function, various superlative price or quantity indices can be derived. For example, if one postulates that production technologies can be reasonably represented by a 'translogarithmic' [102] specification, which has been a widely used and tested tool in econometric analysis, then, under standard assumptions about producer behavior, the so called Törnqvist index

[100] See *"Essays in Index Number Theory"*, Volume I, W.E. Diewert and A.O. Nakamura (Editors), 1993 (Elsevier Science Publishers).

[101] Diewert, W.E., 1976. "Exact and Superlative Index Numbers," *Journal of Econometrics* 4, 115–145.

[102] An homogeneous translogarithmic aggregator *f* has the following form:

$$\ln f(x_1,...,x_n) \equiv \alpha_0 + \sum_i \alpha_i \ln x_i + \frac{1}{2}\sum_i \sum_j \alpha_{ij} \ln x_i \ln x_j \text{ where}$$

$$\sum_i \alpha_i = 1; \alpha_{ij} = \alpha_{ji}; \sum_{ij} \alpha_{ij} = 0$$

provides an exact formulation for an output quantity (or price) index. Similarly, under the assumption of homothetic quadratic preferences (i.e., the aggregator function is a monotonically increasing function of a quadratic linearly homogeneous function), Fisher's ideal index number provides an exact formulation for the underlying theoretical index.

5.285. To conclude this section, it is worth mentioning that although the economic approach to index number theory is perhaps the most compelling approach, the axiomatic approach and the stochastic approach still have some advantages. In particular, these two approaches do not suffer from the following limitations of the economic approach: (i) the economic approach is based on optimizing behavior, an assumption which may not be warranted in general; (ii) the economic approach generally relies on 'separability' assumptions (for example, the homothetic preferences assumption) about the underlying aggregator functions, assumptions that are unlikely to be true in general and (iii) the economic approach is usually based on ex ante expectations about future prices, expectations which cannot be observed, whereas the test and stochastic approaches are based on ex post accounting data, which can be observed.

5.286. The next section presents some characteristics of the internationally most used types of index numbers to aggregate economic quantities over time, namely the Laspeyres, Paasche, and Fischer volume indices.

Appendix 5(b): Comparison of index types

5.287. This appendix provides more detailed information on the criteria used to assess different types of indices for the compilation of a monthly (or quarterly) IIP. Such criteria are, for instance, relevant in the axiomatic approach (see appendix 5(a)). The criteria and their definitions are presented first, followed by an assessment of each of the Laspeyres, Paasche and Fisher indices against these common criteria for index numbers.

The following notations are used in this section:

- $q^t = (q_1^t, \ldots, q_n^t)$: Quantity vector at period *t*
- $p^t = (p_1^t, \ldots, p_n^t)$: Price vector at period *t*
- $Q(p^0, p^1, q^0, q^1)$, $P(p^0, p^1, q^0, q^1)$: Quantity and price index (as a function of the quantity and price values in period 1 with base period 0)
- V^t : Value in period *t* ($V^t = \sum_{i=1}^{n} p_i^t q_i^t$)

Period 0 is serves as the base period in this notation.

Note: For two quantity (or price) vectors q^a and q^b, we say $q^a < q^b$ if $q_i^a \le q_i^b$ for all $i \in \{1, \ldots, n\}$ and $q_k^a < q_k^b$ for at least one k.

Common criteria for index numbers

	Criteria	Definition	Explanation
1	Positivity	$Q(p^0, p^1, q^0, q^1) > 0$	The quantity index is larger than zero.
2	Continuity	$Q(p^0, p^1, q^0, q^1)$ is continuous.	$Q(q^0, q^1, p^0, p^1)$ is a continuous function of its arguments (i.e. base prices, current prices, base quantities and current quantities)
3	Additivity	$Q(p^0, p^1, q^0, q^1) = \frac{\sum_{i=1}^{n} p_i^* q_i^1}{\sum_{i=1}^{n} p_i^* q_i^0}$ where p^* is the common reference price vector, $p^* \equiv (p_1^*, \ldots, p_n^*)$	At current quantities, the value of an aggregate is equal to the sum of its components. At constant quantities, additivity requires this identity to be preserved for the extrapolated values of the aggregate and its components, when their values in some reference period are extrapolated to some other period using a set of interdependent quantity index numbers, or, alternatively, when the values of an aggregate and its components in some period are deflated using a set of interdependent price index numbers based on some other period.
4	Identity or constant quantities test	$Q(p^0, p^1, q, q) = 1$	If the quantities in the base period and the current period are identical, then the quantity index does not show any change regardless of the price vectors used.
5	Fixed-basket or constant prices test	$Q(p, p, q^0, q^1) = \frac{\sum_{i=1}^{n} p_i q_i^1}{\sum_{i=1}^{n} p_i q_i^0} = \frac{V^1}{V^0}$	If prices are identical in both periods (i.e. $p^0 = p^1 = p$), then the quantity index is equal to the value of the basket in current period 1 divided by the value of the basket in the base period 0.
6	Proportionality in current quantities	$Q(p^0, p^1, q^0, \lambda q^1) = \lambda \cdot Q(p^0, p^1, q^0, q^1)$ for $\lambda > 0$	When current quantities are multiplied by the positive number λ , the new quantity index is λ times the old quantity index.
7	Inverse proportionality in base-period quantities	$Q(p^0, p^1, \lambda q^0, q^1) = \lambda^{-1} \cdot Q(p^0, p^1, q^0, q^1)$ for $\lambda > 0$	When all quantities in the base period are multiplied by the positive number λ , the new quantity index is λ^{-1} times the old quantity index.

	Criteria	Definition	Explanation
8	Invariance to proportional changes in current prices	$Q(p^0, \lambda p^1, q^0, q^1) = Q(p^0, p^1, q^0, q^1)$ for $\lambda > 0$	When current-period prices are all multiplied by the number λ, the quantity index remains unchanged.
9	Invariance to proportional changes in base prices	$Q(\lambda p^0, p^1, q^0, q^1) = Q(p^0, p^1, q^0, q^1)$ for $\lambda > 0$	When base-period prices are all multiplied by the number λ, the quantity index remains unchanged.
10	Commodity reversal test	$Q(p^0*, p^1*, q^0*, q^1*) = Q(p^0, p^1, q^0, q^1)$, where p^t* and q^t* denote (compatible) permutations of the components of vectors p^t and q^t, respectively, for t=0,1.	The quantity index remains unchanged if the ordering of products is changed.
11	Commensurability test	$Q\begin{pmatrix}\alpha_1^{-1}p_1^0,\cdots,\alpha_n^{-1}p_n^0;\alpha_1^{-1}p_1^1,\cdots,\alpha_n^{-1}p_n^1; \\ \alpha_1 q_1^0,\cdots,\alpha_n q_n^0;\alpha_1 q_1^1,\cdots,\alpha_n q_n^1\end{pmatrix}$ $= Q(p_1^0,\cdots,p_n^0;p_1^1,\cdots,p_n^1;q_1^0,\cdots,q_n^0;q_1^1,\cdots,q_n^1)$ For all $\alpha_1 > 0,\cdots,\alpha_n > 0$	The quantity index does not change if units of measurement for the products are changed.
12	Time reversal test	$Q(p^0, p^1, q^0, q^1) = 1/Q(p^1, p^0, q^1, q^0)$	If the data for base period and current period are interchanged, then the resulting quantity index is equal to the reciprocal of the original quantity index.
13	Price reversal test	$Q(p^0, p^1, q^0, q^1) = Q(p^1, p^0, q^0, q^1)$	If the price vectors for the two periods are interchanged, then the quantity index remains invariant.
14	Quantity reversal test	$\dfrac{\left(\dfrac{\sum_{i=1}^n p_i^1 q_i^1}{\sum_{i=1}^n p_i^0 q_i^0}\right)}{Q(p^0, p^1, q^0, q^1)} = \dfrac{\left(\dfrac{\sum_{i=1}^n p_i^1 q_i^0}{\sum_{i=1}^n p_i^0 q_i^1}\right)}{Q(p^0, p^1, q^1, q^0)}$ i.e. $P(p^0, p^1, q^0, q^1) = P(p^0, p^1, q^1, q^0)$	If the quantity vectors for the two periods are interchanged, then the implicit price index corresponding to the quantity index $Q(p^0, p^1, q^0, q^1)$ remains invariant.

	Criteria	Definition	Explanation
15	Factor reversal test	$P(p^0, p^1, q^0, q^1) = Q(q^0, q^1, p^0, p^1)$ and therefore $Q(p^0, p^1, q^0, q^1) \cdot P(p^0, p^1, q^0, q^1)$ $= Q(p^0, p^1, q^0, q^1) \cdot Q(q^0, q^1, p^0, p^1)$ $= \frac{\sum_{i=1}^{n} p_i^1 q_i^1}{\sum_{i=1}^{n} p_i^0 q_i^0} = \frac{V^1}{V^0}$	If $Q(p^0, p^1, q^0, q^1)$ is a good functional form for the quantity index, then reversing the roles of prices and quantities in the formula should give a good functional form for the price index $Q(q^0, q^1, p^0, p^1)$. Thus the product of the quantity index and the price index ought to be equal to the ratio of total values in periods 1 and 0. In other words, multiplying a quantity index and a price index of the same type is equal to the proportionate change in the current values.
16	Mean value test for quantities	$\min_i \left(\frac{q_i^1}{q_i^0} \right) \le Q(p^0, p^1, q^0, q^1) \le \max_i \left(\frac{q_i^1}{q_i^0} \right)$	The quantity index lies between the minimum and maximum rates of growth of the individual quantities.
17	Mean value test for prices	$\min_i \left(\frac{p_i^1}{p_i^0} \right) \le \frac{\left(V^1 / V^0 \right)}{Q(p^0, p^1, q^0, q^1)} \le \max_i \left(\frac{p_i^1}{p_i^0} \right)$	The implicit price index lies between the minimum price ratio and the maximum price ratio.
18	Monotonicity in current quantities	$Q(p^0, p^1, q^0, q^1) < Q(p^0, p^1, q^0, q^2)$ if $q^1 < q^2$.	If some period 1 quantity increases, then the quantity index must increase.
19	Monotonicity in base quantities	$Q(p^0, p^1, q^0, q^1) > Q(p^0, p^1, q^2, q^1)$ if $q^0 < q^2$.	If any period 0 quantity increases, then the quantity index must decrease.
20	Monotonicity in current prices	$\frac{\left(\frac{\sum_{i=1}^{n} p_i^1 q_i^1}{\sum_{i=1}^{n} p_i^0 q_i^0} \right)}{Q(p^0, p^1, q^0, q^1)} < \frac{\left(\frac{\sum_{i=1}^{n} p_i^2 q_i^1}{\sum_{i=1}^{n} p_i^0 q_i^0} \right)}{Q(p^0, p^2, q^0, q^1)}$, i.e. $P(p^0, p^1, q^0, q^1) < P(p^0, p^2, q^0, q^2)$ if $p^1 < p^2$	If any period 1 price increases, then the implicit price index that corresponds to the quantity index $Q(p^0, p^1, q^0, q^1)$ must increase.
21	Monotonicity in base prices	$\frac{\left(\frac{\sum_{i=1}^{n} p_i^1 q_i^1}{\sum_{i=1}^{n} p_i^0 q_i^0} \right)}{Q(p^0, p^1, q^0, q^1)} > \frac{\left(\frac{\sum_{i=1}^{n} p_i^1 q_i^1}{\sum_{i=1}^{n} p_i^2 q_i^0} \right)}{Q(p^2, p^1, q^0, q^1)}$, i.e. $P(p^0, p^1, q^0, q^1) > P(p^2, p^1, q^0, q^1)$ if $p^0 < p^2$	If any period 0 price increases, then the implicit price index that corresponds to the quantity index $Q(p^0, p^1, q^0, q^1)$ must decrease.

Criteria met by the various types of indices discussed in this publication

	Criteria	Laspeyres	Paasche	Fisher
1	Positivity	✔	✔	✔
2	Continuity	✔	✔	✔
3	Additivity Test			✔
4	Identity or Constant Quantities Test	✔	✔	✔
5	Fixed-Basket or Constant Prices Test	✔	✔	✔
6	Proportionality in Current Quantities	✔	✔	✔
7	Inverse proportionality in Base-Period Quantities	✔	✔	✔
8	Invariance to Proportional Changes in Current Prices	✔	✔	✔
9	Invariance to Proportional Changes in Base Prices	✔	✔	✔
10	Commodity Reversal Test	✔	✔	✔
11	Commensurability Test	✔	✔	✔
12	Time Reversal Test			✔
13	Price Reversal Test			✔
14	Quantity Reversal Test			✔
15	Factor Reversal Test			✔
16	Mean Value Test for Quantities	✔	✔	✔
17	Mean Value Test for Prices	✔	✔	✔
18	Monotonicity in Current Quantities	✔	✔	✔
19	Monotonicity in Base Quantities	✔	✔	✔
20	Monotonicity in Current Prices	✔	✔	✔
21	Monotonicity in Base Prices	✔	✔	✔

Note: “ ✔ ” indicates that the index meets the criterion

Appendix 5(c): Fixed weight versus chain approach (example)

5.288. This appendix aims to demonstrate that a fixed weight and chain approach produce different results.[103] In the example below, period T_0 prices are used to calculate the index for period T_2 in the fixed weight approach while period T_1 prices are used in the chain approach. This demonstrates the impact of frequently updating weights in an index chain-linking process.

5.289. Panel (i) provides the data for use in this example. For each of three products (A, B and C), price and quantity data, as well as a value figure (unit price multiplied by quantity), are presented.

[103] Section 5.4.4 discusses the fixed weight and chain-linked indices and provides rationale for why the chain-linked approach is preferred.

Panel (i) Item data

Product	Period T_0			Period T_1			Period T_2		
	Unit price ($)	Quantity	Value p_0q_0	Unit price ($)	Quantity	Value p_1q_1	Unit price ($)	Quantity	Value p_2q_2
A	10	20	200	12	17	204	15	18	270
B	12	15	180	13	15	195	14	19	266
C	15	10	150	17	15	255	18	16	288

5.290. Panel (ii) displays value data (unit price multiplied by quantity) when prices are held constant. This is a process to obtain constant price (or volume) data for each item and for the total. The first three columns of data are volume data in the prices of period T_0, while the last two columns are in the prices of period T_1. These data are used in the calculation of the fixed weight and chain indices.

Panel (ii) Calculation of values when prices are held constant

	With prices of T_0			With prices of T_1	
Product	Period T_0	Period T_1	Period T_2	Period T_1	Period T_2
	value(p_0q_0)	value(p_0q_1)	value(p_0q_2)	value(p_1q_1)	value(p_1q_2)
A	200	170	180	204	216
B	180	180	228	195	247
C	150	225	240	255	272
Total	530	575	648	654	735

5.291. Panel (iii) provides the fixed weight as well as chain indices for the total of items a, b and c for periods T_0 through T_2. The index reference period for both indices is period T_0 and is identified by the index 100.0. The fixed weight index for 'period T_0 to T_1' in panel (iii) is obtained by:

$$I_{fixed,0,1} = \frac{\sum_i p_{0,i}q_{1,i}}{\sum_i p_{0,i}q_{0,i}} \cdot 100 = \frac{575}{530} \cdot 100 = 108.5$$

5.292. A similar process is carried out for the fixed weight index for 'period T_0 to T_2':

$$I_{fixed,0,2} = \frac{\sum_i p_{0,i} q_{2,i}}{\sum_i p_{0,i} q_{0,i}} \cdot 100 = \frac{648}{530} \cdot 100 = 122.3$$

5.293. The process to calculate the chain index is somewhat different (and is made apparent in the example for period T_2 chain index). The chain index result in period T_1 is calculated in the same way as for the fixed weight index. For period T_2, the chain index is obtained by:

$$I_{Chain,0,2} = \frac{\sum_i p_{0,i} q_{1,i}}{\sum_i p_{0,i} q_{0,i}} \cdot \frac{\sum_i p_{1,i} q_{2,i}}{\sum_i p_{1,i} q_{1,i}} \cdot 100 = \frac{575}{530} \cdot \frac{735}{654} \cdot 100 = 121.9$$

5.294. Note that period T_1 and T_2 quantities for the chain index are re-valued in terms of period T_1 prices (not period T_0 prices as per the fixed weight index).

Panel (iii) Comparison of fixed weight and chain indices

	Period T_0	Period T_1	Period T_2
Fixed weight Laspeyres	100.0	108.5	122.3
Chain-linked Laspeyres	100.0	108.5	121.9

5.295. As stated above, the purpose of this example is to show that the index results are different when a fixed weight (i.e 122.3) or chain index (i.e. 121.9) approach are employed to calculate the IIP.

Chapter 6: Data dissemination

6.1 Introduction

6.1. This chapter outlines the issues and topics associated with data dissemination, both generally and in the context of the IIP. Section 6.1 introduces the topic of data dissemination, while section 6.2 presents data dissemination principles and section 6.3 outlines publication activities. Section 6.4 discusses data revisions with a focus on the IIP. Section 6.5 presents international reporting recommendations. The chapter concludes with section 6.6, which provides additional dissemination reference material.

6.2. Data dissemination consists of the distribution or transmission of statistical data to policy makers, business community and other data users. It is one of the most important activities of data producers. Data may be made available to users via a variety of means. Two of the most common are printed publications and electronic publications on the Internet. Publication is the action of making statistical information public.

6.3. Dissemination of IIP statistics includes the presentation of information that meets predetermined format standards, as well as ensuring data accessibility via various dissemination mediums. The presentation of data and method of dissemination should, to a large degree, be influenced by the target audience/users.

6.2 Dissemination principles

6.4. National and international statistical agencies generally have a pre-existing set of principles and standards that they apply to the dissemination of their statistics. These principles have developed over time and are guided by international recommendations such as those found in the *International Recommendations for Industrial Statistics 2008*.

6.5. Three almost universal principles have been implemented by statistical organizations. These are: *Statistical confidentiality*; *Equality of access* and *Objectivity*. These principles are discussed below.

6.2.1 Statistical confidentiality

6.6. The United Nations Fundamental Principles of Official Statistics state: “Individual data collected by statistical agencies for statistical compilation, whether or not they refer to natural or legal persons, are to be strictly confidential and used exclusively for statistical purposes.” (UNSC 1994). Data should not be disseminated when they allow persons or economic units to be identified either directly or indirectly. Breaching confidentiality bears the risk of undermining the trust between the national statistical office, other data producers, respondents and users. As a result, individual data providers may not cooperate with data collections in the future and data users may question the objectivity and reliability of data from the national statistical office.

6.7. In the context of industrial statistics, data collected by survey or administrative sources are usually published in the form of tables, often accompanied by graphics or diagrams and contain aggregated information regarding a number of economic units. Sometimes it is possible to deduce information about an individual unit from aggregated information especially when the contribution of one economic unit dominates the total.

6.8. To protect against the disclosure of data from an individual economic unit, statistical disclosure controls for tabular data should be put into place. While such controls are applied at the dissemination stage, they are pertinent to all stages of the statistical process.

6.9. The most common practices to protect the disclosure of confidential data include:

- *Aggregation*, i.e. a method where a confidential cell in a table is aggregated with another cell so that the information is disseminated for the aggregate and not for the two individual cells. This, for example, often results in grouping of data which are confidential at the class (4-digit) level of ISIC with another class (or other classes) and present and disseminate them at the group (3-digit) level of ISIC.; and
- *Suppression*, i.e. removing records from a database or a table that contains confidential data.

6.2.2 Equality of access

6.10. Statistics compiled by national statistical offices and other government data providers are generally considered collective goods, which implies that every citizen can access data under equal terms. In most cases a press release is the first publication containing newly available data and serves dual purposes: firstly, it makes the data officially public, and secondly, it sends a signal to the data users that additional data on the subject can be obtained from the national statistical office/data producer.

6.11. Data should be released according to a set timetable and to all users at the same time. To ensure this occurs, the national statistical office/data producers should develop and announce an advance data release calendar. The advance data release calendar should be publicised (e.g. posted on the websites) at least three months in advance of scheduled release dates. In addition, contact details of relevant statisticians who can answer questions by users should be included with the release of data.

6.12. It is acknowledged that pre-release of official statistics needs to occur in certain circumstances and this is best determined by individual statistical organizations. For example, given the high level of market and community interest in some statistical series, statistical agencies may determine that it is important from a 'public good' perspective that government officials receive data in advance of official release. This is to allow time for government officials to undertake analysis and to develop for example a briefing to be provided to relevant Ministers after lifting of the embargo. Key Ministers are then able to respond in an informed manner to requests from the media upon release of the statistics, thereby avoiding any inadvertent misinterpretation.

6.13. The timely release of the IIP is paramount to its usefulness by policy makers, analysts and the wider public. It is noted that there is a trade-off between timeliness and quality. It is therefore recommended that the monthly IIP be released within 6 weeks after the end of the reference month.

6.2.3 Objectivity

6.14. The released data should not be accompanied by subjective interpretations, judgments or recommendations, as this is likely to compromise the independent and objective position of the national statistical office. The focus of accompanying commentary should be to assist users to make their own judgments about the economic implications. The released data should also include methodological explanation and advice.

6.15. National statistical offices/data producers are, however, entitled to comment on erroneous interpretation and misuse of statistics.[104]

6.3 Publication activities

6.16. Publication involves the action of making statistical information public in printed form or on the Internet and also includes CD-ROMs, magnetic tapes, audiocassettes, radio and TV broadcasts, as well as any other media that can meet the same objectives. Publication involves a series of steps, including: selecting and presenting content for publication; selecting publication types and formats; producing IIP publications; reviewing of publications prior to being published; and promoting and monitoring the use of IIP statistics. Each of these steps is discussed below.

6.3.1 Selecting and presenting content for publication

6.17. Preparing statistical publications requires a careful consideration of the available data and the needs of the data users. The types of content included in a publication are key figures (e.g. percentages, rates of change), tables and graphs.

6.18. It is usual to highlight key figures in publications. Common examples are monthly and annual percent changes of total industrial production. Tables are a useful way of presenting both summary data and detailed data.

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[104] Fundamental Principles of Official Statistics, Principle 4 – Prevention of misuse. See http://unstats.un.org/unsd/methods/statorg/default.htm

6.19. Agencies involved in the production of IIP publications need to that ensure these publications are drafted so that content is presented in meaningful ways. The following key presentation principles are recommended for an index of industrial production:

- Both 'original' IIP series and seasonally adjusted series should be published;
- Index numbers should be presented to one decimal place;
- Changes between month-to-month and change from the same month one year earlier should be presented;
- A reference period needs to be determined and convention is that this period is set to a value of one hundred (100.0);
- The main contributors to change should be presented to users, i.e. those product groups or industries that are primarily responsible for the monthly movement in the IIP.

6.20. In addition, the provision of an adequate description of characteristics and methodologies specific to indices is as important to users, as are quality assessments of the data. Consideration should also be given to having different levels of information, targeted at different kinds of users. It is therefore recommended that the following metadata be provided:

- Precise definitions of the underlying economic concepts that the indices intend to measure;
- Specific mention of any limitations in the use or application of the indices;
- Descriptions of the methodologies used in the compilation of the index, with particular reference to the index calculation methods, entailing the choice of index formula and the strategy for constructing the index series;
- Weighting system used, weight update practices and frequency of weight update;
- Computation at various aggregation levels, selection of base year (weight reference period), frequency of re-basing and procedures for linking indices;
- Treatment of changes in the composition of commodities in the market, as well as changes in quality; and
- Comparison of the methodologies applied against underlying IIP concepts and a description of the impact of departures.

6.3.2 Selecting publication types and formats

6.21. The type of publications produced and the dissemination format of these publications depend on the audience and factors such as ensuring information are timely, accessible and understandable. These considerations need to be weighed against the cost in terms of money, resources and time required to produce the publications.

6.22. Two main types of publications can be used to disseminate IIP statistics. Concise publications include press releases, fact sheets and profiles, while thematic publications contain detailed data 'by industry' and 'by region'.

6.23. Concise publications are short publications and may include key indicators, summary tables, graphs and concise supporting text. They generally have a larger audience than detailed thematic publications/reports.

6.24. Thematic reports are more detailed publications that include tables (e.g. standard tables), along with other information such as graphs, supporting text and metadata. The audience for such reports is specialized and includes policy analysts and researchers. While the audience for such publications may be small, the analytical use of the data makes this audience very important.

6.25. Publications can be produced in hardcopy format or electronic format. The upfront cost of publishing statistical products in hardcopy (traditional hardcopy formats such as bulletins, digests, abstracts and yearbooks are still widely used) are greater than for electronic information (spreadsheets, text files as well as PDF, CSV, DOC, XLS, XML formats), however, there are costs associated with electronic formats, including budgets required to pay for administrative and technical support.

6.26. The time lag between data collection and data dissemination by a traditional print media is greatly reduced when these publications are disseminated via the Internet. In practice, Internet dissemination is usually possible around the same time as the print version has been finalised and sent off for reproduction and distribution. This allows users to access IIP statistics via the Internet before they would normally receive a print version of the same publication.

6.3.3 Review of publications prior to being published

6.27. The purpose of a review process is to judge whether the statements made are fully supported by evidence, whether the most important inferences on the basis of the new data available were taken into account, and whether the methods used stand up to scrutiny in the face of current knowledge. At a minimum it is important to consult with experts both on the subject matter and on statistical methods, have the publications reviewed internally prior to release, check for errors in the publication (e.g. check details such as the consistency of figures used in the text, tables and charts), and ensure that all references are accurate and are referred to in the text.

6.3.4 Promotion and monitoring of the use of IIP publications

6.28. The promotion of information and publications is a key element of the dissemination process. Promotions should be targeted and include policy developers, decision makers in government, the media, the business community, researchers known to use IIP data, and the general public. Promotions may include presentations to the media and the general public, as well as technical seminars for government agencies and researchers, regarding key trends observed. Such presentations and seminars could coincide with the publication of major reports. Presentations and seminars also facilitate feedback that can help improve future publications.

6.29. It is impossible to know the success of dissemination efforts without monitoring the use of IIP statistics. The Internet has provided statistical agencies with various ways of tracking the popularity of its publications. Still, in many instances it is difficult to know for what purpose data are used, or who uses the data. At a minimum, the unit within the national statistical office responsible for disseminating hardcopy publications should record requests or sales of hardcopy publications. This serves as a basic indicator of the use of these publications. In addition, the unit responsible for maintaining the website should also record the number of “hits” over time on IIP Internet pages, and the number of downloads of IIP publications.

6.4 Data revisions

6.30. The revision of data previously released is an essential part of country practices on compilation of industrial statistics. The revision of the estimates is an inescapable statistical activity in all countries, both developed and developing. It is inherent in the way estimates are compiled and released by the national statistical offices – from ‘preliminary data’ (based mainly on trends in indicators and statistical techniques), to ‘provisional data’ (based on limited amounts of data) to ‘final data’ (based on comprehensive data).

6.31. Revisions occur as a consequence of the trade-off between the need for timeliness of published data and their reliability, accuracy and comprehensiveness. To meet user needs, national statistical offices compile timely preliminary estimates that are revised later when new and more accurate information becomes available. Although repeated revisions may in general be perceived as reflecting negatively on the reliability of official industrial statistics, the attempt to avoid them by producing accurate but rather outdated data will result in failure to satisfy user needs, particularly for the IIP whose advantage is its combination of high frequency and fast availability.

Reasons for revisions of data

6.32. In general, there are two reasons for revisions - (i) revisions due to “normal” statistical procedures (for instance new information available, change in methodology, change in data sources, change of base year); and (ii) revisions due to the correction of errors that may occur in source data or in processing.

6.33. It is recommended that corrections of errors (statistical or data processing errors) are done in a transparent manner as soon as they are detected. The revisions should be explained to the users in a way that gives assurance that corrections were not politically motivated.

6.34. Countries should develop a revision policy for normal statistical data revisions.[105] The development of a revision policy should aim to provide users with the necessary information to cope with revisions in a more systematic manner. Essential features of a well-established revision policy are its predetermined schedule, reasonable stability from year to year, openness, advance notice of reasons and effects, easy access to sufficiently long time series of revised data as well as adequate documentation of revisions included in the statistical publications and databases. Users will be reassured if they see that revisions take place within the framework of an overall policy and according to predetermined schedules.

Recommended practices for data revisions

6.35. There is a need for countries to follow good practices with regard to data revisions, as it will not only help the national users of the data but also promote international consistency. It is recommended that the following revision practices be followed by countries:

- A statement by the national statistics office about the reasons and scheduled revisions should be made public and be readily accessible to users;
- The revision cycle should be relatively stable from year to year. (Users place great importance on a revision schedule that is regular);
- Major conceptual and methodological revisions should be introduced as required, balancing the need for change and users' concerns;
- Revisions should be carried back several years to give consistent time series;
- Details of revisions should be documented and made available to users. The basic documentation should include identifying data in the statistical publications that are preliminary (or provisional) and revised data, explaining the sources of revisions, and explaining breaks in series when consistent series can not be constructed; and
- Users should be reminded of the size of likely revisions based on past history.

6.36. Countries implement these recommended revision practices for the IIP in a variety of ways. For example, in the U.S., when the IIP data for the most recent month are published, revised estimates for the previous five months are published, while revisions that incorporate benchmarks and methodological improvements are published annually.

6.5 International reporting

6.37. The availability of high quality international statistics, accessible by all, is a fundamental element of a global information system. In the context of an ever increasing integration of national economies into the international economy through trade, foreign investment, capital flows, migration and the spread of technology, global and regional

[105] The OECD/Eurostat Task Force on Revisions Analysis has prepared guidelines on revisions policy and analysis. See: www.oecd.org/document/21/0,3343,en_2649_34257_40016853_1_1_1_1,00.html

economies have a significant impact on national economies. International statistics therefore provide an important information source from which policy makers and analysts can make assessments about current and future national and international economic conditions.

6.38. The IIP is an important short-term statistic in an international context and long time series of global, regional and national IIP data currently exist.[106] Data collected and disseminated by international organizations depend on the quality and completeness of the data supplied by countries. All countries are therefore encouraged to report IIP data internationally.

6.39. It is recommended that the IIP data be reported internationally on a (at least) quarterly basis with a lag of no more than 6 weeks after the reference quarter at the 2-digit level of ISIC Rev. 4, while monthly IIP data are to be reported at the 1-digit level of ISIC Rev.4 with a lag of no more than 6 weeks after the reference month..

6.6 Additional guidance on dissemination issues

6.40. The above principles and recommendations are covered in significant detail in a number of publications. The following publications provide detailed guidance on the presentation and dissemination of all official statistics (i.e. not just limited to the IIP):

- United Nations, Fundamental Principles of Official Statistics (1994);
- International Monetary Fund (IMF), Producer Price Index Manual: Theory and Practice (2004) – Chapter 13;
- Organisation for Economic Co-operation and Development (OECD), Data and Metadata Reporting and Presentation Handbook, (2006);
- Statistics Canada, Informing Users of Data Quality and Methodology, Section E.3, (2000); and
- United Nations, International Recommendations for Industrial Statistics (2008).

[106] The collection of these index numbers by the United Nations started in the 1950's following the recommendations of the Statistical Commission at its 5th Session in 1950. The United Nations Statistics Division (UNSD) currently compiles and disseminates IIP data at the world, region and country level on a monthly, quarterly and annual basis.

PART II

GUIDANCE ON IMPLEMENTATION

Chapter 7: Quality Assessment and Guidance to Compile an IIP

7.1. This chapter presents a quality assessment framework for an IIP as well as practical guidance to compile the index. Section 7.1 presents the framework that can be used to assess the complete IIP production process, including sampling and survey design, questionnaires, editing, compilation and dissemination. Section 7.2 uses the relevant components of the quality framework presented in section 7.1 to specifically evaluate the suitability of IIP data variables and methods. The framework is used to classify the variables and methods as ‘preferred’, ‘alternative’ and ‘other’. Section 7.3 then presents the ‘preferred’, ‘alternative’ and ‘other’ variables and methods for all ISIC Revision 4 classes in scope of industrial production.

7.1 Dimensions of quality

7.2. Most statistical institutions at the national and international level attempt to systematically evaluate the quality of their own statistical output using various tools and processes. A quality framework[107] is presented here as a basis for discussing ways to assess, maintain and improve the overall quality of an IIP. The overall quality assessment of the IIP includes issues relating to data variables, as well as index compilation and dissemination.

7.3. In general, quality is defined as “fitness for use” or “fitness for purpose” in terms of user needs. This definition uses a multi-dimensional framework to assess quality rather than, say accuracy, which has traditionally been the measure of quality. Even if data are accurate, they cannot be said to be of good quality if they are produced too late to be useful or cannot be easily accessed or appear to conflict with other data. Alternatively, a variable to produce the IIP that is regarded as conceptually preferred may not be sufficiently timely or it may not be sufficiently accurate. In this case it would be desirable to use another variable that scores higher against the overall evaluation of suitability for use in compiling a monthly IIP.

7.4. The quality of a statistical product is assessed via the following seven dimensions:

- Relevance: Statistics are compiled to meet the strong demands of analysts and policy makers. Relevance depends upon both the coverage of the required topics and the use of appropriate concepts.

[107] This section is a summary of section 5.5.3 in the *OECD's Manual for an index of services production*. Topics are covered in brief in this publication while detailed description can be obtained from the OECD manual. Further, detailed information on the OECD quality framework is available at www.oecd.org/statistics/qualityframework

- Accuracy: Accuracy refers to the closeness between the values provided and the (unknown) true values. Accuracy has many attributes, and in practical terms there is no single aggregate or overall measure of it.

- Credibility: The credibility of data products refers to the confidence that users place in those products based simply on their image of the data producer, i.e., the brand image.

- Timeliness: Data should be made available quickly after the reference period.

- Accessibility: The accessibility of data products is described as how readily the data can be located, the suitability of the form in which the data are available, the media of dissemination, and the availability of metadata and user support services. It also includes the affordability of the data.

- Interpretability: The interpretability of data is closely related to the users' understanding of the data for their use. Thus the degree of interpretability depends on all aspects of information on the data such as adequacy of the definitions of concepts, target populations, variables and terminology, limitations of the data, etc.

- Coherence: The coherence of data products reflects the degree to which they are logically connected and mutually consistent. Four important sub-dimensions for coherence can be distinguished:
  − coherence within a dataset;
  − coherence across datasets;
  − coherence over time; and
  − coherence across countries.

7.5. The cost to produce necessary statistics is an additional criterion in assessing quality in regard to short-term statistics. Cost efficiency can be described as a measure of the costs and provider burden relative to the output. Provider burden is a cost that happens to be born by the provider, but is a cost nevertheless.

7.6. A difficult element of any quality framework is its implementation. Some scoring systems include quantitative measures for comparison purposes, while others rely heavily on qualitative statements to highlight priority areas for data improvement. Many of these frameworks require specialist knowledge of the data in question for them to operate effectively.

7.7. It is recommended that a quality review of the IIP using a quality assessment framework be undertaken every four or five years, or more frequently if significant new data sources become available.

7.2 Evaluating the suitability of data variables and methods

7.8. This section utilizes the relevant aspects of the quality framework presented in section 7.1 to classify variables as “preferred” (representing best practice), “alternative”, and “other” in order to produce an IIP by industry.

7.9. The *preferred approach* presents the variables and methods that are considered to be most appropriate as a short-term indicator in an IIP context. If this preferred variable is not available, the use of *alternative variables* should be considered. The *other variables* typically produce a less precise measure and should be used to compile a monthly IIP only until a preferred (or even an “alternative”) variable becomes available. It is acknowledged that ‘other’ variables could produce acceptable results, depending on the country and activity context.

7.10. The six issues relevant to an assessment of the suitability of data variables are listed here with a brief explanation. The requirements specific to short-term indicators are the focus of this suitability assessment. Such an assessment uses a subjective approach rather than a quantitative evaluation and requires industry knowledge by the statistician or "industry expert".

7.11. The six suitability issues are:

- <u>Relevance:</u> The purpose is to measure short-term <u>change</u> in value added. An indicator should be designed to do that, rather than, for instance, being designed to measure the level of the indicator at a point in time. Therefore the indicator should measure changes in output (value added) rather than some other variable or concept;

- <u>Accuracy:</u> The level of accuracy of the indicator itself should be acceptable. Accuracy can be assessed in terms of the degree to which the data correctly estimate or describe the quantities or characteristics they are designed to measure;

- <u>Timeliness:</u> As the purpose is to estimate short-term change in value added, a short-term indicator is required to be made available quickly, i.e. shortly after the end of the period to which they relate. Timeliness also includes the concept of <u>periodicity / frequency.</u> That is, in order to reflect monthly (or quarterly) value added, an indicator should ideally consist of independent monthly (or quarterly) observations. (e.g. release of IIP data approximately 6 weeks after the end of the reference period for monthly indices);

- <u>Interpretability:</u> The concept of interest here is coverage. An indicator that estimates short-term change in value-added should cover, in some representative fashion, the full range of businesses or other types of organizations that are included within the industry or sector category in question; and

- Coherence: The same indicator should be used throughout the entire time series. If there are definitional changes, adjustments should be applied to ensure consistency and to enable comparison over time and between countries, etc.

7.12. Section 7.3 of this publication presents the results of the quality assessment of industrial production data variables and methods. The results are presented as the set of 'preferred', 'alternative' and 'other' methods and variables for each ISIC Revision 4 class in scope of industrial production.

7.3 Recommended variables and methods for calculating an IIP for each class of ISIC Revision 4

7.13. For many countries the source of data to compile the IIP is a survey that is conducted monthly specifically for this purpose. Therefore the Survey of Industrial Production will provide the majority of the required data. However, this is not the case in all countries and in some cases various data sources are utilized to compile the index. The attached table assumes that the primary data source is the Survey of Industrial Production and therefore focuses attention on the variables and methods to compile the index.

7.14. The explanatory notes presented in the table are a summary or subset of the complete explanatory notes which can be found in the ISIC Revision 4 publication.[108]

7.15. The column 'Products or product groups' in the following table provides a suggested list of industrial products or product groups for each industry. This list could be used by countries to construct the elementary or base level of the industrial production index. Countries should review the product list to determine if these products are significant in individual domestic economies.

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[108] Statistical Methods, Series M, No.4, Rev.4 (United Nations publication, Sales No. E.08.XVII.25). The United Nations Statistics Division (UNSD) website also contains the complete updated reference relating to ISIC Rev.4 (http://unstats.un.org/unsd/class).

ISIC Section: B – Mining and quarrying

Division: 05 – Mining of coal and lignite

This division includes the extraction of solid mineral fuels includes through underground or open-cast mining and includes operations (e.g. grading, cleaning, compressing and other steps necessary for transportation etc.) leading to a marketable product. This division does not include coking (see 1910), services incidental to coal or lignite mining (see 0990) or the manufacture of briquettes (see 1920).

The division is divided into 2 classes: 0510 Mining of hard coal; 0520 Mining of Lignite

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
0510	**Mining of hard coal**	This class includes: - mining of hard coal: underground or surface mining, including mining through liquefaction methods - cleaning, sizing, grading, pulverizing, compressing etc. of coal to classify, improve quality or facilitate transport or storage.	- Coal - Briquettes and similar solid fuels manufactured from coal	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**0510**
0520	**Mining of lignite**	This class includes: - mining of lignite (brown coal): underground or surface mining, including mining through liquefaction methods - washing, dehydrating, pulverizing, compressing of lignite to improve quality or facilitate transport or storage	- Lignite	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**0520**

Division: 06 – Extraction of crude petroleum and natural gas

This division includes the production of crude petroleum, the mining and extraction of oil from oil shale and oil sands and the production of natural gas and recovery of hydrocarbon liquids. This includes the overall activities of operating and/or developing oil and gas field properties, including such activities as drilling, completing and equipping wells, operating separators, emulsion breakers, desilting equipment and field gathering lines for crude petroleum and all other activities in the preparation of oil and gas up to the point of shipment from the producing property.

This division excludes support activities for petroleum and gas extraction, such as oil and gas field services, performed on a fee or contract basis, oil and gas well exploration and test drilling and boring activities (see class 0910). This division also excludes the refining of petroleum products (see class 1920) and geophysical, geologic and seismic surveying activities (see class 7110).

The division is divided into 2 classes: 0610 Extraction of crude petroleum; 0620 Extraction of natural gas.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
0610	**Extraction of crude petroleum**	This class includes: - extraction of crude petroleum oils	- Petroleum oils and oils obtained from bituminous minerals, crude	**Volume indicator (output-based)** Quantities measured in barrels	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	0610
0620	**Extraction of natural gas**	This class includes: - production of crude gaseous hydrocarbon (natural gas)	- Natural gas, liquefied or in the gaseous state	**Volume indicator (output-based)** Quantities measured by volume, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	0620

Division: 07 – Mining of metal ores

This division includes mining for metallic minerals (ores), performed through underground or open-cast extraction, seabed mining etc. Also included are ore dressing and beneficiating operations, such as crushing, grinding, washing, drying, sintering, calcining or leaching ore, gravity separation or flotation operations.

This division excludes manufacturing activities such as the roasting of iron pyrites (see class 2011), the production of aluminium oxide (see class 2420) and the operation of blast furnaces (see classes 2410 and 2420).

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
0710	**Mining of iron ores**	This class includes: - mining of ores valued chiefly for iron content - beneficiation and agglomeration of iron ores This class excludes: - extraction and preparation of pyrites and pyrrhotite (except roasting), see 0891	- Iron ores and concentrates, other than roasted iron pyrites	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	0710
0721	**Mining of uranium and thorium ores**	This class includes: - mining of ores chiefly valued for uranium and thorium content: pitchblende etc.	- Uranium and thorium ores and concentrates	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	0721
0729	**Mining of other non-ferrous metal ores**	This class includes: - mining and preparation of ores valued chiefly for non-ferrous metal content.	- Copper, ores and concentrates - Nickel ores and concentrates - Aluminium ores and concentrates - Precious metal (gold, silver, platinum) ores and concentrates	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	0729

Division: 08 – Other mining and quarrying

This division includes extraction from a mine or quarry, but also dredging of alluvial deposits, rock crushing and the use of salt marshes. The products are used most notably in construction (e.g. sands, stones etc.), manufacture of materials (e.g. clay, gypsum, calcium etc.), manufacture of chemicals etc. This division does not include processing (except crushing, grinding, cutting, cleaning, drying, sorting and mixing) of the minerals extracted.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
0810	**Quarrying of stone, sand and clay**	This class includes: - quarrying, rough trimming and sawing of monumental and building stone such as marble, granite, sandstone etc.	- Slate - Marble - Granite, sandstone and other monumental or building stone - Gypsum; anhydrite; limestone flux; limestone and other calcareous stone, of a kind used for the manufacture of lime or cement - Natural sands - Pebbles, gravel, broken or crushed stone - Clays	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**0810**

Division: 08 – Other mining and quarrying – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
0891	**Mining of chemical and fertilizer minerals**	This class includes: - mining of natural phosphates and natural potassium salts - mining of native sulphur - extraction and preparation of pyrites and pyrrhotite, except roasting - mining of natural barium sulphate and carbonate (barytes and witherite), natural borates, natural magnesium sulphates (kieserite) - mining of earth colours, fluorspar and other minerals	- Natural calcium phosphates, natural aluminum calcium phosphates and phosphatic chalk; carnallite, sylvite and other crude natural potassium salts	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	0891
0892	**Extraction of peat**	This class includes: - peat digging - peat agglomeration - preparation of peat to improve quality or facilitate transport or storage	- Peat	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	0892
0893	**Extraction of salt**	This class includes: - extraction of salt from underground including by dissolving and pumping - salt production by evaporation of sea water or other saline waters - crushing, purification and refining of salt by the producer	- Salt and pure sodium chloride	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	0893

Division: 08 – Other mining and quarrying – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
0899	**Other mining and quarrying n.e.c.**	This class includes: - mining and quarrying of various minerals and materials.	- Precious stones (including diamonds, but not industrial diamonds) and semi-precious stones, unworked or simply sawn or roughly shaped - Industrial diamonds, unworked or simply sawn, cleaved or bruted ; pumice stone; emery; natural corundum, natural garnet and other natural abrasives	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**0899**

Division: 09 – Mining support service activities

This division includes specialized support services incidental to mining provided on a fee or contract basis. It includes exploration services through traditional prospecting methods such as taking core samples and making geological observations as well as drilling, test-drilling or redrilling for oil wells, metallic and non-metallic minerals. Other typical services cover building oil and gas well foundations, cementing oil and gas well casings, cleaning, bailing and swabbing oil and gas wells, draining and pumping mines, overburden removal services at mines, etc.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
0910	**Support activities for petroleum and natural gas extraction**	This class includes: - oil and gas extraction service activities provided on a fee or contract basis:	- Test drilling in connection with petroleum or gas extraction - Exploration services in connection with petroleum or gas extraction - Liquefaction and regasification of natural gas for purpose of transport	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	0910
0990	**Support activities for other mining and quarrying**	This class includes: - support services on a fee or contract basis, required for mining activities of divisions 05, 07 and 08	- Exploration services - Draining and pumping services, on a fee or contract basis - Test drilling and test hole boring	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	0990

ISIC Section: C – Manufacturing

Division: 10 – Manufacture of food products

This division includes the processing of the products of agriculture, forestry and fishing into food for humans or animals, and includes the production of various intermediate products that are not directly food products. The activity often generates associated products of greater or lesser value (for example, hides from slaughtering, or oilcake from oil production).

This division is organized by activities dealing with different kinds of products: meat, fish, fruit and vegetables, fats and oils, milk products, grain mill products, animal feeds and other food products. Production can be carried out for own account, as well as for third parties, as in custom slaughtering. Some activities are considered manufacturing (for example, those performed in bakeries, pastry shops, and prepared meat shops etc. which sell their own production) even though there is retail sale of the products in the producers' own shop. However, where the processing is minimal and does not lead to a real transformation, the unit is classified to Wholesale and retail trade (section G).

Production of animal feeds from slaughter waste or by-products is classified in 1080, while processing food and beverage waste into secondary raw material is classified to 3830, and disposal of food and beverage waste in 3821.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1010	**Processing and preserving of meat**	This class includes: - operation of slaughterhouses engaged in killing, dressing or packing meat: beef, pork, poultry, lamb, rabbit, mutton, camel, etc.	- Meat of bovine animals, fresh or chilled, frozen - Meat of swine, fresh or chilled, frozen - Meat of sheep, fresh or chilled, frozen - Meat and edible offal of poultry, fresh or chilled, frozen	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1010**

Division: 10 – Manufacture of food products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1020	**Processing and preserving of fish, crustaceans and molluscs**	This class includes: - preparation and preservation of fish, crustaceans and molluscs: freezing, deep-freezing, drying, smoking, salting, immersing in brine, canning etc.	- Fish, fish fillets, other fish meat and fish livers and roes, frozen - Fish, dried, salted or in brine; smoked fish; edible fish meal - Fish, otherwise prepared or preserved; caviar	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1020
1030	**Processing and preserving of fruit and vegetables**	This class includes: - manufacture of food consisting chiefly of fruit or vegetables, except ready-made dishes in frozen or canned form.	- Vegetables (uncooked or cooked by steaming or boiling in water), frozen - Vegetables provisionally preserved - Fruit juices and vegetable juices - Fruit and nuts, uncooked or cooked by steaming or boiling in water, frozen - Jams, fruit jellies and fruit or nut puree and pastes	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1030

Division: 10 – Manufacture of food products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1040	**Manufacture of vegetable and animal oils and fats**	This class includes the manufacture of crude and refined oils and fats from vegetable or animal materials, except rendering or refining of lard and other edible animal fats.	- Animal oils and fats, crude and refined, except fats of bovine animals, sheep, goats, pigs and poultry - Soya-bean, ground-nut, olive, sunflower-seed, safflower, cotton-seed, rape, colza and mustard oil, crude	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by volume, by product or weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1040**
1050	**Manufacture of dairy products**	This class includes: - manufacture of fresh liquid milk, pasteurized, sterilized, homogenized and/or ultra heat treated - manufacture of milk-based drinks - manufacture of butter	- Processed liquid milk - Cream - Cheese and curd - Ice cream and other edible ice - Yoghurt and other fermented or acidified milk and cream	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by volume, by product or by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1050**
1061	**Manufacture of grain mill products**	This class includes: - grain milling: production of flour, groats, meal or pellets of wheat, rye, oats, maize (corn) or other cereal grains	- Wheat or meslin flour - Cereal flours other than of wheat or meslin - Groats, meal and pellets of wheat and other cereals - Rice, semi- or wholly milled	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1061**

Division: 10 – Manufacture of food products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1062	**Manufacture of starches and starch products**	This class includes: - manufacture of starches from rice, potatoes, maize etc. - wet corn milling	- Starches; inulin; wheat gluten; dextrins and other modified starches - Tapioca and substitutes therefore prepared from starch, in the form of flakes, grains, siftings or similar forms	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1062**
1071	**Manufacture of bakery products**	This class includes the manufacture of fresh, frozen or dry bakery products.	- Crispbread; rusks, toasted bread and similar toasted products - Gingerbread and the like; sweet biscuits; waffles and wafers	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1071**

Division: 10 – Manufacture of food products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1072	**Manufacture of sugar**	This class includes: - manufacture or refining of sugar (sucrose) and sugar substitutes from the juice of cane, beet, maple and palm.	- Raw cane or beet sugar - Refined cane or beet sugar and chemically pure sucrose, in solid form, not containing added flavouring or colouring matter - Refined cane or beet sugar, in solid form, containing added flavouring or colouring matter; maple sugar and maple syrup	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1072
1073	**Manufacture of cocoa, chocolate and sugar confectionery**	This class includes: - manufacture of cocoa, cocoa butter, cocoa fat, cocoa oil	- Cocoa butter, fat and oil - Cocoa powder, not sweetened - Cocoa powder, sweetened - Chocolate and other food preparations containing cocoa (except sweetened cocoa powder), in bulk forms	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1073

Division: 10 – Manufacture of food products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1074	**Manufacture of macaroni, noodles, couscous and similar farinaceous products**	This class includes: - manufacture of pastas such as macaroni and noodles, whether or not cooked or stuffed - manufacture of couscous - manufacture of canned or frozen pasta products	- Uncooked pasta, not stuffed or otherwise prepared - Pasta, cooked, stuffed or otherwise prepared - Couscous	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1074
1075	**Manufacture of prepared meals and dishes**	This class includes the manufacture of ready-made (i.e. prepared, seasoned and cooked) meals and dishes.	- Meals prepared of meat, poultry, fish or vegetables - Frozen pizza	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1075
1079	**Manufacture of other food products n.e.c.**	This class includes: - decaffeinating and roasting of coffee - production of coffee products.	- Coffee, decaffeinated or roasted - Green tea (not fermented), black tea (fermented) and partly fermented tea - Soups and broths	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1079
1080	**Manufacture of prepared animal feeds**	This class includes: - manufacture of prepared feeds for pets, including dogs, cats, birds, fish etc. - manufacture of prepared feeds for farm animals, including animal feed concentrates and feed supplements	- Preparations of farm animal feeds - Pet foods	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1080

Division: 11 – Manufacture of beverages

This division includes the manufacture of beverages, such as nonalcoholic beverages and mineral water, manufacture of alcoholic beverages mainly through fermentation, beer and wine, and the manufacture of distilled alcoholic beverages.

This division excludes the production of fruit and vegetable juices (see class 1030), the manufacture of milk-based drinks (see class 1050) and the manufacture of coffee, tea and maté products (see class 1079).

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1101	**Distilling, rectifying and blending of spirits**	This class includes: - manufacture of distilled, potable, alcoholic beverages: whisky, brandy, gin, liqueurs, "mixed drinks" etc.	- Undenatured ethyl alcohol of an alcoholic strength by volume of 80% vol or higher - Ethyl alcohol and other spirits, denatured, of any strength	**Volume indicator (output-based)** Quantities measured by volume, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1101**
1102	**Manufacture of wines**	This class includes: - manufacture of wine	- Sparkling wine of fresh grapes - Wine of fresh grapes, except sparkling wine - Vermouth and other wine of fresh grapes flavoured with plats or aromatic substances	**Volume indicator (output-based)** Quantities measured by volume, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1102**
1103	**Manufacture of malt liquors and malt**	This class includes: - manufacture of malt liquors, such as beer, ale, porter and stout - manufacture of malt This class also includes: - manufacture of low alcohol or non-alcoholic beer	- Beer made from malt - Malt, whether or not roasted	**Volume indicator (output-based)** Quantities measured by volume, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1103**

Division: 11 – Manufacture of beverages – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1104	**Manufacture of soft drinks; production of mineral waters and other bottled waters**	This class includes: - manufacture of non-alcoholic beverages, except non-alcoholic beer and wine	- Waters (including mineral waters and aerated waters), not sweetened nor flavoured, except natural water, ice and snow - Other non-alcoholic beverages	**Volume indicator (output-based)** Quantities measured by volume, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1104**

Division: 12 – Manufacture of tobacco products

This division includes the processing of an agricultural product, tobacco, into a form suitable for final consumption.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1200	**Manufacture of tobacco products**	This class includes: - manufacture of tobacco products and products of tobacco substitutes: cigarettes, cigarette tobacco, cigars, pipe tobacco, chewing tobacco, snuff - manufacture of "homogenized" or "reconstituted" tobacco This class also includes: - stemming and redrying of tobacco This class excludes: - growing or preliminary processing of tobacco, see 0115, 0163	- Cigars, cheroots, cigarillos and cigarettes of tobacco or tobacco substitutes - Other manufactured tobacco and manufactured tobacco substitutes; "homogenized" or "reconstituted" tobacco; tobacco extracts and essences	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product *or* quantities measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1200**

Division: 13 – Manufacture of textiles

This division includes preparation and spinning of textile fibres as well as textile weaving, finishing of textiles and wearing apparel, manufacture of made-up textile articles, except apparel (e.g. household linen, blankets, rugs, cordage etc.). Growing of natural fibres is covered under division 01, while manufacture of synthetic fibres is a chemical process classified in class 2030. Manufacture of wearing apparel is covered in division 14.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1311	**Preparation and spinning of textile fibres**	This class includes: - preparatory operations on textile fibres.	- Raw silk (not thrown) - Wool, degreased or carbonized, not carded or combed - Wool and fine or coarse animal hair, carded or combed	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1311
1312	**Weaving of textiles**	This class includes: - manufacture of broad woven cotton-type, woollen-type, worsted-type or silk-type fabrics, including from mixtures or artificial or synthetic yarns	- Woven fabrics of silk or of silk waste - Woven fabrics of carded wool or of carded fine animal hair - Woven fabrics of flax	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity measured by area, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1312
1313	**Finishing of textiles**	This class includes: - bleaching and dyeing of textile fibres, yarns, fabrics and textile articles, including wearing apparel	- Bleached jeans - Pleating and similar work on textiles - Waterproofing, coating, rubberizing, or impregnating purchased garments - Silk-screen printing on textiles and wearing apparel	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity measured by area, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1313

Division: 13 – Manufacture of textiles – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1391	**Manufacture of knitted and crocheted fabrics**	This class includes: - manufacture and processing of knitted or crocheted fabrics	- Pile fabrics and terry fabrics, knitted or crocheted	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity measured by area, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1391**
1392	**Manufacture of made-up textile articles, except apparel**	This class includes: - manufacture, of made-up articles of any textile material, including of knitted or crocheted fabrics	- Blankets, including travelling rugs - Bed, table, toilet or kitchen linen - Quilts, eiderdowns, cushions, pouffes, pillows, sleeping bags etc. - Curtains, valances, blinds, bedspreads - Tarpaulins, tents, camping goods, sails, sunblinds - Flags, banners, pennants etc. - Dust cloths, dishcloths and similar articles, life jackets, parachutes	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity measured by area, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1392**
1393	**Manufacture of carpets and rugs**	This class includes: - manufacture of textile floor coverings: - carpets, rugs and mats, tiles	- Carpets and other textile floor coverings, woven, not tufted or flocked - Carpets and other textile floor coverings, tufted	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity measured by area, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1393**

Division: 13 – Manufacture of textiles – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1394	**Manufacture of cordage, rope, twine and netting**	This class includes: - manufacture of twine, cordage, rope and cables of textile fibres or strip or the like, whether or not impregnated, coated, covered or sheathed with rubber or plastics	- Twine, cordage, rope and cables	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity measured by unit of length, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1394
1399	**Manufacture of other textiles n.e.c.**	This class includes all activities related to the manufacture of textiles or textile products, not specified elsewhere in division 13 or 14, involving a large number of processes and a great variety of goods produced.	- Narrow woven fabrics; narrow fabrics of warp without weft assembled by adhesive (bolducs); labels, badges and similar articles of textile materials, not embroidered - Nonwovens - Textile products and articles for technical uses (including wicks, gas mantles, hosepiping, transmission or conveyor belts, bolting cloth and straining cloth)	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1399

Division: 14 – Manufacture of wearing apparel

This division includes all tailoring (ready-to-wear or made-to-measure), in all materials (e.g. leather, fabric, knitted and crocheted fabrics etc.), of all items of clothing (e.g. outerwear, underwear for men, women or children; work, city or casual clothing etc.) and accessories. There is no distinction made between clothing for adults and clothing for children, or between modern and traditional clothing. Division 14 also includes the fur industry (fur skins and wearing apparel).

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1410	**Manufacture of wearing apparel, except fur apparel**	This class includes the manufacture of wearing apparel. The material used may be of any kind and may be coated, impregnated or rubberized.	- Wearing apparel made of leather or composition leather - Outerwear made of woven, knitted or crocheted fabric, non-wovens etc. for men, women and children: coats, suits, ensembles, jackets, trousers, skirts - Underwear and nightwear made of woven, knitted or crocheted fabric	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1410
1420	**Manufacture of articles of fur**	This class includes manufacture of articles made of fur skins.	- Articles of apparel, clothing accessories and other articles of fur skin	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1420

Division: 14 – Manufacture of wearing apparel – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1430	**Manufacture of knitted and crocheted apparel**	This class includes: - manufacture of knitted or crocheted wearing apparel and other made-up articles directly into shape: pullovers, cardigans, jerseys, waistcoats and similar articles	- Panty hose, tights, stockings, socks and other hosiery, knitted or crocheted - Jerseys, pullovers, cardigans, waistcoats and similar articles, knitted or crocheted	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1430

Division: 15 – Manufacture of leather and related products

This division includes dressing and dyeing of fur and the transformation of hides into leather by tanning or curing and fabricating the leather into products for final consumption. It also includes the manufacture of similar products from other materials (imitation leathers or leather substitutes), such as rubber footwear, textile luggage etc. The products made from leather substitutes are included here, since they are made in ways similar to those in which leather products are made (e.g. luggage) and are often produced in the same unit.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1511	**Tanning and dressing of leather; dressing and dyeing of fur**	This class includes: - tanning, dyeing and dressing of hides and skins	- Chamois leather; patent leather and patent laminated leather; metallised leather - Tanned or dressed furskins	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by area, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1511
1512	**Manufacture of luggage, handbags and the like, saddlery and harness**	This class includes: - manufacture of luggage, handbags and the like, of leather, composition leather or any other material, such as plastic sheeting, textile materials, vulcanized fibre or paperboard, where the same technology is used as for leather	- Luggage, handbags and the like, of leather, composition leather, plastic sheeting, textile materials, vulcanized fibre or paperboard - Saddlery and harness, for any animal, of any material	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1512

Division: 15 – Manufacture of leather and related products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1520	**Manufacture of footwear**	This class includes: - manufacture of footwear for all purposes, of any material, by any process, including moulding	- Waterproof footwear, with outer soles and uppers of rubber or plastics - Footwear with uppers of textile materials, other than sports footwear - Ski-boots, snowboard boots and cross-country ski footwear - Tennis shoes, basketball shoes, gym shoes, training shoes	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1520**

Division: 16 – Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials

This division includes the manufacture of wood products, such as lumber, plywood, veneers, wood containers, wood flooring, wood trusses, and prefabricated wood buildings. The production processes include sawing, planing, shaping, laminating, and assembling of wood products starting from logs that are cut into bolts, or lumber that may then be cut further, or shaped by lathes or other shaping tools. The lumber or other transformed wood shapes may also be subsequently planed or smoothed, and assembled into finished products, such as wood containers. With the exception of sawmilling, this division is subdivided mainly based on the specific products manufactured. This division does not include the manufacture of furniture (3100), or the installation of wooden fittings and the like (4330).

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1610	**Sawmilling and planning of wood**	This class includes: - sawing, planning and machining of wood	- Wood, sawn or chipped lengthwise, sliced or peeled, of a thickness exceeding 6 mm; railway or tramway sleepers (cross-ties) of wood, not impregnated - Wood, continuously shaped along any of its edges or faces (including strips and friezes for parquet flooring, not assembled, and beadings and mouldings)	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by volume, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1610**

Division: 16 – Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1621	**Manufacture of veneer sheets and wood-based panels**	This class includes manufacture of veneer sheets thin enough to be used for veneering, making plywood or other purposes.	- Plywood consisting solely of sheets of wood - Other plywood, veneered panels and similar laminated wood - Particle board and similar board of wood or other ligneous materials - Fibreboard of wood or other ligneous materials	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by volume, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1621
1622	**Manufacture of builders' carpentry and joinery**	This class includes manufacture of wooden goods intended to be used primarily in the construction industry.	- Builders' joinery and carpentry of wood (including cellular wood panels, assembled parquet panels, shingles and shakes)	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by volume, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	1622

Division: 16 – Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1623	**Manufacture of wooden containers**	This class includes manufacture of packing cases, boxes, crates, drums and similar packings of wood	- Packing cases, boxes, crates, drums and similar packings, of wood; cable-drums of wood; pallets, box pallets and other load boards, of wood; casks, barrels, vats, tubs and other coopers' products and parts thereof, of wood (including staves)	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1623**
1629	**Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials**	This class includes manufacture of various wood products.	- Tools, tool bodies, tool handles, broom or brush bodies and handles, boot or shoe lasts and trees, of wood - Tableware and kitchenware, of wood - Articles of natural cork - Manufactures of straw, of esparto or of other plaiting materials; basketware and wickerwork	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1629**

Division: 17 – Manufacture of paper and paper products

This division includes the manufacture of pulp, paper and converted paper products. The manufacture of these products is grouped together because they constitute a series of vertically connected processes. More than one activity is often carried out in a single unit. There are essentially three activities: The manufacture of pulp involves separating the cellulose fibers from other impurities in wood or used paper. The manufacture of paper involves matting these fibers into a sheet. Converted paper products are made from paper and other materials by various cutting and shaping techniques, including coating and laminating activities. The paper articles may be printed (e.g. wallpaper, gift wrap etc.), as long as the printing of information is not the main purpose.

The production of pulp, paper and paperboard in bulk is included in class 1701, while the remaining classes include the production of further-processed paper and paper products.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1701	**Manufacture of pulp, paper and paperboard**	This class includes: - manufacture of bleached, semi-bleached or unbleached paper pulp by mechanical, chemical (dissolving or nondissolving) or semi-chemical processes - manufacture of cotton-linters pulp - removal of ink and manufacture of pulp from waste paper - manufacture of paper and paperboard intended for further industrial processing	- Chemical wood pulp - Newsprint - Composite paper and paperboard, not surface-coated or impregnated	**Volume indicator (output-based)** Quantity measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1701**

Division: 17 – Manufacture of paper and paper products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1702	**Manufacture of corrugated paper and paperboard and of containers of paper and paperboard**	This class includes manufacture of corrugated paper and paperboard	- Sacks and bags of paper - Corrugated paper and paperboard - Cartons, boxes, cases, record sleeves and other packing containers (except bags) of paper	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1702**
1709	**Manufacture of other articles of paper and paperboard**	This class includes manufacture of household and personal hygiene paper and cellulose wadding products.	- Toilet or facial tissue stock, towel or napkin stock and similar paper, cellulose wadding and webs of cellulose fibres - Paper cups, dishes and trays - Envelopes and letter-cards	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1709**

Division: 18 – Printing and reproduction of recorded media

This division includes printing of products, such as newspapers, books, periodicals, business forms, greeting cards, and other materials, and associated support activities, such as bookbinding, plate-making services, and data imaging. The support activities included here are an integral part of the printing industry, and a product (a printing plate, a bound book, or a computer disk or file) that is an integral part of the printing industry is almost always provided by these operations.
Processes used in printing include a variety of methods for transferring an image from a plate, screen, or computer file to a medium, such as paper, plastics, metal, textile articles, or wood. The most prominent of these methods entails the transfer of the image from a plate or screen to the medium through lithographic, gravure, screen or flexographic printing. Often a computer file is used to directly ''drive'' the printing mechanism to create the image or electrostatic and other types of equipment (digital or non-impact printing). Though printing and publishing can be carried out by the same unit (a newspaper, for example), it is less and less the case that these distinct activities are carried out in the same physical location. This division also includes the reproduction of recorded media, such as compact discs, video recordings, software on discs or tapes, records etc.
This division excludes publishing activities (see section J).

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1811	**Printing**	This class includes: - printing of newspapers, magazines and other periodicals, books and brochures, music and music manuscripts, maps, atlases, posters, etc	- Newspapers, journals and periodicals - Books and brochures, music and music manuscripts, maps, atlases, posters	**Volume indicator (output-based)** Quantity (count) of printed items, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1811**
1812	**Service activities related to printing**	This class includes: - binding of printed sheets, e.g. into books, brochures, magazines, catalogues etc., by folding, assembling, stitching, glueing, collating, basting, adhesive binding, trimming, gold stamping	- Binding of printed sheets, e.g. into books, brochures, magazines, catalogues etc - Engraving or etching of cylinders for gravure	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**1812**

Division: 18 – Printing and reproduction of recorded media – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1820	**Reproduction of recorded media**	This class includes: - reproduction from master copies of gramophone records, compact discs and tapes with music or other sound recordings	Reproduction from master copies to: - Tapes - Records - Compact discs and DVDs	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of reproductions, by type	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1820**

Division: 19 – Manufacture of coke and refined petroleum products

This division includes the transformation of crude petroleum and coal into usable products. The dominant process is petroleum refining, which involves the separation of crude petroleum into component products through such techniques as cracking and distillation. This division also includes the manufacture for own account of characteristic products (e.g. coke, butane, propane, petrol, kerosene, fuel oil etc.) as well as processing services (e.g. custom refining).
This division includes the manufacture of gases such as ethane, propane and butane as products of petroleum refineries.
Not included is the manufacture of such gases in other units (2011), manufacture of industrial gases (2011), extraction of natural gas (methane, ethane, butane or propane) (0600), and manufacture of fuel gas, other than petroleum gases (e.g. coal gas, water gas, producer gas, gasworks gas) (35420).
The manufacture of petrochemicals from refined petroleum is classified in division 20.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
1910	**Manufacture of coke oven products**	This class includes: - operation of coke ovens - production of coke and semi-coke - production of pitch and pitch coke - production of coke oven gas - production of crude coal and lignite tars - agglomeration of coke	- Coke and semi-coke of coal, of lignite or of peat; retort carbon	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1910**
1920	**Manufacture of refined petroleum products**	This class includes the manufacture of liquid or gaseous fuels or other products from crude petroleum, bituminous minerals or their fractionation products. Petroleum refining involves one or more of the following activities: fractionation, straight distillation of crude oil, and cracking.	- Motor spirit (gasolene) - Kerosene - Lubricating petroleum oils and oils obtained from bituminous minerals - Gas oils	**Volume indicator (output-based)** Quantities measured by volume, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**1920**

Division: 20 – Manufacture of chemicals and chemical products

This division includes the transformation of organic and inorganic raw materials by a chemical process and the formation of products. It distinguishes the production of basic chemicals that constitute the first industry group from the production of intermediate and end products produced by further processing of basic chemicals that make up the remaining industry classes.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2011	**Manufacture of basic chemicals**	This class includes the manufacture of chemicals using basic processes, such as thermal cracking and distillation. The outputs of these processes are usually separate chemical elements or separate chemically defined compounds.	- liquefied or compressed inorganic industrial or medical gases - dyes and pigments from any source in basic form or as concentrate - Hydrocarbons and their halogenated, sulphonated, nitrated or nitrosated derivatives	**Volume indicator (output-based)** Quantities measured by volume, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2011**
2012	**Manufacture of fertilizers and nitrogen compounds**	This class includes: - manufacture of fertilizers	- Nitrogenous fertilizers, mineral or chemical - Potassic fertilizers, mineral or chemical (except carnallite, sylvite and other crude natural potassium salts)	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2012**

Division: 20 – Manufacture of chemicals and chemical products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2013	**Manufacture of plastics and synthetic rubber in primary forms**	This class includes the manufacture of resins, plastics materials and non-vulcanizable thermoplastic elastomers, the mixing and blending of resins on a custom basis, as well as the manufacture of non-customized synthetic resins.	- Polymers of ethylene, in primary forms - Polymers of styrene, in primary forms - Polymers of vinyl chloride or other halogenated olefins, in primary forms - Polyacetals, other polyethers and epoxide resins, in primary forms; polycarbonates, alkyd resins, polyallyl esters and other polyesters, in primary forms	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by volume, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2013
2021	**Manufacture of pesticides and other agrochemical products**	This class includes manufacture of insecticides, rodenticides, fungicides, herbicides	- Pesticides	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by volume, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2021

Division: 20 – Manufacture of chemicals and chemical products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2022	**Manufacture of paints, varnishes and similar coatings, printing ink and mastics**	This class includes manufacture of paints and varnishes, enamels or lacquers	- Paints and varnishes (including enamels and lacquers); prepared pigments, prepared opacifiers and prepared colours, vitrifiable enamels and glazes etc - Printing ink	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by volume, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2022
2023	**Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations**	This class includes: - manufacture of organic surface-active agents - manufacture of soap - manufacture of paper, wadding, felt etc. coated or covered with soap or detergent	- Organic surface active agents, except soap - Detergents and washing preparations - Soap - Perfume	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by weight, by product or by volume, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2023
2029	**Manufacture of other chemical products n.e.c.**	This class includes: - manufacture of propellant powders - manufacture of explosives and pyrotechnic products, including percussion caps, detonators, signalling flares etc.	- Essential oils and concentrates - Prepared explosives; safety fuses; detonating fuses; percussion or detonating caps; igniters; electric detonators - Chemical elements and compounds doped for use in electronics	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2029

Division: 20 – Manufacture of chemicals and chemical products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2030	**Manufacture of man-made fibres**	This class includes: - manufacture of synthetic or artificial filament tow - manufacture of synthetic or artificial staple fibres, not carded, combed or otherwise processed for spinning	- Synthetic filament tow and staple fibres, not carded or combed - Synthetic filament yarn (except sewing thread and multiple or cabled yarn), not put up for retail sale - Artificial filament tow and staple fibres, not carded or combed - Artificial filament yarn (except sewing thread and multiple or cabled yarn), not put up for retail sale	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantities measured by area, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2030

Division: 21 – Manufacture of basic pharmaceutical products and pharmaceutical preparations

This division includes the manufacture of basic pharmaceutical products and pharmaceutical preparations. This includes also the manufacture of medicinal chemical and botanical products.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2100	**Manufacture of pharmaceuticals, medicinal chemical and botanical products**	This class includes manufacture of medicinal active substances to be used for their pharmacological properties in the manufacture of medicaments: antibiotics, basic vitamins, salicylic and O-acetylsalicylic acids etc.	- Provitamins, vitamins and hormones; glycosides and vegetable alkaloids and their salts, ethers, esters and other derivatives; antibiotics - Lysine and its esters and salts thereof; glutamic acid and its salts; quaternary ammonium salts and hydroxides; lecithins and other phosphoaminolipids; acyclic amides and their derivatives and salts thereof; cyclic amides (except ureines) and their derivatives and salts	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**2100**

Division: 22 – Manufacture of rubber and plastics products

This division includes the manufacture of rubber and plastics products.
This division is characterized by the raw materials used in the manufacturing process. However, this does not imply that the manufacture of all products made of these materials is classified here.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2211	**Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres**	This class includes manufacture of rubber tyres for vehicles, equipment, mobile machinery, aircraft, toy, furniture and other uses.	- New pneumatic tyres, of rubber, of a kind used on motor cars - New pneumatic tyres, of rubber, of a kind used on motorcycles or bicycles - Other new pneumatic tyres, of rubber	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of rubber tyres produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2211**
2219	**Manufacture of other rubber products**	This class includes: - manufacture of other products of natural or synthetic rubber, unvulcanized, vulcanized or hardened	- Unvulcanized compounded rubber, in primary forms or in plates, sheets or strip - Tubes, pipes and hoses of vulcanized rubber other than hard rubber - Conveyor or transmission belts or belting, of vulcanized rubber	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of rubber products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2219**

Division: 22 – Manufacture of rubber and plastics products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2220	**Manufacture of plastics products**	This class includes the processing of new or spent (i.e. recycled) plastics resins into intermediate or final products, using such processes as compression molding, extrusion molding, injection molding, blow molding and casting. For most of these, the production process is such that a wide variety of products can be made.	- Tubes, pipes and hoses, and fittings of plastics - Sacks and bags, of plastics - articles for the conveyance or packing of goods, of plastics; stoppers, lids, caps and other closures, of plastics	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of plastic products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2220

Division: 23 – Manufacture of other non-metallic mineral products

This division includes manufacturing activities related to a single substance of mineral origin. This division includes the manufacture of glass and glass products (e.g. flat glass, hollow glass, fibres, technical glassware etc.), ceramic products, tiles and baked clay products, and cement and plaster, from raw materials to finished articles. The manufacture of shaped and finished stone and other mineral products is also included in this division.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2310	**Manufacture of glass and glass products**	This class includes the manufacture of glass in all forms, made by any process and the manufacture of articles of glass.	- Unworked cast, rolled, drawn or blown glass, in sheets - Safety glass - Slivers, rovings, yarn and chopped strands, of glass - Bottles, jars, phials and other containers, of glass	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity of glass sheets measured by area, by product Quantity (count) of glass products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2310**
2391	**Manufacture of refractory products**	This class includes: - manufacture of refractory mortars, concretes etc.	- Refractory bricks, blocks, tiles and similar refractory ceramic constructional goods, other than those of siliceous earths - Refractory cements, mortars, concretes and similar compositions	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of refractory products produced, by product Quantities of refractory cements, mortars, concretes and similar compositions measured by volume, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2391**

Division: 23 – Manufacture of other non-metallic mineral products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2392	**Manufacture of clay building materials**	This class includes: - manufacture of non-refractory ceramic hearth or wall tiles, mosaic cubes etc.	- Non-refractory ceramic building bricks, flooring blocks, support or filler tiles, roofing tiles, chimney-pots, cowls, chimney liners, architectural ornaments and other ceramic construction goods	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2392
2393	**Manufacture of other porcelain and ceramic products**	This class includes: - manufacture of ceramic tableware and other domestic or toilet articles - manufacture of statuettes and other ornamental ceramic articles	- Ceramic sinks, baths, water closet pans, flushing cisterns and similar sanitary fixtures - Ceramic tableware, kitchenware, other household articles and toilet articles	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2393
2394	**Manufacture of cement, lime and plaster**	This class includes: - manufacture of clinkers and hydraulic cements, including Portland, aluminous cement, slag cement and superphosphate cements	- Plasters - Quicklime, slaked lime and hydraulic lime - Portland cement, aluminous cement, slag cement and similar hydraulic cements	**Volume indicator (output-based)** Quantities measured by volume, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2394

Division: 23 – Manufacture of other non-metallic mineral products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2395	**Manufacture of articles of concrete, cement and plaster**	This class includes: - manufacture of precast concrete, cement or artificial stone articles for use in construction:	- Articles of plaster or of compositions based on plaster - Tiles, flagstones, bricks and similar articles, of cement, concrete or artificial stone - Prefabricated structural components for building or civil engineering, of cement, concrete or artificial stone	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2395**
2396	**Cutting, shaping and finishing of stone**	This class includes: - cutting, shaping and finishing of stone for use in construction, in cemeteries, on roads, as roofing etc.	- Marble, travertine and alabaster, worked, and articles thereof	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**2396**

Division: 23 – Manufacture of other non-metallic mineral products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2399	**Manufacture of other non-metallic mineral products n.e.c.**	This class includes: - manufacture of millstones, sharpening or polishing stones and natural or artificial abrasive products, including abrasive products on a soft base (e.g. sandpaper)	- Millstones, grindstones, grinding wheels and the like, without frameworks, for working stones, and parts thereof, of natural stone, of agglomerated natural or artificial abrasives, or of ceramics; natural or artificial abrasive powder or grain, on a base of textile, paper or other material	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2399**

Division: 24 – Manufacture of basic metals

This division includes the activities of smelting and/or refining ferrous and non-ferrous metals from ore, pig or scrap, using electrometallurgic and other process metallurgic techniques. This division also includes the manufacture of metal alloys and super-alloys by introducing other chemical elements to pure metals. The output of smelting and refining, usually in ingot form, is used in rolling, drawing and extruding operations to make products such as plate, sheet, strip, bars, rods, wire, tubes, pipes and hollow profiles, and in molten form to make castings and other basic metal products.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2410	**Manufacture of basic iron and steel**	This class includes operations of conversion by reduction of iron ore in blast furnaces and oxygen converters or of ferrous waste and scrap in electric arc furnaces or by direct reduction of iron ore without fusion to obtain crude steel.	- Pig iron and spiegeleisen in pigs, blocks or other primary forms - Ferro-manganese - Ferro-chromium - Ingots, other primary forms, and semi-finished products of iron or non-alloy steel - Flat-rolled products of iron or steel	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2410**
2420	**Manufacture of basic precious and other non-ferrous metals**	This class includes production of basic precious metals and non-ferrous metals	- Silver, gold or platinum, unwrought or in semi-manufactured forms, or in powder form - Unrefined copper; copper anodes for electrolytic refining - Unwrought nickel	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2420**

Division: 24 – Manufacture of basic metals – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2431	**Casting of iron and steel**	This class includes the casting of iron and steel, i.e. the activities of iron and steel foundries.	- Casting of semi-finished iron products - Casting of semi-finished steel products - Casting of steel castings	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2431
2432	**Casting of non-ferrous metals**	This class includes the casting of semi-finished products of aluminium, magnesium, titanium, zinc etc.	- Casting of semi-finished products of aluminium, magnesium, titanium, zinc etc. - Casting of light metal castings - Casting of heavy metal castings - Casting of precious metal castings - Die-casting of non-ferrous metal castings	**Volume indicator (output-based)** Quantities measured by weight, by product	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2432

Division: 25 – Manufacture of fabricated metal products, except machinery and equipment

This division includes the manufacture of "pure" metal products (such as parts, containers and structures), usually with a static, immovable function, as opposed to the following divisions 26-30, which cover the manufacture of combinations or assemblies of such metal products (sometimes with other materials) into more complex units that, unless they are purely electrical, electronic or optical, work with moving parts. The manufacture of weapons and ammunition is also included in this division.
This division excludes specialized repair and maintenance activities (see group 331) and the specialized installation of manufactured goods produced in this division in buildings, such as central heating boilers (see 4322).

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2511	**Manufacture of structural metal products**	This class includes: - manufacture of metal frameworks or skeletons for construction and parts thereof (towers, masts, trusses, bridges etc.)	- Bridges, bridge sections, towers and lattice masts, of iron or steel - Doors, windows and their frames and thresholds for doors, of iron, steel or aluminium - plates, rods, angles, shapes, sections, profiles, tubes and the like, prepared for use in structures, of iron, steel or aluminium	**Volume indicator (output-based)*** Quantities measured by weight, by product Quantity (count) of structural metal products produced, by product *or* **Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**2511**

* This industry produces a variety of metal products (from bridges to steel plates). Therefore the volume indicator to be used will depend on the product being measured. This is why a variety of preferred volume methods are presented for this industry.

Division: 25 – Manufacture of fabricated metal products, except machinery and equipment – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2512	**Manufacture of tanks, reservoirs and containers of metal**	This class includes: - manufacture of reservoirs, tanks and similar containers of metal, of types normally installed as fixtures for storage or manufacturing use	- Reservoirs, tanks, vats and similar containers (other than for compressed or liquefied gas), of iron, steel or aluminium, of a capacity exceeding 300 litres, not fitted with mechanical or thermal equipment - Containers for compressed or liquefied gas, of iron, steel or aluminium	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2512
2513	**Manufacture of steam generators, except central heating hot water boilers**	This class includes: - manufacture of steam or other vapour generators - manufacture of auxiliary plant for use with steam generators	- Steam or other vapour generating boilers (other than central heating hot water boilers capable also of producing low pressure steam); super-heated water boilers - Auxiliary plant for use with boilers	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2513

Division: 25 – Manufacture of fabricated metal products, except machinery and equipment – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2520	**Manufacture of weapons and ammunition**	This class includes: - manufacture of heavy weapons (artillery, mobile guns, rocket launchers, torpedo tubes, heavy machine guns)	- Revolvers, pistols, other firearms and similar devices; other arms - Bombs, grenades, torpedoes, mines, missiles and similar munitions of war and parts thereof - Heavy weapons (artillery, mobile guns, rocket launchers, torpedo tubes, heavy machine guns)	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2520
2591	**Forging, pressing, stamping and roll-forming of metal; powder metallurgy**	This class includes forging, pressing, stamping and roll-forming of metal - powder metallurgy: production of metal objects directly from metal powders by heat treatment (sintering) or under pressure	- Forging, pressing, stamping and roll-forming of metal - Powder metallurgy: production of metal objects directly from metal powders by heat treatment (sintering) or under pressure	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	2591
2592	**Treatment and coating of metals; machining**	This class includes: - plating, anodizing etc. of metals - heat treatment of metals - deburring, sandblasting, tumbling, cleaning of metals - colouring and engraving of metals - non-metallic coating of metals	- Plating, anodizing etc. of metals - Heat treatment of metals - Deburring, sandblasting, tumbling, cleaning of metals	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	2592

Division: 25 – Manufacture of fabricated metal products, except machinery and equipment – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2593	**Manufacture of cutlery, hand tools and general hardware**	This class includes: - manufacture of domestic cutlery such as knives, forks, spoons etc.	- Knives (except for machines) and scissors - Spoons, forks, ladles, skimmers, cake-servers, fish-knives, butter-knives, sugar tongs and similar kitchen or table ware - Hand tools (including, hand saws, files, pliers)	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2593**
2599	**Manufacture of other fabricated metal products n.e.c.**	Please refer to the ISIC explanatory notes for a description of various activities that are in-scope of this class.	- Tanks, casks, drums, cans, boxes and similar containers - Nails, tacks, staples (except staples in strips), screws, bolts, nuts, screw hooks, rivets, cotters, cotter-pins, washers	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2599**

Division: 26 – Manufacture of computer, electronic and optical products

This division includes the manufacture of computers, computer peripherals, communications equipment, and similar electronic products, as well as the manufacture of components for such products. Production processes of this division are characterized by the design and use of integrated circuits and the application of highly specialized miniaturization technologies.
The division also contains the manufacture of consumer electronics, measuring, testing, navigating, and control equipment, irradiation, electromedical and electrotherapeutic equipment, optical instruments and equipment, and the manufacture of magnetic and optical media.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2610	**Manufacture of electronic components and boards**	This class includes the manufacture of semiconductors and other components for electronic applications.	- Interface cards (sound, video, etc) - Display components (plasma, polymer, LCD) - Electronic resistors and capacitors	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, with quality adjustments, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2610**
2620	**Manufacture of computers and peripheral equipment**	This class includes the manufacture and/or assembly of electronic computers, such as mainframes, desktop computers, laptops and computer servers.	- Desktop, laptop, notebook, mainframe computers - Printers - Monitors - Scanners	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, with quality adjustments, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2620**
2630	**Manufacture of communication equipment**	This class includes the manufacture of telephone and data communications equipment used to move signals electronically over wires or through the air such as radio and television broadcast and wireless communications equipment.	- Cordless telephones - Radio and television transmitters - Cellular phones	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, with quality adjustments, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2630**

Division: 26 – Division 26: Manufacture of computer, electronic and optical products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2640	**Manufacture of consumer electronics**	This class includes the manufacture of electronic audio and video equipment for home entertainment, motor vehicle, public address systems and musical instrument amplification.	- Televisions - CD and DVD players - Headphones (e.g. radio, stereo, computer) - Speaker systems	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2640
2651	**Manufacture of measuring, testing, navigating and control equipment**	This class includes the manufacture of search, detection, navigation, guidance, aeronautical and nautical systems and instruments.	- Radar apparatus - Surveying instruments - Meteorological instruments - radiation detection and monitoring instruments	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2651
2652	**Manufacture of watches and clocks**	This class includes the manufacture of watches, clocks and timing mechanisms and parts thereof.	- Watches - Clocks - Time-recording equipment (e.g. parking meters) - components for clocks and watches	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2652
2660	**Manufacture of irradiation, electromedical and electrotherapeutic equipment**	This class includes manufacture of irradiation apparatus and tubes (e.g. industrial, medical diagnostic, medical therapeutic, research, scientific)	- Irradiation apparatus and tubes - CT and PET scanners - Hearing aids - Magnetic resonance imaging (MRI) equipment	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2660

Division: 26 – Division 26: Manufacture of computer, electronic and optical products – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2670	**Manufacture of optical instruments and photographic equipment**	This class includes the manufacture of optical instruments and lenses, such as binoculars, microscopes (except electron, proton).	- Optical microscopes, binoculars and telescopes - Film cameras and digital cameras - Optical magnifying instruments - Lenses and prisms	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2670
2680	**Manufacture of magnetic and optical media**	This class includes the manufacture of magnetic and optical recording media.	- Blank magnetic audio and video tapes - Blank diskettes - Blank optical discs - Hard drive media	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2680

Division: 27 – Manufacture of electrical equipment

This division includes the manufacture of products that generate, distribute and use electrical power. Also included is the manufacture of electrical lighting, signalling equipment and electric household appliances. This division excludes the manufacture of electronic products (see division 26).

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2710	**Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus**	This class includes the manufacture of power, distribution and specialty transformers; electric motors, generators and motor generator sets; switchgear and switchboard apparatus; relays and industrial controls.	- Electric distribution transformers - Arc-welding transformers - Transmission and distribution voltage regulators - Electric motors	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2710
2720	**Manufacture of batteries and accumulators**	This class includes the manufacture of non-rechargeable and rechargeable batteries.	- Primary cells and primary batteries - Lead acid batteries - Electric accumulators	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2720
2731	**Manufacture of fibre optic cables**	This class includes: - manufacture of fiber optic cable for data transmission or live transmission of images	- Fiber optic cable for data transmission or live transmission of images	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity measured by unit of length, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2731
2732	**Manufacture of other electronic and electric wires and cables**	This class includes the manufacture of insulated wire and cable, made of steel, copper, aluminium.	- Insulated wire and cable, made of steel, copper, aluminium	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity measured by unit of length, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2732

Division: 27 – Manufacture of electrical equipment – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2733	**Manufacture of wiring devices**	This class includes the manufacture of current-carrying and non current-carrying wiring devices for electrical circuits regardless of material.	- Plastic non current-carrying wiring devices including plastic junction boxes, face plates, and similar, plastic pole line fittings - Boxes for electrical wiring (e.g. junction, outlet, switch boxes) - Switches for electrical wiring (e.g. pressure, pushbutton, snap, tumbler switches)	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2733
2740	**Manufacture of electric lighting equipment**	This class includes the manufacture of electric light bulbs and tubes and parts and components thereof.	- Ceiling lighting fixtures - Chandeliers - Flashlights - Electric insect lamps - Street lighting fixtures (except traffic signals)	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2740

Division: 27 – Manufacture of electrical equipment – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2750	**Manufacture of domestic appliances**	This class includes the manufacture of small electric appliances and electric housewares.	- Refrigerators - Freezers - Dishwashers - Washing and drying machines - Vacuum cleaners - Electric water heaters	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2750
2790	**Manufacture of other electrical equipment**	This class includes the manufacture of miscellaneous electrical equipment other than motors, generators and transformers, batteries and accumulators, wires and wiring devices, lighting equipment or domestic appliances.	- Battery chargers - Door opening and closing devices, electrical - Sirens - Electrical signalling equipment such as traffic lights and pedestrian signalling equipment	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2790

Division: 28 – Manufacture of machinery and equipment n.e.c.

This division includes the manufacture of machinery and equipment that act independently on materials either mechanically or thermally or perform operations on materials (such as handling, spraying, weighing or packing), including their mechanical components that produce and apply force, and any specially manufactured primary parts.
This includes the manufacture of fixed and mobile or hand-held devices, regardless of whether they are designed for industrial, building and civil engineering, agricultural or home use. The manufacture of special equipment for passenger or freight transport within demarcated premises also belongs within this division.
This division distinguishes between the manufacture of special-purpose machinery, i.e. machinery for exclusive use in an ISIC industry or a small cluster of ISIC industries, and general-purpose machinery, i.e. machinery that is being used in a wide range of ISIC industries.
This division also includes the manufacture of other special-purpose machinery, not covered elsewhere in the classification, whether or not used in a manufacturing process, such as fairground amusement equipment, automatic bowling alley equipment, etc.
This division excludes the manufacture of metal products for general use (division 25), associated control devices, computer equipment, measurement and testing equipment, electricity distribution and control apparatus (divisions 26 and 27) and general-purpose motor vehicles (divisions 29 and 30).

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2811	**Manufacture of engines and turbines, except aircraft, vehicle and cycle engines**	This class includes: - manufacture of internal combustion piston engines, except motor vehicle, aircraft and cycle propulsion engines.	- Marine engines - Railway engines - Pistons, piston rings, carburetors and such for all internal combustion engines - Turbines	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2811**

Division: 28 – Manufacture of machinery and equipment n.e.c. – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2812	**Manufacture of fluid power equipment**	This class includes: - manufacture of hydraulic and pneumatic components (including hydraulic pumps, hydraulic motors, hydraulic and pneumatic cylinders, hydraulic and pneumatic valves.	- Hydraulic and pneumatic components (including hydraulic pumps, hydraulic motors, hydraulic and pneumatic cylinders, hydraulic and pneumatic valves, hydraulic and pneumatic hose and fittings) - Fluid power systems - Hydraulic transmission equipment	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2812**
2813	**Manufacture of other pumps, compressors, taps and valves**	This class includes: - manufacture of air or vacuum pumps, air or other gas compressors	- Air or vacuum pumps, air or other gas compressors - Pumps for liquids - Industrial taps and valves	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2813**
2814	**Manufacture of bearings, gears, gearing and driving elements**	This class includes: - manufacture of ball and roller bearings and parts thereof - manufacture of mechanical power transmission equipment.	- Ball or roller bearings - Gears and gearing; ball or roller screws, gear boxes and other speed changers	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2814**

Division: 28 – Manufacture of machinery and equipment n.e.c. – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2815	**Manufacture of ovens, furnaces and furnace burners**	This class includes: - manufacture of electrical and other industrial and laboratory furnaces and ovens, including incinerators	- Electrical and other industrial and laboratory furnaces and ovens - Mount electric space heaters - Electric household-type furnaces	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2815**
2816	**Manufacture of lifting and handling equipment**	This class includes manufacture of hand-operated or power-driven lifting, handling, loading or unloading machinery.	- Pulley tackle and hoists, winches, capstans and jacks - Lifts, escalators and moving walkways - Cranes, mobile lifting frames, straddle carriers	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2816**
2817	**Manufacture of office machinery and equipment (except computers and peripheral equipment)**	This class includes: - manufacture of calculating machines - manufacture of adding machines, cash registers	- Adding machines, cash registers - Postage meters, mail handling machines - Staplers and staple removers - Photocopy machines	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2817**

Division: 28 – Manufacture of machinery and equipment n.e.c. – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2818	**Manufacture of power-driven hand tools**	This class includes manufacture of hand tools, with self-contained electric or non-electric motor or pneumatic drive.	- Circular or reciprocating saws - Drills and hammer drills - Hand held power sanders - Pneumatic nailers - Buffers - Routers - Grinders	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2818**
2819	**Manufacture of other general-purpose machinery**	This class includes: - manufacture of industrial refrigerating or freezing equipment, including assemblies of major components - manufacture of air-conditioning machines, including for motor vehicles - manufacture of non-domestic fans	- Air-conditioning machines - Industrial refrigerating or freezing equipment - Filtering or purifying machinery and apparatus for liquids - Spray guns, fire extinguishers, sandblasting machines, steam cleaning machines	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2819**
2821	**Manufacture of agricultural and forestry machinery**	This class includes: - manufacture of tractors used in agriculture and forestry	- Tractors used in agriculture and forestry - Mowers, including lawnmowers - Ploughs, manure spreaders, seeders, harrows	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2821**

Division: 28 – Manufacture of machinery and equipment n.e.c. – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2822	**Manufacture of metal-forming machinery and machine tools**	This class includes the manufacture of machine tools for working metals and other materials (wood, bone, stone, hard rubber, hard plastics, cold glass etc.)	- Machine tools for turning, drilling, milling, shaping, planing, boring, grinding - Punch presses, hydraulic presses, hydraulic brakes, drop hammers, forging machines - Electroplating machinery	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2822
2823	**Manufacture of machinery for metallurgy**	This class includes the manufacture of machines and equipment for handling hot metals.	- Machines and equipment for handling hot metals (converters, ingot moulds, ladles, casting machines) - Metal-rolling mills	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2823
2824	**Manufacture of machinery for mining, quarrying and construction**	This class includes the manufacture of continuous-action elevators and conveyors for underground use	- Front-end shovel loaders - Bulldozers and angledozers - Mechanical shovels, excavators and shovel loaders - Boring, cutting, sinking and tunnelling machinery	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	2824

Division: 28 – Manufacture of machinery and equipment n.e.c. – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2825	**Manufacture of machinery for food, beverage and tobacco processing**	This class includes: - manufacture of agricultural dryers - manufacture of machinery for the dairy industry	- Cream separators - Milk processing machinery (e.g. homogenizers) - Presses, crushers etc. used to make wine, cider, fruit juices - Bakery ovens, dough mixers, dough-dividers, moulders - Machinery to make confectionery	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2825**
2826	**Manufacture of machinery for textile, apparel and leather production**	This class includes the manufacture of textile, apparel and leather production machinery.	- Machines for preparing, producing, extruding, drawing, texturing or cutting man-made textile fibres, materials or yarns - Spinning machines - Textile printing machinery	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2826**

Division: 28 – Manufacture of machinery and equipment n.e.c. – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2829	**Manufacture of other special-purpose machinery**	This class includes the manufacture of special-purpose machinery not elsewhere classified.	- Machinery for making paper pulp - Printing and bookbinding machines - Machinery for producing tiles, bricks, shaped ceramic pastes, pipes - Semi-conductor manufacturing machinery - Aircraft launching gear, aircraft carrier catapults and related equipment	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2829**

Division: 29 – Manufacture of motor vehicles, trailers and semi-trailers

This division includes the manufacture of motor vehicles for transporting passengers or freight. The manufacture of various parts and accessories, as well as the manufacture of trailers and semi-trailers, is included here. The maintenance and repair of vehicles produced in this division are classified in 4520.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2910	**Manufacture of motor vehicles**	This class includes: - manufacture of passenger cars - manufacture of commercial vehicles.	- Passenger cars - Commercial vehicles (vans, lorries, over-the-road tractors for semi-trailers etc) - Buses, trolley-buses and coaches - Motor vehicle engines - Chassis fitted with engines	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of motor vehicles produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2910**
2920	**Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers**	This class includes: - manufacture of bodies, including cabs for motor vehicles - outfitting of all types of motor vehicles, trailers and semi-trailers - manufacture of trailers and semi-trailers.	- Bodies, including cabs for motor vehicles - Outfitting of all types of motor vehicles, trailers and semi-trailers - Trailers and semi-trailers	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2920**

Division: 29 – Manufacture of motor vehicles, trailers and semi-trailers – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
2930	**Manufacture of parts and accessories for motor vehicles**	This class includes the manufacture of diverse parts and accessories for motor vehicles.	- Brakes, gearboxes, axles, road wheels, suspension shock absorbers, radiators, silencers, exhaust pipes, catalytic converters, clutches, steering wheels, steering columns and steering boxes	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2930**

Division: 30 – Manufacture of other transport equipment

This division includes the manufacture of transportation equipment such as ship building and boat manufacturing, the manufacture of railroad rolling stock and locomotives, air and spacecraft and the manufacture of parts thereof.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3011	**Building of ships and floating structures**	This class includes the building of ships, except vessels for sports or recreation, and the construction of floating structures.	- Passenger vessels, ferry boats, cargo ships, tankers, tugs - Warships - Fishing boats and fish-processing factory vessels - Floating docks, pontoons, coffer-dams, floating landing stages, buoys	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**Deflated indicator** Value of raw material consumption (major materials) used in production deflated by appropriate quality adjusted PPI	**3011**
3012	**Building of pleasure and sporting boats**	This class includes: - manufacture of inflatable boats and rafts - building of sailboats with or without auxiliary motor - building of motor boats	- Inflatable boats and rafts - Canoes, kayaks, rowing boats, skiffs - Motor boats - Sailboats	**Volume indicator (output-based)** Quantity (count) of products produced, by product *or* **Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**3012**

Division: 30 – Manufacture of other transport equipment – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3020	**Manufacture of railway locomotives and rolling stock**	This class includes: - manufacture of electric, diesel, steam and other rail locomotives - manufacture of self-propelled railway or tramway coaches, vans and trucks, maintenance or service vehicles	- Electric, diesel, steam and other rail locomotives - Railway or tramway rolling stock - specialized parts (bogies, axles and wheels, brakes and parts of brakes; etc)	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**Deflated indicator** Value of raw material consumption (major materials) used in production deflated by appropriate quality adjusted PPI	3020
3030	**Manufacture of air and spacecraft and related machinery**	This class includes: - manufacture of airplanes for the transport of goods or passengers, for use by the defence forces, for sport or other purposes - manufacture of helicopters	- Airplanes for the transport of goods or passengers, for use by the defence forces, for sport or other purposes - Helicopters - Spacecraft and launch vehicles, satellites, planetary probes, orbital stations, shuttles	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**Deflated indicator** Value of raw material consumption (major materials) used in production deflated by appropriate quality adjusted PPI	3030
3040	**Manufacture of military fighting vehicles**	This class includes: - manufacture of tanks - manufacture of armored amphibious military vehicles - manufacture of other military fighting vehicles	- Tanks - Armored amphibious military vehicles - Military fighting vehicles	**Volume indicator** Quantity (count) of products produced, by product *or* **Deflated indicator** Number of hours worked adjusted for changes in productivity	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**Deflated indicator** Value of raw material consumption (major materials) used in production deflated by appropriate quality adjusted PPI	3040

Division: 30 – Manufacture of other transport equipment – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3091	**Manufacture of motorcycles**	This class includes: - manufacture of motorcycles, mopeds and cycles fitted with an auxiliary engine - manufacture of engines for motorcycles - manufacture of sidecars - manufacture of parts and accessories for motorcycles	- Motorcycles, mopeds and cycles fitted with an auxiliary engine - Engines for motorcycles - Sidecars	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	3091
3092	**Manufacture of bicycles and invalid carriages**	This class includes: - manufacture of non-motorized bicycles and other cycles, including (delivery) tricycles, tandems, children's bicycles and tricycles	- Non-motorized bicycles and other cycles - Parts and accessories of bicycles - Invalid carriages with or without motor	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	3092
3099	**Manufacture of other transport equipment n.e.c.**	This class includes: - manufacture of hand-propelled vehicles: luggage trucks, handcarts, sledges, shopping carts etc. - manufacture of vehicles drawn by animals: sulkies, donkey-carts, hearses etc.	- Hand-propelled vehicles: luggage trucks, handcarts, sledges, shopping carts - Vehicles drawn by animals: sulkies, donkey-carts, hearses	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	3099

Division: 31 – Manufacture of furniture

This division includes the manufacture of furniture and related products of any material except stone, concrete and ceramic. The processes used in the manufacture of furniture are standard methods of forming materials and assembling components, including cutting, moulding and laminating. The design of the article, for both aesthetic and functional qualities, is an important aspect of the production process.
Some of the processes used in furniture manufacturing are similar to processes that are used in other segments of manufacturing. For example, cutting and assembly occurs in the production of wood trusses that are classified in division 16 (Manufacture of wood and wood products). However, the multiple processes distinguish wood furniture manufacturing from wood product manufacturing. Similarly, metal furniture manufacturing uses techniques that are also employed in the manufacturing of roll-formed products classified in division 25 (Manufacture of fabricated metal products). The molding process for plastics furniture is similar to the molding of other plastics products. However, the manufacture of plastics furniture tends to be a specialized activity.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3100	**Manufacture of furniture**	This class includes the manufacture of furniture of any kind, any material (except stone, concrete or ceramic) for any place and various purposes.	- Chairs and seats for offices, workrooms, hotels, restaurants, public and domestic premises - Sofas, sofa beds and sofa sets - Special furniture for shops: counters, display cases, shelves - Furniture for bedrooms, living rooms, gardens - Laboratory benches, stools and other laboratory seating	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**3100**

Division: 32 – Other manufacturing

This division includes the manufacture of a variety of goods not covered in other parts of the classification. Since this is a residual division, production processes, input materials and use of the produced goods can vary widely and usual criteria for grouping classes into divisions have not been applied here.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3211	**Manufacture of jewellery and related articles**	This class includes: - production of worked pearls - production of precious and semi-precious stones in the worked state, including the working of industrial quality stones and synthetic or reconstructed precious or semi-precious stones	- Pearls - Coins, including coins for use as legal tender, whether or not of precious metal - Precious metal watch bands, wristbands, watch straps and cigarette cases - Working of diamonds	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	3211
3212	**Manufacture of imitation jewellery and related articles**	This class includes: - manufacture of costume or imitation jewellery	- Costume or imitation jewellery (rings, bracelets, necklaces, and similar articles of jewellery made from base metals plated with precious metals) - Jewellery containing imitation stones such as imitation gems stones, imitation diamonds	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	3212

Division: 32 – Other manufacturing – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3220	**Manufacture of musical instruments**	This class includes the manufacture of stringed instruments, keyboard stringed instruments, including automatic pianos, keyboard pipe organs, including harmoniums and similar keyboard instruments with free metal reeds, etc.	- Stringed instruments - Keyboard stringed instruments - Percussion musical instruments - Wind instruments	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	3220
3230	**Manufacture of sports goods**	This class includes the manufacture of sporting and athletic goods (except apparel and footwear).	- Hard, soft and inflatable balls - Hard, soft and inflatable balls - Rackets, bats and clubs - Skis, bindings and poles - Ski-boots - Sailboards and surfboards - Requisites for sport fishing, including landing nets - Requisites for hunting, mountain climbing etc. - Leather sports gloves and sports headgear - Ice skates, roller skates	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	3230

Division: 32 – Other manufacturing – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3240	**Manufacture of games and toys**	This class includes the manufacture of dolls, toys and games (including electronic games), scale models and children's vehicles (except metal bicycles and tricycles).	- Dolls and doll garments, parts and accessories - Action figures - Toy animals - Toy musical instruments - Playing cards - Board games and similar games - Electronic games: chess etc	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**3240**
3250	**Manufacture of medical and dental instruments and supplies**	This class includes the manufacture of laboratory apparatus, surgical and medical instruments, surgical appliances and supplies, dental equipment and supplies, orthodontic goods, dentures and orthodontic appliances.	- Surgical drapes and sterile string and tissue - Dental fillings and cements - Bone reconstruction cements - Dental laboratory furnaces - Operating tables - Examination tables - Hospital beds with mechanical fittings - Dentists' chairs	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**3250**

Division: 32 – Other manufacturing – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3290	**Other manufacturing n.e.c.**	This class includes the manufacture of a variety of goods not elsewhere classified.	- Fire-resistant and protective safety clothing - Ear and noise plugs (e.g. for swimming and noise protection) - Gas masks - Brooms and brushes - Pens and pencils of all kinds - Globes - Umbrellas, sun-umbrellas, walking sticks, seat-sticks	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (output-based)** Quantity (count) of products produced, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**3290**

Division: 33 – Repair and installation of machinery and equipment

This division includes the specialized repair of goods produced in the manufacturing sector with the aim to restore machinery, equipment and other products to working order. The provision of general or routine maintenance (i.e. servicing) on such products to ensure they work efficiently and to prevent breakdown and unnecessary repairs is included.
This division does only include specialized repair and maintenance activities. A substantial amount of repair is also done by manufacturers of machinery, equipment and other goods, in which case the classification of units engaged in these repair and manufacturing activities is done according to the value-added principle which would often assign these combined activities to the manufacture of the good. The same principle is applied for combined trade and repair.
The rebuilding or remanufacturing of machinery and equipment is considered a manufacturing activity and included in other divisions of this section.
Repair and maintenance of goods that are utilized as capital goods as well as consumer goods is typically classified as repair and maintenance of household goods (e.g. office and household furniture repair, see 9524).
Also included in this division is the specialized installation of machinery. However, the installation of equipment that forms an integral part of buildings or similar structures, such as installation of electrical wiring, installation of escalators or installation of air-conditioning systems, is classified as construction.
This division excludes the cleaning of industrial machinery (see class 8129) and the repair and maintenance of computers, communications equipment and household goods (see division 95).

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3311	**Repair of fabricated metal products**	This class includes the repair and maintenance of fabricated metal products of division 25.	- Repair of metal tanks, reservoirs and containers - Repair and maintenance for pipes and pipelines - Mobile welding repair - Platework repair of central heating boilers and radiators	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**3311**

Division: 33 – Repair and installation of machinery and equipment – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3312	**Repair of machinery**	This class includes the repair and maintenance of industrial machinery and equipment like sharpening or installing commercial and industrial machinery blades and saws; the provision of welding (e.g. automotive, general) repair services; the repair of agricultural and other heavy and industrial machinery and equipment (e.g. forklifts and other materials handling equipment, machine tools, commercial refrigeration equipment, construction equipment and mining machinery), comprising machinery and equipment of division 28.	- Repair and maintenance of pumps and related equipment - Repair of valves - Repair of gearing and driving elements - Repair and maintenance of industrial process furnaces - Repair of other power-driven hand-tools	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**3312**
3313	**Repair of electronic and optical equipment**	This class includes the repair and maintenance of goods produced in groups 265, 266 and 267, except those that are considered household goods.	- Repair and maintenance of the measuring, testing, navigating and control equipment - Repair and maintenance of irradiation, electromedical and electrotherapeutic equipment - Repair and maintenance of optical instruments and equipment	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**3313**

Division: 33 – Repair and installation of machinery and equipment – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3314	**Repair of electrical equipment**	This class includes the repair and maintenance of goods of division 27, except those in class 2750 (domestic appliances).	Repair and maintenance of: - power, distribution, and specialty transformers - electric motors, generators, and motor generator sets - switchgear and switchboard apparatus - relays and industrial controls	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**3314**
3315	**Repair of transport equipment, except motor vehicles**	This class includes the repair and maintenance of transport equipment of division 30, except motorcycles and bicycles. However, the factory rebuilding or overhaul of ships, locomotives, railroad cars and aircraft is classified in division 30.	Repair and routine maintenance of: - Ships - Pleasure boats - Locomotives and railroad cars - Aircraft - Aircraft engines - Drawn buggies and wagons	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**3315**

Division: 33 – Repair and installation of machinery and equipment – con't

3319	**Repair of other equipment**	This class includes the repair and maintenance of equipment not covered in other groups of this division.	Repair of: - Fishing nets, including mending - Ropes, riggings, canvas and tarps - Fertilizer and chemical storage bags - Reconditioning of wooden pallets, shipping drums or barrels, and similar items - Pinball machines and other coin-operated games - Restoring of organs and other historical musical instruments	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**3319**
3320	**Installation of industrial machinery and equipment**	This class includes the specialized installation of machinery. However, the installation of equipment that forms an integral part of buildings or similar structures is classified as construction.	Installation of - Industrial machinery in industrial plant - Industrial process control equipment - Industrial communications equipment - mainframe and similar computers - Irradiation and electromedical equipment etc. - Bowling alley equipment	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**3320**

ISIC Section: D – Electricity, gas, steam and air conditioning supply

This section includes the activity of providing electric power, natural gas, steam, hot water and the like through a permanent infrastructure (network) of lines, mains and pipes. The dimension of the network is not decisive; also included are the distribution of electricity, gas, steam, hot water and the like in industrial parks or residential buildings.

This section therefore includes the operation of electric and gas utilities, which generate, control and distribute electric power or gas. Also included is the provision of steam and air-conditioning supply. This section excludes the operation of water and sewerage utilities, see 36, 37. This section also excludes the (typically long-distance) transport of gas through pipelines.

Division: 35 – Electricity, gas, steam and air conditioning supply

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3510	**Electric power generation, transmission and distribution**	This class includes the generation of bulk electric power, transmission from generating facilities to distribution centers and distribution to end users.	- Generation of electricity - Transmission of electricity	**Volume indicator (output-based)** Quantity of electric power generated measured by unit of energy (e.g. megawatt hours)	**Deflated indicator*** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	3510
3520	**Manufacture of gas; distribution of gaseous fuels through mains**	This class includes the manufacture of gas and the distribution of natural or synthetic gas to the consumer through a system of mains.	- Supply of gas - Gaseous fuels with a specified calorific value, by purification, blending and other processes from gases of various types including natural gas - Transportation, distribution and supply of gaseous fuels of all kinds through a system of mains	**Volume indicator (output-based)** Quantity of gas distributed, measured by volume, by product	**Deflated indicator*** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	3520

* See footnote on the next page.

Division: 35 – Electricity, gas, steam and air conditioning supply – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3530	**Steam and air conditioning supply**	This class includes: - production, collection and distribution of steam and hot water for heating, power and other purposes	- Production, collection and distribution of steam and hot water for heating, power and other purposes - Production and distribution of cooled air - Production and distribution of chilled water for cooling purposes - Ice, including ice for food and non-food (e.g. cooling) purposes	**Volume indicator (output-based)** Quantity of steam, water or ice distributed, measured by volume, by product	**Deflated indicator*** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**3530**

* In circumstances where the deflation method is used for industries 3510, 3520 and 3530, it is likely that several different price indices would be required. This is because different prices are charged by the producer depending on the type of consumption (i.e. different prices are paid by residential, commercial and industrial users).

ISIC Section: E – Water supply; sewerage, waste management and remediation activities

This section includes activities related to the management (including collection, treatment and disposal) of various forms of waste, such as solid or non-solid industrial or household waste, as well as contaminated sites. The output of the waste or sewage treatment process can either be disposed of or become an input into other production processes. Activities of water supply are also grouped in this section, since they are often carried out in connection with, or by units also engaged in, the treatment of sewage.

Division: 36 – Water collection, treatment and supply

This division includes the collection, treatment and distribution of water for domestic and industrial needs. Collection of water from various sources, as well as distribution by various means is included.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3600	**Water collection, treatment and supply**	This class includes water collection, treatment and distribution activities for domestic and industrial needs. Collection of water from various sources, as well as distribution by various means is included. The operation of irrigation canals is also included; however the provision of irrigation services through sprinklers, and similar agricultural support services, is not included.	- Distribution services of water - Water collection - Water treatment	**Volume indicator (output-based)** Quantity of water collected, treated or supplied, measured by volume	**Volume indicator** Number of connections to the water supply system	**Volume indicator (input-based)** Quantity of raw materials measured by weight used in the water treatment process	**3600**

Division: 37 – Sewerage

This division includes the operation of sewer systems or sewage treatment facilities that collect, treat, and dispose of sewage.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3700	**Sewerage**	This class includes the operation of sewer systems or sewer treatment facilities	- Sewerage removal services usually provided using equipment such as waste pipes, sewers or drains - Sewerage treatment services using dilution, screening and filtering, sedimentation, chemical precipitation	**Volume indicator (output-based)** Quantity of sewerage removed or treated, measured by volume	**Volume indicator** Number of connections to the sewer system	**Volume indicator (input-based)** Quantity of raw materials measured by weight used in the sewerage treatment process	**3700**

Division: 38 – Waste collection, treatment and disposal activities; materials recovery

This division includes the collection, treatment, and disposal of waste materials. This also includes local hauling of waste materials and the operation of materials recovery facilities (i.e. those that sort recoverable materials from a waste stream).

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3811	**Collection of non-hazardous waste**	This class includes the collection of non-hazardous solid waste (i.e. garbage) within a local area, such as collection of waste from households and businesses by means of refuse bins, wheeled bins, containers etc may include mixed recoverable materials	- Collection of non-hazardous solid waste (i.e. garbage) - Collection of recyclable materials - Collection of construction and demolition waste	**Volume indicator (output-based)** Non-hazardous waste collected, measured by weight, by product	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**3811**
3812	**Collection of hazardous waste**	This class includes the collection of solid and non-solid hazardous waste, i.e. explosive, oxidizing, flammable, toxic, irritant, carcinogenic, corrosive, infectious and other substances and preparations harmful for human health and environment	- Collection of hazardous waste, (such as used oil from shipment or garages, bio-hazardous waste, used batteries)	**Volume indicator (output-based)** Hazardous waste collected, measured by weight or by volume	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	**3812**

Division: 38 – Waste collection, treatment and disposal activities; materials recovery – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3821	**Treatment and disposal of non-hazardous waste**	This class includes the disposal, treatment prior to disposal and other treatment of solid or non-solid non-hazardous waste.	- Operation of landfills for the disposal of non-hazardous waste - Disposal of non-hazardous waste by combustion or incineration or other methods - Treatment of organic waste for disposal - Production of compost from organic waste	**Volume indicator (output-based)** Non-hazardous waste disposed, measured by weight, by product	**Volume indicator** Number of hours worked adjusted for changes in productivity *or* **Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	3821
3822	**Treatment and disposal of hazardous waste**	This class includes the disposal and treatment prior to disposal of solid or non-solid hazardous waste, including waste that is explosive, oxidizing, flammable, toxic, irritant, carcinogenic, corrosive or infectious and other substances and preparations harmful for human health and environment.	- Operation of facilities for treatment of hazardous waste - Treatment and disposal of toxic live or dead animals and other contaminated waste - Incineration of hazardous waste - Disposal of used goods such as refrigerators to eliminate harmful waste - Treatment, disposal and storage of radioactive nuclear	**Volume indicator (output-based)** Hazardous waste disposed, measured by weight, by product	**Volume indicator** Number of hours worked adjusted for changes in productivity *or* **Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	

Division: 38 – Waste collection, treatment and disposal activities; materials recovery – con't

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3830	**Materials recovery**	This class includes: - processing of metal and non-metal waste and scrap and other articles into secondary raw materials, usually involving a mechanical or chemical transformation process	- Mechanical crushing of metal waste such as used cars, washing machines, bikes etc. with subsequent sorting and separation - Dismantling of automobiles, computers, televisions and other equipment for materials recovery - Mechanical reduction of large iron pieces such as railway wagons - Shredding of metal waste, end-of-life vehicles etc.	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Volume indicator (input-based)** Number of persons employed adjusted for changes in productivity	3830

Division: 39 – Remediation activities and other waste management services

This division includes the provision of remediation services, i.e. the cleanup of contaminated buildings and sites, soil, surface or ground water.

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternate method	Other methods	ISIC class
3900	**Remediation activities and other waste management services**	This class includes: - decontamination of soils and groundwater at the place of pollution, either in situ or ex situ, using e.g. mechanical, chemical or biological methods	- Decontamination of soils and groundwater at the place of pollution - Decontamination of industrial plants or sites - Decontamination and cleaning up of surface water following accidental pollution - Asbestos, lead paint, and other toxic material abatement	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**Deflated indicator** Value of output deflated by appropriate quality adjusted PPI	**Volume indicator (input-based)** Quantity of raw materials measured in weight used in remediation activities	**3900**

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